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"Shaping the Future: Moving Beyond Boundaries"

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Message from the Conference Chair

Dr. Sampath Kannangara

Executive Dean & CEO – International College of Business and Technology

It is a great privilege to Chair the Annual International Research Symposium of ICBT, '**AIRS'2020**' to be held online on 18th February 2021 at 2.00PM Sri Lanka Time (8.30AM GMT). This is the third International research symposium organized by the International College of Business and Technology. This will continue to move forward in the research arena under the ISSN-2659-2061.

The theme for this year is "Shaping the future: Moving beyond boundaries" which has opened up in to a multidisciplinary approach consisting of five main session themes. They are Social Sciences, Engineering and Construction, Health Sciences, Business Management and Information Technology.

This research theme is a timely choice where the whole world is facing an unprecedented challenge due to the Covid-19 outbreak in addition to other global challenges such as depletion of resources, global warming and climate change. During the past year, many industries saw the impact of the pandemic and the devastating effects that challenged the norms and the perception of the future.

As a result, industries and research communities are working towards reshaping our future and moving beyond previously known boundaries. Technological transformations are taking place to overcome the new challenges introduced by the global pandemic.

It is important to note that this will not be the last such challenge the world will face in the near future. Therefore, these global challenges must be overcome through a transnational concentrated effort. These challenges also provide opportunities for all to contribute and provide solutions. The research community is in the forefront of the continuous effort of mankind to overcome these challenges and to thrive as a civilization.

This conference will be a platform for academic and industrial researchers to publish their work in above-mentioned areas that would contribute to shaping the future of our civilization.

Message from the Editor-in-Chief

Dr. Kalum Kathriarachchi

Head of Department of Engineering and Construction

International College of Business and Technology

Dear Colleagues,

Welcome to the Proceedings of the 3rd ICBT Annual International Research Symposium (AIRS). The global pandemic caused by COVID-19 has led to a major shakeup of how academic and society meetings are hosted. The traditional platform of in-person events is not currently an option, yet the appetite for information sharing and knowledge exchange remains. As a result, AIRS organizers are choosing to go virtual rather than cancel or postpone.

First, I would like to express my gratitude to authors, reviewers and participants of 2nd AIRS. Secondly I would like to express my deepest appreciation to the authors whose technical contributions are presented in these proceedings. It is because of their excellent contributions and hard work that we have been able to prepare these proceedings.

Education without innovative research and development is meaningless for the community. This is more so when we are intertwined globally and contribution to global knowledge is the call of the day. I feel highly motivated by the positive response from contributors and like-minded educational fraternities exhibiting their deep interest in bringing this 3rd ICBT Annual International Research Symposium.

AIRS endeavours to provide a forum for academicians, researchers and practitioners who are fascinated in the discussion of data driven innovation sand are keen to promote, share and publish relevant high-quality research in the domains of Engineering, Health Science, Information Technology, Business Management and Social Science. Thus, AIRS aims to promote the data driven innovations in various fields and provides assistance in decision making in relevant areas.

On behalf of the editorial board, I am very obliged to our track chairs/ co-chairs for their great efforts in reviewing the papers in their tracks and organizing to assign other volunteer reviewers, the conference technical program committee members, and the designated reviewers.

I would like to hear from you as well as your valuable suggestions on improving our virtual symposium AIRS further. I sincerely extend my thanks to contributors, editorial board members and looking forward for continuous support in future.

I look forward to an exciting day of insightful presentations, discussions, and sharing of technical ideas with colleagues from around the world. I thank you for attending the conference and I hope that you enjoy your visit to virtual conference AIRS.

Profound Regards,

Editor-in-Chief

Dr. Kalum Kathriarachchi

KEY NOTE SPEAKERS

KEY NOTE SPEECH 01:

Professor Leigh Robinson
Pro Vice Chancellor Partnerships and External Engagement

Title:
"How research can explain performance at the Olympic Games"

- Professor Leigh Robinson is a Professor of Sport Management and Pro-Vice Chancellor: Partnerships and External Engagement.
- Leigh oversees the University's activities in student recruitment, global engagement, wellbeing and sustainability.
- She has a global reputation for her research and knowledge exchange in the development of competitive advantage and capacity building in developing sport nations.
- She has worked with a range of organisations, such as the International Olympic Committee, the British Olympic Association, Trinidad and Tobago Olympic Committee and the Malaysian Government.
- Leigh is a member of the Board of Sport Wales and an advisor to Olympic Solidarity, the education commission of the Olympic Committee.

KEY NOTE SPEECH 02:

Dr Patryk Kot
Senior Lecturer – Liverpool John Moores University

Title:
"Preparing effective research proposals to jumpstart your research"

- Dr Patryk Kot graduated from Liverpool John Moores University with a BSc (Hons) in Computer Technology, MSc (Eng) in Microelectronic Systems Design and a PhD entitled "The feasibility of using EM waves in determining the moisture content and factors effecting measurements in building fabrics", completed in 2017.
- From 2016, he worked as a Research Assistant within the Built Environment and Sustainable Technologies (BEST) Research Institute working on Healthcare sensor technologies, underwater sensing and energy from waste.

- In 2017, he became a Senior Lecturer at Liverpool John Moores University within the Civil Engineering department.
- In 2019, he became a Reader in Sensor technologies whilst leading multiple externally funded research projects in structural health monitoring, material characterisation and healthcare.

KEY NOTE SPEECH 03:

Professor John MacIntyre
Pro Vice Chancellor (International) University of Sunderland

Title:
"The Boom of Applied Artificial Intelligence and the Need for Ethical AI"

- Professor John MacIntyre is Pro Vice Chancellor at the University of Sunderland.
- He did his doctorate in Applied Artificial Intelligence in the early 1990s, and went on to establish the Centre for Adaptive Systems which became recognised by the UK Government as a Centre of Excellence in Applied AI.
- He has published more than 150 papers and given numerous keynote presentations at events around the world.
- He is the Editor-in-Chief of Neural Computing & Applications, a role he has held since 1996. NC&A publishes peer-reviewed original research on applied AI.
- John is also Co Editor-in-Chief of a new journal, AI and Ethics, which he established with Professor Larry Medsker of George Washington University this year.
- The first original research and thought leadership pieces were published online in AI and Ethics in October 2020.

KEY NOTE SPEECH 04:

Dr. Ochini Madanayake
Consultant for research publicity – University of Moratuwa

Title:
"How to complete your Masters dissertation with flying colours: Tips for new researchers".

- Dr. Ochini Madanayake botained her Ph.D. from Faculty of Engineering & Information Sciences, University of Wollongong, Australia in 2014. Her Thesis Titled as "Managerial Roles in Top Management Support for Information Technology and Systems Projects".
- She completed her MSc from Department of Management of Technology, Faculty of Engineering, University of Moratuwa, Sri-Lanka in 2004. Her masters research titled as "Diffusion of Groupware Technology in Sri-Lankan Organizations".
- Dr Ochani engaged with Project Management Institute (USA) as a Project Management Professional (PMP) and she has served as Oracle Certified Database Administrator for Oracle Corporation (USA).
- She has served as a Consulting Lecturer at Ministry of Finance, Sri Lanka, Academic Course Developer at University of Wollongong, and contributed in curriculum development for several universities and institutions.
- Over 30 research projects have been supervised with the majority being with MBA students attached to the University of West of England (UK).

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BUSINESS MANAGEMENT

IMPACT OF COMPENSATION PRACTICES ON RETENTION OF OPERATIONAL LEVEL EMPLOYEES: CASE STUDY OF TEA MANUFACTURING COMPANY IN SRI LANKA

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Abstract

The research gap was identified after an extensive review in the field of employee turnover, specifically in the context of tea industry and more particularly in the Sri Lankan context. According to the problem statement, researchers agree that there is a growing problem related to retaining operational level employees in Sri Lankan tea industry. This study aimed to fill the gap left by the previous research especially in assessing monetary and non-monetary compensation practices influencing retention of operational level employees in Sri Lankan tea industry. The study carried out sample basis and the sample content of 100 respondents who have been selected through simple random sampling technique. Five points, Likert scale, structured questionnaires were distributed among hundred (100) respondents and ninety-one (91) of were collected. According to findings of this study, researcher identified work life balance is the most influential factor on retention among compensation practices. Study also, concluded non-financial rewards mostly influence on retention of operational level employees than financial rewards.

Keywords

Monetary compensation, Non-monetary compensation, Retention

Introduction

Employees are fortified to remain in the same organization long period is called retention. Retention is appraised as the intention of employees to stay loyal in their current working place (Chiang and Birtch, 2014). Das and Baruah (2013) noted that employee retention is an ability of an organization to allow employees to stick to the organization in the long run. Yousaf et al. (2014) implied the organization should use appropriate policies, strategies, and approaches in order to retain employees in the long run. Agbenyegah (2019) stated financial incentive was the most powerful motivator. To increase productivity and retention, employees should be motivated by financial rewards (Yousaf et al. 2014). Non-monetary compensation is a type of reward that are not included as a part of an employee's pay. There are physical or perceptible incentives. Though money is the major factor in retention, non-financial incentives also have a direct impact on retention. Jobs with different duties, accountability, independence, empowerment, and career development prospects are very essential in gratifying employees' particular wants and may arrive at a situation that makes the employee feel the work in itself is noteworthy of putting more energy devoid of the necessity of any outside compensation. There are various types of non-monetary incentives used to retain staff in organizations (Chiang and Birtch, 2014).

Armstrong (2015); Opatha (2012) defined the reward system as a formal or informal method used by employers to pay employees. Jiang et al. (2009) defined a reward as a significant tool

to attract, motivate, and retain employees. Similarly, Kwon and Hein (2013) agreed with this definition by stating that total reward is a way of attracting, motivating, and retaining employees. Contrary to this, Jiang et al. (2009) only agrees with partial aspects of the definition, outlining that total reward includes both financial and non-financial rewards.

Over the past decades, operational level employees' turnover has become a major concern for tea factories in Sri Lanka. Tea is one of the major gross domestic products in Sri Lanka. Increment of tea production has positive affect on economic growth. Turnover of operational level employees had become an issue for tea manufacturing in Sri Lanka. This study provides conclusions and recommendations to overcome the turnover issue of operational level employees in order to increase the level of tea production.

Research question

- How do compensation practices affect retention of operational level workers in Sri Lankan Tea Industry?

Objectives

Main objective

- To examine the impact of compensation practices on retention of operational level workers in Sri Lankan tea industry.

Secondary objectives

- To investigate the impact of monetary compensation on retention in Sri Lankan tea industry.
- To investigate the impact of non-monetary compensation on retention in Sri Lankan.
- To identify the most important compensation practice that contributes to the retention of operational level workers in Sri Lankan tea industry.
- To make recommendations to the tea factories on possible ways or strategies to improve employee retention based on research findings

Methodology

Sampling and data collection

The deductive approach was used in this research and this comprises quantitative data. The population this study population is operational level employees who are working in well-known tea factory in Sri Lanka. Here the population is 783. The study carried out sample basis and the sample content of 100 respondents who have been selected through simple random sampling technique. Five points, Likert scale, structured questionnaires were distributed among hundred (100) respondents and ninety-one (91) of were collected. The response rate of respondents is 91% and it was at a satisfactory level. The responses obtained were analyzed using SPSS 21 version. Statistical techniques such as measure of central tendency, correlation and regression analysis were used in the research. The transformed total scale scores of each compensation component were used as independent variables and transformed total scores of retention of operational level employees as the dependent variable.

Conceptual framework

Basic salary, bonuses, performance-related pays, reward and recognition, promotion and opportunity growth, work-life balance, leadership, work environment, training, and development has a strong impact on employee retention (Das and Baruah, 2013; Lok, Westwood and Crawford, 2005; Kossivi, Xu and Kalgora, 2016). According to Gardner, Van-Dyne and Pierce (2014); Patnaik and Padhi (2012), monetary compensation like basic salary, bonuses, incentives, performance related pay have a positive impact on retention. Osibanjo et al. (2014) promotion, work-life balance and flexible working hours are identified as non-monetary compensation. Hytter (2007); Das and Baruah (2013) stated compensation is the key retention strategy.

The previous literature which has been reviewed by this study supports to develop conceptual model of this study appeared as Figure 1. Internal equity and external equity are recognized as the indicators of monetary compensation (Opatha, 2012). Working hours and care leave entitlement are recognized as the indicators of work-life balancing (European Commission, 2017). Autonomy and supervision are recognized as the indicators of work environment (Opatha, 2012).

Independent Variables
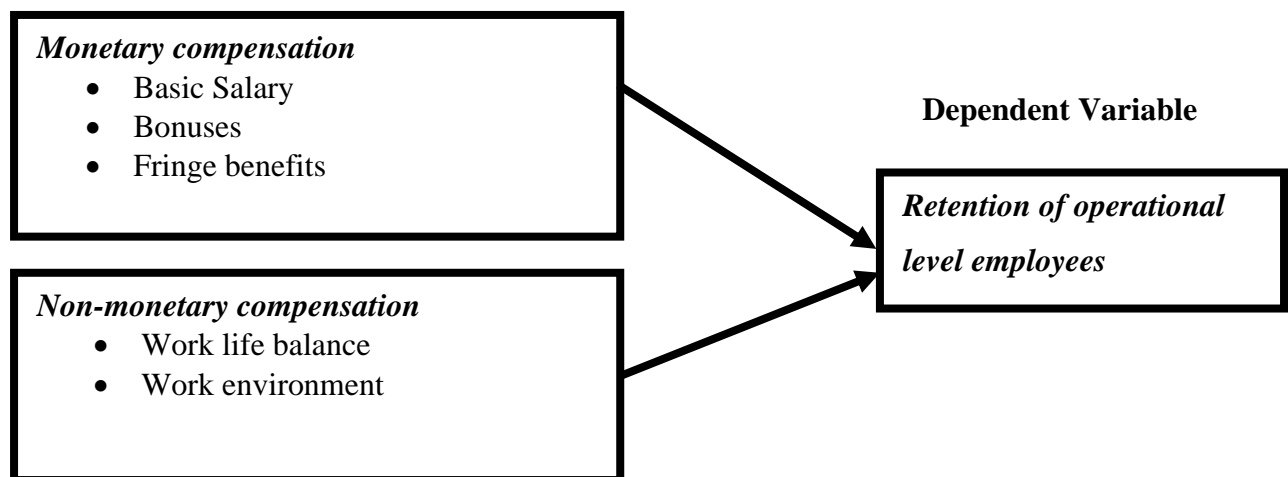
Figure 1: Conceptual framework

Hypotheses

H1: There is an impact of basic pay on retention of operation level employees.

H2: There is an impact of bonuses on retention of operation level employees.

H3: There is an impact of fringe benefits on retention of operation level employees.

H4: There is an impact of work life balance on retention of operation level employees.

H5: There is an impact of work environment on retention of operation level employees.

H6: There is a significant impact of monetary compensation on retention of operation level employees.

H7: There is an impact of non-monetary compensation on retention of operation level employees.

Results and Discussion

Table 1: Reliability of the variables

Variable	Dimension	Cronbach's Alpha	Reliability
Independent Variables	Basic salary/wage	0.901	Reliable
	Bonus	0.916	Reliable
	Fringe benefits	0.898	Reliable
	Work life balance	0.887	Reliable
	Work environment	0.928	Reliable
Dependent Variable	Retention	0.968	Reliable

According to the table 1, independent variables are having a Cronbach's Alpha values of 0.901 for basic salary/wage, 0.916 for bonus, 0.898 for fringe benefits, 0.887 for work life balance and 0.928 for work environment as these numbers are being greater than 0.75, those are high reliable variables. The Dependent variable of retention have a Cronbach's Alpha value of 0.968 and that is very close to one and this dependent variable high reliable.

Descriptive statistics

According to the results of descriptive analysis, there are 48 male respondents (52.8%) and 43 female respondents (47.2%) in the sample. Majority of operational level employees that is, 41.9% are in the age of 30-40 years. Further, the most of the respondents 49.3% have 2-4 years working experience in the present job. Majority of respondents have GCE O/Level qualification.

Correlation analysis

Table 2: Correlation between independent variables and retention of employees

		Basic salary	Bonuses	Fringe benefits	Work life balance	Work environment
Retention of the operational level employees	Pearson correlation	.197	.103	-.007	.504	.227
	Sig. (2-tailed)	.171	.473	.952	.002	.112
		N= 91				

**Correlation is significant at the 0.05 level

As shown by the table 2, there is a moderate positive correlation between work life balance and retention. Its correlation value is given as 0.504 at the significance level of 0.05.

Table 3: Regression analysis for retention of operational level employees- Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Transformed basic salary	.201	.178	.216	1.660	.115

Transformed bonuses	.108	.182	.131	0.898	.398
Transformed fringe benefits	-.083	.143	-.078	-0.531	.793
Transformed work life balance	.509	.225	.513	1.835	.000
Transformed work environment	.254	.157	.267	1.706	.107

Table 4: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.
1	.942a	.893	.887	.31466	97.314	.000

According Table 3, work life balance (t=1.835, p= 0.000) emanated as the most significant variable in explaining the variance in retention of operational level employees at 5% level of significance. Basic salary, bonuses, fringe benefits and work environment practices are insignificant variables in amplification of the variance in employee retention. Work life balance has the strongest effect on retention of operational level employees with a B-value of 0.509. Further, the results of regression analysis articulate that the adjusted R^2 of 0.893 with five independent variables and this indicates that 89.3% of total variance of retention of operational level employees is explicated by compensation practices. Table 4 illustrates that F-value as 97.314 that is significant at p=0.000. These statistical evidences designate that five independent variables are reliable predictors of retention of operational level employees.

Table 5: Summary of hypotheses testing for the dimensions of the independent variables

Code	Hypothesis	Accept/Reject
H1	There is an impact of basic pay on retention of operation level employees	Rejected
H2	There is an impact of bonuses on retention of operation level employees	Rejected
H3	There is an impact of fringe benefits on retention of operation level employees	Rejected
H4	There is an impact of work life balance on retention of operation level employees	Accepted
H5	There is an impact of work environment on retention of operation level employees	Rejected

Table 6: Regression analysis for retention of operational level employees- Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-.292	.208		-1.463	
Transformed monetary compensation	.439	.198	.402	2.973	.013

Transformed non-monetary compensation	.673	.174	.593	3.385	.001

According to table 6, monetary compensation (p=0.013 < 0.05) is significant in the retention of operational level employees. Therefore, the statistical evidences provide clear presumption to reject the null hypothesis and its alternative hypothesis *H6: There is an impact of monetary compensation on retention of operation level employees* is supported by statistical data.

According to table 6, Pearson correlation and sig values articulates non-monetary compensation (Pearson correlation= 0.497 and sig value=0.041) is the most significant variable and it has a stronger effect on employee retention when comparing with monetary compensation. Further, B-value of 0.673 and standardized beta of 0.593 for non-monetary compensation illustrates the strongest effect on retention. Table 6, implies non-monetary compensation (p=0.001 < 0.05) there is enough evidence to reject the null hypothesis. Therefore, its alternative hypothesis *H7: There is an impact of non-monetary compensation on retention of operation level employees* is supported by statistical data.

Discussion

Empirical studies by Das and Baruah (2013); Patnaik and Padhi (2012); Kossivi, Xu and Kalgora (2016); concluded monetary compensation practices are significantly affect employee retention. This is proved by above results. This results also revealed non-monetary compensation practices are also significant influence on retention of operation level employees. This is contrasted to the findings of Hytter (2007); Arnolds (2005); Kossivi, Xu, and Kalgora, (2016). As per conclusions of Yousaf et al. (2014); Chiang and Birtch (2014); Osibanjo et al. (2014) studies above results illustrate non-monetary compensation is the most important factor of employee retention when comparing with the monetary compensation.

Conclusion and Recommendations

Work life balance is the most influential factor on retention of operational level employees in Sri Lankan tea industry. Operational level employees of Sri Lanka tea industry highly concern about work life balance and work environment retention practices. Above analysis clearly evaluated non-financial rewards mostly influence on retention of employees than financial rewards. Further study conclude that Sri Lankan tea factories should consider about work life balance and work environment retention practices when taking retention decision

Recommended top management of Sri Lankan tea factories to offer flexible and remote working, encourage supervisors to focus on productivity rather than hours, encourage breaks, regularly review workloads, reconsider time off, offer cash plans and ask employees for views in order to increase work life balance retention practice. Investment in physical environment, encourage work life balance and appreciation and support may lead factories for commendable work environment. Accordingly, Sri Lankan tea factories should strengthen non-monetary compensation practices as they are the most influential factors on retention. This study also recommends to do future research regarding an impact of compensation practices on retention of operational level employees in Sri Lanka tea industry.

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THE IMPACT OF LEADERSHIP STYLES ON EMPLOYEE PERFORMANCE IN HIGHER EDUCATION SECTOR

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Abstract

Leadership is an art of motivating employees to act toward achieving a common goal and needs. The research problem of this study is "How does leadership styles affect employee performance at one of the leading firms in Sri Lankan Higher education sector?". Three research objectives are raised along with the research questions; 1) To examine the impact of leadership styles on employee performance at one of the leading firms ,2) To identify the most influential leadership style on employee performance at one of the leading firms ,3) To provide recommendations to improve most influential leadership styles to enhance employee performance at one of the leading firms. Seven major leadership styles were used for the study. The findings suggested that Democratic and Transformational leadership styles have positive impact on the employee performance. Lastly, few recommendations have been provided. Due to high ethical grounds, the researcher has kept the original company name hidden by replacing it with one of the leading firms.

Keywords: Employee Performance, Higher Education Sector, Leadership Styles

Introduction

The role of leadership holds a high significance in creating the vision, mission, objectives, strategies, policies and methods while directing and coordinating the organizational activities (Xu & Wang, 2008). Currently, organizations are in need of effective leaders who comprehend the complications of the promptly changing global environment (Bunmi, 2007). Modern day organizations are facing many problems such as high labour turnover, unethical practices, poor financial performance and etc. This can be a result due to lack of effective leadership (Khajeh, 2018). The present study aims to explore the impact of leadership styles and organizational performance using seven major leaderships styles such as Transformational leadership, Transactional leadership, Autocratic, Democratic leadership, Laisses-faire, Bureaucratic and Strategic leadership (Kaleem et al,2013). Klien et al (2013) has conducted a research using 2,662 employees from 311 organizations and proved, that organizational culture and performance are related to the type of leadership style (Klein, et al., 2013).

The selected company is one of the leading higher education providers in Sri Lanka and they are having different departments and sections to process the day to day work and process the flow of works. The bottom level employees are having a leader to guide them but it was observed that most of the time the employees are facing with many conflicts and problems with their assigned leaders. Sometimes it can be misunderstanding, conflict with the duty, communication problems or incorrect guidance to do the work. Further, the preliminary interviews had with few employees and managers have mentioned that these conflicts have resulted to increase the employee turnover in the company. Organizations need strong leadership styles that can stimulate the employee performance. Nowadays, the transformation and innovation of public and private sector have raised a great concern on the outcome and the

way of leading (Bass et al, 2003). Hence, the leader is a key person to the success or failure of the institution or even an entire nation (Ather and Sobhani,2007). Though there are plenty of empirical studies on leadership styles, concerning the subject to higher education industry in Sri Lanka is found to be minimal. Therefore, that indicates an empirical gap for the study. Further, there is a gap in the current literature examining overall the effect of these seven leadership styles on employee performance in the Sri Lankan context. Therefore, the research question addressed in this study is "How does leadership styles affect employee performance at one of the leading firm in Sri Lankan Higher education sector?". According to the literature seven leadership styles such as Autocratic, Democratic, Transformational, Transactional, Strategic, Laissez-faire and Bureaucratic Leadership Style were considered to address the identified problem.

The objectives of this research are,

- To examine the impact of leadership styles on employee performance at one of the leading firm in Sri Lankan Higher education sector.
- To identify the most influential leadership style on employee performance at one of the leading firm in Sri Lankan Higher education sector.
- To provide recommendations to improve most influential leadership styles to enhance employee performance at one of the leading firm in Sri Lankan Higher education sector.

Methodology
Conceptual Framework
Independent Variables   **Dependent Variable**
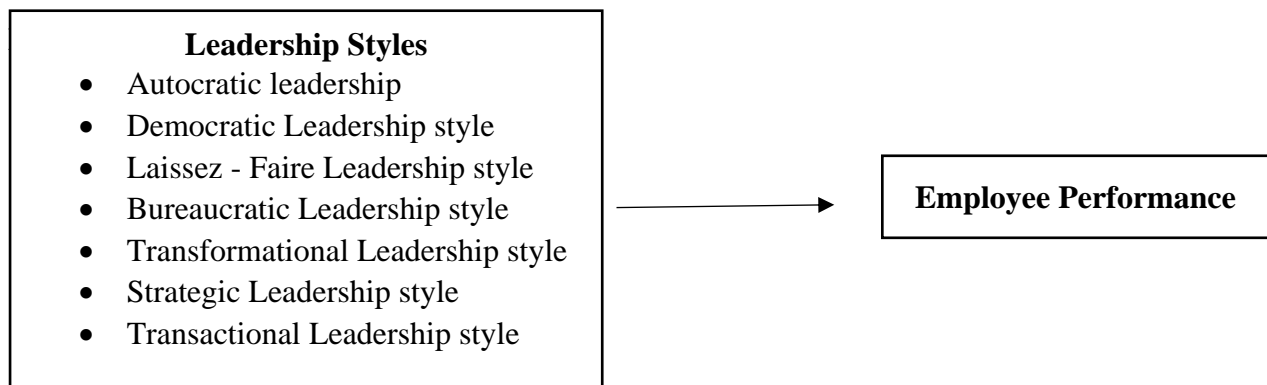
Figure I – Conceptual Framework

Hypothesis

H1: There is a significant relationship between Autocratic leadership style on employee performance

H2: There is a significant relationship between Democratic leadership style on employee performance

H3: There is a significant relationship between laissez- faire leadership style on employee performance

H4: There is a significant relationship between bureaucratic leadership style on employee performance

H5: There is a significant relationship between transformational leadership style on employee performance

H6: There is a significant relationship Strategic leadership style on employee performance

H7: There is a significant relationship transactional leadership style on employee performance

Study area and Data

This study has used the positivist philosophy with quantitative methodology. Deductive approach and survey strategy has used for this study. As the research choice, multi-method has been used and data collection was done using a structured questionnaire. A validated questionnaire was adopted. Five point Likert scale has been used to measure the impact of leadership styles on employee performance. Both primary and secondary data were gathered for this study. Population size was 220 employees who are working at the selected organization. The sample of this study consisted of 30 respondents who are working in different departments. Statisticians have shown that sample size of 30 usually result in a sampling distribution for the mean that is very close to a normal distribution (Saunders et al.,2011). By using the probability sampling technique, stratified sampling method has been used as the sampling method. The different departments such as Administration, Marketing, Accounts and Faculty of the company has considered as strata's and employees were chosen randomly and proportionately to the department size. Time horizon is cross sectional. To reduce the effects of mono-method bias, respondents were informed that their responses would be anonymous (Podsakoff et al.,2003). Reliability was tested using Cronbach alpha for all the variables and it was above 0.6. SPSS 21 version was applied to present and analyse the data. Collected data has first screened and then analyzed using descriptive statistics, correlation and multiple regression analysis.

Results and Discussion

Descriptive statistics

Demographic Information

Majority are found to be male (53.3%) respondents and most of the respondents are in the age category of 31-35 (36. 7%). Most of the respondents (66.7%) are married and have completed master's degree (43. 3%).According to the results of designations, majority (26.7%) are in the Assistant Managerial level. Further, majority of respondents (43.3%) are having working experience of 6 to 10 years.

Correlation Analysis

Table I: Correlation between independent and dependent variable

Independent variable	Dependent Variable (Employee Performance)	p-value
Autocratic Leadership	-.017**	0.930
Democratic Leadership	.815**	0.000
Laissez-Faire Leadership	.320**	0.084
Bureaucratic Leadership	.037**	0.848
Transformational Leadership	.812**	0.000
Strategic Leadership	.654**	0.000
Transactional Leadership	.695**	0.000

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Researcher's work ,2020

As shown by above table, it demonstrates the results of correlation analysis for employee performance and leadership styles. According the results of Pearson correlation, there is a strong positive relationship between Democratic leadership and Transformational leadership style on employee performance and moderate relationship between Strategic leadership, Transactional leadership style. weak positive relationship between Laissez faire leadership and Bureaucratic leadership on employee performance. There is a negative relationship between Autocratic leadership and employee performance. The relationship between independent variables and dependent variable are highly significant at 1% significance level. Among the leadership styles, democratic leadership style has found to be the highly correlated/most influential leadership style on employee performance.

Regression Analysis

Table II: Model Summary

Model Summary								
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			
					R Square Change	F Change	df1	df2	Sig. F Change
1	.935^a	.874	.834	.30027	.874	21.873	7	22	.000

a. Predictors: (Constant), Bureaucratic_Leadership, Transformational_Leadership, Laissez_Faire_Leadership, Autocratic_Leadership, Democratic_Leaderhip, Transactional_Leadership, Strategic_Leadership

Table III: Coefficients

Coefficients^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.042	.600		.070	.944
	Democratic_Leaderhip	.633	.122	.604	5.170	.000
	Autocratic_Leadership	-.012	.113	-.010	-.108	.915
	Laissez_Faire_Leadership	-.124	.115	-.103	-1.076	.294
	Strategic_Leadership	-.240	.161	-.257	-1.492	.150
	Transactional_Leadership	.228	.144	.246	1.584	.128
	Transformational_Leadership	.553	.143	.508	3.875	.001
	Bureaucratic_Leadership	-.017	.086	-.018	-.200	.843
a. Dependent Variable: Employee_Performance						

Results of the regression analysis show that the adjusted R^2 is 0.834 and this reveal 83.4% of total variance in employee performance is explained by leadership styles.

Hypotheses testing
According to the results of Pearson correlations (Hypotheses testing Phase 1) and regression analysis (Hypotheses testing Phase 2) of the findings, it can be concluded that democratic leadership and transformational leadership style is statistically significant (p=0.000<α=0.01). This indicates strong evidence for rejecting the null hypothesis and accepting the alternative hypothesis. That is *H2: There is a impact between Democratic leadership style on employee performance*is accepted and *H5: There is a impact between Transformational leadership style on employee performance* is accepted.

Further, the results for Strategic leadership style and Transactional leadership style, only the Pearson correlations has accepted the alternative hypothesis(p=0.000<α=0.01) but in regression analysis, statistical evidences support to accept the null hypothesis for strategic leadership (p=0.150 >α=0.01) and for Transactional leadership style(p=0.150 >α=0.01).Therefore, *H6:There is a impact between Strategic leadership style on employee performance*is rejected and *H7:There is a impact between Transactional leadership style on employee performance* is also rejected.

According to the results of Pearson correlations for Autocratic leadership style on employee performance (p= 0.930 >α=0.01) is not significant and that got proved in regression analysis (p=0.915>α=0.01) as well.Therefore,*H1: There is a significant relationship between Autocratic leadership style on employee performance* is also rejected. Similarly,Pearson correlations for Laizze-faire leadership style on employee performance (p= 0.084 >α=0.01) and Beauracratic leadership style on employee performance (p= 0.848 >α=0.01) are not significant and that got proved in regression analysisfor Laizze-faire (p=0.294 >α=0.01) and Beauracratic leadership style (p=0.843 >α=0.01) on employee performance as well.Therefore, *H3: There is a significant relationship between Laissez- faire leadership style on employee performance* is rejected with *H4: There is a significant relationship between Bureaucratic leadership style on employee performance* is rejected.

Conclusions and Recommendations
The main purpose of this study was to examine the impact of leadership styles on employee performance. According to the results of regression analysis showed that some leaderships styles have impact on employee performance and some leaderships do not have impact on employee performance. Overall, this study revealed that Democratic leadership style is the most influencing leadership style on employee performance. Next, Transformational leadership style was found to have an impact on employee performance. On the other hand, regression analysis proved that rest of the leadership styles such as, Autocratic leadership, Laissez-faire leadership style, Strategic Leadership, Transactional Leadership and Bureaucratic leadership style do not predict or have an impact to enhance employee performance.

Therefore, the selected company can improve the democratic and transformational functions. The management can be good listeners such as give everyone a chance to talk and take all of their input into consideration, having a proper functioning open door policy, suggestion boxes to identify the employee needs can be done; rather saying "I want it my way" or "you can have

it your way" to "we will find the best way together" will be a good approach to start Democratic leadership style. Employees want to work for an organization and leader they believe in, respect, trust, and fully expect to be treated fairly in the performance evaluation system. Therefore, having organizational ethics would be paramount important to develop Transformational leadership style at the selected company.

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ADAPTATION OF ONLINE MEDICAL TEST REPORT USAGE IN SRI LANKAN HEALTH CARE SECTOR

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Abstract

Online medical reports offer many benefits in other countries but in Sri Lanka only 34% of people use the internet (Zimon Kemp 2019) and so online medical reports also aren't used much. The goal of this study was to find what factors could be hypothesized to impact online medical report usage, test them and then propose solutions that could improve usage to obtain related benefits. Four independent variables (customer knowledge, internet accessibility, privacy and security and attitudes of people) were used to create a questionnaire that was delivered to a sample size of n= 200 participants. Internet accessibility, privacy/security issues and attitudes of people were found to have a significant impact on the dependent variable, online report usage. Solutions to these factors were proposed.

Key words: Online Medical Test Report, Customer Knowledge, Attitudes, Privacy & Security, Internet Accessibility

Introduction/Literature Review

In today's industries, as value-based business becomes more prevalent over the volume-based business, healthcare employees (doctors, nurses, etc) are required to be more productive and efficient (Kaiser and Lee 2015). Efficiency can be accomplished by using healthcare-data-analytics tools to look at large amounts of intricate health data and its issues. Obtaining this health data is done through the usage of online medical reports. Online report usage includes other advantages such like decreasing waste problem in Sri Lanka (Jayaweera et al. 2019), being more cost-efficient (Haniffa 2004) and possibly resulting in a faster gain of care from providers and secondary consultations. But currently, there are a lot of obstacles preventing the country from being able to get these benefits as only 34% of Sri Lankans used the internet in 2019 alone (Zimon Kemp 2019). Finding out the factors that significantly affect online report usage and offering solutions result in creating a better health care system beneficial to Sri Lanka.

Nearly two-thirds of the Sri Lankan population does not use the internet (Zimon Kemp 2019) and it can be hypothesized that lack of internet accessibility affects online report usage. Next, patient's literacy and IT knowledge directly affects their use of online healthcare (Perzynski et al. 2017) Further, lack of customer knowledge is hypothesized to be another variable affecting online report usage. Some physicians were shown to have a negative attitude towards electronic health (Ward et al. 2008) and in regards to a community, their awareness about the subject of technology will shape their opinions on technology and influence their acceptance of it. (Haque et al. 2019).As these same attitudes may apply to the electronic health system as well, attitudes of people (culture) were hypothesized to impact online report usage. In addition, a study showed that even though patients are more open to obtain online medical reports they are highly concerned about the privacy and security of the results (LaRocque et al. 2015). As a results,

privacy and security issues can be identified as another factor thought to affect online test reportage.

Methodology

For this study purpose, a structured questionnaire was used to find factors that affect the online report usage in the healthcare sector of Sri Lanka. It had questions about the patient's demographics and their preferred method of medical test result delivery from their healthcare provider. Hypothesis were developed based on the literature survey. The dependent variable was online report usage and the independent variables were lack of customer knowledge, lack of internet accessibility, attitudes of people (culture) and issues regarding privacy and security. The answers to the questions were defined on the Likert scale from 1 to 5, where 1 represents "Strongly Disagree" and 5 represents "Strongly Agree".

Initially to generalizing purpose, the study targeted to gain responses from 384 people (Krejcie and Morgan, 1970), however due to access and resource limitations, the sample size was made of 200 respondents.

George and Mallery (2003), is used to measure the reliability acceptable level of the questionnaire.

The descriptive statistic used to develop the sample profile and Correlation Analysis technique was mainly used to identify the relationship between the dependent and independent variables and to analyze the data.

SPSS software was used to analyze regression, correlation, and coefficient in order to present the information in a logical way.
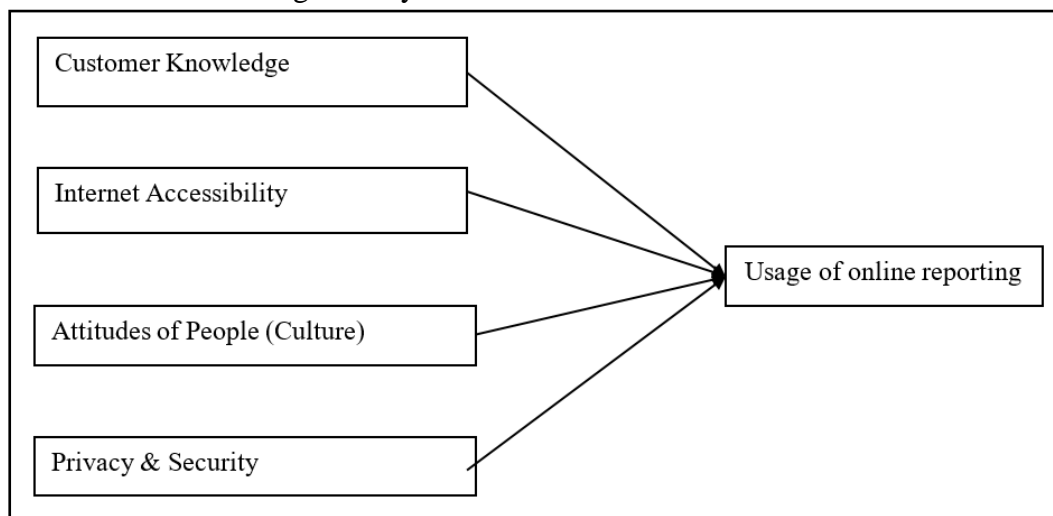
Figure 1. Research Model

Results

Most questionnaires were sent to customers using online platform and some hard copies were distributed to the customers for collecting data.

The Majority (56%) was in the 18 to 30 year age group. The smallest percentage of respondents came from the above 60 year age group. Half of the respondents had a degree/master education and other half a high school diploma. Further, the majority lived in the urban area (52%) and

others in semi-urban areas (42%). Most respondents positive (32% very positive, 42% rather positive) attitudes towards obtaining online medical test reports, only 19% had negative attitudes towards it.

Table 1. Multiple Regression Table Using SPSS Software

Variables	Pearson Correlation	Relationship	Results	Reliability Cronbach's Alpha	Multiple Regression Analysis significance
H1:Customer Knowledge	0.453	Moderate Positive	Accepted	0.74	0.595
H2:Attitudes of People	0.716	Very Strong Positive	Accepted	0.74	0.000
H3:Privacy & Security	0.375	Week Positive	Accepted	0.76	0.004
H4:Internet Accessibility	0.694	Strong Positive	Accepted	0.70	0.000
According to the Model Summary R value-0.757 & R square -0.573					

Reliability of the study was measured by following Cornbach's Alpha test and 0.7 and above reliability, values were obtained to proceed with the analysis. Pearson correlation for lack of customer knowledge is 0.453 which means the variable has positive moderate relationship towards the dependent variable. Attitudes of people have a 0.716 correlation which shows very strong positive relation to the usage of online medical test reports. Privacy and security shows 0.375 correlation, which is weak positive relations towards the usage of online medical test report. Finally lack of internet accessibility shows 0.694, strong positive relationship towards the usage of online medical test reports.

When it comes to multiple regression, analysis shows that the overall model has R-value of 0.757. The R-value of 0.757 indicates that the overall model is strong. From the four independent variables, lack of customer knowledge had a p-value of 0.595 in regards to the dependent variable. Attitudes of people had a p-value of 0.000, privacy and security had a p-value of 0.004 and internet accessibility a p-value of 0.000.

Discussion

There was very little previous research on the topic of online medical test reports specifically in the context of Sri Lanka or any developing country.

In terms of the Pearson correlation coefficient, all variables had a positive relationship of varying degree (strong to weak) with the dependent variable.

From the four independent variables tested, three (attitudes of people, privacy/security and internet accessibility) had a p-values of less than 0.05 and therefore they were found to have a significant impact on the dependent variable, usage of online medical reports.

Lack of customer knowledge had a p-value of 0.595, greater than $p < 0.05$ so it did not have a significant impact on the dependent variable. Possible reason for this might be that the demographic for the questionnaire was made up of a majority (88%) with minimum high school diploma. Another reason could be because the demographic was made up of a majority of

people (56%) in the 18 to 30 year age group. From literature, older generations were the ones that were said to struggle with and hold negative attitudes towards the internet (Ho et al. 2009).

Conclusion and Recommendation

In conclusion, in order to improve the usage of online reports and to get related benefits, it is necessary to concern on the related factors. For enhancing customer knowledge, some suggestions are to make an easily accessible website for patients to obtain their medical reports and health information. Having this website be user friendly and offering service in Sinhala or Tamil instead of in English will help change the attitude of people. In addition this platform should be common among all healthcare providers as having to learn only a single website is better for increasing patient familiarity with the system and it can be placed for healthcare providers to share ideas and knowledge to expand the effectiveness and efficiency of the Sri Lankan Health Care Industry. This website would decrease paper report usage and be a green marketing concept.

For patient concerns about privacy and security of their health information, healthcare providers can establish password protected websites, use strong antivirus and firewall protections programs and encourage their local policy makers to create or update privacy and security policies involving online health care. For issues about incomplete infrastructure, it is suggested that the government be involved and convinced to improve infrastructure.

This study was limited by a non -significant sample size and the demographic of the participants was limited to a majority under 40 years old due to the online nature of the questionnaire. Only 20% of the questionnaires were handed out in person. Further studies have to be done about attitudes of health care providers and patients regarding online services but hopefully the offered solutions can result in the creation of a more efficient online report service system, beneficial not only to healthcare providers and patients but all of Sri Lanka.

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FACTORS EFFECTING ON CUSTOMER ATTITUDES TOWARDS MOBILE ADVERTISING

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Abstract

The main purpose of this study is to identify the factors effect on customer attitudes towards mobile advertising in Sri Lanka and to identify the most influential factor on customer attitudes towards mobile advertising. The article postulates the results based on entertainment, irritation, informativeness, and credibility where the attitudes towards mobile advertising are based on the research (Huu,2015) and (Malkanthi & Konara 2015). A survey is conducted based on 100 respondents and correlation, as well as regression analysis, were done to identify the relationship between entertainment, informativeness, irritation, credibility to find the significant impact of those variables on customer attitudes. The results indicate that there is a positive relationship between entertainment, informativeness, and credibility towards customer attitudes thus there is a negative relationship between irritation and customer attitudes. Based on the results, Entertainment, informativeness, and credibility, have a significant impact on customer attitudes towards mobile advertising and irritation do not have a significant impact on customer attitudes.

Keywords: Attitudes, Credibility, Entertainment, Irritation, Informativeness, Mobile Advertising

Introduction

Mobile Advertising is defined as the interactive mobile advertising platform which is the business of encouraging people to buy products and services using the wireless channel as a medium to deliver the advertising message. (Hashim, et al., 2018). Based on the article (Malkanthie & Konara, 2018) Sri Lanka is one of the leading countries in the world in terms of mobile phone usage. There were 31.80 million mobile connections in Sri Lanka in January 2020 which is equivalent to 149% of the total population. (DataReportal, 2020) And the majority of the Sri Lankan companies are communicating with their target audience to change their customers' attitudes. According to this research (Malkanthie & Konara, 2018) , the majority of the Sri Lankan companies are communicating with their target audience to change their customers' attitude towards them through mobile phone SMS, MMS, Voice, Voice call, and Video calls as the advertisement expenditure of many organizations have been allocated for Mobile ads, also which showing at an increasing rate. An increased number of mobile phone subscribers gives a greater impact and value to mobile advertising, where advertisers see the potential in mobile advertising. Most of the companies strive to examine their sales volume and use advertisements to promote their products and services. Organizations have to scan the real scenario about the factors that impact on customer attitude towards mobile advertising to supplement mobile usage fees and startup costs.

Research Objectives

The key objective of this research is;

1. To identify the factors that effect on customer attitudes towards mobile advertising.
2. To identify the most influential factors on customer attitudes towards mobile advertising.

Significance of the study

The majority of research, with regards to consumer attitude towards mobile advertising, has been conducted in different countries where the findings and conclusions, may not apply to Sri Lankan consumers due to cultural, technological differences. Therefore, in conclusion, the research aims to identify the factors that effect on Sri Lankan customer attitudes towards mobile advertising and also to understand different levels of its significant impact on customers' attitudes. This will be useful to estimate the future mobile advertising industry in Sri Lanka, advertisers, and local scholars.

Methodology

The primary data in this research consist of data retrieved from a questionnaire where information about attitudes and factors that effect on attitudes of customers. Therefore, the sample size of this study is 100 respondents were selected. Convenience sampling was used as Sri Lanka has a strong raising mobile user penetration of 67% thus the sampling frame for a huge number of mobile users would be high. The study conducted by (Etikan, et al., 2016) mentioned inconvenience sampling researcher selects subjects that are more readily accessible, geographical proximity, available at a given time, and subjects are selected based on the study purpose with the expectation. Based on that 100 respondents were selected as the sample size as the sample can help to achieve accurate and reliable results as well as reducing the cost of research (Jamalzadeh, et al., 2012) to test the hypothesis, a survey was conducted using two instruments where an e-mail survey is used because this instrument makes it easy to reach respondents in any place. Additionally, the self-administered face-to-face questionnaires are used for those who did not know to provide answers online.

In Section – A, demographic data were collected which consisted of Gender, Age, Occupation in SPSS, and Ms. Excel is used to analyze the Purpose of mobile usage hence consumer's main purpose varies. Section - B adopted five points Likert scale method from 1 = Strongly Dissatisfied to 5 = Strongly Satisfied agree to measure four independent variables which are Entertainment, Informativeness, Irritation, and Credibility and a dependent variable which is customer attitude, respondents have indicated their agreement level based on five points Likert Scale and it is conducted from the statistical package for the social sciences [SPSS]. All closed-ended questions are developed based on the framework given below by utilizing indicators proposed by the previous researchers in their operationalization.
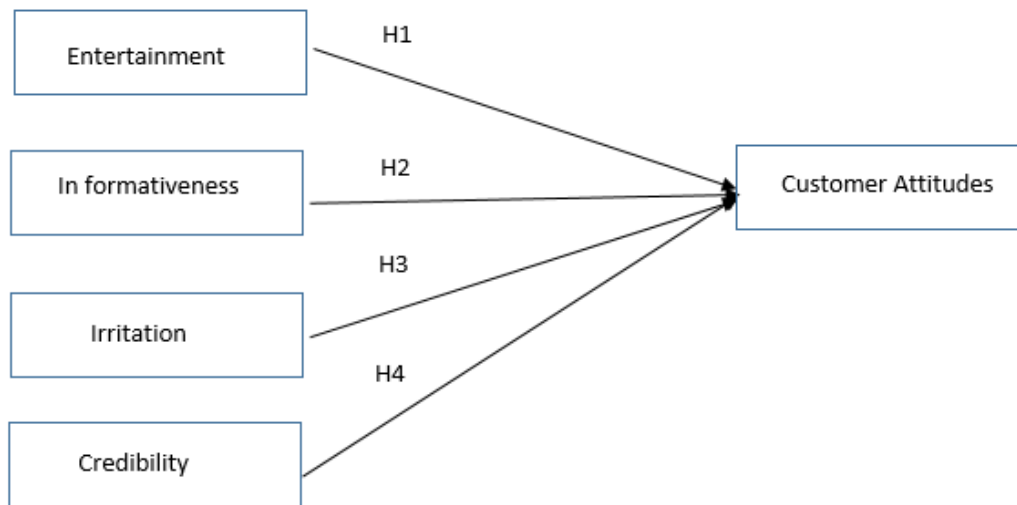
Figure 01: Conceptual Framework.

Entertainment

H_0 : There is no impact of entertainment on customer attitude.

H_1 : There is an impact of entertainment on customer attitude.

Informativeness

H_0 : There is no impact of informativeness on customer attitude.

H_1 : There is an impact of informativeness on customer attitude.

Irritation

H_0 : There is no impact of irritation on customer attitude.

H_1 : There is an impact of irritation on customer attitude.

Credibility

H_0 : There is no impact of credibility on customer attitude.

H_1 : There is an impact of credibility on customer attitude

Table 01: Operationalization

Factors	Indicator	Source
1. Entertainment	Enjoyable	(Xu , 2006)
	Funny	(Xu , 2006)
	Interesting	(Lun, et al., 2014)
2. Informativeness	Accuracy	(Xu , 2006)
	Timeliness	(Xu , 2006)
	Usefulness	(Xu , 2006)
3. Irritation	Annoy	(Xu , 2006)
	Offend	(Xu , 2006)
	Insult	(Xu , 2006)
4. Credibility	Truthfulness	(Xu , 2006)
	Believability	(Xu , 2006)
	Fulfillment	(Xu , 2006)
5. Attitude	Perception.	(Huu, et al., 2015)
	Better than the traditional ways of advertising.	(Huu, et al., 2015)
	Receive and read mobile advertisements.	(Lun, et al., 2014)

Results

Below pie chart is presented in Microsoft Excel which statistics show that the majority of customer's the main purpose is calling and texting [60 %] and 17% are using for mobile application, 7% to download music/game, some of the customer use for other purposes which is in 5%, it is found that customers use mobile phones to read the newspaper as in 4% and 2% are for educational purposes and customers who use 'All' the purposes in the mobile phone have been stated and it is showed clearly there is an equal 1 % percentage level for entertainment, relaxing and reading.
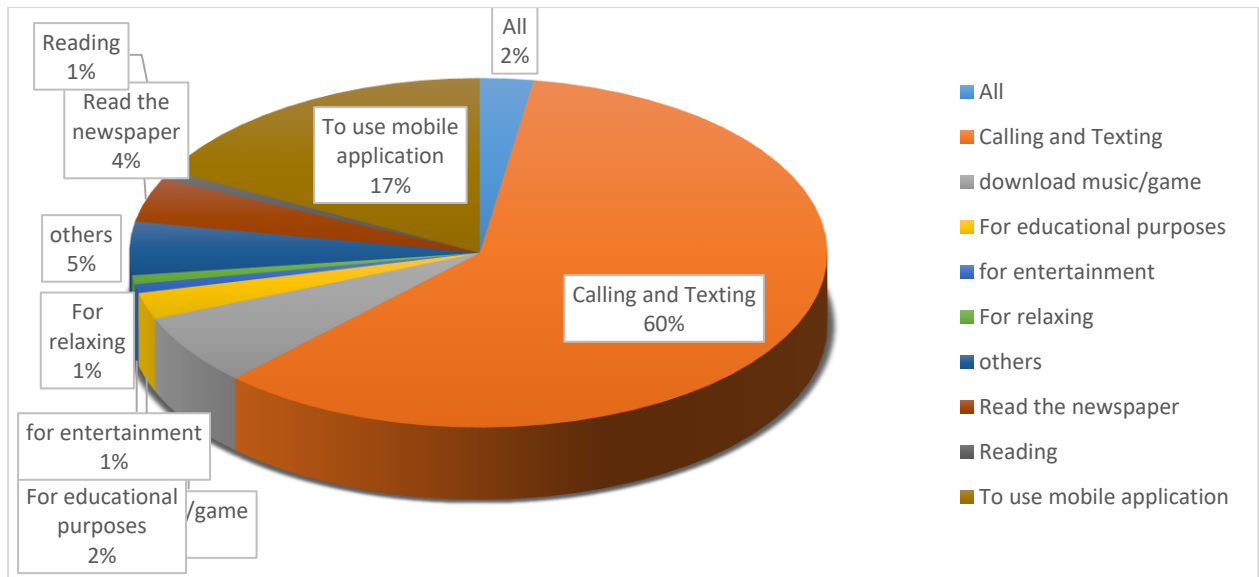
Figure 02: Purpose of mobile usage

Entertainment

Table 02: Correlation Between Customer Attitude and Entertainment

Correlations

		Customer_Attitude	Entertainment
Customer_Attitude	Pearson Correlation	1	.648**
	Sig. (2-tailed)		.000
	N	100	100
Entertainment	Pearson Correlation	.648**	1
	Sig. (2-tailed)	.000	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).
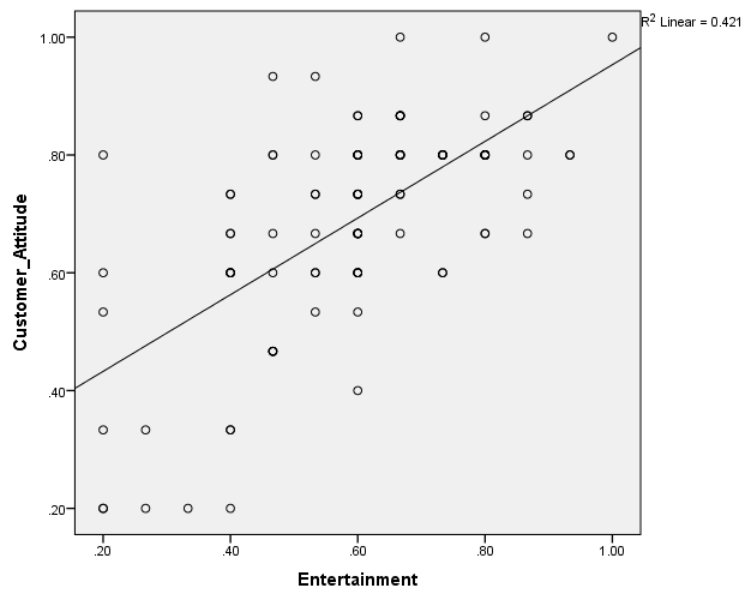
Figure 03: Correlation between Customer Attitude and Entertainment

According to the Scattered diagram, it shows an upward slope, it releases that there is a positive relationship between customer attitude and entertainment. In the correlation table, the Pearson Correlation value 0.648 it implies that there is a strong positive linear relationship between customer attitude and entertainment, furthermore, sig value 0.000 which is less than 0.05, therefore, is enough evidence to reject the null hypothesis at 5% level of significance. It implies that there is a significant difference between customer attitude and entertainment.

Informativeness

Table 03: Correlation Between Customer Attitude and Informativeness
Correlations

		Customer_Attitude	Informativeness
Customer_Attitude	Pearson Correlation	1	.676**
	Sig. (2-tailed)		.000
	N	100	100
Informativeness	Pearson Correlation	.676**	1
	Sig. (2-tailed)	.000	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

According to the Scattered diagram, it shows a positive relationship between customer attitude and informativeness. In the Correlation table, the Pearson Correlation value is 0.676 it implies that there is a moderate linear relationship between customer attitude and informativeness, further sig value 0.000 which is less than 0.05, therefore, is enough evidence to reject the null

hypothesis at 5% level of significance. It implies that there is a significant difference between customer attitude and informativeness.
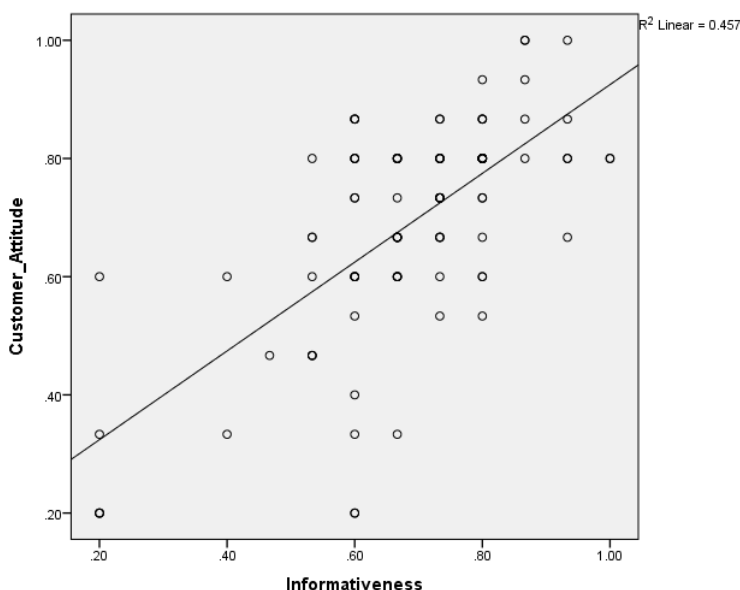
Figure 04: Correlation between Customer Attitude and Entertainment

Irritation

Table 04: Correlation Between Customer Attitude and Irritation

Correlations

		Customer_Attitude	Irritation
Customer_Attitude	Pearson Correlation	1	-.084
	Sig. (2-tailed)		.404
	N	100	100
Irritation	Pearson Correlation	-.084	1
	Sig. (2-tailed)	.404	
	N	100	100

According to the Scattered diagram, it shows the downwards slope, therefore there is a negative relationship between customer attitude and irritation. In the Correlation table, the Pearson Correlation value is -.084 it reveals that there is a strong negative linear relationship between Customer Attitude and Irritation. Further sig value 0.404 which is greater than 0.05, therefore, is not enough evidence to reject the null hypothesis at a 5% level of significance. It implies that there is no significant difference between customer attitude and irritation.
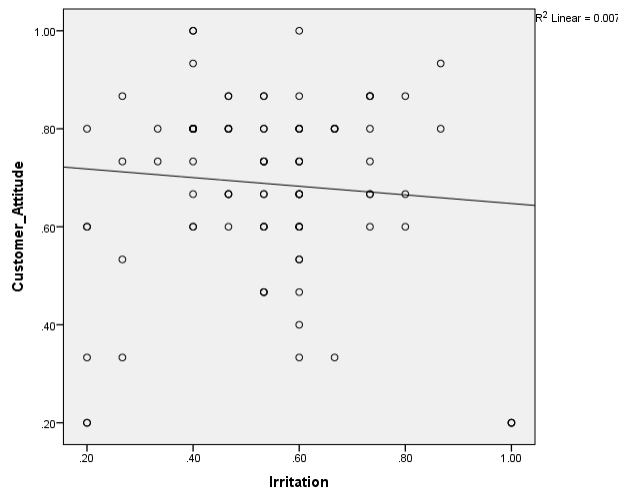
Figure 05: Correlation between Customer Attitude and Entertainment

Credibility
Table 5 Correlation Between Customer Attitude and Credibility

Correlations

		Customer_Attitude	Credibility
Customer_Attitude	Pearson Correlation	1	.596**
	Sig. (2-tailed)		.000
	N	100	100
Credibility	Pearson Correlation	.596**	1
	Sig. (2-tailed)	.000	
	N	100	100

**. Correlation is significant at the 0.01 level (2-tailed).

According to the scattered diagram below, it shows a positive relationship between customer attitude and credibility. In the Correlation table, the Pearson Correlation value is 0.596 it implies that there is a moderate positive linear relationship between Customer Attitude and Credibility. Further sig value is 0.000 which is less than 0.05 therefore there is enough evidence to reject the null hypothesis at a 5% level significantly. It implies that there is a significant relationship between customer attitude and Credibility.
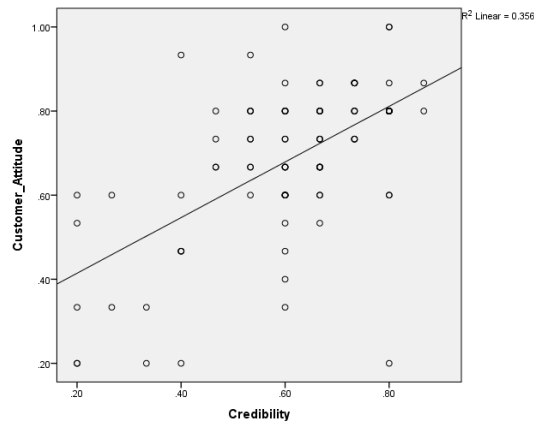
Figure 06 Correlation Between Customer Attitude and Credibility

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.748ᵃ	.560	.541	.12346

a. Predictors: (Constant), Credibility, Irritation, Entertainment, Informativeness

According to the model summary, the adjusted R square value is 0.541, it implies that out of total variabilities, 54.1 % of variabilities are explained by the regression model.

ANOVAᵃ

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.841	4	.460	30.205	.000ᵇ
	Residual	1.448	95	.015		
	Total	3.289	99			

a. Dependent Variable: Customer_Attitude

b. Predictors: (Constant), Credibility, Irritation, Entertainment, Informativeness

As per the ANOVA Table 8, the sig value is 0.000 which is less than 0.05 therefore there is enough evidence to reject the null hypothesis at a 5% level, It implies that the model is adequate.

H_0 : The model is not adequate

H_1 : The model is adequate

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.123	.069		1.785	.078
Entertainment	.301	.095	.300	3.169	.002
In formativeness	.405	.107	.365	3.792	.000
Irritation	-.042	.074	-.041	-.571	.569
Credibility	.214	.106	.193	2.026	.046

a. dependent Variable: Customer_attitude

The one above coefficients Table 9, indicates the sig value of Entertainment, it is 0.002 which is less than 0.05. Therefore, there is enough evidence to reject H_0 at a 5% level. It implies that there is a significant impact of entertainment and customer attitude.

Sig value of informativeness is 0.000 which is less than 0.05. Therefore, there is enough evidence to reject H_0 at a 5% level. It implies that there is a significant impact of Informativeness and customer attitude.

According to the sig value of Irritation of 0.569 which is greater than 0.05. Therefore, there is not enough evidence to reject H_0 at a 5% level. It implies that irritation does not have a significant impact on customer attitude.

Further, the sig value of Credibility is 0.046 which is less than 0.05. Therefore, there is enough evidence to reject H_0 at a 5% level. It implies there is a significant impact of credibility on customer attitude.

Conclusion

Compared to the research objectives mentioned earlier, the study can be concluded that entertainment, informativeness, irritation, and credibility are the factors effect on Sri Lankan customer attitudes towards mobile advertising. Based on the results, there was a significant impact of the factors except for irritation on customer attitudes towards mobile advertising. Customers mostly use mobile advertisement information and buy products/services available in the market place. It was found mobile advertisement is enjoyable to most customers, some people considered interesting in mobile advertisements as well as they assume credibility in mobile advertising mostly it is worked as a reference for purchasing. Therefore, entertainment and informativeness are the most influential factors on customer attitudes in Mobile Advertising.

The research was further identified Irritation as a significant factor affecting respondents' attitudes, that customers find it is missable, annoying, often offended, and spammed even though consumers like the idea about mobile advertising . The customer attributes tend to be positive for almost all the factors thus customer attitude is positively related to entertainment, informativeness, and credibility where customers are more willing to accept mobile advertising as it is an effective, profitable digital marketing method and easily accessible than the internet and other advertising methods.

Recommendations

The suggestion is given for future development of the study and to create a positive attitude in mobile advertising where the variables in determining the customer attitude in mobile advertising can be altered, to enhance the improvement of customer attitude in mobile advertising "personalization" can be used as to identify whether customers are willing to give out their personal data to gain more personalized mobile advertising.

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FACTORS INFLUENCING MATTALA AIRPORT USAGE AS A DOMESTIC TRANSPORTATION MODE:FROM PASSENGERS' PERSPECTIVE.

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Abstract

Usage of the Mattala Rajapaksa International airport in Sri Lanka is far below the expectations. Therefore research attempted to find the factors influencing the use of Mattala Airport as a domestic transportation mode from the passengers' perspective, using a convenient sampling technique. The sample size was 384, and descriptive analysis, correlation and multiple linear regression analysis were carried out.

Research findings revealed that the airport usage is having a moderately strong negative relationship with 'Cost of Domestic and Scenic Flights', a weak positive relationship with 'Surrounding Facilities', a weak negative relationship with Ground Access 'Time' and 'Cost'. Group effect of the model representation towards airport usage is 49.1%. It mainly recommends to introduce domestic air travel service in-between Bandaranaike International Airport and Mattala Airport as scheduled flights at a discounted rate of air fee. Further to introduce scenic flights at discounted rates and to improve surrounding facilities.

Key Words: Airport, Mattala, Passenger, Usage

Introduction

Mattala Rajapaksa International Airport (MRIA) has invested huge sunk cost and incurring a lot as maintaining cost, but the usage is minimal. Therefore, the research problem was defined as "Low usage of Mattala Rajapaksa International Airport in Sri Lanka, which leads to huge losses demands a research study to identify factors and remedial actions".

The present situation in terms of traffic density or passenger count is not a must factor which indicates the airport's future (Badanik et. al.,2010). Using MRIA as a domestic transportation mode would be a more realistic and sustainable remedy as an initial step, thus identifying the influencing factors is very vital. Pasha, and Hickman, (2016) have emphasized that the process starting from passenger's origin up to the end of aircraft boarding, should be smooth as possible. Thus should consider environmental, social and economic aspects of the whole journey. Therefore Cost, Surrounding facilities and Ground access were considered for the study after reviewing literature.

Significance and Limitations

This research is beneficial for Airport operator (AASL), airlines, leisure travellers, government, investors, and other transportation mode facilitators. The study was not addressing the threat involved from the surrounding natural habitat to MRIA or vice-versa. With the political changes, decisions regarding MRIA might vary in-to certain extend, but this was not taken in-

to consideration. The study sample was not equally distributed among all the provinces; thus ground access time and cost may vary among the participants.

Objectives
The main objective was to identify factors influencing the Mattala Rajapaksa International Airport usage and then to recommend improvements to increase its use.

Methodology

Independent Variable

| Cost of Domestic and Scenic Flights (IV1) |
| Surrounding Facilities (IV2) |
| Ground Access Time (IV3) |
| Ground Access Cost (IV4) |

H_1
H_2
H_3
H_4

Dependent Variable
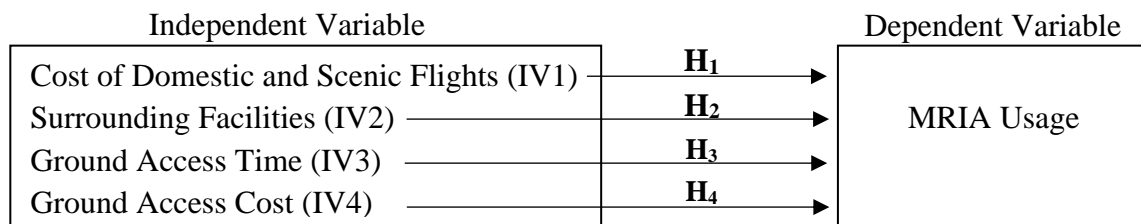
MRIA Usage

Figure I: Conceptual Framework

The study leads four hypotheses whereas;

$H_{1,0}$: Cost of Domestic and Scenic Flights has no relationship with the MRIA usage.

$H_{1,A}$: Cost of Domestic and Scenic Flights has a relationship with the MRIA usage.

$H_{2,0}$: Surrounding Facilities has no relationship with the MRIA usage.

$H_{2,A}$: Surrounding Facilities has a relationship with the MRIA usage.

$H_{3,0}$: Ground Access Time has no relationship with the MRIA usage.

$H_{3,A}$: Ground Access Time has a relationship with the MRIA usage.

$H_{4,0}$: Ground Access Cost has no relationship with the MRIA usage.

$H_{4,A}$: Ground Access Cost has a relationship with the MRIA usage.

Since the study focused on passengers' perspective and as a mode of domestic transportation, the entire Sri Lanka's population were selected as the study population. Using the 'Sample Size Calculator' (confidence level of 95%, confidence interval of 5), the calculated sample size was 384. Convenient sampling was used to collect data since cluster sampling was not possible as reaching MRIA passengers was not practical with the minimum usage.

Secondary data was collected through published journal articles, conference reports, AASL and other web sites. Primary data collection was carried out through a questionnaire, and Five Point Likert Scale was taken as the questions measuring scale. A pilot test was carried out among 12 participants, and questionnaire reliability was tested using Cronbach Alpha Test. Research data were collected between 30/08/ 2019 - 04/09/2019.

Quantitative analytical techniques were applied, and SPSS version 21 was used, the chosen significance level (alpha) for the study was 0.05, whereas the corresponding confidence level was 95%. It was assumed that all the associations were as linear. Multicollinearity was first tested, next Multiple Linear Regression analysis was carried out to find the group model effect and then the four hypothesis were tested.

Results and Discussion

Table I: Descriptive Analysis Table

Variable	N	Mean	Standard Deviation
Cost of Domestic and Scenic Flights (CDS)	384	3.799	0.703
Surrounding Facilities (SF)	384	3.618	0.635
Ground Access Time (GAT)	384	3.899	0.628
Ground Access Cost (GAC)	384	3.684	0.647
MRIA Usage	384	3.639	0.677

Table 1 summarizes the descriptive statistics of the data. As there are lower standard deviations, equal variances can be observed within the data set.

Table II: Correlation Matrix

	MRIA Usage	CDS	SF	GAT	GAC
MRIA Usage	1				
CDS	-.629**	1			
SF	.358**	-.310**	1		
GAT	-.368**	.232**	-.277**	1	
GAC	-.336**	.143**	-.095	.487**	1

**Correlation is significant at the 0.01 level (2-tailed)

In the above correlation matrix, since large correlation coefficients do not present between the selected independent variables, it does not indicate the presence of multicollinearity. Therefore regression analysis can be carried out for further analysis.

Multiple Regression Analysis Results for the Model

Table III: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.700	.491	.485	.48623

Table IV: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	86.326	4	21.582	91.286	.000
	Residual	89.602	379	.236		
	Total	175.928	383			

According to table IV as $F_{(4,379)} = 91.286$, $p < 0.05$ the model effect is statistically significant thus can accept the overall model. As R square = 0.491, 49.1% of the variance of MRIA usage is explained by the regression model.

Table V: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (constant)	5.034	.203		24.745	.000
CDS	-.517	.038	-.531	-13.568	.000
SF	.129	.036	.144	3.631	.000
GAT	-.121	.047	-.112	-2.553	.011
GAC	-.208	.046	-.192	-4.560	.000

Group effect interpretation;

MRIA Usage = 5.034 - 0.517 CDS +0.129 SF -0.121 GAT -0.208 GAC

Considering the beta weights the independent variables can be ranked based on their contribution to MRIA usage as CDS (-.531) , GAC (-.192), SF (.144) and GAT (-.112) respectivly.

Since sig. value is less than the chosen significance level of 0.05 for CDS [p (.000) < 0.05], SF [p (.000) < 0.05], GAT [p (.011) < 0.05], and GAC [p (.000) < 0.05], respectively, this result in rejecting all the four null hypothesis ($H_{1,0}$, $H_{2,0}$, $H_{3,0}$, $H_{4,0}$) and accepting the alternate hypothesis ($H_{1,A}$, $H_{2,A}$, $H_{3,A}$, $H_{4,A}$) respectively. This indicates that there is a relationship between MRIA usage and CDS, SF, GAT, and GAC respectively.

For CDS, as its coefficient is negative it indicates a moderately strong negative relationship with MRIA usage. This result evidence the same findings of Beifert,.(2015) and Slusarczyk.(2016) as the domestic airport usage increase with lower rates of air fee. For SF, as its coefficient is positive it indicates a weak positive relationship with MRIA usage, which indicates the enhancement of surrounding facilities increase the airport usage. Slusarczyk,.(2016) indicates similar findings as increased accessibility are needed to attract passengers.

There is a weak negative relationship with both GAT and GAC, with the MRIA usage as the respective coefficients are negative. Similar results were found by Paliska et. al., (2016) as the most vital factor for the choice of airport is the access time. According to Carstens,.(2014) it has found that both the access cost and time is having a significant influence on to passengers' airport decision.

Conclusions

Data analysis reveals that all the independent variables have a relationship with MRIA usage and usage decrease with the increase of cost of domestic and scenic flights, ground access time and cost, and increase with the availability of surrounding facility improvements. As there is a

moderately strong negative relationship with CDS, it indicates that if domestic and scenic flight tickets are offered at a discounted rate, then MRIA usage can be increased. The model consists of all four factors. To increase MRIA usage should first address CDS, then GAC, SF and GAT respectively. The overall model impact is 49.1%, balance 50.9% might be due to other factors found in the literature review such as flight frequency or birds presence issue.

Recommendations

As a new market development approach, introducing domestic air travel service in-between Bandaranaike International Airport and MRIA as schedule flights through narrow-bodied or turboprop/light aircrafts at a discounted rate of air fee, will enhance the domestic usage, this can be done even through Rathmalana airport. MRIA will be the ideal place for any low cost carrier who is looking for a base airport. As promotional activities discounted joint tickets can be provided with international air tickets. Domestic ticket promotions can join together with bank credit/debit cards and even issue with hotel accommodation packages. In addition should introduce scenic flights at discounted rates for the untapped segment who prefer sightseeing while adhering to existing restrictions.

Surrounding facility improvements are recommended, with supermarkets, residential areas and hotels with a wider price range. Further railway access needs to be linked to MRIA. Though Ground Access Time/Cost depends on passenger's location, one way of reducing total ground time is through reducing Ground Access Time from MRIA to destination or vice-versa. That can achieve by providing airport shuttle service for selected destinations, which inevitably reduce the Ground Access Cost. Through outsourcing additional investments of these supportive services can be managed. Proper positioning of MRIA is required through enhancement of perception by enhancing destination image with ecotourism.

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FACTORS INFLUENCING ACCESS TO FINANCE BY SMEs IN SRI LANKA. A STUDY DONE IN COLOMBO DISTRICT.

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Abstract

Almost every company in today's world began as a Small to Medium Enterprise (SME). SMEs globally have a very significant contribution to the provision of goods and services to society. Without SMEs, big companies will not be able to meet the demand for goods and services in an expanding their customer base. SMEs can only grow if there is access to finance and other forms of finance cannot sufficiently support them.

Therefore, the objectives of this research have identified and assessed the entrepreneurial characteristics that influence the SMEs' access to finance and identified challenges perceived by SMEs to be faced by them in accessing credit facilities from Banks and other financial institutions. Convenience sampling was used for the sample size of 100 SMEs. Binary logistic regression was used to identify the impact of factors associated with difficulties in access to finance. Size of the business, age of the owner and experience of the owner were significant factors affecting access to finance.

Keywords: Financial difficulties, Small and medium enterprises (SMEs), Access to Finance, Enterprise Surveys, Collateral, Entrepreneurial skills.

Introduction

Small and medium-sized enterprises (SMEs) plays a vital part in almost all economies in the world, especially it is the backbone of developing economies like Sri Lanka. The Sri Lankan Government has taken many measures to support the development of SMEs, which play a crucial role in Gross Domestic Product (GDP) growth, employment creation, equitable income distribution, regional development, innovation and resource utilization. (CMA-Sri Lanka, 2018) Today, Sri Lanka has more than 500,000 SMEs, each employing three to five persons on average. According to research, together with micro-enterprises and SMEs that are not registered, it estimated that 52% of GDP comes from this sector. Further, Sri Lanka has a little over 3,000 SMEs (firms with a turnover of less than Rs. 150 million) registered as exporters and collectively contribute to less than 5% of Sri Lanka's exports (Census & Statistics , 2016). SMEs also plays a critical role globally, where small and medium enterprises account for 90% of all businesses globally. In addition, SMEs generate 60% of employment worldwide and it provides jobs to 80% of the workforce in the developed world. The most important finding was that 50% of global Gross Value Added (GVA) is contributed by SMEs. According to an international firm survey, trade barriers, poor access to information, costly requirements and lack of trade finance are major hurdles to international trade for SMEs. These trade costs represent bigger for SMEs than large firms, and this appears to be true in the case of Sri Lanka. (Peterhoff, 2014)

Background of the study

The phrase "Access to finance" means that an SME can have good physical access to lenders that want to lend, but the cost and suitability of products make borrowing impractical. Which means that SMEs will have no hindrances in obtaining financial products (e.g. deposits and loans) and services (e.g. insurance and equity products) at an affordable cost. The lack of finance, which universally accepts as one of the obstacles faced by the SMEs in their growth. One primary responsibility of any business owners is to contribute capital for the setup and running of the business. According to Chowdhury & Alam (2017), size and age of the firm and their inability to produce collateral found to be affecting the firms' access to funding.

Significance of the study

This research is been conducted to examine the impact of financial characteristics that affect SMEs' availability of funding and to identify and assess the impact of entrepreneurial characteristics that influence the SMEs' access to finance. Furthermore, it also identifies challenges perceived by SMEs to face by them in accessing credit facilities from Banks and the impact of firms' characteristics on SMEs' access to finance.

Methodology

Data collection

The author selected a sample size of 100 SMEs from different industry sectors such as restaurants, plastics, knitting, small dairy process, toys, potteries, dying, small machine shops, leather goods, chemical, transport, constructions etc. The author has conducted the research in Colombo district, which is the capital of Sri Lanka and located in the western province of the country. SME products are exported. Convenience sampling method was used to select the sample since the SMEs located in the region of the research are too many that it is impossible to include every SME within a short duration of time. The data were collected by directly interview the sample population with the help of a questionnaire for self-guidance. A five-point Likert type scale statements were used to measure the variables where 1 stand for strongly disagree/very low and 5 stands for strongly agree/very high effect on the statements. Descriptive analysis was conducted to identify some important patterns of observations. Further, binary logistic regression was conducted to identify the significant factor associated with access to finance by SMEs because of the binary nature of the response variable (access to finance; 1 = Yes, 0 = No). Six exploratory variables were considered for the binary logistic regression, i.e.: Age of Business, Business Size, Age of Owner, Owner Experience, Interest rate, Strict conditions.

Data Analysis

In order to get a valid result, face-to-face interviews were conducted with 100 SMEs Owners in different places within Colombo district. Information were taken from 28 different sectors SMEs owners in Colombo district. According to descriptive analysis, out of 100 selected SMEs, only 56 SMEs have enough access to finance to run their business and the rest of 44 SMEs don't have enough access to finance to run their business. Moreover, the majority of the owner believes that collateral may or may have an impact on access to finance. Whereas, there are equal number of owners who agrees and disagrees to this statement and most of the SME

owners believe that experience of the owner and educational background impacts towards accessing finance. out of 100 SME owners, most of the owners disagreed to the statement that their age strict them to access finance. SME owner believes that age is just a number when it comes to the business. Results shows that majority of the owner believes that there is not a lengthy banking process and some owners agreed to this statement. Finally, responses given by SME owners regarding the high and prohibitive interest rates by financial institutions when obtaining loans to SMEs show that a similar number says it is high and not much high.

Analysis of factors associated with access to finance by SMEs

Binary logistic regression was conducted to identify the significant factor associated with access to finance by SMEs. Results of the above-mentioned test are given in this section.

Table 1 Omnibus tests of model coefficients

Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	19.435	6	.003
	Block	19.435	6	.003
	Model	19.435	6	.003

Omnibus test of model coefficients shows the overall indication of how well the model performs over the model that none of the predictors are entered. This is referred to as a goodness of fit test. According to results, the chi square value is 19.435 with sig-value of 0.003 which is less than 0.05 means that our model as a whole fits significantly better than an empty model.

Table 2 Model summary

Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	115.167[a]	.177	.239

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

The Cox & Snell R Square and Nagelkerke R Square values provide an indication of the amount of variation in the dependent variable explained by the model. These values are describing as pseudo R square statistics. According to Table 2, the values of Cox & Snell R Square and Nagelkerke R Square are 0.177 and 0.239 respectively. It implies that between 17.7 percent and 23.9 percent of variability is explained by this model.

Table 3 Hosmer and Lemeshow test

Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	6.262	8	.618

Table 3 shows the result of Hosmer and Lemeshow test. It tests whether the model is worthwhile or not. In case of Hosmer and Lemeshow test, poor fit is indicated by significant value less than 0.05. According to Table 3, the sig-value is 0.618 and it is greater than 0.05. Therefore, it implies that the model has a good fit.

Table 4 Parameter estimates

Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1ª	**Age of Business**	.016	.044	.129	1	.720	1.016
	Business Size(1)	-1.512	.607	6.208	1	.013*	.220
	Age of Owner	-.065	.035	3.397	1	.065**	.937
	Owner Experience	.097	.045	4.548	1	.033*	1.102
	Interest rate	-.028	.231	.015	1	.902	.972
	Strict conditions	-.098	.259	.142	1	.706	.907
	Constant	2.841	1.499	3.594	1	.058	17.130
a. Variable(s) entered on step 1: Age of Business, Business Size, Age of Owner, Owner Experience, Interest rate, Strict conditions							

*Significant at 5% level of significance
**Significant at 10% level of significance

According to the parameter estimate table, it can be observed that the logistic regression coefficient of age of business is 0.016. Therefore, the positive logistic regression coefficient of age of business implies that when age of the business increases, the probability of getting financial aid or support increases by 0.016 log odds. This is not a significant factor affecting the access to finance by SMEs as the sig value is greater than 0.05. It can be clearly identified that the business size is significant at five percent level of significance since the sig-value is less than 0.05. Further, it can be observed that the logistic regression coefficient of business size is -1.512. Therefore, the negative logistic regression coefficient of business size implies that when the size of the business moves from medium to small, the probability of getting financial aid or support decreases by 1.512 log odds. Moreover, it can be clearly identified that the age of the owner is a significant at ten percent level of significance since the sig-value is less than 0.10. Further, it can be observed that the logistic regression coefficient of business

size is -0.065. Therefore, the negative logistic regression coefficient of age of the owner implies that when age of the owner increases, the probability of getting financial aid or support decreases by 0.065 log odds. Further, it can be identified that the experience of the owner is a significant at five percent level of significance since the sig-value is less than 0.05. Further, it can be observed that the logistic regression coefficient of experience of the owner is 0.097. Therefore, the positive logistic regression coefficient of experience of the owner implies that when the experience of the owner increases, the probability of getting financial aid or support increases by 0.097 log odds. Since the logistic regression coefficient of interest rate is -0.028. Therefore, the negative logistic regression coefficient of interest rate implies that when the SME owners believes that the interest rate is high, the probability of getting financial aid or support decreases by 0.028 log odds. This is not a significant factor affecting the access to finance. Even though the strict conditions are not a significant factor affecting the access to finance by SMEs, it can be seen that the logistic regression coefficient of the strict conditions is negative and it is -0.098. Therefore, the negative logistic regression coefficient of strict conditions implies that when the SME owners believes that there are stricter conditions in accessing finance, the probability of getting financial aid or support decreases by 0.098 log odds.

Therefore, the logistic regression model is written as follows based on above results.

$$\log it(Y) = \ln\left(\frac{\pi}{1-\pi}\right) = 2.841 + 0.016 \times \text{Age of business} - 1.512 \times \text{Business size*} - 0.065 \times \text{Age of the owner**} + 0.097 \times \text{Experience of the owner*} - 0.028 \times \text{Interest rate} - 0.098 \times \text{Strict conditions}$$

Where,

Y = enough access to finance (Yes or No)

Significant at 5% level of significance
**Significant at 10% level of significance*

Conclusion and Recommendations

Based on the responses from the participating SMEs, it becomes very clear that SMEs in Sri Lanka are facing major challenges in accessing finance from banks or other financial institutions. Results reveal that out of selected six factors associated with access to finance. Such as Age of business, Size of the business, Age of the owner, Experience of the owner, Interest rates and Strict, condition. Three factors were identified as significant factors affect access to finance by SMEs in Sri Lanka, i.e. size of the business, age of the owner and the experience of the owner. The result is strengthening by literature because the literature shows that size, age of the firm and their inability to produce collateral associated with access to finance by SMEs (Chowdhury & Alam, 2017).

The recommendation is that government of Sri Lanka should be actively supporting and developing SMEs by developing and creating more financial institutions like BSIC (The banks for Small Industries and Commerce) that should be deal exclusively with SMEs financing. This would help in creating SME friendly environment that would boost up economic prosperity and stability of the nation like Sri Lanka. The second important point is the financial institutions of Sri Lanka should be actively supporting by providing finance on suitable terms such as lower

interest, longer loan repayment period and reducing transactions costs. Moreover, SMEs have to focus on different sectors rather than sticking to one sector. This helps SME owners to generate more income and help them to do the repayment on time without having more financial pressure.

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IMPACT OF TRADITIONAL MEDIA ADVERTMENTS ON CONSUMER BUYING BEHAVIOUR: BASED ON A SBU OF A FMCG COMPANY IN SRI LANKA

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Abstract

Companies invest in various media platforms to influence consumer buying behavior and all these media platforms have a different composition (Sama,2019). Hence a deeper understanding on them with its implications on consumer buying behavior need to be established. As per the preliminary investigation, the author has found main three traditional media platforms that affect to the selected strategic business unit (SBU) of Fast Moving Consumer Goods (FMCG) company. They are Television (TV) advertisements, Billboard advertisements and Mobile Vehicle advertisements. This study aims to explore the impact of traditional media advertisements on consumers buying behavior towards SBU of FMCG Company in Sri Lanka. This study involves data from 84 respondents. The primary data has been done using the quantitative approach, with an online survey instrument, based on structured questionnaire. The secondary data has been done through the review of previously established literature. Statistical tools such as Cronbach alpha test were used to analyze the collected data. The findings suggested that TV advertisements are the most persuasive medium that impact Consumer Behaviour. To sum up, few recommendations have been provided.

Key words: Traditional Media Advertisements, Consumer Buying Behaviour, FMCG Company, SBU

Introduction

In a competitive market, it is important for businesses to grab consumers' attention through advertisements. Consumer Buying Behavior is a process which represents a number of actions that a purchaser will take before actually making the final purchase (Cave, 2017). The primary mission of any advertiser is to spread information about the products effectively by reaching consumers and to impact their attitude and buying behaviour (Makad, 2016). Even in the theory of planned behaviour, behavioural intentions are said to be formed on the basis of attitudes, subjective norms and perceived behavioural control (Ajzen,1991). Therefore, to enhance the buying behavior, advertising has become one of the key influential factor in the contemporary business. Modern day, advertisements have significantly increased and expanded through new platforms such as social media, mobile, email and etc. Thus, it was significantly noticed still the organizations are heavily relying on Television, Billboards, Leaflets, Magazines, Newspapers and Radios and Mobile vehicle advertising. In the recent past publications, many researchers were trying to analyze the modern media advertising platforms rather highlighting the usage of traditional media advertising platforms. Though many scholars highlight many drawbacks in traditional media advertising, the reason for this long existence of traditional media advertising can also be questioned back from them. Advertisers still prefer traditional mediums such as TV and Print media for advertisements (Statista,2016). As per the literature highlights; TV advertisements, Billboard advertisements and Mobile Vehicle advertisements were selected as the traditional media advertisement methods.

The selected SBU is one of the colossal player in the beverage sector and plays an important role in consumers' daily diet. In previous years, health experts have criticized the brand and it resulted to drop the 4.5 health star rating to 1.5 star rating (Sullivan, 2018). It has massively impacted to each branch of the company and that resulted to incur more cash on advertising and promotional campaigns. With parallel to the modern media platforms and campaigns they have given the main priority to traditional media advertising to regain the loss market. That denotes the significance of traditional media advertisements on consumer buying behavior. Therefore, the research question addressed in this study is "How does traditional media advertisements affect on consumers buying behavior towards selected SBU of FMCG Company?

This will be addressed using three research objectives. They are,

- To explore the impact of traditional media advertisements on Consumer Buying Behavior towards selected SBU of FMCG Company.
- To understand the most important traditional media advertisement method that contribute to increase the Consumer Buying Behavior towards selected SBU of FMCG Company.
- To provide recommendations to improve the most important traditional media advertisement method to increase the Consumer Buying Behavior towards selected SBU of FMCG Company.

Methodology

Conceptual Framework

Independent Variables   **Dependent Variable**
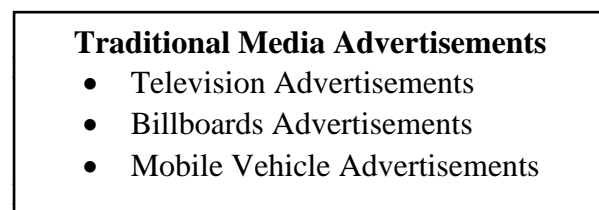
Figure 1: Conceptual Framework

Hypothesis

H1 = There is a positive relationship between television advertising on consumer buying behaviour

H2 = There is a positive relationship between billboards advertising on consumer buying behaviour

H3 = There is a positive relationship between mobile vehicle advertising on consumer buying behaviour

Study area and Data

This study has used the positivist philosophy with quantitative methodology. Deductive approach and survey strategy has used for this study. As the research choice, multi-method has been used and data collection was done using a structured questionnaire. Questionnaire consist of two sections as demographic section and impact of traditional media advertisements on consumer buying behavior section. Three point, Five point and Six point Likert scale have been used. The level of measurement of the study consist with nominal, ordinal, ratio and interval.

Both primary and secondary data were gathered for this study. Population consisted the consumers who are consuming the SBU products of FMCG Company in Sri Lanka. The sample of this study consisted of 84 consumers around the Colombo district. The unit of analysis include individual consumers of SBU. By using the non-probability sampling technique, convenience sampling and purposive sampling method has been used as the sampling methods. Time horizon is cross sectional. To reduce the effects of mono-method bias, respondents were informed that their responses would be anonymous (Podsakoff et al.,2003). SPSS 21 version was applied to present and analyze the data. Collected data has first screened and then analyzed using descriptive statistics, correlation and multiple regression analysis.

Results and Discussion

Demographic Information

Majority of the respondents are found to be female respondents (54.8%) and most of the respondents are in the age category of 20-29 (70.6%). Further, majority are unmarried (82.1%) and unemployed (69%) while having a basic degree (47.1%) as the highest educational qualification.

Correlation Analysis

Table 1: Correlation between independent and dependent variable

Independent variable	Dependent Variable (Consumer Buying Behaviour)	p-value
Television Advertisements	.578**	0.000
Billboard Advertisements	.397**	0.000
Mobile Vehicle advertisements	.217**	0.048

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Researcher's work ,2020

As shown by above table, it demonstrates the results of correlation analysis for traditional media advertising and consumer buying behavior. According to the results of Pearson correlation, there is a moderate positive relationship between Television advertisements and consumer buying behavior and weak positive relationship between Billboard advertisements and weak positive relationship between Mobile vehicle advertisements and consumer buying behavior. The relationship between independent variables and dependent variable are highly significant at 1% significance level. Out of the selected methods, Television advertisement has found to be the most important traditional media advertisement method that contribute to increase the Consumer Buying Behavior towards selected SBU of FMCG Company.

Regression Analysis

Table 2: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.631 a	.398	.375	3.05490	.398	17.632	3	80	.000
a. Predictors: (Constant), Transforme_Mobile_Vehicle_Advertising, Transforme_Television_Advertising, Transforme_Billboard_Advertising									
b. Dependent Variable: Transforme_Consumer_Buying_Behaviour									

Results of the regression analysis show that the R value is 0.398 and this reveal 39.8% of total variance in consumer buying behavior is explained by selected traditional media advertising. This low R-square value suggests that apart from the selected types, there are some other important traditional media platforms that affect the consumer buying behavior of SBU.

Table 3: ANOVA

ANOVAª

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	493.647	3	164.549	17.632	.000 b
	Residual	746.591	80	9.332		
	Total	1240.238	83			

a. Dependent Variable: Transforme_Consumer_Buying_Behaviour
b. Predictors: (Constant), Transforme_Mobile_Vehicle_Advertising, Transforme_Television_Advertising, Transforme_Billboard_Advertising

ANOVA table shows that overall model is significant. Slope of the line is zero. Can reject the null hypothesis.

Table 4: Coefficient Table

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.205	2.706		-.445	.657

	Television advertising	.637	.115	.504	5.559	.000
	Billboard advertising	.265	.114	.222	2.323	.023
	Mobile vehicle advertising	.116	.125	.086	.931	.355
a. Dependent Variable: Consumer buying behaviour						

Hypotheses testing

According to the results of Pearson correlations (Hypotheses testing Phase 1), Television advertising (p=0.000<α=0.01) and Billboard advertising (p=0.000<α=0.01) is significant. In regression analysis (Hypotheses testing Phase 2) of the findings, also got confirmed that Television advertising (p=0.000<α=0.05) and Billboard advertising (p=0.023<α=0.05) is statistically significant. This indicates strong evidence for rejecting the null hypothesis and accepting the alternative hypothesis. That is *H1 = There is a positive relationship between television advertising on consumer buying* is accepted and *H2 = There is a positive relationship between billboards advertising on consumer buying behaviour* is accepted.

Further, the results of Pearson correlations for Mobile Vehicle advertising on consumer buying behavior (p= 0.048 >α=0.01) is not significant and that got proved in regression analysis (p=0.355>α=0.05) as well. Therefore, *H3 = There is a positive relationship between mobile vehicle advertising on consumer buying behaviour* is rejected.

Conclusions and Recommendations

This study revealed that there is a relationship between traditional media advertising on consumer buying behavior towards selected SBU of FMCG Company. Among the selected media channels, Television advertisements have become the most persuasive medium of advertisement which can highly impact on Consumers Buying Behaviour. Empirical evidence of Raju and Devi (2012) showed that Television is the major medium of Advertisements. As mentioned by Sonkusare (2013) Television advertising plays a vital role in Consumers' Buying Behavior and it is mostly providing information about FMCG products. Moreover, the second hypothesis proved that there is a weak positive relationship between the Billboard advertisements and Consumer Buying Behaviour. Thus, the result is inconsistent with the previous studies by Nyarko, Tsetse and Avorga (2015) who found that Billboard advertising is an effective way of gaining information about products and Services. Further, third hypothesis got rejected in the analysis that Mobile Vehicle Advertising does not have any impact on Consumers Buying Behaviour. The result is inconsistent with the research done by Hobbos (2018) who state that Mobile Vehicle advertising is an extremely effective mode to get the attention of various audiences due to its mobility. Since most of the respondents got attached to Television advertisements, company can plan to use and develop television adverts properly by adding new concepts, ideas with a clear message to gain new customers, create brand loyalty and brand awareness. Further can add more creativity to TV adverts without making customers bored with same pattern. It is said by marketing experts that first three seconds are the most engaging time for any audience. Therefore, capturing the audience's attention during those three seconds will be highly crucial. Use of influencers with compelling stories, memorable tag lines would add more value to TV advertisements.

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INFLUENCE OF SUBJECTIVE NORMS TOWARDS E-BANKING ADOPTION: A MULTIVARIATE ANALYSIS

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Abstract

Technological advancements positively affect economic progression and development of the countries in the long run. One of the broadly studied areas of technological transformation is the retail financial services which includes consumer banking activities with reference to the wide-ranging service sector of the country. E-banking enables customers to experience a vast array of financial services instantly with any time access to the particular user. Similarly, one of the factors determining e-banking adoption is the social influence; particularly from friends and family members, towards accepting varied e-banking services. However, mere formation of favorable intentions/attitudes and performing the behavior/action for adoption of e-banking are quite different aspects although both seems alike. Moreover, it is noted that when the intention to perform the action is stronger, it is highly likely that specific behavior/action will be performed. Nonetheless, in practice; this phenomenon is dependent on the particular context. Therefore, this research addresses the significance of subjective norms towards intentions and actions on adoption of consumer e-banking in the context of Sri Lankan private banks. Sample was drawn from the e-banking using students of Uwa Wellassa University. Data collected through self-administered questionnaires from the respondents. At first, 400 questionnaires were distributed and 279 duly completed questionnaires were considered for the final data analysis. Theory of reasoned action has been and dimensions of the variables were measured by five-point Likert scale. In order to test the hypotheses MANOVA was used primarily whilst ANOVA with contrast tests and discriminant function analysis followed. Empirical evidence supported both the hypotheses indicating the significance of subjective norms towards both the intentions and actions on adoption of e-banking, specifying the importance of subjective norm of the friends. Finally, researcher has produced several suggestions related to future researches on e-banking adoption area.

Keywords: Banks, E-banking, Intentions, Online banking, Subjective norms

Introduction

Banking services continued to dominate the financial sector, accounting for a substantial share of the total assets of the financial sector (CBSL, 2020). Nevertheless, profitability of the banking sector has declined attributable to the rise in operating costs. Therefore, this negative scenario could be addressed by minimizing operational costs while improving other income sources concurrently by facilitating e-onboarding whilst promoting e-banking services. Primary objective of the study is to identify the influence of subjective norm (SN) towards user intentions and actions on adoption of e-banking (AoEB). Secondly, to identify the differences in between 3 SN groups (SN-friends, SN-family and control group) against intentions and actions on AoEB.

Conceptual framework and hypotheses of the study

Theory of Reasoned Action (TRA) has been used to explain the user behavior in different scenarios such as health behavior and consumer behavior explanations (Albarracin & Ajzen, 2007; Colman, 2015; Fishbein, 1967; Fishbein & Ajzen, 1975; Safeenaet al., 2018). Upon perusal of previous literature, following conceptual model was proposed.

Subjective norms (SN) are also one of the critical determinants of behavioral intentions and denote the way perceptions of relevant groups or individuals for instance the family members, friends and peers, that might affect one's performance of the behavior (Fishbein, 1967). Ajzen describes SN as the specific perceived social pressure to perform or not perform the behavior by an individual (Albarracin & Ajzen, 2007). As stated by the TRA, individuals develop certain beliefs or normative beliefs as to whether or not the certain behaviors are acceptable (Fishbein & Ajzen, 1975). These beliefs form one's perception of the behavior and determine one's intention to perform or not to perform the particular behavior (Albarracin & Ajzen, 2007; Fishbein & Ajzen, 1975). For instance, if a person believes that e-banking adoption (the specific behavior) is acceptable within one's social group, one will more likely be willing to engage in the said activity. Alternatively, if one's friends groups perceive that the given behavior is not favorable, person is less likely to engage in that. Nevertheless, SN also take into account people's motivation to comply with their respective social circle's views and perceptions, which may vary depending on the situations and the individual's motivations (Fishbein & Ajzen, 1975).

Conceptual model
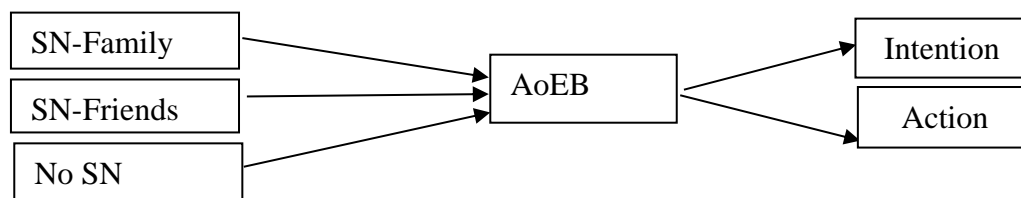
Figure 1: Conceptual model

A conceptual model for mobile banking adoption has depicted the importance of SN in accepting mobile bank technology (Illiaet al., 2015). Exploratory study of internet banking technology adoption using an integrated model has shown the significance of SN in Indian e-banking context (Safeena et al., 2018). Considering the aforementioned facts following hypotheses were proposed,

H_11- SN is significant determinant of intentions and actions on AoEB

H_12-There are significant differences in SN influenced by friends, as against family

Methodology

For the present study, deductive methodology and quantitative method has been followed. The survey strategy is usually associated with a deductive research approach. It is a popular and common strategy in business and management research area. Surveys using questionnaires are popular as they allow the collection of standardized data from a sizeable population in a highly economical way, allowing easy comparison. In addition, the survey strategy is perceived as

authoritative by people in general and is both comparatively easy to explain and to understand (Bell et al., 2018; Ghauri et al., 2020; Zikmund et al., 2013). The survey strategy allows to collect quantitative data which could be analyzed quantitatively using descriptive and inferential statistics. In addition, data collected using a survey strategy can be used to suggest possible reasons for particular relationships between variables and to produce models of these relationships. Further, population of interest for the preset study was the e-banking patronizing customers of the top three private commercial banks operating in Sri Lanka. Correspondingly, dimensions of the variables were measured by five-point Likert scale. For each concept the resultant measure or scale is represented by a scale score created by combining the scores for each of the rating questions. Each question is often referred to as a scale item. In the case of a simple Likert scale, for example, the scale score for each case would be calculated by adding together the scores of each of the questions (items) selected (deVaus, 2002). Accordingly, Questionnaire survey was conducted in which the respondents were the students of Uwa Wellassa University (UWU) those who are using e-banking facilities of private commercial banks. Respondents were selected on random sampling method as per registration numbers. Overall, 400 questionnaires were distributed and 279 duly completed questionnaires were considered for the final data analysis.

Results and Discussion
IBM SPSS version 20 package was deployed for data analysis of the study. The socio-demographic characteristics pertaining to the sample is in line to examine the research issue in the specified context as most of the demographic features of the population are being adequately replicated by the designated sample of the research study. In summary, most of the respondents were males as against female counterparts. Similarly, highest number of respondents were represented in the age group of 18-22 where most of the respondents were Sinhalese. Simultaneously, large number of respondents have been represented in the years of banking relationship category where it was equal or less than three years of banking relationship with respective banks.

Whilst satisfying the assumptions pertinent to Manova, it was noted that observations were statistically independent. Similarly, as mentioned previously, randomly sampling was followed from the population of interest and measured at an interval level. Afterwards, checked the assumption of univariate normality for each dependent variable in turn (considering practicality and as the univariate normality is a necessary condition for multivariate normality). The assumption of equality of covariance matrices was checked using variance-covariance matrices that were compared between groups using Box's test. This test was non-significant indicating that the matrices are the same. The effect of violating this assumption is unclear, except that Hotelling's T^2 is robust in the two-group situation when sample sizes are equal (Hakstian et al., 1979).

Following table 1 shows, an initial table of descriptive statistics. This table contains the overall and group means and standard deviations for each dependent variable. It is obvious from the means that respondents had comparatively more AoEB-related intentions than adoption actions.

Table 1-Descriptive Statistics

	SN	Mean	Std. Deviation	N
Action	Family	3.2860	.27715	81
	Friends	3.9483	.62791	141
	No SN	3.6849	.58498	57
	Total	3.7022	.60896	279
Intention	Family	3.9679	.60432	81
	Friends	4.5220	.43311	141
	No SN	4.1035	.46559	57
	Total	4.2756	.55469	279

Table 2 shows, the main table of results. Test statistics are quoted for the intercept of the model and for the group variable. The group effects are of interest because they depict whether or not the SN had an effect on the AoEB. For these data, Pillai's trace ($p < .05$), Wilks's lambda ($p < .05$), Hotelling's trace ($p < .05$) and Roy's largest root ($p < .05$), all reach the criterion for significance of .05. As per the results it could be noted that the type of SN had a significant effect on AoEB.

Table 2-Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.985	8778.717[b]	2.000	275.000	.000	.985
	Wilks' Lambda	.015	8778.717[b]	2.000	275.000	.000	.985
	Hotelling's Trace	63.845	8778.717[b]	2.000	275.000	.000	.985
	Roy's Largest Root	63.845	8778.717[b]	2.000	275.000	.000	.985
SN	Pillai's Trace	.285	22.924	4.000	552.000	.000	.142
	Wilks' Lambda	.727	23.769[b]	4.000	550.000	.000	.147
	Hotelling's Trace	.359	24.613	4.000	548.000	.000	.152
	Roy's Largest Root	.306	42.237[c]	2.000	276.000	.000	.234

a. Design: Intercept + SN

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

A significant MANOVA could be followed up using either univariate ANOVA or discriminant analysis (occasionally called discriminant function analysis also). In discriminant analysis, it looks to see how it can best separate (discriminate) a set of groups using several predictors.

Table 3shows the significance tests of the variates. These show the significance of both variates ('1 through 2' in the table), and the significance after the first variate has been removed. So, effectively it tests the model as a whole, and then removes variates one at a time to see whether

what's left is significant. In this case with only two variates, gets only two steps: the whole model, and then the model after the first variate is removed (leaves only the second variate). When both variates are tested in combination Wilks's lambda has the same value (0.727), degrees of freedom (4) and significance value (.05) as in the MANOVA. Point to note from this table is that the two variates significantly discriminate the groups in combination (p < .05), and also the second variate alone is also significant, (p < .05). Consequently, the group differences shown by the MANOVA can be explained in terms of two underlying dimensions in combination and individually by 2 one, as well.

Table 3-Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	.727	87.857	4	.000
2	.949	14.293	1	.000

Following graph (Figure 1) plots the variate scores for each person, grouped according to the experimental condition to which that person belonged. In addition, the previous group centroids are shown as blue squares. The graph and the tabulated values of the centroids depicts that (Refer the big squares labelled with the group names) variate 1 discriminates the friends SN group from the family SN (Note the horizontal distance between these centroids). The second variate differentiates the no-treatment group (No SN) from the two interventions (See the vertical distances), but this difference is not as significant as for the first variate.
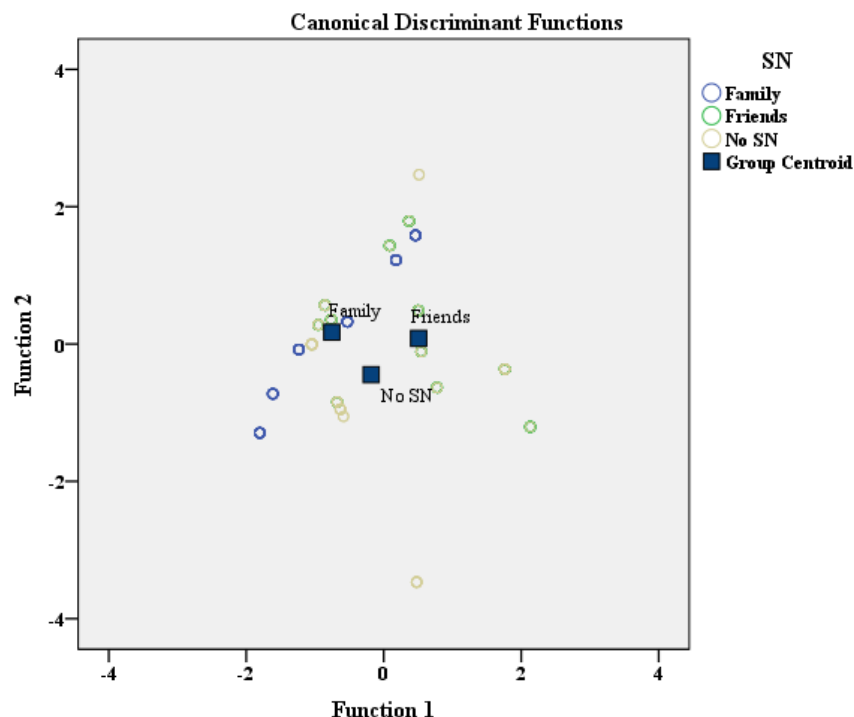
Figure 2-variate scores

As shown in figure 2, means and CIs between the dependent variables in each SN group are given. Data on mean already given under the descriptive statistics at the very beginning.

Figure 3 shows graphs of the relationships between the dependent variables and the group means of the original data. The graph of the means shows that friends SN increases both the intentions and actions towards AoEB. It was discovered from the discriminant analysis that friends SN and family SN can be differentiated from the control group based on variate 2, a variate that has a different effect on intentions and actions. Could note that friends SN is better than family SN and no-treatment groups at increasing intentions and actions related to AoEB. Similarly, it was also discovered that friends SN and family SN could be distinguished by variate 1, a variate that had the similar effects on intentions and actions on AoEB.

In conclusion, Manova test statistics indicated that SN has a significant effect on AoEB. Referring to following figure 3, identified that friends SN is better at changing both actions and intentions on AoEB. Hence, noted that both the hypotheses pertinent to the present study, have been supported by the empirical evidences as already discussed.
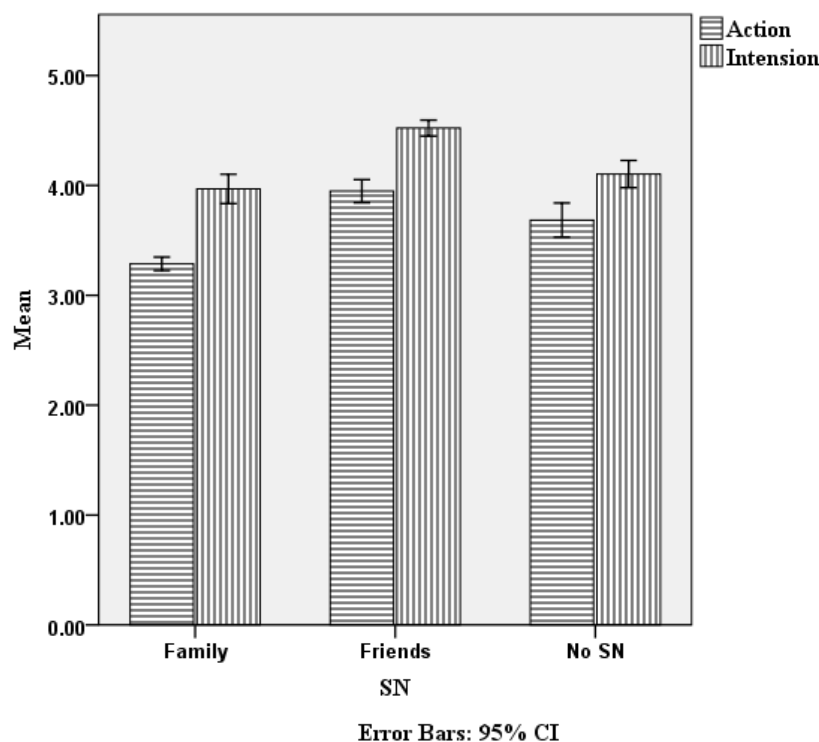
Figure 3-Means and CIs between the dependent variables in each SN group

Conclusion and Recommendations

MANOVA indicated that SN has a significant effect on AoEB and findings are in line with previous research findings as well (Illia et al., 2015; Nayanajith et al., 2019 & 2020; Safeena et al., 2018). Referring to figure two, concluded that friends SN is better at changing both actions and intentions on AoEB. Hence, noted that both the hypotheses have been supported by the empirical evidence of the study. Accordingly, No SN group can be distinguished from

the two groups using the variate that has opposite effects on intentions and actions on AoEB. Also, the friends SN and family SN groups can be distinguished by the variate that has similar effects on intentions and actions. So, friends SN is better than both No SN and family SN, regardless of thinking it's more important to target intentions or actions.

There were several limitations which confine the reliability to generalize the research findings. To begin with, as respondents of the study were the students of the UWU, it could be possible to obtain different results in the case of conducting the research in another context as the respondents may not exactly replicate the whole Sri Lankan e-banking customers of the selected private commercial banks. However, findings could be used by banking and financial institutions in promoting online financial services to a greater extent in line with marketing strategies that will reduce the underbanked and unbanked population considerably alongside easy to use technology innovations. Meanwhile, as there were restrictions due to time and other resources, future researches could be performed with improved representation of the entire population to validate the research findings in different contexts

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THE IMPACT OF PROFITABILITY ON THE PERFORMANCE OF TWO BANKS IN SRI LANKA: COMPARATIVE STUDY OF A LOCAL BANK WITH A FOREIGN BANK

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Abstract

Financial sector plays a significance role in the economic development of Sri Lanka. It is generally agreed that a strong and healthy banking system is the backbone of any country. Banks in Sri Lanka have been undergoing major challenges in the financial environment over the past years. Purpose of this study is to observe to what level the profitability impact on the performance of banks in Sri Lanka. To do a comparative study a local bank is compared with a foreign bank. In order to avoid negative impacts and maintain financial stability in the country, it is important to identify the determinants that influence the overall performance of banks in Sri Lanka. Financial data from a local bank and a foreign bank have been taken into consideration to carry out the study. Panel data has been collected from annual reports of a local Bank and a foreign bank listed on Colombo Stock Exchange (CSE) for the period of ten years from 2012 to 2018. This study aims in giving the analysis of the determinants of the two banks' profitability in Sri Lanka, on their performance, over the period 2012-2018. The findings of this research provides information to both present and future investors for making the decisions on which factors should be analyzed when they invest on banking sector in Sri Lanka. The banks details will be collected from the annual reports and analyzed by using anova to find out the impact.

Key words: Local Bank, Foreign Bank, Profitability, Performance, Sri Lanka, ROE, ROA, Current ratio, Net Profit Margin

Introduction

Commercial banks play an important and active role for emerging an economy of a nation. It leads to bring a rapid growth in the various sectors in the country, when the banking sector in a country is functioning in an efficient, effective, and disciplined way. Many factors may impact on performance of commercial banks. In this study only the profitability of two banks are taken into consideration to check how it impacts the banks' performance. Changes of profitability may lead for occurring unsystematic and systematic risks within the bank and it will impact the performance. Both risks may have greater influence on profitability of the banks. In Sri Lanka, commercial banks take a significant share for operating the economy by their procedure such as taking currency as deposit from the people who have excess fund and providing such money to the people who want to invest in expansion activities. Commercial banks are listed under the sector of bank finance and insurance companies, which is one sector among 20 diversified sectors in Colombo stock exchange (CSE) in Sri Lanka. Altogether 26 licensed commercial banks consist of 13 domestic banks and 13 foreign banks and 6 licensed specialized banks are functioning in Sri Lanka. Central bank of Sri Lanka was started in 1950 as an apex institution to manage, direct and as the controller of the entire activities of banking and financial sectors in Sri Lanka. In order to protect financial institutions from unexpected

losses, external parties of the banks such as Central Bank of Sri Lanka and Basel Committee are developing policies and releasing guiding articles time to time. This paper is levelled at the investigation of determinants of profitability of commercial banks and how they impact the performance of the banks. (Cbsl.gov.lk, 2020)

Background of the study

Financial industry is the mainstay of any country's economy. Sri Lanka is a country with large number of small and medium industries (SMIs). For these industries to move forward, financial interaction is important. Most entrepreneurs found it difficult to raise capital on their own when starting their own business. As a result of the revised interest rates on deposits, more funds are flowing into commercial banks, making them strengthened in lending. With the entry of new commercial banks including foreign banks, market share of dominant players are decreasing, affecting their degree of profitability. Banking as an industry has been very competitive and innovative globally. The directions given by the regulator will ensure to keep the pace of economy of the country at a sound level by making commercial banks more strengthened. (Export.gov, 2020)

Significance of the study

This research mainly focusses on the performances between a local bank and a foreign bank in Sri Lanka. The criteria such as the Net Profit Margin, ROE and the ROA is the main focus when comparing the two Banks. To capture the profitability of each bank the NPM is used. This research will also serve as a source of secondary data to future researchers who intend to carry out further research work on the topic "Comparative study on a local bank with a foreign bank" or any related topic. The outcome of the investigation may assist the investors, regulators, and bank management in making their decisions.

Conceptual Framework
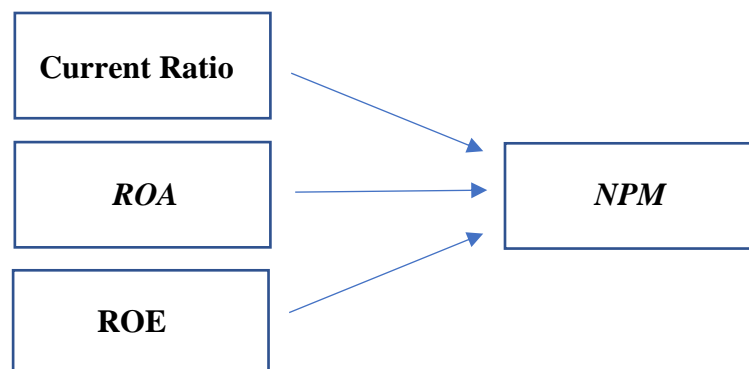
Figure 01: Conceptual Model

Hypothesis

HA – There is no relationship between Current Ratio and NPM
HB – There is no relationship between ROA and NPM
HC – There is no relationship between ROE and NPM

Methodology

Data collection

Secondary data has been used in the completion of the report. This research is regarding the net profitability margin of two commercial banks in Sri Lanka, only secondary data which are mainly financial statements are considered. Due to the convenience two banks in Colombo are chosen for the sample: One local bank & one foreign bank operating in the country.

Secondary data are data that have been collected by others, also known as readymade data. Secondary data analysis contains a researcher using the evidence that somebody else has collected for his or her own determinations. Researchers influence secondary data study in an effort to answer a new research question, or to inspect a substitute perspective on the original question of a previous study. A regression model was used to find the correlation between ROA, ROE and NPM.

Data Analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.976[a]	.953	.907	.72515

a. Predictors: (Constant), Current_Ratio_LB, ROA_LB, ROE_LB

According to model summary table, it shows that out of total variabilities 90.7% of variabilities are explained by the regression model.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	32.296	3	10.765	20.473	.017[b]
	Residual	1.578	3	.526		
	Total	33.874	6			

a. Dependent Variable: NPM_LB

b. Predictors: (Constant), Current Ratio_LB, ROA_LB, ROE_LB

The sig-value of regression is 0.017 which is less than 0.05. It implies that the regression model is significant at 5% level of significance.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.502	1.915		.784	.490
	ROA_LB	1.410	2.000	.157	.705	.532
	ROE_LB	.598	.167	.797	3.575	.037
	Current_Ratio_LB	6.094	3.138	.247	1.942	.147

a. Dependent Variable: NPM_LB

According to coefficient table, regression coefficients of ROA, ROE and current ration are 1.410, 0.598 and 6.094 respectively. It implies that there is a positive impact of ROA, ROE and current ratio on NPM of local banks. Further, the sig values of ROA, ROE and current ratio were 0.532, 0.037 and 0.147 respectively. It implies that there is a significant impact of ROE on NPM of local banks at 5% level of significance. However, ROA and current ration did not show any significant impact. Therefore, the model can be expressed as,

$$NPM_{LB} = 1.502 + 0.598 \times ROE_{LB}$$

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.957ᵃ	.915	.831	1.15464

a. Predictors: (Constant), Current_Ratio_FB, ROE_FB, ROA_FB

According to model summary table, it shows that out of total variabilities 83.1% of variabilities are explained by the regression model.

ANOVAᵃ

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	43.289	3	14.430	10.823	.041ᵇ
	Residual	4.000	3	1.333		
	Total	47.289	6			

a. Dependent Variable: NPM_FB

b. Predictors: (Constant), Current_Ratio_FB, ROE_FB, ROA_FB

The sig-value of regression is 0.041 which is less than 0.05. It implies that the regression model is significant at 5% level of significance.

Coefficientsᵃ

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	25.525	4.911		5.198	.014
	ROA_FB	5.816	2.024	1.090	2.874	.064
	ROE_FB	.216	.414	.137	.523	.637
	Current_Ratio_FB	.007	.051	.040	.135	.901

a. Dependent Variable: NPM_FB

According to coefficient table, regression coefficients of ROA, ROE and current ration are 5.816, 0.216 and 0.007 respectively. It implies that there is a positive impact of ROA, ROE and current ratio on NPM of foreign banks. Further, the sig values of ROA, ROE and current

ratio were 0.064, 0.637 and 0.901 respectively. It implies that there is a significant impact of ROA on NPM of foreign banks at 10% level of significance. However, ROE and current ration did not show any significant impact. Therefore, the model can be expressed as,

$$NPM_{FB} = 25.525 + 5.816 \times ROA_{FB}$$

Conclusion

Financial performance of banks can be measured in terms of ROA and ROE. Bank performance is the support and the drive of any banking activity. First, researchers distinct the values of assessment and exhibiting of bank performance, then, concepts and models clarifying banks performance were developed. The numerous studies were attentive on countries that depend on the majority of banks in the world. The results attained can be classified between the banks conferring to the application of the model or the description of the factors of the banking performance. The major aim of this study is to study the impact of Current Ratio, ROE and ROA on profitability of commercial banks in Sri Lanka. Data has been collected from two commercial banks, one as local bank and the other a foreign bank for a period from 2012 to 2018 from annual reports of randomly selected banks. The findings of this study revealed that Current Ratio, ROE and ROA both has positive significant impact on profitability of the banks. Similar kind of study can be done by taking more mutual data such as using the capital adequacy, Asset quality and Liquidity to measure the performance of eh banks, and by including other commercial banks as well in sample. Also, more research can be done by counting both internal and external factors for more effective results.

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IMPACT OF INTERNET BANKING SERVICE QUALITY ON CUSTOMER SATISFACTION: A CASE STUDY

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Abstract

This study was done to explore the impact of internet banking service quality on customer satisfaction at one of the leading commercial bank in Horana area. For this study, efficiency, reliability, easy and convenience, security and confidentiality were taken as the dimensions of independent variable. A structured questionnaire was administered among sixty respondents to gather primary data. Frequency analysis, measures of central tendency, correlation analysis and simple regression analysis were applied to for data analysis. This study evidently concluded that easiness and convenience are the best predictors of customer satisfaction. However, efficiency, reliability and security and confidentiality also positively affect customer satisfaction. Hence, this study recommended that each bank should implement internet banking platforms to provide a convenient service to their customers.

Key Words: Customer Satisfaction, Internet banking service quality Easiness and Convenience, Efficiency, Reliability, Security and Confidentiality

Introduction

Complying with the trend in using internet for the businesses banking industry also started to get the maximum support of the internet for banking purposes at its earliest. As a result, a new service called e-banking or the internet banking was emerged (Sakhaei, Afshari and Esmaili, 2014). It is obvious that as well as all the other service providers, main intension of each bank was to satisfy their customers. So, as mentioned by Sakhaei, Afshari and Esmaili (2014); Sanjeepan (2017); Kahandawa and Wijayanayake (2014) customer satisfaction is highly important to the banking institutions and it is a challenging task. Internet banking is recognized as a strong tool to face with this. There are various dimensions of internet banking service quality that impact on the customer satisfaction like efficiency, reliability, convenience, security and privacy, accuracy etc. (Sanjeepan, 2017). A research by Premarathne and Gunatilake (2016) has concluded that, still, Sri Lankan banks as the financial service providers and customers as beneficiaries are not taking the real benefit of Internet banking and some customers are still having the uncertainty regarding the security of internet banking. Therefore, this research attempts to resolve the research question, of "*How does internet banking service quality impact customer satisfaction at one of the leading commercial bank in Horana Area?*"

Objectives of the Study

The main objective of this research is to study the impact of internet banking service quality dimensions on customer satisfaction of a leading commercial bank in Horana area. This research also attempts to identify the most impacting internet banking service quality dimensions on customer satisfaction.

Significance of the Study

This research enables the bank to get a clear insight about main dimensions of internet banking what the customers are looking for. The research findings provide a strong platform to improve these dimensions and through that satisfy the financial customers at a greater extent. This will be helpful for the bank to expand their online banking customer count as well.

Methodology

Conceptual Framework

Empirical studies done by Priyanath and Perera (2018); Vetrivel, Rajini and Krishnamoorthy (2020); Hammoud, Bizri and El Baba (2018) have concluded that the efficiency of the internet banking is having a positive impact on the customer satisfaction. According to Sakhaei, Afshari and Esmaili (2014); Hammoud, Bizri and El Baba (2018), there is a significant impact on reliability on customer satisfaction compared to other dimensions. As exemplified by Kahandawa and Wijayanayake (2014); Hammoud, Bizri and El Baba (2018) due to the easiness and convenience, people do not want to visit the bank every time and they can easily access the bank via their mobile phones. Thirupathi and Govindaraju (2015); Sakhaei, Afshari and Esmaili (2014) security and confidentiality most important factors that influencing customer satisfaction in banking industry.

The previous literature which has been reviewed by this study supports to develop the conceptual model of this study appeared as Figure 1. Efficiency, reliability, easiness and convenience and security and confidentiality are treated as the service quality dimensions of Internet banking and customer satisfaction as the dependent variable.
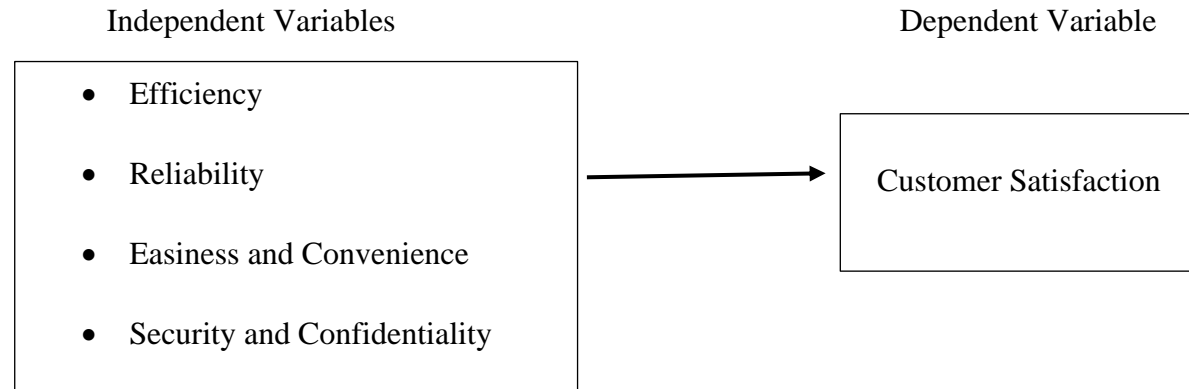
Figure 1: Conceptual framework

Hypotheses

H1: Efficiency of internet banking has an impact on customer satisfaction.
H2: Reliability of internet banking has an impact on customer satisfaction.
H3:Easiness and convenience of internet banking has an impact on customer satisfaction.
H4: Security and confidentiality of internet banking has an impact on customer satisfaction.
H5: Internet banking service quality has an impact on customer satisfaction.

Sampling and Data Collection

The deductive approach was used in this research and this comprises quantitative data. Population of this study is the customers of the leading commercial banks in Horana area who are using the internet banking. Sixty customers were selected as the sample of the study using cluster sampling and convenient sampling methods. Both primary and secondary data were used for this research. A structured questionnaire was distributed to gather primary data among sixty respondents and fifty-five of were collected. Journal articles, text books, thesis were used as secondary sources of data. Statistical techniques such as frequency analysis, measures of central tendency, correlation analysis and regression analysis have been used to analyze data. Statistical calculations have been done using SPSS 20 version.

Data Analysis and Discussion

Reliability of Data

Table 1: Reliability Analysis of the Variables

Variable	Dimension	Cronbach's Alpha	Reliability
Independent Variables	Efficiency	0.899	Reliable
	Reliability	0.868	Reliable
	Easiness and convenience	0.876	Reliable
	Security and confidentiality	0.938	Reliable
Dependent Variable	Customer satisfaction	0.958	Reliable

As per table 1, for all the selected variables, Cronbach's Alpha values are given above 0.7 and this reflects all the selected variables are reliable.

Descriptive Analysis

According to the results of descriptive analysis, there were 50.9% of females and 49.1% of males. Majority of the participants were under the age category of 25 - 35 Years and it was 83.6%. From the fifty-five participants, 70.9% were single while balance 29.1% were married. Other than that, 44 customers were employed in private sector and the mode for that was calculated as 1 which represents the private sector employee category. When analyzing the number of years using internet banking, majority of them are had 1 – 5 Years of experience and it was 54.5% and 30 customers.

Correlation Analysis

Table 2: Pearson correlation between dimensions and customer satisfaction

No	Dimension	Dependent Variable (CS)
1	Efficiency	0.648**
2	Reliability	0.604**
3	Easiness and Convenience	0.785**
4	Security and Confidentiality	0.724**

**. Correlation is significant at the 0.01 level (2-tailed).

As shown in the table 2, by looking at the correlation coefficient, it can identify that there is a moderate positive correlation among efficiency and customer satisfaction and reliability and customer satisfaction since r = 0.648 and r = 0.604 respectively. But when it comes to the easiness and convenience r = 0.785. This shows that there is a strong positive correlation between easiness and convenience and customer satisfaction. As per table 2, security and confidentiality is also having with a reasonable positive relationship with customer satisfaction as r = 0.724.

Linear Regression Analysis

Table 3: Summary of simple linear regression analysis of dimensions

Dimension	Model Summary	ANOVA Table		Coefficients Table	
	Adjusted R Square	P - Value	F	B	Beta Coefficient
Efficiency	0.409	0.000	38.431	0.625	0.648
Reliability	0.352	0.000	30.366	0.665	0.604
Easiness and Convenience	0.609	0.000	84.934	0.795	0.785
Security and Confidentiality	0.515	0.000	58.261	0.686	0.724

As shown in table 3, the adjusted R square of efficiency is 0.409. The adjusted R square emphasizes that 40.9% variance in customer satisfaction is explained by efficiency. It shows that the dimension "efficiency" moderately explains the variance in customer satisfaction. According to the output of ANOVA, F-value is 38.431 at p–value = 0.000 < α = 0.01. This statistically prove that efficiency is a predictor of customer satisfaction. Therefore, the null hypothesis is rejected and its alternative hypothesis is that ***H1: Efficiency of internet banking has an impact on customer satisfaction*** is supported by statistical data.

Above table exemplifies the adjusted R square of reliability model is0.352 and it reflects that 35.2% variance of customer satisfaction is explained by reliability. The explanatory power of reliability in explaining customer satisfaction is at moderate level. ANOVA results reveals that F-value is 30.366 at p–value=0.000 < α=0.01. This statistically prove that reliability is a predictor of customer satisfaction. Therefore, the null hypothesis is rejected and its alternative hypothesis is that ***H2: Reliability of internet banking has an impact on customer satisfaction*** is supported by statistical data.

In terms of easiness and convenience, the adjusted R square is given as 0.609. This reflects that 60.9% variance customer satisfaction is explained by easiness and convenient. The explanatory power of easiness and convenience in explaining customer satisfaction is at a substantial level. F-value is 84.934 at p–value=0.000<α=0.01 with b=0.795 and beta coefficient=0.785. This statistically prove that easiness and convenience is a good predictor of customer satisfaction. Therefore, the null hypothesis is rejected and its alternative hypothesis is that ***H3: Easiness and convenience of internet banking has an impact on customer satisfaction*** is supported by statistical data.

As per the results in linear regression model of security and confidentiality, adjusted R square is 0.515 and it reflects that 51.5% variance of customer satisfaction is moderately explained by security and confidentiality. The results of ANOVA table show that F-value is 58.261 at p–value=0.000<α=0.01. This statistically prove that security and confidentiality is a predictor of customer satisfaction. Therefore, the null hypothesis is rejected and its alternative hypothesis is that *H4: Security and confidentiality of internet banking has an impact on customer satisfaction* is supported by statistical data.

Table 4: Summary of Simple Linear Regression Analysis of Internet banking service quality

Variable	Model Summary	ANOVA Table		Coefficients Table		
	Adjusted R Square	P-Value	F	B	Beta Coefficient	t
Internet banking service quality	0.614	0.000	86.904	0.900	0.788	9.322

Table 4 illustrates that the adjusted R square of internet banking service quality model as 0.614 and it reflects that 61.4% variance of customer satisfaction is explained by internet banking service quality. This explanatory power is at a substantial level. Above table exemplifies that F=86.904, t=9.322 at p–value=0.000 < α=0.01 with B=0.900 and beta=0.788. Therefore, there are statistical evidences to reject the null hypothesis and its alternative hypothesis of *H5: Internet banking service quality has an impact on customer satisfaction* is accepted.

Discussion

The main purpose of this research was to examine the impact of internet banking service quality on customer satisfaction. The results of this study revealed that internet banking service quality dimensions i.e., efficiency, reliability, easiness and convenience and security and confidentiality positively correlate with customer satisfaction with beta coefficient of, 0.648, 0.604, 0.785 and 0.724 respectively. It reveals that easiness and convenience is having the strong positive relationship with customer satisfaction. According to the simple linear regression, all four dimensions are identified as the predictors of customer satisfaction in relation to the internet banking service quality. This finding is compatible with the findings of Kahandawa and Wijayanayake (2014); Sakhaei, Afshari and Esmaili (2014); Hammoud, Bizri and El Baba (2018). The adjusted R square of easiness and convenient of 0.609 reflects that 60.9% variance customer satisfaction is explained by easiness and convenient. F-value is 84.934 at p–value=0.000<α=0.01 with b=0.795 and beta coefficient=0.785. This statistically prove that easiness and convenience is a good predictor of customer satisfaction. However, this finding contradicts with Vetrivel, Rajini and Krishnamoorthy (2020).

Conclusion and Recommendation

Based on the above discussion, this study evidently concludes that all four dimensions of internet banking service quality i.e. efficiency, reliability, easiness & convenience and security and confidentiality are predictors of the satisfaction of customers of the selected bank in Horana area. This study further concludes that the most influential determinant that determine customer

satisfaction is easiness & convenience. The overall regression model developed for internet banking service quality provided sound statistical evidences to conclude that internet banking service quality makes a substantial impact customer satisfaction.

With the technological development and competitiveness in the banking industry, it is recommended each bank to implement internet banking platform. It is recommended that every bank to create their website platforms in a way that customers can easily do their online transactions and other required banking services. In addition, the banks should give their attention for security and confidentiality when they implement and continuing with internet banking.

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PROFESSIONAL'S SATISFACTION ON THE SERVICES PROVIDED BY THE PLASTICS AND RUBBER INSTITUTES OF SRI LANKA

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Abstract

The Plastics and Rubber Institute of Sri Lanka (PRISL) being the professional association of the polymer sector in the country, is lacking in members and participants for professional events organized by the institute. This research looked into satisfaction of the industry professionals on the services provided by PRISL. Four independent variables, membership, continuous professional development, education and networking were identified and a survey was conducted to gather data. Descriptive statistical analysis and bivariate correlation analysis were carried out. The results showed professionals are satisfied with services relating to membership, CPD and education provided by the institute. These variables showed significant correlation with satisfaction of the professionals as well. This research is significant since no similar research regarding PRISL has been carried out before. This research can use as a starting point for future research on the PRISL as well as other professional associations of Sri Lanka.

Keywords: Continuous professional development, Plastics and rubber institute, Professional associations, Professional networking, Professional's satisfaction,

Introduction

Plastics and rubber industry, the industry of manufacturing value added finished products from plastic and rubber raw materials (commonly called as "Polymers") is a huge global industry, expected to reach USD 2.0 trillion by 2022 and shows an annual growth of 4-5% (Cullmann, 2019). It is Sri Lanka's third largest merchandise export sector (National Chamber Of Exporters Sri Lanka, 2018) and has a high potential of growth. The Plastics and Rubber institute of Sri Lanka (PRISL) is the apex professional's association of the polymer sector in the country. It carries the responsibility to create and maintain the professionals, which the local industry needs to achieve substantial growth and to provide the intended services to those professionals in a manner in which their aspiration and intentions are fulfilled.

The term "Professional" can be defined based on their education, occupation, specialized field, license, responsibilities, decision making required in the job, experiences (Etherington & Hawley, 1998) and someone who displays high levels of expertise and efficiency (Dall 'Alba, 2009). A professional association (professional body or society) is a non-profit organization, by a group of people in a learned occupation maintaining and overseeing legitimate practice of that occupation, representing the interest of the professional members, safeguarding the public interest and maintain the privileged position of the profession (Speight, 2015).

This research studied, to what extent PRISL as the national association for the polymer industry is satisfying the requirements and aspirations of the industries manufacturing sector professionals parallel to the volume and technology growth the local industry has obtained.

Objectives of the Study

RO1. To identify the factors influencing satisfaction of industry professionals on the services provided by PRISL.

RO2. To explore the perception of the industry professionals on the value and effectiveness of the services received from PRISL.

RO3. To recommend effective ways to improve the services rendered to the industry professionals by PRISL.

Methodology

Roles of a professional body includes, defining and upholding the standards of its members, provide specialized knowledge related to the field (Australian Education Institute, 2007), conducting education, training, Continuous Professional Development programs, Networking & communications (Chartered Institute of Building, 2015). Professionals use their membership standardizations as a tool to defend their corporate and business position (Jakobs, 2019), to get recognized and to reach people with similar values and interests (Patricia & Dana , 2005). CPD programs provides various opportunities to professionals to learn new skills and knowledge required for long term carrier development (Murdock & Carol, 2003). Professional institutes need to align their education & training programs with aspirations, expectations and needs of stakeholders / employers (Pritam, et al., 2012). Professional networking is the process of developing relationships with people in the field of one's occupation (Solem, et al., 2012). According to findings of literature four independent variables which are mostly affecting to satisfaction of the industry professionals were identified and following conceptual model was formulated.
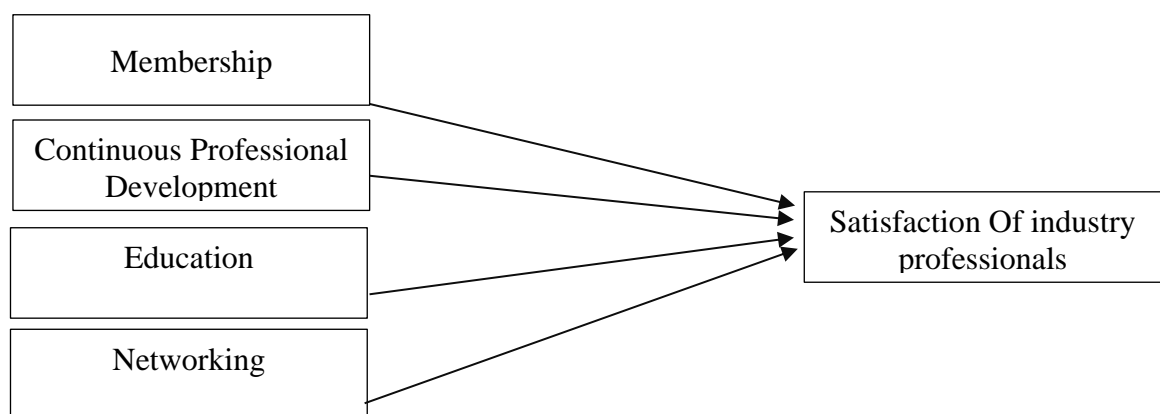
Figure 1. Conceptual model of the research

A questionnaire with 1 – 5 Likert scale with 11 demographic questions and 28 research questions was used to collect data required for this research. The survey was conducted with private and public sector professionals who are employed directly or service providers to rubber and plastic manufacturing sector in grade of "officers" to "Directors & CEO's". For this research simple random sampling was used.

The population considered was 2,221. As per Krejcie and Morgan sample size table, the sample size for this research is 327. The researcher assumed 95% of the sample will reflect the true population characteristics. For 95% confidence level the K value is 1.96 (Sekaran & Bougie,

2011). Due to the time constrains and non-responsiveness of the sample, 175 reply's from professionals were analysed for this research.

Results

Out of 175 respondents, only 16% were female, 84% was male. About half of the respondents, 52.57% were PRISL members. 61% of respondents were above 40 years where as 59.3% of Sri Lanka's labour force is above 40 years of age (Department of Census and Statistics, 2019). 77.15% of respondents had an education of a degree or above. More than half of the respondents, 52.51% are professionally qualified in Rubber and Plastic technology and 40% were qualified in engineering or other natural science disciplines. Out of the respondents 25% employed in the grade of Executive, 38% in the field of research and development. 93.14% of respondent's organisations were manufacturing for export markets. 60% of the respondents were from the dry rubber based manufacturing segment.

Descriptive statistical analysis

Following table summarized the descriptive results.

Table 1. Descriptive results on industry professional's agreement

AREA	% AGREED
PRISL Membership	
PRISL membership is recognised in the industry	80%
PRISL membership is important for career development	60%
Benefits from the PRISL to the members	69%
CPD programs organised by PRISL	
CPD programs are up to date	87%
CPD programs are useful for career development	73%
Education programs conducted by PRISL	
Content of education programs are up-to-date	85%
Structured education programs develop competencies in students	83%
PRISL education will uplift careers of those who are already involved in the industry	91%
Students completing education from PRISL have similar level of knowledge compared to students completing similar education elsewhere	60%
PRISL qualification is in similar recognition to other higher education institutes and universities	51%
Networking events organised by PRISL	
Professionalism of the networking events organised by the PRISL	48%
Professional presence and participations in the organised networking events.	77%

Relationship between independent and dependent variables

Pearson's Correlations coefficient was used to analyse direction, strength and significance of bivariate relationships.

Table 2. Corelation of independent and dependent variables

		MEMBERSHIP	CPD	EDUCATION	NETWORKING	SATISFACTION
MEMBERSHIP	Pearson Correlation	1	.427**	.434**	.585**	.217**
	Sig. (2-tailed)		.000	.000	.000	.004
	N	175	175	175	175	175
CPD	Pearson Correlation	.427**	1	.432**	.368**	.207**
	Sig. (2-tailed)	.000		.000	.000	.006
	N	175	175	175	175	175
EDUCATION	Pearson Correlation	.434**	.432**	1	.440**	.179*
	Sig. (2-tailed)	.000	.000		.000	.017
	N	175	175	175	175	175
NETWORKING	Pearson Correlation	.585**	.368**	.440**	1	-.043
	Sig. (2-tailed)	.000	.000	.000		.573
	N	175	175	175	175	175
SATISFACTION	Pearson Correlation	.217**	.207**	.179*	-.043	1
	Sig. (2-tailed)	.004	.006	.017	.573	
	N	175	175	175	175	175
**. Correlation is significant at the 0.01 level (2-tailed).						
*. Correlation is significant at the 0.05 level (2-tailed).						

Membership, CPD and Education having positive R values (0.271, 0.207 and 0.179 respectively), each has a weak positively relationship with satisfaction of the industry professionals. Membership and CPD having significance values 0.004, 0.006 has a significant correlation ($P<0.01$). Education also has a significant correlation ($P<0.05$) having significance of 0.017. R value of -0.043, indicates networking opportunities created by PRISL has a weak negative relationship with satisfaction of industry professionals. There is no significant correlation between the two variables, since the sig. value is 0.573 ($p<0.01$ & $p<0.05$). Since the significance value in homogeneity of variance of Membership, CPD and Education are respectively 0.000, 0.001, 0.014 and ANOVA are 0.00 (is < 0.05), null hypothesis can be rejected and alternative hypothesis can be accepted.

Discussion

Results indicates PRISL membership, education programs and the CPD programs are aspired by the industry professionals. Further they are looking towards the institute to create networking opportunities. There for, it's clear these are influencing factors on professional's satisfaction; hence first research objective is satisfied.

Second objective was to identify perception on the value and effectiveness of the services provided by PRISL. As per the professional's PRISL membership has a good recognition in the industry. Professionals find the CPD programs are up to date and useful. The educational coursers are accepted to be up to date and to develop competencies necessary in students. However, the institute must work towards improving the recognition and opportunity of the qualification they provide within the industry. Networking events and opportunities created by the institute was the least admired by industry professionals, there for must find ways and means to improve in this area.

80% agreed the institute must increase the use of social media and new media in communication and propaganda work. 92% expect the PRISL to conduct more CPD programs. The highest agreement of this survey of 95% confirmed that the professionals are in the view the PRISL should introduce a mechanism for the young professional's and new member to network with industry experts and leaders. And 92% agreed the institute should work towards creating more opportunity and recognition for the members. Hence the third objective of the research if achieved and the recommendations are further elaborated in the following section.

Conclusions and Recommendations

The perception of the industry professionals is positive in regard of the institute. Industry professionals agree PRISL is effective and relative in the services they provide in relation to memberships, CPD and education. The survey confirmed the PRISL membership is highly regarded in the industry. However, the institute has more space to do better on the networking opportunities they create for the professionals.

According to the research findings following recommendations can be made. Since, similar number of members and non-members participated the survey indicates the non-members interest in affairs of PRISL. By adopting proper marketing strategy, new members can be easily attracted. The institute should try to improve the use of social media and new media in communication and propaganda. Professionals highly agreed that PRISL should introduce a mechanism for young professional and new members to network with industry leaders and experts. Include more futuristic knowledge in future CPD programs organised by PRISL. Take steps to improve awareness, status and recognition of the PRISL membership within and outside the industry. Capitalise on membership and education provided by the institute to attract, expand & increase the affairs of the institute. The institute should revisit their strategy for organising networking opportunities and create more effective and relative networking events for the industry professionals. Further research can be conducted on the identified variables to gain more focused insight on how the functions of the institute and similar institutes can be improved. Further, this research can be used as a reference and a benchmark to study other professional associations in Sri Lanka.

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A STUDY PREDICTING JOB SATISFACTION FROM EMPLOYEES' MOTIVATION AMONG BANKING SECTOR IN KANDY DISTRICT

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Abstract

Employees are the heart of the organization. For any organization to operate smoothly and without any interruption, employee cooperation cannot be replaced with anything else. It is of utmost importance that the employees of the organization not only have a good relationship with the top management, but also they maintain a healthy and professional relationship with their co-workers. The following study is a self-conducted research on how motivational tools impact the job satisfaction of the employees. A sample 50 individuals was selected and 10 individuals were interviewed with a self-administered questionnaire to obtain primary data. The data was analyzed using statistical analysis method. The results obtained indicate that if employees are positively motivated, it improves both their effectiveness and efficiently drastically for achieving the organizational goals.

Key Words: Employee Motivation, Employee Performances and Job Satisfaction

Introduction

Steers et al (2004) said one of the important function of human resource manager is to ensure job commitment at the workplace, which only can be achieved through motivation. Robert (2008) stated that a large portion behind these difficulties can easily be solved by imparting proper motivation. In this era of competition, organizations nowadays are emphasizing on the management of Human Resources. Central Bank of Sri Lanka (2019) mentioned that the rapid expansion has generated a lot of internal management problems in the banking sector in Kandy District. One of the special issues is the low level of employee job satisfaction that brought difficulties in various aspects. These problems are all relevant with fast employee's job satisfaction. Dickson (1973) stated Employee Satisfaction has a great impact on organzaitions productivity and sustainability. Company staff is the internal part of every organization as it's through them that profit is generated to the company Steers et al (2004). The aim of this research is to ascertain the key factors, among several factors impacting on the employee job satisfaction of the banking sector and finally to come out with recommendations to reduce employee dissatisfaction and increase satisfaction of employees in the banking sector in Kandy Sector.

Objectives

Objective of the study is to explore how different key variables motivate employee and assist the banking sector. The main intentions of this study are:

- To analyze how attributes of employee motivation contibutes to job satisfaction.
- To identify the relationship between employee motivation and job satisfaction.

Research Questions

- How attributes of employee motivation make a contribution for Job satisfaction?
- What is the relationship between employee motivation and Job satisfaction?

Conceptual Framework
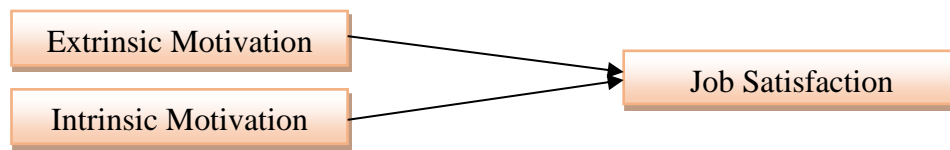
Figure 1: Conceptual Framework

Hypothesis

H1: There is a relationship between Intrinsic Motivation and Job Satisfaction

H2: There is a relationship between Extrinsic Motivation and Job Satisfaction

Methodology

The research design for this study was mixed method pragmatism. For this study, employees with different designations and experience level were chosen as target population in the banking sector. A total of 50 employees were chosen and they were provided with the questionnaire and also conducted a semi structured interview with 10 samples. Their responses for the questionnaires were collected as primary data. Afterwards these data were analyzed to get an overall idea regarding the impact of motivation on different strategies. Using the sampling method, a sample size of 50 respondents was obtained. The respondents were selected using stratified random sampling. Data was collected from primary source. The primary data was conducted through structured questionnaire and some personal interview. Analysis was performed using multiple regression analysis and correlation analysis and thematic analysis for qualitative analysis.

Results and Discussions

The SPSS software has been used to execute the analysis, which was set at the 0.01 significance level. A sample size of 50 employees and the response rate was 100%.

Objective 1

Table 1: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.624ª	.390	.364	.33910	.906

a. Predictors: (Constant), EM, IM

b. Dependent Variable: Job Satisfaction

Table 1 indicates that the value of R-square for the model is 390. This means that 39.0 percent of the variation in the improvement of job satisfaction can be explained from the two independent variables. In general, R square always increases as independent variables are added to a multiple regression model. The adjusted R-square for the model is .364 which indicates only a slight overestimate with the model.

Table 2: ANOVA Table

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.452	2	1.726	15.012	.000^b
	Residual	5.404	47	.115		
	Total	8.857	49			

a. Dependent Variable: Job Satisfaction

b. Predictors: (Constant), EM, IM

Table 2 indicates that 5.404 of variation can be explained by residual and 3.452 of dependent variable job satisfaction is explained by regression. It suggests that residual model is fitted well because the significance is 0.000 which is less than 0.05 significance level.

Table 3: Coefficient Table

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.443	.404		1.099	.277		
	IM	.196	.111	.230	1.776	.082	.773	1.294
	EM	.630	.170	.481	3.710	.001	.773	1.294

a. Dependent Variable: Job Satisfaction

In order to find the contributions of each independent variable and dependent variable included in the above table. We have notice the value standardized coefficient (Beta). The greater value of beta and less value of significant level (P<0.05) of each independent variable will show the strongest contribution to dependent variable (Pallant, 2005,p.153). The largest beta coefficient for extrinsic motivation is 0.481 at significance level 0.001, meaning that extrinsic motivation makes the strongest unique contribution to explaining employee job satisfaction as compared to intrinsic motivation. Therefore, it can be concluded that there is a positive impact among the motivation and job satisfaction among the employees in the Banking Sector in Kandy district.

Objective 2

Table 4: Correlation between Job Satisfaction and Intrinsic Motivation

		IM
Job Satisfaction	Pearson Correlation	.459^{**}
	Sig. (2-tailed)	.001
	N	50

The correlation coefficient is 0.459. It indicates a positive relation between intrinsic motivation and job satisfaction. P – Value is 0.001, less than the significance level of 0.05. Therefore, the researcher confirmed the hypothesis H1. Interview results further shows that employees working with intrinsic motivation have a positive relationship between job satisfaction. Below statement assure it,

[…] intrinsic motivation helps me to engage in creativity. For example, when I recognize my job role is significant, I'll spend more time in understanding the organizational challenges and

searching a creative solution. When I perceive that I've the capability to perform the job role effectively, I've the self will power over my job. Because of this self will power and creativity that is gained by the intrinsic motivation I am satisfied with my job.

[Employee 01]

Table 5: Correlation between Job Satisfaction and Extrinsic Motivation

		EM
Job Satisfaction	Pearson Correlation	.591**
	Sig. (2-tailed)	.000
	N	50

The correlation coefficient is 0.591. It indicates a positive relation between extrinsic motivation and job satisfaction. P – Value generated from the analysis result is 0.000. This is less than the significance level of 0.05. Therefore, the researcher confirmed the hypothesis H2. Interview results further shows that employees working with extrinsic motivation have a positive relationship between job satisfaction and extrinsic motivation. Below statement assure it,

[…] well! Extrinsic motivation has a big power. Extrinsic motivation can stimulate interest and participation in us which we didn't have the initial interest to do. Like, I am the senior manager in this branch when I'm being praised by my executive level managers, I'm being satisfied with the job I do.

[Employee 05]

Discussion

According to the banking sector in Kandy district there is a positive impact among the motivation and job satisfaction among the employees. That means, the staff is motivated by monetary and non – monetary incentives. They tend to feel more empowered to do their jobs at a consistently high level. That, in turn, helps them to feel like they are a valued and important part of the company, which correlates to increased job satisfaction.

The bivariate correlation conformed a strong positive relationship between intrinsic motivation and employee Job Satisfaction. Therefore, the results proved that to engage employees in their job, management have to provide intrinsic motivation. More specifically management has to consider interesting work, job appreciation, satisfaction and stress in consideration while making any intrinsic compensation plan for their employees. According to the results most of employees wants to find their work interesting, most of them wants to be appreciated for their work, and most of them wants to be satisfied working for banks.

The bivariate correlation conformed a strong positive relationship between extrinsic motivation and employee job satisfaction. Therefore, to engage employees in their job, management need to pay more attention to extrinsic motivation as compared to intrinsic motivation. More specifically management has to take job security, good wages, promotion and growth, and recognition in consideration while making any extrinsic compensation plan for their employees. Management needs to pay more attention towards extrinsic motivation as compared to intrinsic motivation. According to results of the study most of employees wants to attain job security at their first place, most of them are attracted by good wages, most of them wanted to

get promoted and trained to perform more better, and most of them expect recognition in the form of rewards, bonuses etc.

Conclusion and Recommendation

The purpose of the study was to investigate the relationship between intrinsic motivation and job satisfaction, and extrinsic motivation and job satisfaction. It is concluded that there is strong positive relationship between work motivation and employee job satisfaction. Both intrinsic and extrinsic motivation has some impact on employee job satisfaction. Management of bank should consider these factors while working employee job satisfaction. Similarly, extrinsic motivation was measured through job security, good wages, promotion and growth and recognition. As compared to intrinsic motivational factors extrinsic motivational factors were considered more important by bank employees. Therefore, management of the bank is required to concentrate more on these factors for employee engagement as compared to intrinsic motivational factors. This study proved that both intrinsic and extrinsic motivation is to the greater extent relate to employee job satisfaction. Any changes in intrinsic and extrinsic motivation will occur changes in employee job satisfaction, therefore, bank management needs to formulate such polices that can make balance between intrinsic and extrinsic motivation factors for employee job satisfaction.

This study will help employers to conduct further surveys for management implications. Banking sector will be equipped with useful information regarding motivation and job satisfaction, which will help to formulate policies accordingly. Both organizations and employees could use the findings of the study for better outcomes. Employers motivational support enable employees to be engage in their job roles that leads them to become more productive and proficient. This proficiency would facilitate them to work with overall management for the benefits of organizations.

This research finds a direct relationship between work motivation and job satisfaction, an indirect relationship could also be investigated with the help of mediator variable i.e., employee engagement. We conducted our research from employee's perspective by using employee engagement. It would be interesting to consider management perspective by using organizational employee engagement. This research is a mixed study; qualitative study could also be adopted to validate the results of this study.

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FACTORS AFFECTING EFFECTIVE DEBT COLLECTION IN MAHANAMA MARKETING (PVT) LTD

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Abstract

The aim of this research is to identify the factors affecting to effective debt collection in Mahanama Marketing (Pvt) Ltd. Debt is a crucial fact affecting the cash flow of an organization. Currently most of the banks, financial institutions and distributor agents find it difficult to collect debts from their customers. Since Mahanama Marketing is also facing the same issue hypothesis were developed to find a solution for this problem. Systematic random sampling method has used for this research to select a sample of 50 dealers from the target population. Views from the despondence were collected using a questionnaire applying five point likert-scale. By analyzing the gathered information some hypotheses which are developed accepted and some are rejected. Since information management, resources and customer-supplier relationship have significant impact on debt collection process the company has to attentively manage these resources to enhance the effectiveness of debt collection process.

Keywords: Customer-supplier Relationship, Information Management, Resources

Introduction

Currently, recovering debts is one of the major issues that local companies face. Mahanama Marketing (Pvt) Ltd is a distribution organization operates in Colombo-South area Sri Lanka. Mahanama Marketing sells goods for 30- 60 days period of credit. Since the company often found that they don't receive payments on time they have to face with major financial issues. According to Peeters (2003) (citied in Jayawardena et al, 2014) factors such as inflation, economic recession, political instability, poor investment and staff weak skills are affecting to the credit recovery. Poor debt collection can cause collapse of the business due to a lack of cash flow at critical stages of operations. This research project achieved following specific objectives throughout the study.

1. To identify impact of information management to the credit recovery process.

2. To identify impact of organizational resources to the credit recovery process.

3. To identify impact of customer-supplier relationship to the credit recovery process.

Intention of this study is to help the management in Mahanama Marketing to maintain a good cash flow by identifying effective debt collection factors.

Methodology

The population was total number (500) of debtors of Mahanama Marketing. Mugenda (2003), recommends that 10% is an adequate sample for a survey. Systematic random sampling method was used to select a sample of 50 dealers from the target population as it gives equal chance of selection of the sample units from the target population, a starting point is chosen at random and thereafter at a regular interval of 10. A structured questionnaire provided the primary data.

It has included some personal questions and relative Likert Scale questions that ranged from "1= completely disagree" to "5= completely agree". Questionnaire presented to the respondent by a hardcopy for on-time response. Sales report, total collection report, rep-wise collection report of 12 months and the statement of financial position of Mahanama Marketing used as

Independent variables

Information management

- Documentation & data
- Technology
- Decision making

Resources

- Tangible
- Intangible

Customer – Supplier relationship

- Purchase behaviors
- Communication

Dependent variable

Debt collection process
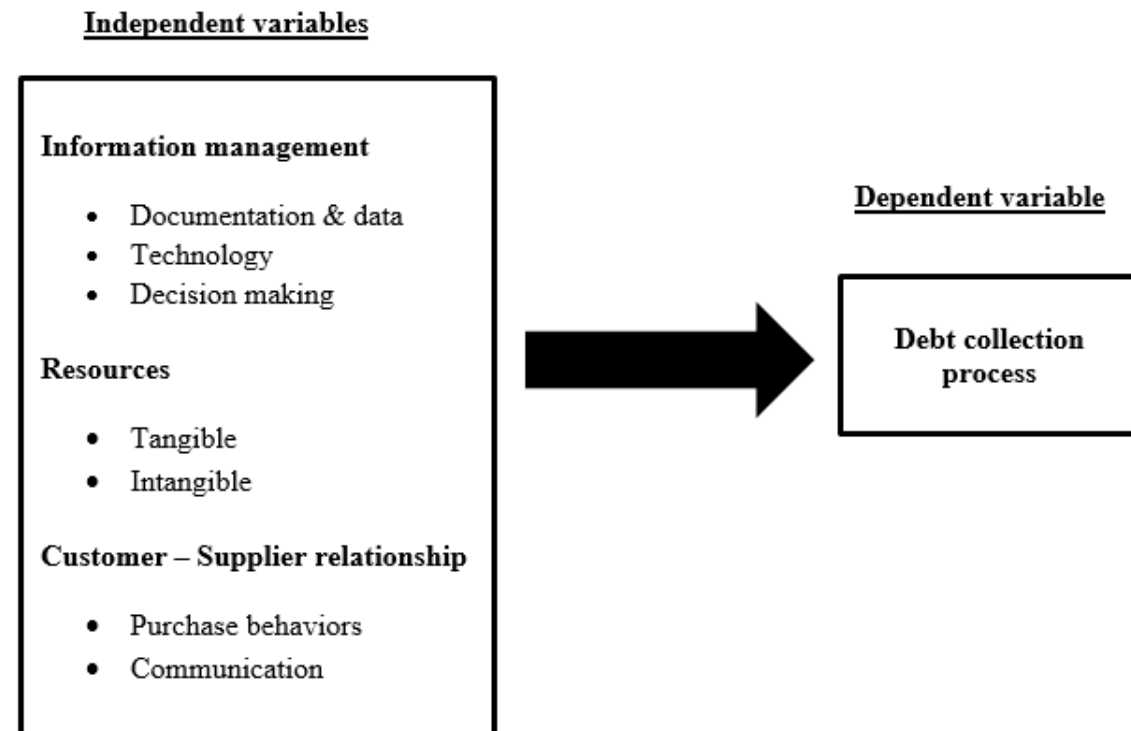
secondary sources.

Figure I – Conceptual Framework

Hypothesis

- HA_0: There is no significant relationship between information management and debt collection process.

- HA_1: There is a significant relationship between information management and debt collection process.

- HB_0: There is no significant relationship between company resources and debt collection process.

- HB_1: There is a significant relationship between company resources and debt collection process.

- HC_0: There is no significant relationship between customer-supplier relationship and debt collection process.

- HC_1: There is a significant relationship between customer-supplier relationship and debt collection process.

Results
Descriptive Statistics
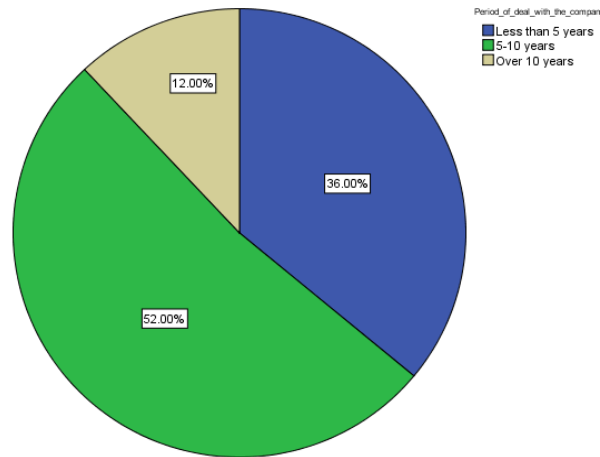
Figure II – Period of Dealing with the Company

Figure II shows how long have the dealers engaging in business activities with Mahanama Marketing.
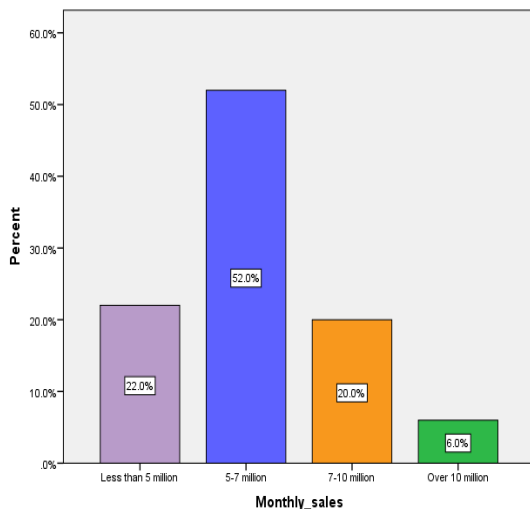
Figure III – Monthly Sales
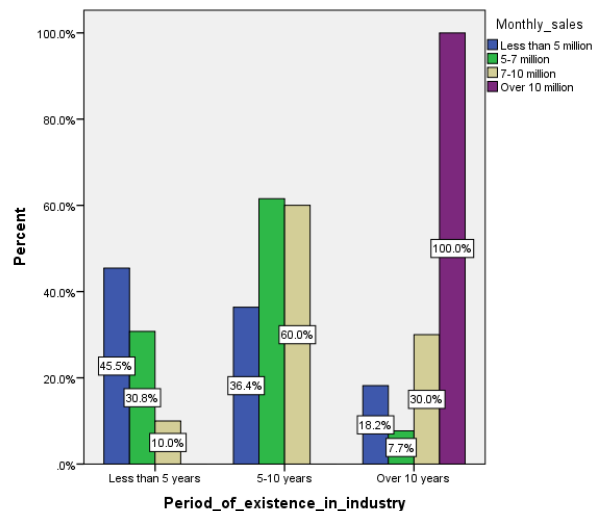
Figure IV - Monthly Sales and Period of Existence in the Industry

Figure III shows the sales which a dealer achieves monthly. When analysing sales most of the dealers achieve sales in between 5 to 7 million. Monthly sale of a dealer is a significant fact because it shows how much of debts can they settle monthly.

Figure IV shows the distribution of monthly sales among the period, dealers exist in the industry. According to the analysis dealers who exist in the industry for more than 10 years are the ones who earn more than 10 million sales monthly. It shows that period exist in the industry have a significant impact on growth of the sales.

Table I - Information Management and Debt Collection Process

Statement	Answers (in percentage)				
	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1. Do you find it helpful if we send an outstanding report stating that amount of dues you have to settle, a week before the collection?	0%	6%	12%	56%	26%
2. Does the company send reminders (letter of demand) for your return cheques and overdue outstanding?	30%	48%	18%	4%	0%
3. Company manage information more efficiently about their dealers	38%	40%	16%	4%	2%
4. Is it important to use new technological methods for the debt collection process?	1%	5%	10%	34%	50%

Table I shows the summary of answers provided by dealers for the questions asked in information management part section.

Table II - Resources and Debt Collection Process

Statement	Answers (in percentage)				
	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1. Do you think the company's debt collectors are well trained for perform the task of debt collection?	18%	44%	28%	10%	0%
2. Debt collectors have good negotiation skills to deal with customers	10%	42%	40%	8%	0%
3. Company use enough technological resources in their debt collection process	6%	48%	38%	6%	2%
4. Do you agree if the company reduce the current credit period and gives an additional discount instead of that?	24%	42%	19%	12%	3%

Table II shows the summary of answers provided by the participants for the questions regarding resources and debt collection process.

Table III - Customer-Supplier Relationship and Debt Collection Process

Statement	Answers (in percentage)				
	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
1. Do you have a good recognition/ trust about the company?	0%	8%	10%	38%	44%
2. The company responds positively to the issues (damages, sales return) regarding purchased goods from the company.	28%	40%	20%	6%	6%
3. Do you receive the goods you ordered within a short period of time?	16%	32%	30%	16%	6%
4. If the company gives you an additional discount when you settle your payments at the time when goods deliver, do you agree?	4%	10%	24%	38%	24%
5. If the credit period is extended by 10 days when you settling debts through cheques, will you agree to issue a dated cheque within 10 days from the date of delivery of the goods?	4%	6%	18%	34%	38%

Table III shows the summary of answers provided for the questions regarding customer-supplier relationship and debt collection process.

Inferential Statistics

Table IV - Reliability Analysis

Variables	Cronbach's Alpha	Reliability
Information management	.405	Not Reliable
Resources	.716	Reliable
Customer-supplier relationship	.874	Reliable

Table IV summarizes the Cronbach's Alpha which measures of internal consistency reliability of measurement scales. The Cronbach's Alpha values of resources and customer-supplier relationship are higher than 0.7 (reliable) which indicates that those three scale items produce good constant results of repeated measurements. The variable, attitude toward information management is not a good scale item to produce constant results since; its Cronbach's Alpha value is less than 0.7 (not reliable).

Table V - Correlation Analysis

Independent variables	Pearson Correlation with Debt collection process	Correlation as a percentage	Significant
Information management	.595	59.5%	.000
Resources	.517	51.7%	.000
Customer-supplier relationship	.675	67.5%	.000

Table V summarizes Pearson correlation values and significant values of independent variables. If significant value is less than 0.05 it can be identified as a significant relationship.

Regression Analysis

Regression analysis is a mathematical way of sorting out the relationship between an independent variable or variables and dependent variable.

Table VI - Model Summary and ANOVA:

Model summary	Adjusted R Square	0.458
ANOVA	Significant	.000

According to above table VI, the independent variables that have been tested under this research, explain 45.8% about the dependent variable (debt collection process). Also the research fits to the model (model fit is 0.000) because ANOVA significant value is 0.000 which is less than 0.05.

Table VII – Standardized Beta co-efficient and Significant values

Independent variables	Standardized coefficient - Beta	Significant
Information management	.266	.004
Resources	-.048	.769
Customer-supplier relationship	.530	.003

This research proposed 3 hypotheses (HA1, HB1, HC1) and it was predicted that all independent variables have either positive or negative influence on dependent variable.

Table VII summarized standardized beta co-efficient values and significant values for 3 independent variables. Based on the values in table VII we can summarize the results as follows;

Table VIII – Hypothesis Testing

Hypothesis	Result
HA1- Information management has a positive impact on effectiveness of debt collection process.	Accepted
HB1- Resources have a positive impact on effectiveness of debt collection process.	Rejected
HC1- Customer-supplier relationship has a positive impact on effectiveness of debt collection process.	Accepted

Discussion

The risk of poor credit management can lead to poor performance, as the cost of servicing the debt can develop beyond the capacity to repay due to internal difficulties either due to poor resource management or income loss (Swanson et al, 2008 cited in Kamar et al, 2016). According to the gathered information from past researches key determinants of effective debt collection have identified as below.

Information Management

Company's recovery plan should be supported by good documentation, data and management information. For effective and efficient information management, Systems Theory can be identified as a working hypothesis, whose main function is to provide a model for explaining, predicting, and controlling phenomenon (Bertalanffy, 1962). A company needs to develop an efficient information system to analyse collections and monitor past due customers. In current violated environment, advanced technologies are much needed for an effective debt collection while maintaining good customer relationship. For effective debt collection it is not only documentation, data and technology are important but also knowledge management skills are required to develop better decision making process.

Resources

Resource Based View Theory explains that a company should be considered as a collection of physical and human resources bound together in an organizational structure (Penrose, 1959). A debt collection process will be success how good human resource which means the staff of the organization involved in its implementation. It is important to delegate duties and responsibilities in collection process among every staff member for effective debt collection. It is important to educate staff members in techniques and strategies, such as how to deal with the typical arguments of the delinquent client, how to handle difficult people, what types of clients exist, tips and verbal cues for communication, the typical profile of the delinquent client, and negotiation techniques (Karungari, 2012).

Customer - Supplier Relationship

The customer supplier relationship theory was proposed by (Robert et al, 1994 cited in Hamisu, 2011) which means there are costs and benefits that accrue to both the lender (supplier) and the borrower (customer) in their relationship created by the debt recovery techniques. In this scenario debt is generally associated with the purchase of intermediate goods. A major reason firms provide credit is to prevent customers from switching to another supplier or competitor therefore, they allow certain period of credit facility to their customers to pay the value of goods they purchased. Distributor agent is the intermediate party act as the debt collector in this process.
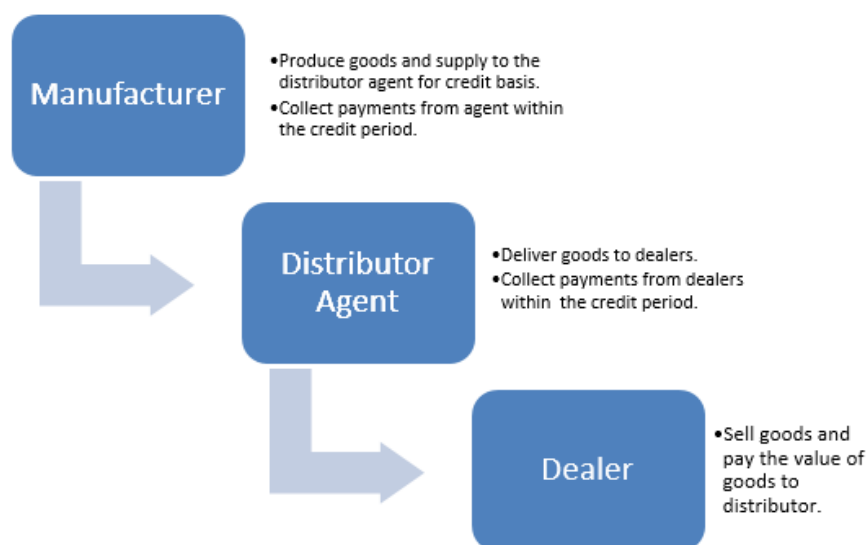
Figure V – Relationship between customer and supplier in the debt collection process

Customers and suppliers are not integrated to one company but maintain durable contractual relationships while keeping their separate organizational identities (Seo et al, 2017). The link between the supplier and the customer should be as in (Cunat, 2004) that makes it costly for the customer to find alternative suppliers and makes it costly for the supplier to lose its current customers.

Conclusions and Recommendations

Information Management

When summarizing and analysing the answers provide by the respondents, below are the issues have found in information management and debt collection process:

- Company doesn't send reminders for their customers those who delayed payments.

- Company doesn't manage information more efficiently about their dealers.

- Lack of using new technological methods in debt collection process.

Sending reminders such as letter of demand, emails, calls are much important to get customers pay at time. Maintaining outstanding reports, keep payments records, arrange and duly filed invoice copies of customers can follow for efficient information management. To effectively manage information using new technologies are vital because people can't keep all records in their mind and analyse them when they need, therefore company should use new technologies for enhance their debt collection process.

Resources

There are several issued regarding the resources and company's debt collection process as well. They are:

- Company doesn't have well trained debt collectors for perform the task of debt collection.

- Debt collectors doesn't have good negotiation skills to deal with customers.

- Company doesn't have enough technological resources in their debt collection process.

Company should provide training opportunities for their debt collectors such as organizing seminars, leadership programmes, motivation and etc. These training programmes and activities help them to develop their leadership, personal and negotiation skills. Since currently company doesn't have enough technological resources they should invest more to gain such resources. To improve the effectiveness of debt collection, incentives can be established for motivate debt collectors meanwhile it will enhance the productivity of workers as well.

Customer-Supplier Relationship

In customer-supplier relationship there are two main issues which affect the effectiveness in debt recovery process. They are:

- Company doesn't respond positively to issues regarding purchased goods.

- Company found delay to deliver goods to their customers.

Significant recommendations also can find in this section through dealer's responds. Since customers are positively respond to fourth and fifth questions under this category company can,

- Gives an additional discount to customers who are willing to settle value of goods at the time of delivery.

- Gives an extended 10 days credit period to the customers who are willing to issue post-dated cheques within 10 days from the delivery.

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HOW DO EMOTIONAL INTELLIGENCE AND WORK LIFE BALANCE AFFECT ON JOB STRESS: WITH REFERENCE TO SIMDI COMPANY PVT LTD IN MALDIVES.

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Abstract

Having a good work life balance and good emotional intelligence are very crucial for any employee to deal with job stress. If an employee is dealing with a poor work life balance and high level of job stress, it is essential that the employees have an emotional intelligence level, so that they can understand what is going around them and can prevent themselves from dealing with poor work life balance and job stress. The study was conducted to identify the relationship between work life balance and job stress as well as the relationship between emotional intelligence and job stress. In order to achieve objectives, twenty resondents were selected using convenience sampling method from sales and finance department of the selected organization, Maldives. Data were collected through a structured questionnaire. Results of the Pearson correlation analysis indicates that job stress decreases when employees have good emotional intelligence and healthy work life balance.

Key words: - Emotional intelligence, Job stress, Work life balance.

Introduction

Emotional intelligence is a type of social intelligence that involve the ability to monitor one's own and other's emotions, to discriminate among them, and to use the information to guide one's thinking and actions (Mayer & Salovey, 1993), and this is very important for any individual to possess as then they could identify as to how are they feeling, and can identify if they are stressed or not. It is very crucial that the employers possess this quality in order to identify if the employees are dealing with any kind of stress, so they can take measures to reduce job stress of such employees. The authors also believe that the scope of emotional intelligence include the verbal and nonverbal appraisal and expression of emotion, the regulation of emotions in the self and others, and the utilization of emotional content in problem solving (Mayer & Salovey, 1993). According to Goleman (1998), there are four main indicators of emotional intelligence, i.e. self-awareness, self-management, social awareness and relationship management. This model is focused on discussing personal competence and social competence. Self-awareness, self-management belong to personal competence while social awareness and relationship management are coming under social competence. Over the past several years there has been a good deal of speculation regarding the relationship of emotional intelligence and certain aspects of transformational leadership (Caruso, et al., 2020). They also believed that employees have high emotional intelligence when they worked in teams, and the work they accomplish seems to be more effective compared to employees with lower emotional intelligence (Caruso, et al., 2020). It is also believed that the employees having emotional intelligence competencies manage their negative emotions in the workplace and report fewer psychological problems with high levels of job satisfaction and organizational commitments (Rahim, 2010). Another researchers point of view it can be stated that "the concept of EI

(Emotional Intelligence) postulates that the two different mental processes, which are thinking and feeling, actually work together" (Maamari & Majdalani, 2016).

There are different definitions to describe as to what work life balance is, and it is not the same for all employees working in an organization. The work life balance from the employee viewpoint can be defined as the dilemma of managing work obligation and personal/ family responsibilities (Lockwood, 2003). Moreover, poor work life balance results increasing levels of stress can rapidly lead to low employee morale, poor productivity and decreasing job satisfaction (Lockwood, 2003), and due to this particular reason the company will have to either fire the employees who are having difficulties in having a healthy balance between work and personal life, which would therefore require additional charges to hire more employees and advertise job opportunities. According to Beauregard & Henry (2009), employees deal with poor work life balance will also affect the employees mentally as well as physically, but it would also take a troll over the employers and the entire organization, and that there would be an increased amount of overhead and the level of productivity will gradually decrease. A research conducted by Rahman (2019) in order to identify the impact of work life balance on job satisfaction among the female bankers in Bangladesh concluded that indicators of work life balance such as Workplace Support, Nature of Work, Work-Life Balance Programs and Available Personal Time have association with job satisfaction. Further, it has been identified that working hours, work conditions and work pressure act as significant indicators of work life balance on employee job satisfaction (Adikaram & Jayatilake, 2016).

Stress is defined as one of the most serious health issues of the twentieth century, which is not only a problem for individuals in terms of physical and mental disability, but for the employers and governments who have started to assess the financial damage .The research article also states that it is possible that work motivations may alter the job stressor-strain relationship, and act as a moderator. Further, it shows that having social support in the office space like, help superiors or colleagues, and help received from outside the workplace like help from family members can affect job stress (Lu, 1999). Employees face job stress and unhealthy work life balance in some point especially among employees in sales and finance department in organizations as they have to deal with more stress because of the hectic work they do. Being in the sales department all the sales employees will thrive to get the highest number of sales within a given time frame, and the financial employees will try their level best to maintain a good financial health of the organization.

In order to conduct this study one of the leading company in Maldives was used. The selected organization is one of the premium distributors in Maldives, and that organization deals with broad range of brands of FMCG products, liquor products, resort-ware, IT products. Its divisions in Maldives include Beverages, Hospitality & Leisure. It has taken over 40 years to meticulously source the finest and most relevant world renowned products including 201 employees.

Therefore, this study was conducted to identify,

1. The relationship between of emotional intelligence and job stress of employees in sales and finance department of the selected organization, Maldives

2. The relationship between of work life balance and job stress of employees in sales and finance department of the selected organization, Maldives

The conceptual framework used for this research is:

Independent variable   Dependent variable
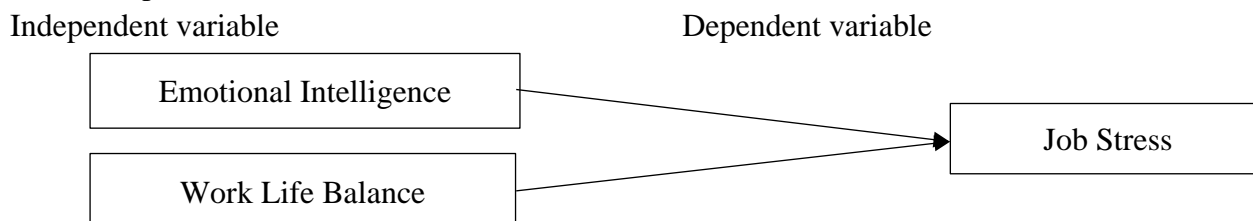
Figure 2: Conceptual framework

Methodology

In order to achieve above mentioned objectives 20 employees were selected from sales and finance department of the selected organization using convenience sampling. Structured questionnaire was given among selected employees. The questionnaire contains Likert scale questions to measure indicators used for emotional intelligence, i.e. self-awareness, self-management, social awareness and relationship management. Indicators used for work life balance were nature of work, work place support, available personal time and work hours. Pearson correlation analysis was conducted through SPSS version 20 in order to check following hypothesis.

H_{01}: There is no significant relationship between emotional intelligence and job stress

H_{11}: There is a significant relationship between emotional intelligence and job stress

H_{02}: There is no significant relationship between work life balance and job stress

H_{12}: There is a significant relationship between work life balance and job stress

Results and Discussions

According to the results of descriptive analysis, it can be identified that some employees working in the selected organization believe that they have more job stress due to the fact that some employees get more work compared to other employees who are idle. This can be a major issue as it might result to poor relationship between the employee and employer, therefore resulting to poor work performance, lack of interest towards work and unhealthy work life balance.

Table 1: Correlation analysis

		Job stress
Emotional intelligence	Pearson Correlations	-.036
	Sig. (2-tailed)	.881
	N	20
Work life balance	Pearson Correlations	-.223
	Sig. (2 – tailed)	.345
	N	20

According to the results of the correlation analysis, the correlation coefficient between emotional intelligence and job stress was **-0.**036. It implies that there is a weak negative relationship between emotional intelligence and job stress**.** Furthermore, the sig value of 0**.**881 implies that there is no significant relationship between emotional intelligence and job stress at **5%** level of significance**.** Moreover, the correlation coefficient between work life balance and job stress was -**0.**223 and it implies that there is a weak negative linear relationship between work life balance and job stress**.** Furthermore, it could also be stated as the sig value is 0**.**345 which is higher than 0**.**05**.** It indicates that there is no significant relationship between work life balance and job stress at 5% level**.**

Conclusion and recommendations

According to results, it can be concluded that employees with high emotional intelligence will face through lower levels of job stress and employees having a healthy work life balance deals with less job stress. Moreover, majority of employees deal with job stress and unhealthy work life balance.

In order to overcome such situations some of the employees had suggested that there should be more programmes to motivate the employees and introducing more flexible hours so that they can maintain a healthy work life balance. Besides this organizations can introduce more team bonding events in which both the employer and employees of the team can get along with each other therefore creating a more fun and healthy work environment for both the employee and employer. The main advantage of encouraging good relationship between employees and employer is that, the employee can come up to the employee more openly with whatever problem or issue they have regarding work and they have the trust towards the employer knowing that the employer will help them out in the best way they can. Hence employee's job stress level will relatively be low and they can be more work oriented in the upcoming days.

In conclusion it could be stated that all employees deal with job stress from different industries and departments and it could be due to various reasons. Also according to the above finding it could also be stated that the lower the emotional intelligence and unhealthy work life balance create job stress, as they are unable to identify as to what are their most prominent needs at the moment, and are unable to handle too much at once.

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ENGINEERING AND CONSTRUCTION

GREEN CONSULTATION-RFID BASED MEDICAL DATA CARD SYSTEM

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Abstract

Green consultation is a project that focused on user-friendly and paperless medical documentation. This project is based on RFID technology. RFID stands for radio frequency identification method that adopted in many fields including the healthcare industry. This method can prevent unnecessary paper works in the clinical documentation as well as it can overcome the patient related difficulties about their medical records. The RFID card, which we have used for this project, is a pocket-sized card. This card is acceptable to be scanned through a RFID reader easily. This medical record system is secured through this RFID technology and we had a special concerned about the patient privacy.

Key words: Cards, Contactless, Documentation, Healthcare, RFID.

Introduction

In this technological era, there is a rapid growth in information systems and data management. In the healthcare industry, the medical data management through digital technology takes the field in to higher state in today's world. When it comes to smart card system, this can vary based on different factors such as the data storage method, used software and the identification methods used in the identification. The identification of each patient record can be done using QR code, Bar code, RFID…etc.

RFID is the used technology for the Green Consultation project. RFID is an automatic identification technology. The most significant feature in this technology is it has identification fields but it does not need a direct view to the object.

For the project, the RFID card was used, which consist of small radio transponder (Figure 2).

Figure 1: RFID cards and reader.

When triggered by an electromagnetic interrogation pulse from a nearby RFID reader device, the card transmits digital data, usually an identifying inventory number (Figure 2).

Figure 2: RFID mechanism

RFID technology cannot standalone without the proper interface design and a database. To achieve the most successful output, Visual Studio, XAMMP, MySQL were useful for the implementation. As this is a trial version, computer local host is being used with the database.

However, it has to be rearranged with the hospital server to work with the database with large number of medical records.

The RFID card store patient's personal information and medical details. The doctors and medical administrators can retrieve the details of the patient by scanning the card using the RFID reader.

Problem Identification

As Sri Lanka is a middle income country, which has limitation in affording for smart technologies to the healthcare since it is already spending high amount of money for health care including medical equipment and devices, medicine…etc. The experiences regarding unsatisfactory situations on health information management was one of major problems identified.

This project will help to improve of having accurate, high quality and timely important information management system in healthcare industry. Additionally, with the Covid -19 outbreak, the social distancing matters a lot. Then this project will be useful for contactless medical documentation. Our project is an inexpensive solution that can overcome all the delays, insecurities, misplacement of medical documents.

Background

Among the identification techniques, RFID was an ideal choice rather than using barcodes and QR codes. It can read from greater distance than barcodes/ QR codes. It does not need to be positioned in a line of sight with scanner and it is safe than all other identification technologies. Rajabzadeh and Ajami (2013) described the RFID technology and patient safety as, "RFID is a wireless technology capable of automatic and unambiguous identification".

According to Panescu Dorin's statement "the RFID technology has great potential to be widely used in hospital systems for tracking inventory, location of patients and combating of medicines counterfeiting" (Panescu, 2006). The application of this technology in radiographs and records to ensure the correct identification of the patient have described by (Booth, 2006). Florentino et al. (2008) explained how the RFID-based hospital automation initially uses contactless smart cards to store patient's data and for the authentication of employees.

Pai, (2017) stated, "The health monitoring using RFID project mainly aims at building a better means of storing and retrieving data". Students from Stefan Cel Mare University of Suceava, Romania designed a RFID-based integrated system for patients and medical staff identification and tracking, called "RFID Hospital Tracker". Tudor Ioan Cerlinca stated that "RFID-based system could be used in hospitals with large patients flow, allowing hospital staff to read patients' identification tags, which can help avoid some medical errors, like giving patients improper prescriptions or someone else's treatment" (Cerlinca, 2010).

Turcu et al. (2009) presented a RFID-based System for Emergency Health Care Services, focusing the emergencies regarding medical care. A conference Paper written by Hanada and Kudou (2013) explain that, "A non-contact type RFID tag system uses wireless communications or magnetic resonance. Therefore, it is important when installing an RFID tag system in a hospital" (Hanada and Kudou, 2013). During a conference paper, Haddara and Staaby (2018) explained the safety issues, as "It is believed that the majority of the medical errors caused by misidentifications are preventable by introducing integrated IT

infrastructures". IOSR Journal of Computer Engineering did a project on RFID Based Centralized Patient Monitoring System and Tracking in 2014. According to Goel et al. (2014), "RFID is known for its unique ID number. Using this advantage, in the first section the monitoring of a patient is done whenever he arrives at the hospital and the second section is patient tracking where in case of any emergency in a closed environment the patient is provided with assistance in a short span of time". To highlight the concept of medical documentation, Gaponova and Vuokila, (2017) conducted a research to propose appropriate software to enhance doctors' performance. The Benefits and Barriers to RFID Technology in Healthcare also considered during the project. Charlotte Seckman stated that, "RFID has the potential to save organization's time and money by providing real-time traceability, identification, communication, temperature, and location data for people and resources" (Seckman, 2017).

With the encouragement and ideas through the research, our project have designed by adding our own ideas and formats such as information forms (Figure 3-6).

Figure 3: References for departments   Figure 4: References for consultants

Figure 5: Automatic BMI calculator   Figure 6: Data retrieving based on date

Methodology

Preliminary Work

Before step into the designing and implementation session, confirmation of the usefulness of this project has been verified through a questionnaire survey. The survey subjected 32 patients whom participated to their monthly clinic in the Base Hospital, Gampola, Sri Lanka. To the awareness of this new concept, a poster presentation has done by focusing on the participants' awareness (Figure 7).

The questionnaire covered all of their state, experiences related to medical records, the difficulties they faced with the ordinary medical documentation method and their awareness about this concept. Both positive and negative feedbacks were useful in further proceedings.
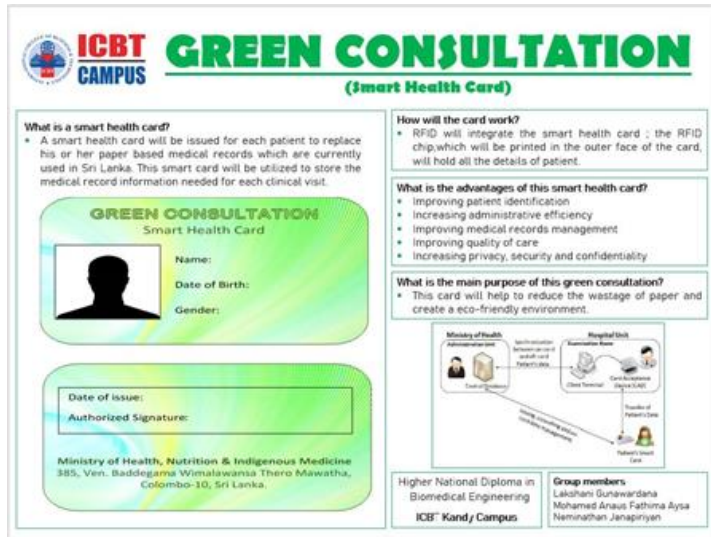
Figure 7: Poster Presentation

Results and Discussion

Collected data were analyzed manually. The result is demonstrated below using MS Excel (Figure 8).
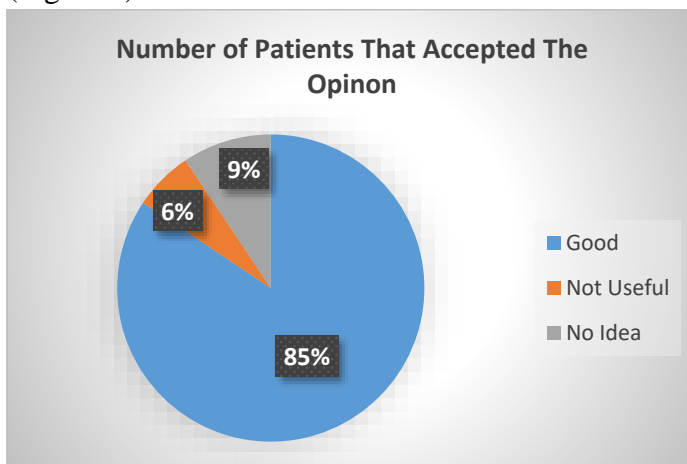
Figure 8: Questionnaire survey results

According to the above analysis, the majority of the participants had a good response towards the concept.

Design & Implementation

Figure 9: Block diagram for RFID conceptual design

The interface of the project have made through Visual Studio 2019 using C#. The server XAMMP cross-connected the local host database with the visual studio interfaces. The main outlooks have three options as add patient (registration), add medical records and search patient feature. During the registration, the RFID card scanned through the reader and the patient data

can be added using the same RFID card reading. However, as it is the primary key of the registration process, the repetition of the same RFID number during the registration has been avoided. Moreover, eliminated it in the "add medical data" form to add upcoming medical data of the same patient regularly. "Search Patient" form can be used to fill and check medical records. The history of the medical data sorted by date to avoid the complexity of data handling.
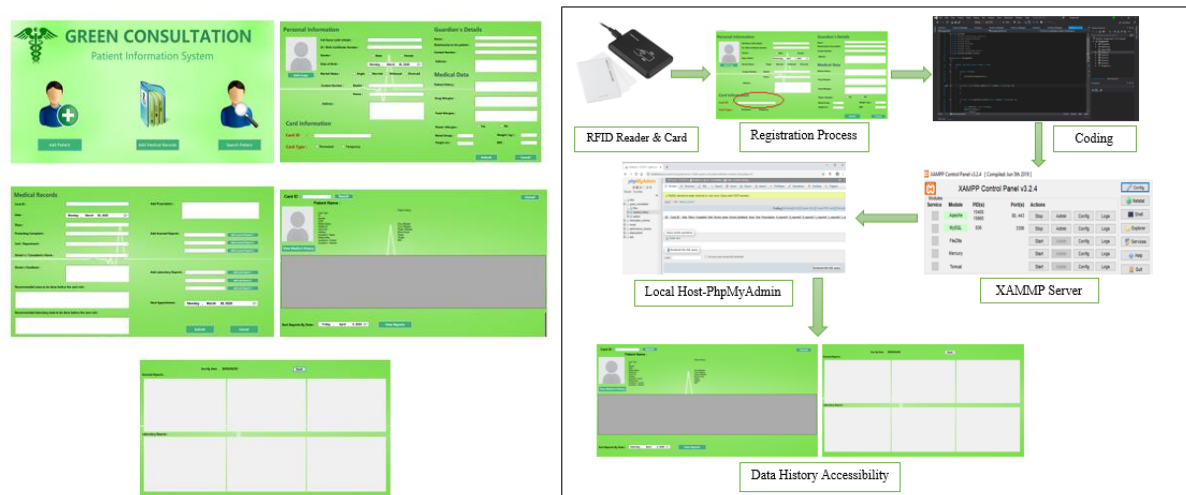
Figure 10: Final Output

The database (local host-PhpMyAdmin) is where the data stored while the server XAMMP connect the interface and that database as mentioned earlier.

Scan reports and test reports can be uploaded to this only as an image (jpg) in this trial version. If there is any missing information, rest of the data will be rejected.
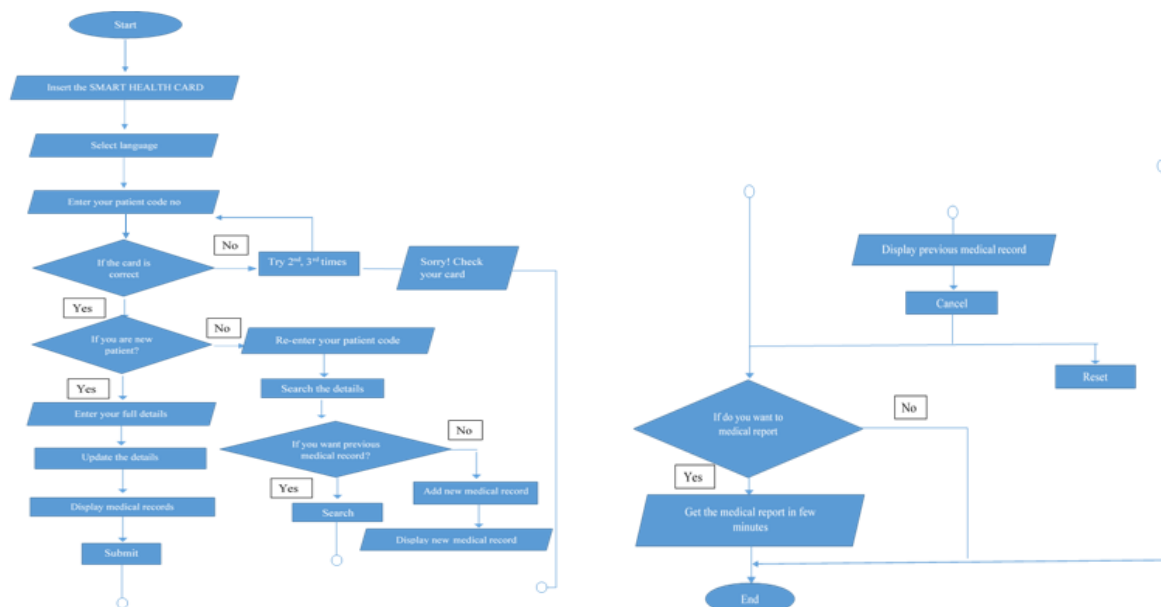
Figure 11: Flow Chart

Advantages of this Project

This project can improve the quality of healthcare and it will enhance the administrative efficiency. This concept can overcome all the difficulties of patients regarding their medical records and it can secure the patient records too. Additionally, it saves labor cost because it designed to be computerized, and concentrated around minimum personals. This is useful for

contactless medical care during situations like Covid-19 outbreak. Finally yet importantly, this design is needful for countries that have poor economic conditions, as this design cost is very low.

Conclusion

This project is an environmental and user-friendly project, which based on the medical records in the hospital. It functions with RFID technique. As a group, we could successfully complete the trail version of our database system and the smart card. Through the implementation process, errors that occur during the designing, implementing and testing levels could eliminate with improvements. This concept is a good solution for environmental pollution as it can lead the complete hospital system into paperless working protocol. This is trial version of the concept and further improvements are ongoing.

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MULTI HEALTH PARAMETER MONITORING STROLLER KIT FOR BABIES

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Abstract

Obesity in babies and children is increasing rapidly among them more prone to cardiovascular and musculoskeletal disorders as adolescents or adults. It is also seen an increase of Sudden Infant Death syndrome (SIDS) in past couple of years. A main disorder related to SIDS is Obstructive Sleep Apnea (OSA). It is also important to continuously monitor the body temperature of any infant to identify deteriorate health conditions. This paper suggests a device capable of measuring baby's weight and body temperature along with a humidity sensor to detect bedwetting, which is a symptom of infant sleep apnea syndromes. Weight is proposed to measure using 4 load cells while the temperature would be measured using a thermistor. This device is proposed to implement as a body cushion to a stroller seat which will make it more accessible to many consumers. To enhance the safety of the stroller by increasing the nighttime visibility author has proposed a LED light array. The complete device was working as it was initially planned.

Keywords: Temperature, Weight, Nocturnal Enuresis

Introduction

According to a survey conducted by World Health Organization (WHO) (Obesity, 2019), it was found out that obese infants and young children ages between newborn to 5 years have increased globally from 32 million in 1990 to 41 million in 2016. And the majority of this obese children live in developing countries with a significant increment rate of 30% compared to developed countries. According to the findings of Gungor and colleagues (Gungor, et al., 2010) it was succinct that monitoring the weight till 24 months is a fair screening tool to identify at-risk infants gaining weight in the latter childhood. WHO agrees intervention for these obese infants is necessary to prevent children being obese during childhood, adolescence and adulthood. The expert committee has recommend (SE & Committee, 2007) all the pediatricians to start obesity prevention during infancy because these children are more likely to develop critical health complications as adults including, cardiovascular diseases, musculoskeletal disorders, cancer types and even disabilities. According to McCormick's findings (McCormick, et al., 2010) it is possible to diagnose an obese baby at the age of 6 months.

Sleep Apnea Syndrome (SAS) covers a vast area including Obstructive Sleep Apnea (OSA), Central Sleep Apnea (CSAS) and Positional Obstructive Sleep Apnea Syndrome (pOSA). From these OSA is the most common among infants and typically caused by blockages in airway passages. In United States prevalence of OSA had been shown as almost 2% of the pediatric population but in present that number is increasing rapidly (Rocker & Bruno, 2018). A report from Sweden states that the incidence of apnea during the first four days of life is at 0.035% from the population while another study from Italy 0.41% from live births. Nowadays premature births are increasing and it is clinically evident those preterm infants are more prone

towards apnea conditions. To distinguish OSA from other sleep apnea conditions it is recommended to check for snoring, restless sleep and bedwetting (Nocturnal enuresis - NE). Also Barone and his team concluded in 2009 (JG, et al., 2009) that obese and NE are associated with OSA but not related to each other and clearly has stated that OSA should be considered in obese children with NE. It is possible to take preventive measures if these symptoms are detected early. Within this paper author will propose a method to detect one crucial symptom to distinguish OSA from others i.e., bed wetting.

Body temperature is another crucial measurand when monitoring the health condition of premature or normal babies. Continuous body temperature monitoring is vital when diagnosing an OSA infant also it is important in identifying infections prior it gets worse.

According to the report prepared by "Team SafeStroll" more than 11,160 babies have come across emergency treatments (Du, et al., 2010) because of stroller related injuries during a one year time span, which makes carriages the baby item well on the way to cause damage. Thus author has also suggested few stroller safety enhancements in this paper.

In order to measure the weight of the baby author propose to use a system with 4 load cells. In 2017 Widianto and colleagues (Widianto, et al., 2017) concluded that there would be no effect for the weight measured even if the baby was moving. But as an accuracy enhancement author suggest to use a mean calculation value. The most of the available devices to detect dampness in baby diapers are using electrodes and wires which indicates obvious drawbacks like strangling of the baby and electric shock. In this paper author suggests a humidity sensor to detect the bedwetting. Current existing devices use mostly LM35 temperature sensor to measure the body temperature. The LM35 sensor is very sensitive to even slight motion, making it inappropriate for this particular application. Other than that thermistor consumes low power with compared to the LM35. Also to increase the nighttime visibility of the stroller author has used a LED array which will again consume a less amount of power. This complete system is to be integrated on to a removable stroller body support. A 9V rechargeable battery along with a PIC18F4550 microcontroller will be used.

Methodology

The author has used load cells with a maximum weight capacity of 50kg. These strain gauges are resistors which will react to both compression and tension on the top surface. The three wires of the load cells will be connected in a way that it will create a Wheatstone bridge. Author has make the wire arrangements carefully to eliminate any extra resistors. Wheatstone bridge can be identified as a network of four resistive legs and one or more of these legs act as active sensing elements. The Wheatstone bridge is electrically equivalent for two parallel voltage divider circuit. With load on every one of the sensors, the pressure resistance are diminished. HX711 module board is an analog to digital converter designed for weigh scales. This has two input analog channels with the ability to amplify the signal. The wires can be connected to each other according to the figure 1. To enhance the accuracy of measurements the system will consider the weights detected during a 10ms period and get the mean value. This will help to ignore the error that can occur due to motion artifacts of the baby. The basic relationship between the weight and the milli-voltage is 20 to 2mV.
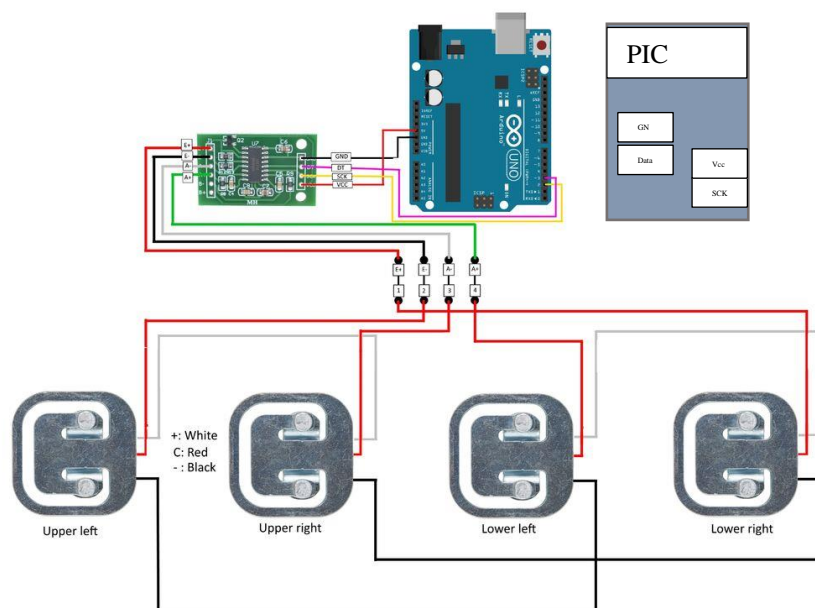
Figure III Diagram for connections between load cells, HX711 and PIC MCU

The author has used the 'DHT 11' sensor which is developed by Adafruit to detect bedwetting. The sensor with a wire up to 20 meters range will measure the temperature with a tolerance of 2% and humidity with a tolerance of 5%. DHT11 sensor comprises of a resistive kind humidity estimation segment and NTC type temperature estimation part. It gives moistness and temperature esteem on exceptionally aligned computerized yield signal. Thus it is important to gauge this computerized yield signal with the assistance of a microcontroller to quantify temperature and dampness. So it has a solitary wire sequential interface that will utilize this interface to associate DHT11 sensor with pic microcontroller.

By utilizing the thermistor in arrangement with a fixed resistance framing a basic voltage divider organize, it is possible to discover the temperature by the adjustment in voltage of the voltage divider because of change in temperature. The author has selected the NTC MF52AT type thermistor. To implement the voltage divider a 10k resistor is used. The same Pic® 18F4550 microcontroller is used with a LCD to display the output data. To control the brightness of the LCD another 10k resistor is being used and this LCD has the ability of displaying 32 characters, in 2 rows 16 characters each.
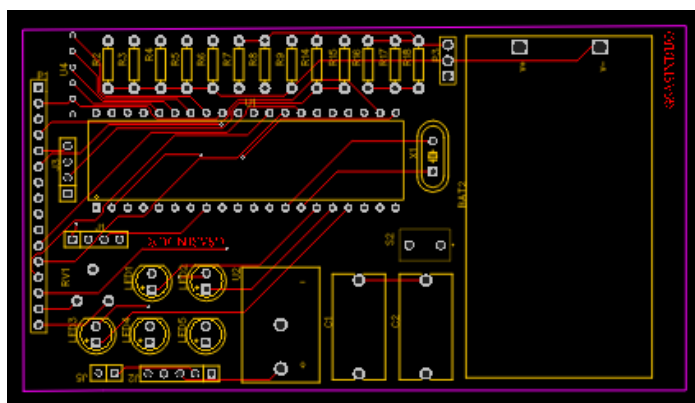
Figure IV The PCB circuit designed using EasyEDA software

Decision flow diagram
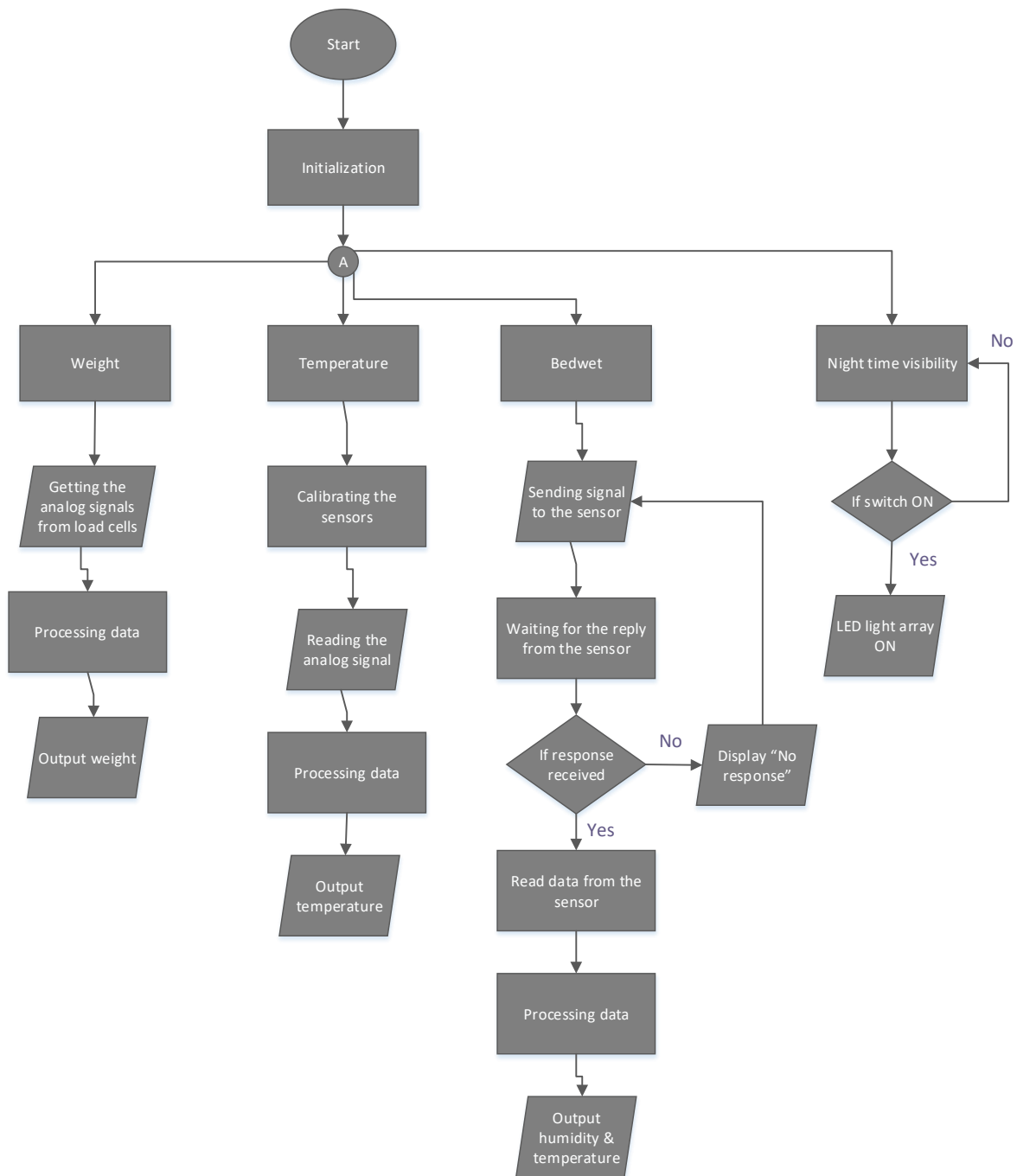
Results

Below figure 3 shows the body temperature comparison between the medical grade thermometer and the NTC thermistor used in this project.
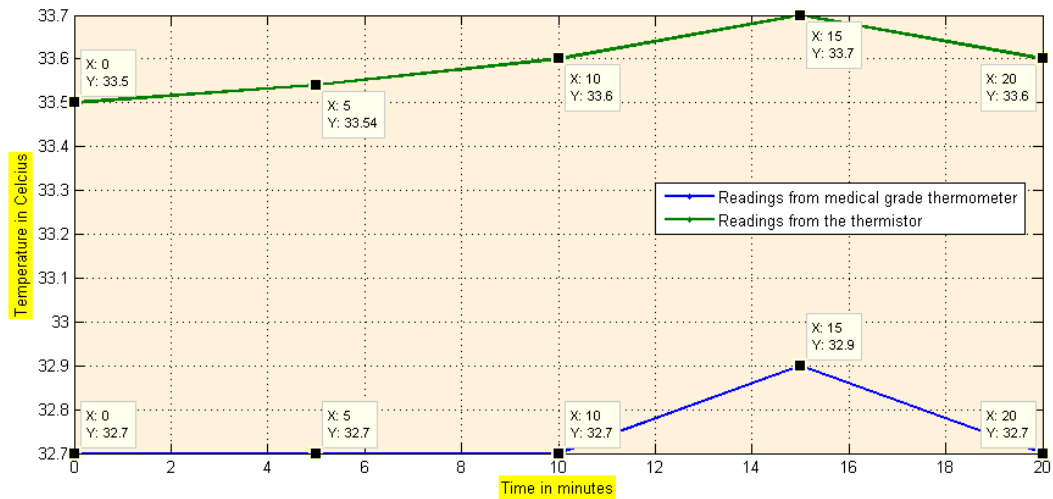
Figure V Temperature results comparison between NTC thermistor and Medical grade thermometer

Outside temperature comparison obtained by the DHT11 sensor and a typical room thermometer is illustrated from figure 4 below.
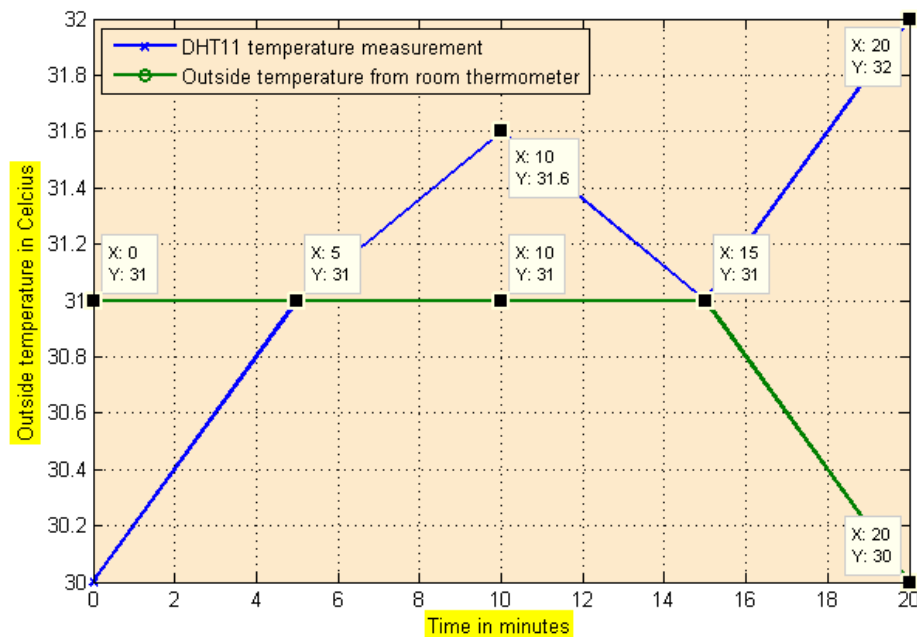
Figure VI Room temperature comparison obtained using DHT11 sensor and Room thermometer

Other than the temperature results DHT11 sensor can also measure the relative humidity. Those result comparison is shown in figure 5.
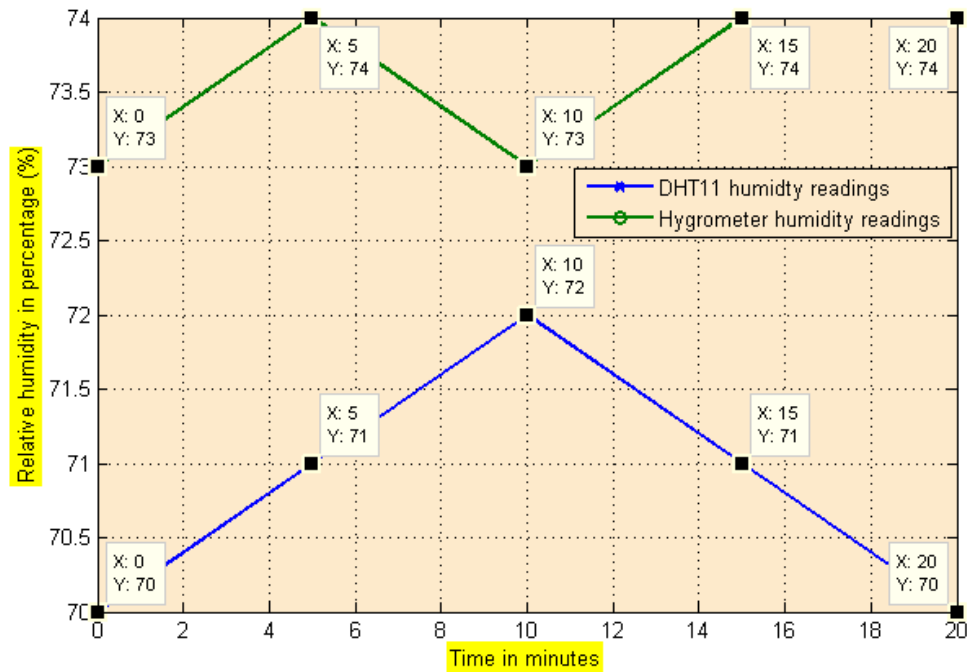
Figure VII Humidity comparison of results obtained through DHT11 and hygrometer

Below graph in figure 6 depicts the weight values acquired from the invented scale using load cells taking existing weights as the references.
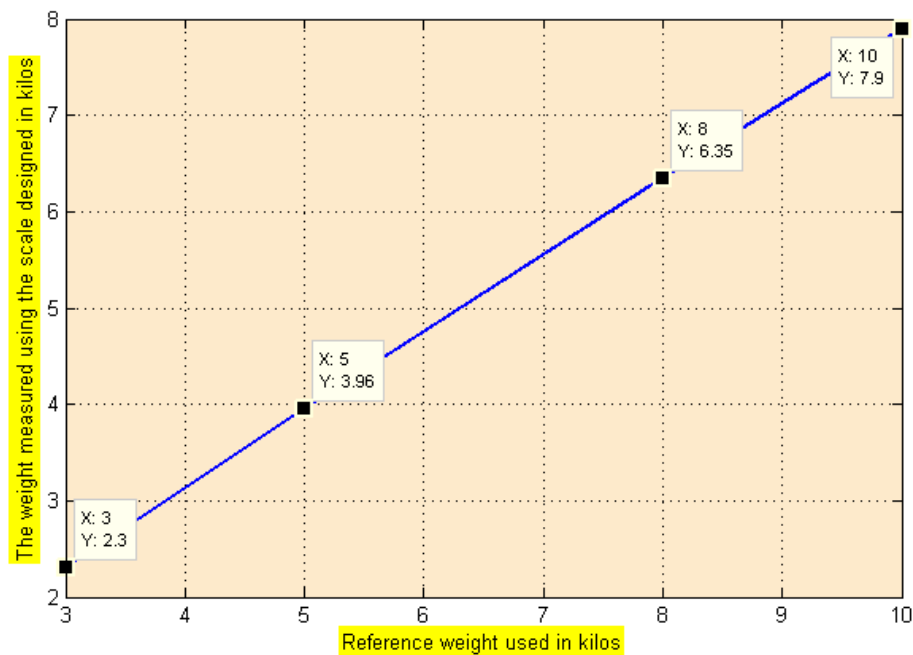
Figure VIII Weight results obtained via the invented scale against the reference weights

Reasons for Deviations of Results

The slight difference between two relative humidity results taken by the DHT11 sensor and the hygrometer might be due to two technologies used in those sensors. The DHT11 uses the capacity and the chosen digital hygrometer uses the resistance as their measurands. This will ultimately affect the accuracy of the results. When it comes to the comparison between body

temperature results, again the difference could be due to the technology difference. The medical grade digital thermometer has a thermocouple while the NTC thermistor is a thermistor type with comparatively high accuracy. Plus, thermocouple0 is directly contacted with the test subject while the DFT11 thermistor is not directly contacted like that. With the results it was evident the outside temperature measured by the DHT11 sensor and the normal digital thermometer is almost similar because they both use NTC thermistors. The reason for the variations in weight measured should be due to the calibration issues and sensor placements.

Discussion

This device was designed to both measure the weight & temperature and also to detect bedwetting. This system also comprises of a LED light array as a safety enhancement feature during the nighttime. The full complete circuit was working in a satisfactory manner. Bedwetting was tested by pouring some water to a fabric, which is kept closer to the DHT11 sensor and it was possible to see a clear increase of the humidity. The slight difference between the results could be due to the sensitivity difference of the two sensors. Considering the results, it was clear that the results obtained are with a higher accuracy. When it comes to the temperature measurement it was seen the values are stable even though there was a difference in temperature values acquired through them. The author used two fingers to apply heat on the thermistor and also used the same method with the medical grade thermometer. In order to acquire the readings at the same time author had to use the both hands. This same DHT11 sensor has the ability of detecting the room temperature. From the results it was evident that readings taken was accurate as the readings acquired from a professional room thermometer. Weight scale needed to be calibrated further to acquire more accurate measurements. The light array designed was also working according to the design with the click of a toggle switch.

Conclusion

From the research that has been carried out, it is possible to conclude that monitoring baby's weight and Nocturnal enuresis is crucial to identify Obstructive Sleep Apnea syndrome and those two can be clearly identified using the proposed device in the above project. Temperature measurement obtained via NTC thermistor was comparatively stable and accurate because it only gave 0.05 deviation from the medical grade thermometer. Also, there was only a 1% - 3% deviation on the relative humidity measurement. The properly working light system was helpful to gain nighttime visibility of the stroller and enhance the safety.
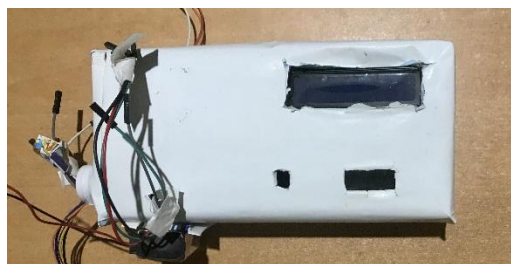
Figure IX The final controller and displaying segment
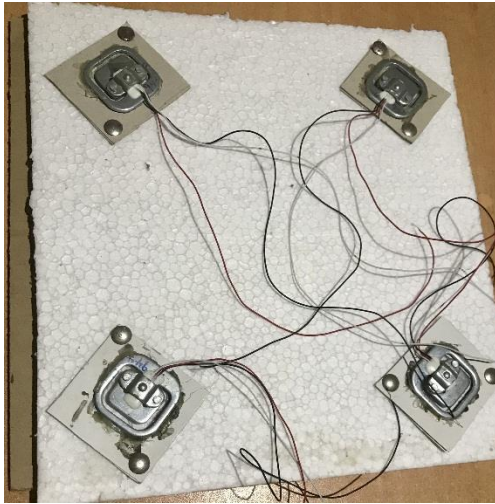
Figure X The final weighing scale platform

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ADJUSTABLE-FIT FOOT MOUSE- A COMPUTER INPUT ASSIST DEVICE FOR INDIVIDUALS WITH UPPER LIMB DEFECTS

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Abstract

Unemployment is a significant problem among amputees in Sri Lanka. In amputees who are mentally sound with the required qualifications to be employed, the physical inability to execute certain tasks due to unavailability of low cost, quality assistive devices hinder the employment opportunities of these individuals. Bilateral arm amputees and individuals with upper limb defects are at an even bigger disadvantage as they are unable to use a computer, which is an integral part of any job. The main objective of introducing this device is to offer a low-cost computer input assist device to bridge the gap between the cost and quality of assistive devices and thereby, increase employment opportunities. The accuracy of the device was calculated using Movement Variability (MV) and Movement Error (ME) parameters and the results indicated that the accuracy and error limits were acceptable for a foot mouse when compared to a USB mouse used by hand.

Keywords: Bilateral arm amputation, Foot mouse, Image Processing, Upper limb defects

Introduction

The Public Administration Circular No.27/88 states that 3% of all public service and public co-operations vacancies should be filled by disabled persons given that these individuals have the required qualifications and that the disability does not hinder performance. (Hrcsl.lk, 1988) Although this circular was released in 1988, according to the Ministry of Social Welfare in Sri Lanka, as of May,2003, only 26% of individuals with disabilities in mobility were employed. In the private sector, only 13% were disabled employees when compared to the entire workforce in Sri Lanka. (Anon, 2003). Sri Lanka is also a signatory of the United Nations Convention on the Rights of Persons with Disabilities (CRPD) which was ratified in 2016, and under work and employment of article 27, it states that persons with disabilities should be facilitated to gain access to technical guidance programs and that these individuals should be employed in the public sector and private sector. (Un.org, n.d.) It is evident through the above statistics and facts that although various policies have been introduced to facilitate employment of disabled persons, they have not been carried out in an acceptable manner.

Most jobs at present require the ability to use a Personal Computer (PC) or a laptop. Bilateral arm amputees are at a major disadvantage due to the lack of low cost, computer input assist devices which increases the chance of unemployment even more. As stated by (Peng,2017) in a study done on how computer skills affect worker employment in the United States, having computer skills not only reduces employee displacement, but also enable re-employment in other locations. (Peng, 2017)

Therefore, it is evident that there exists a local and global need for low-cost computer input assist devices to help such individuals to get equal employment opportunities and thereby improve and increase their quality of life. The adjustable-fit foot mouse addresses two main

issues regarding the devices currently available in the market. Namely, the cost and design of the foot accessory.

A comparison of cost and features of similar devices can be done by observing the tables given below.

Table 1: Cost of similar devices

Product	Price ($)	Price in Rupees
Boomer foot mouse	695.00	125,795
Switcheroo	167.00 - 298.00	30,227 – 53,938
Superswich	299.00	54,119
Interactive Mouse for PC	74.00	13,394
BIG TRACK trackball	98.00	17,738
SAM trackball switch adapted mouse device	251.00	45,431

It is evident from the above table that similar devices have a very high price point in general. This is mainly because units are not manufactured in bulk and due to the advanced technology used in some of the devices.

Table 2: Features of similar devices

Product	Features			
	Switch operated	Button/panel	Assistance needed to be used	Technology used
Boomer foot mouse	No	Yes	No	Wireless bluetooth
Switcheroo	Yes	Yes	No	A USB mouse is needed
Interactive mouse for PC	Yes	Yes	Yes	A USB mouse is needed
BIG TRACK trackball	Yes	Yes	No (Hand- Ambidextrous)	Trackball technology
SAM trackball	Yes	Yes	No	Gross motor function is required

When taking features of similar devices into consideration, the shortcomings of the design of the Billi Foot mouse and Boomer foot mouse are addressed. Billi Foot mouse is another similar product that comprises of a button panel and a slipper. The slipper is not designed in a way to accommodate bilateral arm amputees or individuals with poor upper limb function to wear it without assistance and is said to be very difficult to be used whilst wearing shoes. Both the Billi foot mouse and Boomer foot mouse requires pressing buttons, clicking or exerting pressure with the foot which can lead to knee and ankle pain and even tendinitis of the foot with prolonged use. (Footmouse Review, 2020)

The adjustable-fit foot mouse comprises of a dual switch operated pneumatic foot device which uses the mechanisms of inflation and deflation to provide the user with the required fit. This was inspired by shoe designs such as the Nike Air and the Reebok PUMP. This is completely operable by foot and therefore, does not require the use of hands or assistance of another person. By using color tracking in tandem with image processing, the virtual mouse component was designed. This device does not comprise of any buttons. This feature prevents the foot having to exert pressure and from assuming un-natural positions which greatly reduces the risk of knee, ankle pains and tendonitis.

It is by using the above stated technology and very few electronic components that the cost of production of this device was brought down to just $28.42 (Rs 5,145). The Boomer foot mouse

is the most similar product to the adjustable-fit foot mouse and it is clear by comparing the price, that the adjustable-fit foot mouse is 96% less in cost.

The methodology used to design the adjustable-fit foot device and the color tracking virtual mouse components are described below.

Methodology

The flow chart of the entire device is given below to clarify the working of the device.
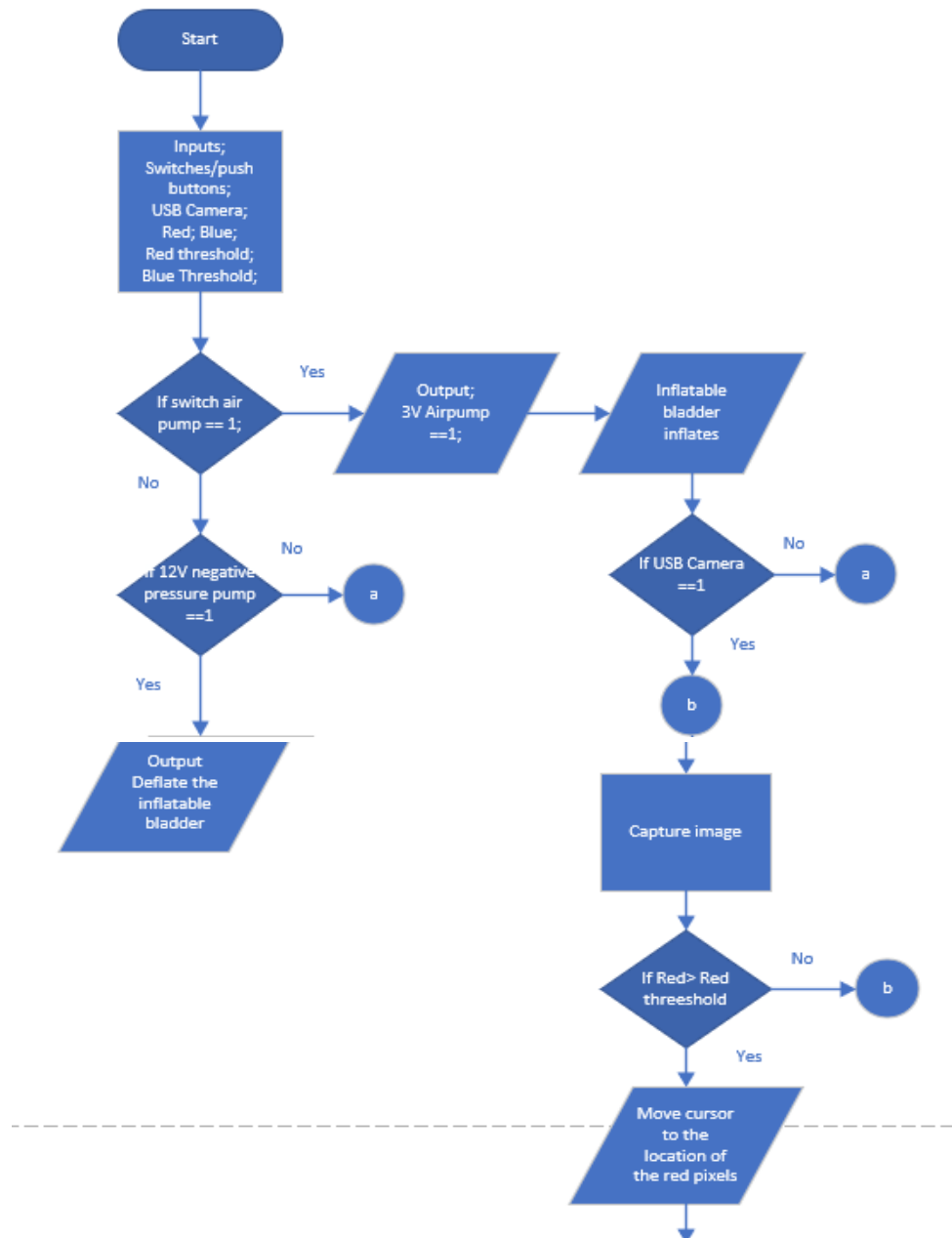
Figure 1:Flow chart of the device
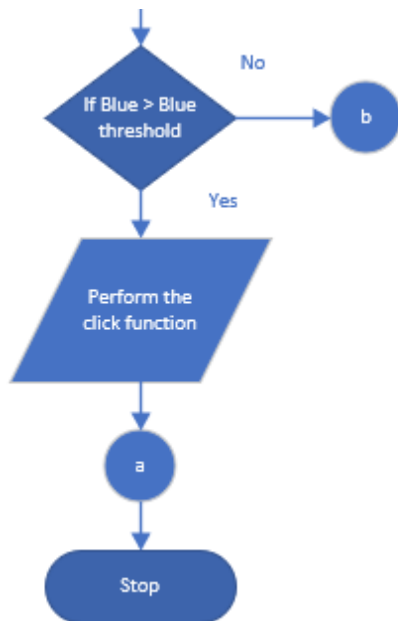
Figure 2: Continuation of flow chart

Figure 3:The Adjustable-fit foot device

The process can be explained as follows. The required fit for the foot device can be obtained by operating the switches of the 3V air pump and the 12V suction pump. The inflatable bladder will inflate and deflate respectively to ensure a comfortable fit.

Once the foot device is comfortably fitted, the Matlab software can be used to detect the outer red and blue on the outer covering of the foot device. A USB web camera is used to capture the image of the movements of the foot and Matlab is used to process these images frame by frame. If red color is detected, then the cursor will emulate the foot movements on the computer screen. If blue color is detected and the motion of the cursor is stopped for a brief period of time, the click function will be performed. Thus, the action of the regular USB mouse can be reciprocated by the adjustable-fit foot mouse as described above.

Results and Discussion

During the testing phase, the working of the air pump, suction pump and the air-seal of the inflatable bladder were tested and it was deemed that both pumps functioned properly and the inflatable bladder was air-tight. In addition to this, the color tracking virtual mouse and image processing component was tested and the left, right, up and downwards movement of the mouse cursor was successful.
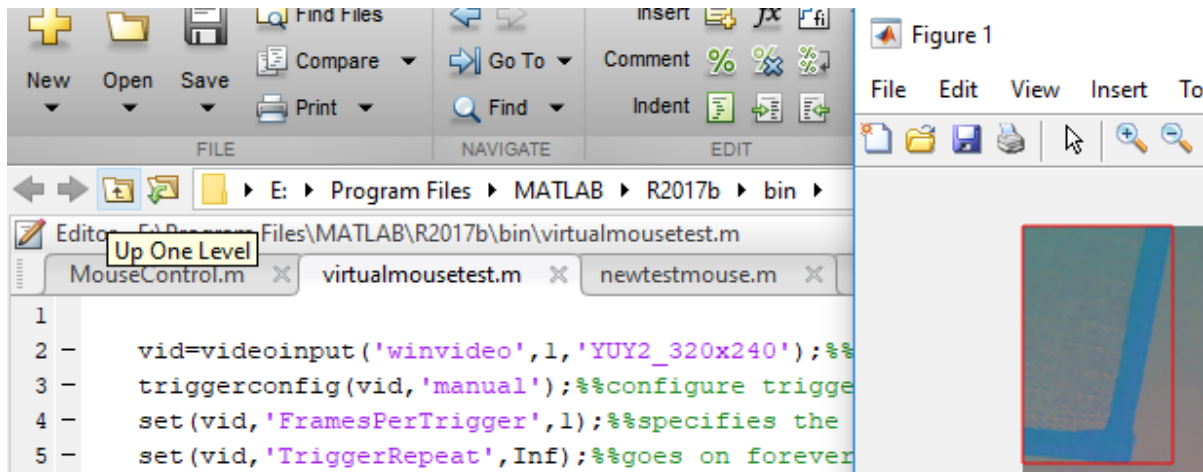
Figure 4:Successful movement of the cursor to the "Up One Level" icon

The accuracy of pointing devices can be calculated using movement variability and movement error. (MacKenzie, Kauppinen and Silfverberg, 2001) In order to calculate the Movement Variability (MV) and the Movement Error (ME), of the adjustable-fit foot mouse when compared to the USB mouse used by hand, the following equations were used.

$$Mv = \sqrt{\frac{\sum(yi - \bar{y})}{n-1}}$$

$$ME = \frac{\sum|yi|}{n}$$

In order to calculate the above mentioned parameters, two targets as shown in the figure below was used along with MousePosition application to detect the x,y coordinates. For a perfectly executed trial, the MV and ME should be 0.
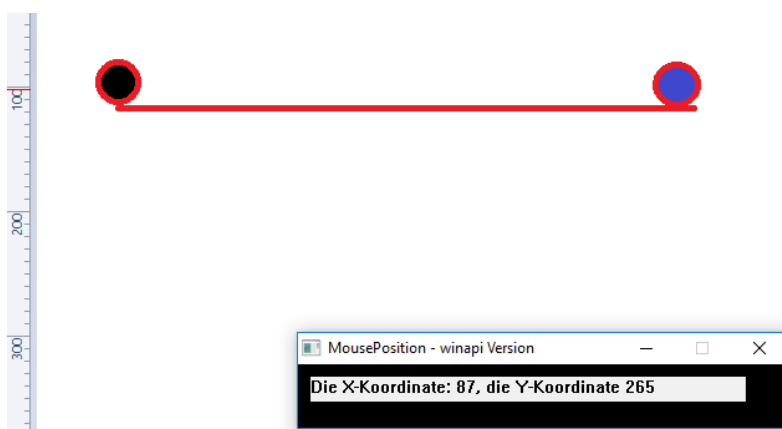
Figure 5:Path used to calculate the accuracy

The coordinates used and the results obtained are tabulated below.

Table 3:Coordinates used for calculating MV and ME

Coordinates used for the path taken by the USB mouse by hand (x,y)	Coordinates used for the path taken by the adjustable-fit foot mouse (x,y)
(87,265)	(286,379)
(208,272)	(483,343)
(305,271)	(540,379)
(381,261)	(620,400)
(470,259)	(752,367)

The subplot of the paths taken is given below.
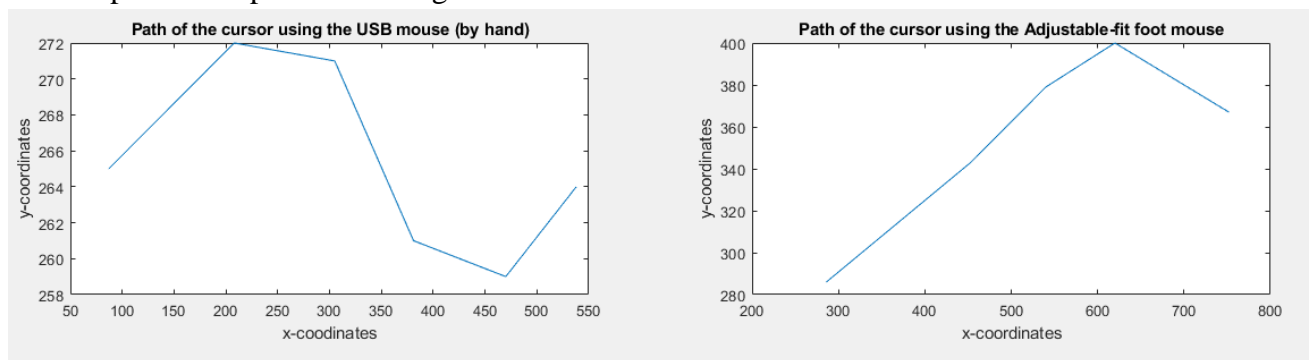
Figure 6: Paths taken by USB mouse and foot device

The MV and ME values calculated for the USB mouse used by hand are 0.25 and 266.6. The respective MV and ME values obtained for the adjustable-fit foot mouse are 3 and 373.6 for this specific trial. It should be noted that the MV and ME values will change for each and every trial as the path taken to reach the target will be different each time. By comparing the values, it is clear that the error margins and accuracy of the adjustable-fit foot mouse is acceptable when compared to a USB mouse used by hand, as extreme precision and accuracy along a path is not necessary to take the cursor from one target to another.

Although the click function happened as required in the first instance that it was tested, it is noteworthy to mention that due to the default issues with the Java bot such as its resolution dependence and image scaling, the repetitive nature of this outcome can range from low to moderate.
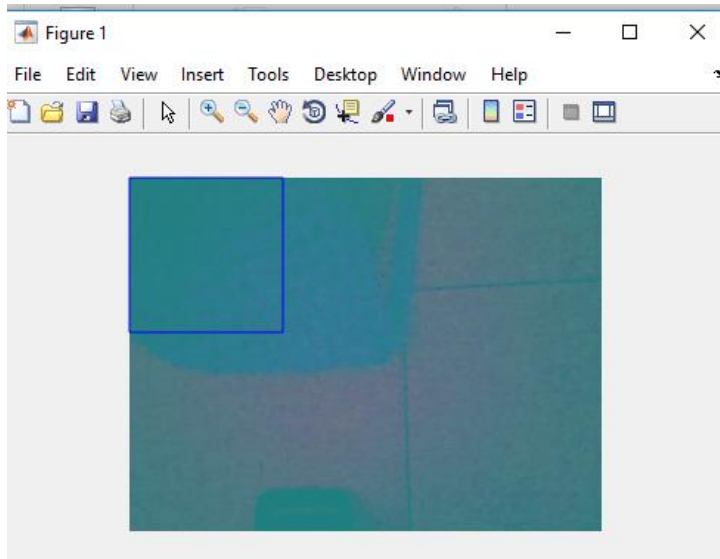
Figure *7*: Result obtained when testing the clicking function
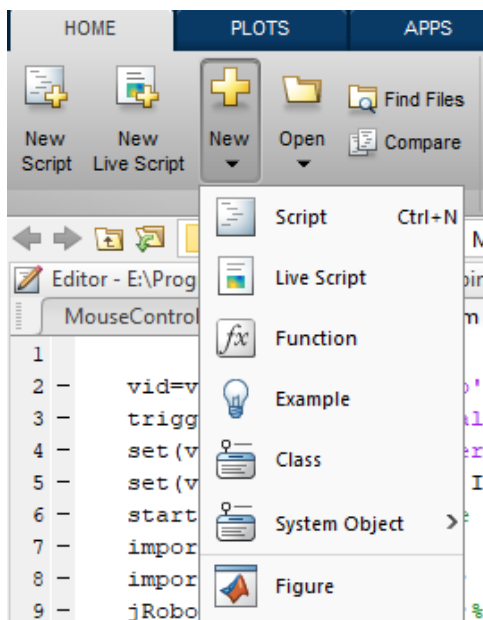
Figure *8*: Result obtained when "New"icon was clicked successfully

Conclusion

This device was introduced to allow bilateral arm amputees and individuals with upper limb defects to use the computer with no assistance and minimal prior training. Through the testing phase it was deemed that the accuracy and error limits of the adjustable-fit foot mouse was acceptable when compared to a USB mouse used by hand. It could be stated that, the testing of the device was successful to a large extent and all the intended objectives were met, resulting in a solution that will contribute to the resolution of the unemployment issue of not only bilateral arm amputees but also all individuals with upper limb defects.

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MEDICAL TRANSPORTATION

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Abstract

Medical transportation is one of the most important aspect in medical field that also deals with the lives of people. Herein, two drones have been used; quadcopter and a hexa-copter as their stability differs in weight lifting. According to the experiments hexa-copter has more lifting power than the quadcopter, along with this drones have been developed through a combination of technologies that includes advance high security and safety options, live computer vision using GPS technology. In-order to carry the desired medical aids a fully automated chamber has been designed. The chamber has an ability to maintain all the medical conditions that is needed to transport medicines, blood and organs. The main condition that should be consistently monitored is the temperature, which is controlled by water-cooling system in the chamber. The interior of the chamber can be live streamed and can be tracked while transporting this enhance the security and safety of the medical aids transported.

Keywords: Automated chamber, Drone technology, Peltier effect, UAVs, Cooling system

Introduction

The development of technology in the means of transportation has been able to uplift the quality and the efficiency of services provided all around the world. Drones (UAVs) are the most recent mean of transport which blends with technological development. the drone technology, which play on medical transportation in medical emergency with effective delivery under a favorable and safe environment.

The Background

UAVs are used by the military forces of many countries immediately after the World War II (Guilmartin, 2020). With the development of technology more developed drones were introduced for military purposes and after 2010 there were a great interest in drone innovations in commercial field by highlighting its purpose as a delivery vehicle (Vyas, 2020).

Upon them, the influence of drone technology has given provoking thoughts in healthcare. There are many ongoing researches throughout the world which focus on life saving ability of customized drones. "Seattle's Village Reach" project in Malawi is to transport blood samples from hospitals in remote areas to main hospitals in Lilongwe, "Flirtey" drone project is to deliver first aid kits and emergency medications in Nevada, the EHang with Lung Biotechnology PBC in United States is developing an autonomous drone which is capable of transporting donated organs all over the world, in Netherlands a TU Delft Ambulance Drone has been designed as a prototype by integrating a cardiac defibrillator and a two-way communication (radio and video), thereby it can act in an emergency of a cardiac arrest until

the emergency service arrive. These drone projects are few of the main 9 worldwide ongoing drone projects which will revolutionize the healthcare industry (Dragolea, 2018). Other than those, the Polish Air Force Institute of Technology has created a drone named AtraxM to support redeem operations and air transport. This drone is able to carry blood, medicines and basic dressing materials for an accident site. Zipline company and the Rwandan government has started a drone project for emergency delivery of life saving blood facility within the western half of the country as an initial step, they also have mentioned that they are looking forward to distribute vaccines and medicines using drones. The UNICEF and Australian Government have supported the Vanuatu's Ministry of Health and Civil Aviation to delivery essential vaccines throughout there 82 remote islands using drones (Kent, 2019). Drones can be customized and are developed to work in medical field has many features related to the navigation, and safety of the aids transported (Higgins GL 3rd, 2012).

In recent studies, there are no specialized chamber to carry the medical materials safely while transporting. The favorable storage temperature for blood components is 4 ℃ to 2 ℃ (Hardwick, 2008), for medication its 8 ℃ to 15 ℃ and for organs its 4 ℃ to 8 ℃ (Bellini & D'Andrea, 2019). Hence, the cooling process is vital and the cooling system is made by combining Peltier effect with water cooling system. This system is widely used and efficient mean of heat removal as water has high thermal conductivity along with high specific heat capacity and the main mechanism used to release the absorbed heat is convection (The Editors of Encyclopaedia Britannica, 2016). Apart from this main system, the interior of the chamber is protected by the effect of environmental temperature by using the heat conduction principles (conduction, convection and radiation).

Problem Identification

Sri Lanka is still a developing country and also has many rural areas with poor infrastructure, therefore transportation via vehicles consumes time and also human effort. When focusing on medical transportation, it should be very much efficient as the duration of transportation may counts the seconds of a patient's life. Herein, we have mainly focused on transporting the most vital aids such as medicine and blood to emergency sites and also organs from a donor hospital to a receiving hospital with minimum human effort, within a short time and secure manner.

Methodology

The initial step of this project was collecting data and performing researches based on medical transportation using drones. Then based on the information two drones were developed, they are; a quadcopter and a hexa-copter (Figure 1).

The 6-rotor configuration have a more efficient flight and more power, it is an essential safety factor in comparison to quadcopter which has 4 rotors. The functionality of the propellers, motors, ESC, flight controller, battery, and drone frame are very important to fly successfully. The drone is to activate the thrust generated by the downward pushing air against gravity by rotating the propellers mounted on its motors to lift the drone. In this way, the speeds of all the propellers can be controlled independently.

Figure 1: The developed quadcopter and hexa-copter

Multirotor drone propellers are arranged in pairs to create a balance, rotating either clockwise or anti-clockwise which helps the drone to hover, climb, descend, or impact its yaw, pitch and roll by adjusting the speed of these propellers. In this project, Electro stability controllers of 40A (Figure 2), AMP2.8 Flight controller, DJI m-light flight controller and DJI V2 flight controller have been used (Figure 3).

Figure 2: The ESC

Figure 3: The Flight controller

The chamber is mainly focused on maintaining the physiological factors that are favorable for the organs and blood transport. This cooling chamber consist of a compact water-cooling system and the inner temperature is can be changed as desired. In addition to the temperature the internal humidity and pressure also maintained. Figure 4 and Figure 5 shows the simple schematic diagram and the prototype of the chamber respectively.
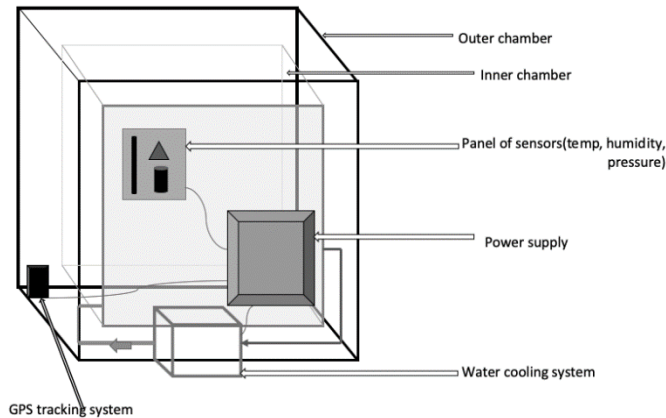
Figure 4: The schematic diagram of the chamber.
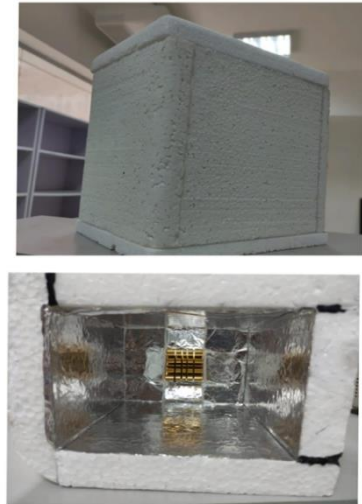
Figure 5: The prototype of the chamber.

The chamber consists of two boxes, the inner chamber is maintained with the favorable physiological environment. Sensors are monitor the internal environment and display on LCD. Vacuum is maintained in between the chambers to prevent the heat conduction. Styrofoam sheets have used to make the chamber to reduce weight. The chamber is supplied with a separate power supply system and a separate GPS tracking system.

When an emergency site or a hospital needs to transport medical aid via this drone system, the user should change the state of the chamber to 'ON' and according to the medical aid transported the inner temperature and humidity specifications can be fed and then the user should place the materials inside safely. Then the chamber should be connected to the drone. Then using the GPS system of the drone, the user should give the target site to be reached and also the user should connect the GPS system of the chamber to perform live tracking. Ones the task is over the drone system will return by its own to the sent site.

Results and Discussion
The following figure 6 shows the two drones which had been implemented for our study.

Figure 6: The assembled quadcopter and hexa-copter

When considering the stability of the two drones we obtained the following results.

Graph 1: The stability of the quadcopter.   Graph 2: The stability of hexa-copter.
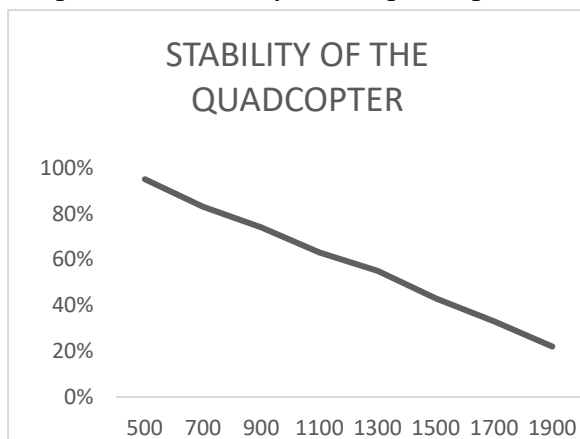
STABILITY OF THE QUADCOPTER

STABILITY OF THE HEXACOPTER
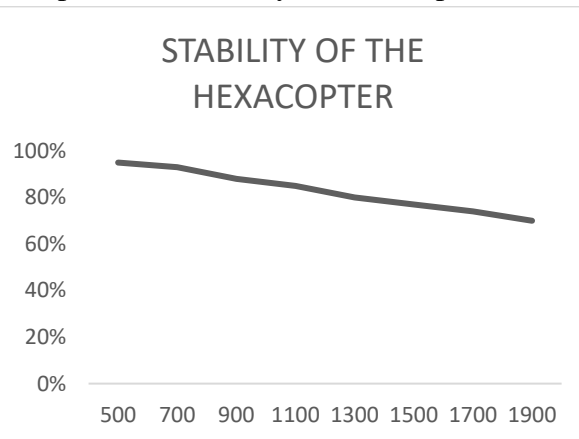
When considering the results, it shows that quadcopter is more stable in light weights and hexa-copter is stable in both light and higher weights. According to the experiments, our drones were able to move at a speed of 20 km/h at a maximum range of 15 km.

When considering the chamber, it was completed under a constant weight of 500g. The water-cooling system was able to maintain a constant temperature of 4 °c for 2 hours and this duration can be increased by developing the water-cooling system and Peltier system. And also, when a temperature is given as a command to the chamber it takes about 5 minutes to gain the desired temperature. The GPS tracking system of both gave the desired results and this is to be further developed.

Conclusion and Recommendation

The drones that we have used in this study are assembled, to step forward customized drones according to our specifications should be designed and implemented using 3D printing technology. The safety of the drone should be developed by installing a parachute system this will protect the drone if a system failure occurs. And also, all the necessary police stations will be provided with a tracking system to track the medical drone to ensure the safety drone and the medical aids transported. An alarm system will be implemented to inform the hospital after the task is over. Further developments are ongoing and expected final outcome shown in figure 7 and 8 respectively.

Figure 7: The 3D model of the chamber   Figure 8: The 3D model of the final product

The technology develops every second, with this basic prototype we hope to develop this project to a more advanced system by combining more technologies and implement an effective transporting system to our healthcare industry. The application of drones in the healthcare industry has given a great advantage, and support to hospitals to provide a quality and effective service to people who needs instant treatments to save their lives. Furthermore, a special box was not designed to transport medical aid until present day, thereby we have implemented a safe automated chamber combined with many technologies to keep a step forward in medical transportation.

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PAINLESS PNEUMATIC NEEDLE FREE INJECTION DEVICE FOR BOTH CLINICAL AND PERSONAL USE

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Abstract

Needle free injection technology is a type of a subcutaneous infusion method, which can be used to administer medications such as vaccines, insulin and pain relievers to a patient's body via the surface of the skin through penetration caused by liquid pressure, generated by using a liquid jet system instead of a needle. Gas powered needle free system is one of the alternative technologies that is currently being used in needle free injection devices which incorporates propulsive chemical reactions as its main source of power. Due to this reason, the technology has some serious drawbacks such as adverse health effects and decreased overall efficiency of the device. Therefore, in the proposed design, a pneumatic-based system had been implemented to eliminate the use of the aforementioned technology, thereby overcoming the issues mentioned in the previous system with promising results.

Keywords: NFID, Injectant, Ampoule syringe, Trypanophobia

Introduction

The use of drug infusion systems dates back to the mid-18th century, starting with the implementation of the world's first subcutaneous injection in 1844. Since then, the evolution of drug delivery devices has kept on widening up to the current stature of implementing modern-day devices, where the conventional polypropylene plastic syringe has become one of the popular infusion devices that is predominantly used to administer the aforementioned types of medications in the fields of medicine.

The conventional syringe uses a needle to puncture the skin so as to gain access to the targeted region to perform the desired method of infusion (i.e. Intradermal, Subcutaneous, Intravenous etc.). However, in time to come, the administration of medications via such devices had become a tedious task to be performed among new born babies, small children and adults suffering from Trypanophobia (i.e. the fear of medical procedures which involve injections) which has resulted in causing needle-stick injuries in individuals while the procedures took place. As a solution for this, the NFI technology had been introduced as an experimental substitute to overcome the problem.

In 2013, Portaro, R. has stated that detonative chemical reactions found in automotive applications (i.e. formation of NaN_3 gas that triggers the activation of air bags) can be used in NFID s. The drawback of this technology is that such reactions require instantaneously applied external forces of higher magnitudes to trigger them. Apart from that, the substances emitted as byproducts from the propulsive reaction were found toxic. Therefore, it cannot be used in any sort of medical grade device.

In the same year, Golub et al. and Krivokorytov et al. have designed a prototype that could produce a non-stationary detonation wave to propel the injectant at a velocity of 70 ms^{-1} by combusting a material composed of a hydrogen air mixture that produces water as a byproduct.

But the prototype wasn't capable of performing a successful infusion since, the force created by the detonative, combustion reaction was insufficient to generate the maximum pressure and velocity required for penetration.

In 2019, Portaro et al. and Dick et al. have designed and implemented a prototype of a detonation-driven needle-free injection device which used a sensitive combustible pre-mixed stoichiometric acetylene-oxygen mixture for its propulsive reactions. The reactions were performed within a circular combustion chamber made of steel with a detonation length of 590 mm and an inner diameter of 26.4 mm. The prototype required higher detonation pressure levels in order to increase the magnitude of its resulting pressure levels, thereby making it possible to perform successful infusions. But the same principle cannot be applied for handheld devices that require shorter detonations lengths since, the above-mentioned reactions could be fatal and could cause injuries if performed without changing the ratio of the combustible mixture and adjusting the detonation pressure according to the length of the detonation chamber. On the other hand, maintaining a lower ratio for the combustible mixture and decreasing detonation pressure below its optimum level may cause decreased efficiency in the device.

Methodology

Figure 1 The complete unit
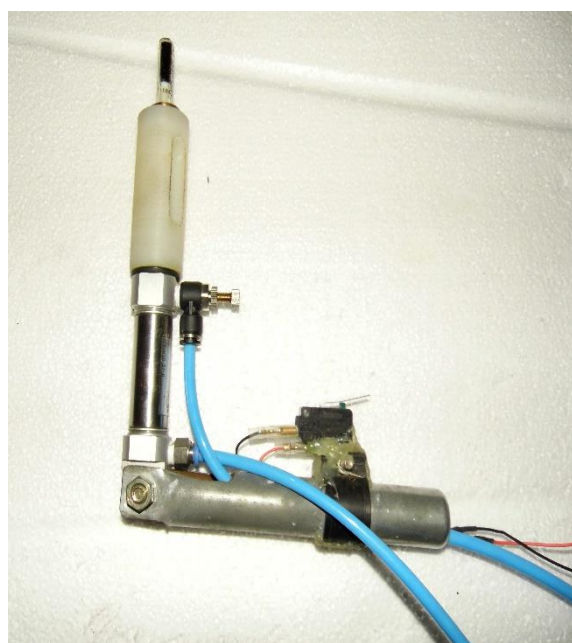
Figure 2 Triggering mechanism

Firstly, the output force that needs to be exerted onto the surface of the skin, bore size of the pneumatic cylinder and the maximum input pressure applied to the plunger of the ampoule syringe have been calculated. The maximum output pressure at the orifice of the syringe had been considered as 20 MPa while the diameter of the plunger had been measured as 4.2 mm. With the help of these two parameters, the maximum output force was measured as 277.088N. The bore size of the pneumatic cylinder and the maximum input pressure applied to the plunger have been measured as 881998.49 Pa and 21 mm by using equation 1 and 2 respectively.

$$Thrust = Pressure \times Area \times Efficiency$$

$$\frac{A(Driver)}{A(Plunger)} = \frac{P(Stagnation)}{P(Driver)}$$

Equation 1 SMC/The Pnue Book (2020)   **Equation 2 Portaro, R.,(2013)**

Most of the components for the prototype were selected according to the above-mentioned calculations (i.e. especially when designing the actuation system). The prototype consisted of three main units which included a control unit, an actuation system and a power supplying unit. The control unit powered by an ATMEGA328PU microcontroller was used to communicate with components connected to it. The program for the control unit was written by using C language. The actuation system was the unit that was responsible for pressurizing and actuating the liquid medication inside the ampoule syringe to cause penetration at the site of infusion. The unit was comprised of a double acting pneumatic cylinder, a 2-way 5/3 solenoid valve, Arduino compatible 5 V 2 channel relay module, two 12 V automotive relays, 6 mm connector and control valves, a trigger switch and 6 mm air tubing. The pneumatic cylinder was controlled by the activation of the solenoid valve, driven by the 2-channel relay module in combination with the two automotive relays. The automotive relays have been used to reduce the continuous flickering of the two relay units in the 2-channel relay module. The trigger switch was used to trip the relay units of the relay module between ON and OFF states on consecutive presses, thereby controlling the opening and closing of the solenoid valve in either direction to cause extension or retraction of the pneumatic cylinder.

The guide that holds the ampoule syringe in place was made out nylon. The material was selected because of its higher mechanical strength and anti-slippery nature that it retains at metal-nylon interfaces under heavy mechanical stresses and loadings. A 16×2 digital liquid crystal display was use to display the current state of device with respect to the activation of the relay units on the relay module. Both the control unit and the actuation system were powered by two separate power supply units where the control unit was powered by battery pack of 12 V while the actuation system was externally powered by using a pair of 12 V lead acid batteries via the relay module.

The device was tested by injecting samples of colored water into a rubber-foam kind of a ball and a piece of meat under different input pressure levels and the data obtained was recorded to find the optimum input pressure level at which the device was capable of giving promising results. All the results were taken by injecting even sample volumes of the liquid. Trials that showed no signs of liquid patches that spread across the innermost layer that is close to the outermost surface of either one of the testing bodies during post-injection period were considered as successful infusions. The ampoule syringe that had been used in this experiment was a commercially available product.

Results and Discussion
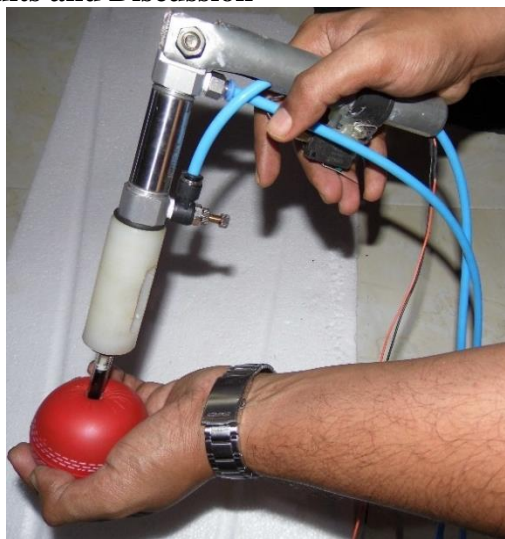
Figure 5 Injecting a liquid sample into ball

Figure 6 Injecting a liquid sample into the foam a piece of meat

The results for this particular project have been acquired according to the mathematical calculations mentioned under methodology. Figures 5 and 6 show the procedure of injecting a liquid sample into a foam ball and a piece of meat while figures 7 to 9 represent the results obtained during post injection period. Figures 7 to 9 also represent that the infusion process performed via the device was indeed successful. The two automotive relays that have been used in combination with the 5V dual-channel relay module to control the opening and closing of the 5/3-way double solenoid valve were capable of reducing the flickering of the relay units on the relay module as expected. The 12 V 1.8 Ah battery pack which was used to power up the control board and energize the coils within the relays units of the relay module was capable of powering up to 10 successful infusions with a single charge.

Figure 7 Results obtained after infusion of liquid Continued

Figure 8 Results of infusion-:

Figure 9 Results of infusion-: Continued

Conclusion and Recommendations

An input pressure between 0.8 MPa to 1 MPa is quite enough to administer smaller drug volumes via needle-free injection technology. Therefore, this device is indeed capable of performing successful infusions under the above-mentioned parameters with greater efficiency when a constant air supply is maintained. Certain modifications and improvements are still being carried out with the intention of adding newer components such as an automated volume controlling system combined with an air bubble detection system to automate the process of filling and priming ampoule syringes while eliminating the formation of air bubbles within the syringe and a smart monitoring system with an improved user interface to provide more versatility to the controllable functions and to make it more user-friendly to the person who uses it. In addition to that, the currently used pressurized air supply system (air compressor) has been planned to be replaced with a portable pre-charged pneumatic cylinder with an air pressure of 200 Bars along with an appropriate regulatory system in order to increase the number of infusions performed while maintaining a low noise environment during operation.

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TIDAL ENERGY PRODUCTION TECHNIQUES AND ITS POTENTIAL IN SRI LANKA: A REVIEW

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Abstract

Tides are long term waveforms that rise with flood currents and fall with ebb currents due to the gravitational force of the earth, moon, and the sun. These tides can be used to generate energy using semi-permeable barrages, by harnessing tidal streams and dynamic tidal power generation. Unlike rain, wind, and sun, high tide and low tides are regular, and thus tidal energy is one of the most reliable energy sources compared to hydro, wind, and solar energy. Tidal energy generation techniques and related calculations, requirements for Tidal Energy extraction, Tidal Energy generation around the world, Tidal Energy Potential in Sri Lanka and barriers and drivers of tidal energy generation are reviewed in this paper.

Key Words: Generation, Power, Tidal Energy, Tidal Range

Introduction

Tidal energy is a clean and reliable form of renewable energy. However, tidal energy is still in its initial stages compared to other forms of renewable energy. There are ongoing researches to find its potential in many countries, while considering the technological and economic factors related to tidal energy. Theoretically, the available ocean energy is far larger than the energy demand of human race, but most of it is inaccessible. (Fraenkel, 2002)

This review analyzes the tidal energy generation techniques, barriers & drivers to understand its potential in Sri Lanka.

1. TIDES

Tides are resulted from the gravitational force of moon and the sun, and the rotation of the earth (Bryden & Melville, 2004). Types of tides include diurnal, semidiurnal and mixed types. (Hagerman, G., et al., 2006) The highest point of the tide is the spring tide and the lowest point is the neap tide (Vikas, et al., 2016).

2. TIDAL ENERGY GENERATION TECHNIQUES

There are two methods of generating electricity from the tides namely: tidal range devices, which utilize the difference in water level between high and low tide and tidal stream devices, which utilize the energy of flowing water in tidal currents (A. Roberts, et al., 2016).

Tidal Energy is extracted through Tidal Stream generators, Tidal barriers and also dynamic Tidal Power dams (Rubayiat Tousif & Shaiyek Md. , 2011). It would also be possible to develop marine current turbines in the waters where there are tidal raises which create currents. (Bahaj & Myers, 2003)

2.1 TIDAL STREAM GENERATORS

Tidal Stream turbines use the same technology as in wind turbines. The kinetic energy in moving water is used to turn the turbines which converts in to mechanical energy and then the

generator converts it to electrical energy. Water is moved by tides and the underwater turbine blades are angled such that they are turned by the tidal streams. The spinning blades cause the gear box to turn the induction generator and produce electricity. The turbines can be placed in harbors and lagoons which naturally has fast flow of water.

The rotors are mounted on tubular steel columns into sockets mounted in seabed. These structures need support structures to hold them steady. There are 3 types of such structures: Gravity Structure, Piled Structure, and Floating Structure. Four types of turbines are used in Tidal stream generators and they are Horizontal Axis Turbines, Vertical Axis Turbines, Reciprocating Devices (Oscillating Hydrofoils), and Venturi Effect Tidal Stream Devices. (Chauhan, et al., 2015)

2.2 TIDAL BARRAGES

Tidal Barrages generate energy using the potential energy in the tidal currents. A tidal Barrage is a dam built across a bay or estuary that consists of turbines, sluice gates, embankments and ship locks. This needs a Tidal range of at least 5m, and the techniques are similar to hydroelectric generation. But Tidal currents flow in both directions, thus the turbines used are either unidirectional or bi-directional. (Etemadi, et al., 2011)

There are two types of Tidal Barrages named, Single Basin System and Double Basin System.

2.2.1 SINGLE BASIN SYSTEM

The Single Basin System (refer Figure 1) has one basin and there are three methods of energy extraction by using Hydraulic Turbine Generators.

- Ebb Generation: First the basin is filled with water and then the water is let out to flow through low head turbines and the generators generate energy until the hydrostatic head drops to the level which turbines operate efficiently. (Etemadi, et al., 2011)

- Flood Generation: During the flood current, the turbines and sluice gates are closed until a sufficient hydrostatic head is achieved and then the turbine gates are opened to let the current flow through. This method cause an average sea level drop in the basin, thus considered as a less favorable method for shipping and the environment. (Etemadi, et al., 2011)

- Two way Generation: Uses both flood currents and Ebb currents to generate electricity.
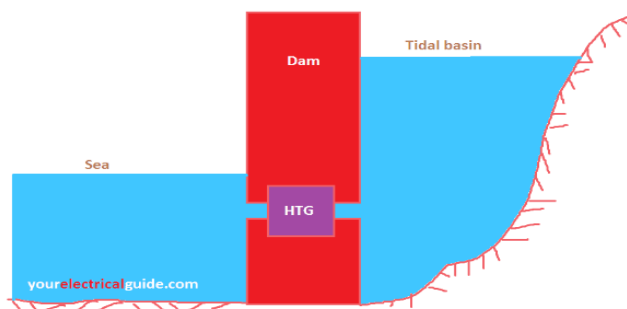
Figure 1 Single Basin Tidal Power Plant (Sharma, 2015)
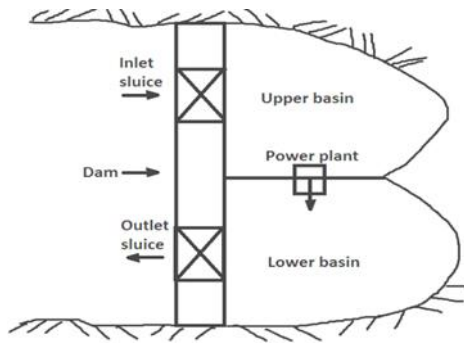
Figure *2* Double Basin Tidal Power Plant (Sharma, 2015)

2.2.2 DOBLE BASIN SYSTEM

This system consists of two basins as shown in Figure 2. The main basin behaves like the ebb generation single-basin system. A percentage of the electricity generated during the ebb phase is used to pump water to and from the second basin to ensure that there would always be a generation capability.

2.3 DYNAMIC TIDAL POWER DAMS

Dynamic Tidal power dam is a 30km to 60km long dam which runs perpendicular to the shore and terminates with a 'T' shape as shown in Figure 3. Where these dams are implemented, the tides flow parallel to the coast. Dynamic tidal power dams cause a height difference in two sides of the dam in this kind of coasts and converts the potential energy in to electricity. As water flows through the dam, a series of turbines are turned. (Afework, et al., 2019)
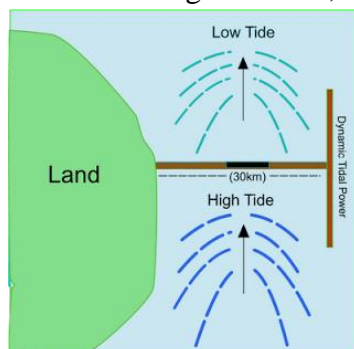
Figure *3* Dynamic Tidal Power dam (Afework, et al., 2019)

3. REQUIREMENTS FOR TIDAL ENERGY GENERATION

Important parameters affecting tidal energy extraction are; basin area, tidal range and the tidal inlet characteristics. (Mendi, et al., 2017)

Tidal Range is the vertical height difference between high tide and low tide. (Wang & Wang, 2019). Basin area should be larger in order to capture more water, thus the water head would be higher for potential energy extraction. Tidal inlet is a point where sea waters meet the ocean waters. (Mendi, et al., 2017)

According to the standards given in (Couch & Briden, 2006), the Tidal energy extraction needs a local water depth of 25-45 meters to accommodate the large turbines, easy access to nearby grid connection and flood currents and ebb currents of high average velocities such as 3ms^{-1}.

4. TIDAL ENERGY GENERATION RELATED EQUATIONS

The Output Power generated by converting Kinetic energy to electrical energy in a tidal stream turbine is given by Equation 1

$$P = \frac{1}{2}\xi\rho AV^3 \qquad\qquad \textbf{Equation 1}$$

Where:

ξ - Efficiency of the turbine,

ρ - Density of sea water,

A - Cross sectional area of the turbine and

V - Velocity of the stream. (Bahaj & Myers, 2003)

The Potential energy that is carried by a volume of water is given by Equation 2.

$$E = \frac{1}{2}A\rho gh^2 \qquad\qquad \textbf{Equation 2}$$

Where:

h - Vertical tidal range,

g - Gravitational acceleration ($9.81 ms^{-2}$)

A - Horizontal area of the barrage basin,

P - Density of sea water ($1025 kg/m^3$)

The output power generated by converting this potential energy to Electrical energy can be calculated according to the tidal duration, time and power generation efficiency. (Rubayiat Tousif & Shaiyek Md. , 2011)

5. TIDAL ENERGY GENERATION AROUND THE WORLD

- La Rance Tidal Power Plant in France is the oldest Tidal Power Plant in the world has a tidal range of average 8.2 meters. It supplies a peak rating of 240 MW. Installation cost payback period was 20 years. (Zainol, et al., 2017). The cost of the project was 95 Million Euros. (Laleu, 2009) The cost of production per kilo watt hour is 0.04 Euros(0.048 USD). (IRENA, 2014)

- Sihwa tidal power station in South Korea has a mean operating tidal range of 5.82m and a capacity of 254MW (LEE, 2011) The cost of production per kilo watt hour is 0.02 Euros(0.024 USD). (IRENA, 2014) Cost of the project was 313.5 billion Korean Won. (LEE, 2011)

- Jiangxia Pilot Tidal Power Plant in China has a maximum Tidal Range of 8.39 meters. It first started with a 500kW generator set and with time it is expanded to 3.9MW (ZAINOL, et al., 2017)

- Garolim Tidal Power plant in South Korea generates 480MW of Power, has a tidal range of 4.7 meters and a basin area of $100 km^2$. (Rashid, et al., 2012)

- Severn Tidal Power plant in United Kingdom generates 8640MW of power, has a tidal range is 7.8 meters, and a basin area of $450 km^2$. (Rashid, et al., 2012)

- Cobequid Tidal Power Plant in Canada generates 5338MW of power, the tidal range is 12.4 meters, and the basin area is $240 km^2$. (Rashid, et al., 2012)

Number of European studies has estimated that for 2020 for current tidal technologies are between EUR 0.17/kWh and EUR 0.23/kWh. (IRENA, 2014)

6. TIDAL ENERGY GENERATION POTENTIAL IN SRI LANKA

The tidal pattern along the Sri Lankan coast is semidiurnal, experiencing two low and two high tides a day with a tidal period of 12 hours and 25 minutes. (Mendi, et al., 2017)

There are 85 identified tidal inlets around Sri Lanka. Tidal range around the country varies from 0.45m to 0.65m. There are few basins of areas as large as 316km^2 near Puttlam Bay and 290km^2 near Nochchimunai which has tidal ranges 0.6m and 0.61m respectively. The output power can be calculated by dividing Energy Generation Potential per day by time in seconds in one day. (Mendi, et al., 2017)

Using above data and equations, the Potential Energy carried out by the wave can be calculated of Puttlam Bay, the largest basin area and the tidal range values available. (Mendi, et al., 2017).

- The Potential energy that is carried by a tide near Puttlam Bay

$$= \frac{1}{2} \times 316,000,000 m^2 \times 1025 kgm^{-3} \times 9.81 ms^{-2} \times (0.6m)^2$$
$$= 571942620000 J$$

- The Potential Power that is carried by 2 low tides and 2 high tides
$$= 4 \times 571942620000 J = 2287770480000 J$$

- Thus, the power generation potential
$$= \frac{\text{Energy generation potential}}{time\ in\ 1\ day} = \frac{2287770480000 J}{86400\ s} = 26478825 W$$

This is nearly a 26.5 MW. However, with the turbine efficiency, generator efficiency and Betz Law applied, the power output could be even less.

7. BARRIERS AND DRIVERS OF TIDAL ENERGY GENERATION

Table *1* Barriers and Drivers of Tidal Energy Generation

Drivers	Barriers
Tidal energy is independent from seasons or the weather type, thus it is more predictable compared to other sources of energy such as wind or solar energy (Abdulsahib & Mohammed, 2018)	There is a slight noise generated from the turbine, and a huge noise if the turbine is designed badly, and the long term noise and the turbine installation might harm the seabed and marine species like sperm and fin whales, dolphins, tunas and swordfish. (T M El-Geziry, et al., 2009)
Tidal Energy is renewable and clean. (ZAINOL, et al., 2017)	Tidal power plant construction costs are high. (ZAINOL, et al., 2017)
Tidally driven coastal currents provide an energy density four times greater than air. (Vikas, et al., 2016)	Water quality in the bay may change due to sediments and change the water turbidity. (ZAINOL, et al., 2017)
Tidal energy exists on a worldwide scale from deep ocean waters. (Vikas, et al., 2016)	Research is still at initial stages (Vikas, et al., 2016)

The following table shows a cost comparison of generating tidal energy compared with other technologies.

Table 2: Average generation Costs of Different Generation Technologies

Generation Technology	Average cost of generation (USD/kWh)

Thermal Oil*	0.15 (Rs. 28.76)
Hydro*	0.0093 (Rs. 1.80)
Thermal Coal*	0.051 (Rs. 9.93)
Solar**	0.068
Onshore Wind**	0.053
Offshore Wind**	0.115
Tidal ***	0.20 – 0.28 (EUR 0.17 – 0.23)

* Source (CEB, 2018) converted to USD for ease of comparison

**Source (IRENA, 2019)

*** Source (IRENA, 2014), estimated costs for 2020 converted to USD for ease of comparison

It is evident that the cost of generating 1 kWh of electricity using Tidal energy is higher than all other power generation options with current state of the art technologies.

Discussion and Conclusion

Tidal energy is a predictable, clean, sustainable and renewable energy source. Tidal Energy can be extracted by two methods, one using tidal range devices such as Tidal Barrages and Dynamic Tidal Power Dams and the other is by Tidal Stream Generators. The power extraction capacity of tidal energy mainly depends on the tidal range. Drawbacks of tidal energy include potential harm to marine life and high installation costs.

When the potential power generation in Sri Lanka is calculated for the largest basin area and the highest tidal range it gives a value of 26.5MW. This is a low potential compared with other countries due to limited tidal differences. Furthermore, the cost of generation is higher than other energy generation methods. More research and cost efficient technological advancements in tidal energy generation will be needed for tidal energy to be a viable renewable energy generation option for Sri Lanka.

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SLEEP INDUCING SIGNAL GENERATOR FOR INSOMNIA PATIENTS

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Abstract

Comparing to normal individuals, the Insomnia patients are unable to fall a healthy, sound sleep at night due to stress, anxiety, depression etc. Insomnia causes daytime symptoms such as fatigue, drowsiness, and daytime accidents too. Therefore, the Insomnia patients are totally addicted to high dose sleeping pills although they have adverse effects. This project proposes an electromagnetic field based sleep-inducing system for Insomnia patients to use alternatively to drugs, which has minimum level of adverse effects on health. Moreover, this device generates the same pattern of waves that creates in brain during sleep and the human brain contains the ability of sensing those low frequency electromagnetic waves. There's no direct contact between the electromagnetic device and the patient's skin due to the free space transmission of electromagnetic waves. A radiator coil is used to generate the electromagnetic radiation; the final output and it was measured using the deflection of a galvanometer.

Keywords: Brain waves, Electromagnetic field, Insomnia, Radiator coil, Non-rapid eye movement (NREM)

Introduction

Insomnia is difficulty of falling asleep, being asleep for a long time and waking up too early in the morning for a period of more than one month. It is reported that the main causes for Insomnia are prolonged stress, depression, anxiety, death of a loved one, disturbance of biological clock and restless legs syndrome [Kumara et al. 2016]. These patients are totally addicted to high dose sleeping pills although they have adverse effects on health [Lone and Sethi, 2017].

As reported by Hasan, Dev and Ahammad (2013), the main reason for poor sleep quality of Insomnia patients is the inability to reach their sleep to the 3rd stage of sleep cycle and also they have pointed out that the Insomnia patients have double the risk of diabetes, heart failures, seven times the risk of abusing to alcohol and drugs.

Kumara et al. (2016) reported that the humans have the ability to sense natural earth's magnetic fields involuntarily. And the human brain generates brain waves with different frequencies of electromagnetic radiation [Ulfatjahan, Todare and Gaikwad, 2017].

Electrical activity of brain during sleep

There are four main frequency ranges of brain waves that indicates different brain states. When the person closes his eyes and go to sleep, Alpha waves are generated and when the person falls asleep, the brain waves decelerate to Theta waves. [VeryWellMind, 2019]

1. Beta waves (12-18 Hz frequency)
   - Cognitive tasks: decision making, problem solving and alertness.
2. Alpha waves (8-12 Hz frequency)
   - Quietly flowing thoughts and relaxation.

3. Theta waves (3-7 Hz frequency)
   ● Daydreaming and meditation.
4. Delta waves (0.5-3 Hz frequency)
   ● Deep sleep.

Sleep Cycle

In general there are five stages or cycles of sleep, the first cycle takes around 90 minutes and the rest of the cycles take around 90 to 120 minutes. Each cycle is divided in to two main sleep modes namely Non-rapid eye movement (NREM) sleep and REM sleep. NREM sleep mode is again divided in to three stages namely N1, N2 and N3. Researchers have pointed out that each sleep cycle occurs in the order of N1 to N2 to N3 again back to N2 and then to REM stage. (sleepfoundation.org, 2020). After passing through four stages of Non REM sleep, then it enters to REM sleep. This stage of sleep is characterized by high frequency brain waves. (Hasan, Dev and Ahammed (2013),)
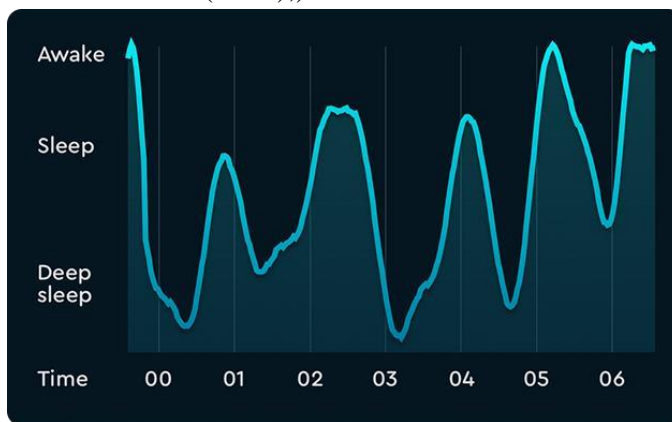
Figure 1 - : Human Sleep Cycle (Source: Sleep Cycle)

According to previous researchers, when human is relaxed by closing eyes, Alpha waves with 10Hz are generated in brain. In N1 stage, the Theta waves with 3Hz - 7Hz are generated. In N2 stage sleep spindles and brain waves with 12Hz-14Hz are generated. In N3 stage, the Delta waves with 1Hz- 4Hz are generated. Ultimately in the REM sleep cycle, fast and random waves with frequency of 15Hz – 30Hz are generated. (Tuct Sleep, 2020)

Methodology

This sleep inducing device has to be kept near the patient's bed to get the best results and there is no direct contact between the patient's skin and the electronic device due to the free space transmission of electromagnetic waves. When a healthy individual enters to the sleep cycle and in the N1 stage of NREM sleep, the brain waves decelerate to theta waves and they last for 5-10 minutes.

Although the Theta wave has a frequency range of 3-7 Hz, the mean value of the frequency range frequency tallies with the proved waveform. When the device is powered, 5 Hz frequency, which is similar to the frequency of brain theta waves, is generated by the oscillator. (Astable frequency generator circuit) The connection between the microcontroller and the oscillator is controlled by the switching circuit. Then the generated frequency is fedded to the radiator coil through the interface circuit. The respective magnetic field is generated by this radiator coil for 8 minutes to induce sleep in Insomnia patients.

Table 1 – Sleep Cycle 1: Frequency Range & Mean Frequency of each Brain Wave

Stages of Sleep Cycle 1		Type of Brain Wave	Frequency Range (Hz)	Frequency Mean (Hz)	Duration Range (minutes)	Duration Mean (minutes)
NREM	N1	Theta	3-7	5	5-10	8
	N2	Sleep spindles & K complexes	12-14	13	10-25	18
	N3	Delta	1-4	3	20-40	30
	N2	Sleep spindles & K complexes	12-14	13	10-25	18
REM		Fast & random	15-30	23	10	10

This sleep inducing device is programmed to radiate a specific electromagnetic field for a specific time, which is respective to the each stage of the sleep cycle. (N1→N2→N3→N2→REM) This process continues for 8 hours for four sleep cycles and at the end, a buzzer is alarmed to wake up the patient.
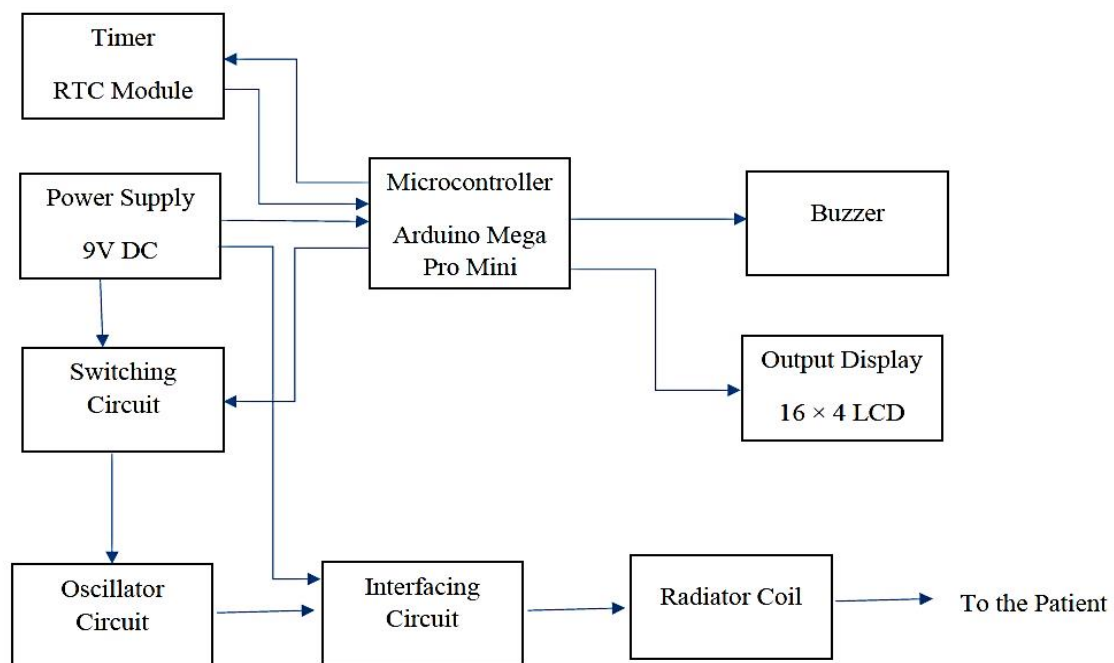
Figure 2– Block Diagram of Sleep Inducing Device

Five switching circuits consisting BC547 transistors (*Fig. 3*) are included in this design. The base of the transistor is driven by 5V, which is supplied by controlling Arduino. D14, D15, D16, D17 and D18 pins of the microcontroller, are coded as output pins to supply 5V to the

switching circuits which are interfaced with the 3Hz, 5Hz, 13Hz, 23Hz and 28Hz frequency generator circuits respectively (*Fig. 4*).
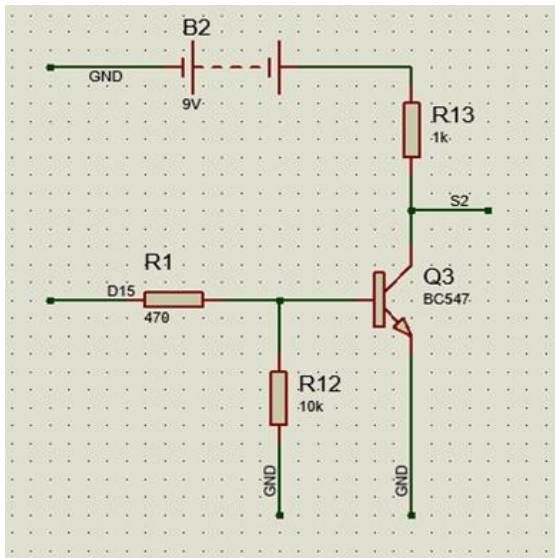
Figure 3- Switching Circuit
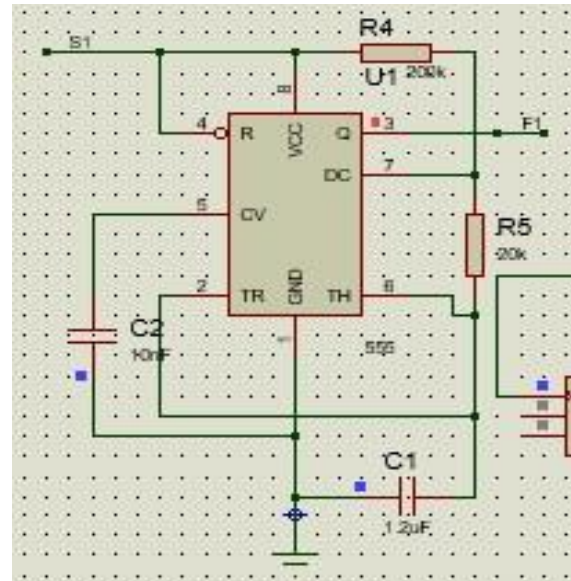
Figure 4 – Frequency Generator Circuit

Table 2 - Arduino Mega Pro Mini board pin function

Pin No	Connections
Vin	9V input supply voltage
5V	LCD display VDD pin & VEE pin RTC module VCC pin Buzzer's positive pin Switch pin 1
GND	LCD display VSS pin, RW pin & K pin RTC module GND pin Switching circuits' GND Frequency generator circuits' GND Interface circuit's GND Buzzer's negative terminal Switch - 10 kΩ resistor of voltage divider circuit
D2, D3,D4, D5, D11, D12	LCD Display Pins
D10	Buzzer's positive terminal
D14, D15, D16, D17, D18	Switching circuits' input terminals
D20, D21	RTC module pins
D46	Switch pin 2

Table 3 – Real-Time Clock (RTC) module pin function

Pin Name	Description	Arduino Board Connections
VCC	Power supply	Connected to 5V Pin in Arduino
GND	Ground pin	Connected to GND pin in Arduino
SDA	Serial Data Pin	Connected to D20 pin in Arduino
SCL	Serial Clock Pin	Connected to D21 pin in Arduino
SQW	Square Wave Output Pin	-
32K	32 kHz oscillator output	-

NE 555IC, as the main controlling unit of each frequency generator circuits is driven using 4.5V-16V supply voltage, operated in Astable mode and the frequency is varied using two external resistors and single capacitor.

Each frequency generator (FG) circuit is connected to the radiator coil via the interface circuit. Only one FG is ON at a time and generates a unique frequency transferred to the radiator coil and which generates the respective magnetic field.
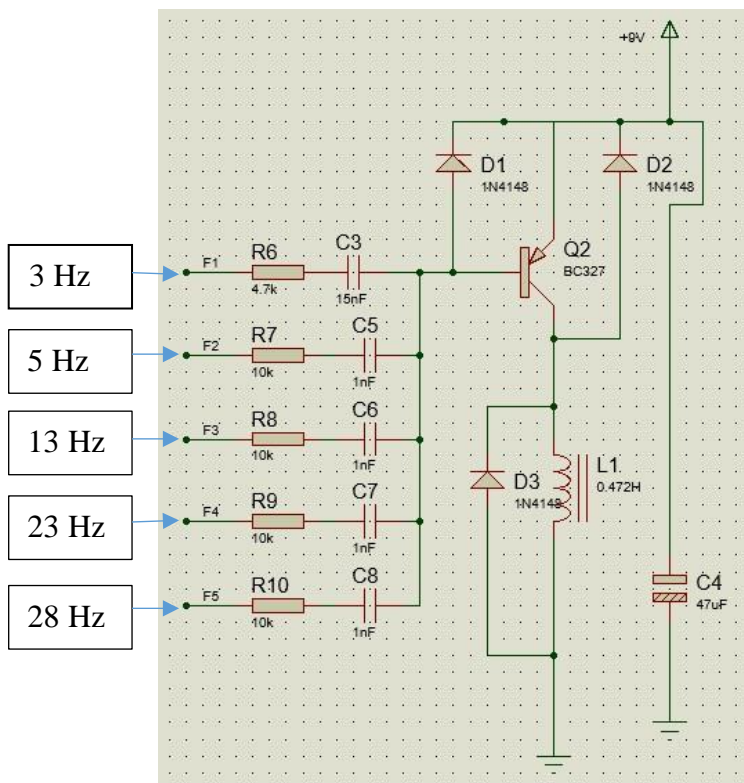
Figure 5 – Interfacing of FGs and Radiator coil
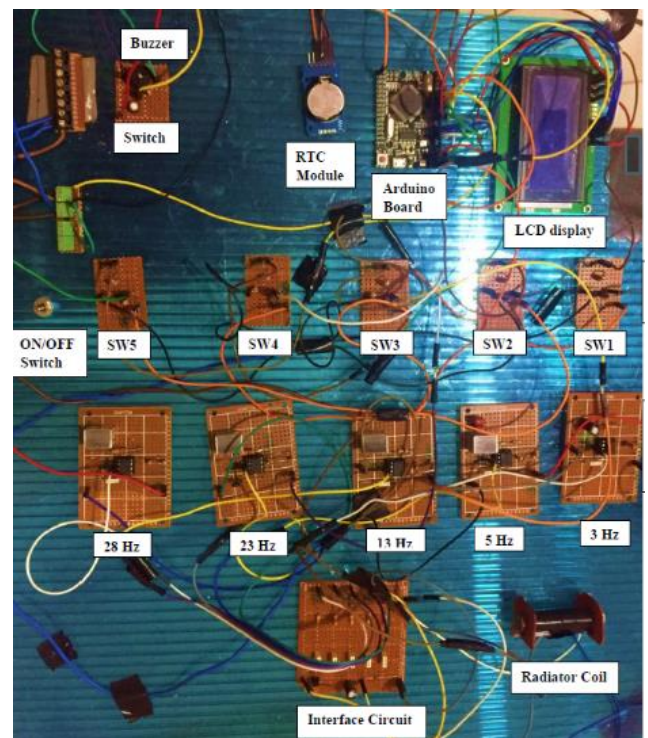
Figure 6- Sleep Inducing Device Hardware Design

The radiator coil is designed using a 40 mm long, 6mm diameter steel bolt and it is randomly winded 600 turns using a 0.2 mm enameled wire which is used to propagate electromagnetic fields with respect to the frequencies generated by the frequency generator circuits. The coils are specifically interfaced to the frequency generator circuits.

Testing and Analysis

The main parameters which have to be tested in this sleep inducing device circuit are the electromagnetic radiation, voltage, pulse waveform and the frequency

Table 4 - Main Parameters of Sleep-Inducing Device

Parameter	Description	Measuring Instrument
Electromagnetic Radiation	Radiator coil	Galvanometer
Voltage	At base terminal of BC327 transistor of interface circuit	Multimeter
Pulse Waveform		Oscilloscope
Frequency	At input terminal of radiator coil	Multimeter

A galvanometer was set near the radiator coil to observe the deflection. Then the oscilloscope was placed at base terminal of BC327 transistor of interface circuit (Figure 9) to observe the pulse waveform. The input voltage at base terminal of BC327 transistor of interface circuit is measured upon switching ON the system. Then the frequency at the input terminal of radiator coil is observed (Figure 9) through a multimeter (Meterman, Model: 38XR) (Figure 10)

Results & Discussion

The sleep inducing output condition wave, (Figure 7) which was simulated in Proteus, is resemble to the slow oscillation brain waves which was recorded in parietal cortex of rats (Figure 8). [Cole, S. and Voytek, B., 2017].
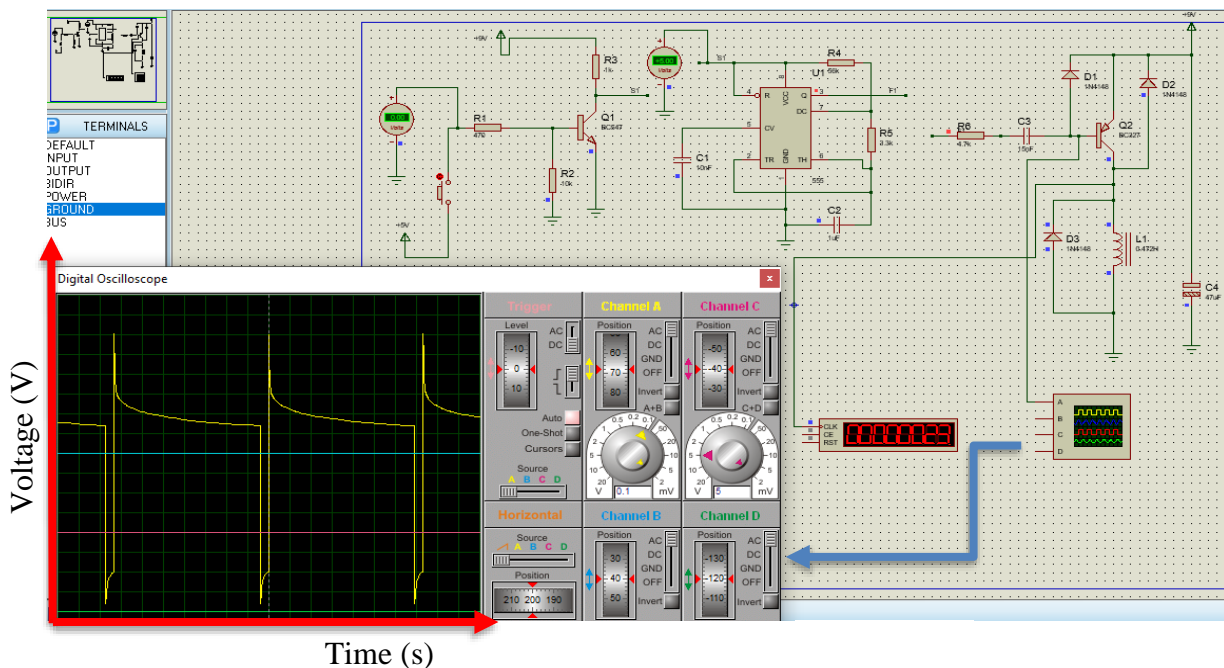
Figure 7- Sleep Inducing Condition Wave Time Domain Plot.
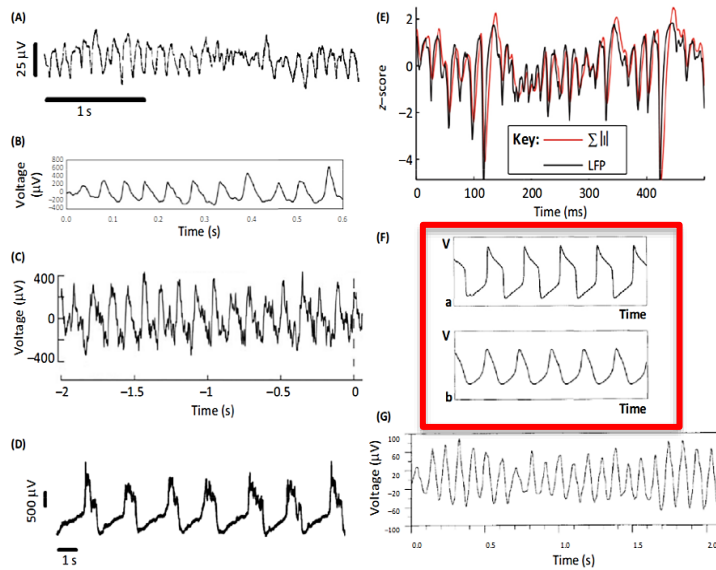
Figure 8 - Slow Oscillation Brain Waves of Rats. (Source: Sapien Labs 2020)

Therefore, it reveals that the test circuit radiates an electromagnetic field with the relevant properties, which is capable of inducing sleep. The test setup schematic diagram of Interface circuit is shown below. (Figure 9)
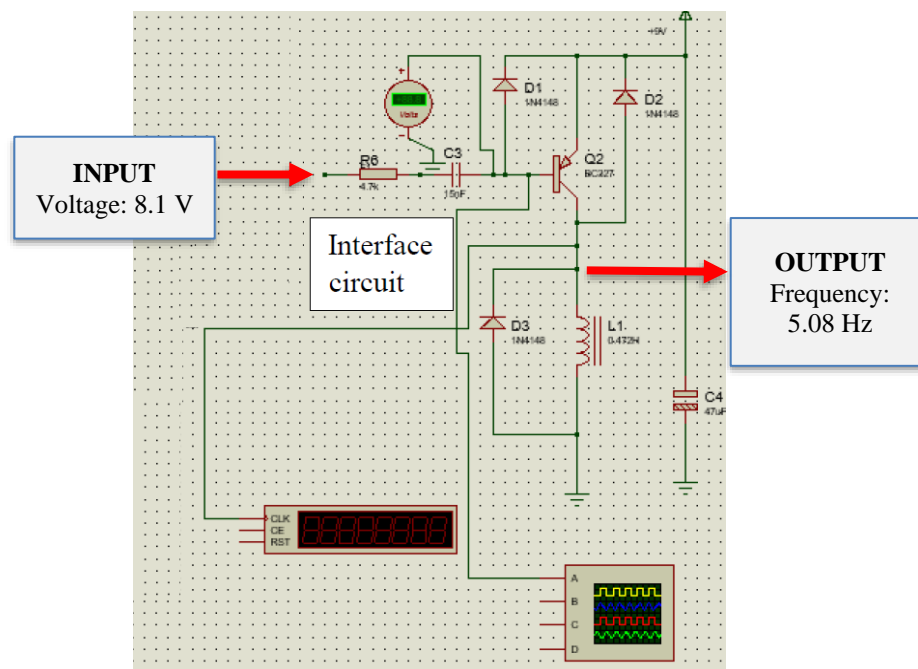
Figure 9 - Test Setup Schematic Diagram

The sleep inducing output condition wave time domain plot is represented in Figure 7 and the parameter values are given below. (Table 5 – Table 9)

Table 5 - Results of NREM stage 1- [N1]

Parameter	Output taken from		Simulation Results (Proteus)	Practical Results
Voltage	Input Terminal of Switching Circuit	SW1	5.00 V	4.792 V
		SW2	0.00 V	44 mV
		SW3	5.00 V	4.792 V
		SW4	5.00 V	4.795 V
		SW5	5.00 V	4.795 V
	Input Terminal of Frequency Generator Circuit	FZ1	0.00 V	21.2 mV
		FZ2	5.00 V	6.7 V
		FZ3	0.00 V	20.6 mV
		FZ4	0.00 V	21.5 mV
		FZ5	0.00 V	21.2 mV
	Base terminal of transistor of interface circuit		8.46 V	8.1 V
Frequency	Input terminal of radiator coil		5 Hz	5.08 Hz

Table 6 - Results of NREM stage 2 - [N2]

Parameter	Output taken from		Simulation Results (Proteus)	Practical Results
Voltage	Input Terminal of Switching Circuit	SW1	5.00 V	4.793 V
		SW2	5.00 V	4.795 V
		SW3	0.00 V	45.0 mV
		SW4	5.00 V	4.805 V
		SW5	5.00 V	4.792 V
	Input Terminal of Frequency Generator Circuit	FZ1	0.00 V	21.6 mV
		FZ2	0.00 V	20.6 mV
		FZ3	5.00 V	6.87 V
		FZ4	0.00 V	22.2 mV
		FZ5	0.00 V	21.0 mV
	Base terminal of transistor of interface circuit		8.95 V	8.3 V
Frequency	Input terminal of radiator coil		13 Hz	13 Hz

Table 7 - Results of NREM Stage 3- [N3]

Parameter	Output taken from		Simulation Results (Proteus)	Practical Results
Voltage	Input Terminal of Switching Circuit	SW1	0.00 V	32.2 mV
		SW2	5.00 V	4.76 V
		SW3	5.00 V	4.77 V
		SW4	5.00 V	4.78 V
		SW5	5.00 V	4.77 V
	Input Terminal of Frequency Generator Circuit	FZ1	5.00 V	6.7 V
		FZ2	0.00 V	19.8 mV
		FZ3	0.00 V	20.9 mV
		FZ4	0.00 V	22.2 mV
		FZ5	0.00 V	22.6 mV
	Base terminal of transistor of interface circuit		8.46 V	8.1 V
Frequency	Input terminal of radiator coil		3 Hz	3.09 Hz

Table 8 - Results of NREM stage 4 [Again back to N2]

Parameter	Output taken from		Simulation Results (Proteus)	Practical Results
Voltage	Input Terminal of Switching Circuit	SW1	5.00 V	4.77 V
		SW2	5.00V	4.77 V
		SW3	0.00 V	31.7 mV
		SW4	5.00 V	4.78 V
		SW5	5.00 V	4.77 V
	Input Terminal of Frequency Generator Circuit	FZ1	0.00 V	21.5 mV
		FZ2	0.00 V	19.9 mV
		FZ3	5.00 V	6.8 V
		FZ4	0.00 V	22.0 mV
		FZ5	0.00 V	22.2 mV
	Base terminal of transistor of interface circuit		8.95 V	8.2 V
Frequency	Input terminal of radiator coil		13 Hz	13 Hz

Table 9 - Results of REM stage [stage 4]

Parameter	Output taken from		Simulation Results (Proteus)	Practical Results
Voltage	Input Terminal of Switching Circuit	SW1	5.00 V	4.77 V
		SW2	5.00 V	4.78 V
		SW3	5.00 V	4.77 V
		SW4	0.00 V	32.8 mV
		SW5	5.00 V	4.77 V
	Input Terminal of Frequency Generator Circuit	FZ1	0.00 V	21.7 mV
		FZ2	0.00 V	20.1 mV
		FZ3	0.00 V	20.6 mV
		FZ4	5.00 V	6.80 V
		FZ5	0.00 V	22.1 mV
	Base terminal of transistor of interface circuit		9.33 V	8.5 V
Frequency	Input terminal of radiator coil		23 Hz	23 Hz
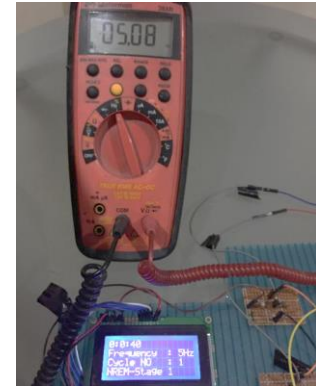
Figure 10 - frequency at Input Terminal of Radiator Coil

This device radiates an electromagnetic field, which makes a soothing environment for a sound healthy sleep. The main benefit of this project is that it is a drug free method to treat Insomnia condition with almost zero side effects.

Conclusion & Recommendation

It was finally concluded that it is the ideal solution to treat Insomnia patients, which is a drug free and a method of minimum adverse effects on health. The main theory behind this project is that the involuntary ability of human brain to sense the artificially generated low power electromagnetic waves in the external environment which induces sleep. Due to the decreased power of those signals, the radiation effect on the patients is in a minimum level. In this project, the properties of condition signal , has proved under one frequency.(for the mean value of brain wave frequency range) This sleep inducing device has to be kept near the patient's bed and there is no direct contact between the patient's skin and electronic device as the electromagnetic waves transmit in free space. Rather than inducing sleep, this device can be used for stress releasing, reduction of anxiety and soothing minds.

Other future enhancements associated to this research work, which includes:
- To retrieve more reliable results, a spectrum analyzer can be used.
- Other than monitoring and inducing sleep, certain features such as relaxing music, bedtime alerts, snoring detection etc. can be added to the initial project.

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MULTI LANGUAGE VOICE APPRATUS FOR VERBALLY IMPAIRED PEOPLE ALONG WITH AN ANDROID APPLICATION (MLVA)

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Abstract

Sign language is used by verbally impaired people to communicate with each other as well as with the normal people. One of the most significate problem that our society facing is people with disabilities such as deaf and mute people finds difficulties to cope with the fast growing modern technology. Communication between deaf-mute and normal people have always been a challenging task. Normally deaf mute people uses sign language for communication, typically sign language is a sensitive and natural way for communication between normal and dumb people. But many people are unable to understand the sign language. In order to overcome the complexity the multi-Language voice apparatus along with an android application is introduced to deaf-mute people. Therefore a sign language translator were needed to understand what exactly deaf-mute speak and communicate with the normal society. Hence this makes the communication between normal society and the verbally impaired people mush easier.

The main aim is to develop a cost effective, portable gesture recognizing system along with an android Application that can identify the different gestures used in Sri Lankan sign language and to obtain different outputs such as text, speech, images in three different three languages. The proposed system is equipped with a Bluetooth module, Cotton glove, Microcontroller, thirteen Metal studs, an OLED display and mobile phone. This device can be used in hospital wards to treat mute patients to enhance the patient comfortable.

Keywords: Android application, Gesture recognition, Multi language voice apparatus, verbally impaired people, Wireless smart glove

Introduction

According to Emad E. Abdallah there are people who are suffering from deafness or hearing loss which is either totally or partially. (Sciencedirect.com, 2016).According to World Health Organization 360million people around the world which is 5% of the world`s population and 32 million of them are children who are suffering from hearing loss. Usually non dumb people believes that dumb people are not that intelligent as a non-dumb person. But this belief is a myth. Because they have sharp intelligence.

According to Princesa Cloutier in 2016 he says that in 1999, an effort were taken to answer the problem which is interaction between normal people and the mute people.

According to the (Ahmad Zaki Shukor ,2015) Published on 2015 Mainly there are two different method of gesture recognizing methods. They are Sensor based gesture recognition approaches and Hand gesture recognizing approaches. The data glove approaches and visual based approaches comes under the sensor based method and The Virtual button comes under the hand gesture recognizing method. The Virtual button is the newly introduce method of gesture recognizing.

According to the article (Pathak1, Chitranshe and Mongia2, 2015) this system have use sensor based approaches to create the data glove but this design have three sensors. They are flex,

contact and three axis accelerometer. These sensors are very expensive. According to (Ahmad Zaki Shukor ,2015) shows that the virtual button approaches is the newly introduce method. The main purpose of the virtual button is to produce certain key actions on events such as like huddle and release by the accuracy of the hand movements of pressing and relaxing separately. The virtual button has the ability to identify different sorts of gestures send generated correct commend. It will observe the squeezed movements with the help of IR optic sensors. Based on the IR radiation values these sensors generates a voltage value.

When a deaf or a dumb person is hospitalized the hospital staff may face and feel difficulty to treat that person because of the communication gap between a normal person and a verbal impaired person. Sign language is used by deaf or dumb persons to communicate with people. But only another verbally impaired person or a person who have learned sign language can understand this language but not a normal person. There is a huge communication obstruction among verbally impaired people and non-verbally impaired people. This project is aimed to develop a cost effective, portable gesture recognizing system along with an android Application that can identify the different gestures used in Sri Lankan sign language and to obtain different outputs such as text, speech, images in three different three languages which includes Sinhala, English, and Tamil. This development were invented to get a high accuracy Multi Language Voice Apparatus along with an android application. A sign language translator along with an android application must be established to confrontation of these kind of issues. So verbally impaired people and normal people will be able to communicate with both parties without any issues.

Methodology

This system is designed to translate hand gestures into Asian sign language. A glove based approach was chosen for the purpose. The hardware module consists of a tailored glove, microcontroller (Arduino Nano), Bluetooth module (HC-05), twelve metal stud (acts as sensors), and OLED display. Software module was developed to encode and decode the recognized signs and to develop the android application.

The glove is the main part of the hardware module. We decided to use a handmade glove to produce a low cost system. Overview of the system is shown in Figure1.The proposed system starts with a glove. Once the glove finger point attach with the reference finger point of the glove the sensor number of the attached point of the glove is displayed on the OLED display with the sensor number. Their outputs to the microcontroller ADC channels. The processed ADC values are then considered with the threshold values to recognize the gestures. The microcontroller transmits the signals through UART wireless module to the smart phone in a serial way.

Hardware Module
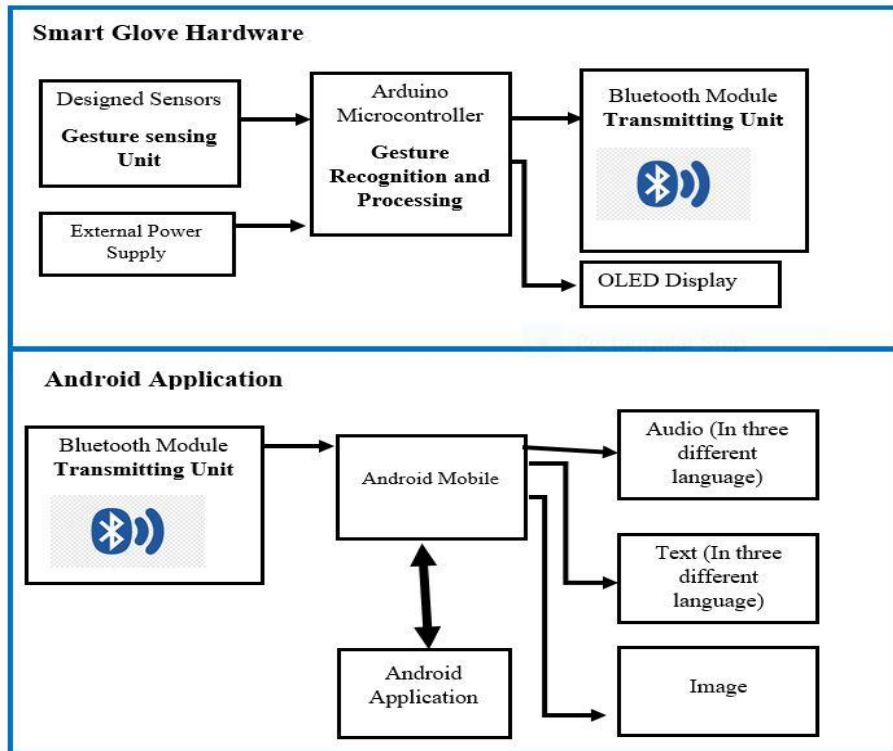
Figure 1: Block diagram of the proposed system.

Hardware of the data glove

The glove is designed for one hand. Thirteen metal studs are attached to the glove, each sensor(metal stud) was fixed on the 1 point of the thumb(common stud),3points of the index,middle,ring and pinky fingers accordingly shown in Figure 2.They were embedded on a cotton material based glove. OLED display was mounted on the upper side of the glove to display the sensor number and the performed gestures text as shown in Figure3.
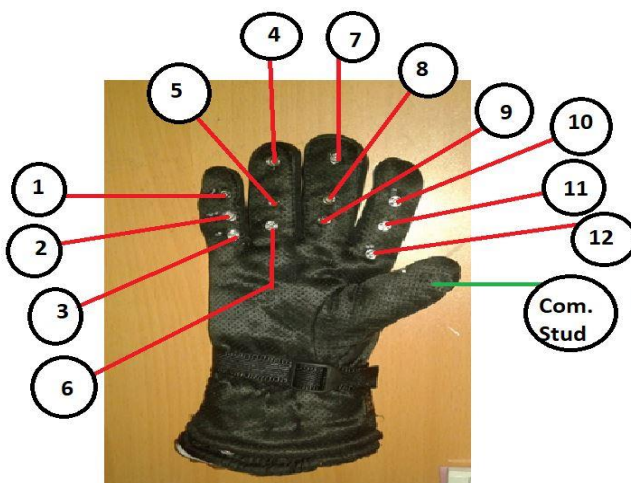
Figure 2: Alignment of metal studs on the glove.   *Figure 11: Output of the OLED display.*

Metal stud:

As shown in Figure 2 metal studs are used for gesture recognition. It transmit a signal to the microcontroller. These twelve metal studs are connected to the microcontroller via an internal pull up resistor. It varies the voltage based on the gesture as shown in Figure10.

The microcontroller:

Arduino Nano has been selected to be the microcontroller. It features with a low power consumption, high processing speed as well as the low cost.

HC-05 Bluetooth module:

Wireless communication is fulfilled by HC -05 Bluetooth module. It allows to transfer data from microcontroller to any android mobile phone. Here it sends data asynchronously.

OLED display:

It uses I2C Communication, less weight and ability to show more details than the normal LCD display.

Figure 12: Hardware of the data Glove.

Software Module

Gesture recognition:

As shown in Figure 6 the system is developed. All starts with the hand gestures that are converted by metal studs to analogue signals. Analogue signals are converted into digital signals and processed by the microcontroller each sentence has its gesture. By the pin configuration the sentence are recognized and converted into text. Or else the process is repeated. As shown in Figure9.

Android Application:

As shown in Figure 7 an android application is developed. Android application was developed by using MIT App inventor 2. Figure 5 illustrates the designed android application.
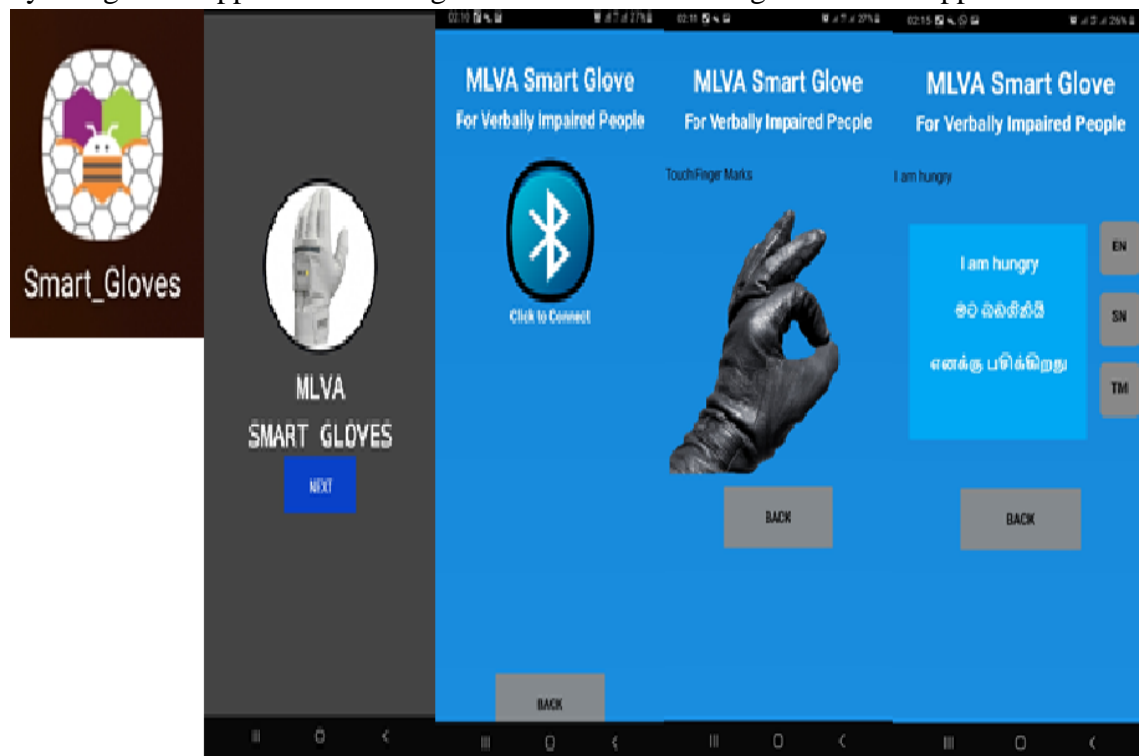
Figure 13: Screen shots of the android application GUI.
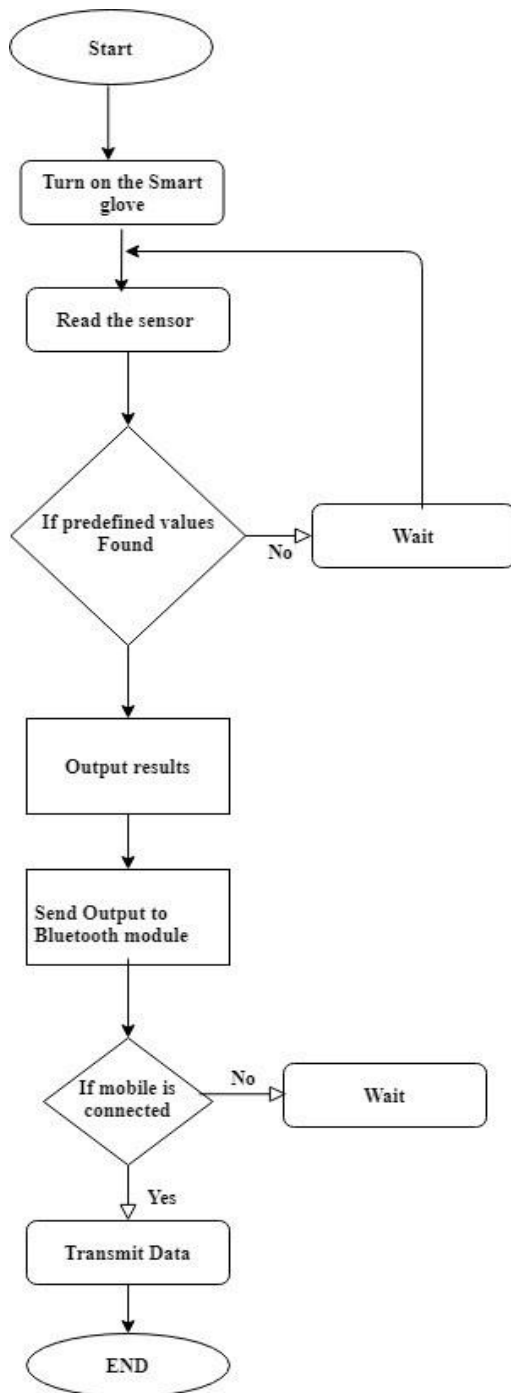
Figure 14: Flow chart of the gesture the

Recognition system.
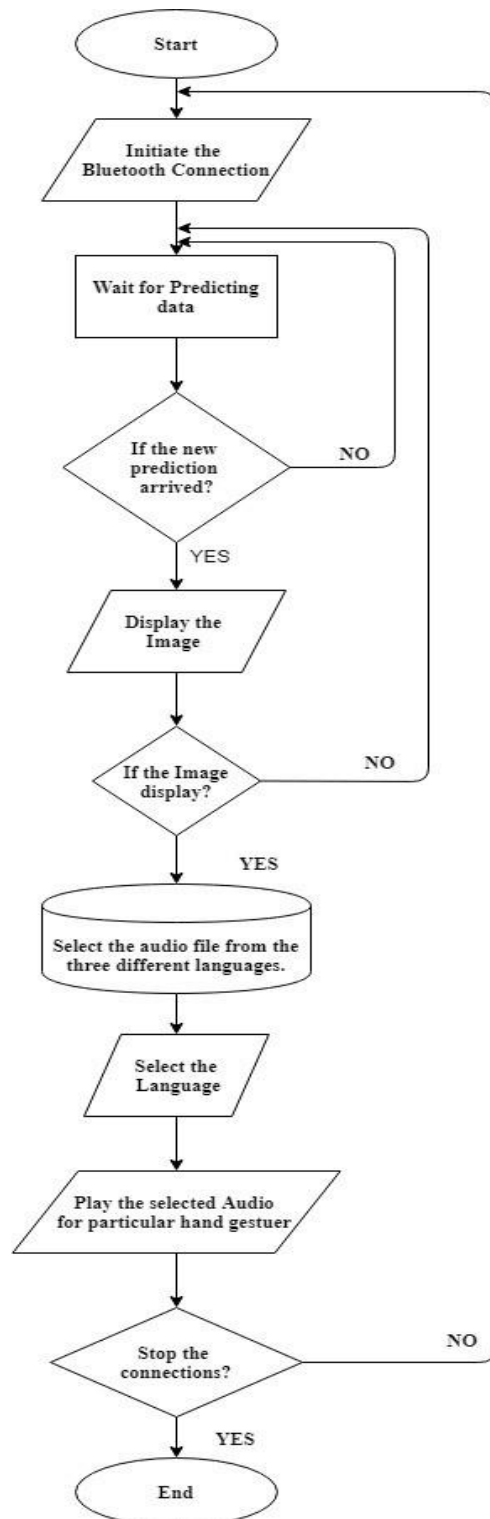
Figure 15: System flow chart of

Android application.

Results and discussions
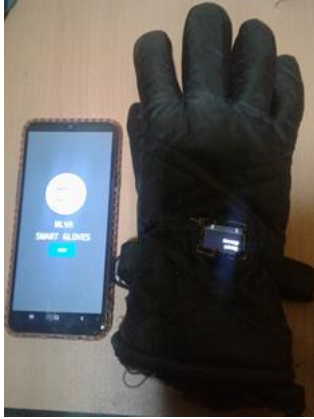
Figure 16: Final Design.

The designed MLVA system was designed to interpret hand gestures in the form of words and sentences. Asian sign language is as some other languages, certain expressions/sentence are expressed by one hand, while other uses two hands. The microcontroller and the power supply unit is mounted in the smart glove without causing any discomfort to the user. Final design is shown in Figure 8.

The system was tested for sentence. Currently 12 expressions have been programmed to be tested as shown in table1. The average of accuracy of recognition was 91.66% according to the equation 1.The advantage of this system is no prior training is required for the user. The Android application was developed to receive the recognized gestures via Bluetooth module. The designed application is called as "Smart Glove". It receives Sinhala, English and Tamil isolated expressions. These expressions are recognized. The recognized gestures are converted into text, image and speech in three different languages Sinhala, English and Tamil. As shown in Fig 5.

Equation 1

$$Recognition\ Accuracy = \frac{No.of\ sentance - No.of\ flase\ result\ patterns}{No.of\ sentance} \times 100\%$$

$$= \frac{12-1}{12} \times 100\%$$

$$= \frac{11}{12} \times 100\%$$

$$= 91.66\%$$

Below table displays the testing's and the results of the designed system. EN – English Language, SN- Sinhala Language, TM-Tamil Language, TX/ RX- Transmitting /Receiving data

Table 1: Results obtained via testing.

Number of the sensor	Description /Display of the gesture	Sensor is detected	The OLED Display outputs	Bluetooth connection		Designed Android Application (Outputs in 3 different Languages)								
				TX	RX	EN	SN	TM	EN	SN	TM	EN	SN	TM
1	I am Hungry	✓	✓	✓	✓	✓			✓			✓		
2	I want to go to the washroom	✓	✓	✓	✓	✓			✓			✓		
3	I am thirsty	✓	✓	✓	✓	✓			✓			✓		
4	I feel pain	✓	✓	✓	✓	✓			✓			✓		
5	Call the doctor	✓	✓	✓	✓	✓			✓			✓		
6	I am happy	✓	✓	✓	✓	✓			✓			✓		
7	I am ok	✓	✓	✓	✓	✓			✓			✓		
8	I want to go home	✓	✓	✓	✓	✓			✓			✓		
9	I am a dumb person	✓	✓	✓	✓	✓			✓			✓		
10	Thank you	✓	✓	✓	✓	✓			✓			✓		
11	I need help	✓	✓	✓	✓	✓			✓			✓		
12	I am sorry	✓	✓	✓	✓	✓			✓			✓		
Common Stud	Zero Volt (0V)	✓	✓	✓	✓	✓			✓			✓		

(✓ Means testing & obtaining results are successful)
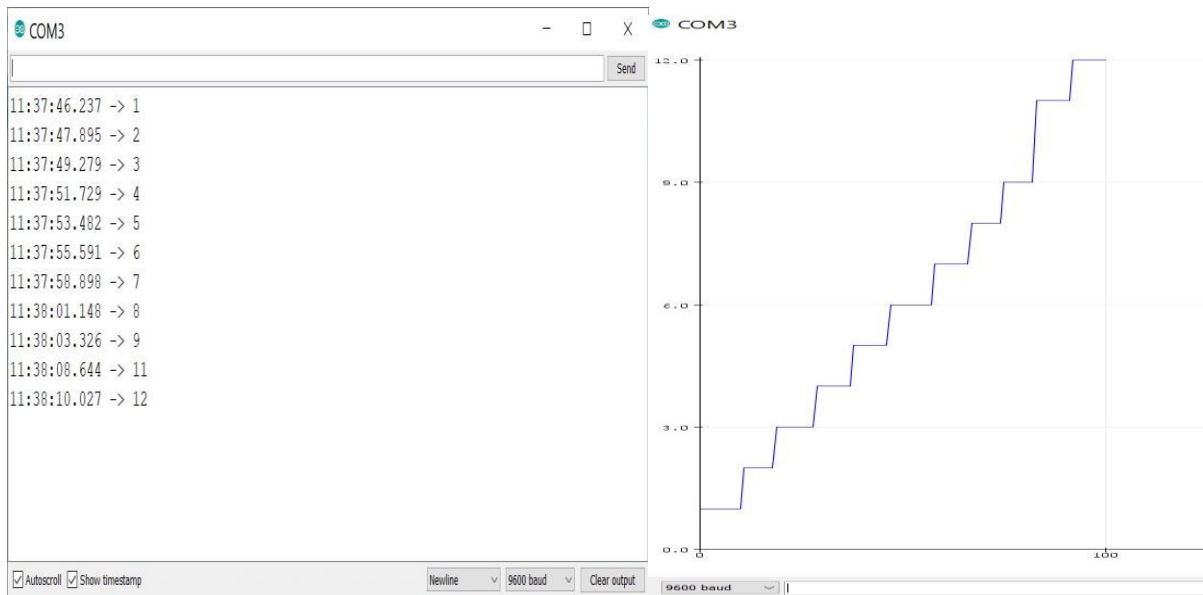
Figure 9: Results of Serial Monitor.   *Figure10: Results of Serial Plotter.*

Conclusions and Recommendations

A Smart glove based android application is designed to reduce the communication gap between deaf/dumb people and the normal people. It translate the Asian sign language in the form of words and expressions and text. Moreover, Android applications "Smart Glove" is developed to translate gestures into text, speech and images in three different languages including Sinhala, English and Tamil language. In fact, the system is featured by ease of interface, no prior training, low costs and portable which is easy to use. The system has 91.66% accuracy. But it depends on the physical performance of the signer. The system can be generalized for different sign language such as japan sign language etc. In fact the designed system can be programmed to translate more gestures. In general the proposed system with the android application is an effective way to communicate with deaf/dumb people by interpreting their hand gestures in text, image and speech forms.

It is very crucial to mention that the system is portable and the real cost of the glove based system is very cost effective when comparing the commercial ones and the flex sensors based glove systems. Price of a commercial smart glove is around approximately 3000 US $.The cost of the MLVA smart glove is approximately 19.21US$. It is calculated as follows; one glove 4.56 US$.12metal studs 0.11US$.Arduino Nano 4.56 US$. Bluetooth is 4.56US$, OLED display4.78US$. External battery 0.64US$.Finally this device along with the android application can be used as a translating device for dumb people where as it can also be used as a biomedical applications as well as an industrial application which includes verbally impaired, paralyzed patients and hospital staff members etc.

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FULL SCALE LABORATORY TESTING OF BALLASTED AND SLAB TRACKS FOR HIGH-SPEED RAILWAY

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Abstract

Full-scale laboratory-based testing facility is used to compare the long-term settlement performance of a precast concrete slab track section to a ballasted track (with concrete sleepers) resting on a compacted substructure. The railway track substructure is constructed from a 1.2 metre deep combined subgrade and frost protection layer, according to modern high-speed rail standards such as those specified in Germany. Phased cyclic loading is then used to simulate the primary loading mechanism of a train after 3.4 million load cycles representing many years' worth of train passages. Displacement transducers, earth pressure cells and accelerometers are employed to determine the permanent settlement, the cyclic displacement, transient stresses and vibrations of the track. The equipment, loading combinations, material properties and experimental displacement results are presented and compared. The results indicate that the ballasted track experienced 20 times more settlement when compared to the concrete slab track under the same loading conditions, even though the ballasted track was tested at a slightly higher compacted state due to the concrete slab track test being conducted first.

Keywords: Full-scale cyclic testing; Railway track settlement; Railway track stiffness; Long-term track behaviour; Ballast and concrete slab track

Introduction

The growing demand for high-speed rail is increasing both in the UK and worldwide but the economic pressure leads to the need to reduce construction costs. However, with reducing the initial costs of the physical construction, the duration of the construction and the earthworks, the life-cycle costs can be lowered significantly. A new type of track support system can reduce these three principle costs of conventional embankments. In addition to developments in track support structures, the track itself also inevitably has gained a notable importance with the development of slab tracks. Ballasted tracks require regular maintenance, which needs to be reduced by means of increasing the stiffness and durability. This research therefore investigates the performance of ballasted track and reinforced concrete slab track, which is precast in a factory to be assembled on site rapidly.

The full-scale Geo-pavement and Railways Accelerated Fatigue Testing (GRAFT-2) facility (shown in Figure 1) located at Heriot-Watt University in Edinburgh, UK is used to test the section of a precast slab track and conventional ballasted track with concrete sleepers resting on the conventional embankment. These test combinations enable to identify the design recommendations for both super-structure properties and sub-structure such as geotechnical parameters for high-speed standards.
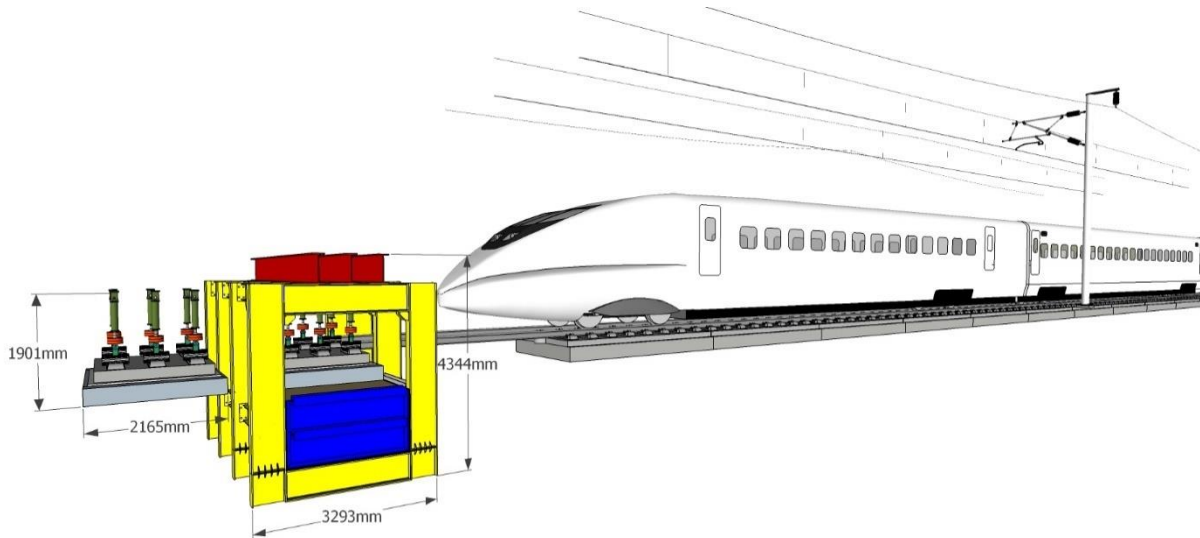
Figure 1. GRAFT-2 with demonstration of functioning the high speed train over the slab track.

Methodology

In this study, a full-scale testing facility, called GRAFT-2, is used to evaluate the performance of the tracks and its associated sublayers. The main purpose of this facility is to test and characterise the long-term and short-term performance of tracks. The accelerated testing approach means that many years of train passages on a full scale, combined track-subgrade simulation in a matter of days/weeks. GRAFT-2 operates using 6 independent hydraulic actuators (Figures 1 and 2) over 3 full sized sleepers to simulate the passage of a moving train. Each piston applies loads on a rail segment to excite the track.
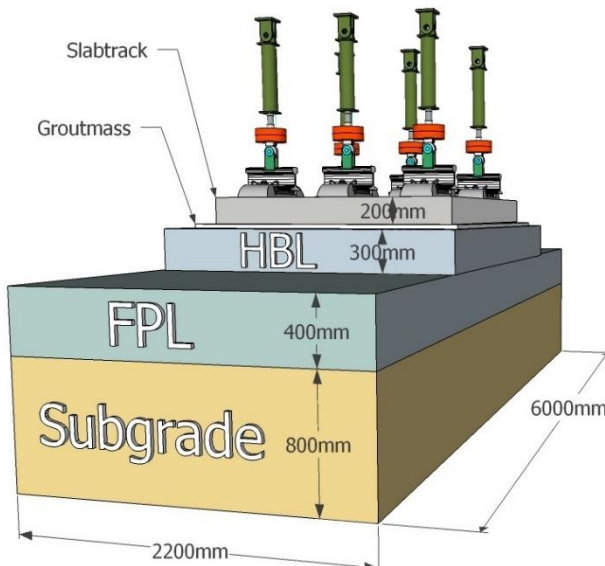
Figure 2. Model of substructure and super structure incorporated in the test facility for concrete slab track test.

The depth of the substructure, including the subgrade and the Frost Protection Layer (FPL), was 1.2 m. The substructure consisted of a well-graded granular limestone according to ASTM

[1]. The optimal moisture content was determined by a modified Proctor compaction test, carried out at the geotechnics laboratory at Heriot-Watt University, and its value was 4.5%. The effective internal friction angle φ' was measured to be 35˚ at the optimum moisture content, the specific gravity parameter was 2.69 and the maximum dry density was 22.2 kN/m^3. It was assumed that the moisture content did not change during the testing period.

The height of the subgrade was 800 mm and the thickness of the FPL was 400 mm, as presented in Figure 2. They correspond to the German ZTVE-StB 94 standard [2]. In this standard the deflection modulus E_{v2} should be at least 120 MN/m^2 for the FPL and at least 60 MN/m^2 for the subgrade. The deflection modulus E_{v2} was verified using a static plate load test in accordance with DIN-18134 standard [3]. The coefficient of permeability (k) should be between 10^{-5} m/s and 10^{-4} m/s for the FPL and relative density (D_r) within 98% to 100% for the FPL and subgrade. In this paper the E_{v2} value of the FPL was estimated through the plate load test to be 133.55 MN/m^2, and E_{v2}/E_{v1} was 1.42, the permeability k was evaluated through the permeability test and was found to be 10^{-5} m/s and D_r was 100%. Further laboratory tests found the E_{v2} value of the subgrade to be 67.71 MN/m^2, E_{v2}/E_{v1} = 1.55 and D_r = 98%.

The ballasted track test followed the concrete slab track test (i.e. ballast was placed after removal of the concrete slab track and the HBL). Therefore for the ballasted test, the main part of the substructure remained unchanged and only the superstructure was fully replaced. The top 50 mm of the FPL was however replaced between the tests due to the disturbance caused by removing the HBL. This thin replaced layer was compacted to the same level as before. A TX190L geogrid was laid over the FPL. The geogrid was used to reduce penetration of ballast into the substructure geomaterial. The results obtained in a study from the University of Nottingham Railway Test Facility indicated the potential reduction in settlement achieved when an appropriate geogrid is installed under the ballast [4,5]. The ballast was placed in 100 mm intervals to reach 400 mm thickness immediately under the sleepers as shown in Figure 3. In this study standard G44 sleepers were positioned at 650 mm spacing.
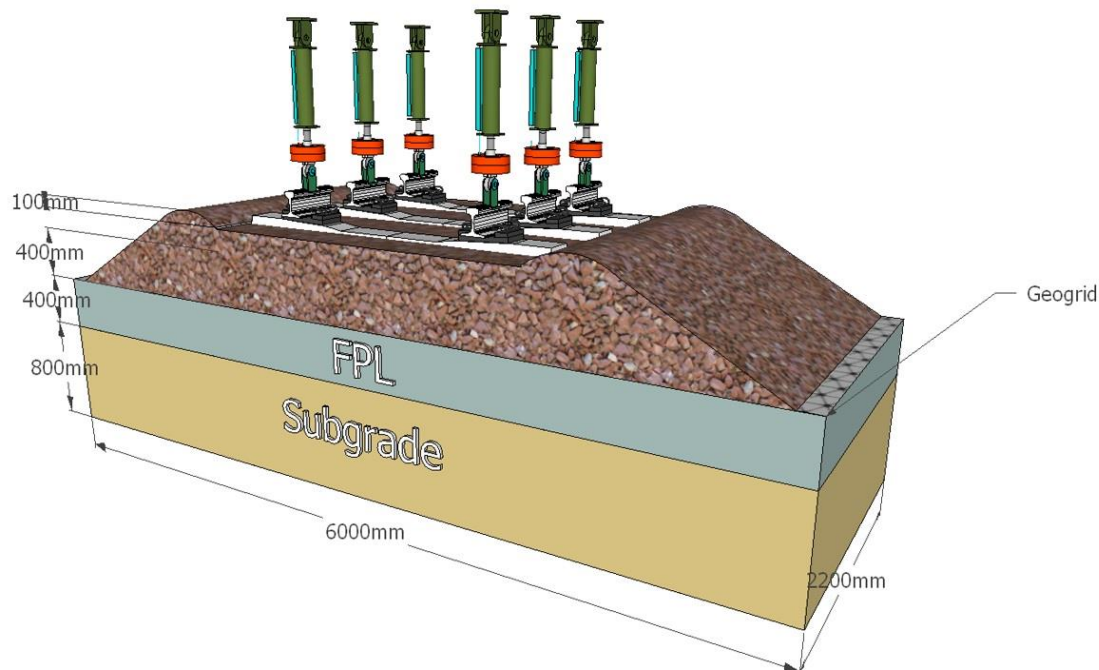
Figure 3. Layout of ballasted track and substructure.

The final set-ups of slab track and ballasted track are presented in Figure 4.

Figure 4. Slab track and ballasted track in GRAFT-2, respectively.
Testing

The appropriate redistribution of the axle load for the initial static tests over the ballasted and concrete slab tracks was applied by considering the full axial load. This was simulated by assuming that approximately 50% of the load would pass directly into the middle sleeper with just a quarter going to each adjacent sleeper as presented in a Figure 5. This approach was based on the use of the approximate model of a beam on an elastic foundation. The effects caused by wheel rail irregularities were not considered [6].
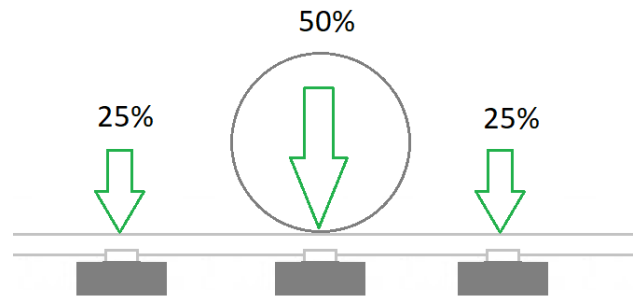
Figure 5. Redistribution of the load for static tests

The cyclic/dynamic tests were carried out with two different loads and frequencies. The first case, termed Dynamic I, was performed with a frequency of 5.6 Hz and lower forces as indicated in Table 1. The second case, Dynamic II, was carried out with a lower frequency, 2.5 Hz, and higher forces (see Table 1). The primary limitation was the capacity of GRAFT-2. Frequency of 5.6 Hz was calculated based on the distance between two bogies on the same rolling stock. Higher frequencies than 5.6 Hz were not feasible to reach. On the other hand, 2.5Hz was the frequency at which the GRAFT-2 performed the best in terms of higher loads.

Table 2. Loading sequences of the ballasted and concrete slab track tests.

TEST	Axle load on middle sleeper (kN)	Redistribution of load per actuator (kN)	Redistribution of load over the sleeper (%)	Frequency (Hz)	Time interval between sleepers (s)	Duration
Static I	63.77	15.94, 31.88, 15.94	25, 50, 25	N/A	N/A	620 s
Static II	83.34	20.84, 41.69, 20.84	25, 50, 25	N/A	N/A	788 s
Dynamic I	117.72	58.86, 58.86, 58.86	100, 100, 100	5.6	0.0065	1.17×10^6 cycles
Dynamic II	166.71	83.34, 83.34, 83.34	100, 100, 100	2.5	0.0065	2.20×10^6 cycles

Results

A static compressive load was applied to the slab track (ST) and ballasted track (BT) in the same manner. At the beginning (Static I), a load of approximate 16 kN was applied for 620 s and then (Static II) a load of 21 kN was applied for 788 s on adjacent sleepers, as shown in Figure 6. The exact values of the applied forces in the experiment on the sleeper or slab are presented in Table 1.
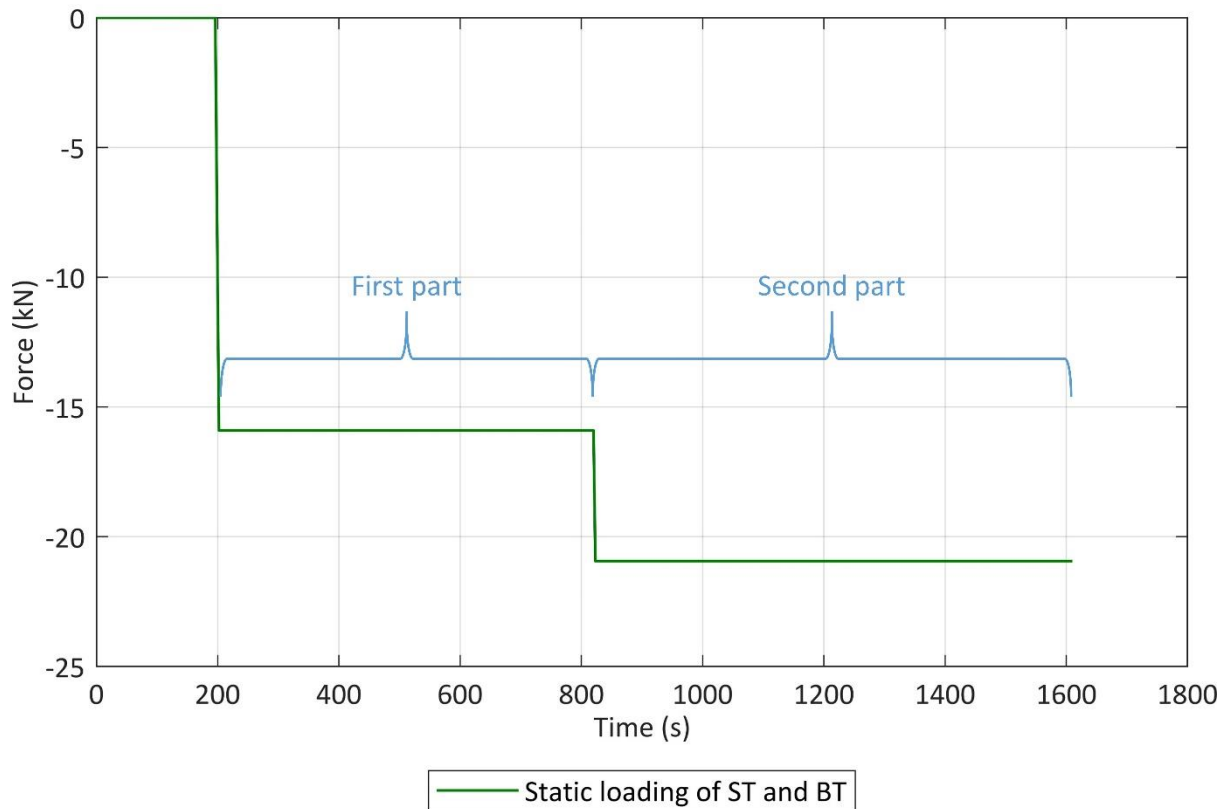
Figure 6. Force vs time for ballasted and concrete slab track.
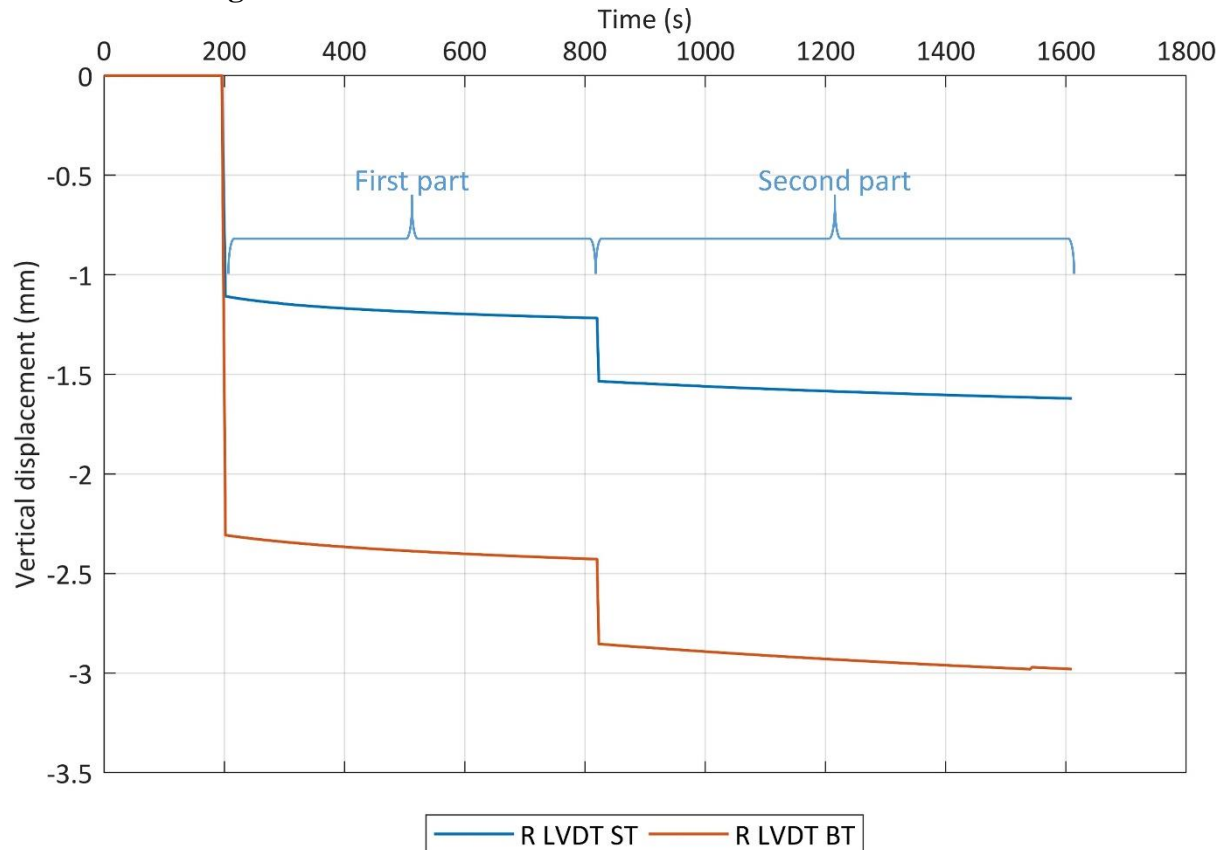
Figure 7. Vertical displacement vs time on the top of rail for ballasted (R LVDT ST) and concrete slab track (R LVDT ST).

As previously mentioned, two cyclic/dynamic tests were performed successively (Table 1). The first one was performed with a varying peak load of 58.86 kN at 5.6 Hz and the second one with a varying peak load of 83.34 kN at 2.5 Hz. As shown in Figure 8, the load amplitudes and sinusoidal signals at the two frequencies show similar patterns for the concrete slab track and the ballasted track tests.

During testing the cyclic load cannot be allowed to go to zero because a tensile drift of the actuator would then occur which might result in the actuator trying to lift off the sleeper or slab – in the latter case the slab would then try to lift off the HBL or the FPL which might result in damage to the HBL. Therefore, sinusoidal loading ranging between 12 kN and 58.86 kN at 5.6 Hz and between 4 kN and 83.34 kN at 2.5 Hz was adopted. The loads of 12 kN and 4 kN represent seating loads to prevent this lifting of the slab or sleepers at any instant of the cyclic loading.
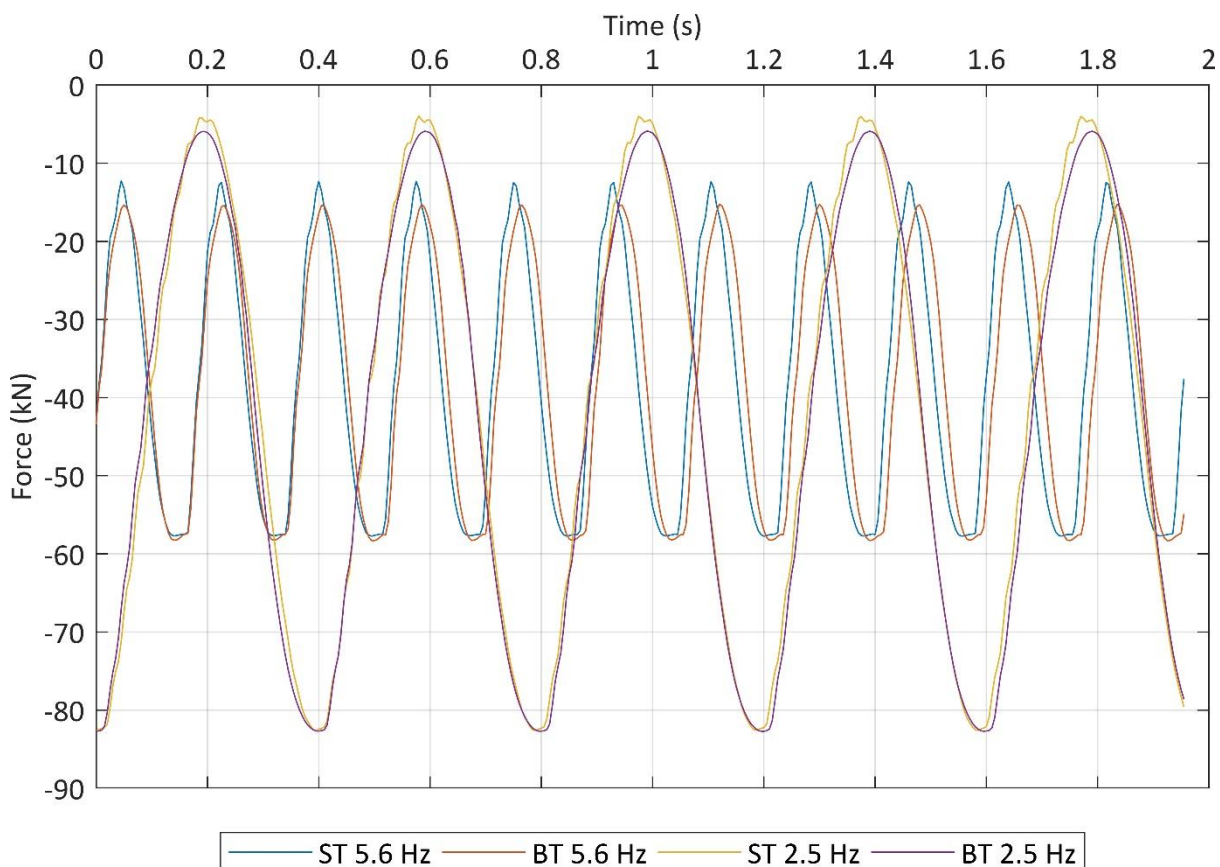
Figure 8. Force vs time for ballasted track (BT) and concrete slab track (ST) at 2.5 Hz and 5.6 Hz.

The results of the cumulative settlement of the concrete slab track and the ballasted track are presented in Figure 9.
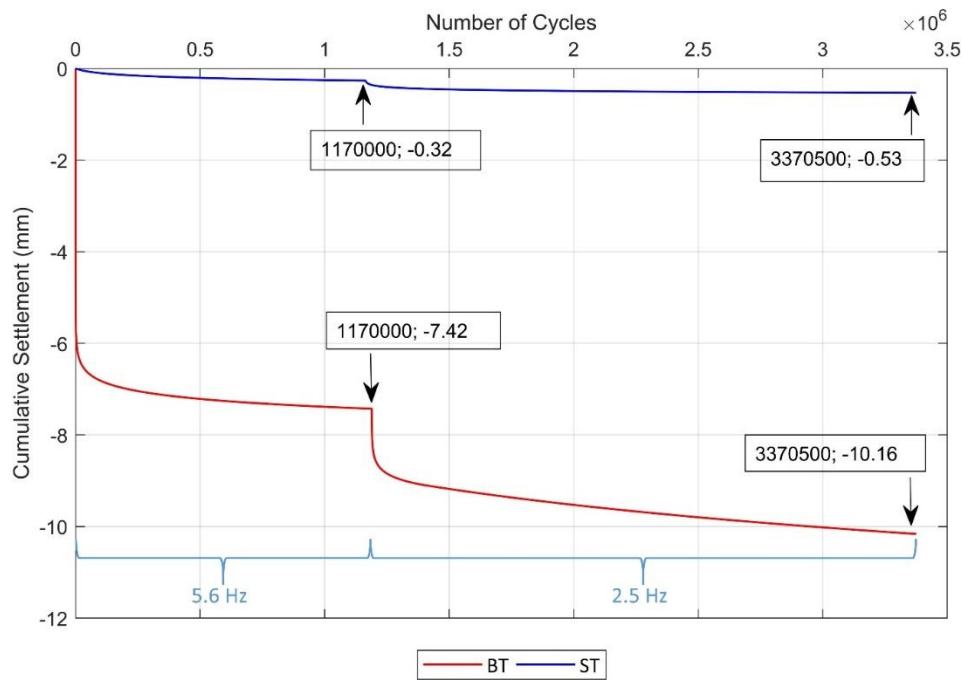
Figure 9: Cumulative settlement of concrete slab track (ST) and ballasted track (BT) vs number of cycles.

The figure shows that the cumulative settlement in the ballasted track is approximately 20 times higher in comparison to that of the concrete slab track under the same loading conditions. This is confirmed in both loading aspects of the ballasted track test, i.e. at 5.6 Hz and 2.5 Hz cyclic frequencies which, as shown in Figure 9, have two stages of cumulative settlement.

The second increase in the cumulative settlement (particularly evident in the ballast test) clearly highlights, that in a real track loading environment, recommencement of plastic deformation (ballast and/or subgrade) can occur due to increases in the peak load even when a resilient state has already been achieved at the lower peak loading level.

The penetration of ballast into the subgrade during the ballast test was likely reduced by the presence of the geogrid; which was placed at the interface between the subgrade and the ballast layer. Although the measured ballasted track settlement includes both the ballast and the substructure (FPL and subgrade) deformation, it can be reasonably assumed that there was relatively little settlement within the substructure, due to the high initial stiffness of the formation after the concrete slab track test, when compared to the settlement generated within the ballast layer itself [7, 8] during loading.

Conclusions

It was clearly observed that the concrete slab track performed significantly better in terms of cumulative settlement and peak rail displacements when compared to the ballasted track. The main reason for the observed higher settlement of the ballasted track was thought to be due to the unbound nature of ballast, rather than due to the settlement of the substructure. It is therefore possible that had the ballasted track been tested first it would have experienced an even higher track settlement.

The main concluding remarks drawn from the testing results presented in this paper are as follows:

- Both the ballasted and concrete slab track followed typical shakedown periods even at the high formation stiffness.
- The total settlement of the concrete slab track is significantly lower than that of the ballasted track under cyclic loading even when its initial formation stiffness is slightly lower than that of the ballast.
- The amplitudes of the track displacements were higher at the lower frequencies, i.e. the greater loads. Under cyclic loading the amplitudes of the sleepers, in the case of the ballasted track test, were nearly 20 times higher than those of the concrete slab track test.
- In the cyclic/dynamic tests a change in the amplitude of the actuator stroke after millions of loading cycles was observed. The amplitudes slightly declined due to the stiffness increase in the substructure indicating plastic settlement during shakedown.

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CRACK DETECTION OF CONCRETE BEAMS USING NOVEL ELECTROMAGNETIC SENSORS

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Abstract

This paper studies the possibility of applying novel microwave sensors for crack detection in concrete beams. Initially, a microstrip patch antenna with a Split Ring Resonator structure was designed and fabricated. An experimental programme was then carried out and both the structural and the sensor responses were monitored. Four reinforced concrete beam specimens were subjected to 3-point bending. The performance during loading was monitored via the use of load cell, displacement transducers and crack width gauges. Microwave sensors were employed to the beams prior to the casting of the concrete and the signal readings were also recorded during testing. The microwave and the crack width gauges measurements were analysed and compared. It was demonstrated a strong linear relationship between the electromagnetic signal and the crack width measurements, thereby suggesting the technique's potential.

Keywords: Electromagnetic; Sensor; Concrete Beams; Crack Detection

Introduction

Structural health monitoring (SHM) provides continuous feedback for the "state" of the constituent materials and structural members and can be a useful tool to ensure structural integrity and safety and detect damage evolution (Chang et al., 2003). Continuous monitoring over a period of time offers a full history database for a structure, which can be used to estimate performance deterioration of civil infrastructure. In order to complement existing sensing technologies for SHM, the present study examines the potential of using microwave sensors for crack detection in concrete structures. Recently, electromagnetic sensors have gained interest as a method to monitor moisture content in concrete structures (Kot et al., 2016; Teng et al., 2019). The use of microwave technology offers low cost, low profile flexibility in the design and adaptation of sensors. This study will demonstrate a potential sensor solution for detection and prediction of crack propagation in reinforced concrete (RC) beams.

Methodology

Aiming to evaluate the potential of the microwave sensors to be applied for crack detection in concrete structures, an experimental programme was undertaken.

Design and fabrication of sensors

In this study, the theoretical model of concrete specimen with various crack widths and Split Ring Resonator (SRR) was designed and simulated using High Frequency Structural Simulation software tool (HFSS) (see Figure 1). The SRR sensor was designed to operate in the frequency range between 1 to 10GHz with multiple resonant frequencies. The use of SRR design allows to reduce dimensions of the antenna for preventing disturbances in the concrete specimens, while offering resonant frequencies at lower ranges, which increases the penetration

capability of the designed antenna. The theoretical model of concrete specimen with proposed embedded sensors were initially simulated with various crack's width namely 0.00mm to 0.60mm as presented in Figure 2.
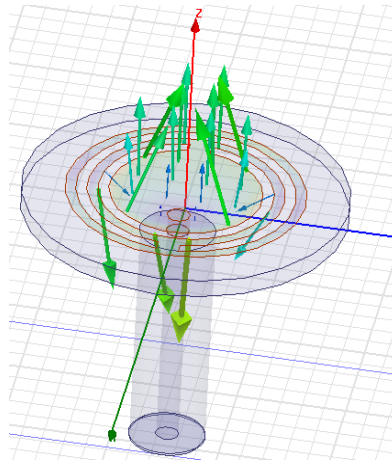
Figure 1. Designed Split Ring Resonator antenna
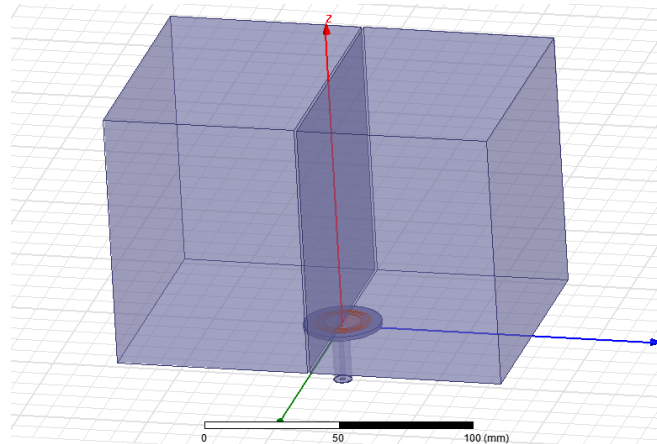
Figure 2. Theoretical model of Concrete Specimen with a crack

The developed sensors were fabricated on double-sided 1.6 mm FR4 PCB sheet using a LPKF ProtoMat D104 unit (see Figure 3). Then the SMA connectors were inserted through the probe-fed hole of the antennas and soldered on the patch (top layer) and the ground plane (bottom layer) of the antennas.

Figure 3. Fabricated antennas using LPKF ProtoMat D104

Design and fabrication of concrete beams

Four RC beams were designed in accordance with EN 1992-1-1 (2004). The beams had a square cross-section (200 mm × 200 mm) while the total length was 1400 mm. The concrete was grade C40/50 and steel reinforcement bars were grade S500. Crushed limestone aggregates (20 mm down), sand (Mersey Grit), OPC Type II and a water-to-cement ratio equal to 0.45 were used for the concrete mix. The cover to the reinforcement for bond and durability was 30 mm. The longitudinal steel bars were 20 mm diameter. The shear links had diameter 8 mm and were placed with 100 mm spacing. The microwave sensor was placed close to neutral axis (NA) (i.e. the centre of the square cross-section, where negligible longitudinal stresses and strains were expected) in order to capture the crack propagation in the tensile zone just below it.

The formwork for the concrete beams was initially constructed and the longitudinal steel reinforcement bars and the shear links were fabricated. A microwave sensor was installed at the designated position before the pouring of the concrete. Upon demoulding, the beams were painted on both lateral sides in order to make the crack formation and propagation detectable. Demec studs were applied at the central tension region of the beams in order to monitor the crack opening within the most heavily stressed areas. Four stud sets were bonded on the concrete's surface at a set horizontal distance of 50 mm on either side of the centreline and at vertical distances equal to 80 mm, 60 mm, 40 mm and 20 mm from the beam's NA.

Structural testing experiments

The specimens were cured for 7 days and were then located at the test rig of Henry Cotton Laboratory of Liverpool John Moores University for the experimental investigation. The beams were loaded until 100 kN vertical load. The beams spanned 1200 mm with an overhang of 100 mm from both sides of the supports which were pinned. The mid-span deflection during testing was monitored through linear displacement transducers (LVDTs). Synchronised data acquisition systems were used for the structural response and signal measurements (see Figure 4). The signal data were captured via a bespoke LabVIEW program on a laptop connected to the Vector Network Analyser (VNA).
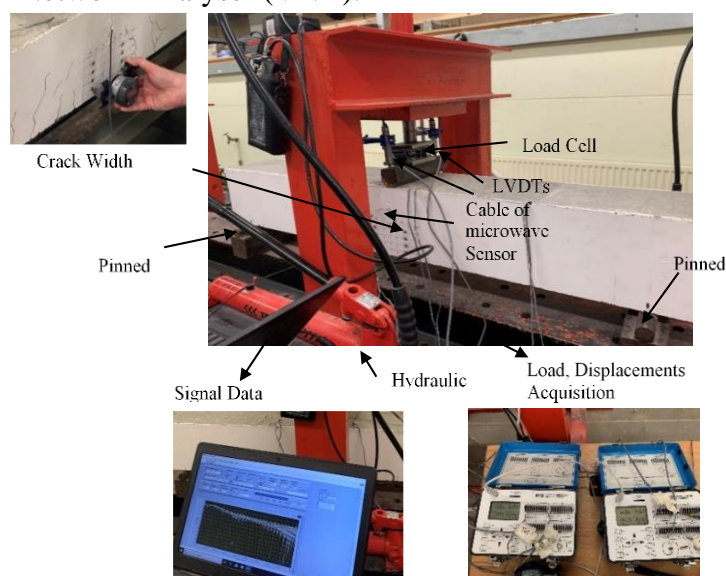
Figure 4. Experimental set-up including instrumentation and data logger system

Results & Discussion

The full simulated frequency spectrum was scanned across using a bespoke LabVIEW program, aiming to identify a linear relationship between the sensor response (S_{11}) and the crack width (mm). It was observed that S_{11} increases as the crack width grows, i.e. less and less energy/power is absorbed by the concrete specimen as there is an opening air gap, which changes the penetration of the electromagnetic (EM) signal, as well as changing the reflection of the signal. The raw simulation data is presented on Figure 5.
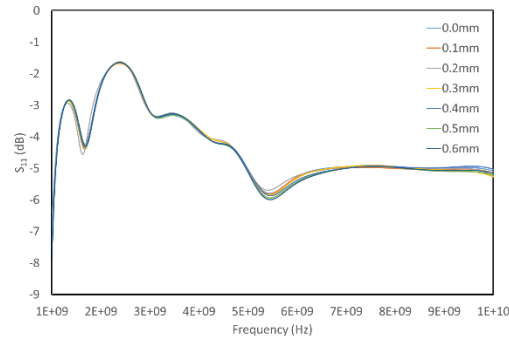
Figure 5. Simulated raw data of sensor response on various crack's widths

The structural response for all specimens was monitored through the load versus mid-span displacement curves as well as the crack width recordings. During testing, the developed cracks and their propagation were marked, as shown in Figure 6. As anticipated for concrete beams under pure flexure, a symmetrical crack pattern was observed.
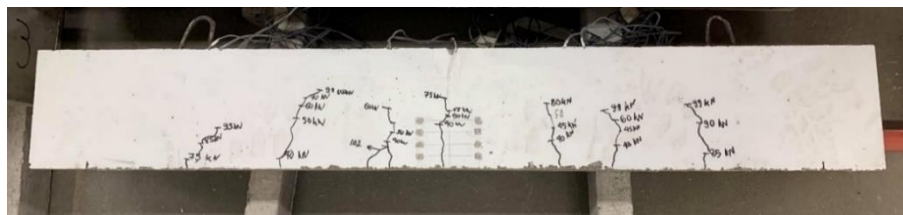
Figure 6. Crack pattern of tested concrete beam

The readings from the crack width gauges (Demec studs) and the new sensor signal values were compared. The microwave measurements were provided by the S-Parameter (i.e. S_{11}, reflection coefficient), namely complex data (real and imaginary data of the signal) and magnitude from the Rohde & Schwarz VNA. Figure 7 presents the raw data of sensor response (S_{11}) at different crack width namely 0.1mm, 0.2mm, 0.3mm, 0.4mm and 0.5mm.
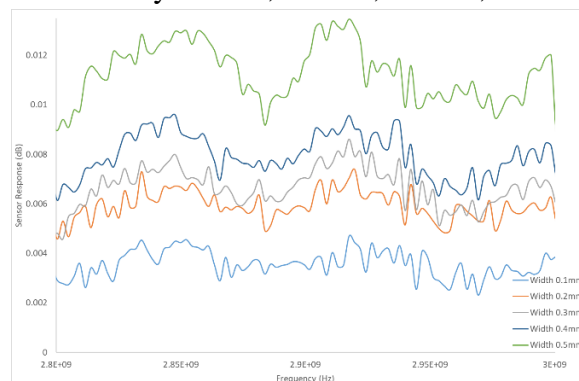
Figure 7. Raw data for sensor response on various crack's widths

To determine a relationship between the crack width measurements and the electromagnetic response, the results were plotted together, as shown in Figure 8. As can be seen, a strong linear relationship with R^2 above 0.90 for specimens 1, 2, 3 and 4 can be seen for the EM response and the crack width readings. Overall it is demonstrated the potential of the microwave sensors to detect cracking in RC structures. This could be potentially applied as an indicator of a structural failure.

a) Specimen 1

b) Specimen 2

c) Specimen 3

d) Specimen 4
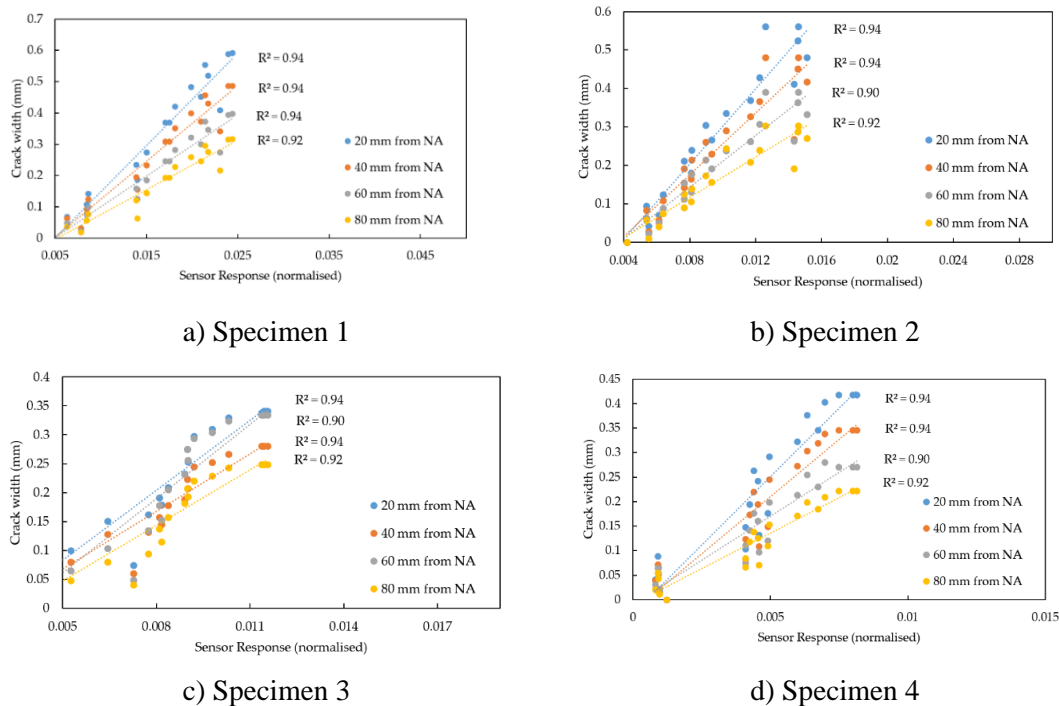
Figure 8. Linear correlation between the crack width and sensor response at 2.9 GHz

Conclusions

A structural testing programme including four concrete beams subjected to in-plane bending was carried out in order to evaluate the potential of microwave sensing technology as a means of SHM. Preliminary modelling was performed and a novel microwave sensor was specifically designed for this application. The sensor was inserted in the beams' reinforcement cage before the casting of the concrete. A bespoke LabVIEW program was used in order to capture the microwave measurements during testing. The signal data were within 1 to 10 GHz frequency range and were provided by the S_{11}-reflection coefficient. The signal readings at the region where the largest crack was observed were compared to those of the crack width gauges. It was found a linear regression with R^2 values very close to unity. Further study is recommended in order to increase the experimental pool of data and understand the correlation relationships for various crack patterns and widths, thus enhancing the technique's reliability.

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FULL FACE TUNNEL EXCAVATION IN SOILS

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Abstract

In this paper the different methods and implications of full-face tunnel excavation in soils are analysed through numerical FEA (Finite Element Analysis) software and compared with construction monitoring data, empirical predictions and previous analysis from studied literature. A 2D plane strain analysis of a section of the Milan metro-line 5 was conducted under free field conditions using PLAXIS software to display its impact on ground settlements and deformation around the tunnel face. The results found that the FEA model produced an accurate prediction of the settlement troughs, impact of the grouting pressure, and construction of the second tunnel tube on the final induced settlements. Empirical prediction equations were also used to fit Gaussian curves against the numerical curves which produced an accurate alignment of trough width to the numerical prediction.

Keywords: Finite Element Analysis, Full-Face Excavation, Settlements.

Introduction

With the ever-expanding urban landscapes within our cities the demand for sustainable infrastructure is growing constantly, and with the need to reduce carbon emissions from congested highways transport innovation is a necessity. Thus, increasing the need for underground construction to accommodate new infrastructure from expanding rail networks or highway tunnels. Due to this extensive research into the analysis and prediction of ground movements have developed over the years through empirical and numerical methods (Nikumbh, 2017, Elmanan et al, 2015). Through Finite Element Analysis (FEA), 2D and 3D models of the construction can be analysed in varying ground conditions. This paper aims to use and compare these prediction techniques with comparison to monitoring data collected from a chosen case study to evaluate the ground settlements induced by Tunnel Boring Machines (TBM). The most common forms of TBM'd tunnels in recent times are metro tunnels to provide infrastructure for major cities (Chapman et al, 2018). As typical metro tunnels consist of a network of tunnels, it is also necessary for the analysis of the impact of the excavation on the ground conditions when multiple tunnels are constructed (Maidl et al, 2012). Therefore, the following objectives for this research were drawn:

- To conduct a case study on the Milan metro-line 5, assessing the impacts of full-face tunnel excavation of singular and twin-tunnels in soils.
- Produce a 2D plane-strain analysis of a section of the Milan-metro 5 of the initial singular tunnel excavation and then of the second twin-tunnel excavation under free field conditions using FEA software PLAXIS.
- Evaluate the induced settlements, effective stresses and impact of the second tunnel excavation on the overall settlements and compare results to monitoring data fitted with empirical prediction techniques and 3D FEA models from the relevant literature.

Methodology

The section of tunnel for the model was selected on a stretch of roughly 1km between San Siro and Segesta stations. In which the tunnel axis remained at a depth of 15m, and the observed ground conditions stayed consistent as a gravelly sand soil, with a water table depth of 15m throughout. This provided the basis of a relationship between predicted ground settlement of the 2D FEA model against the average monitored settlement. The results of the FEA model were compared with the monitoring data fitted with Gaussian curves through Equation 1 (Peck, 1969) and 3 (O'Reilly & New, 1982). The first tunnel construction was first analysed singularly before the second tunnel was then modelled to be sequentially constructed after the first tunnel. As the section of tunnel modelled also carries several of the assumptions made for Equation (3), a Superposition of the Gaussian curves was fitted to analyse the impact of the second excavation on the maximum settlements.

$$S_v(x) = S_{vmax} \exp\left(-\frac{x^2}{2i_x^2}\right) \qquad (1)$$

In which S_{vmax} is the maximum settlement given above the tunnel centreline, x is the lateral distance from tunnel centre line, $S_v(x)$ the settlement at a given lateral distance from the centre line, and i_x the point of inflection on the curve given by:

$$i_x = Kz_o \qquad (2)$$

$$S_v(x) = \left[S_{vmax} \exp\left(-\frac{x^2}{2i_x^2}\right)\right] + \left[S_{vmax} \exp\left(-\frac{x-d^2}{2i_x^2}\right)\right] \qquad (3)$$

In which K is a constant depending on the nature of the ground, given generally as between 0.2-0.45 for sand and gravels (Mair and Taylor, 1997; Bloodworth, 2002). z_o is the depth of the tunnel axis.
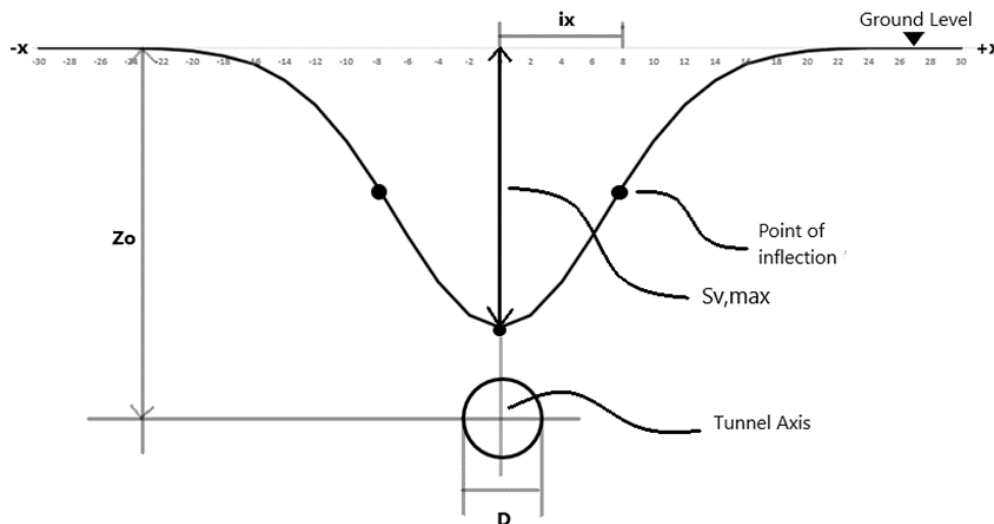
Fig. 1. Gaussian fitted transverse settlement trough above a tunnel axis.

Data Collection

The monitored maximum settlements (Sv,max) above both tunnel axis were collected and average values for maximum settlement along this section were calculated. An average value for point of inflection (ix) was obtained through the estimated ix values along the first tunnel axis. An average ix for the section was taken as 5.8m between S1-S25, and by rearranging Equation (2), an average value of K could be calculated as 0.39.

Table 1. Average values of Sv,max and Volume Loss above Tunnel 1 and 2 axis after first (a) and second (b) excavation and values of ix for first tunnel excavation.

	Sv,max (1a) (mm)	Sv,max (1b) (mm)	Sv,max (2b) (mm)	Volume Loss % (1a)	Volume Loss % (2b)	ix (1a) (m)
Average	11.54	13.84	11.88	0.5%	0.5%	5.80

Finite Element Model

A 2D plane-strain model was constructed of the tunnel construction. The soil and tunnel parameters were collected based on the site investigations from previous research (Fargnoli et al. (2013, 2015) and were based on the entire section of tunnel between monitoring stations S1-S25. The volume loss (V_L) which is caused by tunnel construction using TBM's was simulated through the software using the contraction method (Plaxis, 2018), in which a contraction is applied to the tunnel lining to simulate the volume loss experienced in the tunnel construction. Typically for an earth pressure balance machine in non-cohesive soil volume losses at 0.5% can be attained, therefore this value was selected as the design value for contraction (C_{ref}). The tunnel lining is constructed completely at once and is considered homogeneous and the grouting process for the tunnels were simulated by applying an equally distributed pressure on the surrounding soil of 150kN/m^2 for Tunnel 1 and 170kN/m^2 for Tunnel 2.
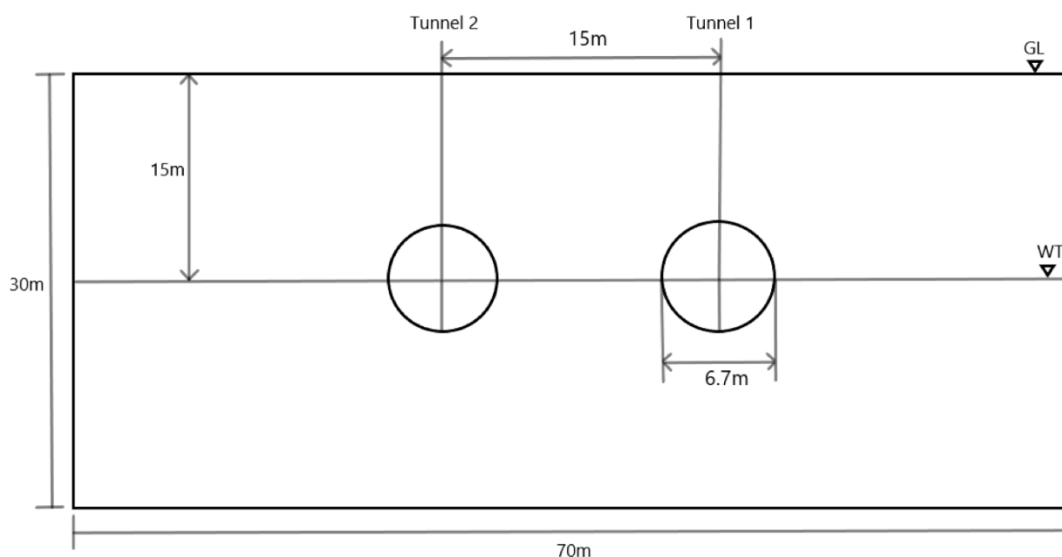
Fig. 2. Dimensional diagram for the 2D FEA model (PLAXIS).

Results and Discussion

The first stage of the construction consisted of the excavation of the first tunnel tube and the second stage consisted of the sequential excavation of the second tunnel tube. As displayed in Table 2, the settlements record above both tunnel axis were recorded and compared to the average monitoring data values. It can be seen that the FEA model correctly predicted the settlements induced by both stages of construction above both tunnel tubes. To show the effects of the construction of both tunnels on the surrounding ground the total displacements are displayed in Fig. 3. As can be clearly seen the FEA model correctly predicted the expected settlement trough of the singular tunnel construction with a Sv,max of 14.14mm. Upon completion of the second tunnel the FEA also correctly predicted an increase in the Sv,max above Tunnel 1 to 15mm and the settlements above the 2nd tunnel axis being smaller than the settlements above the 1st tunnel axis at 13mm. However all settlements were slightly overestimated in comparison to monitoring data as displayed in Table 2. Through analysing the settlements before and after the grouting process it was also shown that this simulation correctly predicted a reduction in maximum settlement as a result of grouting.

Table 2. Maximum Settlements recorded in finite element analysis compared with monitored data.

	Construction Stage	
	First	**Second**
Tunnel 1 FEA Model	14.14mm	15mm
Tunnel 2 FEA Model	-	13mm
Tunnel 1 Monitoring Data (Average)	11.54mm	13.84mm
Tunnel 2 Monitoring Data (Average)	-	11.88mm
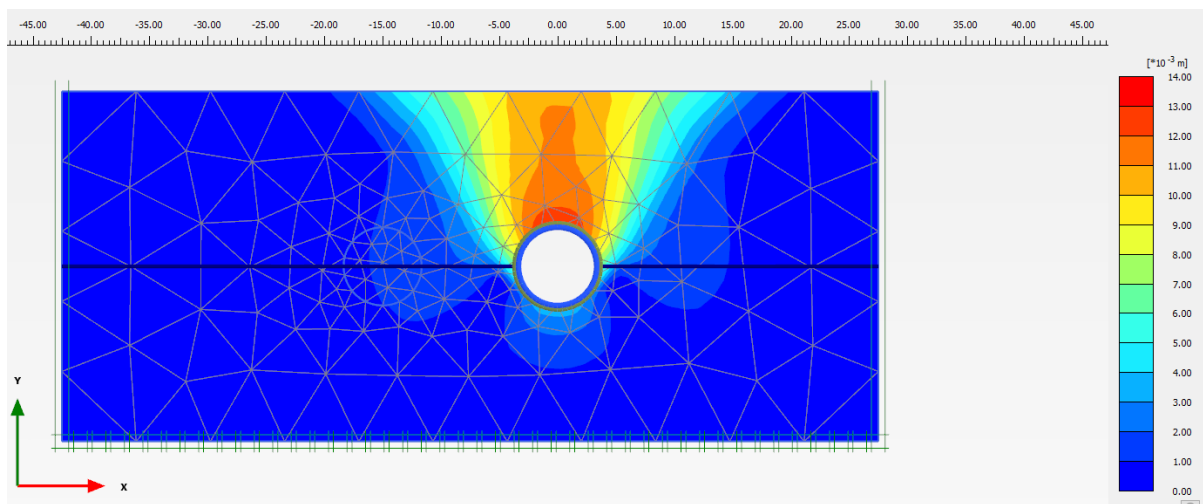
Fig. 3. Total displacements upon completion of the first tunnel.
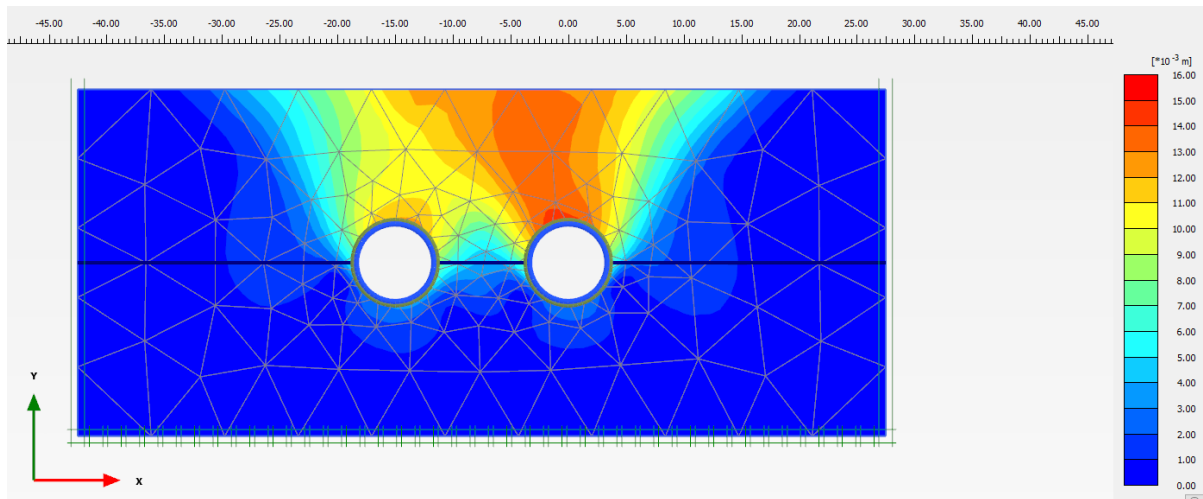
Fig. 4. Total displacements upon completion of the second tunnel.

The effective stresses in the y direction in the model are also displayed to show a concentration of compressive stresses in the site of Tunnel 2 before its construction. This can be said to be the cause of the reduced settlement above the 2nd axis and in other sequential twin-tunnel excavations.
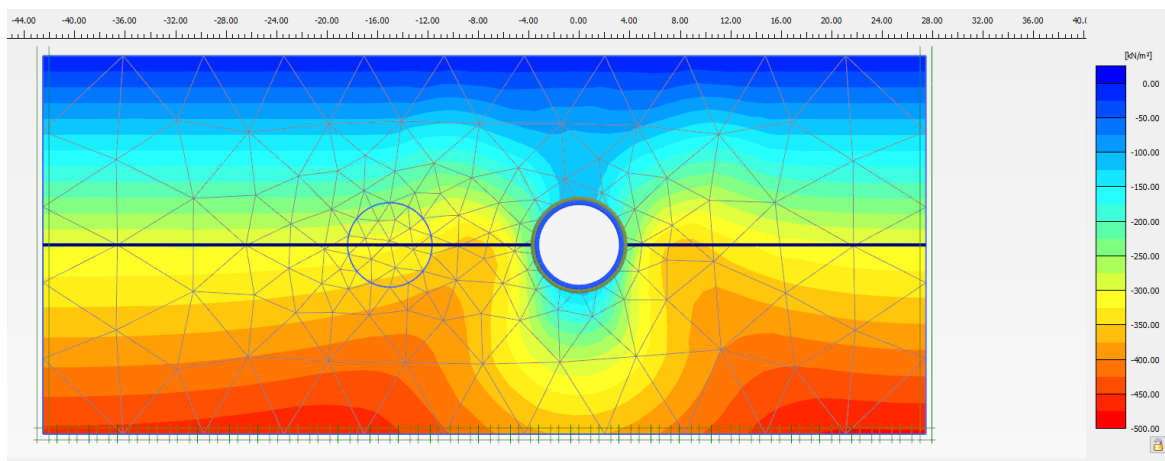
Fig. 5. Effective stresses in the y direction after first tunnel excavation.
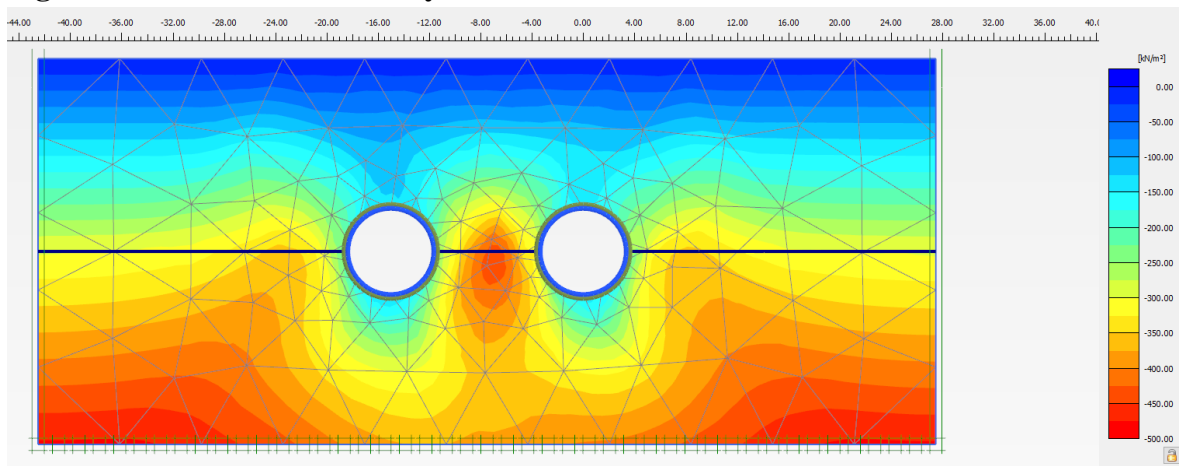
Fig. 6. Effective stresses in the y direction after second tunnel excavation.

As displayed in Fig.7 and 8, the FEA produced trough widths of roughly 20m laterally to the tunnel axis. An empirical curve was fitted using Equation 1 to the maximum settlement average from the monitoring data above the first tunnel, using an average value of ix = 5.8m. This produced an accurate comparison of trough width with predicted numerical curve displayed in Fig. 7, although showing the clear overestimation of settlement and resulting volume loss. This can again be seen in Fig. 8 for the prediction after the 2nd tunnel construction, producing similar curves and accurate trough widths, however slightly overestimating all settlements across the curve.
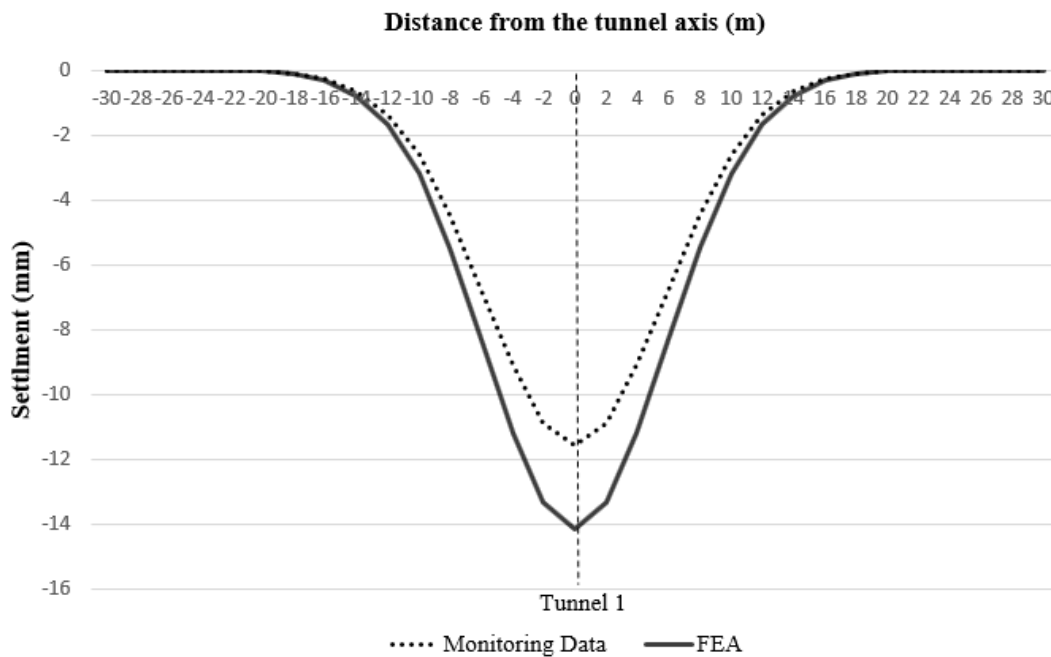
Fig. 7. Comparison of settlement trough given by monitoring data and FEA results for Tunnel 1.
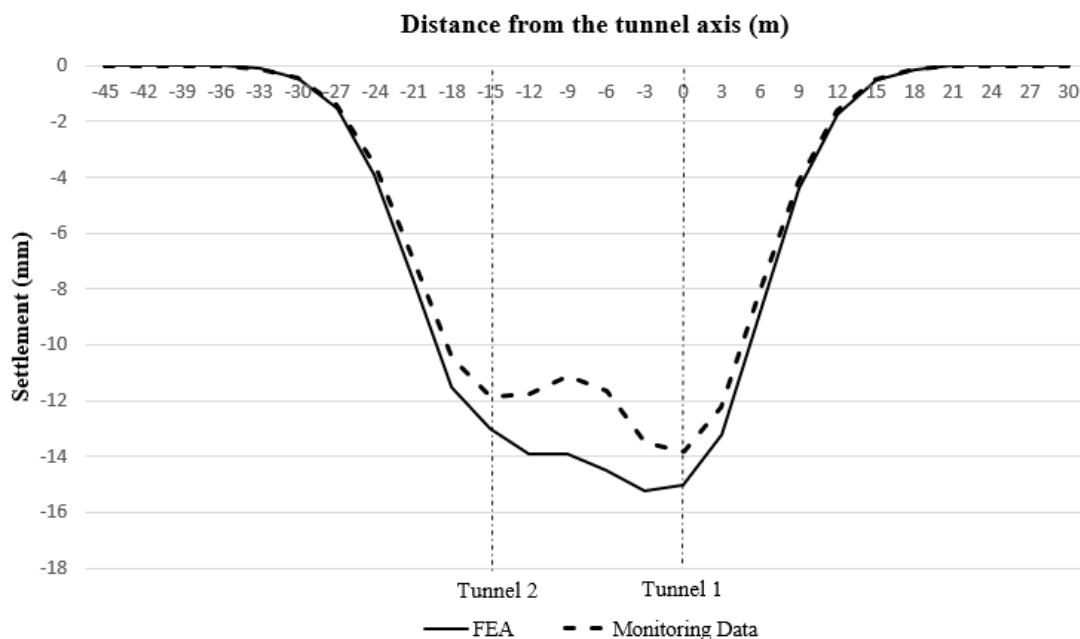
Fig. 8. Comparison of settlement trough given by monitoring data and FEA results for Tunnel 1 and 2.

Conclusions and Recommendations

All objectives of this research were achieved, and it can be concluded that the 2D FEA prediction model using the contraction method can produce accurate predictions for ground settlements in the construction of singular and twin TBM'd tunnels and provides a quick and easy prediction tool for engineers in the design process. These predictions could be further improved by using a finer mesh in the modelling of the soil. This research could be continued through analysing these prediction techniques in varying ground types in further case studies and also through obtaining more substantial amounts of monitoring data of the transverse settlement profile to further analyse the accuracy of the predictions between twin tunnels. Particularly in the area between the tunnel tubes in which the empirical prediction of the settlement troughs does not account for the impact of sequential excavation. In addition, the impact of twin tunnels at different depths in close proximity could also be explored.

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A STUDY ON IMPORTANCE OF MEP QSS FOR THE BUILDING CONSTRUCTION PROJECTS IN KANDY CITY

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Abstract

This research is to find out the importance of MEP QSs for the building construction projects in Kandy city. Moreover, to identify the scope of work of MEP QSs and to control the project budget of MEP works in building construction projects in due course. Based on the analysis it identified that there are major MEP works to be done by MEP QSs and also identified importance of the assigning MEP QSs to do all these MEP related works more efficiently and accurately to control the project budget and provide the better output to the building construction project. Further, the data analysis has done based on the answers given by the responders for the particular questionnaire.

Key Words: MEP QSs, MEP works, importance

Introduction

Basically, "building services" are the building's life. They largely contribute to the sustainability of the building. There are various types of building services, such as lighting, heating and ventilation, the elevators and escalators, acoustics, plumbing, power supply and energy management systems, the security and safety systems (Dublin Institute of Technology, 2012). MEP engineering is the science and art of planning, designing and managing the MEP systems of a building. They are important at all stages of the construction process. They assist in decision making, cost estimation, construction administration, documentation, building management and building maintenance. When consider about the construction professions, Architects, Engineers and Quantity Surveyors can be considered as key figures. (Ashworth, 2013). Now clients are looking for specific quantity surveyors for the respective fields (Perera & Yapa, 2005). In addition to that Perera & Yapa said that the quantity surveyors with thorough knowledge about different construction sectors experience are in high demand (Perera & Yapa, 2005).

Since the scarcity of specific quantity surveyors in Sri Lanka, many project consultants and contractors are facing lots of problems when finding the right employees. Also the project teams are trying to cover-up the MEP related works by using civil QSs or by another alternator. These kind of situations will be affected badly to project cost and as well as the quality & durability of the building. Therefore, it is important to figure out the importance of MEP QSs to the building construction projects.

Aim:

To find out the importance of MEP quantity surveyors for the building construction projects in Kandy city.

Objectives:

☐   Identify the scope of MEP QSs of building construction projects in Kandy city.

☐   Identify the difference between the work scope of MEP QSs & Civil QSs of building construction projects in Kandy city.

☐   Analyse the most important aspects of knowledge and experiences of QSs in MEP works in building construction projects in Kandy city.

Methodology

To carry out the above objectives, used the following methodology.

Data collection carried out through a questionnaire survey, submitted the questionnaire around thirty-five numbers of professionals in construction industry in Kandy City. Questionnaire prepared by adding most important questions relevant to the scope applicable to works of MEP QSs & to identify the knowledge area of responders, about MEP works in a building project and find out the necessity of MEP QSs for their work place / construction projects. Next the analysed all the collected data using qualitative data analysing method and categorized them. Finally, the researcher considered all the analysed data and then determined the conclusion.

Results & Discussion

As mentioned in the data collection method, questionnaire was distributed among thirty-five industrial professionals such as project managers, civil engineers, quantity surveyors and other professionals related to construction industry in Kandy city. There were thirty responses received. Among them 86.7% was professional quantity surveyors and remaining 13.3% was project managers, civil engineers and other professionals in the construction industry in Kandy city.

The necessity of MEP QSs comes through experience when dealing with workplace problems. Most responses came from 1 to 4 years of experiences level and 5 to 10 years of experiences level and also it shows that the people who engaged with the construction industry in the recent past have responded. Moreover, among those thirty responders the majority is engaged with the modern construction projects with the new technologies. And below summarized the results received.
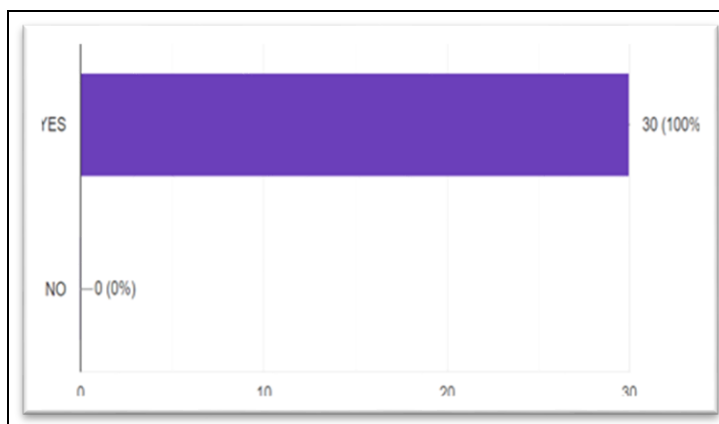
Figure 01 – "Awareness of quantity surveying practices in MEP services".

According to above diagram (Figure 01) all of the responders were agreed that they are well aware about the two major components in building construction sector such as civil and MEP services.

As an answer for the particular question, "MEP related works in a building construction project can be done by a quantity surveyor who is having experience only in civil works?" 70% of responders have chosen "No" that means their point of view is that there must be a quantity surveyor who is having experience and knowledge in MEP works to do the MEP related works in a building project.

Is it important to assign MEP Quantity Surveyors to control the budget of building construction projects? for this particular question 90% have agreed that it is important to assign a MEP QS to control the project budget.
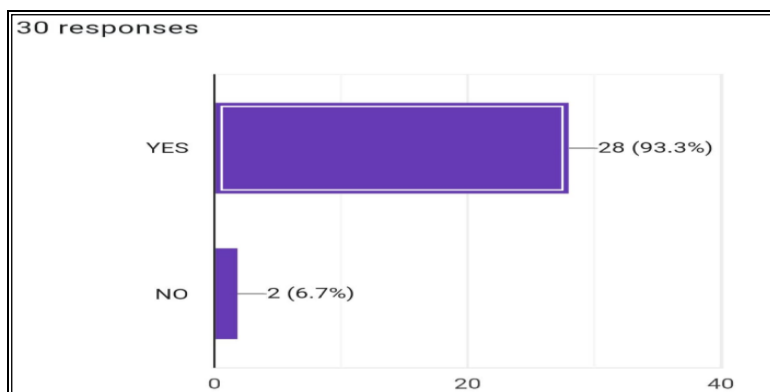
Figure 02 – "Necessity of MEP QSs for the relevant MEP works in construction projects"

According to the figure 02; when questioned about necessity of MEP QSs at the contract stage for the MEP works such as variation claims, 93.3% of responders were agreed to assign a MEP QS to involve such a situation as beneficiary party of the project.

Also following results received through the analysis.

For the MEP works in pre-contract stage like pricing BOQ for MEP items, 85.7% were agreed to assign a MEP QS to do particular job and they have left the explanation for that as MEP QS can do above mentioned work more efficiently and accurately than civil QS.

Moreover though the level of experience for pricing BOQ of MEP services shows very high it seems there are considerable number of responders are not having the experience in pricing BOQs in pre-contract stage, this situation may occurred due to lack of knowledge and experience in MEP services , dealing with suppliers to get quotations for MEP items is in an average level ,this may happened due to non-availability of expert QSs for the MEP works, average level of evaluations and awarding has done for the MEP services, among those responders half of them have given less value engineering proposals to the project in order to enhance the quality of design and reduce the budget, 85.7% of responders were agreed that they need a MEP quantity surveyor to complete the MEP works related to pre-contract stage, the usage of SMM/SLS 573 to measure the MEP work is in average level and law level, responders are having an average and high level of working experience in contract stage of MEP services in a project, most of the responders have experience in preparing claims

including MEP works but the accuracy of claims couldn't be guaranteed if there were not expertise person in MEP works, the responders are in an average and lower level in identifying and preparing variation claims, responders are having high level of experience to take-off joint measurement for MEP works in construction sites, there are only few responders o having experience in managing cash floor, most of the responders were agreed to assigned MEP QSs to do all the above mentioned activities efficiently and accurately, as a percentage of 93.3% taken for that.

Conclusion & Recommendation

The results of this investigation shows that, MEP QSs play a vital role in the building construction industry and those works cannot be done by civil QSs or other industrial professionals to get maximum output in MEP field. On the other hand, study has presented significant areas where QS professionals need to be well aware about MEP works.

Main objective of the study was to identify the scope of MEP QSs of building construction projects in Kandy city. Also identified the current situation of MEP QSs in building projects in Kandy city by gathering opinions of the QSs, project managers and industrial professionals. Thereafter, further discussions were carried out on the MEP work applications regarding current practices, criteria and also many kinds of MEP systems in building projects. Then the discussion was carried out on the importance of involvement of QS professionals for those tasks. Moreover, study has emphasized on importance of MEP QSs to the construction industry and the critical knowledge areas required for QSs to preform MEP works and among all the responders 86.7% of the responders were professional QSs and most of them were agreed that there should be a MEP QS to accomplish the MEP work in building construction project; it seems those QSs were faced lots of problems while they were dealing with MEP works.

Next objective of this research was to identify the difference between work scopes of MEP QSs & Civil QSs, through the experience and knowledge levels of QSs and other industrial professionals related to MEP works. According to the data analysis it identified that there are several major works which can be done by MEP QSs than the civil QSs or any other industrial professionals. Therefore, as the main aim of this study was to find out the "Importance of MEP QSs for the building construction projects in Kandy city" was reached successfully and satisfactorily through this chapter.

Based on the data analysis, the main idea was there should be a MEP QS to do all the MEP relevant works efficiently and accurately, mainly for the followings; to control the budget of building projects with new technologies ,to quantify the MEP works for BOQs in Pre -contract stage, to price the MEP works in BOQ for pre-contract stage, to deal with suppliers to get quotations to price MEP items in unprized BOQ, to provide value engineering ideas /proposals for the MEP works in order to enhance the quality of design and reduce the project budget, to identify & prepare the variation claims for MEP works, to prepare and submit the IPA/IPCs including MEP works, to manage the cash flows for the MEP works, to prepare BOQs for MEP related works by using SMM/SLS 573 etc.

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THERMAL PERFORMANCES OF FAÇADE CLADDINGS OF COMMERCIAL BUILDINGS IN SRI LANKA

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Abstract

This research addresses thermal performances of façade cladding as an approach to improve energy efficiency of buildings. After a comprehensive study on literature, quantifying of thermal performances has accomplished in five different façade claddings by sample modeling and evaluation of real scaled commercial building thermal performances through computer simulation using 'DesignBuilder' software. It is investigated the trellis system is the best thermal performing façade cladding, fitting with Sri Lankan climate by calibrating of ETTV and U-values referring the Energy Efficient Building Code. And substantial reduction of the annual cooling energy is experienced due to the vegetation cover of the cladding. A relationship of second order polynomial with R^2 of 0.7272 is obtained among the ETTV and the annual cooling energy for analyzed commercial building. The building energy demand can be control in design stage by introducing Trellis cladding system, to encourage climate responsive building planning and to improve the energy efficiency in the building.

Key Words: Building envelop, Façade cladding, Thermal performances

Introduction

In relation with the world is moving towards sustainable building design, the research community pay significant attention towards to energy efficiency of buildings. Buildings are the respondents for 40% of global energy consumption (Asan H., 2006).

As buildings act as a climatic modifier of indoor built environment from the external climate (Asan H, Sancaktar Y.S., 1998), the thermal performance of the exterior building envelops is responsible for a huge part of total cooling energy consumption of the building.

External heat gains and losses of the building are occurred through envelop. Therefore, it is clear that the properties of the envelop materials directly affect to the thermal and visual comfort of the occupants and the energy consumption of the building. The concept of Envelop Thermal Transfer value (ETTV) and application of façade cladding to the building envelop design address the improvement in energy efficiency of building. Façade cladding is a non-load bearing panel that is fixed to supporting structure to building (Cheng, C.Y., et al 2010).

According to the literature findings most studies have end up with finding time lag and decrement factor as the critical performance measures of a building envelop. But, they were based on constant exterior surface heat transfer coefficient conditions. And it was observed that walls with lower decrement factors and higher time lags are the most suitable wall type to tropical climate that minimize the energy consumption. The current study attempts to find out the best matching façade system to Sri Lankan context and what would the relationship between ETTV & green façade be by sample modeling of different façade claddings exposing to the real climate conditions under careful investigation of innovative façade cladding components.

Methodology

Qualitative Research

Undertake **Literature Review** Relevant to Topic

Statistical Study of Façade Cladding

Quantifying of Thermal Performance

Design of Experimental Models: Orientation and Plant Selection, Determination of U-value for Thermal and Energy Performance of Façade Claddings

Measure: Temperature Data for Ambient, Air Gap, Internal Surface Temperature of Modeled Façade Claddings

Compare: The Modeled Shed Temperatures with Conventional Shed i.e., Internal Surface of each Façade and External Surface temperature

Use Temperature data for Green Façade in **ETTV** upon Reviewing the Energy Efficient Building Code

$$ETTV = 12 (1\text{-}WWR)\ U_W + 3.4\ (WWR)\ U_f + 211\ (WWR)\ (CF)\ (SC)$$

ETTV – Envelop Thermal Transfer Value
WWR – Window to Wall Ratio
U_W – Thermal Transmittance of Opaque Wall Section
U_f – Thermal Transmittance of Window Section
SF – Solar Factor, (186 W/m2)
CF – Solar Correction Factor for the Orientation of the Fenestration

Thermal Performance **Analysis** in Case of Real Building Application through 'DesignBuilder' Software & **Calibrating** Grounded on Energy Efficient Building Code

Figure 1: Summery Flow of the Research Methodology

To comparative purposes of primary analyzed data, the mathematical investigation was carried out via computer simulation software. The main objective behind the computer simulation is to analyze the mandatory requirements recommended in the building code in order to optimize the energy efficiency of commercial buildings through their building envelops of identified best fitting envelop from the **primary temperature data analysis**.

There the collected building characteristics of selected real scale commercial building has been uploaded to the 'DesignBuilder' software and noted down the ETTV of present in conventional façade system. $50\ W/m^2$ is the recommended value for the dry bulb temperate zones buildings that should sustain as the indoor climate of building.

The computer simulation procedure of the research concentrated on the analyzing of the annual cooling energy of the selected building under the hypothesis of the reduction of the annual cooling energy with the reduction of the ETTV value. Standing on the aim of the project, for the analyzing purposes the ETTV value of the building were controlled by only changing the U-value of the façades. For that, the ETTV value variation has been checked introducing UV treated timber and the trellis system for the existing building. Here, the respective annual cooling energy values (for modified building by introducing the UV treated timber and trellis system separately) have been found by the DesignBuilder computer simulation software.

So, the correlation of the ETTV and the annual cooling energy has derived through the computer simulation.
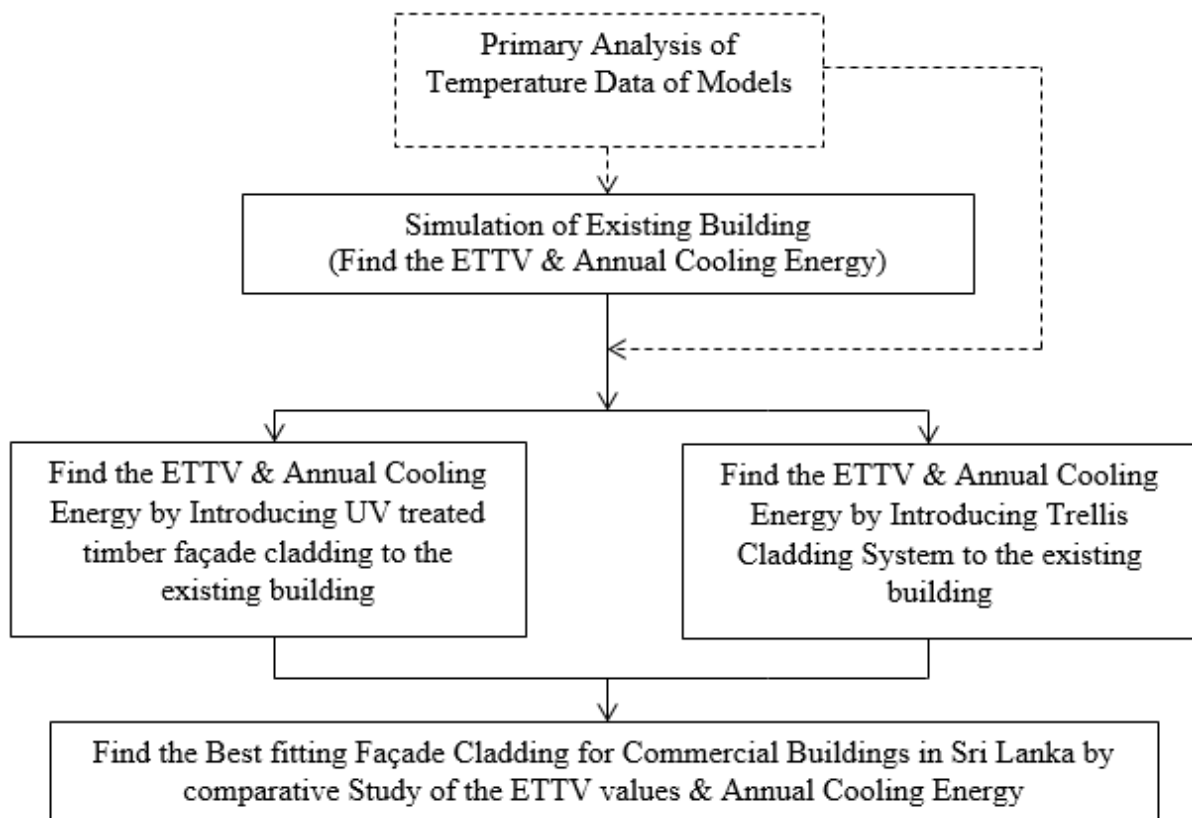
Figure 2: Summery of Computer Simulation Procedure

As ETTV deals with the conduction heat gain, in order to formulate relationship between ETTV and the façade system, the detailed procedures with mathematical modeling regarding thermal performance analysis of commercial buildings should be quantified using temperature data, shading coefficient value, and heat gain formulation made of ETTV and steady-state heat gain of roof. Finally, analyzing the derived temperatures vs. time graphs, U-values and ETTVs; the best fitting façade cladding to Sri Lankan commercial buildings should be determined.

Results

The following drawn Graph:1 represents the variation of the indoor climate of the five experimental models with the ambient temperature.

Graph 1: Indoor Climate Temperature Variation with the Ambient Temperature against Time
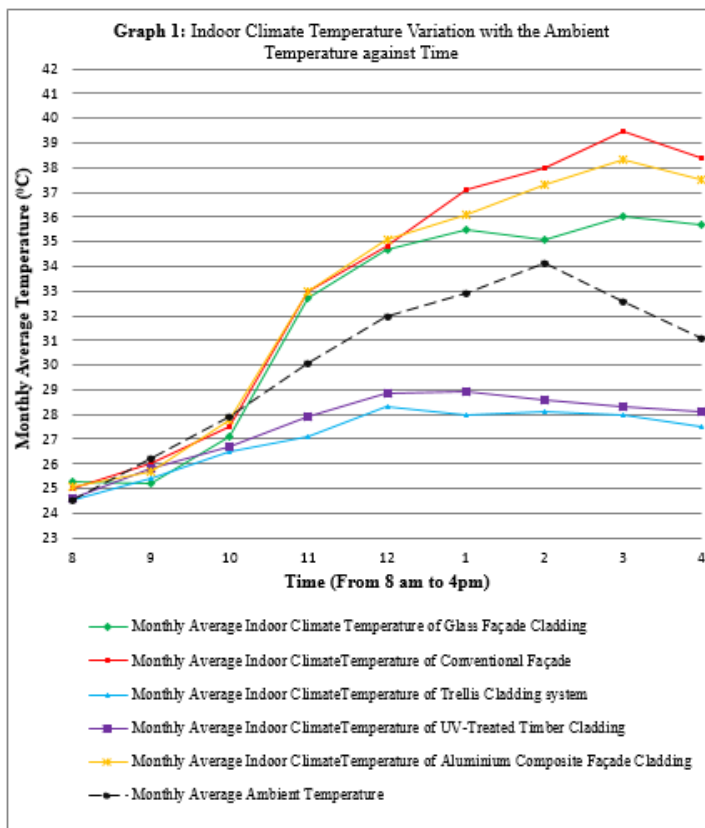
The variation of the ambient temperature shows a gradual increase within 8 a.m. to 2 p.m.

In between the period of 9 a.m. to 10 p.m. all the models indoor temperatures are lesser than the ambient temperature as all the models have sealed against thermal leakage through the internal climate, in making sure the thermal equilibrium through the internal and external envelop of the building.

Aluminium composite façade cladding; the statistically the most common type, shows a variation of indoor climate temperature of 12 ^{0}C which is lesser than that of the conventional façade model, it shows a higher indoor temperature by 0.3 ^{0}C than that the conventional façade model. And model's average indoor temperature throughout a day period is also a higher value by 3.8 ^{0}C than the conventional façade.

All the façade cladding models represent their qualities as passive indoor climate controllers after 12p.m. It is an advantage in minimizing the demand of cooling energy.

The lowest indoor temperature variation is shown by the Trellis cladding system. But, both the UV treated timber façade cladding and the Trellis cladding system shows a lesser average indoor temperature throughout a day.

The trellis cladding represents the green living wall. The living plant in the trellis structure, absorb energy for sustaining their photosynthesis process. This green cover act as a protective barrier to heat flux through the outer façade[4]. So, it causes to the lowest average indoor climate temperature of the trellis system.

Even though, throughout the day the lowest average indoor temperature (27.1 ^{0}C) is shown by the trellis cladded model, the UV treated timber cladding has the capability of reducing the increased indoor temperature quicker than the Trellis system.

After 2.00p.m. to 4.00p.m. a gradual reduction of the indoor climate temperature can be identified in both trellis cladding system and UV treated timber cladding system through the Graph: 3. But, within this period, the ambient temperatures show higher values than the indoor climate temperatures of models. As the effectiveness of solar radiation decreases in the evening, and the passive indoor climate controlling effect of the models, cause to increase the indoor temperature of models than ambient temperatures[5].

The conventional façade cladding is responsible in reducing the indoor climate temperature of the model from 28.1 ^{0}C to 27.5 ^{0}C (reduction of 0.6 ^{0}C) within two hours of period from 2.00p.m. to 4.00p.m. But, in order to minimize the energy consumption of a commercial building by means of reducing the energy use in operation the environmental control equipment such as air conditioners (A/C), this quick reduction of the indoor temperature should be shown at the peak average ambient temperatures (around 12p.m. to 2p.m.).

For a better analysis of the thermal performances of the five modeled façade systems, it is important in identifying the outer surface temperatures variations of the models (Graph: 2), as it directly affect to the variation of the indoor climate temperatures of models by affecting to the heat flux through the façade cladding.

Graph 2: Outer Surface Temperature Variation of Facade Claddings with the Ambient Temperature against Time

— Monthly Average Outer Surface Temperature of Glass Façade Cladding
— Monthly Average Outer Surface Temperature of Conventional Façade
— Monthly Average Outer Surface Temperature of Trellis Cladding System
— Monthly Average Outer Surface Temperature of UV-treated Timber Cladding
— Monthly Average Outer Surface Temperature of Aluminium Composite Façade Cladding
— ◆ — Monthly Average Ambient Temperature

Aluminium composite façade has always the highest external surface temperatures than the ambient temperature. And hence the highest average air gap temperature. It may lead to uncomfortable condition to the nearby people.

Change of ambient condition due to trellis system touches the low cooling energy demand of commercial buildings. Owing to trellis system, air gap temperature was comparatively lower than ambient temperature. The average temperature of air gap was 5 – 6.4 ^{0}C less than ambient temperature (relatively same to UV treated timber).

Even though, it is hard in judging about the heat flux with the available data of all the modeled façade claddings, the average temperature gap of each façade gives a good understanding about the thermal conductivity of each façade claddings.

Following table shows the respective temperature gaps of each modeled façade claddings.

Table 1: Temperature Gap within Indoor & Outer surface Temperature of each Modeled Façade Cladding

Modeled Façade Cladding Typology	Temperature Gap within Indoor & Outer Surface (^{0}C)
Conventional Façade	0.5
Glass Façade cladding	0.6
Aluminium Composite Façade Cladding	0.8
UV-treated Timber façade cladding	1.1
Trellis cladding	1.3

Considering, the best human comfort level of 22^0C to 26^0C, the setting point of air conditioning equipment of any commercial building in Sri Lanka is 24^0C. So, through the analysis of the indoor climate temperatures of modeled façade cladding systems, it is clear that the **cooling energy demand can be minimize by introducing of trellis cladding system and also, UV treated timber for commercial buildings**; due to lesser temperature gap between the average indoor climate temperatures of these two types and the point temperature that should maintain in a commercial building.

Discussion

Through the primary analysis UV treated timber and the trellis system have identified as the best indoor climate modelers. For comparative purposes of primary analyzed data, the mathematical investigation was carried out via computer simulation software.

According to the extracted table through the simulation procedure, the derived annual cooling energy requirement is 430.22MWh and the ETTV of the existing building is 34.57W/m^2. So, it is a well below value comparatively to the prescriptive requirement of the Building Code as 50W/m^2 the maximum ETTV for dry temperature zone's buildings. So, the selected real scale building is undergoing with the Building Code requirement.

After modifying the existing building in simulation software by introducing UV treated timber and Trellis Cladding façade, the annual cooling energy requirement is 420.40MWh and 420.23MWh respectively. According to the derived values in modified buildings, a clear relationship of the ETTV and the annual cooling with $R^2 = 0.7272$ were explored as shown in the below **Graph:3**.

Graph 3: Variation of the Annual Cooling Energy Demand vs. ETTV

$y = 4.9224x + 258.21$
$R^2 = 0.7272$
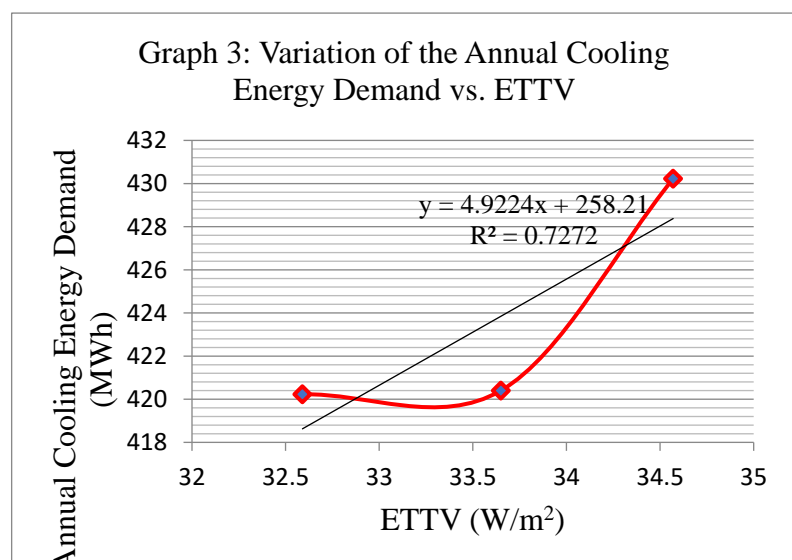
So, introducing of both UV treated timber façade cladding and the trellis cladding system for a building façade can be identified as <u>effective passive indoor climate control systems</u>.

By introducing the trellis cladding system to the existing building which consisted with conventional walls, the ETTV could reduce by 1.98 W/m². And, the annual cooling energy requirement also reduces by 9.99 MWh. The reduction of the ETTV and the value of the annual cooling energy requirement, after introducing the UV treated timber façade cladding to an existing building's wall is respectively 0.92 W/m² and 9.82MWh. Therefore, through the computer simulation, the trellis system can be identified as the best fitting façade cladding for commercial buildings in Sri Lanka by means of analyzing the thermal performances of different façade claddings.

Conclusions and Recommendation

Both by quantifying thermal performance through the experimental set up and simulations in this study reveals that the thermal bridging by Trellis Cladding System significantly reduces the thermal performance in commercial envelopes.

A second order polynomial relationship with R^2 of 0.7272 has explored in between the ETTV and the annual cooling energy requirement of the simulated real scale building. Hence, there is a potential to substantially reduce cooling energy consumption by implementing the best matching façade cladding to a building.

This study recommends that it is possible to affect around 50% reduction in the impact of common thermal bridges by providing detailed guide lines, along with the Building Code to minimizing the cooling energy demand by introducing passive façade construction technologies such as trellis system. Therefore, energy saving and control can be achieved while providing indoor thermal comfort to the occupancy which affect to their efficiency and the productivity with readily available techniques.

As this research limiting for one species of plant in trellis cladding system, in addition a new comprehensive study can be undertaken in identifying of the best fitting trellis cladding system to Sri Lanka by implementing different plant species to trellis system those common in Sri Lanka and have the ability of adoption their growth in lattice structure.

Furthermore, life cycle cost analysis (LCCA) can be also undertaken along with the study, before recommending the best fitting façade cladding for a particular building type.

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ANALYZING FACTORS TO IMPROVE TIME MANAGEMENT OF SUBCONTRACTOR WORKS IN THE SRI LANKAN CONSTRUCTION INDUSTRY

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Abstract

Subcontractor time management is a highly regarded element in the construction industry. However due to the poor time management in the Sri Lankan construction industry as well as the existing research gap in the local context focusing on the topic under emphasis, the development of a suitable conceptual framework was much needed. Therefore, a conceptual framework was successfully established in this research for subsequent industrial applications. The preliminary conceptual framework was first deduced by means of critically analyzing the globally available secondary articles on the identified research area. Afterwards the framework was made comprehensive by further reviewing a broad-based case study that included a selected set of construction projects distributed across the country. Accordingly, the most important elements of time management were well acknowledged thereby providing suitable solutions and recommendations to the Sri Lankan construction industry.

Key words: Construction Industry (CI), Sri Lankan, Sub-contractor (SC), Time management, Building construction project

Introduction

Time, despite being a fundamental ingredient in human affairs has been ignored for most of the worldly attributes (Bluedorn and Denhardt, 1988). Hence much focus is given towards projects and organizations since recently (Claessens et al., 2007) and this is carried out by monitoring and controlling time most effectively, thus the evolvement of time management (Eilam and Aharon, 2003). The PMBOK (sixth edition) emphasizes on the importance of time management and its prominence in project management; specially during applications of project-based cultures such as in the construction industry (PMBOK6, 2017).

The construction industry which is defined as a man-made physical asset presently faces many challenges with regards to completing projects on time hence many practitioners address construction delay as a major problem (Memon et al., 2014; Spence and Mulligan, 1995). To simplify these challenges as well as support the inbuilt characteristic of being a multifaceted platform influencing other industrial sectors, its key stakeholders such as main contractors and subcontractors play a major role in delivering the projects successfully. SC are lower-tier contractors that are relied upon by main contractors to facilitate time management by increasing time efficiency, reducing project costs, and regularizing the standards in construction projects (Beardsworth et al., 1988; Bresnen et al., 1985). Thus, SC are known to be a major contributor in the CI; specially in building and infrastructure construction projects (Rodrigo and Perera, 2017).

However, with the peak of SC involvement in CI, many issues have been surfaced questioning the project schedule, cost and quality standards; especially in the Sri Lankan CI since it has more than 7% contribution towards the country's Gross Domestic Product (GDP) and is the 4th

largest funder to the local economy (Jayalath and Gunawardhana, 2017; Ruddock et al., 2010; Yates and Hardcastle, 2003). Scholars have identified time delays of SC works as the vital component causing projects to fail and highlighted the urgent requirement to address the SC poor time management for overall project success (Carnell, 2005; Chong, 1994; Flyvbjerg, 2003).

The importance of this study can be further justified by similar caliber projects experienced by the author. Three multi-storied office buildings constructed by government and private institutions in Colombo during the recent past years had faced project delays that calculate to approximately more than one and half of its original project duration. One of the core reasons of this delay is the inability of subcontractor management by its stakeholders. The subcontractor works of these three projects were taken for granted and away from the critical path of the project thus forcing the scope and cost of the project to be revised ultimately increasing the project duration.

Therefore, as a result of the limited research in the above area and the existing knowledge gap in the Sri Lankan context, a comprehensive study was carried out to assess the problem and provide solutions and recommendations to the industry.

Objectives

The aim of this research was to provide recommendations and improve time management in subcontractor works in the Sri Lankan Construction Industry (CI). To do so, the general objectives were achieved as follows. Firstly, factors were analyzed to improve time management in subcontractor works in the Sri Lankan Construction Industry; followed by recommending suitable improvement strategies of Time Management in Subcontractor works in the CI.

This research carried 4 specific objectives that focused on achieving the general objectives and they can be listed down respectively according to the following manner. To study how time is managed in SC works in CI, to identify and analyze the factors that affect time management in SC works in the CI, to identify the consequences of improperly managed time in the CI and finally to emphasize the factors analyzed in order to improve time management in SC works in the SL CI.

Conceptual framework

A preliminary conceptual framework indicated below was developed to propose a step by step approach on identifying, constructing, and implementing the phenomenon under investigation (Grant and Osanloo, 2014). The Introduction and literature review of this research has provided effective methods to improve time management in subcontract works in the perspective of the Sri Lankan CI. Furthermore, they were helpful in identifying and critically analyzing secondary data referred from a wide range of authentic sources and pointing out substantial aspects to improve time management of subcontractor works in the Sri Lankan CI.
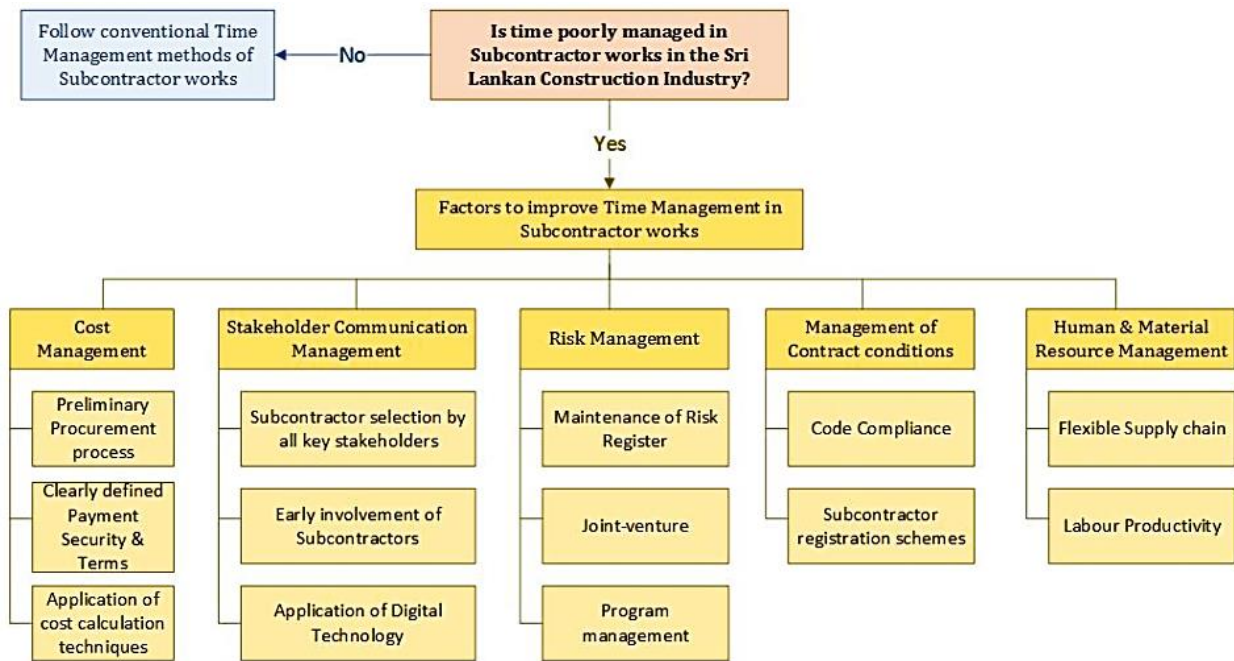
Figure 1 - Preliminary Conceptual Framework

Methodology

Most researchers drive to be effective by examining data for change and stability overtime, hence involving data coverage of multiple existing data sets (Greenhoot and Dowsett, 2012). Furthermore, vast amounts of data are being gathered and archived by scholars and researchers across the globe; thus, the feasibility of exploiting existing data for any research is more prevalent under the current context (Johnston, 2017).

Due to the above reasons and as directed by the university guidelines for the purpose of this research, inductive methodology was followed by referring and analyzing secondary data related to the research area. Qualitative data was gathered and assessed to critically compare the theories discussed by various scholars, on time management of subcontractors in the construction industry. Once sufficient data was gathered, a conceptual framework was formulated to identify the SC time management methodologies presently followed in the CI.

Subsequently the research results were obtained by selecting a set of building projects within the geographical area of Sri Lanka in order to study the actual behavior of SC time management so that the same can be critically compared proceeding with the modification of the conceptual framework upon sufficient discussion carried out. The identified building projects were from the sectors of commercial, residential and special purpose type in order to ensure a comprehensive coverage within the domestic CI (Hecht, Meinel and Buchroithner, 2015). Further justification on the case study selection is interpreted in the figure followed in the results chapter.

Results

Aimed at providing appropriate recommendations and achieving the predetermined goals and objectives of this research, the cases identified are studied considering the perspective of the Sri Lankan CI to explore present practices on time management of subcontract works for which results were gained on the subject researched.

The CI is distinguished into three categories respectively and the same is highlighted in the diagram below. Due to findings by Rodrigo and Perera (2017), on 77.8% of SC involvement in building construction, the research was focused on the building construction industry for a more effective output. For this, six projects were identified; 2 from each sector indicated as commercial, residential and special purpose type.
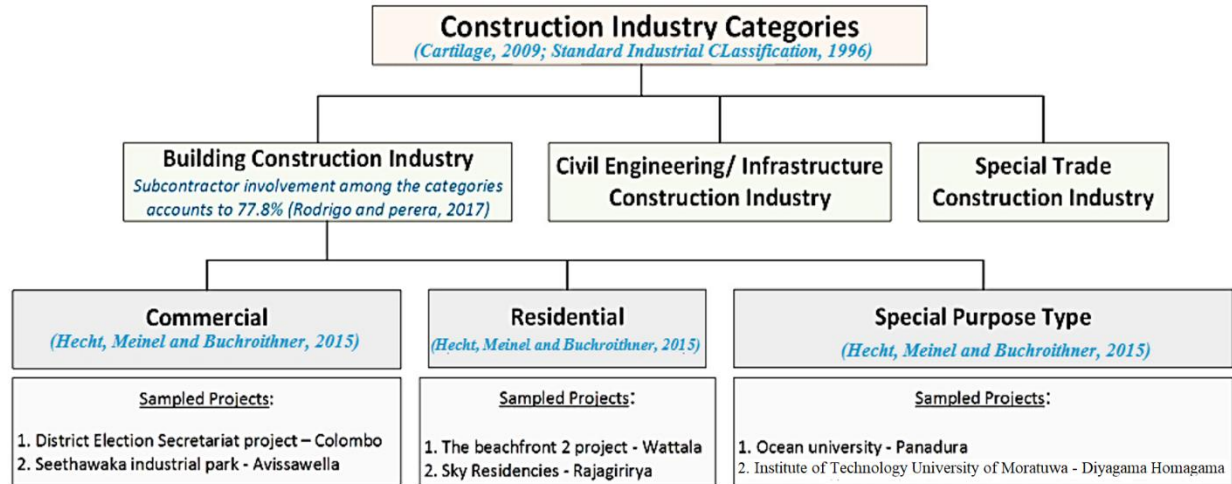
Figure 2 - Categorization of sample case study projects

Sri Lanka's urban population has witnessed a strong up-stick due to the rapid construction developments specially in the western provincial region (Gunawardhana and Jayalath, 2017). For such reasons, the six projects identified above were selected from the western province to represent the overall construction projects involving subcontractor works in the Sri Lankan construction industry, since the western province is known to be the backbone of provinces with regards to building construction. It is important to note that the number of projects were limited to six due to the availability of reliable secondary resources. Considering the criteria discussed the identified cases which are represented in the summarized table below.

Table 1- Summary of the Cases under study

Case Study No.	Construction Project Management	Nature of Project	Project Budget	Project Duration/ Completion	Reference to Document studied
Case Study 1	District Election Secretariat project (DES) - Colombo	Commercial (Office)	Rs. 58 Million (USD 0.8 Million)	1995 to 2000 (05 years)	(Maddewithana, n. d)
Case Study 2	Seethawaka industrial park (SIP) - Avissawella	Commercial (Manufacturing plant)	Rs. 540 Million	2000 (year of completion)	(Lakshman, 2003)
Case Study 3	The Beach front -2 project (BF-2) - Wattala	Residential	Rs. 1500 Million	2018 to 2020 (2 years)	(AmPark Consulting Services, 2018)
Case Study 4	Sky Residencies project (SR) - Rajagiriya	Residential	Rs. 5000 million	2018 (Year of completion)	(Jayasinghe, 2016)
Case Study 5	Ocean university panadura(OUP) - Panadura	Special purpose – (University)	Rs. 275 Million	2016 to 2019 (3 years)	(Wijesekera, Daluwatta and Devaisy, 2017)
Case Study 6	Institute of Technology University of Moratuwa - Diyagama Homagama	Special purpose – (University)	Rs. 215 Million (USD 1.4 million)	2013 to 2017 (3.5 years)	(ITUM Annual Report, 2017)

A study on subcontractor works were carried out on the projects identified above with the parameters as explored in the literature review and indicated in the conceptual framework. The projects were analyzed to identify to which extent the cost management techniques, stakeholder communication techniques, Risk management, contractual conditions and resource management were applied as per the parameters incorporated in the conceptual framework.

Discussion

Extensive research conducted in the literature review explored the theoretical aspects of time improvement factors of subcontractor works in the Sri Lankan CI. Assessment of the cases studied provided an in-depth analysis on how construction projects in Sri Lanka implement and apply the identified factors listed in the conceptual framework related to different elements of time improvement strategies in subcontractor works. Therefore, a critical comparison was carried out between the contents of the literature reviewed on factors of time improvement in subcontractor works and respective results obtained through the cases studied, so that gaps and additional practices were able to be identified thereby providing suitable solutions and recommendations.

Each project as studied in the results chapter included gaps on time management strategies when compared with the conceptual framework developed; however additional factors contributing to the time improvement were clearly practiced with unique involvement towards the project success. Subsequently upon evaluation of the factors and sub factors of time management the same was graphically explained in order to identify the distribution of these time management factors among the Sri Lankan SC industry a whole. Thus, below indicates the summarized graphs that provide a clear understanding on the analyzed factors as discussed above.

Summarized overview of the discussion on cases studied
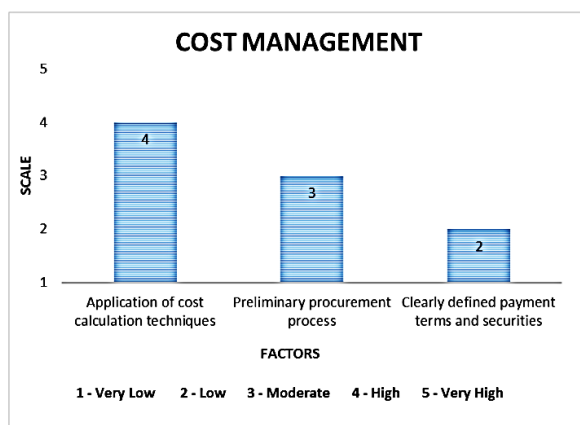
Figure 3 - Cost Management
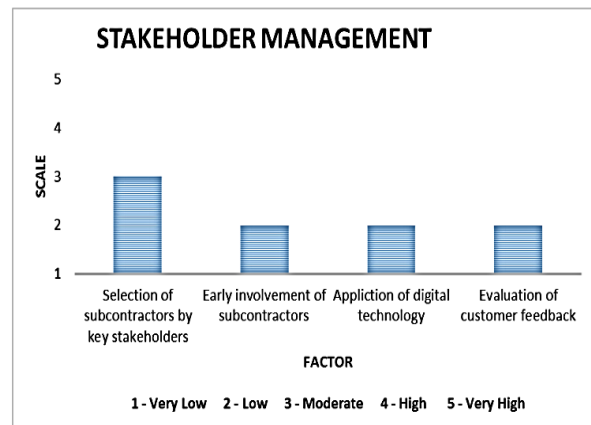
Figure 4 - Stakeholder Management
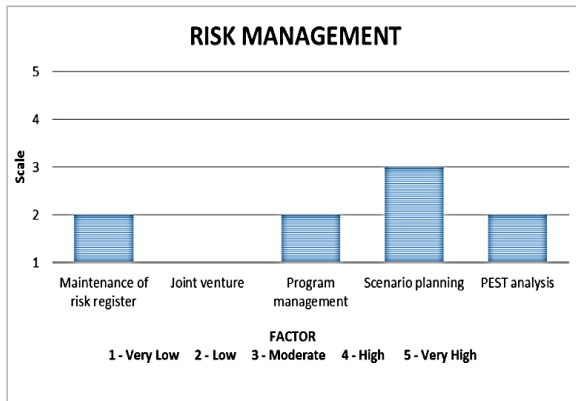
Figure 5 - Risk Management
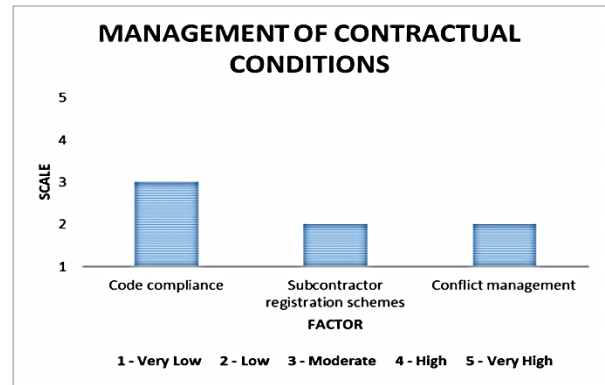
Figure 6 - Management of contractual conditions
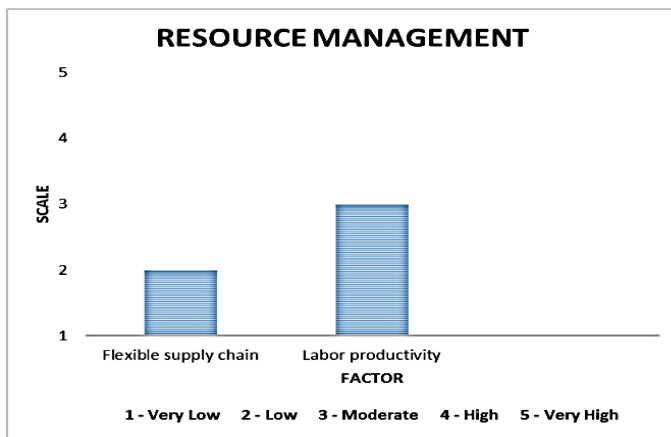
Figure 7 - Resource management

Conclusion

With the observant of the current subcontractor practices in various countries including Europe, Australia, Georgia and Indonesia, the scholarly research on theoretical concepts on a general perspective and the present applications related to the Sri Lankan CI; Unique time improvement strategies were recognized with the help of a comprehensive conceptual framework which is formulated and shown below. The following modified framework was collectively influenced by the case study conducted from local subcontractor industry and the preliminary conceptual framework.
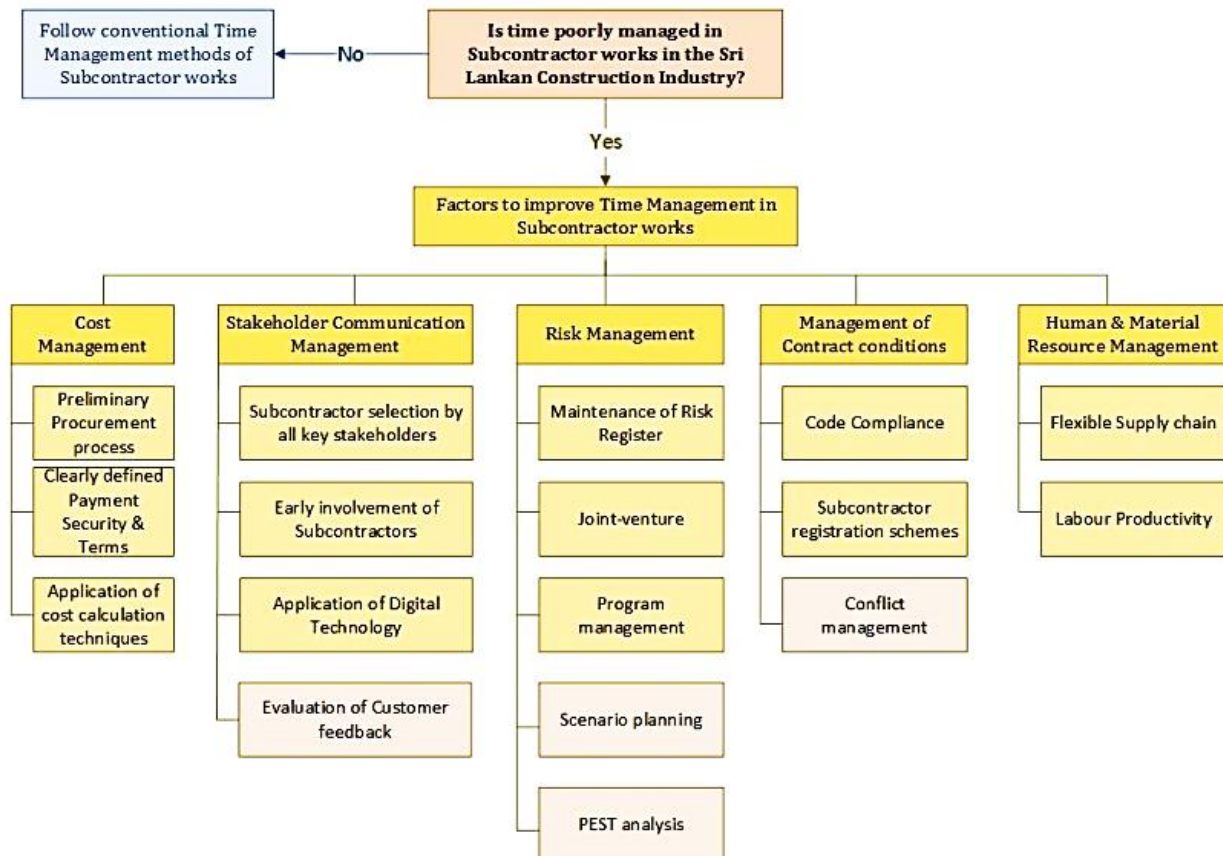
Figure 8 - Modified conceptual framework

As indicated in the framework above, many time improvement factors were recognized and can be classified as cost management, stakeholder communication management, risk management, management of contractual conditions and resource management. These time improvement strategies are required to benefit the subcontractors focusing on the Sri Lankan construction trade hence identifying the gaps and proposing suitable solutions and recommendations to the local industry.

Thus, finally according to the above discussions and modified framework, suitable recommendations on subcontract works time management were provided. The recommendations included implementation of methodologies on managing costs, proper stakeholder communications, risks mitigation strategies, contractual conditions and resources as put forward after the analysis on scholarly theories. Furthermore, inclusions of customer feedback, scenario planning, PEST analysis and conflict management were the additional factors grasped from the practical outset of the Sri Lankan subcontract industry.

The study by Loosemore (2014) indicates the improvements for time management in the overall subcontract works, while the investigation by Akintan and Morledge (2013) provided suitable suggestions; both articles collaboratively defending the solutions and recommendations given at the conclusion of this research justifying it as an acceptable approach towards fulfilling the aims and goals of this research. Therefore in conclusion, this frame work which was thus formulated by the data generated from the study carried out, could

be effectively used for the improvement of time management of subcontractor works in the Sri Lankan Construction industry.

Practical Application

In the present context, a 14 storey academic building for a private university in the suburbs of colombo is undergoing delays in its execution phase. Firstly, the procurement strategies of the project had not been properly formulated. This can be identified by cross referencing the framework with the project condition. Therefore the procurement process can be closely monitored to prevent any conflict between the agreed terms and execution.

Stakeholder communication is also a cause for the project delay due to lack of involvement by key stakeholders in evaluating the subcontractors. Furthermore the digital infrastructure was not properly backed up for uninterrupted communication and coordination which was strongly felt during the COVID-19 pandemic period. While some of these concerns could only be rectified after experiencing them, it is obvious that the other issues could be readily avoided or minimized without causing further delay.

Finally, the flexibility in the supply chain of the project was not witnessed as resource management had not been properly planned. The stakeholders were confused on the process of obtaining the resources as no proper guideline had been shared among all. This needs to be properly addressed by first identifying the causes with the help of the framework developed.

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AN INVESTIGATION OF MATERIAL MANAGEMENT & ITS IMPACT IN HIGH RISE BUILDINGS IN SRI LANKA

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Abstract

The main aim for conducting this research that, ensure the effective material management system eliminating the issues/impacts for high rise buildings in Sri Lanka. It is observed that there are massive inefficient MM systems in high rises buildings in Sri Lanka. Research data has collected under three categories. Comprehensive Literature review, Questionnaire Survey, and Structured Interview Survey. Key findings by investigating the research, a significant relationship between Material Management system and Project cost, and effective IT-Oriented program is required for enchasing the MM System. Fully coordination is required among team members of the project and required the latest innovation procurement methods for purchasing, quality management, and Inventory related works. Recommended implementing the proper implementation method for MM System at the beginning of the project. Successfully found the solutions to mitigate the impacts/issues by proposing the in-efficient MM system for the successful completion of the High-rise project.

Key words: ERP-   Enterprise resource planning, JIT Method - Just in Time, MM System - material management system, MRP-Material requirement planning

Introduction

MATERIAL MANAGEMENT

In construction, governing the field and workplace events, planning, implementing is the material management practice. Correct use of places where construction materials are available at the places whenever required is the goal of material management. (Patel.H. et al., 2015) According to Madhavi (2013) Materials management is defined as a management process that is compulsory in planning and controlling the correct quality of materials, and a good price for the right quantity as required. Johnson and Malucci (1999) explained the complete cycle of material management beginning from the planning process until utilizing the material into the project process. So all of the manufacturing, transporting, storing, and utilizing processes would be entered.

AIMS AND OBJECTIVES

AIM

The aim of the research is to ensure the effective material management system eliminating the issues/impacts for high rise building projects.

OBJECTIVES

- Identify the types/sections of material management system and those results linking to the literature review
- Investigate the issues and impacts for each types of material management system in local projects.

- Finding the solutions based on the material management techniques and recommending the best performs material management systems for a high rise building.

SIGNIFICANCE OF THE STUDY

In high rise building construction, material management is a valuable concept. Important of this is, reducing the project cost and also giving numerous benefits. Many more research papers, case studies and abstracts has been published by the Authors addressing to the material management system by different aspects; ex. MM system of different countries, different construction scales, specified products.

 "An Investigation of Material Management & Its Impact in high rise buildings in Sri Lanka" is the research topic that has been not published by any Author so far globally. By this research is preparing to achieve its aims and objectives and dreaming to put in hand successful and productivity output.

Methodology

To achieving the aim, the objectives of the research must be manipulated under the perfect methodology. Singh, Y.K., (2006) this research had been identified under the main three objectives which were summarized in the Introduction part.

This research was aimed to use mixed methods, both quantitative and Qualitative believing that embracing this combination reaches having the advantage of gaining a powerful research plan and succeeding in effect plus trustworthy results. Objectives were discussed by the mixed method as follows and Objective 01 will be discussed in a future research.

PLAN A – (QUESTIONNAIRE SURVEY)

According to Naoum (1998) there are certain distinctive advantages of using questionnaire survey. For achieving the objective 02 and 03, prepared the questionnaire to receive the feedback from the professionals. In this assignment, targeted fifty professionals under the few different professional groups in Industry (experienced in relevant positions). Minimum 06 persons from each category participated in the survey. As usual practice in the survey, questions are evaluated from 1- 5 in relation to the level of contribution and effect of each factor.

PLAN B – (STRUCTURE INTERVIEWS)

Plan B was implemented by selecting at least 03 ongoing or completed high rises projects and conducting the case study (visiting site and interviews) with management groups. Expecting to hold 20-30 minutes interview to discuss their impacts/issues and also the enhancement points, good managing techniques that they have taken to mitigate them.

Results

Objective 01 identified the types/sections of the material management system achieved with the research paper. Further discussion will be required in the future.

1. **Materials Requirements Planning (MRP)**
2. **Enterprise Resource Planning (ERP)**
3. **Purchasing**
4. **Inventory Planning and Control**
5. **Flow and Supply of Materials**

6. Quality Control of Materials
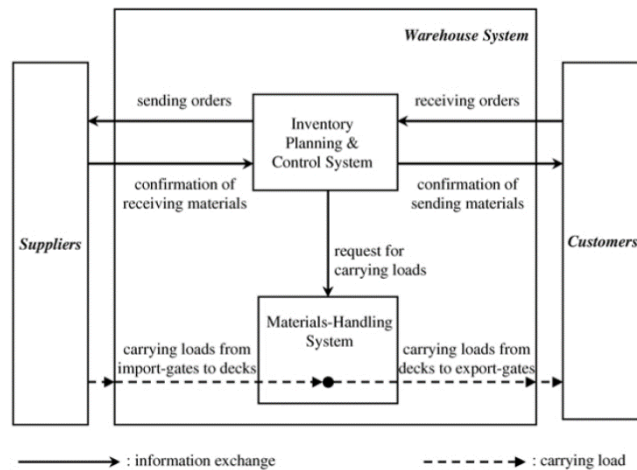
Figure 01- Inventory Planning and Controlling System
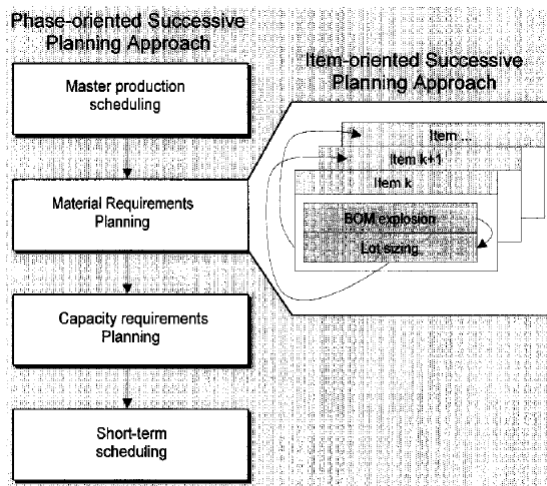
Figure 1. Phase-oriented and item-oriented successive planning approach of material requirements planning.

Figure 02- Figure of Material Requirement Planning

Objectives had been achieved by questionnaire Survey and Structure Interview Survey. Under the Plan A, questionnaire was prepared and sent to selected professionals receiving their outcome. (Refer to the below Table 01)

Table 01- Distribution of Respondents by Profession

Profession	No. of Response	As a Percentage
Director/Manager	10	19.2%
Project/Site Engineer	12	23.1%
Architect	11	21.2%
Quantity Surveyor	10	19.2%
Stores In-charge	9	17.3%
Total Response	**52**	**100%**

Responds has been received upon the experience of the professionals and it is presented in Table 02. As per the results, most of them are under the 5-10 experience categories.

Table 02- Distribution of Respondents by Experience

Experience Range	No. of Response	As a Percentage
Below 05 Years	11	19.2%
5-10 years	20	23.1%
11-15 years	17	21.2%
Above 15 years	4	19.2%
Total Response	**52**	**100%**

Questionnaire Survey Structure was build up under the 04 main sections by touching the overall Material management system. There were 27 multi-choice questions and one short answer question for expressing personal ideas. Mean value had been introduced to measure the high value of the response against each question.

Table 03- Most important points- Questionnaire Survey

Most important points were identified through the Questionnaire Survey through the Participants marks
1. MM System was recommended by participants to increase project profit and efficiency.
2. Improper preservation of resources effecting badly for the MM System.
3. Effecting badly for MM System by calculating excess quantity, changing of specifications, design changes and etc.
4. The improper method of Storage, fewer store spaces, no proper identification of material performance creating uncomfortable situation for MM system.
5. There should be proper labor handling systems, appropriate labor requirement, safety procedures and better communication required for MM System.
6. To maximize the value of MM system, need to manage excessive transport cost, selecting proper supply chain and maintain proper procurement method.
7. Gathering all departments and taking decisions would be highly important for MM System.
8. Using latest IT soft wares, programs, systems, security systems for implementing productive MM System.

To achieve objectives, three high-rises projects were selected for the structured interview to analyzing the current actual effect or success of the Material management system. The Chief in-charge person was called for the interview of each project. All responsible persons were interviewed for 15-20 minutes and 12 questions were for the response. Noticed that there are some common impacts/ enhancing methods has identified from their responses related to all three projects.

Table 04- Most important points- Interview Survey

Most important points were identified through the Structured Interview
1. Delays for granting BOI approvals for imports by the government.
2. Changing Gazettes time to time
3. Implementing the ERP/MRP System
4. Using Computer data base software
5. Arranging CCTV and Well Security system for site premises
6. Coordinating all departments together to discuss issues of the MM system
7. Training programs required for the person who follows MM System
8. Implementing JIT Method

Discussion

According to the research findings, it was noted that most of the respondents have given marks to control wastages and avoiding improper handling of the material by the controller as profitable for the project. Also Kasim et al. (2005) described with his research the importance of controlling the wastages of materials to gain project profit. Also noted that proper Inventory management system should require for getting benefits for the projects during the research. This had been described by Eckert et al. (2007) in his research, as a modern successful method, respondents has identified the importance of the JIT Inventory system. (Just in Time) Sahari et al. (2012) also stated that.

Pursuant to the results of this research and the results of Patil et al (2013) both described that achieving the objectives of the MM system efficiently, there should be proper procedures on material planning, purchasing, procuring, receiving, storing quality assurance, selecting a professional supply chain and etc. Further noted that adequate space is required for storing and handling the materials smoothly. Also, Respondents have illustrated the requirement of logistic process regarding warehouses, workshops, and access roads that should be more flexible to achieve the requirement and also explained by the Author (Pellicer, et al., 2013)

As stated in his research by Donyavi. S (2009), highlighted common problems that can be forced on the material management system. Also, the same issues and problems have been detected in this research such as; failure on ordering at one time, delivering at the wrong time, over-ordering, wrong material identification, and ordering, theft cases, inadequate materials. Also, he mentioned that one or more of these happening forces the project delay and loss.

In this research, it was admired by the respondent about modern ERP/MRP system for MM system giving more benefits Implementation of Materials Management in Construction Projects. Kasim et al. (2011) also pointed out on the ICT (Information and Communication Technology) to implement to MM System. Risk management factor also important point that had been discussed in this research. Insurance for transferring the risk for high rises construction projects. Also Kulińska, E., (2014) has described about the importance of cost of risk in material management.

Conclusion and Recommendation

KEY FINDING OF THE RESEARCH

- Most of projects are following the manual operation systems in their projects concerned the MM System.
- There is a significant relationship between these MM process systems and project value. Most of them depending on project cost compared to the process.
- Identified the more prioritized impacts or solutions by referring to high scores of mean values throughout the Questionnaire Survey.
- Most of the Interview surveys were keen on required to implement proper IT-Oriented programs (ERP/MRP) system for the MM system
- Most of high- rise project investors were eligible for receiving duty-free tax facility for material imports as an encouragement the country developed programs implementing by the government.
- There is a significant relationship between material management system and project delivery in terms of delay and cost overrun.
- Highly detected on this research, the Government has taken more time to release the approvals for the import materials, due to changing import policies time to time contractors facing so many obstacles and loss due to delaying progress as well as some additional penalties.

In this research, it is highly understood that the present material management system having so many practical issues/impacts to enhance the system. The recommendation is made the material management system as the key considerable unit when comparing other construction events. There is a significant relationship with the projected profit with the system if it implemented inefficiently. Because 60% of the cost value will be for the materials when considering the total project cost. The recommendation is made to implement a proper implementation method for the MM System at the beginning of the project. As respondents said if can implement with some ERP system that will be the best option to mitigate lots of impacts those forcing for enhancing the system. It can link with the MM system and other related sources. Further recommending a good security system for the stores and project premises. Other rest of the impacts that arise during the project period can be mitigated by taking the best solution discussing with the management. Also, the JIT system, having more benefits related to the MM system.

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A STUDY TO DETERMINE THE MOST SUITABLE MODERN ROAD CONSTRUCTION TECHNIQUE FOR WESTERN PROVINCE IN SRI LANKA

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Abstract

Public transport in Sri Lanka mainly based on the road network which centred on Sri Lanka's capital city of Colombo. Unfortunately, transportation in Sri Lanka is a serious problem. Hot weather conditions and insufficient maintenance often lead to deterioration of asphalt roads in Sri Lanka. The conducted research provides of introducing robust modern road construction methods such as plastic roads, cell filled concrete roads, permeable concrete roads, solar roads and electric priority roads for the Western province in Sri Lanka. A questionnaire survey has developed by the aid of interviews done with professionals in the industry. Web articles, books, journal articles, websites and previous researches have used as a secondary data collection method. Conclusion and recommendations mainly based on hypothesis test to find out the most suitable modern road construction method for the Western province in Sri Lanka.

Keywords: Feasibility Study, Modern Road Construction Technologies, Most Suitable Method

Introduction

Roads are the backbone of the country's transport sector. Roads help to transport people and goods, increase economic growth and reduce the poverty of a country. About 93% of land transport in Sri Lanka consists of roads. Roads play a vital role in the sustainable development of a country. The construction industry is changing rapidly, and new materials and technologies are constantly being introduced. Future Roads are focused on supporting the Sri Lankan government and industries to respond for issues and risks related to climate change, availability of natural resources, and issues related to energy. Sri Lanka needs to go beyond traditional road construction methods to minimise the disadvantages of ordinary road construction.

Problem Identification

Traffic congestion is one of the most prevalent transport problems in the present. As attested by (Hewage, 2018), Sri Lanka is experiencing a substantial financial and human hour loss due to lack of proper traffic in large Colombo areas, with an estimated loss of Rs 360 billion per annum.

Waste plastic is another big problem in Sri Lanka. Plastic can be used to improve strength and durability properties in road construction and pavement, as an insulator or conduit in building construction, as a raw material for textile production, and as a fastener for bulk items (Aljerf, 2015; Kamaruddin, et al., 2017).

Asphalt concrete depletes natural resources. Asphalt is a petroleum-based product. Hydrocarbons released in the asphalt manufacturing process. This issue leads to air pollution.

Asphalt roads can damage during heavy rains and dangerous weather conditions. The durability of asphalt roads is short.

Objectives

- To study which modern road construction technique applies to Western Province in Sri Lanka by considering existing road construction technology.
- To explore an eco-friendly modern road construction method for the Western province in Sri Lanka.
- To investigate a modern road construction method with minimum construction cost.
- To propose the most suitable modern road construction method for Western Province in Sri Lanka.

Significance of The Study

This study encourages the government sector and private sector of the road construction industry to adopt successful modern road construction technologies to Sri Lanka. The students can improve and develop other research based on this study. The content of this study is very important to ministries related to natural resources, disaster management and geological survey and mines to suggest eco-friendly road construction methods.

Limitation

This study is limited to analyse feasibility to such areas as financial, environmental and technology for Western province in Sri Lanka. Life cycle cost assessment does not apply for the modern road construction types and considering as short-term projects for an initial investment.

Plastic Roads

According to (economynext, 2018), Asset Group of Companies Private Limited has embarked on plastic road construction in Sri Lanka. The pilot project is 500m road from Ratmalana to Borupana in the South of Colombo. To this project, waste plastic was extracted from Municipal waste (see Figure i).

Figure *1*: Plastic road in Ratmalana

Adapted from: (Daily News, 2018)

Road strength is twice stronger than normal roads and does not increase the cost of road construction are salient features of the plastic roads.

Cell Filled Concrete Roads

Cell filled concrete roads are much cheaper compared to asphalt concrete roads. The average life span of a cell filled concrete paths can be 15 – 20 years. Cracks do not appear on road carriageway due to the flexibility of this road type. Construction of cell filled concrete ways is mainly based on human resources and not much machinery required. This road construction method is ideally suited for rural roads. Acknowledged to (Roy, et al., 2010), cell filled pavement is only suitable for low volume traffic and not suitable for heavy load traffic, and foundation failure of shear occurred.

Permeable Concrete Roads

Pervious concrete has been used in pavement applications ranging from driveways and parking lots to residential streets, alleys, and other low-volume roads (Tennis, et al., 2004). Pervious concrete is also widely used in Europe and Japan for roadway applications as a surface course to improve skid resistance and reduce traffic noise, where porous concrete is a layer over the impermeable layer. Glendale Stadium Parking and Ride Facility in Arizona has been constructed by permeable concrete. Acknowledged to (Stiffler, 2020), a 32,000-square-foot road established in 2006 in the Sultanate of Snohomish County, Washington used an inflatable pavement for public ownership.

Reduces the stormwater runoff and allows more efficient land development are salient features of permeable roads.

Solar Roads

Figure 2: Solar roads

Adapted from: (McFadden, 2019)

A solar roadway is a series of structurally engineered solar panels that can drive. The idea is to replace current petroleum-based asphalt roads, parking lots and driveways with solar road

panels that collect energy to be used by homes and business and ultimately to be able to store excess energy in or alongside the solar roadways (Shingate, et al., 2017) (See Figure ii). Acknowledged to (Jeff, 2018; Hruska, 2014; sandpointidaho, 2017), some Europe countries are still taking benefits of solar roads.

Electric Priority Roads

An interesting new idea that recently came to our attention is the Electric Priority Lane. It would work as a separate lane with the purpose of giving the option to E.V (electric vehicles) users to charge on the go. This would benefit them in the way of not having to stop and look for a charging station. Electric Priority Lanes would also function as a way for electrical cars to do long distance traveling (Realgymnasiet, 2015) (see Figure iii).
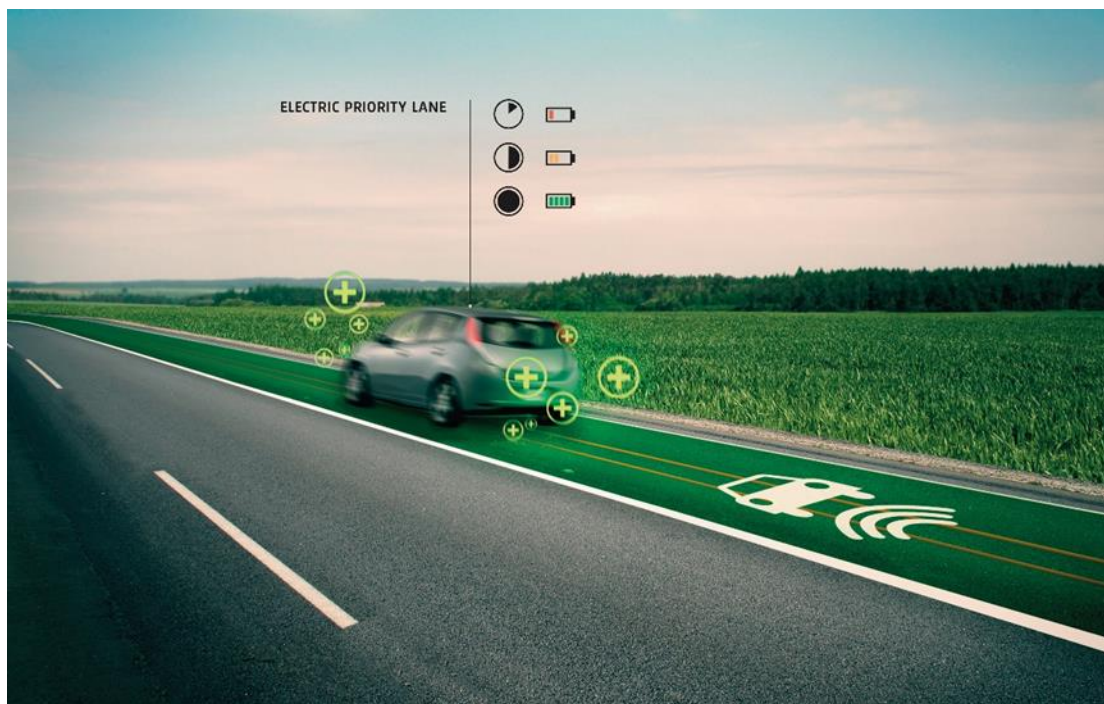
Figure 3: Electric priority lane

Adapted from: (studioroosegaarde.net, 2019)

Netherlands, Norway and Korea have electric priority roads. Roads now no longer remain as a medium to travel from one place to another. People can now use it to charge electric cars and harness solar energy due to its large, exposed surface area.

Methodology

As a primary data collection method, a questionnaire will be prepared using Google Forms to collect data from 175 number of industry professionals. The Likert scale will be used to analyse and improve the accuracy of the data which is collected by the questionnaire. Collected data transfer to data analysation software called SPSS. Books, journals, reports and internet sources use as secondary data collection to justify most suitable road construction method. Four hypothesises develop and analysed by mathematical analysis methods such as descriptive analysis, correlation analysis and regression analysis.

Hypothesis

H₁: Plastic road does not require specific technology compared to other modern road construction techniques.

H₂: Plastic road is an environmentally friendly method compared to other modern road construction techniques.

H₃: Plastic road is a cost-effective road construction method compared to other modern road construction techniques.

H₄: Plastic road is the most suitable road construction method for the Western province in Sri Lanka by considering environmental issues, technology issues and construction cost.

Results

Descriptive analysis

Table *1*: Summary of descriptive analysis for Technology

Concept	Factor	Technology		
		Mean value	Score range	Category
Road construction methods	Plastic roads	3.82	3.67 - 5.00	Strong
	Cell filled concrete roads	3.66	2.33 - 3.67	Moderate
	Permeable concrete roads	3.47	2.33 - 3.67	Moderate
	Solar roads	3.22	2.33 - 3.67	Moderate
	Electric priority roads	2.98	2.33 - 3.67	Moderate

Table *2*: Summary of descriptive analysis for Environment

Concept	Factor	Environment		
		Mean value	Score range	Category
Road construction methods	Plastic roads	3.61	3.67 - 5.00	Moderate
	Cell filled concrete roads	3.52	2.33 - 3.67	Moderate
	Permeable concrete roads	3.33	2.33 - 3.67	Moderate
	Solar roads	3.24	2.33 - 3.67	Moderate
	Electric priority roads	2.71	2.33 - 3.67	Moderate

Table *3*: Summary of descriptive analysis for Financial

Concept	Factor	Financial		
		Mean value	Score range	Category
Road construction methods	Plastic roads	3.69	3.67 - 5.00	Strong
	Cell filled concrete roads	3.51	2.33 - 3.67	Moderate
	Permeable concrete roads	3.32	2.33 - 3.67	Moderate
	Solar roads	2.02	1.00 - 2.33	Adverse
	Electric priority roads	1.95	1.00 - 2.33	Adverse

Highest mean values in the above tables (see Table i, ii and iii) represent strong relationship between dependent variables and independent variables. Plastic roads are in 'strong' category. Other road types are in 'moderate' and 'adverse' categories in the mean value table.

Correlation Analysis

Table *4*: Matrix of inter-correlation

Measure	Mean	Standard Deviation	Plastic roads	Cell filled concrete roads	Permeable concrete roads	Solar roads	Electric priority roads	Road type
Plastic roads	3.82	1.681						
Cell filled concrete roads	3.66	1.524						
Permeable concrete roads	3.47	1.509						
Solar roads	3.22	1.611						
Electric priority roads	2.98	1.427						
Road type	3.43	1.692						
Technology	3.70	1.765	0.967	0.912	0.881	0.869	0.892	0.954

Table 5: Relationship between technology and road type

Relationship with technology	Pearson correlation	Significance level	Strength of correlation
Road type	0.954	0.000	Strong positive relationship
Plastic roads	0.967	0.000	Strong positive relationship
Cell filled concrete roads	0.912	0.000	Strong positive relationship
Permeable concrete roads	0.881	0.000	Strong positive relationship
Solar roads	0.869	0.000	Strong positive relationship
Electric priority roads	0.892	0.000	Strong positive relationship

Table 6: Matrix of inter-correlation

Measure	Mean	Standard Deviation	Plastic roads	Cell filled concrete roads	Permeable concrete roads	Solar roads	Electric priority roads	Road type
Plastic roads	3.61	1.589						
Cell filled concrete roads	3.52	1.602						
Permeable concrete roads	3.33	1.593						
Solar roads	3.24	1.621						
Electric priority roads	2.71	1.375						
Road type	3.28	1.432						
Environment	3.74	1.626	0.958	0.922	0.903	0.937	0.852	0.951

Table 7: Relationship between environment and road type

Relationship with the environment	Pearson correlation	Significance level	Strength of correlation
Road type	0.951	0.000	Strong positive relationship
Plastic roads	0.958	0.000	Strong positive relationship
Cell filled concrete roads	0.922	0.000	Strong positive relationship
Permeable concrete roads	0.903	0.000	Strong positive relationship
Solar roads	0.937	0.000	Strong positive relationship
Electric priority roads	0.852	0.000	Strong positive relationship

Table 8: Matrix of inter-correlation

Measure	Mean	Standard Deviation	Plastic roads	Cell filled concrete roads	Permeable concrete roads	Solar roads	Electric priority roads	Road type
Plastic roads	3.69	1.610						
Cell filled concrete roads	3.51	1.597						
Permeable concrete roads	3.32	1.591						
Solar roads	2.02	1.123						
Electric priority roads	1.95	1.068						
Road type	2.90	1.417						
Financial	3.70	1.430	0.921	0.903	0.891	0.792	0.592	0.928

Table *9*: Relationship between financial and road type

Relationship with financial	Pearson correlation	Significance level	Strength of correlation
Road type	0.928	0.000	Strong positive relationship
Plastic roads	0.921	0.000	Strong positive relationship
Cell filled concrete roads	0.903	0.000	Strong positive relationship
Permeable concrete roads	0.891	0.000	Strong positive relationship
Solar roads	0.792	0.000	Positive relationship
Electric priority roads	0.592	0.000	Moderate positive relationship

The significance level of the above correlation analysis shows a value of 0.000 (see Table v, vii and ix). According to the correlation statistics, significance level should below 0.05 to get a strong relationship between independent variables and dependent variables. Also, Pearson correlation values circulate 1.000 and it shows a strong relationship between variables. Hence, both variables have linearity.

Regression Analysis
Technology Factor

Table 10: Independent variables and dependent variables compared to technology
Coefficients[a]

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Standard error	Beta		
(Constant)	0.008	0.076		0.110	0.911
Plastic roads	0.635	0.063	0.620	10.200	0.000
Cell filled concrete roads	0.605	0.132	0.585	4.566	0.000
Permeable concrete roads	0.328	0.089	0.371	3.692	0.000
Solar roads	0.180	0.083	0.200	2.800	0.000
Electric priority roads	0.093	0.071	0.195	2.151	0.000

Sig. values of independent variables are zero. Hence, sig. value related to constant will be neglected. The table according to the adjusted constant sig. value as follows (see Table x),

Table 11: Adjusted constant value

Coefficients^a

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Standard error	Beta		
Plastic roads	0.636	0.063	0.622	10.205	0.000
Cell filled concrete roads	0.606	0.133	0.584	4.562	0.000
Permeable concrete roads	0.329	0.087	0.373	3.690	0.000
Solar roads	0.190	0.084	0.203	2.802	0.000
Electric priority roads	0.095	0.070	0.192	2.153	0.000

Table 12: Analysis of variance (ANOVA) F chart

ANOVA^b

Model	Sum of squares	df	Mean square	F	Sig.
Regression	1732.583	5	410.953	3852.063	0.000^a
Residual	18.235	155	0.182		
Total	1750.818	160			

b. Dependent variable

Table *13*: Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.750	0.700	0.687	0.32504

The significance value of plastic roads, cell filled concrete roads, permeable concrete roads, solar roads and electric priority roads is zero and it means to have a considerable effect on technology factor. Due to easiness of writing formula, following abbreviation continues, according to the coefficient table (see Table xi) regression equation can be written as follows,

$$y = c + mx$$

Dependent variable = Population y intercept + Population slope coefficient x Independent variable

According to the scenario,
Technology = 0.636 Plastic Road + 0.606 Cell Filled Concrete Road + 0.329 Permeable Concrete Road + 0.190 Solar Road + 0.095 Electric Priority Road ⟶ 1
The R^2 value is 0.700. This indicates the model adequacy of modern road types with technology is 70%.

Environmental Factor

Table *14*: Independent variables and dependent variables compared to the environment

Coefficients[a]

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Standard error	Beta		
(Constant)	0.010	0.079		0.180	0.922
Plastic roads	0.644	0.065	0.613	9.520	0.000
Cell filled concrete roads	0.623	0.142	0.593	4.689	0.000
Permeable concrete roads	0.356	0.070	0.385	3.781	0.000
Solar roads	0.242	0.072	0.180	2.752	0.000
Electric priority roads	0.198	0.061	0.172	2.100	0.000

Table *15*: Adjusted constant value

Coefficients[a]

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Standard error	Beta		
Plastic roads	0.646	0.080	0.623	9.521	0.000
Cell filled concrete roads	0.622	0.066	0.595	4.620	0.000
Permeable concrete roads	0.357	0.145	0.386	3.688	0.000
Solar roads	0.241	0.085	0.200	2.750	0.000
Electric priority roads	0.199	0.065	0.170	2.120	0.000

Table *16*: Analysis of variance (ANOVA) F chart

ANOVA[b]

Model	Sum of squares	df	Mean square	F	Sig.
Regression	1752.421	5	415.932	3714.023	0.000[a]
Residual	18.438	155	0.172		
Total	1770.859	160			

b. Dependent variable

Table *17*: Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.880	0.820	0.752	0.28476

The significance value of plastic roads, cell filled concrete roads, permeable concrete roads, solar roads and electric priority roads is zero and it means to have a considerable effect on environmental factor. According to the coefficient table (see Table xv) regression equation can be written as follows,

Environmental = 0.646 Plastic Road + 0.622 Cell Filled Concrete Road + 0.357 Permeable Concrete Road + 0.241 Solar Road + 0.199 Electric Priority Road ————▶2

Financial Factor

Table *18*: Independent variables and dependent variables compared to financial

Coefficients[a]

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Standard error	Beta		
(Constant)	0.020	0.081		0.195	0.932
Plastic roads	0.720	0.062	0.611	8.236	0.000
Cell filled concrete roads	0.673	0.078	0.591	6.964	0.000
Permeable concrete roads	0.628	0.066	0.422	4.992	0.000
Solar roads	0.592	0.078	0.195	3.847	0.000
Electric priority roads	0.542	0.053	0.095	2.180	0.000

Table *19*: Adjusted constant value

Coefficients[a]

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Standard error	Beta		
Plastic roads	0.717	0.080	0.612	8.235	0.000
Cell filled concrete roads	0.671	0.063	0.590	6.962	0.000
Permeable concrete roads	0.629	0.075	0.421	4.990	0.000
Solar roads	0.591	0.064	0.193	3.848	0.000
Electric priority roads	0.540	0.079	0.098	2.190	0.000

Table *20*: Analysis of variance (ANOVA) F chart

ANOVA^b

Model	Sum of squares	df	Mean square	F	Sig.
Regression	1812.685	5	391.726	3625.135	0.000^a
Residual	19.238	155	0.142		
Total	1831.923	160			

b. Dependent variable

Table *21*: Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.920	0.880	0.863	0.39856

The significance value of plastic roads, cell filled concrete roads, permeable concrete roads, solar roads and electric priority roads is zero and it means to have a considerable effect on financial factor. According to the coefficient table (see Table xxi) regression equation can be written as follows,

Financial = 0.717 Plastic Road + 0.671 Cell Filled Concrete Road + 0.629 Permeable Concrete Road + 0.591 Solar Road + 0.540 Electric Priority Road ⟶ 3

The R^2 value is 0.880. This indicates the model adequacy of modern road types with technology is 88%.

Feasibility Study

Table *22*: Feasibility study for independent variables and dependent variables

Coefficients^a

Model	Unstandardised coefficients		Standardised coefficients	t	Sig.
	B	Standard error	Beta		
(Constant)	0.016	0.081		0.172	0.901
Plastic roads	0.886	0.062	0.697	8.236	0.000
Cell filled concrete roads	0.721	0.124	0.600	6.964	0.000
Permeable concrete roads	0.673	0.059	0.113	4.992	0.000
Solar roads	0.623	0.042	0.195	3.847	0.000
Electric priority roads	0.576	0.031	0.095	2.180	0.000

Table *23*: Adjusted constant value

Coefficients[a]

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Standard error	Beta		
Plastic roads	0.886	0.064	0.698	8.253	0.000
Cell filled concrete roads	0.721	0.123	0.602	7.108	0.000
Permeable concrete roads	0.673	0.060	0.110	5.112	0.000
Solar roads	0.623	0.044	0.196	3.752	0.000
Electric priority roads	0.576	0.030	0.100	2.183	0.000

Table 24: Analysis of variance (ANOVA) F chart

ANOVA[b]

Model	Sum of squares	df	Mean square	F	Sig.
Regression	1935.772	5	382.721	3523.252	0.000[a]
Residual	18.452	155	0.138		
Total	1954.224	160			

Table *25*: Model summary

Model	R	R^2	Adjusted R^2	Std. error of the estimate
1	0.935	0.923	0.924	0.49568

The significance value of plastic roads, cell filled concrete roads, permeable concrete roads, solar roads and electric priority roads is zero and it means to have a considerable effect on feasibility factor. According to the coefficient table (see Table xxiv) regression equation can be written as follows,

Feasibility = 0.886 Plastic Road + 0.721 Cell Filled Concrete Road + 0.673 Permeable Concrete Road + 0.623 Solar Road + 0.576 Electric Priority Road ⟶ 4

The R^2 value is 0.923. This indicates model adequacy of modern road types with feasibility is 92.3%.
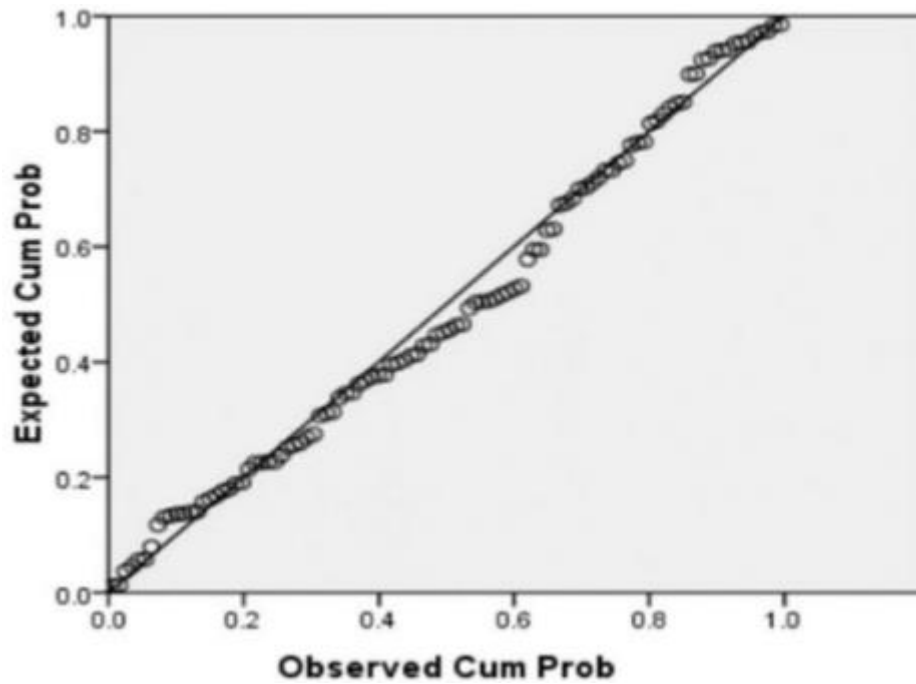
Figure *26*: Normal P-P of regression standardized residual
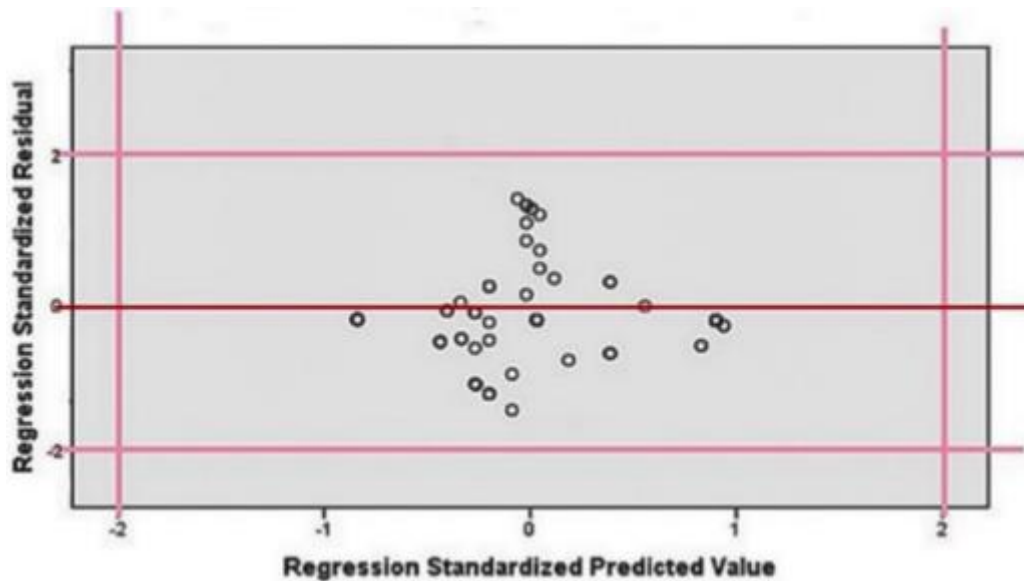
Figure *27*: Scatter graph

Hypothesis Tests

There has a positive Pearson correlation value of plastic roads when considering the technology, environment, financial and feasibility factors. Therefore, it has a strong relationship with the factors (significance level is below 0.05). Thus, statistics prove enough reasons for reject H_0 of the hypothesises.

'To conclude most suitable modern road construction method for Western Province in Sri Lanka' is one of the main objectives of this study. Plastic roads have a great impact on technology, environment, financial and feasibility factors compared to other modern road construction techniques. Above data, interpret, modern road construction techniques will be a great revolution for the road construction industry in Sri Lanka.

Table *28*: Modern road ranking

Road Type	Coefficient	Rank
Plastic Roads	0.886	1
Cell Filled Concrete Roads	0.721	2
Permeable Concrete Roads	0.673	3
Solar Roads	0.623	4
Electric Priority Roads	0.576	5

Conclusions and Recommendations

Based on the regression analysis, feasibility formula interprets the highest rank of the modern road construction techniques. Feasibility formula is an overall test (the relationship between modern road techniques with technology, environment and financial factors) done to find out most suitable modern road construction method to the Western province in Sri Lanka.

According to regression analysis for feasibility factor, most suitable modern road methods for Sri Lanka can be ranked upon highest coefficient values as follows (See Table xxvi),

Feasibility of innovative technology cannot only depend upon numerical data. There are other factors and findings to be considered such as PESTEL analysis, Risk analysis and Life Cycle Cost Analysis. This study is limited to discuss feasibility factors of technology, environment and financial among above feasibility factors because rest is common when compared with existing road types.

According to the (bizenglish.adaderana.lk, 2018), Asset Group has embarked plastic road construction in Sri Lanka. This budget road construction method got success and should be spread to other provinces.

Acknowledged to (Madke & Harle, 2016), construction and maintenance of PCCB pavements are economical, a budget method with simple technology. The existing concrete road technology should be updated to construct cell filled concrete roads.

Under (Tennis, et al., 2004), permeable concrete roads are beneficial to Sri Lanka for stormwater management due to its rapid water disposal mechanism. This value appears to be significantly higher than the cost of a standard asphalt surface of the same length (USD 1.13 million/ km).

According to (Interesting Engineering, 2017; Moynihan, et al., 2019; Mitchell, 2017; Hruska, 2014), solar roads have failures. Also, solar roads are currently impractical due to the high construction cost. The design is far too expensive, unreliable, and does not work. With the technology available today it is not feasible to design such a project. Because of that solar road projects do not suitable for Sri Lanka.

Electric priority road is a good green concept considering technology and environment factors. According to (Karagiannopoulos, 2018), the state-funded project in Sweden, named eRoad Arlanda and costing about USD 5.82 million. The total road length is 2km and the construction cost is much expensive when comparing to other road construction methods. Considering practical feasibility factors, this type is even not suitable for expressways in Sri Lanka.

Engineers can refer to this research as a feasibility study when preparing a project brief for new road construction projects. Sri Lanka must go beyond traditional road construction methods to eliminate the dark side of ordinary asphalt road construction.

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HEALTH SCIENCE

OPTIMIZATION OF A NESTED RT-PCR FOR THE DETECTION OF *Canine morbillivirus* VIRUS IN DOGS.

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Abstract

CDV is a major cause of morbidity and mortality among domestic dogs and is a threat to both domestic and wild animals as it has a broad host range. It is also seen as a threat to conservation as many hosts that are susceptible to infection are endangered species. This study aimed to optimize a sensitive assay to detect CDV RNA. Based on the results obtained from this study the RT-nPCR method optimized in this study is a highly sensitive method of detecting CDV RNA, with a minimum detection level of at least 2^3 less than the assay developed by Frisk, König, Moritz and Baumgärtner (1999) which has been used as a standard assay to detect CDV from clinical samples. Further work must be done in order to develop this assay as a clinical diagnostic tool.

Key Words: Canine Distemper, Viral Detection, Reverse Transcription, Nested PCR

Introduction

Canine distemper is caused by the highly virulent *Canine morbillivirus* (commonly known as canine distemper virus; CDV). Canine distemper was first recorded in Europe in the 18th century and is believed to have been imported from South America. Since then it has spread throughout most of the world and continues to cause morbidity and mortality. Although the primary host for CDV is the domestic dog (*Canis familiaris*), it is capable of infecting and causing fatal disease in a wide range of terrestrial and marine species including many endangered species and is therefore considered a threat to animal conservation as well.

CDV like other *Morbilliviruses* such as *Measles morbillivirus* is mostly transmitted via aerosols or by direct animal-to-animal contact. In domestic dogs, puppies are the most vulnerable as most adult dogs are vaccinated. Specific detection of CDV is usually done using reverse transcription (RT)-PCR as symptoms are non-specific.

The aim of this study is to optimize an RT-nPCR in order to increase the sensitivity of diagnosis of CDV.

Methodology

RNA Templates

CDV positive RNA was provided by the laboratory to be used as the template in this study. This RNA was extracted from a commercially available modified live virus (MLV) vaccine (Vanguard DA2L, Pfizer, USA). Distilled water was used as no template control (NTC) in all assays.

Serial dilution of positive control

Two-fold serial dilutions of the CDV positive control RNA were made up to a dilution factor of 2^{17} in order to measure the minimum detection level of the each assay.

CDV Specific oligonucleotide primers

The primers used in this study were adapted from Frisk, König, Moritz and Baumgärtner (1999) and Di Francesco et al. (2011) and are outlined in Table 1. The CDV Fi/CDV Ro primer pair amplifies a 200bp region within the 350bp amplicon of the CDV Fo/CDV Ro primer pair. The CDV *N* gene is a highly conserved region in the genome and is frequently used for the specific detection of CDV. All of these primers amplify a region of the *N* gene.

Table 1. Oligonucleotide primers used in the this study

Primer Name	Sequence (5'-3')	Amplicon Size
CDV Fw	ACA GGA TTG CTG AGG ACC TAT	287
CDV Rv	CAA GAT AAC CAT GTA CGG TGC	
CDV Fo	AAG ATC TGC CGG CAA AGT AAG CTC TG	351
CDV Ro	CGG TCA TCG TCG TTT CCA TC	
CDV Fi	CAC TCA GAA AGA TCC GAA GTC A	200

CDV Specific RT–PCR using a Standard Assay
RT-PCR was performed according to Frisk, König, Moritz and Baumgärtner (1999) with modifications using the CDV Fw/CDV Rv primer pair (Table 1) in order to determine the minimum detection level.

Temperature gradient PCR
An annealing temperature gradient RT-PCR was performed based on methods described in Di Francisco et al. (2011) with the CDV Fo/CDV Ro primer pair (Table 1) in order to determine the optimum annealing temperature of these primers for this assay. A range of temperatures between 50.0°C and 65.0°C was used as annealing temperature in the MyCycler Thermal Cycler System (Bio-Rad Laboratories, USA).

Primer Gradient PCR
Two step RT-PCR was conducted as mentioned in Di Francisco et al. (2011) with a concentration gradient of the CDV Fo/CDV Ro (Table 1) primer pair in order to determine the optimum primer concentration.

first round RT-nPCR
Two step RT-PCR was performed according to Di Francesco et al. (2011) with modifications based on the results of the temperature gradient PCR and primer gradient PCR using the CDV Fo/CDV Ro (Table 1) primer pair.

Second round RT-nPCR
First round amplification products from 2^9 onwards and the NTC from the first round were diluted ten-fold and amplified using the CDV Fi/CDV Ro primer pair according to Di Francesco et al. (2011) with modifications.

Agarose gel electrophoresis
PCR products were separated by using 2% agarose gels in 0.5X TBE with Ethidium Bromide staining for 60 minutes at 100V. Products were visualized using E-Gel Imager System with UV Light Base (Thermo Fisher Scientific, USA). TrackIt 50bp DNA Ladder (Invitrogen, USA) was used as a standard.

Results

CDV specific RT-PCR using standard assay

The results of the PCR as per Frisk, König, Moritz and Baumgärtner (1999) are shown in Figure 1. The 287bp amplicon specific for the *N* gene of CDV was visible up to the 2^{14} dilution and the NTC was clear.

Temperature gradient PCR and Primer gradient PCR
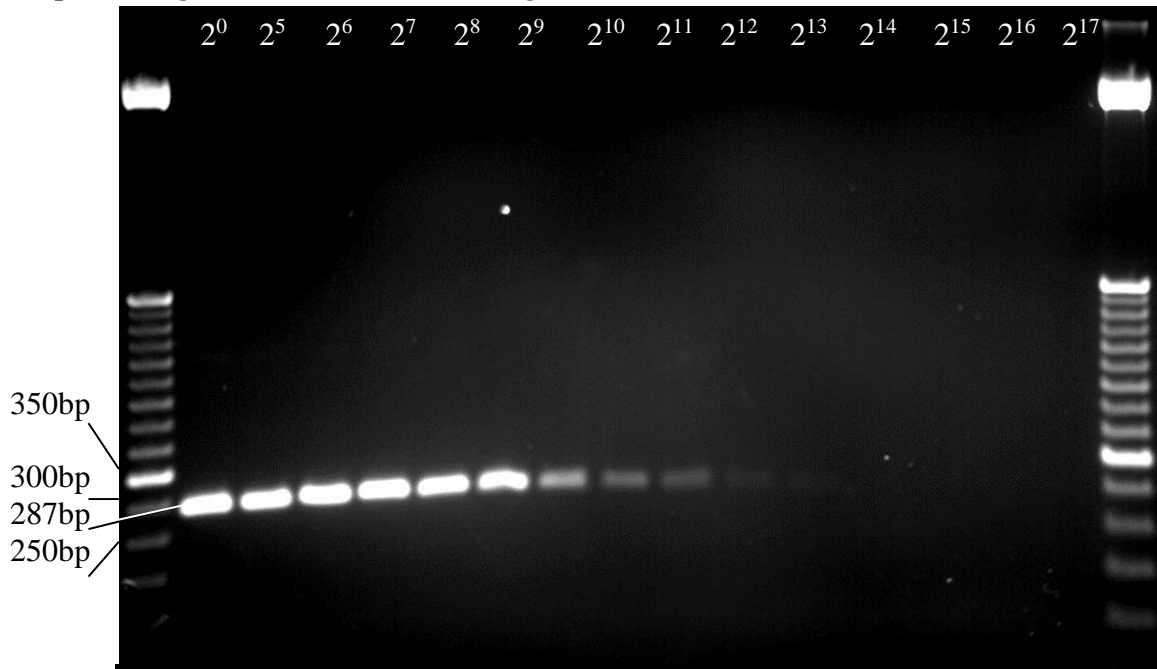
Figure 1 – RT-PCR as per Frisk, König, Moritz and Baumgärtner (1999). Lanes 1 and 17 contain the standard. Lane 16 contains the NTC. Lanes 2 -15 contains the products obtained by diluting the positive control by a factor of 2^0, 2^5, 2^6, 2^7, 2^8, 2^9, 2^{10}, 2^{11}, 2^{12}, 2^{13}, 2^{14}, 2^{15}, 2^{16}, and 2^{17} respectively.

Results of the temperature gradient PCR and primer gradient PCR as per Di Francesco et al. (2011) are shown in Figure 2. The specific amplicon (351bp) is visible on all samples except the NTC. The intensity of the product is the same in the temperature gradient PCR, while the intensity reduces slightly in the primer gradient PCR as the concentration of the primer reduces.
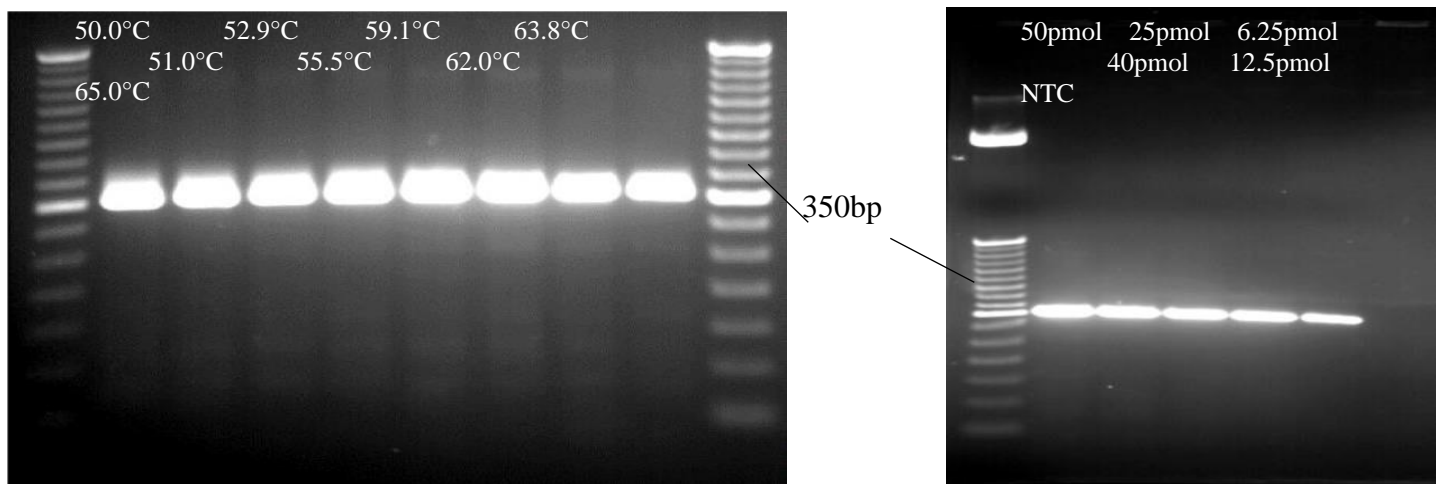
Figure *2* Results of the temperature gradient PCR (left); Lane 1 and 10 containing the standard and lanes 2 – 9 containing products using annealing temperatures 50.0°C, 51.0°C, 52.9°C, 55.5°C 59.1°C, 62.0°C, 63.8°C and 65.0°C respectively and primer gradient PCR (right); Lane 1 ladder Lanes 2 – 6 containing products obtained with 50pmol, 40pmol, 25pmol, 12.5pmol and 6.25pmol of primer respectively and Lane 7 containing the NTC.

RT-nPCR first round

Results of the modified first round RT-PCR as per Di Francesco et al. (2011) are shown in Figure 3. The amplicon (351bp) is clearly visible up to 2^{12}. $2^{14} - 2^{17}$ have faint amplification. No amplification is seen in 2^{13} and the.
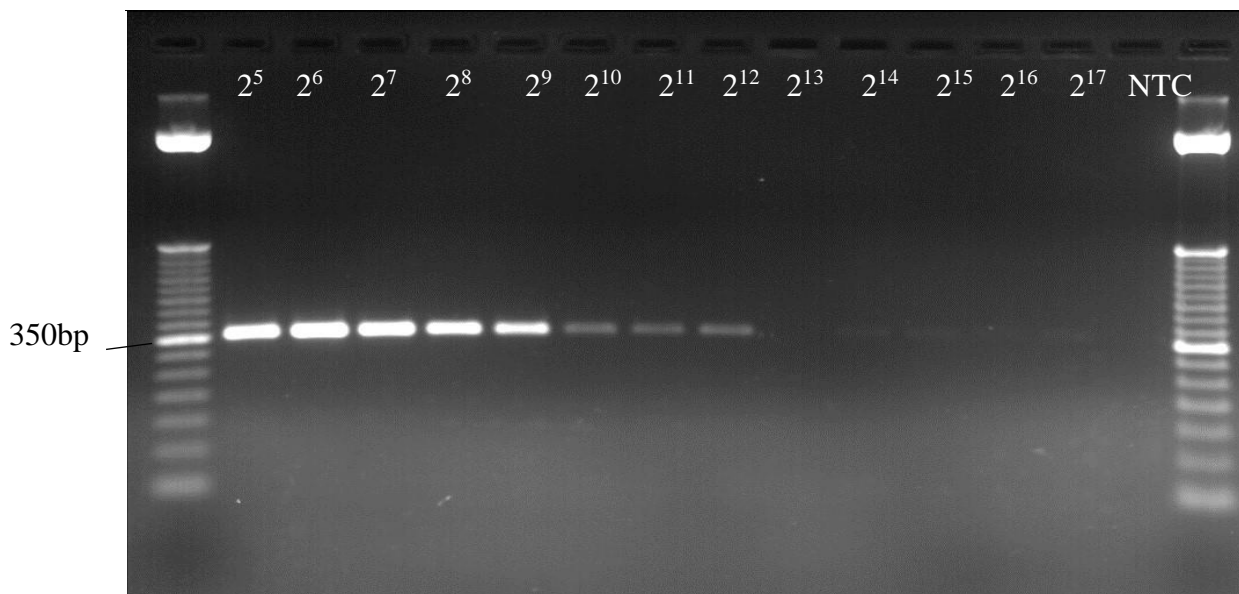
Figure 3 – First Round RT-PCR as per Di Francesco et al. (2011). Lanes 1 and 16 contain the standard. Lane 15 contains the NTC. Lanes 2 -14 contains the products obtained by diluting the positive control by a factor of 2^5, 2^6, 2^7, 2^8, 2^9, 2^{10}, 2^{11}, 2^{12}, 2^{13}, 2^{14}, 2^{15}, 2^{16}, and 2^{17} respectively.

RT-nPCR Second round

Results of the modified second round PCR as per Di Francesco et al. (2011) are shown in Figure 4. The amplicon (200bp) is clearly visible in all samples except for 2^{13}. Both NTCs were clear.
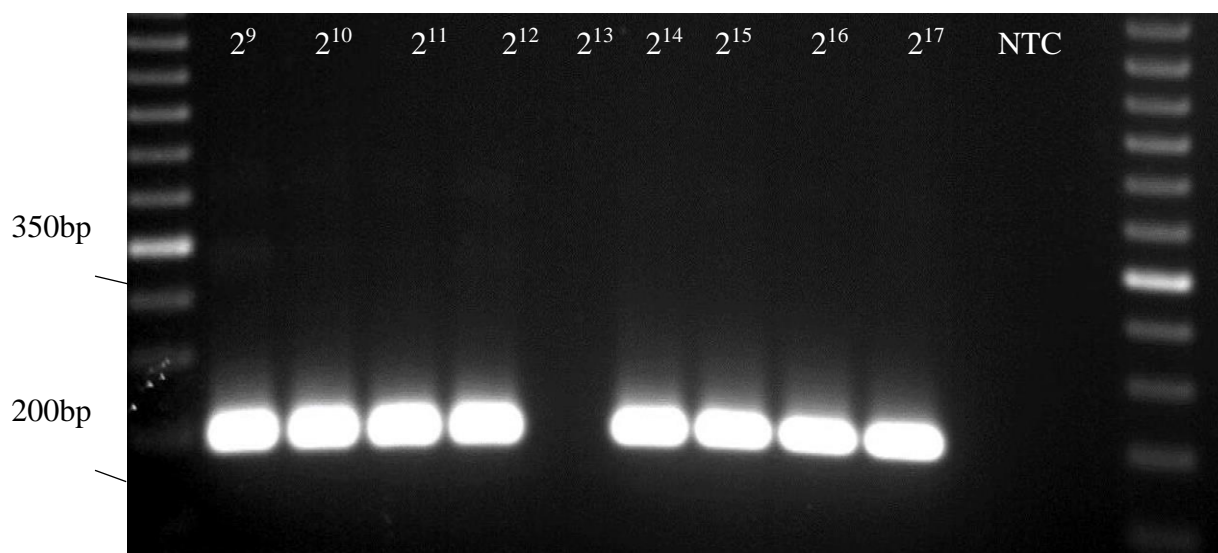
Figure 4 – Second Round PCR as per Di Francesco et al. (2011). Lanes 1 and 13 contain the standard. Lanes 11 and 12 contain the NTC from the first round and the second round NTC respectively. Lanes 2 -10 contains the products obtained by re-amplification of the first round products obtained by diluting the positive control by a factor of 2^9, 2^{10}, 2^{11}, 2^{12}, 2^{13}, 2^{14}, 2^{15}, 2^{16}, and 2^{17}

Discussion

The aim of this study was to optimize a RT-nPCR in order to decrease the minimum detection level of CDV, thus increasing the sensitivity of detection. The minimum detection level of a standard assay developed by Frisk, König, Moritz and Baumgärtner (1999) was optimized and compared to an assay developed by Di Francesco et al. (2011).

RNA extracted from an MLV vaccine was used as a template for this study. Based on this study the minimum detection level of the assay developed by Frisk, König, Moritz and Baumgärtner (1999) was 2^{14}-fold dilution of the template used. This assay is being used as a diagnostic test for CDV RNA.The assay developed by Di Francesco et al. (2011) was optimized by increasing the annealing temperature of the first round to 60°C and the amount of each primer to 6.25pmol for the reverse transcription and the first and second round PCRs.

The melting temperature of the CDV Ro primer was estimated to be 59.08°C. Hence, although there was no inhibition of amplification seen even at 65°C the annealing temperature for the assay was selected to be 60°C in order to ensure sufficient primer annealing occurs especially at low concentrations of the template. The annealing temperature used by Di Francesco et al. (2011) was 48°C. Increasing the annealing temperature reduces non-specific annealing of primers which could lead to false positives.

After first round amplification all, except the 2^{13} dilution had produced an amplicon. Samples from the 2^9 dilution factor onwards were used for second round amplification. Once again all but the 2^{13} dilution had produced an amplicon. It was later determined that amplification in the 2^{13} sample was inhibited due to RNA degradation.

The minimum detection level of the assay developed by Di Francesco et al. (2011) and optimized in this study 2^{17}-fold dilution of the positive control. Since the highest dilution used in this study produced a very intense amplicon in the second round it is possible that the true limit of detection might be even lower.

Conclusion

This study concludes that the minimum detection level of CDV through the assay optimized in this study is at least 2^3 fold less that the assay developed by Frisk, König, Moritz and Baumgartner (1999). Therefore this assay is suitable for sensitive detection of CDV RNA however, its applicability as a diagnostic tool must be tested by using this assay on clinical samples.

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A REVIEW ON THE ETIOLOGICAL FACTORS AFFECTING CHRONIC KIDNEY DISEASES IN SRI LANKA

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Abstract

Chronic kidney diseases (CKD) initially developed in the North Central Province (NCP) of Sri Lanka since the early 1990s. Farmers involved in crop cultivation exhibits a greater prevalence rate compared to non-farmers while the prevalence rate has been escalating with time. Various etiological factors and risk factors contributing to CKD are quality of drinking water, genetic predisposition, diabetes, gender, hypertension, exposure to heavy metals and multifactorial origins, however, the exact cause is unknown. CKD is a severe complication affecting the low-income inhabitants surviving in the rural areas of the country. Dry zones of Sri Lanka involving districts such as Anuradhapura and Polonnaruwa turn out to be endemic regions of CKD. Various studies exhibits quality of drinking water as a major cause of CKD since, majority of low income families follow crop cultivation for living. Exposure to agrochemicals are high and imapct on kidney function is severe which in turn enhances development of CKD.

Keywords: Chronic kidney disease, Chronic kidney disease with unknown etiology, Etiological factors, Prevalence.

Introduction

The kidneys are one of the most essential organs of the human body that carries out fundamental regulatory functions, namely ; management of blood pressure, electrolyte regulation, hormone production, and controlling the acid-base balance (Rem, 2014). Generally, if the overall volume of fluid filtered across nephrons per a given unit of time also referred as glomerular filtration rate (GFR), is less than 60ml/min per 1.73m^2, and/or indicators of a kidney damage are present will lead to CKD identification of a particular individual (Webster *et al.*, 2017).

Various heterogeneous diseases resulting chronic kidney damage, glomerulonephritis, hypertension, diabetes, and unknown etiologies are contributors to the CKD development (Jha *et al.*, 2013). In this study, the possible etiological, and common risk factors affecting CKD in Sri Lanka will be analyzed considering information from published journal articles.

Even though various studies on the occurrence of CKD within Sri Lanka has been carried out, the primary causative agents are unidentified hence, CKD is categorized into 'Chronic kidney disease of unknown etiology' (CKDu), and 'Chronic kidney diseases of unknown etiology multifactorial 3 origins' (CKDu-mfo). CKDu refers to a situation where the exact contributory factor is unknown while CKDu-mfo signifies that two or more etiological factors collectively contribute to CKDu (Wanasinghe *et al.*, 2018).

Up-to-date the prevalence range is from 2%-3% to 15%-23%, while certain investigations highlight that every four to five years the prevalence rate has doubled. In the year 2019 more than 150,000 individuals have suffered from CKD whereas 3% of them died annually (Kafle, Balasubramanya, and Horbulyk, 2019). Occurrence of CKDu was found to be highly endemic

in Anuradhapura and Pollonnaruwa districts of Sri Lanka (Figure 1), hence it is important to identify the etiological factors thereby preventive measures can be implemented.
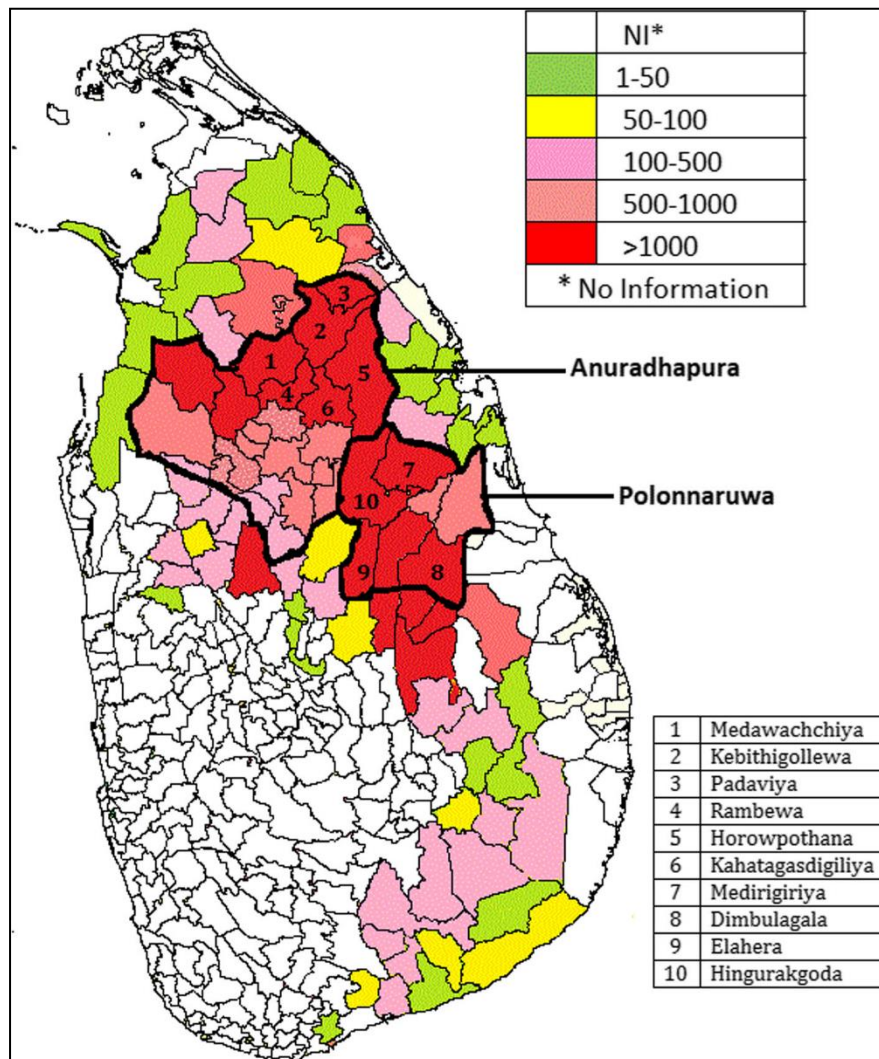
Figure 1 Overall number of CKDu/CKD patients identified in various divisional secretariat areas with respect to a study carried out in the year 2019 (Ranasinghe *et al*., 2019).

Methodology

A systemic literature review in NCBI, Pub med and Google scholar databases restricting the time period for 10 years provided in 252 articles. Review articles were excluded and only research articles were taken into consideration   for the fact that review articles are secondary sources while research articles are original and primary sources of information of the study carried out allowed selection of 17 eligible peer-reviewed articles.

Results

Generally, the North Central, North Western, and Eastern provinces are the areas that are affected with CKDu (Chandrajith *et al.*, 2010). Areas of NCP including Padaviya, Medawacchiya, Mederigirya, Nikawewa, Horowpathana, and Girandurukotte demonstrated 15% of the population suffering from CKDu denoted by a WHO report (Wijetunge *et al.*, 2013). The NCP of Sri Lanka in the region where agricultural activities are carried out, this

factor increases the vulnerability of various unknown diseases due to the exposure to pesticides, agrochemicals , and fertilizers that are greater for a long period (Wanasinghe *et al.*, 2018). According to a study conducted in the district, Sangilikanadarawa, and Halambagaswewa are areas exposed to high risk which is greater than 5%, while areas with individuals at moderate risk are Puhuduvila , and Lolugswewa, lastly Pothana area of Anuradhapura exhibits mild risk towards CKDu (Ruwanpathirana *et al.*, 2019). In the year 2012, a study has denoted that number of CKD patients in the endemic regions has increased by 8000, additionally, 18,000 cases were observed specifically at Anuradhapura district along with over 200 deaths recorded annually (Wanasinghe *et al.*, 2018).

Etiological factors and risk factors of CKD

According to research findings, etiological factors included diabetes, hypertension, trace elements,exposure to heavy metals, multifactorial etiologies including ionicity of drinking water and hardness of water (excess amount of fluoride)(Wanasinghe et al., 2018).

Quality of drinking water

Investigations on CKD in Sri Lanka illustrated that NCP has a high prevalence of CKD for the reason that farmers do not follow safety measure while handling agrochemicals. They consume water from contaminated ground water wells and paddy fields which contributes consumption of agrochmicals inturn leading to CKD (Wanasinghe et al., 2018) .

Gender

In the year 2016 an increment of CKD/CKDu patients has been observed while in 2017 there had been a reduction. It is suggested that provision of safe drinking water has contributed for this reduction. Moreover, age groups of 40 to 60 years are most vulnerable for CKD whereas the majority is suffering in stage 1 of CKD (Ranasinghe *et al*., 2019) .

Predominance in males was observed, since majority of males are farmers, therefore it can be suggested that being a male farmer is a risk factor of CKD (Ranasinghe *et al*., 2019) , however, (Kafle, Balasubramanya and Horbulyk, 2019) notes that, according to the investigation carried out among the rural households of ten districts with a higher prevalence of CKD has recognized that the incidence of CKD in females (62%) were greater compared to males. This contradiction requires further investigations to confirm which gender is more prone to CKD development.

Genetic factors

Diseases leading to congenital abnormalities of the urinary tract and kidney which are present since early childhood are results of single and polygenic causes of CKD. Autosomal dominant poly-cystic kidney diseases may occur later in life as a result of genetic predisposition. Nevertheless,incidence of CKD due to genetic factors are lower compared to the total number (Webster et al., 2017).

Cigarette smoking

Smoking results in kidney deterioration especially in patients with diabetes whereas smoking enhances risk of microalbuminuria, accelerates progression rate of diabetic

nephropathy(Yacoub et al., 2010). (Wanigasuriya, Peiris-John and Wickremasinghe, 2011) noted that, according to the investigation that was implemented individuals with a past of smoking had a five times greater possibility to be inflicted by 'microalbuminuria' (urinary albumin excretion) compared to non smokers.

■ Table 1 Summary of the etiological factors observed in various research studies

Reference of the study	Etiological factor discussed	Potential mechanism	Evidence
(Chandrajith et al., 2011)	Inorganic fluoride	Capability of developing significant nephrotoxic effect on the human proximal tubular cells , however activities of Na+ and Ca2+ determines the toxicity.	It is recorded that, ground water consumption for drinking and domestic purposes contain unique contents of fluoride, calcium and sodium ion concentrations thereby has the potential to result in fatal CKD.
(Chandrajith et al., 2011)	Genetic disposition	Susceptible individuals are at a risk of developing CKD, however exposure to geoenvironmental conditions might trigger the initiation	Positive evidence is available for individuals with a family history of CKD, however family members who are susceptible will only be affected even though all family members are exposed.
(Yacoub et al., 2010)	Smoking	Smoking results in kidney deterioration especially in patients with diabetes. It enhances risk of microalbuminuria, elevates progression rate	It has been illustrates that, smoking (heavy smoking) is a significant risk factor of CKD.

		from microalbuminuria into persistent proteinuria, accelerates progression rate of diabetic nephropathy and reduce the time interval in-between the onset of proteinuria or albuminuria	
(Elledge et al., 2016)	Multifactorial origin	Biological samples analysed ; blood - determination of Pb and Cd concentration. Levels exceeded Us reference values (_1.90μg/dL) soil - levels of As, Cr,Mn present in soil sample exceeded mean concentration. hair - levels of Cd was within the refernce range water - levels of F,Fe,Mn and Pb exceeded applicable drinking water standard.	This litreture postulates mulfactorial origins contributing to CKDu. Exposure to one or more environmetnal factors along with lifestyle and behavioral conditions and genetic predisposition will ultimately contribute for CKDu development of dry-zone inhabitants
(Kafle, Balasubramanya and Horbulyk, 2019)	Diabetes and Hypertension	Endothelial dysfunction, amplified sympathetic tone, enhanced atrial stiffness, increased salt sensitivity and upregulation of renin-angiotensin-aldosterone system as a result of declined eGFR are factors influencing hypertension which will further drive progression	Results illustrates that considering the symptomatic individuals 25% had diabetes, 63% had hypertension and both diabetes and hypertension were observed in 22 % of the studied population.

		of CKD (Pugh, Gallacher and Dhaun, 2019). Diabetes is considered to be one of the major causes of CKD as it leads to diabetic nephropathy. During diabetes glucose levels are escalated increasing strain on nephrons of the kidney and interrupting filtration process (Cavanaugh, 2007).	

Discussion

This literature review analysis allowed us to come across various proposed etiological, and risk factors that contributes to the development of CKD in Sri Lanka. Chandrajith *et al.*, 2011 , denotes that the availability of fluoride ions in drinking water enhances the CKD development since residents, and farmers utilize water from tanks, shallow dug wells, and reservoirs. Quality of drinking water is a major factor that should be considered, the hardness of the water in the dry zones of the country are high, hence accumulation of ions and impact on the functioning of the kidney is greater (Wanasinghe *et al.*, 2018). Cigarette smoking was identified as a risk factor that develops the risk of not only CKD but diseases affecting the respiratory tract, and maybe cancer too (Yacoub *et al.*, 2010). The genetic disposition which may trigger CKD development once exposed to various environmental factors was observed as a risk factor. If a family history of CKD is present, undergoing a gene expression test will be ideal to identify the susceptibility at an early stage (Chandrajith *et al.*, 2011). Lastly, gender has a significant impact on CKD occurrence where studies has proven that males are at a greater risk than females.

Conclusion

In conclusion, diabetes,gender,hypertension, quality of drinking water, smoking, and genetic disposition were the etiological factors observed. As a suggestion to minimize the risk of CKD providing purified water is highly recommended for the reason that quality of drinking water had a significant impact on incidence of CKD according to the literature review. The public has to be educated about the importance of consuming quality water and the prevalence of CKD which might allow them to be more cautious and to take necessary preventive

measure.Additionally, if the government is capable of funding for the diagnostic tests to identify CKD at an early stage for the individuals of the endemic areas this will contribute to reducing the population of CKD affected patients in the country.

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DEMOGRAPHIC RISK FACTORS FOR THE DEVELOPMENT OF HEPATOCELLULAR CARCINOMA VIA NON-ALCOHOLIC FATTY LIVER DISEASE

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Abstract

Hepatocellular carcinoma (HCC) is one of the prevalent cancers globally. The main progression of HCC is by the development of Non-alcoholic fatty liver disease (NAFLD). NAFLD progression to HCC depends on several demographic risk factors; age, gender, genetics and ethnicity. The objective of the current review was to understand the correlation of these demographic risk factors for the development of NAFLD-HCC. The NAFLD-HCC progression is frequent in the ages 65 – 75 years. NAFLD-HCC is highly prevalent in males when compared to females. The ethnicities which have a major risk for NAFLD-HCC are Hispanics, Malays and Indians. Genes such as *PNPLA3, MBOAT7* and *TM6SF2* was associated with NAFLD-HCC. Age gives a high cooperation to NAFLD-HCC. Correlation of age and gender may increase the progression.

Keywords

Hepatocellular carcinoma, Non-alcoholic fatty liver disease, Age, Gender, Ethnicity, Genetics

Introduction

Hepatocellular carcinoma (HCC) is one of the prevalent cancers in the world which is in fifth place. HCC is a leading cause of death related to cancers (Paul, Dhamija and Kedia, 2019; Wong, Ting and Chan, 2018; Piscaglia *et al.,* 2016; Wong, Nguyen and Lim, 2016; Starley, Calcagno and Harrison, 2010) and Non-alcoholic fatty liver disease (NAFLD) is the most common liver disease which is responsible for majority of liver transplantations in Western populations (Muthiah and Sanyal, 2020). NAFLD progresses from simple fatty liver condition to the more aggressive Non-alcoholic Steatohepatitis (NASH). NASH causes cirrhosis which leads to HCC. Influence of risk factors leads the progression without cirrhosis too [Figure 01] (Degasperi and Colombo, 2016; Starley, Calcagno and Harrison, 2010).
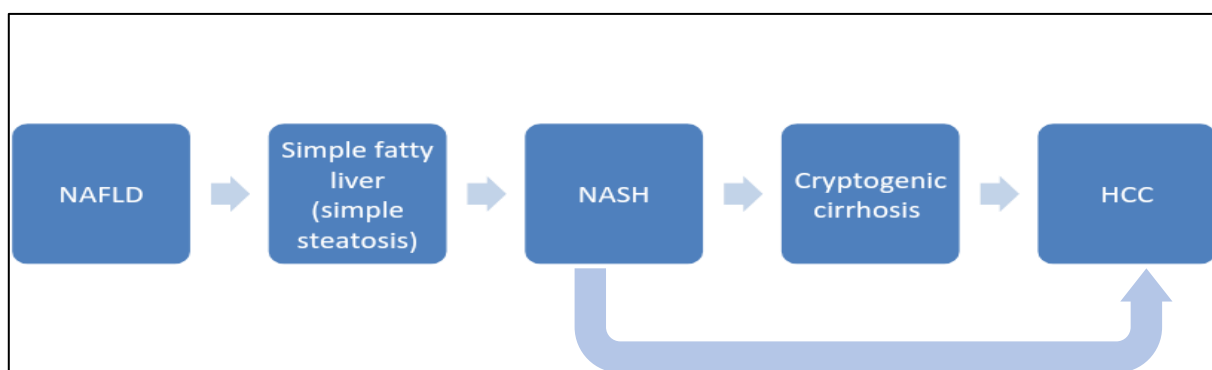
Figure 1: Progression of NAFLD to HCC, the common pathway, NAFLD=Non-alcoholic fatty liver disease, NASH=Non-alcoholic steatohepatitis, HCC= Hepatocellular carcinoma (Degasperi and Colombo, 2016).

Cases of HCC related to NAFLD (NAFLD-HCC) have been increased within the last two decades. Overall NAFLD-HCC prevalence has gradually increased among the countries (Wong, Ting and Chan, 2018; Starley, Calcagno and Harrison, 2010). An overall prevalence

of NAFLD-HCC, on the western and eastern countries has been given as 10%-12% and 1%-6%, respectively, but the prevalence of NAFLD-HCC is not well documented in the general population (Wong, Ting and Chan, 2018).

As the global epidemiology of NAFLD-HCC is currently increasing, an investigation of the etiologies must be considered for the reduction of the condition. The risk factors demonstrate a path to get a clarification about the etiologies. Due to that, this literature is mainly based on the risk factors of NAFLD-HCC. The main purpose of the article is to identify, whether the demographic risk factors are more or less relatable for the NAFLD-HCC progression. The main risk factors which were considered for this literature were age, gender, ethnicity and genetic factors. The reason to choose these risk factors was because they are the demographic characteristics which are common to every human being. This also focus towards the exploration of the most related risk factor among the mentioned ones, which helps the progression of the NAFLD-HCC. The literature also elaborates on a link between the pathogenesis of NAFLD-HCC and the most related risk factor. The relationship of the risk factors along with their biological factors are shown in the literature too.

Methodology

The articles were searched out from the Google scholar and the PubMed sites from 2010-2020. The key words which were searched was Hepatocellular carcinoma, Non-alcoholic fatty liver disease, Demographic, risk factors, age, ethnicity, gender, HCC and NAFLD. 54 articles were downloaded and only 36 articles were referred. The article was finished by 19 August 2020.

Demographic Risk Factors of NAFLD-HCC.

Age

Age is a common risk factor in almost every pathological condition.

Table 1: The literatures which elaborate the risk factor age. *NAFLD-HCC = Hepatocellular carcinoma related to Non-alcoholic fatty liver disease, SD = Standard Deviation.*

Literature	Research period	NAFLD-HCC cohort (n)	NAFLD-HCC mean age in years (SD)	P values
Piscaglia *et al.* (2016)	2010-2012	145	67.8(9.0)	<0.0001
Thompson *et al.* (2018)	2001-2016	48	64.6(9.9)	0.042
Younossi *et al.* (2015)	2004-2009	701	73.24(8.11)	<0.05
Bengtsson *et al.,* (2019)	2004-2017	225	72	<0.001
Lee *et al.,* (2017)	2000-2005	41	>55	<0.001
Wong *et al.,* (2017)	1991-2011	5898	75	0.15
Ioannou *et al.,* (2019)	2012-2018	7068	67.1 (9.7)	<0.001
(Mohamad *et al.,* 2015)	2003-2012	83	64.8 (10.4)	0.035

A study done by Sheedfar *et al.* (2013) showed that the risk of NAFLD-HCC has decreased after the age of 75 and the reason was the decrease of growth factors IGF 1, GH, EGF and TGF-β which help in hepatocyte proliferation with the increase of age.

Gender

NAFLD-HCC is mostly progressed in males when compared to females (Hester *et al.,* 2020; Thompson *et al.,* 2018; Said and Ghufran, 2017; Piscaglia *et al.,* 2016; Degasperi and Colombo, 2016; Younossi *et al.,* 2015).

Table 2: The literatures which elaborate the risk of NAFLD-HCC among the genders. *NAFLD-HCC = Hepatocellular carcinoma related with Non-alcoholic fatty liver disease.*

Literature	Research period	NAFLD-HCC cohort (n)	No. of Females (%)	No. of Males (%)	*P* values
Piscaglia *et al.* (2016)	2010-2012	145	30 (20.69)	115 (79.3)	<0.0001
Thompson *et al.* (2018)	2001-2016	48	13 (27.1)	37 (72.9)	0.53
Bengtsson *et al.* (2019)	2004-2017	225	66 (29.3%)	159 (70.7%)	0.01
Table 2 Continued					
Lee *et al.,* (2017)	2000-2005	41	16 (39.03%)	25 (60.97%)	0.055
Wong *et al.,* (2017)	1991-2011	5898	1947 (33.0)	3951 (67.0)	<0.001
Ioannou *et al.,* (2019)	2012-2018	7068	318 (4.49%)	6750 (95.5%)	<0.001
(Mohamad *et al.,* 2015)	2003-2012	83	29 (34.9%)	54 (65.1%)	0.26

The male gender is more prone to NAFLD-HCC due to the lack of estrogen and the males with disorders in androgen hormones also have a high risk of getting NAFLD-HCC. It also states that the patients with polycystic ovary syndrome (PCOS) and women in menopause, who have low levels of estrogen, also have a risk of NAFLD-HCC progression (Ali *et al.,* 2017).

Ethnicity
NAFLD-HCC also associates positively with the ethnicity. Many literatures elaborate about the risk towards the Hispanics when compared to other ethnicities.

Table 3: The literature elaborating the NAFLD-HCC prevalence in various ethnicities. *NAFLD-HCC = Hepatocellular carcinoma related with Non-alcoholic fatty liver disease.*

Literature	Research period	Country	NAFLD-HCC cohort (n)	Findings	*P* values
Couto *et al.* (2013)	2000-2011	USA	19	No. of Hispanics in the cohort = 11 No. of non-Hispanics in the cohort = 8	0.018
Hester *et al.* (2020)	2004-2015	USA	3019	NAFLD-HCC rate of white Americans have increased from 7.97 to 13.74 per 100000 cases from 2005 to 2014. Hispanics with NAFLD-HCC have increased from 13.49 to 32.85 per 100000 cases from 2008 to 2014.	<0.05

Table 3 Continued					
Wong *et al.,* (2017)	1991-2011	USA	5898	Caucasians= 75.2% from cohort Black= 5.8% from cohort Asian= 7.7% from cohort Hispanics= 5.3% from cohort Other/unknown= 6.1% from cohort	<0.001
Ioannou *et al.,* (2019)	2012-2018	USA	7068	White, non-Hispanic= 76.4% from the cohort Black, non-Hispanic= 7.5% from the cohort Hispanics= 7.1% from the cohort Other= 2% from the cohort	<0.001
(Mohamad *et al.,* 2015)	2003-2012	USA	83	White= 77 (92.8%) from the cohort African American= 4 (4.8%) from the cohort Other= 2 (2.4%) from the cohort	0.032

The ethnicity is generally based on the genetic polymorphisms and among them the H63D polymorphism is found as a main associate with the increment of the risk towards NAFLD-HCC progression of non-cirrhotic HCC patients (which can be developed via NAFLD) (Said and Ghufran, 2017).

Genetics

Carcinogenesis has a close relationship with the genetic mutations. According to literature, it has a 25% probability for NASH to be progressed to HCC (Charrez, 2016). Patatin-like phospholipase domain-containing protein 3 (PNPLA3), membrane-bound Oacyltransferase domain-containing 7 (MBOAT7) and transmembrane 6 superfamily member 2 (TM6SF2) are the most common genes to be mutated and associated with NAFLD-HCC (Pennisi *et al.,* 2019). Matthias and Seneviratne, (2018) stated that the European genome polymorphisms which associate with NAFLD are SOD2 A16V and GSTM1 from OS response pathway, PNPLA3 I148M and TNF G-2384A which involves in inflammatory / immune responses, where Asian studies have shown that PNPLA3 SNP strongly associates with NAFLD progression in Sri Lanka. In India, the SNPs that can be seen in the genes of NAFLD-HCC patients are PZP, PARVB, PNPLA3 and SAMM50 (Matthias and Seneviratne, 2018).

Discussion and Conclusion

Age: Dysfunction of muscles in aging leads to increased oxidative stress, increased inflammation, increased lipid accumulation in intramyocellular areas, reduction of mitochondrial functions which altogether leads to insulin resistance (IR) (Shou, Chen and Xiao, 2020). These mechanisms leads to Free-Fatty Acids (FFA) production via IR (Moon *et al.,* 2013). High FFA accumulation leads to inflammation by resulting which has a high possibility to form Steatohepatitis; a vulgar form of NASH with high accessibility to HCC. The steatosis

has a high rate in NAFLD and IR acts as a stimulator for the progression of HCC (Starley, Calcagno and Harrison, 2010; Wong, Nguyen and Lim, 2016).

Gender: Estrogen and androgens contributes to the inhibition of the progression of carcinogenesis mechanisms. Males are positive for the visceral adiposity. This leads to the high lipid accumulation, lipid peroxidation, insulin resistance and a negative feedback for adiponectine, resulting a chronic inflammation by the releasing of pro-inflammatory cytokines leading to HCC via liver damage (Cheung and Cheng, 2016).

Ethnicity: Hispanics tends to be prone to NAFLD-HCC and according to Couto *et al.,* (2013), the genetic markers of steatosis are the major etiologies for this progression in them. H63D polymorphism mainly associates with the LDL-cholesterol levels and the elevated cholesterol levels along with the H63D gene increasing the iron levels. It leads to the free-fatty acid formation and free Oxygen-radical formation, which are the main generators of progression of NAFLD-HCC via genetic mutations and increased cell proliferation (Raszeja-Wyszomirska *et al.,* 2010).

Genetics: Substitution of isoleucine to methionine in I148M residue in PNPLA3 causes a mutation (Streba *et al.,* 2015) which favors the steatosis in hepatocytes which can be led to steatohepatitis by the other pathogenic factors. The apolipoprotein B (APOB) polymorphisms can have a nonsense mutation in which the phenotype is a disorder in lipoprotein metabolism (Dongiovanni, Romeo and Valenti, 2014).

Male gender is more prone to be affected than the female. The mean age range of the patients with NAFLD-HCC is 58-75 years. Hispanic ethnicity is more likely to get NAFLD-HCC due to the PNPLA3 SNP and the H63D mutation. When considering the demographic risk factors, old age showed a higher contribution to NAFLD-HCC. Increasing age demonstrated a link to the increase of IR by which the pathogenesis of NAFLD-HCC is stimulated. An individual's gender also contributed to a certain extent for the development of NAFLD-HCC. A combination of these two may provide a higher tendency for the development of NAFLD-HCC in an individual. A link between the pathogenesis of NAFLD-HCC can be seen, as the IR increase FFA which leads to the genetic polymorphisms and the release of pro-inflammatory cytokines. As IR is the main feature of diabetes, it can be concluded that Diabetes is a clinical risk factor of NAFLD-HCC.

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A REVIEW ON 3-D BIOPRINTING OF HUMAN CARDIAC TISSUE

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Abstract

There's a significant requirement for developing stronger and novel tissue-engineering attempts, among which 3D bio-printing plays a major role. 3D bio-printing of human cardiac tissue is a major biological solution for restoration of ill-functioning heart. The purpose of this paper is to discuss and review various attempts related to scaffold-based and scaffold-free approaches on 3D bio-printing of human cardiac tissue. This article reviews a set of recently published research-articles on 3D Bio-printing of human cardiac tissue obtained via a literature-search conducted on Google-scholar. Accordingly, the scaffold-based approach includes the use of Extrusion-based-bio-printing technique, dECM-scaffolds, layer-by-layer 3D-hearts and 3D functional cardiac tissues that mimicked the native myocardium whereas the scaffold-free approaches exclude the use of solid-scaffolds/bio-materials and majorly involve the use of spheroids via hanging-drop technique. It can be deduced that scaffold-free approach acts as an alternative to minimize the challenges in the scaffold-based approach in 3D bio-printing of human cardiac tissue.

Key words: 3D-Bio-printing, scaffold-based, scaffold-free

Introduction

Cardiovascular disease (CVD) results the loss of lives in many industrialized-nations, which is caused due to pathological alterations affecting myocardium, heart valves or blood vessels (Alonzo *et al.*, 2019). Current treatments for CVD such as auto-grafting, allo-grafting, xeno-grafting and use of artificial prostheses possess disadvantages such as shortage of readily available donor organs/tissue, immune-rejection, limited durability and anticoagulation therapy. Cardiac tissue engineering and specifically 3D bio-printing tends to provide biological solutions in restoring the malfunctioning heart.

3D Bio-printing also known as additive manufacturing involves automated procedures and standard materials as building units in-order to create 3D objects from customized and specified computer-aided designs (Duan, 2016). Technological advancements have resulted the application of 3D printing technologies to biocompatible materials, cellular materials and supportive components for artificial organ printing and applications in regenerative medicine. Biomaterials used in 3D-bio printing of myocardial tissue include polycaprolactone, sodium-alginate, 3D-printed gelatin, collagen, extracellular matrix-(ECM) and de-cellularized ECM to create platforms for extrusion-based printing. Challenges associated with the use of biomaterials resulted the creation of 3D bio-printed cardiac tissue without using biomaterials (Ong *et al.*, 2017).

Most of the tissue engineering strategies use exogenous bio-compatible scaffolds, where cells are seeded and matured either in-vitro or in-vivo to grow the desired tissue. It offers advantages such as good biocompatibility, cell attachment, cell proliferation, provision of biological, chemical and mechanical clues in order to guide the subsequent cell differentiation and their assembly to form 3D tissue construct (Norotte *et al.*, 2009). Scaffold-free tissue engineering

involves in creating 3D tissues without using polymers and exogenous matrix. Tissues made such, will be composed of the cells and the matrix they secrete. Scaffold-free method produces comparable tissue similar to bio-material based methods, surpassing the challenges encountered in using bio-materials. Spheroids are considered as effective building units in scaffold-free cardiac tissue designing due to its property of having resistance against hypoxia and having the required mechanical integrity for implantation (Bai *et al.*, 2018). This review mainly emphasizes a comparison on the scaffold-based and scaffold-free 3D Bio-printing approaches of human cardiac tissue.

Methodology

A literature-search on Google-scholar was conducted via search phrases such as "3D bioprinting of human heart", "3D bioprinting of cardiac tissue and heart valves" and "Scaffold-based and scaffold-free 3D approaches for bioprinting human heart". Literature published before 2009 were excluded as they could contain outdated information. Articles addressing research on 3D bio-printing of human heart since the year 2009 to 2019 were used for the reviewing process and for the comparison and differentiation of the scaffold-based and scaffold-free approaches.

Results and discussion

Scaffold-based 3D bio-printing of cardiac tissue

In bio-printing of cardiac tissue, scaffolds are utilized for attachment of cardiac cells and to provide them with mechanical support. In this method, cells will be seeded within the scaffolds prior to tissue maturation (Lee *et al.*, 2016).

Seol *et al* discusses about the extrusion-based bio-printing technique used in constructing tri-leaflet heart-valve conduit using biomaterials such as hydrogel of hyaluronic acid and gelatin. Such printed heart-valve conduit was highly viable and had a great capacity for remodeling when assessed after 7 days. In another study laser-assisted-bio-printing technique was applied in delivering human umbilical vein endothelial cells-(HUVECs) and human mesenchymal stem cells onto a specific area on a polyester urethane cardiac patch to regenerate cardiac tissue. The printed construct was implanted into the region of the rat-heart subjected to infarction, demonstrating an improved formation of vessel from bio-printed tissue (Seol *et al.*, 2014).

Lee *et al* discusses a scaffold-based technique where the decellularized-matrix is repopulated with desired cell population. This technique was initially used for heart valves and subsequently was improvised in repopulating a full heart. An advantage of this decellularized-matrix compared to hydrogel-based scaffold is, its ability to retain the native ECM. A major drawback related to scaffold-based method is the non-uniform macro-pore structure formation in the casted scaffolds. However, use of computer-aided technology in designing scaffolds with specific structure and size of the pore, can be taken as an alternative measure. (Lee *et al.*, 2016).

Jung reviews on a study attempted to deliver progenitor cells in a 3D-printed gelatin or hyaluronic-acid patch for recovering the cardiac function in a mouse model with myocardial infarction. There, the cardiac progenitor cells were printed with gelatin allowing the formation of a woodpile array 3D structure. Following four weeks of cardio-myogenic differentiation, the cardiac progenitor cells which were printed, differentiated to phenotypes and expressed troponin 1, cardiac actin and connexin 4B. Four weeks after application to the infarcted area of

myocardium, an increase in the wall thickness and decreased infarct fibrosis was observed (Jung, Bhuiyan and Ogle, 2016).

Duan reviews on a study which used extrusion-based technique and bio-printed alginate and also RGD-modified alginate scaffolds along with human-fetal-cardiomyocyte-progenitor-cells (hCMPC). Printed hCMPCs possessed a greater cell viability, retaining their commitment for cardiac lineage and enhanced gene expression of early cardiac transcription factors and troponin T was observed within the 3D culture (Duan, 2016).

Garetta *et al* discusses the use of decellularized-extracellular-matrix (dECM) scaffolds in tissue and organ engineering and the advancement of 3D bio-printing techniques towards fabrication of biomimetic cell-laden biomaterial constructs. It reviews a work done by Guyette and coworkers in partially repopulating the whole decellularized human heart utilizing a custom human-heart-bioreactor with the capability of providing coronary perfusion along with mechanical stimulation of ventricle wall (Garreta *et al.*, 2017).

Wang *et al* developed a functional cardiac tissue which is able to mimic the features of the naïve myocardium structurally, functionally and physiologically. A fibrin-based composite hydrogel was used as the bio-ink and the bio-printed cardiac tissues were subjected to fabrication by the procession of 03 components; cell-laden hydrogel, sacrificial hydrogel and PCL polymer via 3D bio-printing technique. The constructs constituting cardiomyocytes were printed in layer-by-layer method as per the designing from personalized CAD/CAM software and their custom-made ITOP system (Wang *et al.*, 2018).

Chikae mentions about a previous study where a layer-by-layer method was developed in forming a nanofilm on cell membranes via alternate stacking of various extracellular-matrix, fibronectin and gelatin in-order to construct 3D tissues. It further explains their recent attempt where they constructed 3D-cardiac-tissue via layer-by-layer cell coating method along with a microscopic painting device utilizing a painting needle method (Chikae, 2019)
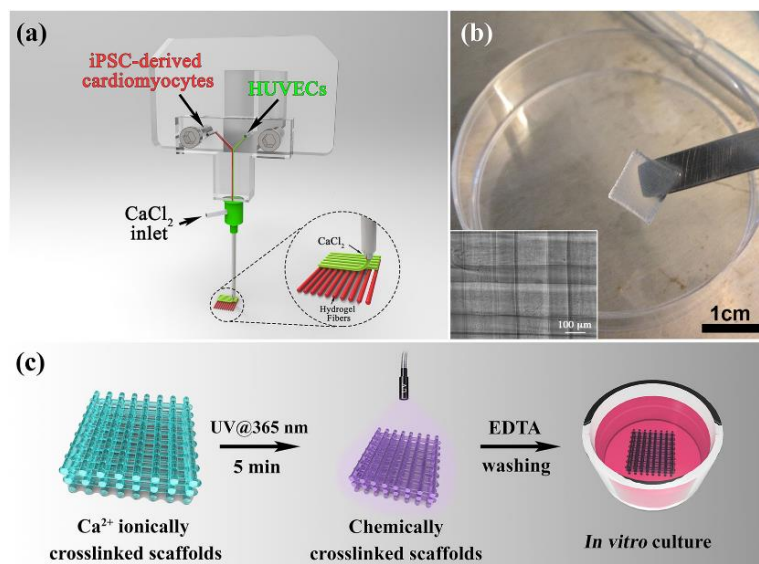
Figure 1: Scaffold-dependent 3D bio-printing of cardiac tissue
Adapted from: (Maiullari *et al.*, 2018)

Scaffold-free 3D Bio-printing of cardiac tissue

In scaffold-free 3D bio-printing, solid scaffolds (usually made from PLA, PCL etc.) aren't being used as structural supports for deposition of cells.

When considering earlier attempts in scaffold-free bioprinting of cardiac tissue, up-to 2009 macroscopic scaffold-free cardiac constructs weren't created using human cardiomyocytes. In 2009, Lee et al described a novel method to create macroscopic scaffold-free human cardiac tissue patches constituting only cells that were derived from human embryonic stem cells (hESCs). Such created cardiac patches beat spontaneously and their size was controlled precisely. The scaffold-free approach eliminates drawbacks of using exogenous materials such as immune reactions, toxic degradation products, mechanical compliance of the material which is thicker than the myocardium and insufficient uniform cell density which is mainly associated with porous scaffold seeding (Lee *et al.*, 2016).

Table 1: Different studies on scaffold-free 3D-bio-printing of human cardiac tissue

Study	Description
▪ (Beauchamp *et al.*, 2014)	▪ Presents the aggregation of self-assembling, scaffold-free, spheroidal microtissue in hanging drop techniques. This study also uses Induced-Pluripotent-Stem-Cell-derived human cardiomyocytes-(iPSC-CMs). Hanging drop microtissues of iPSC-CMs can be generated consistently without ECM proteins, overcoming the sourcing, handling and phenotypic challenges related to primary human cardiomyocytes. The feasibility of scaffold-free 3D culture of commercially available iPSC-CMs which results reproducible microtissues reliable enough in responding to electrical, physical and pharmacological stimuli with prolonged viability is addressed.
▪ (Tan *et al.*, 2014)	▪ A 3D mold-printing technology was developed in-order to generate biocompatible, bio-inert alginate hydrogel molds, facilitating the fusing of tissue spheroids resulting the formation of scaffold-free tissue engineered constructs with specific 3D structures.
▪ (Lee *et al.*, 2016)	▪ Discusses on the use of cell-sheet technology; fabricating cellular compounds without the use of solid scaffolds for structural support. E.g. primary neonatal rat cardiomyocytes, iPSCs and C2C12 mouse myoblasts have been fabricated in the form of cell sheets in previous studies.
▪ (Ong *et al.*, 2017)	▪ A procedure to construct 3D bio-printed cardiac tissue without using biomaterials was developed. Multicellular cardiospheres containing hiPSCs-CMs, human adult ventricular cardiac fibroblasts and HUVECs were assembled using a 3D bio-printer. Even-though biomaterials weren't used, this method enabled the achievement of high cell density and functional cell contacts which created spontaneously beating tissue.
▪ (Wang *et al.*, 2018)	▪ Presents a protocol which demonstrates 3D bio-printing of cardiac tissue without use of biomaterials but only cells in the form of spheroids. It also comments on scaffold-free spheroid-based 3D bio-printers which

	are capable in picking individual spheroids via vacuum suction, positioning them on a needle array.
▪ (Alonzo *et al.*, 2019)	▪ In a most recent article on 3D bio-printing, a successful research conducted in constructing scaffold free 3D bio-printed cardiac patches, exhibited viability, vascularization and cell engraftment after implantation.
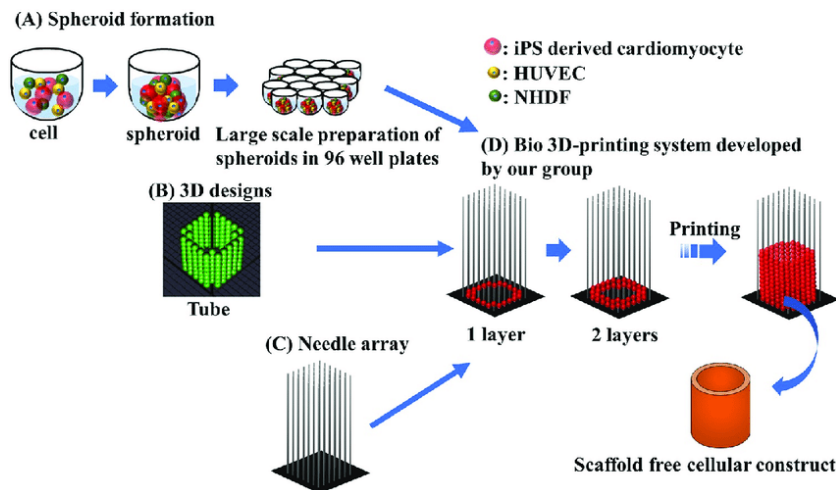
Figure 2: Scaffold-free 3D bio-printing of cardiac tissue
Adapted from: (Arai *et al.*, 2018)

Conclusion

Among the tissue engineering methods, 3D Bio-printing has the potential in becoming a major revolution in biofabrication of tissues and organs. Recent advances resulted the application of 3D bio-printing as a biological solution in restoring the ill-functioning heart and as a promising regenerative medicine application. The biomaterials or scaffolds are supposed to fulfil conditions such as being printable, protection of incorporated cells during printing and being biocompatible with the recipient. Challenges in using the scaffold-dependent approach include immunogenicity, choice of scaffold, degradation rate, toxicity of degradation products, host inflammatory responses and fibrous tissue formation. These challenges can be surpassed by performing cellular assembly, with cells capable in producing their own ECM, using scaffold-free materials. The up-to-date most advanced cardiovascular application of both scaffold-dependent and independent bio-printing is the incorporation of CMs into biomaterials to create cardiac patches with pre-clinical relevance.

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THE FACTORS MODULATING ONEIROLOGY AND COGNITION

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Abstract

Dreams are sequences of images, emotions, sensations and ideas involuntarily prevail in the unconscious mind owing to brain activation during sleep. Oneirology is the scientific study of dreams. The immense overlap between neuroscience of memory and sleep mechanisms; furnish a basis for theories on basic relationship between the dream and cognition. Dreams are actively caused by brain stem and passively synthesized by forebrain. Forebrain is the major passive contributor in the REM phase, which is the crucial phase of the sleep cycle consisting more vivid or memorable dreams due to high brain activity. Owing of current evolution on dream research; this research article addresses the impact of dreaming on fundamental brain mechanisms and cognition pathways. The study was conducted as a nationwide online survey. The objective was to assess the phenomenological dream aspects led by neurofunctional changes throughout sleep. The results of the study reveal that age, gender, diet and status plays a crucial role in dream and cognition.

Keywords

Cognition, Lucid, Oneirology, Precognitive, Rapid eye movement

Introduction

Dreaming phenomenon is a mental condition with changed state of consciousness during sleep resulting unusual forms of declarative memory and characterized by a range of internally generated perceptual, sensory, and emotional experiences. Dreaming appears from brain activity that is mostly independent of interactions with external stimuli (Agostino, Castelnovo and Scarone, 2013). Personally experiencing a network of hallucinatory episodes during sleep is a characteristic to the restriction of aminergic regulation of brain stem. Brain stem actively generate dreams whereas forebrain passively synthesize dreams (Das, 2020). More contemporary theories suggest that dreams are adaptive functions interrelated to learning, emotion-regulation, and memory consolidation (Olsen, Schredl and Carlsson, 2016).

According to specific brain waves and neuronal activity the two basic phases of sleep are rapid eye movement (REM) and non-REM sleep. In non-REM phase brain converts wakefulness pattern electrical oscillations into a slower rhythm during sleep. In REM phase strong metabolic activity is detected in default mood network and in brain areas such as visual associated areas, memory and self-referential processing associated areas (Mutz and Javadi, 2017). Neurotransmitters such as acetylcholine, serotonin and dopamine associated with cognition are found in high levels during REM sleep where dreams are most often dreamt (Gottesmann, 2002).

The aim of this study is to bring about the role of factors such as age, gender, diet and status in modulating dream and cognition related neurological processors; so that dream and cognition associated psychiatric disorders can be effectively treated with regard to them.

Methodology

For "The factors modulating Oneirology and cognition" study, we surveyed a representative sample of 155 individuals (out of 160 initial-participants only 155 responded eligibly) residing in Sri Lanka aged 10 years or older. The survey was conducted in the form of an online-questionnaire;(https://docs.google.com/forms/d/e/1FAIpQLScLmj1axIrHuKGIDN7cAHbmD3yFKNFvvhzllcLzFCV7Tb12wQ/viewform?usp=sf_link) including a quantitative and a qualitative component with multiple-choice form questions designed by modifying the information gained via reviewing published literature and validated surveys on dreams and memory. The participants were able to respond either in English or Sinhala language. The results were analysed via pie-charts, bar-graphs and related calculations and were expressed in the form of percentages. The results gained were compared with previous research-studies

Results and discussion

When analysing the results of the survey, the variation of age didn't play a significant role in the Dream-recall-frequency (DRF). This can be due to the early-adulthood-biased sample population and less number of individuals belonging to younger and older-age groups within the sample population. However, the few number of individuals belonging to the older-age group of 30-39-years and those above 50-years displayed 100% dream-recall ability whereas a declination was observed in 40-49-year age group (33.33%). 84.2% of adolescents (10-19 years) and early-adults (20-29 years) displayed a DRF of 84.2% and 88.5% respectively. A marked difference was observed in the results obtained from our research comparative to other research studies where the usual possibility is an increase in DRF from adolescence (ages 10–19) to early-adulthood (20–29) and a decrease for the next 20 years (Nielsen, 2012).

According to the statistical data 2/3 rd of the total population has dreamt just before waking up which belongs to the REM phase. REM sleep contributes a neuronal environment condition in which the synaptic remodelling crucial in cognition occurs (Poe, Walsh and Bjorness, 2010). 47% of individuals has experienced intense dreams which are vivid and sensory perceptual in nature. Also 92% wake with a clear understanding on what they have dreamt. Majority of the dreams are dreamt in REM sleep which resembles that of being awake due to increased metabolic activity remarked in amygdaloid complexes and hippocampal formation related to emotional processing, occipito-temporal vision associated areas and in areas associated with memory such as medial prefrontal cortex and circuits of the medial temporal lobe region. Enhanced metabolic activity in these areas result in Sensory perceptual vivid dreams and gives a clear understanding of the dream due to strong memory (Mutz and Javadi, 2017). Inhalation of intimate scent during REM sleep result in more negative emotions due to increase activity of emotional processing and Sensory perceptual areas (Okabe et al.,2020). 67% of individuals could not dream in a surrounding with noise or other disturbances as subconscious part of brain gets inactivated on disturbances resulting less dreams as it restricts brain's potentiality to process auditory and visual data (Darbyshire, 2016).

68% of individuals can recall the last 10 minutes episode of the dream seen just before awaken; as conscious memory begins to activate during REM phase. 1/3rd of the population forget their dream 10 minutes after awaken, but rest can remember it more or less than a day. Gender and diet plays a crucial role in dream cognitive ability. 75% of individuals who take vitamin B_6 supplement showed an increase in dream cognition as vitamin B_6 is a cofactor in synthesis of

neurotransmitters which affect cognition such as serotonin, dopamine, noradrenaline and also melatonin hormone (Aspy *et al*., 2018). Oestrogen hormone present in females act on hippocampus region of brain important in cognition. Therefore females are more likely to remember dreams (Frizell and Dumas, 2018). Females were able to recall their dreams more consistently than males with dream-recall percentages of 84.6% and 79.2% respectively. According to further analysis of dream-content with respect to gender, a majority of males (31%) dreamt about females and a considerable number of females dreamt about males comparatively. The encounter of females in dreams were mostly friendly (57.1%) or emotionally threatening (42.8%) irrespective of the gender of the dreamer. The encounter of males in dreams were mostly friendly (48.5%) or emotionally threatening (32.2%) and considerably aggressive (16.1%) irrespective of the gender of the dreamer. The percentage of female-encounter in dreams being aggressive was negligible as of 5.71%.

87% of individuals dream average of 1-5 dreams per night. Individuals over age 10 dream 4–6 times each night which runs 5-20 minutes (Health Research Funding, 2020). Dreams are most often seen in the second half of the night (REM) which accounts one and half hours of 6h sleep (Payne and Nadel, 2004). Number of dreams seen per night and precognition appear to be related. Majority of the individuals who experience more than 4 dreams per night are more likely to dream precognitive dreams. 2/3rd of the population has experienced precognitive dreams that anticipate future possibilities before they occur by some sub selves transferred to the brain based on conscious and non-conscious incidents from past (Mossbridge and Radin, 2018). Enchanting relationship was discovered between precognitive dreams and acetylcholinesterase (AChE) inhibitor; Rivastigmine used in the treating Alzheimer's disease which amplifies REM sleep and cognition by selectively hindering hippocampal and cortical AChE which degrades ACh (Pablos, 2005). This suggests that ACh plays a major role in precognitive dreams. Yet there is no reliable scientific interpretation found on this phenomenon.

70% of individual feel that they dream once or twice a week. Lucid dreaming is a sensation of being aware of dreaming while asleep therefore the dreamer has a control over the actions displayed. During lucid dreaming, frontotemporal cortex; region of brain controlling cognitive processes are activated resulting the control over (Aspy, 2020). A person would sense lucid dream at least once in his life time. 35% of left-handed individuals experience lucid dreams more often. This is because Left hemisphere is crucial in providing vivid, figurative and effective dream episodes (Cohut, 2018). Since 2/3rd of the population are either students or undergraduates of age 20 - 29 years who often plan about future 56% of responders dreamt their future achievements. Different impressions from daily experiences are carried together in the unconscious mind of brain and used to dream up possible aspects of the individual's future (Vavra, 2005).

A widespread perspective in dream analysis is dreaming about strangers. According to the results of the survey, 61% of the responders have dreamt about complete-strangers whereas 91.6% have dreamt about known-people. According to Hall/Van de Castle norms related to dream content, about 50% of the characters dreamt aren't familiar to the dreamer. Sleep researchers believe that dreaming is not 'creating' but recombining characters that were previously stored in long-term memory; thereby, composing dreams mainly of known-characters. By this research, we were able to successfully prove this fact as majority of the

responders dreamt about known characters. However, an unknown-character component of 61% encountered due to less-vivid dreams, hindering the ability to distinguish facial and bodily features required to obtain a precise image of the person dreamt. This is further supported by results obtained from our research where only 11.7% of the sample population experienced vivid-sensing. Another hypothesis attained by researches is that, a person can encounter dozens of human faces on a daily-basis, from which many will remain strangers to the conscious-selves but their faces and figures will be processed by the brain during consolidation; a memory function that occurs during sleep causing the weak memory-traces to strengthen, transferring them to the cortex to be integrated into pre-existing networks and long-term storage (Seigneur, 2018).

20% of pregnant women have experienced changes in their dream content, 21% have an improvement in dream recalling ability and 23% have experienced an increment in dream length. Majority of women could not remember about variability in dreams during pregnancy as the population had many women who had experienced pregnancy years ago. But a significant increase in dream length, recalling ability and a change in dream content were observed in women who are currently experiencing pregnancy. The pregnancy hormones such oestrogen, progesterone and HCG activate the serotonin pathway which is responsible for cognition. Serotonin 5-HT2A receptors are widely distributed in the central nervous system, especially in brain region essential for cognition (Zhang and Stackman, 2015). Since the concentration of oestrogen is increased during pregnancy, synaptic and spine density in the hippocampus is increased significantly resulting increase in dream recalling ability and dream length (Galea, Leuner and Slattery, 2014).

Conclusion

Based on the results of the survey it can be concluded that dreams were mostly seen during REM sleep due to the comparatively high brain activity within that stage similar to that of the awakened stage. Dreams also varied depending on age, gender, diet and social status of the dreamer. The dream content varied amidst positive and negative emotions involving vivid, lucid, clear and intense dreams with mostly friendly, aggressive and emotionally threatening encounters. According to the gender-based analysis of dreams, majority of the participants dreamt about the opposite gender with a marked percentage observed in males dreaming about females. The ability to recall dreams can usually vary depending on age, gender, diet, and pregnancy status of the dreamer and also according to the time at which dreaming occurred. Since our survey mostly emphasized an early adult population (20-29 years), the results obtained were helpful in evaluating the dream-recall ability, dream-theme analysis, dream-content analysis and the relationship between dreams and cognition of the new generation whereas the results obtained from the fewer participants belonging to other age groups were also beneficial in analysing the relationship between dreams and cognition. The results gained from our research can be further utilized in developing a novel perspective for the treatment of dream and cognition related-psychological disorders as a future research direction.

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ROLE OF NEUROGENETICS ON DETERMINING PERSONALITY TRAITS RELATED TO BEHAVIOURAL AND PSYCHIATRIC DISORDERS

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Abstract

The characteristic behaviour of an individual is classified into major five personality traits such as neuroticism, extraversion, openness, agreeableness and consciousness and named as big five personality traits model. These traits are expressed by certain genes encoding for specific chemical messengers targeting the nervous system. Studies have shown associations with behavioural and psychiatric disorders with mutations or alterations in the genes encoding for personality traits and the environment. Understanding these associations are crucial in determining more effective treatment for psychiatric and behavioural disorders. Hence, this review summarizes the current knowledge on the impact of genetics and neurology on determining personality traits related to behavioural and psychiatric disorders. The review reflects the data from 2010, that were gleaned from online search of relevant literature using Medline, Google scholar and PubMed.

Keywords: Behavioural and psychiatric disorders, Neurogenetics, Personality traits

Introduction

The trait is a characteristic that describes response to any situation in a précised way. Emerged evidences identified five major traits; namely extraversion, neuroticism, openness, agreeableness and consciousness and termed as five big personality trait model (Jayawickreme, Zachry and Fleeson, 2019). The trait extraversion includes positive emotions, whereas neuroticism includes negative emotions. Sensitive and imaginative characteristics are categorized under openness trait whereas agreeableness includes modesty, trust and cooperative characteristics. The trait consciousness includes characteristics such as resistance, strong-willed and reliable (Depue and Fu, 2011).

The "Trait theory of personality" is a study of behavioral and psychiatric characteristics associated with an individual's personality. According to this theory, personality falls under polygenic inheritance where multiple genes are involved to enhance or repress the expression of a certain characteristic (Jayawickreme, Zachry and Fleeson, 2019). For example, the trait extraversion encoded by many genes in which WSCD2 on chromosome 12 and PCDH15 on chromosome 10 plays a crucial role. The trait neuroticism is coded by genes such as L3MBTL2 and on 23rd chromosome and NXPH1 on chromosome7 (Lo *et al*., 2017).

The genes which are responsible for particular traits, encode for proteins that act as either neurotransmitters or chemical messengers of neurogenic processes and eventually stimulate the expressions of the brain which determines the behavior and mentality of an individual. The impact of genes on the functionality of neurological processors is termed as neurogenetics. It has been reported that harm avoidance, novelty seeking and reward dependence; personality characteristics are enhanced by the gene expressions of serotonin transporter, dopamine and norepinephrine systems respectively (Delvecchio et al.,2016). Alterations or mutations in genes encoding personality characteristics or mutation in genes allied together with personality

encoding genes are the major cause of behavioral and psychiatric disorders such as attention deficit hyperactivity disorder (ADHD), schizophrenia, bipolar disorder, Alzheimer's disease and depression (Terracciano *et al.*,2010). Not only the genes, but the environment also plays a crucial role in the determining traits related to behavioral and psychiatric disorders.

Understanding the role of neurobehavioral systems that underlie major personality traits, and the impact of mutated genes with environmental factors in behavioral and psychiatric disorders, aid to improve the therapeutic practice with more targeted treatment at the molecular level. Hence, this review summarizes the current knowledge on the impact of neurogenetics on determining personality related to behavioural and psychiatric disorders.

Methodology

The review reflects the data that were gleaned from online search of relevant literature using Medline, Google scholar and PubMed. The search terms used were "personality traits", "neurogenetics" and "behavioural and psychiatric disorders" either alone or in combination. The search was restricted to English language studies and studies published since 2010.

Result and discussion

Neuroticism

As neuroticism focuses on negative emotions such as anxiety, and stress; the genes related to this trait are strongly associated with psychiatric and behavioural diseases such as ADHD (Terracciano et al.,2010). Of the genes responsible for neuroticism, the gene synaptosomal associated protein- 25 KDa (SNAP25) found in intron 1 of chromosome 20p11.2 plays a key role. This gene encodes for SNAP25 protein, which is a member of the SNARE protein family. SNARE proteins are important in releasing neurotransmitters and holding neurotransmitter vesicles at the presynaptic membrane (Kim *et al*,2017b). Animal and human studies have shown associations with deletion of SNAP25 and ADHD (Kustanovich *et al*.,2003; Kim *et al*,2017a). ADHD is a neuropsychiatric polygenetic disorder with a global prevalence of 4%. Absence of SNARE complex due to the deletion of SNAP25 gene improperly regulates dopamine receptors and dopamine transporter-1. This leads to an excess uptake of dopamine in the synaptic cleft resulting in increased uptake of dopamine from the synapse which causes anxiety, aggression and fidgeting which are the general symptoms of ADHD (Asherson and Gurling, 2011). The relationship between neuroticism and ADHD summarized in figure 1.
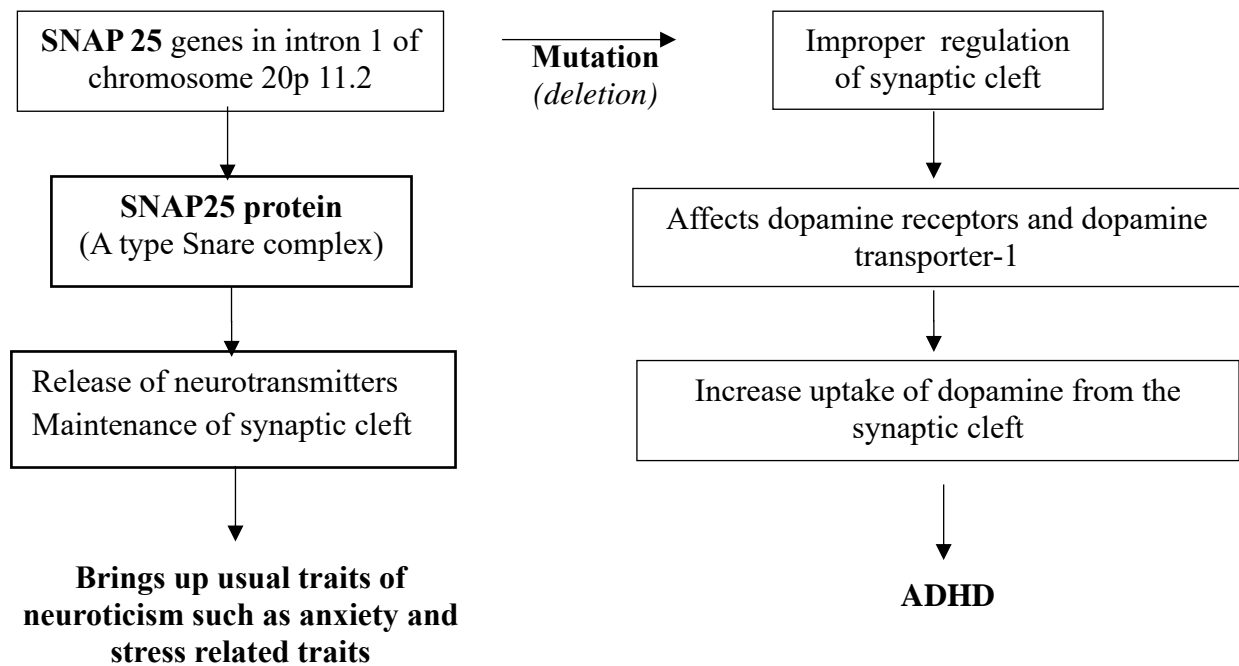
Figure 1. Neuroticism and ADHD development

Extraversion

Extraversion trait includes positive emotions. Of the genes responsible for trait extraversion, the set of genes present in chromosome 16 encoding Cadherin-13(CDH13), a special type of glycosyl phosphatidylinositol-anchored member of the cadherin family, is crucial in ADHD (Terracciano *et al*.,2010). CDH13 regulates the excitatory–inhibitory balance in the hippocampal CA1 region of the brain; important for cognitive flexibility, memory formation and administers stability of synaptic receptors (Kiser *et al*.,2019). Removal of CDH13 gene displayed a higher locomotor activity in mice (Rivero *et al*, 2015). The European human study emphasizes CDH13 deficiency results in behavioural alterations associated with symptoms observed in ADHD, such as learning and memory deficits and also locomotor hyperactivity (Lusky *et al*.,2008). Figure 2 summarizes the relationship between extraversion and ADHD.

Brings up usual traits of extraversion such as positive emotions and impulsivity
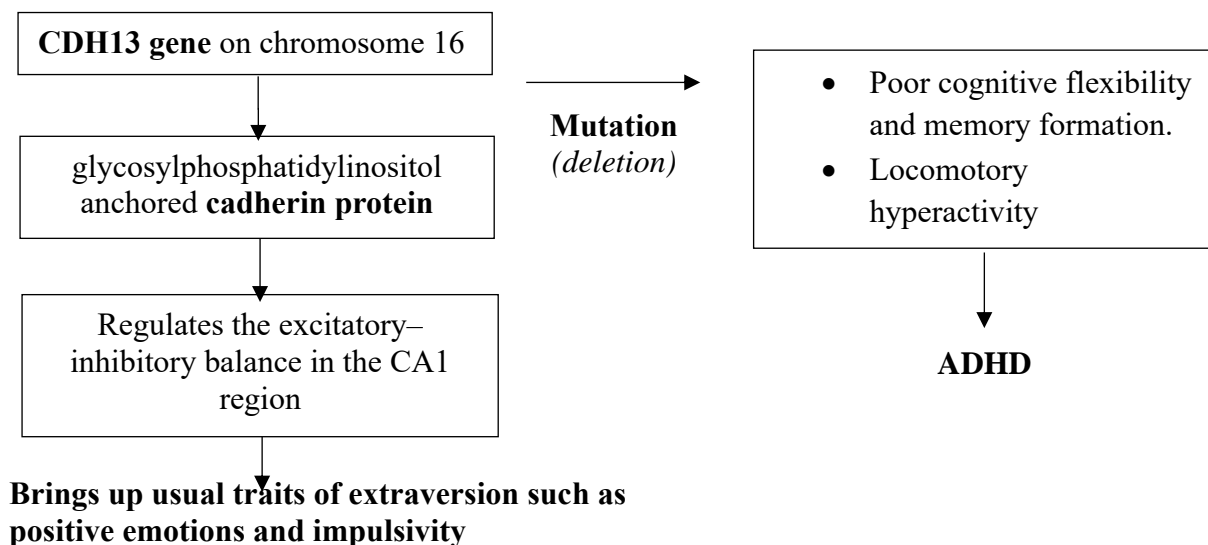
Figure 2. Extraversion and ADHD

Openness

Openness is a trait associated with characteristics such as sensitive and imaginative. An association was observed between genes responsible for openness and CNTNAP2 gene in chromosome 7q35 -36.1. The CNTNAP2 gene encodes a single-pass trans membrane protein that mediates intercellular interactions between neurons and glia cells during the development of nervous system and in the positioning potassium channels within the differentiating axons (Terracciano *et al*., 2010). Expression of exon 13-15 of CNTNAP2 plays an important role in schizophrenia, which is a chronic psychiatric disorder that accounts 1% of global prevalence (Steiner *et al*.,2016).

Deletion of the CNTNAP2 gene affects the axonal differentiation and distress integrity and myelination of white matter especially in oligodendrocytes (Figure 3). Compromised white matter integrity and demyelination lead to alteration of synaptic information processing which in turn acts as a major cause for schizophrenia. Hence, more dopamine will be released from the presynaptic neuron generating continuous action potentials ensuing hallucinations, speech disruptions and lack of emotions which are the key symptoms of schizophrenia (Gonenc et al, 2017).
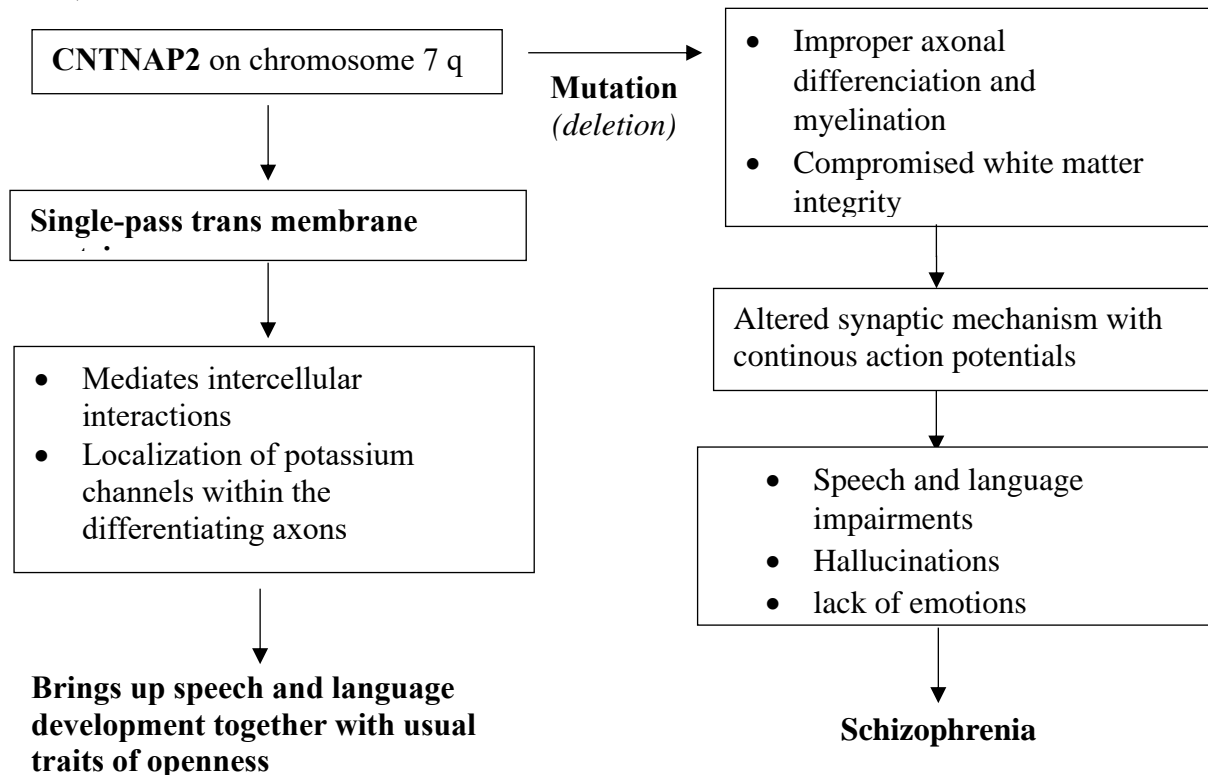
Figure 3. Openness and schizophrenia

Agreeableness

Few of the genes responsible for agreeableness are allele together with CLOCK gene in chromosome 4. The CLOCK gene encodes for circadian rhythm protein, which is responsible for regulating circadian rhythms in metabolism, human behaviour, cognition and emotion. A mutation in the CLOCK gene known as 3111 T/C results in improper regulation of circadian rhythms mainly the light and dark cycle leading to sleep disorder, as the circadian rhythm protein occupies a part of the brain that is directly linked to eyes. Improper regulation of light

and dark cycle affects genes responsible for agreeableness; which in turn increases the release of serotonin and dopamine (Figure 4). Imbalance of serotonin and dopamine results in mood disorders such as depression and bipolar disorder which accounts a global prevalence of 6% and 2.2% respectively (Suzuki *et al*,2017). Hence, the depressed individuals show difficulties in sleeping. Therefore insomnia related with major depressive disorder includes normal sleep onset but repeated awakenings during the second half of the night and early morning (Bidaki *et al*, 2012).

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┌─────────────────────────────┐     Mutation      ┌──────────────────────────────┐
│ CLOCK gene in chromosome 4  │ ───(3111 T/C)───▶ │ Improper regulation of light-│
└─────────────────────────────┘                   │ dark cycle and sleep–wake    │
              │                                    │ cycle                        │
              ▼                                    └──────────────────────────────┘
┌─────────────────────────────┐                                  │
│   Circadian CLOCK protein   │                                  ▼
└─────────────────────────────┘                   ┌──────────────────────────────┐
              │                                    │ Serotonin and dopamine       │
              ▼                                    │ activity affected            │
┌─────────────────────────────┐                   └──────────────────────────────┘
│ Regulation of dark and light│                          │               │
│ cycle                       │                          ▼               ▼
└─────────────────────────────┘                    Bipolar          Depression
              │                                     disorder
              ▼
 Regulation of sleep and wake
 cycle together with usual traits of
 agreebleness
```
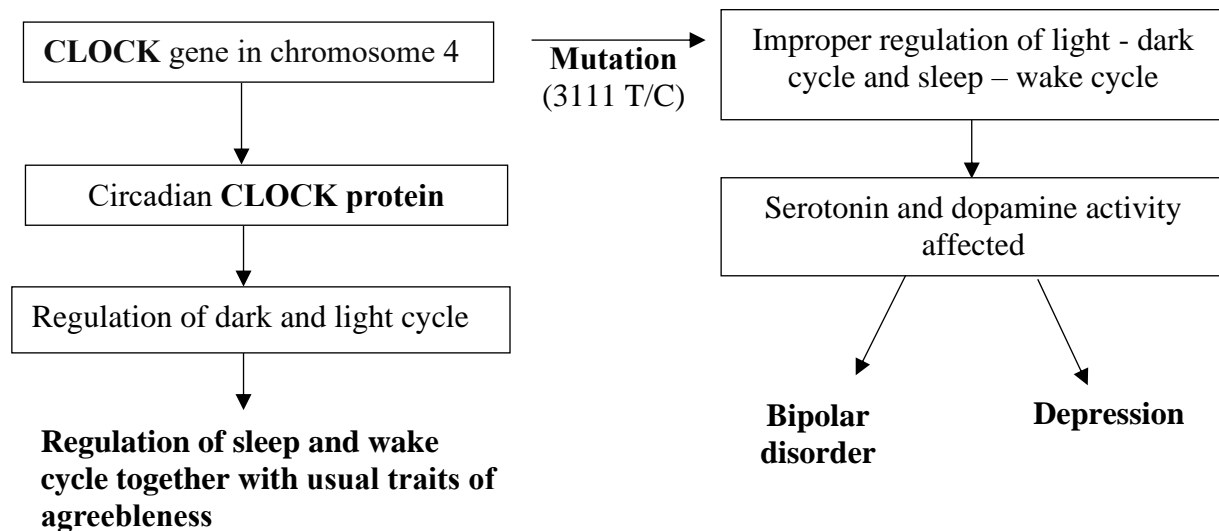
Figure 4. Agreeableness and sleep-mood disorder

Consciousness

A significant correlationship was noted between genes account for trait consciousness such as, genuine and responsible with DYRK1A gene located in chromosome 21q encoding for kinases. Kinases are crucial in formation and maturation of dendritic spines from dendrites in neurons and additionally phosphorylates the amyloid precursor protein and microtubule binding protein tau (Terracciano *et al*., 2010). Mutation in DYRK1A leads to hyper phosphorylated tau which produces inclusions that form neurofibrillary tangles and causes accumulation of amyloid-β which leads to Alzheimer's disease (Figure 5). Further, Increase in kinase level affects the genes and proteins responsible for the trait consciousness and causes mental retardation, which is a symptom of Alzheimer's disease. Alzheimer's disease is a common neurodegenerative disorder which affects 40 million people worldwide (Branca *et al*.,2017).
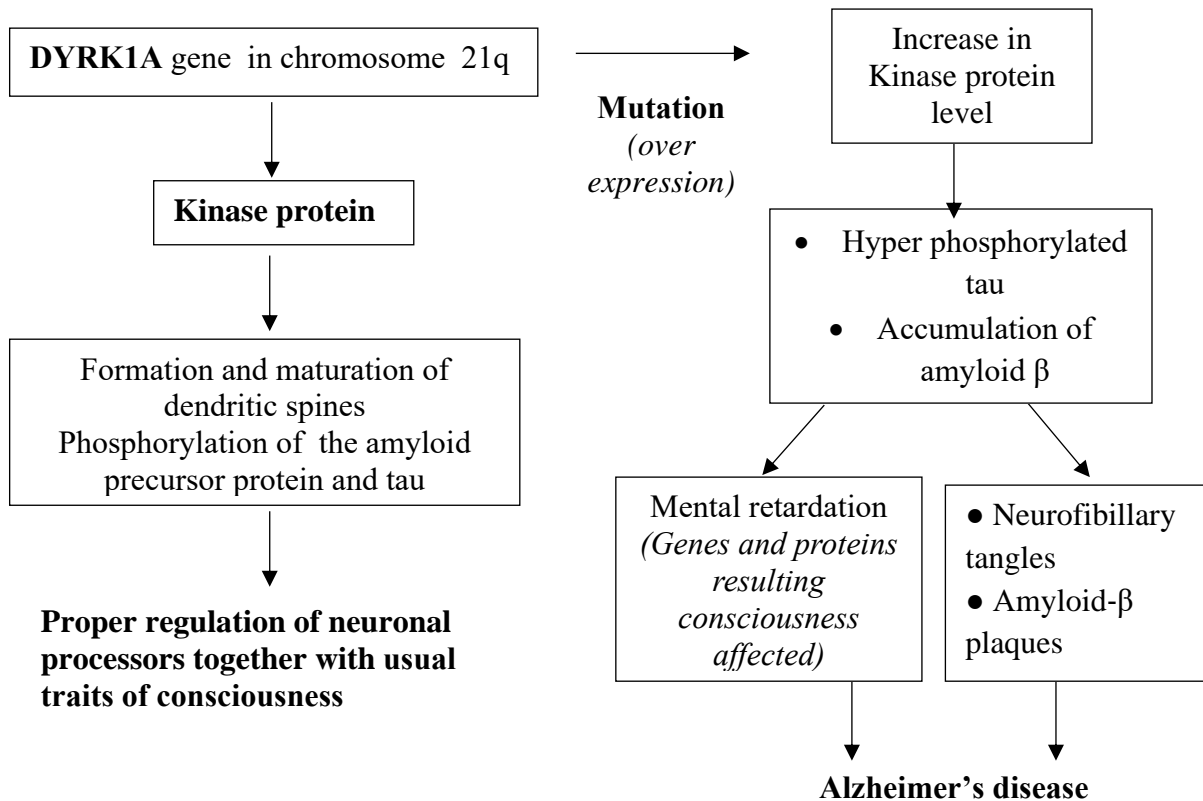
Figure 5. Consciousness and Alzheimer's disease

Role of environment on determining personality

Variations in personality phenotypes are created by neurogenetic and environmental processes that interconnect over time. Diathesis-stress model well describes the development of psychiatric disorders stimulated by genes and the environment. This illustrates that an individual who has genetic predisposition to a particular psychiatric disorder will not develop the disorder unless the genes are triggered by the environment. Study regarding the impact of genetics and environment on personality traits serve as a key diagnostic criterion for neurological disorders (Halldorsdottir and Binder, 2017).

Conclusion

The evidences describe the influence of environmental factors and genotypes which are responsible for the personality traits on psychiatric and behavioural disorders. The altered molecular pathways and neural circuits mediating risk indicates that the psychiatric and behavioural disorders ensue in individuals based on mutations in key genes or genes associated with the key genes encoding for personality traits. Understanding the underlying pathobiology may allow more targeted prevention and treatment strategies at the molecular level.

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HEALTH RISKS AND BENEFITS OF WATERBIRTH

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Abstract

Waterbirth is a mode of birth where the expectant mother remains in the water tub during the pushing phase at which the actual birth of the neonatal occurs. Water birth was introduced and occurred firstly in 1805 and it's on the inclining phase in the recent years. Numerous articles have been published based on waterbirth on its procedure. benefits, factors to consider and experiences of women. The word "Water" itself plays a major role in waterbirth which is given a medical term of hydrotheraphy where the expectant mother is given a water theraphy which eases the labour and the factor of key importance is where the tub is filled with water. This review article is based on the health and safety measures of the mode of delivery whereby explaining the experiences of waterbirths. A sound knowledge on reasons to choose waterbirth as a mode of delivery explaining all the factors to be considered of the mode.

Keywords

Hydrotheraphy, Labour, Delivery, Waterbirth, Low-Risk-Pregnany

Introduction

The traditional painful birth which has been ever since the 1st generation has been converted to a fabulous birth option- the water birth – a pain free birth with increased mobility and decreased risk of operative birth as well of pernineal tears (Carlsson, T. and Ulfsdottir, H ,2020). By opting for waterbirth, the mother could undergo a smooth delivery with decreased labour pain and increased enthusiasm. A successful birth is based on the education provided to the expectant mother on the birth process and its requirements (Harper, B,2014). There are instances where an adverse outcome had been resulted due to improper education and facilities provided by the center in accordance to the procedure. Due to lack of facilities provided by the centre, mothers have obtained negative experiences on the process of water birth whereby assuming it is not a reliable method. In contrast, those who had proper knowledge on the process and did acquire the appropriate facilities have had positive experiences on the process and have supported for the mode of delivery) Fair, C. D. *et al,*2020). Without proper knowledge one could mistake the concepts of water birth and its beneficial factors whereby the purpose of this review is to provide a clear understanding on the concepts of the waterbirth and its beneficial factors clearly distinguishing it from the other modes of birth options.

Methodology

Waterbirth – the method of birth in which the expectant mother gets the control on her body and the neonate. Excess of freedom to move with decreased risk of OASI(Obstetric Anal Sphincter Injury) where hands on is not required and no medical intervention(Burns *et al.*, 2020).24 articles were referred to gain a clear understanding starting from the root of emergence of Water birth , where later those articles were scrutinized within 5 to 10 years range and 15 articles were selected. The data collected were scrutinized based on recent researches. Data was collected based on the experiences of women undergone water birth , health risks and

benefits and the most considerable point whether it is safe or not. Original research articles, journal articles, qualitative and comparisonal articles were chosen for this review.

Results

Water birth is safe and proven by HTA- Health Technology Assessment (Carlsson and Ulfsdottir, 2020).Articles were supportive while the remaining are against as health professionals object it whereas no risks found so far by waterbirth. As per analysis made, It could be stated Waterbirth as 100% safe method. Most of the facts stated on articles against Waterbirth, those studies included complicated pregnancy as well. A fact to point out clearly is that Waterbirth is applicable for low risk and uncomplicated pregnancies. Waterbirth resulting in low incidence of OASI(Burns *et al.*, 2020).Increased sexual pleasure during the birth process and could easily resume to sexual life after the birth process(Camargo *et al.*, 2020).

Positive Expereinces

Table 1. Physical Benefits of waterbirth (Carlsson and Ulfsdottir, 2020).

Physical benefits: the water eases labor progression while offering boyancy and pain relief	
CATEGORIES	SUMMARY OF CONTENT OF CATEGORIES
Pain relief	- Pain relief during the active stage of labor - Warm and soothing for the vulva and perineum - Pain relief enhanced by the buoyancy effect - Possibility to adjust surrounding temperature
Mobility	- Greater possibility to change positions - Easy to find comfortable positions, be upright
Labor progression	- The birth felt smooth - Stronger contractions - Easier dilation of cervix - Child benefited from being born in water - The water benefited the delivery of the placenta
Decreased risk of complication	- From their perspectives decreased risk of medical complications, in particular perineal tears

Table 1.1 Pyschological benefits of Waterbirth((Carlsson and Ulfsdottir, 2020).

Psychological benefits: improved relaxation and control in a demedicalized and safe setting	
CATEGORIES	**SUMMARY OF CONTENT OF CATEGORIES**
General positive feelings	- Described in various positive terms - Felt like the only right thing to do - The experience was only positive, most amazing - Would give birth in water if pregnant again - Related to feelings of harmony
Relaxation	- Relaxing, calming between & during contractions - Buoyancy made it easier to relax, feel comfortable - Opportunity to get rest and recovery
Hightened control	- Focus on their bodies and the birth - Aware of what was happening in their bodies - Aware of their breathing pattern - Felt safe to let go and 'float along'
Less medicalized	- Felt less clinical compared with birth out of water - Felt natural for themselves and their child - Opportunity to feel close to their partner - Possbility to bring the baby up by themselves

Negative Experiences

Equipment-related issues due to the construction of the tub and issues related to being immersed in water	
CATEGORIES	**SUMMARY OF CONTENT OF CATEGORIES**
Obstacle for intimacy	-Obstacle for intimacy with their partner - Midwife unable to be close and guide them
Hinderance for wishes and preferences	- Unable to use desired pharmacological pain relief - Temperature of water difficult to adjust - Water became contaminated by feces and blood
Unsuitable tubs	- Difficulties moving around, going in or out of tub - Tub felt uncomfortable, small and tight - Pain due to small tub - Small tub limited number of birthing positions - Difficulties gaining a good grip in the tub - Need for better suited and larger tubs

Figure 2 . Equipment related issues((Carlsson and Ulfsdottir, 2020)

Fears and worries related to waterbirth	
CATEGORIES	SUMMARY OF CONTENT OF CATEGORIES
Worry of complications	- Possible postnatal infection - Having to rise out of water during expulsion - Worry when difficulties finding heartbeat - That they would accidently drop the child - How the child would react to being born in water

Figure 2.1 Fears of Waterbirth

The above four tables are analysis made by (Carlsson and Ulfsdottir, 2020),which was found out by a qualitative study along with open ended questions from mothers who went through waterbirth. The results are clear as crystal that Waterbirth is a safe method with numerous benefical factors and the negative experiences were soley due to lack of preparatory information and management of the Obsestrics and gynecology unit.to the extend based on all articles reviewed, Waterbirth does not cause any harm nor negative vibes unless the factors contributing to a successful delivery are not considered fully.Post natal infection, which could arise on any mothers who undergo birth irrespective of the mode of delivery.

Discussion

There are various factors to be considered before choosing Water birth, once all factors are appropriate, Water birth becomes a successful mode of delivery. When considering the researches done, women have had positive experiences where labour has taken place in appropriate methods, while a group of negative experiences were observed due to lack of preparatory information on water birth(Carlsson and Ulfsdottir, 2020).In Burns et al. ,2020,It was stated as waterbirth could cause OASI where in the study ,models of exact waterbirth were excluded therefore it proves that Waterbirth is actually a low risk OASI method. The necessities of Waterbirth were included and explained by Kavosi, Z. *et al,*2015,which were a reason for negative experiences experienced by the mothers confessed in the qualitative- open- ended question based study of Carlsson and Ulfsdottir, 2020). Camargo *et al.*, 2020, discusses how sexual life is resumed after water birth and how water birth aids in resuming sexual life. Kavosi *et al.*, 2015 compares the quality of life of mothers undergone caesarean, normal vaginal birth and water birth and henced proved that mothers undergone water birth do have a better quality of life after delivery both physically and mentally.

Conclusions and Recommendations

Water birth is a safe method of uncomplicated and low risk pregnancies which is approved by the HTA. In order to encourage all mothers to opt for waterbirth, the health professionals at the unit should provide the mothers to be proper preparatory informations based on past experiences of other mothers and proper evidence, where it is on declining phase which is the the major reason for low water birth right across the globe. yet, there is a slightly inclining phase on occurance of waterbirths. Midwives to inform clearly and health professional on choices of birth(Carlsson and Ulfsdottir, 2020).Waterbirth not only being a better option of delivery yet a low risk method when considering OASI(Burns *et al.*, 2020).The significance of

the results is to encourage and create awareness on expectant mother which could enable them to choose their mode of delivery.

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THE IMPACT OF DIETARY PATTERNS ON CARDIOVASCULAR DISEASES (CVD)

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Abstract

In recent years, non-communicable diseases based mortality rate globally increased mainly due to cardiovascular disease. Thus, the main aim of the present literature review was to demonstrate the impact of dietary patterns on cardiovascular disease. Approximately 40 published literature reviews were used to gather information for this study. Many studies have been published on the relationship between the risk of cardiovascular disease and various nutrients, foods, and eating patterns. Despite the well-accepted concept that diet has a significant influence on the development and prevention of cardiovascular disease, foods considered healthy or harmful have varied over the years. The main findings of this review were suggested that different dietary pattern nutrient components directly related to cardiovascular disease, where specific food types such LDL that triggers the cardiovascular diseases. In a nutshell, there is a strong impact of dietary patterns on cardiovascular disease. Hence, nutrient composition of foods analysis and identification of the food that triggers the non-communicable diseases recommended for a future clinical study.

Key words : Dietary patterns, cardiovascular disease, LDL, nutrients

Introduction

The modern lifestyle and the dietary patterns have a major influence on cardiovascular diseases. The correlation between dietary patterns and cardiovascular diseases is an essential factor in recent years. A recent study conducted by Lopez *et al.* (2020) shown that most common cardiovascular diseases around the world are; the peripheral artery disease, coronary artery disease, heart failure, arthrosclerosis and cardiomyopathy. Common risk factors for cardiovascular diseases are gender, genotype, age, diet, stress and exercise. The dietary patterns and dietary intake differ according to epidemiological factors, so the cardiovascular disease risk also differs according to epidemiology. The main aim of this literature review was to demonstrate the impact of dietary patterns such as Foods/macronutrients/bioactive compounds on cardiovascular diseases.

Methodology

For this study, all together 40 research papers, medical journals and online publication pages and online articles were used as resources. When searching the articles dietary patterns, cardiovascular disease and dietetics were used as key words.

LDL or low-density lipoproteins effects on CVD

Storey *et al*., (2017) showed that LDL as a one of the major cause of atherosclerotic disease Inflammation markers such as C-reactive protein (CRP) and interleukin-6 (IL-6) are positively correlated with increased risk of cardiovascular events. Where he demonstrated that, decreasing LDL level can decreases cardiovascular risk. Further, the same study clearly showed that

decreasing LDL is beneficial because lower LDL level lower the pro-inflammatory secretion. Pro-inflammatory secretion is triggers by C-reactive protein and interleukin-6. Reducing LDL rich foods such as meat, saturated vegetable oil and coconut oil in the dietary pattern can reduce the cardiovascular disease.

HDL or high-density lipoprotein effects on CVD
Higher levels of HDL are usually beneficial, whereas lower levels of HDL (levels below 40 mg / dL.) are often detrimental. Study conducted by Kosmas *et al.,* (2018) have shown that there is a strong reverse association between high-density serum concentrations of lipoprotein-cholesterol (HDL) and risk of coronary heart disease. However, very high levels of HDL (levels higher 60mg/dL) are not necessarily protective but can also become pro-inflammatory under certain circumstances.

Proteins effects on CVD
Halbesma et al., (2009) showed that, there is an association between high protein intake and cardiovascular disease. Healthy proteins in dietary patterns decrease the cardiovascular diseases. Healthy protein foods are eggs, almond, chicken breast, oats and broccoli. Unhealthy proteins define as if the consist of protein is low than the other compositions such as fats, sodium and fiber. However, higher intake of unhealthy proteins (meat and grain-fed red meat) increase the risk of CVD. Plant-based protein sources are unsaturated, which lowers the LDL cholesterol. Processed meat and red meat mostly consist of saturated fats (LDL), total fat and low amount of proteins.

Secondary metabolites effects on CVD
In 2017, Chrysohoou *et al.,* revealed a combination of pre-hypertension with decreased serum antioxidant potential and increased oxidized LDL possibly suggesting initial pathological changes. (Mangge *et al.*, 2014) shown that exogenous antioxidants such as vitamin A, C and E can modulate endothelium-dependent vasodilatation responses, endothelium-leukocyte interactions, and balance between pro- and anti-thrombotic activities. Low intake of antioxidants, especially vitamins, has associated with an increased risk of CVD .The association between concentrations of antioxidant compounds such as vitamins and the risk of CVD correlated with an increased demand for antioxidant molecules during inflammatory diseases and an inadequate supply of such compounds may worsen the disease. Antioxidant rich food such as vegetables and fruits reduce the risk of CVD.

Table 01: Comparison between different food types, macronutrients, bioactive compounds and cardiovascular disease.

Foods/macronutrients/bioactive compounds	Cardiovascular disease/CVD risk factors	Citations
Fruits and vegetables	Rich in vitamin C and dietary fibers, low in calories. They act as antioxidants in the body, helping to slow down or avoid atherosclerosis.	(Casas *et al.,* 2018)
Meat	Meat is high in protein, iron, zinc and B-vitamins; Nonetheless, it can also contain large quantities of cholesterol and saturated fatty acids, which increase LDL-C and lower triglycerides. High consumption of red meat (rich in heme iron) increases. The endogenous production of N-nitroso compounds Associated with increased epithelial expansion, oxidative stress which leads to atherosclerosis.	(Anand *et al.*, 2015)
Dairy	Enhanced low-fat milk intake is associated with lower LDL-C, triglycerides, plasma insulin, blood pressure. Research has shown that dairy products consume a lower risk of CVD.	(Anand *et al.*, 2015)
Fish	Fish is a source of protein, vitamin D, several B vitamins, Essential amino acids and essential nutrients; and long chain omega-3 fatty acids. Long chain omega-3 polyunsaturated fatty acids reduced in fish Multiple risk factors for CVD including vascular resistance, Blood Pressure, inflammation and endothelial function.	(Anand *et al.*, 2015)
Legumes	Consumption of legumes Improves risk factors for CVD such as cholesterol, Blood Pressure. Legumes are important for reducing risk of coronary artery disease.	(Casas *et al.,* 2018) (Anand *et al.*, 2015)
Olive oil	Olive oil is a simple way to replace unsafe, saturated and trans-fatty acids in animal fats with a source of omega-3 fatty acids that reduces inflammation. Olive oil lowers the risk of heart disease because it helps maintain healthy blood flow and clear plaque from the arteries.	(Casas *et al.,* 2018)
Wine	Wine and its phenolic compounds minimize LDL-c oxidation and oxidation stress and increase NO, enhancing endothelial function. Ethanol also raises HDL-c levels and prevents	(Casas *et al.,* 2018)

	platelet aggregation, facilitates fibrinolysis and decreases system inflammation.	
Carbohydrate	Highly processed carbohydrates include polished white rice, cornstarch and brown rice. Wheat flour with decreased fiber content. In addition to inflammation, too much sugar in a bloodstream will damage the artery walls, leading to further inflammation. Inflammation is a risk factor in coronary artery disease.	(Anand *et al*., 2015)
Omega-3 fatty acid	Omega-3 fatty acids have been reported as potential anti-atherogenic agents for the atherosclerotic process. Omega-3 fatty acid improves the lipid and lipoprotein profile, oxidation, thrombosis, endothelial function, plate stability, platelet aggregation,	(Casas *et al.,* 2018)

Mediterranean dietary pattern is rich with fish, beans, olive oil, whole grain and moderately number of dairy products. As in table 1 fish, olive oil, dairy products and vegetables and fruits reduces the risk of CVD. The Mediterranean diet is one of the most effective dietary patterns for CVD due to low LDL level and rich nutrients. Asian dietary patterns mostly consist of carbohydrate, vegetables, fruits, and grain, meat and fish products. As above mentioned, carbohydrates increase the CVD. Asian diet also has balanced amount of nutrients. Fast food diet consists of processed meat, carbohydrates, and Fatty acids. Fast diet triggers the plaque formation, endothelial dysfunction and high blood pressure resulting CVD. The major dietary pattern that affects arthrosclerosis and coronary artery disease is fast food diet. As an example, the USA diet is mainly consisting of fast food rich with saturated fatty acids, LDL and refined carbohydrates.

Relationship between dietary patterns and cardiovascular diseases in Sri Lanka
There are many questions regarding the commonly consumed in the Sri Lankan diet that could have a major protective impact or risk for CVD. Coconut is one of the major ingredient in Sri Lankan diet. Coconut is consist of higher level of HDL and low level of LDL. Coconut is decreasing the cardiovascular risk (Lathika *et al.,* 2015). In Sri Lanka palm oil is using instead of coconut oil due to low cost this will increase the risk of CVD (Lathika *et al.,* 2015). The Inadequate intake of fruit, vegetables and whole grain goods was the lowest in the rural sector. Over-consumption of deep-fried food is high in residential areas. Baked food and sugar-sweetened beverages are significantly high in urban and residential area. Coastal areas mostly consumed sea food and upcountry area mostly consumed meat. Circulation of the saturated fatty acids, which are typically seen in dairy products and fish, can have a saturated fatty acid Protection of arteriosclerosis among patients in Sri Lanka due to high consumption of fish and milk. Small fish is healthy for the heart as it has omega-3 fatty acids. This Decreases the rates of triglycerides; as it delays the growth rate of atherosclerotic Plaque. A recent study conducted by Sivajenani *et al.,* (2015) fatty food are consumed since childhood because Sri Lankans

mostly consume saturated fats from coconut products, meat, milk and oil. Therefore, this findings indicates the lifestyle of Sri Lankan influencing CVD.

Healthy dietary pattern for preventing CVD

Diet is a critical component of lifestyle affecting cardiovascular risk by body weight and many other pathways. Pallazola *et al* (2019) showed that the diet requires high consumption of non-starchy vegetables, berries, whole grains and legumes. As well as minimal to moderate intake Consumption of nuts, fish, lean beef, Low fat dairy products and vegetable oil. Minimum consume of Trans-fat, saturated fat, sodium, red meat, refined carbohydrates and sweetened sugar Drinks. Eating too much salt can increase the risk of developing hypertension. Having high blood pressure increases the risk that coronary heart disease can develop. Reduced salt consumption lowers the CVD risk. Alcohol consumption should take within the prescribed guidelines.

Discussion

The evidence supports the consumption of balanced dietary patterns, such as the Mediterranean diet or the DASH diet, as opposed to other unhealthy dietary patterns, such as the Western diet, focused on high salt, added sugar and saturated and trans-fat consumption. While strong evidence suggests that the potential health benefits of a large number of foods, nutrients, bioactive compounds and dietary antioxidants can be correlated with CV risk factors or directly linked to the development of CVD. However, there is a knowledge gap related to this study area such as of how food is categories within its composition and association with CVD risk factors. So far, there has been little discussion about dietary patterns and cardiovascular diseases related to Sri Lankan cuisine.

Conclusion

There is a major impact on cardiovascular disease by our sedentary lifestyle and unhealthy diet. Which can cause for the non-communicable disease like CVD. Further, higher level of LDL increases the CVD risk, HDL and antioxidant rich food decreases the risk of cardiovascular disease. Reducing LDL rich foods such as meat, saturated vegetable oil and coconut oil in the dietary pattern can reduce the cardiovascular disease. Higher intake of unhealthy proteins has direct effect on CVD. Foods that increasing the risk of CVD are processed meat, red meat, fried foods and processed foods. Antioxidant rich food such as vegetables and fruits reduce the risk of CVD. Foods that decreasing the CVD risk are fruits, vegetable, legumes and fish. . Therefore, risk for the cardiovascular diseases can reduced by a healthy diet, that diet should change since beginning of the childhood and should combine with an active lifestyle.

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KNOWLEDGE AND AWARENESS TOWARDS COVID-19 AMONG SRI LANKAN SOCIAL MEDIA USERS

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Abstract

The recent COVID-19 infectious disease has become a devastating pandemic with an increased number of morbidity and mortality rates causing unpredictable social disruption, economic loss, and general hardship worldwide. Despite the international preparedness toward pandemics and immediate actions taken by the government of Sri Lanka in battling against the covid-19 outbreak, the outcome of these efforts is highly dependent on the awareness towards COVID-19 of every individual. Therefore, this study was done with the use of a self-reported questionnaire to assess the knowledge and awareness among the Sri Lankan public. Among the survey completers, the majority of the respondents for the online survey were males (50.34%) and were within the age range of 15-25 years (62.96%). The COVID-19 mean awareness score among respondents was at a good level (M = 66.11, SD = 11.09). Thereby, overall, respondents showed an expected level of knowledge regarding COVID-19.

Keywords

COVID-19, Coronavirus, Knowledge, Awareness, Sri Lanka

Introduction

Most of the human infectious diseases are mainly caused by either pathogenic bacteria or viruses, where the history reveals that severe communicable diseases and pandemics are having a viral origin (Huremovic, 2019). *Coronaviridae* virus family has a history of two pandemic events in the past two decades, Severe Acute Respiratory Syndrome (SARS) in 2002 and later in 2012 Middle East Respiratory Syndrome (MERS), respectively (WHO, 2003; Zaki, et al., 2012). WHO (2020) recognized third pandemic from this family started when an outbreak of coronavirus disease (COVID-19) was reported in late December 2019 in Wuhan, China caused by Severe Acute Respiratory Syndrome Corona Virus 2. The first case of COVID-19 in Sri Lanka was reported in Colombo on March 11, 2020 (Epidemiology Unit, 2020).

This newly emerged COVID – 19 pandemic is rapidly creating an impact on the lives of the global population by increasing morbidity and mortality. Predicted death rates of this pandemic has been estimated by 2020 November as 1,433,316. Further, the potential side effects such as Parkinson's disease, kidney damages, heart failure, Cognitive impairment are still under investigation (WHO, 2020; Wexler, 2020; Smith, 2020). Those side effects will have a significant impact on prognosis of individuals which in turn will lead to health care burdens globally. Therefore, it is imperative that public understand the importance of prevention before being infected. Also, misconceptions and false information can accelerate the spread of the

pandemic (Khasawneh, et al., 2020; Al-Zaman, 2020). Thus, while focusing on virology characteristics and clinical burdens of COVID-19 it is important to assess the knowledge and awareness of COVID -19 among general public (Khasawneh, et al., 2020).

The imposed lockdown and curfews restricted humans' physical movements which has led to the increased usage of social media by the public (González-Padilla & Tortolero-Blanco, 2020). Therefore, most of the studies were carried out through social media platforms during the pandemic to ensure the safety and efficiency (Zhong, et al., 2020; Khasawneh, et al., 2020; Al-Hanawi, et al., 2020; Maheshwari, et al., 2020). On that account, this study focuses on evaluating knowledge and awareness among Sri Lankan social media users.

Methodology

A quantitative, cross-sectional study was designed to analyze the knowledge and awareness of COVID-19 among Sri Lankans. The theoretical population of the study was Sri Lankans. An online self-selected survey was designed to collect quantitative data due to the lockdown conditions that prevailed in the data collection period. Thus, the study population was Sri Lankan social media users. The survey was conducted using a structured self-administered questionnaire developed as a google form and distributed through several social media platforms such as Facebook, Instagram, WhatsApp, and Twitter. The questionnaire was originally articulated in English, and to reduce literacy barriers it was translated into Sinhala and Tamil. The respondents were given the freedom to choose a language. The questionnaire was structured into two sections. The first section was about the demographic profile of the respondent whereas the second section was focused on assessing the knowledge and the awareness on COVID 19 with the use of 18 questions. The awareness consists of elements such as symptoms, transmission mode, and prevention measure. The response type was yes, no, and not sure. The 'not sure' option was given to the respondents as this was the emerging period of COVID 19 instead of forcing them to mark 'yes' or 'no'. Responses were collected for ten days and 1172 responses were received. The collected data was analyzed by using Ms. Excel & IBM Statistics SPSS version 23.0. Descriptive statistics and inferential tests were conducted to identify the differences in awareness levels among different demographic groups.

Results and discussion

The majority of the respondents for the online survey were males (50.34%) and were within the age range of 15-25 years (62.96%). The work status of the majority of them were students (51.70%) and only 39.07% were employed. The respondents were categorized according to education level with 34.12% participants were up to degree level, 31.74% participants were up to A/L and 21.24% were up to diploma. The results revealed that the mean awareness score on COVID-19 among respondents was at a good level (M = 66.11, SD = 11.09).

An independent sample T-test and one-way ANOVA were conducted at a 5% statistical significance level to identify the awareness level difference in different demographic groups. There was a statistical difference in awareness level on COVID -19 in different demographic groups based on education, occupation, and age of the participants while there wasn't a

statistically significant difference in awareness level in different demographic groups based on gender and province.

The Tukey post hoc test revealed that the awareness level of COVID-19 with educational level indicated that the students up to O/L were showing a statistically significant difference with all the other four educational groups (Refer Figure 1). This significant difference may have been influenced by less exposure to O/L students towards society.

Figure 1: Mean total awareness scores over educational levels. Error bars represent the standard error of the mean. (Statistical significance *p< 0.05)

To find the interconnection between knowledge on COVID -19 with the occupation of the participants. The raw data were amalgamated into the consequential analysis which is presented in figure 2. The results revealed another important significance between employed and unemployed participants where unemployed participants had less adequate knowledge of COVID -19 compare with employed participants. Therefore, this again emphasizes that the employed people may have gained adequate knowledge because of higher exposure towards society and influenced by many sources while unemployed people may have limited sources that provide knowledge on COVID-19.

Figure 02: Mean total awareness scores over occupation. Error bars represent the standard error of the mean. (Statistical significance *p< 0.05)

Another significant difference was seen in the association between knowledge on COVID-19 with the age of the participants (Figure 3), where age groups 26-35 and 36-45 are more knowledgeable about COVID-19 than the age group of 15-25.
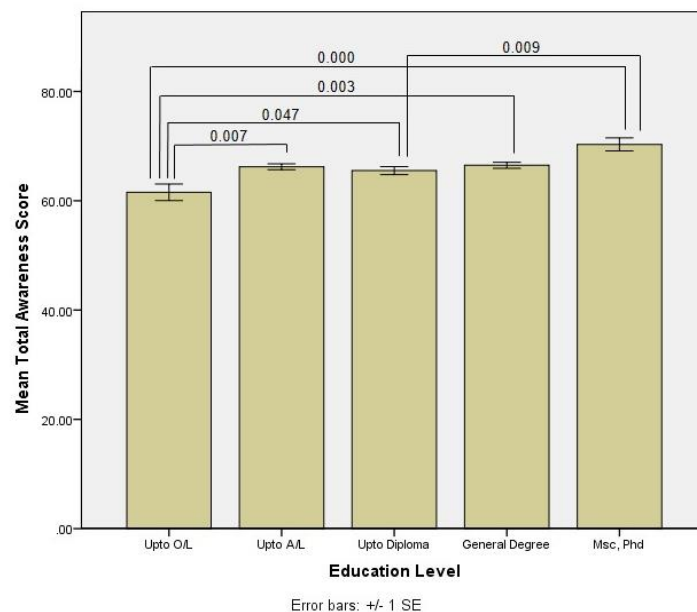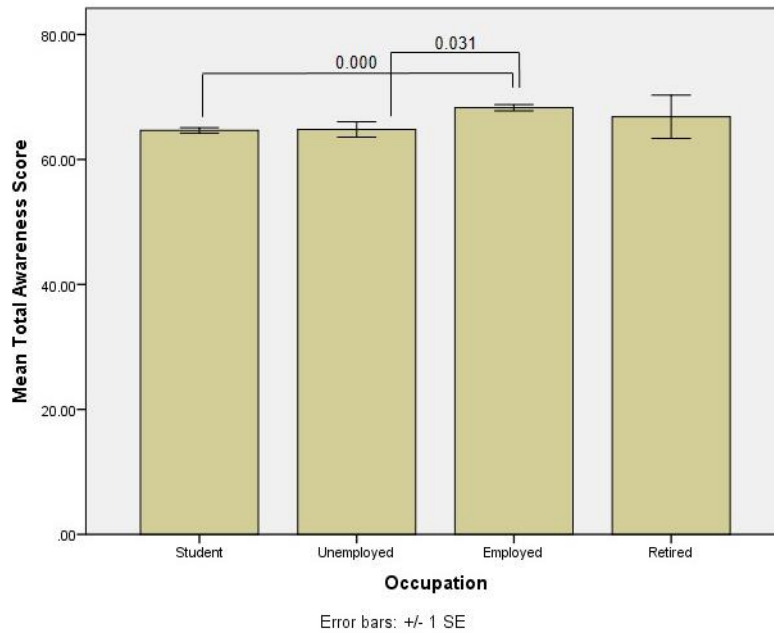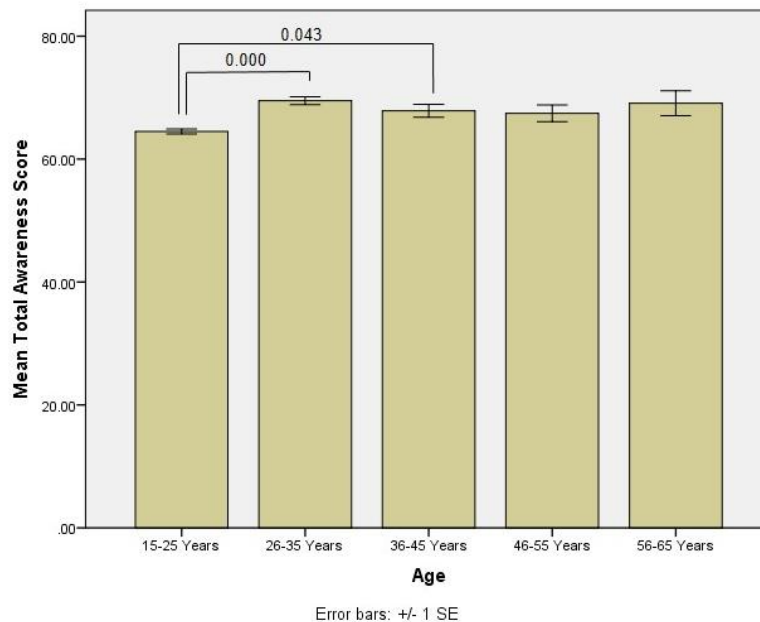

Figure 03: Mean total awareness scores over age. Error bars represent the standard error of the mean. (Statistical significance *p< 0.05)

According to the results of our study low educated, unemployed, and younger (15-25) people showed less adequate knowledge towards COVID-19. Therefore, our study emphasizes that a

wide range of attention and awareness-raising programs are needed to reach these groups of people.

Another similar cross-sectional study that assesses the Knowledge, Attitude and Practices Toward COVID-19 which is done in Saudi Arabia with a questionnaire and a similar design to our current study reveals that greater emphasis should be placed on mass media, to target low-income, low-educated, young people, and men to improve public knowledge on the COVID pandemic, through awareness-raising interventions (Al-Hanawi, et al., 2020).

Conclusion

Overall social media users in Sri Lanka showed expected levels of knowledge and awareness towards COVID-19. Our finding exhibits that the awareness score increases with the elevation of education level as well as employed people showed a good knowledge score. Our study emphasizes that more prominence should be given to less educated and unemployed groups. This study may be useful to healthcare professionals and service providers on further public health improvements and awareness-raising programs.

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INHIBITION OF TUMOR FORMATION AND REDUCTION OF TISSUE NUCLEIC ACID LEVELS IN HUMAN BREAST CANCER BY SNAKE VENOM DISINTEGRIN

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Abstract

The snake venom components cause deceleration of cancerous cells growth. Snake venom therapeutic activity, potency and availability, can make an essential medicine in the future for many diseases and disorders. This article demonstrates two experiments about applications of venoms in cancer treatments, such as Cobra snake venom reduces tissue nucleic acid levels in human breast cancer and Inhibition of tumor formation (breast and prostate) by snake venom disintegrin.

Keywords: Disintegrin, snake venom, breast cancer, tissue nucleic acid levels

Introduction

Snake venoms are the secretions of venomous snakes. These venoms are synthesized and stored in specific parts of their body (ex: venom gland). Snake venoms have the highest toxicity potential to makes options for the development of anticancer agents also snake venoms can degrade or destroy the tumor cells.(Vyas et al., 2013)

Snake venom is clear, viscous and transparent liquid, and also it can be dried to solid crystal form. The ingredients of snake venom can be preserved for long period, if dried solid crystal form is stored properly. The crystal mass can dissolve in blood and water. There are mainly three types of snake venom according to its effects. (Hemotoxic venoms: affects cardiovascular system and blood functions, cytotoxic venoms: targets specific cellular sites or muscles, neurotoxic venoms: harms nervous system of human body).

Snake venom is a complex mixture of enzyme, peptides, proteins, nucleotides and inorganic ions. These Components of snake venoms can used in the treatment of cancer, arthritis, thrombosis, multiple sclerosis, pain, neuromuscular disorders, blood and cardiovascular disorders, infections and inflammatory diseases(Li et al., 2018) . Enzymes present in snake venom hydrolyze proteins and membrane components, which lead to tissue necrosis and blood clotting(Li et al., 2018)

Snake venom contains cytotoxins, cardio toxins, hemotoxins, neurotoxins, nerve growth factor, inorganic cations like zinc, calcium, potassium, sodium and magnesium, etc. Phospholipase A2, ancrod, cobra venom factor, peptides, cytotoxins CT1, CT2 and CT3, serotoxin, L-amino acid oxidases lectins, metalloproteinase, disintegrins, serinoproteases, hyaluronidase, cholinesterase's, salmosin, cathelicidin-BF, aggretin, obtustatin, rhodostomin, albolabrin, colombistatin, saxatilin and lebecetin are some of the components isolated from snake venoms, which are the applications in management of various human cancers.(Li et al., 2018)

Snake venom can differentiate into many groups. As an example some venom components can bind to the cholinergic receptors without causing biological activities, some components can harm to the respiratory muscles then the prey usually dies because muscles have no longer function, a group of toxins inhibits or increases release of acetylcholine then muscle cells can not react to the nerve stimuli and results in spasm or relaxation of muscle, some toxins are

damage to the connective tissues of a body and skin, Cytotoxins and cardiotoxins in the venom causes damage the cell membrane or interfere with the transport of substances or the transduction of signals across the membranes.(Kumar & Shanbhag, 2015)
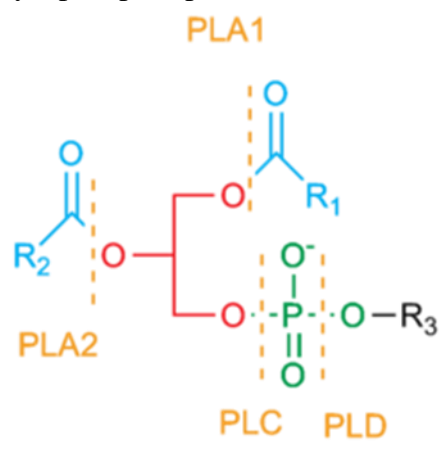
Treatment for the cancer is a major challenge to the medical industry. Current methods of treatments are very costly and have many side effects. Also, patient has to suffer physically, mentally and economically. Some of the snake venom components cause decelerate cancerous cells growth. Snake venom therapeutic activity, potency and availability, can make an essential medicine in the future for many diseases and disorders. Analyzing the pharmaceutical methods snake venom can involve to the medicines and research for treatment of cancer. Snake venoms are studied by scientists for its therapeutically use. The purpose of this article is to review the components of the snake venom and their therapeutic application in cancer therapy.(Yang et al., 2005)

Composition of snake venom

Snake venoms are complex mixtures it has proteins, which have enzymatic activities. Also, snake venoms contain inorganic cations such as sodium, calcium, potassium, magnesium and lesser amounts of zinc, nickel, cobalt, iron, manganese. Some snake venoms also contain carbohydrate, lipid and amino acids. Snake venoms contain at least 25 enzymes, but only few number of enzymes are contain in one venom.(Moga et al., 2018)

Table 1 components of snake venom(Koh et al., 2006)

Component	Description
Proteolytic enzymes	These enzymes breakdown the tissue proteins and peptides. Also known as peptide hydrolases, protease, proteinases. The molecular weight is between 20 000 and 95 000 Da. sometimes these enzymes inactivated by eidetic acid. Some metal ions help in catalysis and involved to activate the venom proteases and phospholipases.
Arginine ester hydrolase	One of the non-cholinesterase enzymes found in snake venoms. It caused to hydrolysis of the ester or peptide linkage, this was mostly found in crotalid, viperid and some sea snake venoms
Thrombin	Thrombin releases fibrin peptides A and B which are responsible for clotting of plasma.
Collagenase	Collagenase is a proteinase enzyme, collagenase digests collagen. Some snake venom contain collagenase which can digests mesenteric collagen fibers.

Thrombin-like enzymes	In nature they are glycoprotein, the molecular weight is between 29 000 to 35 000 Da. These enzymes act as de-fibrinating anticoagulants in vivo, in vitro they clot plasma, and purified fibrinogen. Thrombin like enzymes can be filtered from different snake venoms such as crotalase, agkistrodon, ancrod and batroxobin. Ancrod prevented thrombosis and ensured vessel potency. Crotalase role is fibrin deposition in burns in the animals. The role of fibrin deposition is tumor metastasis.
Phospholipase	Phospholipase A2 (PLA2) were found in snake venom. It has 120 amino acids and 14 cysteine residues forms 7 disulfide bonds. PLA2 can cause hydrolysis of membrane phospholipids and involved to bioactive products. Also, it catalyzes the calcium dependent hydrolysis of the 2-acyl ester bond. It produces free fatty acids and lysophospholipid.
Hyaluronidase	This enzyme also called as the spreading factor. It is related to the edema produced by the venom. It acts to connective tissues and decreases their viscosity, and also catalyzes the cleavage of internal glycoside bonds. Breakdown the hyaluronic barrier and allows other segments of venom to enter the tissues.
. Phosphodiesterase	It releases 5-mononucleotide from the polynucleotide chain and it act as an exonucleotidase, as a result of its affecting

	DNA and RNA functions. This component found in all poisonous snakes
Acetyl cholinesterase	Found in cobra and sea snake venom and absent in viperid and crotalid venoms. The role of Acetyl cholinesterase is catalyzing the hydrolysis of acetylcholine to choline and acetic acid.
R Nase	This is present as the endopolynucleotidase RNase
DNase	It gives oligonucleotides, which terminate 3'esterified phosphate bond in DNA.
5'-Nucleotidase	Nucleotidase is a most active phosphatase in snake venoms, it can hydrolyze phosphate monoesters linked with a 5' position of RNA and DNA.
L-Amino acid oxidase (L-AAO)	It gives yellow color to venom. It catalyzes the oxidation of L-α-amino acid, α-hydroxyl acid.
L-Acetate dehydrogenase	It catalyzes the equilibrium between lactic acid and pyruvic acid and it found in all animal tissues.
Polypeptides	Polypeptides are a low molecular weight protein and enzymatic activities are absent in polypeptides. More than 80 polypeptides were isolated from snake venoms also it has different pharmacological activities

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Methodology

study1

Cobra snake venom reduces tissue nucleic acid levels in human breast cancer

Venom was collected from living cobra snake. And prepared in different dosages such as 10µg 25µg and 50µg per ml. Human breast tissues (cancerous, normal) were collected from different hospitals. One tissue sample were selected. The diagnosis of breast cancer was made by an oncologist through biopsy and patients were classified according to the performance criteria. After surgical cleavage (mastectomy specimen), the tissues were cut into slices and stored separately as the affected (treated as cancerous) and non-affected (treated as normal) portions of the same breast. After These slices were cut into small pieces (1mm in thick) and were put

into ice-cold normal saline and kept immediately into the deep freezer till additional processing.

Incubations, (with and without venom) extractions and estimations was the methods that used for homogeneous preparations. All spectrophotometer estimations were made as mentioned previously. The level of significance was calculated by the method of students 't' test. The RNA, DNA content is expressed as µg/50mg tissues homogenate per 30 minutes at 370C.(Jokhio & Ansari, n.d.)

Study 2

Inhibition of tumor formation by snake venom disintegrin

Rhodostomin was purified from venom of Calloselasma rhodostoma. Triflavin, was from venom of T. flavoviridis. Trigramin was purified from the venom of T. gramineus. Monoclonal antibodies (7E3), integrin a_vb_3 was taken from hospitals. Human breast carcinoma (MCF-7 and MDA-MB-231), prostate carcinoma (PC-3), and osteosarcoma (MG-63) cell lines were obtained. All cell lines were cultured in RPMI 1640 containing 10% fetal bovine serum and 1% penicillin–streptomycin in an incubator with humidified atmosphere of 5% CO2 in air. Primary rat osteoblasts were isolated form calvaria of fetal rats and cultured it. The calvaria of fetal rats were dissected by aseptic technique. The calvaria were divided into small pieces and were treated with 0.1% collagenase solution for 10 min at 37 8C. This complex was pooled and filtered through 70-mm nylon filters. The cells were then grown on the plastic cell culture dishes in 95 air 5% CO2 with Dulbecco's modified Eagle's medium (DMEM). Cell medium was changes twice a week.(Yang et al., 2005)

Human osteosarcoma cell was grown in six well culture plates. Its formed extracellular matrix. Cells were washed by distilled water at 4c and lysed. Cells was rinsed. Saturated with 0.1BSA and washed with RPMI. Tumor cell collected and re suspended. Labelled with (BCECF/AM, 10µg/ml). Probe for cell adhesion for 30 in at 37c. Then BCECF/Mm converted to BCECF by intracellular acetoxymethyl ester hydrolysis. The labeled cell wash and re suspended in PMRI to a density of 1×10^5 ml. re suspended cell were incubated with BAS. Controlled cells were plated in six well culture plate containing extracellular matrices and incubated for 3 h at 37 8C to allow adhesion. After being washed twice with PBS, the non-adherent cells were removed by aspiration and the plates were read with a CytoFluor 2300 fluorescence plate reader (Millipore). To observe tumor cell adhesion to mineralized extracellular matrices of osteoblasts, primary rat osteoblasts were seeded on 6-well plates. Osteoblasts were cultured in DMEM containing 50 mg/ml vitamin C and 10 mM β-glycerophosphate for 2 weeks and the medium was changed every 3 days. Bone nodules form after two weeks. The cell adhesion of tumor cells was then assayed as described above.(Yang et al., 2005)

Analysis apoptosis, tumor cells with or without disintegrin were collected and adjusted. Methanol was added and incubate it. Methanol was removed by centrifugation. And the DNA of the cells as stained with propidium iodide. DNase free RNase volumes are analyzed immediately by a flow cytometer FACS Calibur. In addition, cells were also fixed with 4% paraformaldehyde and stained with Hoechst 33258 (10 µg/ml; Sigma), which no covalently bind helical, double-stranded DNA at AT-rich sequences within the minor groove, for 30 min in the dark and examined under fluorescence microscope.(Yang et al., 2005)

Assay of migration and invasion, the migration of tumor cells was assayed using a Boyden chamber it containing an 8 mm polyvinylpyrrolidone free polycarbonate membrane. Polycarbonate filters were coated with 0.25% gelatin, lower chamber was filled with fetal bovine serum (FBS). Tumor cells were incubated with or without disintegrin for 30 min an aliquot (200 ml) of cells was plated in upper chamber. 10 hours after incubation, all non-migrate cells were removed in upper part of membrane by using cotton swab. And the migrant cells were fixed and stained with 1% crystal violet. Migration was quantified by counting the number of stained cells though the inverted microscope. For the assay of cell invasion, the filters were coated with Matri gel, a basement membrane matrix extracted from Engelbreth-Holm-Swarm mouse sarcoma .Matri gel was diluted to 4 mg/ml using serum free RPMI at 4 8C and an aliquot (20 μl) of Matri gel was added to each filter insert and incubated for 30 min at 37 8C.(Yang et al., 2005)

Binding assays of disintegrin toward tumor cells, the integrins and binding of snake venom disintegrin to tumor cells was assayed using flow cytometer. Tumor cells suspended, fixed and wash. Cells were labels then again washed twice and incubated with secondary FITC-conjugated goat anti-mouse IgG. For 30 minutes in room temperature. After incubation cells were washed twice, re suspended in PBS and analyzed by FACS under this process can use 488and 525 wave length. 10000 cells fluorescence signals were collected to calculate mean fluorescence intensity of single cell and the percentage of positively staining cells. To evacuate the tumor cells and disintegrin bindings, fixed cell were incubated with disintegrin for 1 hour before the primary antibody addition.(Yang et al., 2005)

Intra-tibia injection of MDA-MB-231 in nude mice, MDA-MB-231 ells were cultured by intra tibia injection. Cancer cells was taken with trypsin- EDTA and suspended PBS and cancer cells kept 4^{0}C before inter tibia injection. 4 weeks of female mice were deeply anesthetized using trichloroacetaldehyde monohydrate. Depth (1.5mm) and 30-gauge needle with polythene tube inserted into the proximal tibia. Preventing the cell suspension from spilling the injection site. Cell suspension (0.3 ml) containing 1×10^5 cells was slowly injected into the bone marrow cavity of tibia . A tumor mass was visualized around the proximal tibia. For making sure of bone osteolysis, radiographs were taken by a soft X-ray generating unit.

Statistics, the values given are means scanning electron microscope (S.E.M) the significance of difference between the experimental group and control was assessed by Student's t-test. The difference is significant if the p value is <0.05.(Yang et al., 2005)

Result

Study 1

1. Effect of various concentrations of snake venom on the RNA and DNA levels of human breast cancer and normal breast tissue.(Jokhio & Ansari, n.d.)

Nucleic acids (RNA, DNA)	Control (normal and cancerous)	Various concentrations in snake venom			Whether inhibition significant or not
		I 10 µg/ml	II 25 µg/ml	III 50 µg/ml	
RNA (N)	0.3250+0.0524	0.3267+.0378	0.3267+0.0427	0.3150+0.0339	NS
RNA (Ca)	0.3525+0.0322	0.3383+.214	0.2617+0.0454	0.3267+0.0266	SS
DNA (N)	0.0278+0.0111	0.0228+0.0040	0.0243+0.0068	0.0252+0.0071	NS
DNA (Ca)	0.0437+0.0068	0.0293+0.0078	0.0210+0.0051	0.0302+0.0032	SS

Study 2

1. Adhesion of tumor cell(Yang et al., 2005)
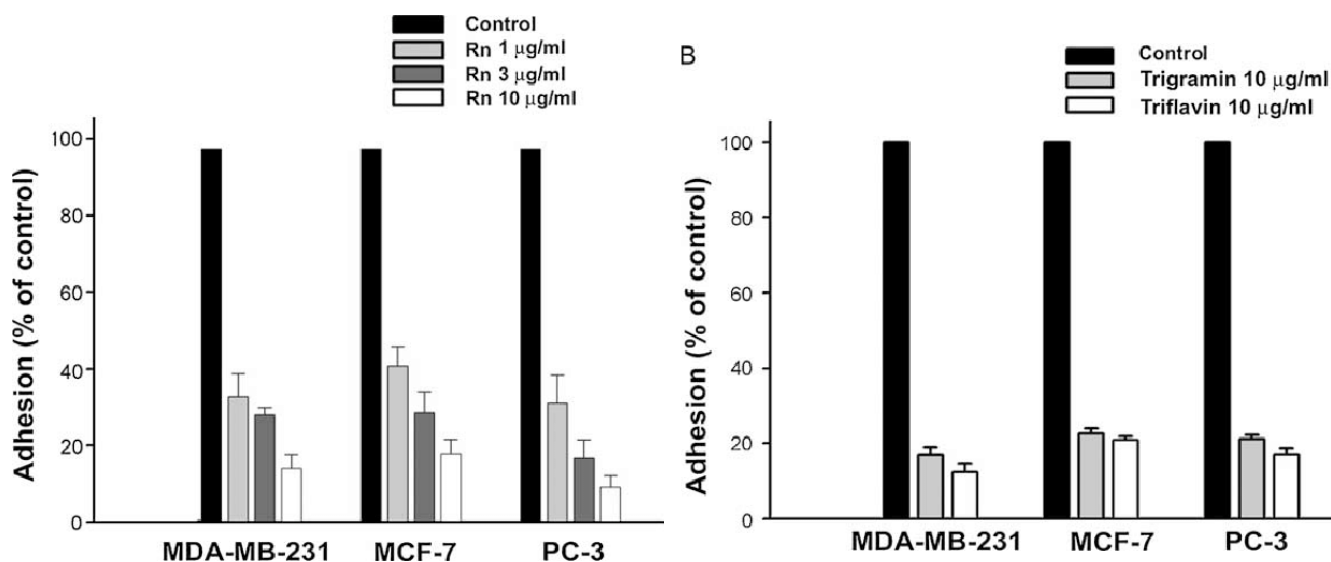
2. Migration and invasion

Migration (Cells/well)
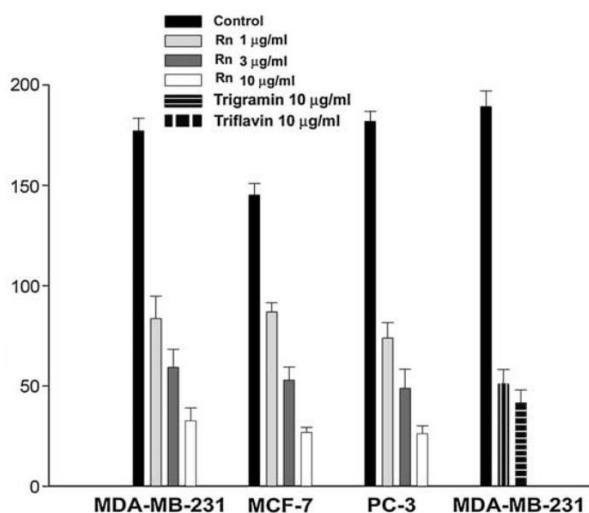
Invasion (Cells/well)
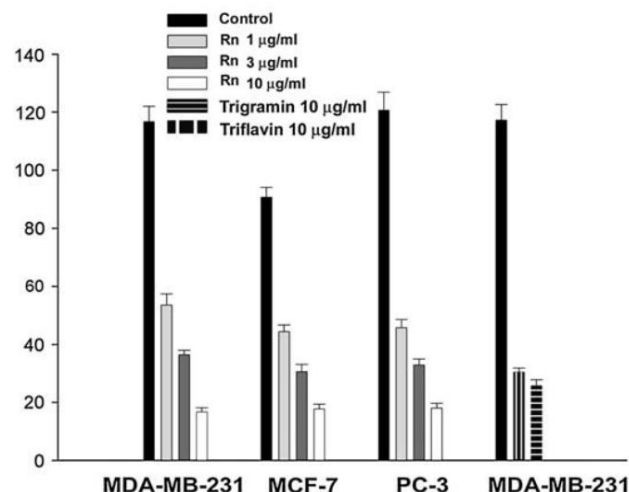
Discussion

Study 1

Under the snake venom reduces tissue nucleic acid levels in human breast cancer there are No significant change was found in nucleic acid levels when normal tissues were treated with variable concentrations of the venom (Table). (Swenson et al., 2004)

But, cancerous breast tissues responded well and DNA and RNA content reduced to a maximum with 25µg/ml venom. The changes of the nucleic acids in normal and cancerous breast tissues, carried about by the venom are mentioned in Table. From the data, RNA, DNA could be observed in the normal breast samples whereas, cancerous tissue samples which have larger concentrations of nucleic acids at basal level, showed a significant ($p<0.001$) fall in the RNA and DNA contents. The corresponding values concerning the reduction of RNA / DNA levels indicate that cancerous tissues could be more sensitive towards the venom. (Swenson et al., 2004)

The data obtained so far showed that cancerous tissues (human-breast) possessed significantly larger amounts of nucleic acids than did the normal tissues. This was agree with the observation for both RNA, DNA that fast growing tissues always contain larger amount of non-sedimentable DNA than differentiated tissues. An increased RNA content in cancer tissue controls increased DNA-dependent - RNA polymerase activity.

There are two major causes (first a change in membrane permeability and second, change at nuclear level) of cell proliferation resulting in metabolic disturbances, excessive lactate production and produce changes in nucleoproteins that could affect the process of protein synthesis. Snake venoms are supposed to be the most complex of animal secretions containing a huge number of compounds with different pharmacological and biochemical activities. Review shows that cobra venom components such as DNAase and RNAase and other enzymes inhibit cancer growth. (Swenson et al., 2004)

Cytotoxin of cobra venom was found to have a more cytotoxic effect on tumour cells than normal cells upon invitro incubation. In our results also no significant change was found to occur in nucleic acids levels when normal tissues were treated with variable doses of the venom but, the cancerous tissues responded well. The RNA and DNA content, were reduced with 25µg/ml venom. It may be expected that venom must first penetrate the nucleus then bind to specific receptor proteins and its initiate the activation of genetic components leading to a number of events. Cancer tissues seem like more sensitive towards venom as has been reported. Results show that venom in small doses can cause inactivation of stimulating enzymes and activating the inhibitory enzymes at that site. This might be one aspect through which venom interferes with the nuclear functions by inducing alterations in the nucleus to restrict the RNA, DNA synthesis through active DNA synthesis which enhance or initiate rapid cell division. Because of these alterations, reduced ability of cells to synthesize DNA from altered templates. Caused to the hypothesis concerning venoms mode of action at nuclear as well as cellular level and it may be demonstrated that suitable concentration of the venom to decrease abnormal cell growth could be 25µg/ml. (Yang et al., 2005)

Study 2

Inhibition of tumor formation by snake venom disintegrin, the molecular mechanisms in which tumor cells metastasize to bone are possible to involve migration, invasion and cell adhesion to bone. then the release of soluble mediators from tumor cells that stimulate osteoclast-mediated bone resorption. Mechanisms of bone metastases by tumor cells are possible involve to the invasion of tumor cells into bone marrow cavity and the adhesion of tumor cells onto bone. It has been demonstrated, overexpression of integrin a_v b_3 in CHO cells stimulates the formation of osteolytic bone lesions in nude mice (Pecheur et al., 2002). Additionally, breast cancer cells overexpression of integrin $a_v b_3$ induced substantially more and larger osteolytic lesion in nude mice compared with MDAMB-231-bearing mice. Using flow cytometer, pretreatment of rhodostomin reduce the binding of 7E3 to tumor cells, it shows that rhodostomin is a potent inhibitor of $a_v b_3$ integrin. Results demonstrated that disintegrin inhibited the adhesion of MDA-MB231, MCF-7 and PC-3cells on to matrix proteins produced by cultured osteoblasts without affecting cell viability of adherent cells. Furthermore, this experiment provided clear evidence about snake venom disintegrins also inhibit cell migration and invasion of breast and prostate carcinoma cells. Also we can demonstrate these snake venom disintegrins did not apply MMP-2 activity (Wu et al., 2003). Then we can confirm the snake venom disintegrins may inhibit avb3 integrin and decrease the migration and invasion of tumor cells. (Yang et al., 2005)

Local administration of snake venom disintegrins not only inhibits the adhesion and migration of tumor cells onto these matrix, but also its inhibit the signaling of small matrix proteins. E.g., it has been reported that snake venom disintegrins inhibit the function of osteoclasts (osteoclasts which provide growth factors to tumor cells via bone resorption). Growth factors, such as transforming growth factor b (TGFb) and insulin-like growth factors (IGFs) I, II are present inside bone matrix and released into the bone microenvironment. It caused to osteoclastic bone resorption. TGFb enhances PTHrP expression of breast cancer cells and IGFs may moderate cancer growth (Mundy, 2002). So cancer cells in bone stimulate osteoclastic bone resorption, initiate a vicious cycle in which growth factors released from matrix increase

tumor cell growth and the production of parathyroid-hormone-related protein (PTHrP). (Yang et al., 2005)
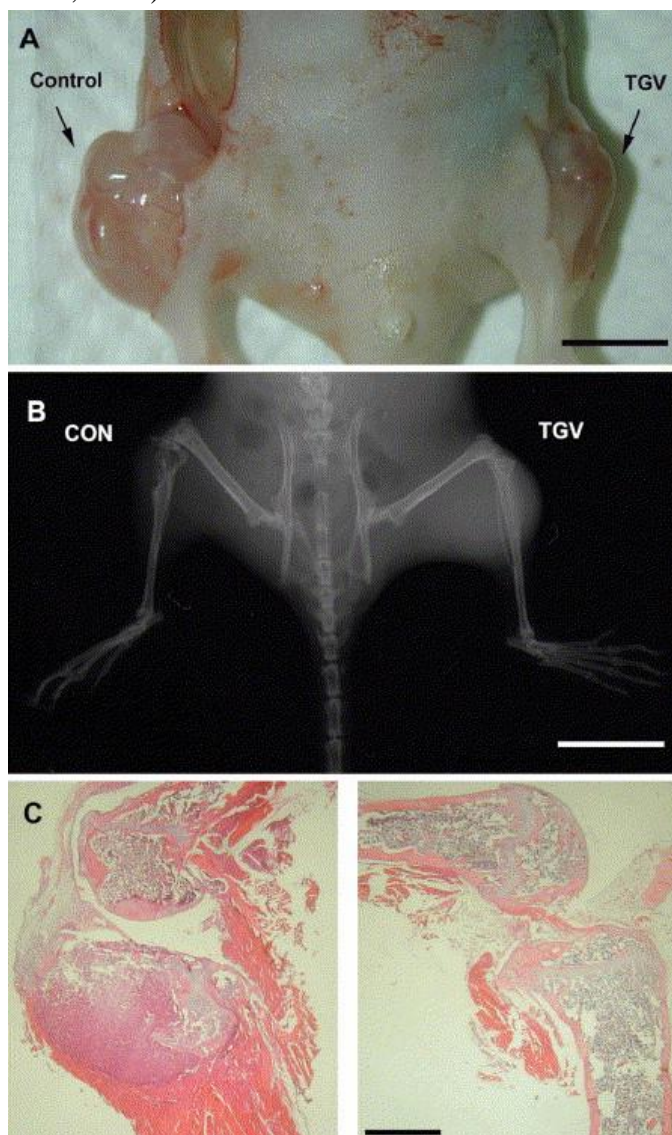
Figure 5.1 Inhibition of tumor formation and osteolytic bone lesion by trigramin in nude mice. Photographs are taken after 30 days of injection of MDA-MB-231 cells.

Injection of MDA-MB-231 tumor cell and trigramin into tibia of nude mice which inhibited tumor formation and osteolytic lesion. The major bone matrix proteins include type I collagen, vitronectin, thrombospondin and fibronectin (Robey, 1996). Integrin avb3 is important to the adhesion of tumor cells to these matrix proteins. Then the inhibition of the tumor formation may result from the decrease of cell adhesion and migration. Demonstrated that inhibition of snake venom disintegrin on tumor growth of the intravenous injection of melanoma cells may result from the inhibition on angiogenesis. Bolus injection of trigramin can inhibit angiogenesis needs further investigation. Also demonstrate xenografts with A549 cells in SCID mice. As tumors reached 60 mm^3 in size (about 1 month), mice were intra-tumor administered rhodostomin (100 ml, 30 mg, once/day). Then the tumor were removed 30 days later, the rhodostomin-treated groups weight of tumor was decreased by 43.4%. This result prove that disintegrin is a useful in clinical treatment of cancer patients. In conclusion, we here found that

administration of disintegrin with tumor cells inhibited tumor growth in bone probably through the decrease of cell adhesion, migration and osteolysis in bone. Indicated results prove that integrin should be target for the development of anticancer drug. These data have important implications for the managements of patients with prostate cancer mediated osteoblastic lesion or breast cancer-mediated osteolysis. Treatment with disintegrin-like drugs can postpone or decrease the progression of metastasis by destroying local tumor growth.(Koh et al., 2006)

Conclusion

Snake venom components cause deceleration of cancerous cells growth. Snake venom therapeutic activity, potency and availability, can make an essential medicine in the future for many diseases and disorders. Different species have different type's venom which depends on their species, geographical location, habitation, climate and age. Cobra snake venom cam apply to reduce tissue nucleic acid levels in human breast cancers and Inhibition of tumor formation by snake venom disintegrin are the examples for the applications. Under these experiments Rhodostomin was purified from venom of Calloselasma rhodostoma. Results was demonstrate the Treatment with disintegrin-like drugs may postpone or decrease the progression of metastasis by destroying local tumor growth.(Yang et al., 2005)

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INFORMATION TECHNOLOGY

TOURISM AND COMMUNICATION BARRIERS

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Abstract

This research work presented in this paper investigates the challenges faced by travellers to distinguish whether there is any contrast found in the issues based on communication barriers while traveling and to estimate the influence on tour issues for travellers. These communication challenges include language, religion, cultural and gastronomy barriers. A survey was conducted to collect required data for the analysis. A critical analysis of the collected data was performed to achieve the objectives of this research. In this study, solutions intern of technology are also discussed along with appropriate analysis for further support. The application mentioned should encourage inter-communication between the travellers and the local people of the destination country which would then in turn generate an atmosphere of welcoming, believing, appreciating and esteem among the two parties so as to more successfully eliminating these communication barriers. Established in this research study, one may conclude that proper evidence from other similar research study were used to support this research with help from analysis as well since it has strong support from them. Thus, the results of this research study are conforming with previous researches of the similar study that affirms the barriers of communication between travellers and their visit to a country. This research study concludes with recommendations for further research in the future.

Key Words: communication barriers, Travel barriers, travellers

Introduction

Tourism is one of the fastest growing industries around the world with people travelling to different countries to experience different cultures and different ways of lives. People get to try new experiences but along with some comes serious communication troubles. These issues are faced when the traveller isn't able to express what they want due to communication barriers between the traveller and the local people. Communication barriers result in travellers facing a lot of issues since it plays a very vital role in traveling.

Majority of communication barriers occur due to language problems when a tourist visits a country, being it their first experience in that country and not understanding the language of the country and thus have problems communicating. The actual problems occur when the tourist or the person visiting the country and the local population does not understand either a language both sides get to speak on neither a third language like English. Without this communication there is no interaction or transmissions of ideas and thoughts and the spreading of experience.

According to TransPerfect, the worlds largest provider of language services and translation related services, the top communication barrier that foreigners face while travelling is navigating the public transportation system. This survey further found out that tourists are not being able to read signs as a big problem when exploring cities in foreign-speaking countries (BusinessWire, 2010).

The challenges faced due to communication barriers can take different forms such as cheating foreigners with higher prices, difficulty in identifying where specific public transport vehicles with native language labels are headed towards, travellers unintentionally violating laws, feeling of loneliness of a lack of belonging in a culture, unable to read local boards and understand the local language, being lost and not knowing where you are in the host country, not being able to figure about the value of money in the host country and many more.

The problem of this communication barrier is usually very condemnatory for people traveling. Due to this, travellers may struggle to express what they want and desire and receive unnecessary and most of the time inaccurate information instead. Communication is very vital and important need which is essential to interact with individuals or group of individuals worldwide as it unites people to exchange information with each other's making communication a very important part of a society or culture.

To overcome communication barriers, it is very important for the tourism industry as verbally expressed by Cohen and Cooper in their research study, "Language and tourism", "Language barriers are, as everyone knows, an important obstacle to transcultural communication" (Erik Cohen, 1986).

These barriers or obstacle do have a massive impact on the destination travellers as their language will definitely differ from the destination country's language as verbalized "Owing to the large count of languages in the world, it is very likely that the tourist's language differs from the language of the host. In order to accommodate to the needs of tourists" (Erik Cohen, 1986)

"In particular, the language gap in overseas travel has been studied as a barrier for intercultural communication between visitors and hosts" (Edgell, 1995) "and it has also been interpreted as an obstacle in the approach to learning about the local culture" (Gmelch, 1997)

Methodology

This research study is descriptive as it outlines if any issues or variances exist in the study problem area due to certain selected factors. These issues have been predominantly recognized primarily based on the questionnaires sent out and with those who have encountered similar issues.

The research area has been constant to not as a particular country but as worldwide since travellers have more experience traveling around the globe and have the exercise of journeying periodically. The respondents to the questionnaire will be those who have travelled at least twice in their life time. The questionnaire sampling size was set to 70 as it was convenient and was seen as the most suitable sampling method as the respondents have volunteered to help provide with the necessary data.

In order to acquire the stated targets of this research study, a quantitative methodology was deployed with the help and support of other secondary data, the usage of travel questionnaires as a medium of statistics collection. This research study also used graphs, scatter plots, box plots and more. The collected data shows meaningful information on the different barriers that are frequently confronted by the people traveling, especially in terms of the communication barriers. Over 50 questionnaires were distributed among the people and 20 more distributed through online platforms but the results showed more answers than what was initially set.

Results

The survey was able to collect a feedback of 88 respondents of which all of them have travelled once or have experience in travelling.

Respondents age:

88 responses
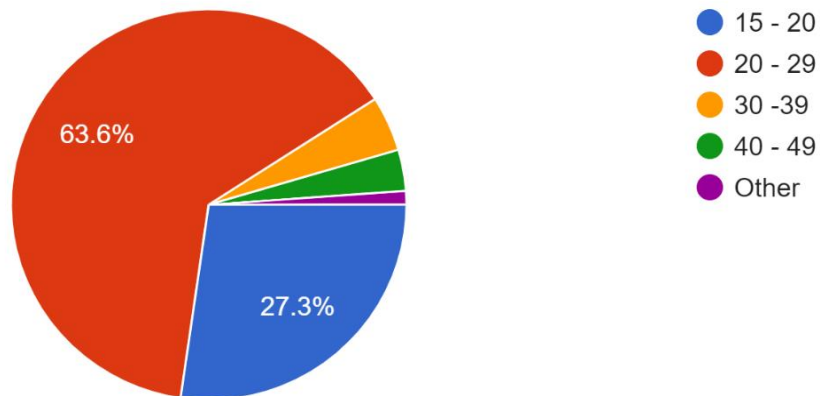
Figure 1 - Respondents age

The above pie chart (Figure 1) shows that majority of the respondents who faced communication barriers in their destination country were between the ages of (20 to 29) taking a whole 63.6% of the entire survey population followed by the ages of (15 to 20) captivating a big 27.3% from the survey population.10% of the adults in the United Kingdom mentioned that "Language barriers" are what's stopping them from traveling around the world as they have limited language skills about the local country language and among these 10% were a majority of respondents with the age from 15 to 24 supporting the above pie chart further. (MCCARTHY, 2017)

4) Have you encountered any type of communication barriers while on the travel?

88 responses
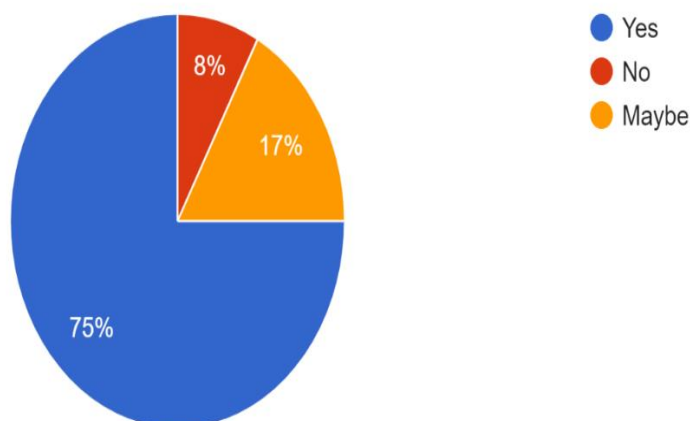
Figure 2 - communication barriers while on the travel2

This pie charts above (Figure 2) shows the percentage of people who faced communication barriers while on the travel and of them 75% of the survey population have faced these issues. The main reason for this is in a social point of view is that, communication is very vital in every aspect of the travel and may not understand the country's culture, language and religion could contribute to these communication barriers. with 86.4% of all respondents who faced this barrier in particular. Second to language barriers is cultural barriers with an average of 48.9% faced by the survey population, bringing the religion barriers to third place with an average of 38.6% encountered by the respondents and finally the gastronomy barriers with a percentage of 13.6% from the respondents. 69.3% had difficulties in understanding the local culture or the culture of their destination country. These respondents of different nationalities had different effects and relations to the cultural, religion and gastronomy barriers of this research.

Discussion

A revelation found in the results was that travellers age and their cultural and religious background played a very vital role in the destination they choose because of the communication barriers. In addition to that, the nationality of the traveller showed greater and more effects to the gastronomy barriers as nationality is linked with the cultural and religious differences that travellers face. These barriers can originate conflicts between the travellers and the destination country. These respondents of different nationalities had different effects and relations to the cultural, religion and gastronomy barriers of this research.

Conclusions and Recommendation

The issue severity encountered by these travellers varies relying on quite a number of factors impacting their travel communication barrier issue. In addition to that, the problem severity varies consequentially based on the respondent's circumstances such as their age, nationality, income, profession, purpose of travel. the type of person traveling, the travellers experience, the traveller's identity, and their personality all have an effect on the communication barrier they face. These communication barriers in global tourism implies limitations associated with religion, cultural factors, lifestyle and more. Communication and language barriers are mainly caused due to cultural differences that travellers face which can be controlled, decreased or totally eliminated with proper tools with the help of Information technology such as Mobile apps which should encourage travellers to face less communication barrier issues.

This solution is not only going to help the tourists but the locals too. This International tourism is distinguished by rapid changes and faster developments and in order for these travellers to get rid of the communication barriers.

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TECHNOLOGICAL INTERVENTION TO AID COMMUNICATION IN CHILDREN WITH AUTISM SPECTRUM DISORDER

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Abstract

Speech impairment is something common to be found in children with ASD (Autism Spectrum Disorder). Technological interventions are widely used for improving speech in children with ASD. There is a scarcity for technology-based solutions to aid the autistic children in Sri Lanka. The principal and 7 special need teachers of a private Special School in Kandy and 7 Speech therapists have been included in this study. It was identified that the children show better responses towards computers and other devices with digital screens. The Picture Exchange Communication System (PECS) has been identified to be a successful method for improving speech impairment, but there are some contradictions where PECS does not go with cultural context and the native language. This paper also discusses a new solution that will suit the Sri Lankan context while incorporating PECS, the suggested mobile application's ability to change the language, picture and other options have been discussed.

Key Words: ASD, Communication, PECS, Sri Lankan Context, Technological intervention

Introduction

Background of the Study

ASD is a neurodevelopment disorder (Copeland, 2018), which includes medium to critical functional disorders, communication deficit is one of them. The complexity of the condition could be mild, moderate or severe which may differ from person to person. These children can hear well, yet they lack the ability to speak and motor plan. A Sri Lankan study state that the ASD prevalence is 1 in 93 children, cited by (Mahmud, 2019). The technological interventions for ASD are cumbersome, nevertheless, they are available in the English-speaking well-to-do countries only (Amani Indunil Soysa & Abdullah, 2018). Sri Lanka being a developing country is unable to facilitate the special needs with technological interventions. The special needs children in Sri Lanka are underprivileged compared to others. UNICEF has stated that the children who are differently abled are found to be school drop-outs as they have identified themselves to be excluded from the mainstream education (UNICEF Sri Lanka, 2020). The reasons are shortage of trained professionals, shortage of proper infrastructure and equipment, limited scope of the curriculum etc (UNICEF Sri Lanka, 2020). The number of speech therapists found in Sri Lanka is very few, and they are found only in urban areas, this is because a degree program in speech and language therapy was initiated only in 2008 in Sri Lanka (Muttaiah, 2015). The speech therapists do not have much sophisticated equipment to train speech. The children who get speech therapies are required to have several therapy sessions depending on their type of complexity. Lack of facilities and parental support keeps this problem unsolved.

Aim and Objectives

The aim of this research is to investigate the possible ways to improve the communication skills in Sri Lankan Autistic children. It is indeed one of the vital matters to look into but unfortunately these children with ASD as a whole, do not receive enough attention.

The objectives of this study are:

- To identify the barriers in learning to communicate
- To identify the factors to reduce the barriers
- To identify the elements that could improve communication skills in children with ASD
- To identify the role of technology to overcome communication deficits in children with ASD

Significance of The Work

The main purpose of this research is to come up with a technology-based solution to overcome the communication problem faced by the autistic children in Sri Lanka. The solution will be limited with the teaching strategy called Picture Exchange Communication System (PECS). Additionally, the solution shall include customizable audio instructions in the preferred language and insertion of pictures relevant to the background and culture.

Methodology

The researcher has chosen the 'Qualitative approach' since it allows the researcher to gather knowledge through one's own experiences and it is a good mechanism to learn the structure as it is, and the researcher has chosen the thematic analysis method to analyse the transcripts since it allows to get a clearer picture about the pattern the researcher investigates, in a flexible way. Focus group discussions and individual interviews have been chosen for this study as it is facilitating to discuss openly on the chosen topic, the Principal and the 7 Teachers of the chosen Special School were added to a group discussion. Additionally, 7 speech therapists were interviewed. All together 15 participants have been included in this study. The researcher has chosen the snowball sampling method under none - probability sampling method. Data was collected using interviews which were made separately for the teachers as well as the speech therapists.

Results and Discussion

As per the analysis carried out, it is identified that communication is a challenge for children with ASD, but it can be improved with the help of speech therapies and parental support in training the children. The speech Therapists prefer to use AACs(Augmentative Alternative Communication) in therapy sessions as AACs are proven to be effective and, they prefer to have them with native languages,

Speech therapist 2 has said

"Even though we use AAC for speech therapy there's no facility to have the native language, I feel that there should be a technological intervention for Sri Lankan children where their native languages can be used with proper pictures representing our cultural values."

The Picture Exchange Communication System has been proven to be the most effective approach in improving communication.

Speech therapist 1 stated that

"It a good method which is more effective. Some children with mild severity even start talking in the 1st or 2nd level of training sessions."

autistic children show better response to digital screens and the use of AACs should be custom made to meet Sri Lankan context.

When considering the findings of this research it is obvious that the communication issue in autistic children needs more attention where the society and the parents should be enlightened about the condition. Based on the gathered demographic details of the students of the chosen special school, the autistic children have varying types of family background. Some parents are well educated, and financially stable, on the other hand you also find families that are financially weak, illiterate and not knowledgeable about their child's condition. Even though the children go to special schools, they do not get one-on-one attentions due to limited number of teachers available in special education stream.

The parents who are knowledgeable and financially strong may give their child private speech therapies and may help the child to talk at home but the parents who are not knowledgeable and financially feeble may not know that the child needs speech therapy and parental support. Even the special schools cannot provide adequate number of therapy sessions for all the children since the special need school are comprised of children having all sorts of disorders.

The speech therapists in Sri Lanka use various methods to improve speech in children with ASD; high tech and low tech AAC. The AACs include PECS, Mobile applications such as JabTalk, Athuru Mithuru, AVAZ etc. (Lilia Villafuerte, 2012) in their study, say that the autistic people have a different way of developing skills where they can explore objects through touching, tasting and caressing. Another previous study by (Hettiarachi, et al., 2019) state that the parents prefer to have their children taught using mobile phones and tabs. Most of the previous studies state that PECS is a successful method to improve speech in children with ASD (McGee, et al., 2001, p. 59), the speech therapists also approved of the fact that PECS is effective, but that is only when it is taught in English as it is, and the problem arises when the child is alien to English language. The steps/stages of PECS cannot be followed when the instructions are translated into the native languages. Apart from that the pictures used in PECS have been found mismatching as it doesn't suit the background and the cultural setup.

Conclusion and Recommendation

According to the study carried out and the findings, the communication impairment of autistic children, their state of education in Sri Lanka, the types of speech therapies given in Sri Lanka and the short comings have been identified. Further It has been identified that Sri Lankan special need children do not get the privileges that are offered by the other well-to-do countries. The identified barriers in learning to communicate are; limited number of special need schools, limited numbers of special need teachers, lack of parental support, lack of resources and facilities, inability to use English with all the children, mismatching of cultural aspects and absence of native languages in AACs.

Moreover, identifying the problem before the age of 3, providing regular speech therapies, enlightening the parents to support their children and providing sufficient equipment or

facilities could reduce the barriers in autistic children learning to communicate. Having said that, it was identified that frequent speech therapies and practices using low-tech AACs like PECS and high-tech AACs like tabs and mobile applications can be used for improving communication skills in autistic children.

The role of technology has been found significant in overcoming communication deficits in children with ASD where using mobile applications and tablets in speech therapies as well as at home can improve communication skills. The need of AACs in speech therapies and the vitality of technological intervention having options to customise the language preferences and content relevant to Sri Lankan context have been recognised.

The studies have also proven that the Sri Lankan parents are very much welcoming mobile technology for communications purpose as well as a source to carry out schoolwork. Autistic children in Sri Lanka who have speech impairment lack the support of technology. Thus, the researcher suggests having a mobile application that shall help the autistic children to improve communication. It is because a mobile application would be cost effective, parents can make use of the devices they have already, needn't more training and the parents can train the children at home as well. The researcher suggests designing the solution using PECS method with voice input in preferred language. This solution would have all the phases available in standard PECS process:

Phase 1: the child learns to pick a picture
Phase 2: the child learns to remove a picture
Phase 3: the child learns to pick a targeted picture out of many
Phase 4: the child learns to join objects with the phrase 'I want.'
Phase 5: the child learns to respond to a question
Phase 6: the child learns to discriminate between the questions 'what do you want?', 'what do you see?' and 'what do you have?'

The reason for the researcher to choose PECS is that it is proven to be a successful method to improve speech, at the same time, none of the existing local mobile applications follow the proper standard PECS method. An advantage of using PECS could be that, it shall help the therapists to monitor the progress of each child's activity based on the time taken to practice a phase and the number of times each phase is practiced.

Furthermore, the therapist or the teacher shall provide each child an individual account which shall store the child's preferences, number of therapy sessions, the number of times each phase is practices at therapies and at home. This application shall have the option to customize the languages as English, Sinhala and Tamil as preferred or understood by the child. In addition, the application shall have auditory facility where the child shall be able to listen to each word or phrase depending on the phase of activity they practice, which shall help the child to remember the words. The sound option shall also be disables since some children are sensitive to sounds and they may get aggressive.

The application would have pictures by default, but insertion of additional pictures and voice notes can also be done by therapists if required. Also, the insertion of pictures to bring up cultural values as well as to let the child witness the real-world scenarios are possible. This may result in children with ASD attempting to speak or Have a proper mode to communicate like an AAC, meaning the children who are verbal will be able to converse after a certain period

of time and the children who are minimally verbal shall use that application as a mean of communication.

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AUTOMATING PUBLIC BUS TRANSPORTATION BY PROVIDING CUSTOMER SATISFACTION USING NFC CARD THROUGH A MOBILE APPLICATION

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Abstract

Avoiding the physical bus ticketing system and reengineering NFC smart card ticketing through a mobile application to make customer satisfaction. Therefore, from different research findings how NFC smart card system can be introduced and how can be adopted into the Sri Lankan bus ticketing system. The sample size is taken from the passengers in the Western province area. The methodology goes under applied research and finding related articles and using descriptive research finding the main objectives and selected the Correlation to check the relationship using quantitative data. Using a conceptual framework derived the independent variable and dependent variable for customer satisfaction using NFC smart technology using a mobile application. With the concerning evidence, it all supports a positive relationship to customer satisfaction using NFC technology by doing correlation analysis and regression analysis.

Key words: Customer Satisfaction, Mobile Application, NFC smart card, Transportation

Introduction

Sri Lanka bus transportation started in 1958 as a public sector, and then in the same year, it nationalized to the government as Ceylon Transport Board (CTB) as the private sector, After it came under the government, they gave a share to the public sector to enhance public transportation between 1978,1990. Therefore, currently, the Government's own bus transportation is known as Sri Lankan Transport Board (SLTB), and the private sector is known as the National Transport Commission (NTC). For a decade, Sri Lankan transportation has been using the manual Ticketing method, which is a piece of printed-paper issued to the customer. From the beginning, SLTB used a printed ticketing system, and later they introduced a machine to give out the tickets to its passengers. As a result of this, the private sector also used the same methodology which is the manual ticketing system. Later on, between 2008 and 2019 both sectors introduced a digitalized ticketing system, however, only a few buses deployed that particular machine. The reason is that some of the buses charge different rates and they don't return the proper balance back to the customer. Due to this situation, a few years later Dialog (one of the major telecommunications providers in Sri Lanka) introduced an NFC card system with that, combined with NTC. However, it did not really succeed as it was only restricted to two provinces in Sri Lanka - which was Kandy and Colombo, it was not reliable for all the passengers. This research-based on Smart ticket top-up system which will reduce the cash transaction and time deduction of going to purchase ticket and reloading to the s card from outlets will be reduced, and upgrade into the new mobile technology. using the mobile application can do the top-up to the smart card and travel surround the western province using the smart card. Users can check the available balance throughout the application. It will be a

better technology to make passengers satisfied and it will be helpful for the Sri Lankan Bus Transportation board also to reduce the congestion.

Objective

The objective of this research is to re-engineer the NFC smart card using a mobile application and make the customer satisfied. The first objective is to reduce the physical cash usage and diverts the passengers to use the NFC smart card via a mobile application. When a passenger buys a ticket using NFC smart card via mobile application user can get an E-receipt, that is how much has been debited for the bus fare. The second objective is bus ticket buying time via mobile application user no need to wait till the conductor come near at the passenger he or she can just hover NFC smart card on the machine and after entering the bus, the exact amount will be deducted from the card, also passenger able to top-up the card through the mobile application and check the card balance through the mobile application, it has been more convenient for the passenger. The third objective is convenience via using a mobile application and the NFC smart card able to track the bus where it is and passengers can check the entire history of the journey he or she travelled. The final objective is brand awareness by giving a proper awareness to the passenger about the technology.

Conceptual framework and hypotheses of the study

The conceptual framework is a structure, which the researcher accepts can best clarify the regular movement of the marvel considered. It is connected with the ideas, experimental exploration, and significant hypotheses utilized in advancing and systemizing the information upheld by the specialist. It is the scientist's clarification of how the exploration issue would be investigated. The conceptual framework derives customer satisfaction by connecting all these variables ticket prices, ticket purchasing time, convenience, brand awareness to find out the relevant data separately, and discussion and review of literature following conceptual model was formulated for the study.
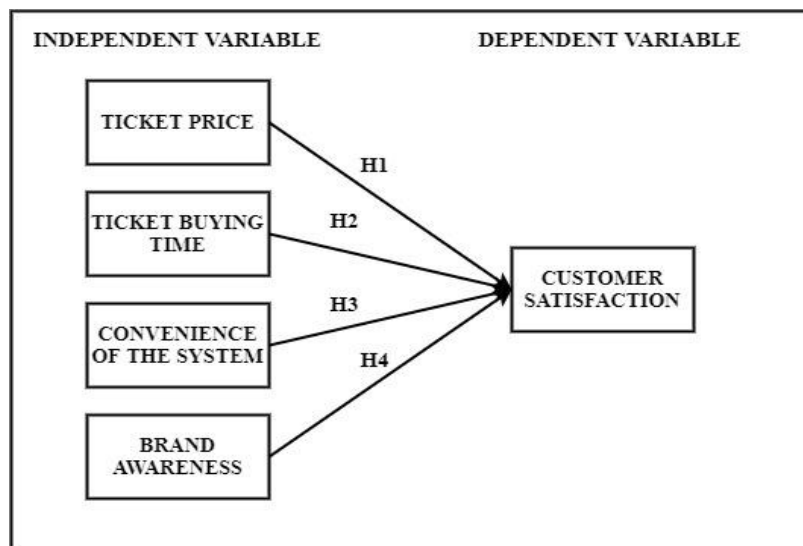
Figure 1 Conceptual Framework

Ticket price is a variable in which passengers can able to travel without physical cash. Ticket buying time will reduce the time of purchasing the ticket manually from the conductor using the NFC smart system via mobile application. The convenience variable is a much important

factor using this can make passenger more reliable to work with the NFC smart card via mobile application. Finally, brand awareness it much required because this technology should reach around the public. By these variables derive the hypothesis giving proper solutions to those variables able to fulfil customer satisfaction by NFC smart card via mobile application.

H11 – There is a positive relationship between Ticket Price and Customer Satisfaction using NFC smart card via the mobile application.

H22 - There is a positive relationship between Ticket Buying Time and Customer Satisfaction using NFC smart card via the mobile application.

H33 - There is a positive relationship between convenience and customer satisfaction using NFC smart card via the mobile application.

H44 - There is a positive relationship between brand awareness and customer satisfaction using NFC smart card via the mobile application.

Methodology

Applied research has been used for the relevant research case by bus transportation. using descriptive research find out the relevant objectives from researches and collect information and find out quantitative data and check the relationship using the correlation method between variables. Respondents selected who were using private and the government public bus transportation in the western province area in Sri Lanka. Sampling method is "Area sampling" because it restricted to a few areas Kalutara, Colombo, Gampaha districts the survey. The selected people are daily travel (work, university, etc.) on the bus, once in a while, and special occasions. This survey fully described what are the problems that they faced, and it shared among the people who travel on the bus to get respondents. The sampling size was 166 questionnaires to be distributed, able to complete the survey with 167 responses to considered for the final data analysis. All four variable ticket price, Ticket buying time, convenience, brand awareness it helps to do the analysis part considering these factors the usability, brand awareness, inconvenience of the passenger who using the public bus transportation. The analysis performed using Cronbach's alpha coefficients to all the variables, to see a relationship between the dependent variable customer satisfaction. Regression analysis was performed to find out the variation and relationship between the independent variable and the dependent variable with the regression model. With the descriptive analysis, from this analysis, it concluded with how people have agreed and disagreed with the variable.

Results of the Analysis
 - Reliability testing
Table 1- Reliability testing using the survey source

#	Variable (Dependent / Independent)	Cronbach's alpha value
1	Customer Satisfaction (Dependent)	0.7519
2	Ticket Price (Independent)	0.7032
3	Ticket Buying Time (Independent)	0.7187
4	Convenience (Independent)	0.7337

5	Brand awareness (Independent)	0.7659

Independent and **Depended** variables are strong enough, the value of each variables **Cronbach's Alpha value** > than **0.7** there is a strong impact on all variables.

- *Correlation & Regression Analysis*

- *Ticket Price*
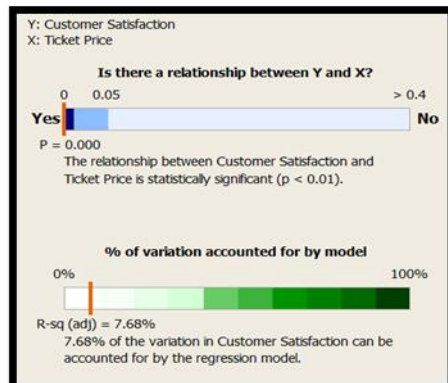
Figure 2- Regression Ticket Price

Figure 3- Correlation Ticket Price

"**Weaker Positive Correlation**"
Correlation of R-value is **> 0.29**

There is a relationship between **Customer Satisfaction** and **Ticket Price.**

H10 will be rejected and **H11** will be strongly accepted

- *Ticket Buying Time*

Figure 4- Regression Ticket Buying Time
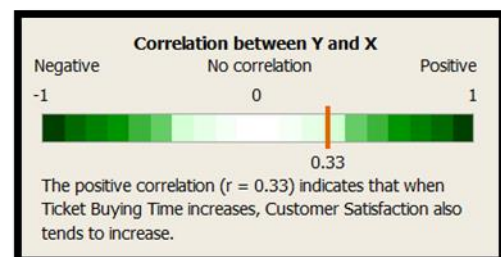
Figure 5- Correlation Ticket Buying Time

"**Weaker Positive Correlation**"
Correlation of R-value is **> 0.33**

There is a relationship between the Customer **Satisfaction** and **Ticket Buying Time** is statistically significant

P - value is < 0.001

H20 will be rejected and **H21** will be strongly accepted
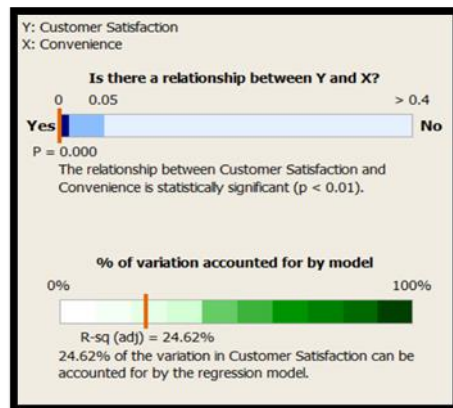
- *Convenience*

Figure 6- Regression Convenience

Figure 7- Correlation Convenience

"**Moderate Positive Correlation**"
Correlation of R-value is > 0.50

There is a relationship between **Customer Satisfaction** and **Convenience**

P - value is < 0.001

H30 will be rejected and **H31** will be strongly accepted
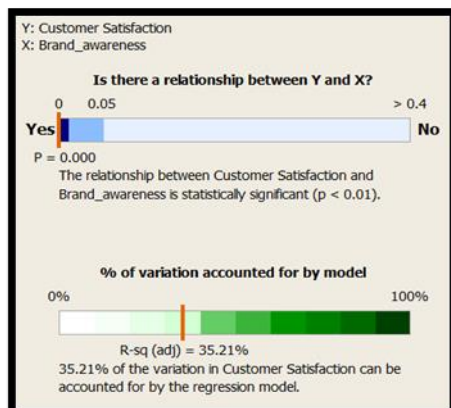
- *Brand Awareness*

Figure 8- Regression Brand Awareness

Figure 9- Correlation Brand Awareness

"**Perfect Positive Correlation**"
Correlation of R-value is > 0.60

There is a relationship between **Customer Satisfaction** and **Brand Awareness**

P - value is < 0.001

H40 will be rejected and **H41** will be strongly accepted

Discussion

The result of the research given a prediction, by introducing the NFC card system through a mobile application will be to make customer satisfaction when travelling in bus transportation. This will support public bus transportation in the western province. The Correlation and the regression analysis are positive, there is a strong positive relationship between the customer satisfaction variable. According to this study it proves by giving a proper brand awareness about the product people will aware of the technology, and it will use for finding out the loopholes about the current issues in the NFC system and it helps to solve all the issues with findings and analysis data.

Conclusion

Ticket Price - The reason that the correlation value to be low, due to most of the passengers didn't come across of being overcharged issues in their bus fare, overall there is a strong relationship between the ticket price and customer satisfaction.

Ticket Buying Time - The reason that the correlation value to be low, because it has done with a smaller crowd of people, overall there is a strong relationship between the ticket Buying time and customer satisfaction.

Convenience - The correlation value is good because most of the responses are positive, Passengers have faced relevant issues. overall there is a strong relationship between convenience and customer satisfaction.

Brand Awareness - The correlation value is good because most of the responses are positive, Passengers have faced relevant issues, overall there is a strong relationship between brand awareness and customer satisfaction.

Recommendations

Independent Variable	Recommendations
Ticket Price	NFC Payment Through the smart card receiving E- Receipt to mobile application
	Ticket packages introducing inside the province monthly, yearly, zone wise packages (Under-price sector it makes it more reliable for the passenger)
Ticket Buying Time	Mobile Application Reload System
	Tap and pay the Ticket Fair
Convenience	Available buses will be displayed (Mobile Application)
	Journey History Display (Mobile Application)
Brand Awareness	Aware of the technology via Posters, Banners, Announcements, Media, Communicate, Social Media
	Re-Branding the current System.
	Promoting the product and doing a brand awareness via campaigns.

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HOLISTIC APPROACH TO OVERCOME VIDEO GAME ADDICTION

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Abstract

Video games are the most popular entertaining hobby in the modern world. Therefore. modern societies are more likely to get addicted to them. Excessive gaming leads gamers to many problems that affect their social relationships, physical and mental health. This study aimed to provide an insight into current perspectives on Gaming Disorder, identify all the possible problems that occur due to game addiction, and provide a holistic solution. The 7 items of GAS were used to differentiate game addicts and non-game addicts. The participants with an average value of more than 3, for 7 items of GAS were considered as game addicts. A correlation study was conducted to identify the motivational factors which lead to game addiction. More than half of the participants were identified as game addicts, Therefore the study concluded that there is a need for a holistic solution from developers' perspective to overcome video game addiction.

Key Words: Addiction, Game Addiction Scale, Gaming Disorder, Holistic Approach, Video games.

Introduction

A regular activity that is done during the leisure time, for enjoyment is known as a hobby, nowadays with the technology advancement, video games are the most popular hobby. A video game is an electronic game that allows users to interact with or control images, through a user interface to generate visual feedback on a two- or three-dimensional video screen device.

The number of games is being increased day by day and modern societies are more likely to get addicted to them. The diagnostic criteria defined by the APA (American Psychiatric Association) and WHO (World Health Organization) for GD (gaming disorder) and IGD (Internet gaming disorder), made the society focus more on the problems that occurred due to excessive gaming. The entertainment, fun, and satisfaction of games, motivate the players to play the games excessively, which leads to game addiction which is also known as gaming disorder.

According to a study, Video game addiction leads to depression, anxiety, social phobia/anxiety, obsessive-compulsive symptoms, and Attention deficit hyperactivity disorder (ADHD), mostly teenagers and youngsters are addicted to games. When considering gender, a higher video game usage can be found among males than females. (González-Bueso, et al., 2018). According to the research conducted by Cesarone and Bernard in 1998, it is clear that the games might have psychological effects that are harmful on younger children, because the children who play violent games, behaves more aggressively than ones who play non-violent games.

The motivational factors which motivate the players to involve in gaming, according to three research articles are, Fantasy (Immersing into the games), Achievement (Challenge), Curiosity, Autonomy (Control), Socialization (Cooperating with other players), Competition, and Recognition (Thomas W.Malone, 1987), (Boyle, et al., 2011), (Yee, 2006). In this study, with

the already identified motivational factors, some other motivational factors were also identified by conducting correlation analysis. The factors which are analyzed in the study are Game genre, Game graphic, Story-based games, Achievement, Socialization, Sexualized games, Curiosity, and Autonomy. By identifying the motivational factors, it will be easy to provide a holistic approach to overcome video game addiction.

Objectives

To identify the motivation factors towards game addiction, and investigate a holistic solution to reduce game addiction.

Methodology

This research study is based on quantitative analysis. The survey was conducted to collect data directly from the gamers to get an idea of the reasons for game addiction and the effects that game addiction cause, and to provide a holistic solution to them. The participants were gamers around the world who are interested to cooperate. Data collection was conducted online by using google forms. The questionnaire was published in some selected gaming clan groups and communities, online. If the accepted margin of error is considered as 5% and the confidence level is considered as 95%, then the recommended sample size is 385 for a population of 5 billion (there are approximately 5 billion gamers in the world).

The questionnaire comprises close-ended questions such as multiple-choice questions, Likert scale multiple-choice questions, and checklist type multiple-choice questions. Clear and short instructions in relevant areas in the questionnaire are provided to the respondents to generate more reliable and useful data.

Conceptual framework

To conduct this study, the conceptual framework was constructed based on 9 motivational factors that are identified based on the literature review. These motivational factors were used to find out whether there is a relationship between them and game addiction. To find out this, the 7-item version of the GAS (Game Addiction Scale) was used to measure video game addiction. The 7 items (questions) are added to the questionnaire. The questions which consist of the 7-items of GAS are Likert scale multiple-choice questions, only one question is a close-ended multiple-choice question. The responses are taken from a 5-point scale, which ranges from 1 = "Never" to 5 = "Very often". The GAS questions focus on core addiction criteria such as salience, tolerance, mood modification, withdrawal, relapse, conflict, and problems. The questions other than the 7 – items of GAS are used to analyze and find other factors such as motivational factors, reasons, and effects of game addiction. The participants with a score of GAS 7 average higher than 3 were considered as game addicts.
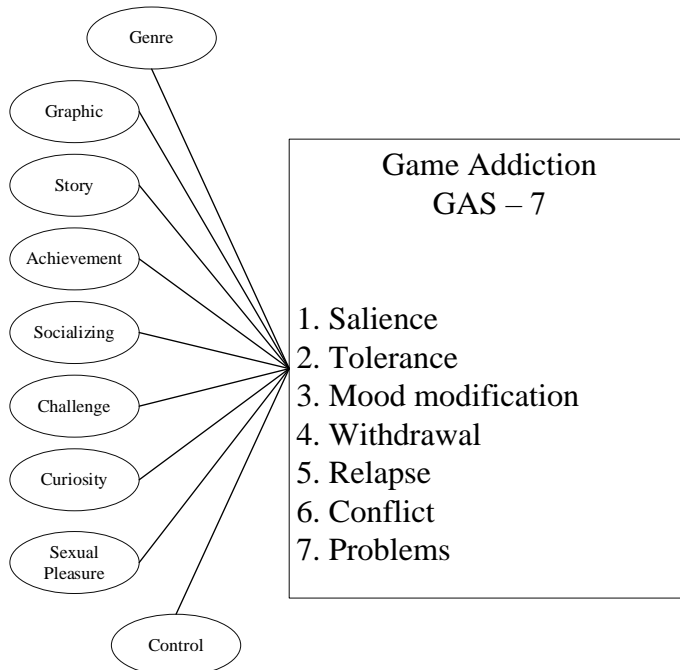
Figure 1: The conceptual framework

Hypothesis

H_1: There is a relationship between Addicts/nonaddicts and Gender.

H_2: There is a correlation ($\dot{\rho} \neq 0$) between Game addiction and Genre.

H_3: There is a correlation ($\dot{\rho} \neq 0$) between Game addiction and graphics.

H_4: There is a correlation ($\dot{\rho} \neq 0$) between Game addiction and Story-based.

H_5: There is a correlation ($\dot{\rho} \neq 0$) between Game addiction and Achievement.

H_6: There is a correlation ($\dot{\rho} \neq 0$) between Game addiction and Socialization.

H_7: There is a correlation ($\dot{\rho} \neq 0$) between Game addiction and Curiosity.

H_8: There is a correlation ($\dot{\rho} \neq 0$) between Game addiction and Sexualized.

H_9: There is a correlation ($\dot{\rho} \neq 0$) between Game addiction and Autonomy.

Results

The participants with a score of GAS 7 average higher than 3 were considered as game addicts. The figure below is the graphical representation of the participants with gaming disorder.
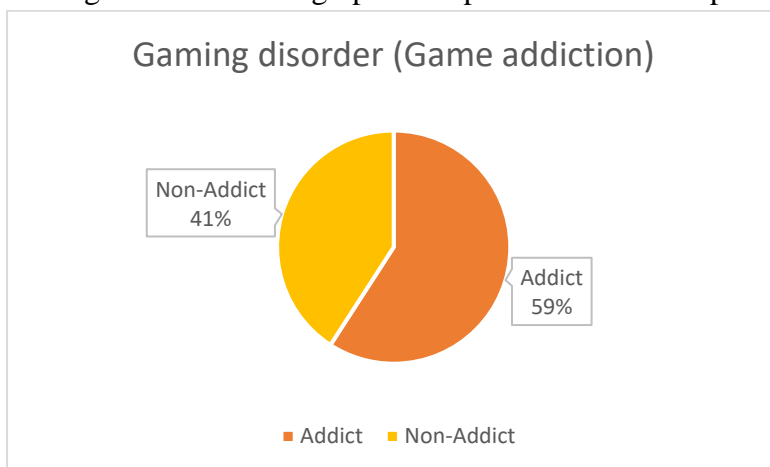
Figure 2: Graphical representation of participants with gaming disorder (game addiction).

As shown in (figure 02), it has been identified that there are 317 participants with gaming disorder. The percentage value is 59%. 41% of the participants are normal gamers (non – game addicts), and the count of the participants is 219.

Chi-Square analysis was conducted to find whether there is a relationship between Addicts/nonaddicts and Gender. The crosstabulation results illustrate that the overall count of Male is higher than females, which is 423 and 98 respectively. The overall count of Addicts is higher than the count of Non-Addicts, which is 317 and 219.

Table 1: Chi-Square Tests

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	12.110[a]	2	.002
Likelihood Ratio	11.928	2	.003
Linear-by-Linear Association	9.042	1	.003
N of Valid Cases	536		

a. 0 cells (0.0%) have an expected count less than 5. The minimum expected count is 6.13.

According to the Pearson chi-squared test, the Sig (2 -Tailed) value was ($p = 0.002$), which means that there is a relationship between Addicts/nonaddicts and Gender at a 5% significance level.

The figure below graphically represents the results of Chi-Square analysis,
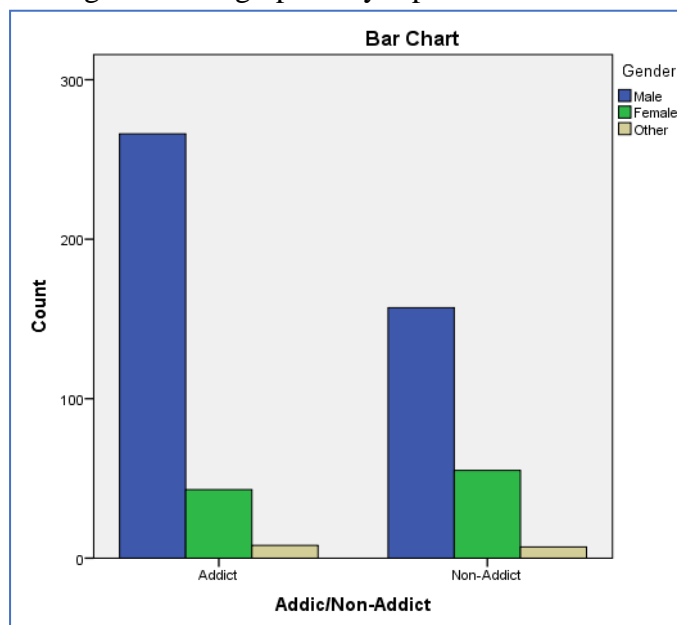
Figure 3: Graphical representation of Addicts/nonaddicts and Gender

According to the interpretation of the clustered bar charts (figure 03), it is recognizable, that the Overall count of Males addicts is higher than the Female addicts' count. The non-addicts count of Females is higher than Male non-addicts. The other genders have 8 addicts and 7 non-addicts.

The correlation analysis, to find out the relationships between the motivational factors and game addiction are shown below.

Table 2: Pearson Correlation for game addiction and the motivational factors

Hypothesis	Sig (2-tailed)	Correlation coefficient ($\dot{\rho}$)	Significance level	Correlation
H1 Genre	.141	.064	0.05	No
H2 Graphic	.037	.090*	0.05	Yes
H3 Story based	.037	.090*	0.05	Yes
H4 Achievement	.000	.238**	0.01	Yes
H5 Socialization	.000	.179**	0.01	Yes
H6 Curiosity	.000	.176**	0.01	Yes
H7 Sexualized games	.267	.048	0.05	No
H8 Autonomy	.000	.220**	0.01	Yes

The motivational factors and their significance levels are Genre 0.141 (**α=0.05),** Graphic 0.037 **(α=0.05)**, Story based 0.037 (**α=0.05)**, Achievement 0.000 (**α=0.01)**, Socialization 0.000 (**α=0.01)**, Curiosity 0.000 (**α=0.01)**, Sexualized 0.267 (**α=0.05)** and Autonomy 0.000 (**α=0.05).** The motivational factors which are correlated to game addiction are Graphic 0.037 **(α=0.05)**, Story based 0.037 (**α=0.05)**, Achievement 0.000 (**α=0.01)**, Socialization 0.000 (**α=0.01)**, Curiosity 0.000 (**α=0.01) and** Autonomy 0.000 (**α=0.05).**

Discussion

The chi-squared test confirmed that there is a relationship between Addicts/non-addicts and gender. The overall count of Males addicts was higher than the Female addicts' count. The non-addicts count of Females is higher than Male non-addicts. So, the results of the research study conducted by (González-Bueso, et al., 2018) can be accepted because higher video game usage can be found among males than females. It is important to consider that there were only 98 females but, 423 males participants.

The motivational factors which are correlated to game addiction are Graphic 0.037 (**α=0.05)**, Story based 0.037 (**α=0.05)**, Achievement 0.000 (**α=0.01)**, Socialization 0.000 (**α=0.01)**, Curiosity 0.000 (**α=0.01) and** Autonomy 0.000 (**α=0.05).**

Conclusion and Recommendation

In this research study, some of the effects of video game addiction and some motivational factors were identified by reviewing some other similar research articles. With the help of the literature review and the sample data set, the analysis was conducted. The number of participants with gaming disorder was identified by using the 7 items GAS. Some additional motivational factors which were not mentioned in other similar research studies were identified.

It is identified that the overall count of Males addicts was higher than the Female addicts' count. The non-addicts count of Females is higher than Male non-addicts. So, the research study concludes that males are more likely to get addicted than females, and the motivational

factors which motivate the gamers are Game graphic, Story-based games, Achievement, Socialization, Curiosity, and Autonomy**.**

As a holistic solution to overcome video game addiction, a game launcher and an app for parents can be used recommended. A game launcher can be used to control and monitor the gamers' gaming activities and a Parent app can be used by parents to control and monitor the gaming activity of their children using the mobile devices. As a future recommendation AI technology such as an artificial neural network (ANN) can be used to study gamers' gaming behaviors and control the gaming activities more effectively than using calculations.

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IMAGE BASED ONLINE PRODUCT SEARCH FEATURE TO IMPROVE THE USER SATISFACTION ON E-COMMERCE SITES IN SRI LANKA

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Abstract

Electronic Commerce generally referred as E-commerce has become a major a part of human life as it helps the people to shop online to buy products and services over the internet without spending time on physical stores. It gives a lot of benefits for the user's time. There is a common problem emerged in searching products as it takes more time to search for a specific product by using keywords or navigating through the product categories. As a solution most popular e-commerce sites like e-bay, Amazon, Alibaba, Boohoo and Venca have an option called Visual Search. It is known as Image Based Online Products Search (IBOPS) which allows the user to upload an image from the gallery or through the camera lenses to search similar products on the website. It displays exact similar products according to the user's uploaded image. By having the feature of IBOPS the user satisfaction will effect in a positive way. By conducting an analysis the researcher were able to validate and display there is an impact for the selected main variables which is User Interface Quality (UIQ), Information Quality (IQ), Ease of Use (EU) and Usability to the increase of customer satisfaction on e-commerce sites in Sri Lanka. The Carl Pearson Correlation technique is used to analyze the hypothesis and to identify the impact between the factors with the significance level of 0.01 at 99% level of confidence. And regression equation is used to further analyze the data with the regression line.

Key words: Visual Search, Image Based Online Product Search (IBOPS), e-commerce

Introduction

E-commerce has completely improved and upgraded with the technologies available. And they have increased their features on their websites to meet the user needs and to increase the satisfaction of their client base. In E-Commerce sites users are allowed to search the products from the product category and from keywords as the Search Engine Optimization is deals with the website structure and the content.

Since there are millions of products on the website customer will struggle to find the exact product from the keywords and through categories. It may not give what exactly the user needs as there is a huge dynamic set of database.

For example, can take a situation where the user needs to search a floral shirt that he or she knows how it want it to look like with the user perspective. For that, the customer will type "floral shirt" and it will give thousands of related products which user needs to filter out and select the exact or similar product that he/she needs to buy after the checking of each pages. (Sunda and V, 2017) When the users are selecting an e-commerce site they will select most user friendly e-Commerce sites.

Primary objective of the research was to identify the main factors that effect for the customer satisfaction from IBOPS option. The researcher has study the use and the problems of Text

Based Online Product Search. And to study the current use of IBOPS and the advantages in International E-commerce sites. Finally to study the application of IBOPS for Sri Lankan e-commerce sites to increase the user satisfaction.

Outcome of the research will give a beneficial aspects for all the consumers of the e-commerce sites. The users will able to identify the meaning of the IBOPS and its influences to the customer satisfaction.

Methodology

Conceptual Framework and the Hypothesis

The research is focus to study the impact of the features that effect on the Customer satisfaction by having the option of Image Based Online Product Search (IBOPS). These are the main features of the IBOPS to increase the customer satisfaction.
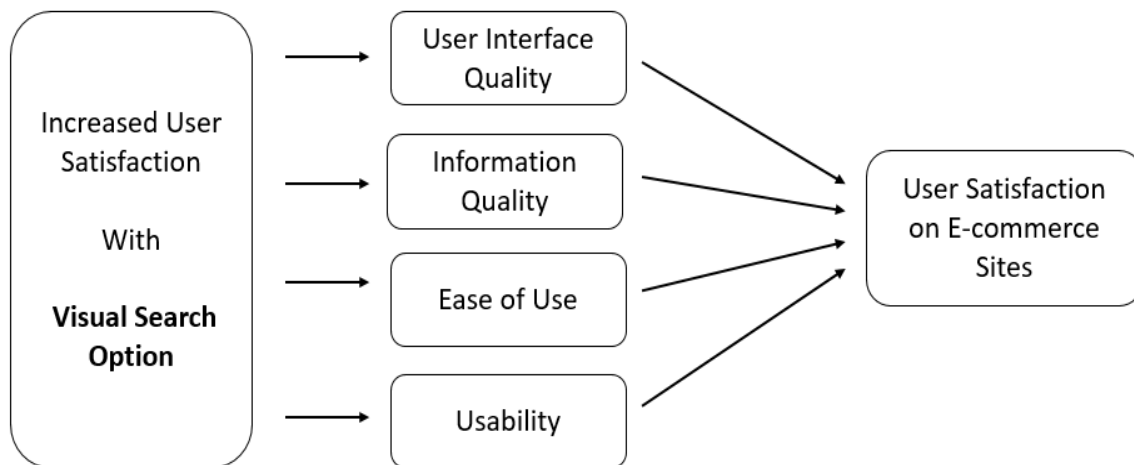
Figure 1: Conceptual Framework

Hypothesis was developed including Alternative and the Null hypothesis for each independent variables with the dependent variable.

The research is an applied research which accessing a part of a searching method is e-commerce websites and the objective type is explanatory design that observes and compare between the utilized variables. The inquiry mode of the research is Quantitative. According to the research problem explanation international and Sri Lankan e-commerce sites related researches have been selected to conduct the research.

The researcher needs to investigate on a small group of people out of all the individuals who interest on doing online shopping using Sri Lankan e-commerce sites. According to Statistica website approximately there were 21.44 million people in 2017 as the total population (Sri Lanka - total population 2014-2024 | Statista, 2020). Out of all 57% of people uses smart phones with the access of internet. But only 27.5% of population has an own internet connection (Hewage and Weerasekara, n.d.). With all that, according to financial inclusion factors only 6.2% from the population are dealing with the e-commerce sites to do online shopping. (Digital 2020: Sri Lanka — DataReportal – Global Digital Insights, 2020)

The sample population is 1,240,000 people (6.2 percentage) from the country with the population is estimated for 20 million. The sample size for the population is 166 when calculated with the Confidence level of 10 and the confidence interval is 99%. (Kemp, n.d.).

For the calculation https://www.surveysystem.com/sscalc.htm is used to calculate the sample size needed.

According to the researcher that has mentioned the random sampling method the sample selection was carried out to explain the problem identification for the area of the problem. To analyze the e-commerce customer satisfaction the researcher has taken 171 responses by distributing a questionnaire who are using e-commerce sites for online shopping.

Results

Reliability Test Summary

According to a previous research done by Namdeo and Rout, George and Mallery had provided a rule that all the Alpha value greater than 0.5 is accepted with different levels. Research has mentioned all the Cronbach Alpha is accepted except the values less than 0.5.

- Overall Alpha Value: 0.8058
  - Acceptable with a very good level.
- **Variables**

Variable	Alpha Value	Status
H1 – User Interface Quality	0.6831	Acceptable
H2 – Information Quality	0.7111	Acceptable with a good level
H3 – Ease of Use	0.5772	Acceptable
H4 – Usability	0.5822	Acceptable
H5 – User Satisfaction	0.6072	Acceptable

Table 1: Summary of the Reliability Test

Summary of the Correlation Analysis.

No.	Variable	P- Value	Correlation	Relationship Between Independent Variable and User Satisfaction
H1	User Interface Quality	0.000	0.37	Moderate Positive Relationship
H2	Information Quality	0.003	0.22	Weak Positive Relationship
H3	Ease of Use	0.000	0.51	Strong Positive Relationship
H4	Usability	0.000	0.28	Weak Positive Relationship

Table 2: Summary of Correlation Analysis

With the above results it shows all the four variables have positive relationships at 99 percent level of confidence (P-value = 0.000, $\therefore$ P<0.001) These study has shown the factor of user interface quality and the Information Quality is a key influencing factor for the research area of Saudi Arabia customer e-commerce sites. (Eid, 2011) With reference to Oman e-commerce sites and shows the ease of use is an important factor which positively influence customer

satisfaction of the e-commerce sites. (Sanyal, 2019) Usability has a positive impact for the trustworthiness of the website to improve the customer satisfaction of e-commerce websites. (Christine Roy, Dewit and Aubert, 2001)

Discussion

According to the past literature done by Eid in 2011 has found evidence to prove there is a relationship between User Information Quality, Information Quality and User Satisfaction. These study has shown the factor of user interface quality is a key influencing factor for the research area of Saudi Arabia customer e-commerce sites. (Eid, 2011). Shouvik Sanyal also has proven the positive relationship of the information quality on User Satisfaction of e-commerce sites through Oman e-commerce sites. (Sanyal, 2019)

Hypothesis has tested in this section using Carl Pearson correlation and the regression analysis. The researcher has been using "Minitab 16 Statistical Software". For each hypothesis first the Regression Analysis has tested and the percentage of variation accounted for by model is also displays to demonstrate the R-Sq value. As R-Sq explains how well the data are around the mean of the variable.

P value for each of the variables has been calculated to identify is it less than 0.01 to decide the relationship is statistically significant with the 99% level of confidence with the sample of 169 responses.

Conclusion

With all the calculated results and according to the past researches, the researcher has broken-down the conclusion into four parts. The conclusion 1 confirms that User Interface quality has an impact for the customer satisfaction. While it's prove the correlation it indicates that when the User Interface Quality increases, User satisfaction against the website also tend to increase as people always measure the quality from the appearance.

The conclusion 2 shows that customer Satisfaction will increase with the Information Quality assuming people can feel the quality of the information on the website. (Eid, 2011)

The conclusion 3 shows that customer Satisfaction will increase with the Ese of Use assuming people always searching for easy methods to do their task. Specially to save time and cost.

The conclusion 4 shows that customer Satisfaction will increase with the Usability assuming people always search things or places where there is no high restrictions as it easy to handle and use for.

This study is only limited to the top level e-commerce sites in Sri Lanka, as there is an initial cost to expend on the e-commerce to deploy the IBOP search feature to their e-commerce sites. In future the researchers can select available all the e-commerce sites to have the IBOPS feature to their websites with a less initial cost.

Recommendation

For the recommendations of the UIQ of the website the website can improve their website with **Visual Designs** by focusing more towards visual designs containing icons, images, and correct placement of the objects and the element. As **typography** is all about the psychology of the design the fonts and designs may change the user's mood. It will also impress the user to use the site. (Orlova, 2016) And also by **using less fonts** that's easy to grab the details when

comparing to the images/visuals. Using color harmony is always choose to give an aesthetic appeal.

To improve the Information Quality the researcher is recommending to use a Web Application Firewall to act as a gateway between two or more networks allowing authorized traffic to be permitted and preventing the access to a network from unauthorized access in order to protect data. (Detect and block bots with Robust Anti-Bot Technology | InfiSecure, 2019)

To improve the **Easy Access** of the website allow the websites to access through mobile phones with a well-structured design and a simple navigation methods.

For the usability proper icons and details will help the user to find the products easily. Especially with the product categories, along with the text detail use of common icons and images.

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ENSURING THE BUSINESS CONTINUITY FOR SME-MODEL GYMNASIUMS IN A POST COVID-19 TIMELINE BASED ON GYM MEMBERS.

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Abstract

As the world was taken out by surprise with a pandemic virus named "COVID-19", the closure of gymnasiums specified under the category as "non-essential public places", is sharing its share of turmoil along with many other. Therefore, the research attempted to identify and analyze the impact of training hours, hygienic standards, mobile payment & brand awareness on ensuring the business continuity of gymnasiums using a mobile application in a post-COVID timeline. The sample population consisted of gymnasium members under the SME (small to medium enterprise) model. The methodology is based on descriptive and correlation under applied research, and the quantitative method has been followed. Further study on the collected data was proceeded by removing identified outliers that can cause a change in the magnitude of regression coefficients. The observed shreds of evidence showed positive relationships of the dependent with the independent variable "Ensuring business continuity by the mobile application" using regression analysis and correlation analysis, even though the correlations' levels were variated.

Keywords: Business Continuity, Post-COVID, Quantitative, SME Gymnasiums

Introduction

As many people as directing themselves to fitness gyms and health clubs to ledge out the side effects of the urban lifestyle, the fitness industry has turned out to be a massive global business. Sri Lanka has opened up promising economic growth forecasts because of its strong growth potential in the gym industry, where the estimated rate is high as 50% per annum elaborated in a newspaper article drafted based on research. With the impact of the pandemic situation around the world and the closure of gymnasiums mandated by the governments around the world as a result, it has left out millions of people with no place to work out and also lead to staff scrambling for survival. After lessons learned from the past followed by H1N1 Swine Flu, Ebola, Zika virus, etc, business continuity planning sets many steps to strengthen the business flexibility and adaptation to the new environment used by major organizations government bodies. Yet the gymnasiums in Sri Lanka under SME weren't able to make amendments to the business functions leading to further downfall even after the curfew lifted with some parameters and guidelines. The 2 major reasons picked up for this downfall were, the lack of capability to improvise the current functional business hours (5 am – 10 pm) while adhering to the health parameters (set to create social distancing to avoid the spread of the virus). The other was, the low chances of possible walk-ins to the gymnasium in a post COVID environment due to the inability to create a surrounding with proper hygienic standards that impact the member's intension of visiting the gym.

Objectives

The objectives are all based on achieving the business continuity process of the SME model gymnasiums. The primary objective of the research is to deploy training hours under booking opportunities for the members. They were creating possibilities for increased numbers in walk-in clients. Secondly, deploy hygienic standards to create a safer space for members to walking and proceed with their workout sessions with no hesitation or fear. Thirdly, deploy a mobile payment platform through the application where members can proceed with a contactless payment method to support the spread avoiding mechanism. Finally, the research attempted to create brand awareness for the application by identifying the trends followed by members that can direct the application's usage.

Conceptual Framework and Hypotheses of the Study

The business continuity process has its origins in the late 1970s under research recovery plans in response to operational risk forcing companies to recovery from various interruptions. Business continuity refers to the company's capability to tolerate and restore itself from contingencies. It focuses on identifying the potential impacts that the organization, which has to face unexpected situations while creating a base of certain levels of resistance and ability to react accordingly. This will protect the processes and the global interest of the organization, including the value of its share on the market. These bases may apply either to all processes or specific areas, solely to the organization's crucial ones. The conceptual model formulated for the study based on the variables supported by the literature review will ensure the gymnasium's business continuity using the mobile application.
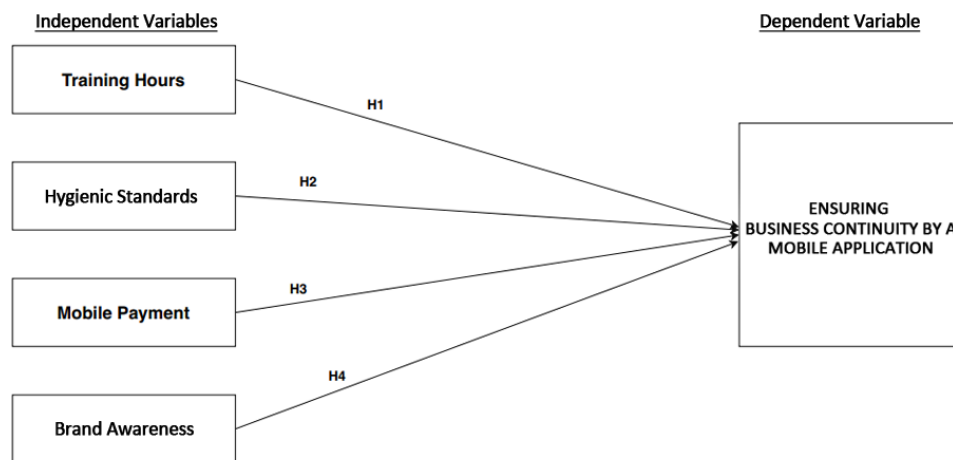
Figure 1 Conceptual Framework

H1₁: There is a linear significance impact of Training hours for the business continuity process at gymnasiums.

H2₁: There is a linear significance impact of Hygienic Standards for the business continuity process at gymnasiums.

H3₁: There is a linear significance of Mobile Payments Option for business continuity process at gymnasiums

H4₁: There is a linear significance of Brand Awareness of the application for the business continuity process at gymnasiums

Methodology

The research is driven through an applied methodology where the objectives of the research achieved using descriptive (attempting to describe variables that are engaged in the situation) plus Correlational methods (to identify the relationships on the aspects of the situation). Since the study is dealt with primary data, data collection theory was taken place in a quantitative method using a question-based survey "Google Forms". The respondents were selected based on an area sampling design under the probability sampling method since only members that attended the gyms under the SME model inside the western province (Colombo, Gampaha, and Kaluthara districts) of Sri Lanka were taken into study. According to the marketing overview published in Daily Mirror, the sample size of 166 ($\pm$10) was calculated based on the population estimated to increase from 278,715 memberships in the year 2014 to 500,000 by the year 2020. Before the survey was disseminated to the sample group, a pilot survey was conducted to 20 members and was tested for its reliability by Cronbach's alpha coefficients. The calculated Cronbach alpha's for each variable showed positive reliability of values above 0.7.

169 members responded successfully where only 160 responses were considered for the analysis as the intended target gym members for the final data analysis. To determine the relationships of independent and dependent variables in the research, Pearson's correlation coefficient was used and regression analysis was performed to investigate the related coefficients. To support a stronger determination of the regression coefficient, the data set was observed for any outliers. Six common responses consisting of outliers were removed to takeout any chances of changes in the direction of coefficient signs.
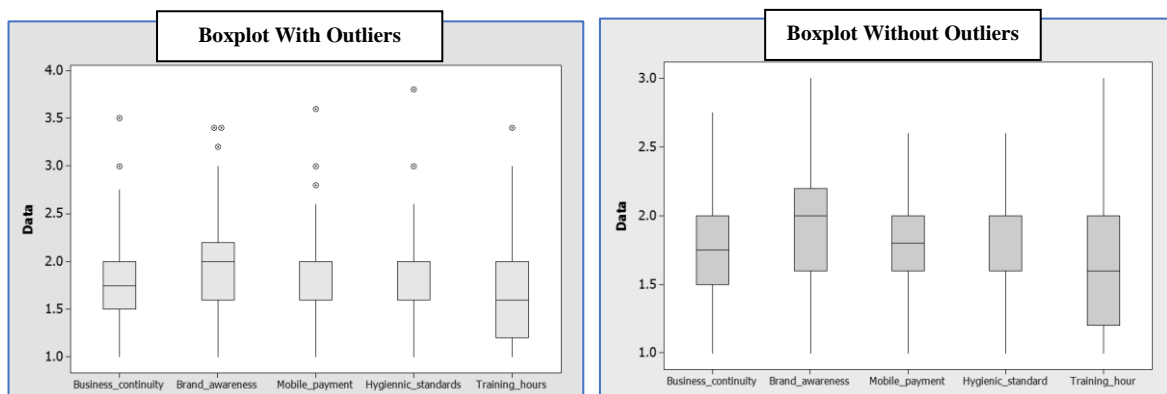
Figure 2 Bloxplot for Variables

Results and Discussions

The minitab statistical software was used to carry out the data analysis on the collected data. Initially, every variable was tested again for its reliability even after the pilot study. As shown in Table 1, some of the variables were below 0.7 of Cronbach's Alpha value. Still, some research papers generally accepted the rule because a Cronbach value of 0.6 - 0.7 is an acceptable level of reliability.

Table 1 Reliability Analysis

Variable	Cronbach coefficient alpha value

Dependent Variable	
Ensuring Business Continuity Process by the application	0.6254
Training Hours	0.7145
Hygienic Standards	0.6877
Mobile Payments	0.7173
Brand Awareness	0.7382

To determine the relationships between independent and dependent variables in the research, Pearson's correlation coefficient was used.

Training Hours and Business Continuity
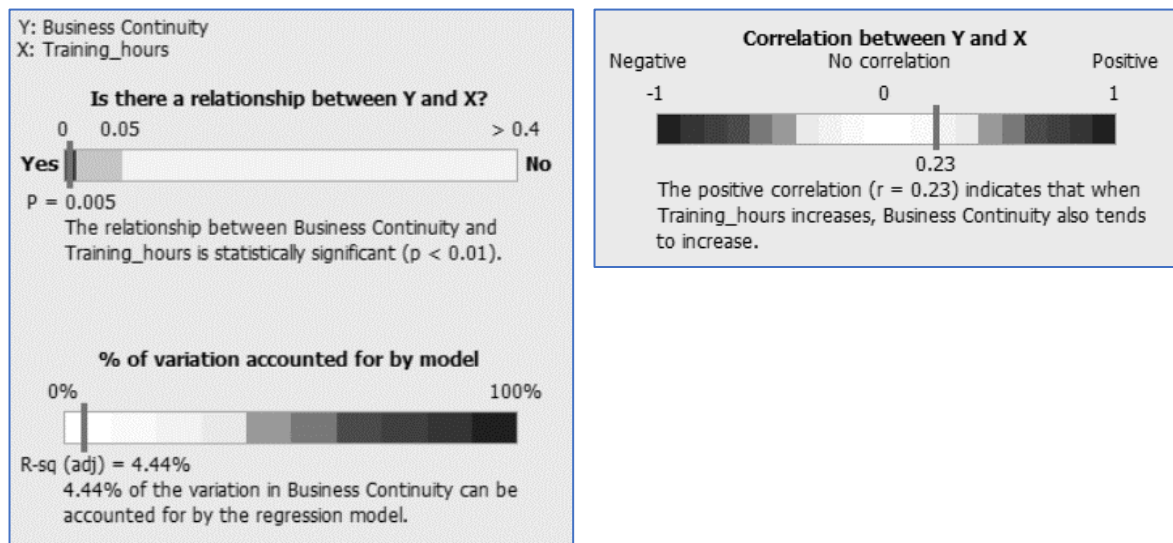
Figure *3* Data Analysis For Training Hours

Based on the results r value is 0.23. It's a "Little if any Correlation" according to the rule of thumb scale correlation coefficient by the Applied Statistics for Behavioral Sciences - 5th edition. As the p-value is less than 0.01, the $H1_0$ can be rejected in favor of $H1_1$.

Hygienic Standards and Business Continuity
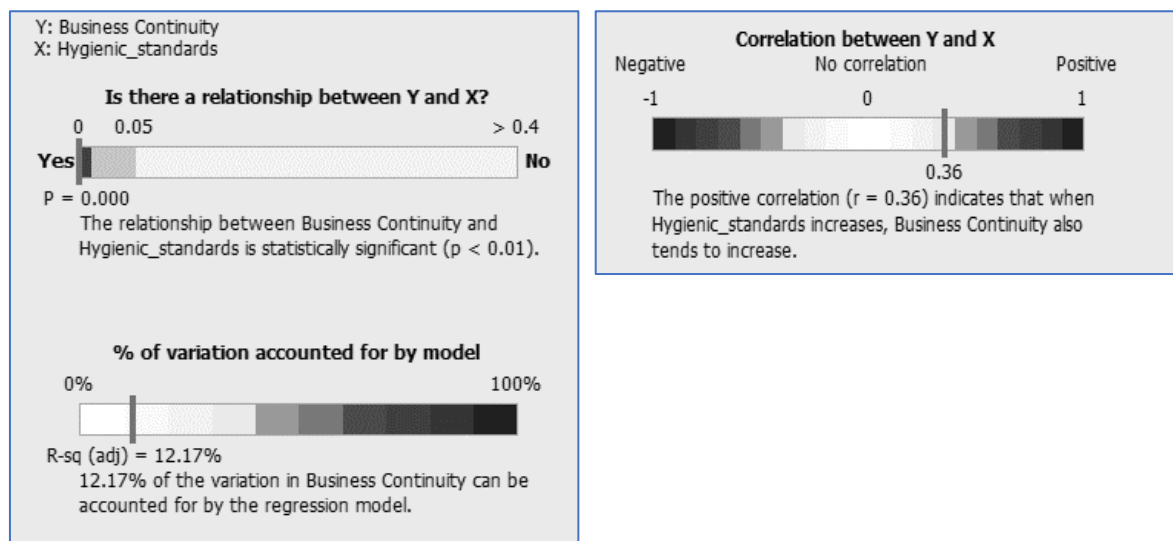
Figure *4* Data Analysis For Hygienic Standards

Based on the results r value is 0.36 and it's a "Low Positive Correlation" according to the rule of thumb scale correlation coefficient. As the p-value is less than 0.01, the $H2_0$ can be rejected in favor of $H2_1$.

Mobile Payment and Business Continuity

Y: Business Continuity
X: Mobile_payment

Is there a relationship between Y and X?

0   0.05   > 0.4

Yes   No

P = 0.000

The relationship between Business Continuity and Mobile_payment is statistically significant (p < 0.01).

Correlation between Y and X

Negative   No correlation   Positive

-1   0   1

0.50

The positive correlation (r = 0.50) indicates that when Mobile_payment increases, Business Continuity also tends to increase.

% of variation accounted for by model

0%   100%

R-sq (adj) = 25.00%
25.00% of the variation in Business Continuity can be accounted for by the regression model.

Figure *5* Data Analysis For Mobile Payment

Based on the results r value is 0.50 and it's a "Moderate Positive Correlation" according to the rule of thumb scale correlation coefficient. As the p-value is less than 0.01, the $H3_0$ can be rejected in the favor of $H3_1$.

Brand Awareness and Business Continuity

Y: Business Continuity
X: Brand_awareness

Is there a relationship between Y and X?

0   0.05   > 0.4

Yes   No

P = 0.000

The relationship between Business Continuity and Brand_awareness is statistically significant (p < 0.01).

Correlation between Y and X

Negative   No correlation   Positive

-1   0   1

0.42

The positive correlation (r = 0.42) indicates that when Brand_awareness increases, Business Continuity also tends to increase.

% of variation accounted for by model

0%   100%

R-sq (adj) = 17.30%
17.30% of the variation in Business Continuity can be accounted for by the regression model.

Figure *6* Data Analysis For Brand Awareness

Based on the results r value is 0.42 and it's a "Low Positive Correlation" according to the rule of thumb scale correlation coefficient. As the p-value is less than 0.01, the $H4_0$ can be rejected in favor of $H4_1$.

Conclusions and Recommendations

The data analysis conducted supported all the hypotheses accepting that each variable had a linear relationship with the corresponding dependent variable "Business Continuity by the mobile application". Yet the correlations of these independent variables across the dependent variable had significant variations. For Training hours, the r-value of 0.23 could be due to the reluctance to compensate for their workout time and the function of booking facility being a new platform for SME model gyms. Hygienic standards, the reason for the r-value of 0.36 could be due to the lack of knowledge on the depth of the situation and the need for these protocols to be followed. Further education by prompt playing on antecedent-based interventions can increase the impact of positivity.

For mobile payment even though the r-value of 0.50 is satisfactory, this would have been better if it was not due to the neutral considerations made on the perspective of security by some respondents' when it comes to the payment option. If the trust is maintained by constant improvement of the authentication processes and privacy will make users feel the reliability of the online payment system through the application. Also the required compatibility and the vonvenience needs to be updated which will eventually increase the intention –of using the service for payments without hesitation. Reason for the r-value of 0.42 is due to lack of engagement by social media platforms by many gymnasiums. But considering the opportunities of a new application approached by these respondents and how positive reviews can direct new users to give it a try is very promising. As long as the application serves its purpose, the application's continuous use can be guaranteed and the chances of the application being abandoned will below.

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IMPROVING THE RAILWAY RESERVATION PROCESS OF SRI LANKA BY IMPLEMENTING A CENTRALIZED RAILWAY RESERVATION SYSTEM

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Abstract

The train transportation sector of Sri Lanka is one of the main travelling mode used by both local and foreign passengers. The train reservation process currently follows the manual way of tickets issuing for passengers. Some mobile service providers collaborated with the SLR and providing mobile train ticket reservations. Based on past research, reports, and other relevant literature regarding railways reservations carried out in Sri-Lanka, several key issues and drawbacks in the existing processes have been identified. Western countries have overcome these issues faced in the railway reservation process effectively by analyzing the passenger's perspective and opinion in service quality of manual-based reservation process, accessibility difficulties, and expected for user-friendly facilities in services. Throughout this research, the main aim is to analyze the problems of the existing railway reservation process and the passenger's satisfaction to come up with solutions for the business re-engineering of SLR reservation services. This research study is analyzing the passenger's satisfaction of the Sri Lanka railway reservation process with three independent variables, they are service quality, Accessibility and User-friendliness. From the results of preliminary and regression data analysis CRRS is recommended as a solution for SLR passengers to get convenience, easily accessible, and manageable service. This will help the SLR to increase the revenue and keep passengers using train transport and reservations successfully in the future.

Keywords: Accessibility, Passenger's satisfaction, Railway reservation process, Service quality, SLR, User-friendliness.

Introduction

In Sri Lanka currently, the mode of travelling by train has become a popular way of transportation. Train travelling is more convenient, safe, fast, and cost-effective for passengers. So far train reservations are conducting manually with reservation counters. SLR collaborated with mobile network service providers to be involved in rail reservations to improve passenger satisfaction and reduce reservation counters' workload and queues. SLR has stated no online booking services are available for train reservations and reservation can be done through phone calls through mobile service providers. At the same time, private agencies are also taking part in providing train ticket reservations. Even though with the involvement of these stakeholders, still the process having some limitations. It is more important to improve the railway reservation process since travelers' usage has been increased and the demand for facilities also increased. Introducing a smart railways reservation is a better solution to wipe out the loopholes of the existing services with information technologies. The Railway transport sector failed to

provide user-friendly, trustable, and fast reservation services. The increasing number of railway passengers is a big challenge to handle with the existing process and SLR required to work business process re-engineering with an innovative solution for the current railway reservation process in Sri Lanka.

Objectives

The main objective is to switch the manual railway reservation process of SLR into an automated smart reservation system to provide better effective services to improve the passenger's satisfaction.

Conceptual Framework and Hypothesis of The Study

Compared to other developing countries, Sri Lanka railway services' reservation processes are not up to the standard to meet the users' satisfactory level. The current administration and functionalities of SLR reservations are lack behind to provide better quality services. The revenue of SLR decreased when compared to past years due to the unsatisfied performance and customer dissatisfaction. Measuring the passenger satisfaction of Sri Lanka public railway transport is significant. Understanding the passenger's satisfaction on existing railway reservations may help the SLR sector focus on the improvement. The functional and technical dimension will have a substantial impact on service quality provided by railway stations. Use of new technologies will improve easily accessible reservation services. The user-friendly reservation facilities are directly impacting on passengers' convenience and satisfaction. Passenger-friendly, trustworthy, and fast services are always needed to satisfy passengers who use train transport. Based on the literature review conceptual discussion model was developed for the study.

Conceptual Model

Independent Variable
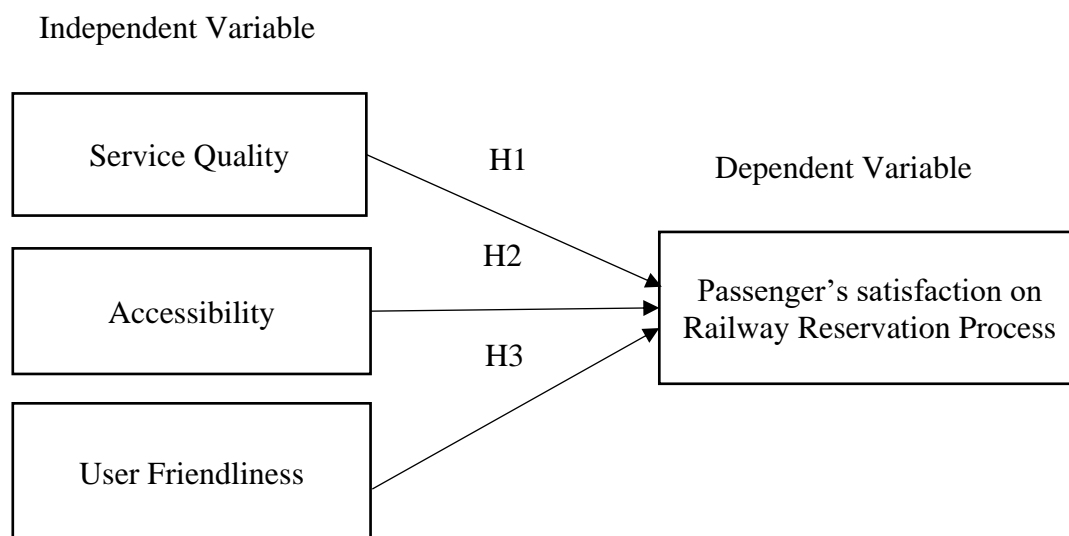
 Figure *1* - Conceptual Framework

This research study's hypothesis has been developed according to the identified independent variable and dependent variables.

H1₁ – There is a significant positive impact of service quality on passengers' satisfaction on the railway reservation process.

According to the previous articles, ' researchers have stated customer satisfaction on the organization can be judged through the organization's service quality. Service quality is an important indicator to measure the passenger's satisfaction with the organization's performance.

H2₁ – There is a significant positive impact of Accessibility on passenger's satisfaction on the railway reservation process.

According to the previous researches' Accessibility for the railway reservation process of Sri Lanka may have a direct or indirect significant impact on passenger satisfaction. Accessibility is one of the key factors to understand the passenger's satisfaction of accessing the railway reservation service provided currently

H3₁ – There is a significant positive impact of User-friendliness on passenger's satisfaction on the railway reservation process.

Many journals are stated operations, security, safety, trust, easy to use and reliability are focusing to change the existing railway infrastructure to increase railway performance to achieve the passenger's satisfaction. User-friendly facilities to fulfil passenger expectations are significant to consider while talking about passengers' satisfaction on the existing reservation process.

Methodology
According to that for this research non-probability sampling method has been taken because convenience sampling used. The samples are collected from friends, family, colleagues who use public train transport and visited people for railway reservation counters by distributing surveys. The method was chosen because a sample of the population is conveniently available to provide the answers, and it is easy to collect information quickly and efficiently. According to the 2018 performance report of Sri Lanka Railways, 1,380,000 people used Sri Lanka public train transport annually. Therefor 166 sample size is collected from SLR passengers, and quantitative research methods have been taken considering the limited time duration, cost, availability of data, and easy Accessibility for respondents. This research's primary source was collected with a closed questions type questionnaire from 116 online surveys and 50 manual surveys. 5-point Likert scale used for data coding for analysis. The preliminary study is conducted based on some of the general questions distributed to the railway passengers to analyses on the discussion. Regression analysis was performed to test the developed hypothesis.

Results

The Minitab was used for analysis and initially reliability of the collected data checked, and descriptive statistics checked the normality of the collected data with descriptive statistics. Simple linear regression analysis is a statistical method used to analyses and explaining the relationship between two quantitative variables.

Reliability Analysis

Overall Cronbach's alpha value of every variable is greater than the 0.7. Therefore, the reliability of the results gathered from the survey considers as good for the research.

Table 1 **-** Reliability Analysis

Variable	Cronbach's Alpha Value	Number of Items
Passenger's satisfaction on the railway reservation process	0.8134	6
Service Quality	0.8935	5
Accessibility	0.8656	4
User Friendliness	0.8994	7

Source: Railway passengers survey data 2020

Normality Analysis

A brief descriptive coefficient is understandably presenting the variables. The results of central tendency and measures of spread show, that data is normally distributed, and all the variables are showing the normality.

Table 2 **-** Descriptive Statistics

Variables		Passenger's satisfaction on the railway reservation process	Service Quality	Accessibility	User Friendliness
Total Count		166	166	166	166
Measures of Central Tendency	Mean	4.2018	4.2759	4.2395	4.2565
	Median	4.3333	4.6000	4.5000	4.4286
	Mode	4.5	5	4.5, 4.75	4.71
Measures of Spread/ variability	Standard Deviation	0.5920	0.7690	0.7362	0.6594
	Variance	0.3504	0.5913	0.5419	0.4348

1st Quartile	3.8333	4.0000	4.0000	3.9643
3rd Quartile	4.6667	4.8000	4.7500	4.7143

Source: Railway passengers survey data 2020

Regression Analysis

Hypothesis Test1 - Service Quality vs Passenger's Satisfaction on Railway Reservation Process.

The linear regression straight line is gradually going upwards. As per the results $P = 0.000$ - Statistically significant ($p < 0.01$). variance is 47.48%. There is a positive correlation among the two variables ($r = 0.62$) since $r > 0$. Therefore, there is a significant linear relationship and when the service quality increases, passenger's satisfaction on the railway reservation process also tends to increase.

Hypothesis Test2 - Accessibility vs Passenger's Satisfaction on Railway Reservation Process.

The linear regression straight line gradually going upwards. As per the results $P = 0.000$ - Statistically significant ($p < 0.01$). variance is 49.38%. there is a positive correlation among the two variables ($r = 0.70$). Therefore, there is a significant linear relationship and when the Accessibility increases, passenger's satisfaction on railway reservation process also tend to increase.

Hypothesis Test3 - User-friendliness vs Passenger's Satisfaction on Railway Reservation Process.

The linear regression straight line gradually going upwards. As per the results $P = 0.000$ - Statistically significant ($p < 0.01$). variance is 48.83% there is a positive correlation among the two variables ($r = 0.70$). Therefore, there is a significant linear relationship and when the user-friendliness increases, passenger's satisfaction on railway reservation process also tends to increase.

Discussion

The research's major finding is discussed critically with the results gathered from preliminary and regression data analysis. According to the preliminary analysis conducted with 166 railway passengers, most passengers using SLR reservation counters and 14.5% of passengers using mobile service providers and 30.1% of passengers using both methods. The results show the frequency of using train reservation the involvement of using weekly is very less only 15.1% because the facilities provided with the existing process is not satisfied the passengers to use reservations frequently. When analyzing the existing process's satisfaction, mostly respondents are stated, improvements are needed for the reservation process. Existing railway reservation needs to be improved in the future to face the challenges in the market to make a profit. Preliminary analysis of respondent's knowledge and availability to access digital devices with internet connectivity 94% of the railway passengers have agreed with their responses. This shows that developing an advanced solution for the railway reservation process can be adaptable by SLR passengers. Traditional methods cost for no value-adding services. This

causes high costs, resources, and valuable times. These problems failed to achieve passenger satisfaction and cause continuing losses to SLR. The discussion was based on the regression analysis results, when there is no service quality there is no passenger satisfaction on the existing reservation process. When there are issues in Accessibility there are issues in achieving passenger's satisfaction on existing reservations. When there is not enough user-friendliness in the existing process there is no passenger satisfaction. Therefore, an improvement in service quality, accessible, and user-friendly impact improves the passenger's satisfaction to run a successful SLR reservation process.

Conclusion and Recommendation

With the help of the results the conclusion can be taken as the service quality, Accessibility, and user-friendliness of the existing railway reservation process need to be improve in the future to provide better railway reservation services. Since most of the passengers have knowledge and resources availability to access digital devices adopting a new technology-based solution won't be a huge issue for passengers. SLR can improve their services with a technology-based solution, increasing the reservation ticket sales and overall annual profit will be increased by Rs.299 million. The recommendation is to create a Centralized Railway Reservation System that will replace all island-wide railway networks with a computerized automated reservation system with innovative features and facilities, eliminating all identified drawbacks in the existing reservation process. Railway reservation operation is centralized with one web-based train reservation system using unique Identification (UID). The recommended systems' benefits are fast, reliable payment options with secure OTP, Saving time and money. At the same time, this will be accessible from any location at any time. The solution will provide accurate and live train information for the reservation process without any third-party involvement. Using QR code-based e-tickets will make the work easy for the ticket checkers and the passengers.

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USER EXPERIENCE DESIGN FOR ELDERLY

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Abstract

User experience is paramount for every smart device, application, system, and website. Without proper UX techniques and methods, the quality of the product or application will be poor. During the early Internet age, the user experience is not considered as important as that of today. With the increase usage and mature technology user experience is considered as an essential design feature in most of the important applications or websites. This article discussed what the user interface is and what is the user experience, how to improve user experience using UX techniques, etc. in detail. The main objective of this research is to find out the ways, to improve user experience in elderly people. This work further elaborates how elderly use technologies, what are the issues they faced in using technologies? how to avoid those issues. This research work concludes with proposed solutions to improve UX for elders. proposed solutions to improve UX for elders.

Key Words: User Experience, User Interface Designs

Introduction

The technologies are advancing faster than ever, but a large number of senior citizens have some issues using the new technological products. Because most of the companies target in younger people with there products and there services. Most of these products and services are not designed with elderly population in mind Currently, there are 600+ million elderly people around the world. (International Day for the Elderly, n.d.) Currently most of the countries are experience this situation. Governments can look at them using less funds it's very useful for countries. According to researchers, this challenge has caused literary waves of how technologies can be brought to this conclusion, and these ideas are beginning to come into government policy and mainstream use. These technical solutions rely on the use of information systems to automate or increase performance in many maintenance systems. Older users may need to interact with these systems with certain skills. Therefore, user interface design, which is concerned with various aspects of human-computer interactions, should carefully consider their requirements to achieve the target outcomes.

When considering this there are several issues in the user interfaces and user experience. Because elders are experienced typical user interfaces and user experience, either as a result of the effects of aging, or unfamiliarity with modern technology. The age that these symptoms become apparent vary from person to person, but is generally defined with elderly or older as 65. It is important to note that the symptoms of aging that appear to affect human-computer interaction can also be found in younger users with similar disabilities. (Dodd, Marc T. P. Adam, & Rukshan Athauda, 2017)

Methodology

This research investigates the common problems faced by elderly people when using web applications. The finding of this research can be used to design better web applications for the elderly. In this research, we recruited 40+ elder individuals from sri lanka. In order to obtain user input we created a questionnaire of 15 general questions and distributed it among participants. Then got most of the comments and accordingly planed web application home page and other pages. Also according to real user data planed how to avoid common issues. The collected data is then analyzed to find interesting insights useful to find answers for our research questions. Most of the elders are between 55,65 around age. when we recruit them we consider their knowledge and how they interest in the internet.

Then got most of the comments and accordingly planed web application home page and other pages. Also according to real user data planed how to avoid common issues.

Figure 1 – Rough designs for homepage

This is the final design of the home page we came with after several iterations. The reason is do this design is user need very simple interface. Elders has some mental and physical issues then if designed some typical design it's useless for them. In this design they can easily identify this large boxes. Also this hasn't include scroll bar for desktop. Because some time they cannot identify that scrolling functions, some of the has issues in their motor skills. Now any on can click these large boxes and see what is in inside.

Results

Figure 2 – Final design for homepage (Design URL: http://betaui.great-site.net)

When considering about final result, proposed system designs are developed and hosted for get results. Also got all the results from Google forms.

	Timestamp	Are you satisfied with hor	Can you clearly identify tl	Is it website font sizes ar	Are you OK with Font col	Can you read contents e	Tool tip assistance is it he	How about the website in	Are yo
2	10/16/2020 22:41:59	Yes	Yes	Yes	Yes	Yes	Yes	I'm ok with mobile phone	Yes
3	10/16/2020 22:42:46	Yes	Yes	Yes	Yes	Yes	Yes	yes i can read content in	Yes
4	10/16/2020 22:44:00	Yes	Confusing	Yes	No	Yes	Yes		Yes
5	10/16/2020 22:45:14	Yes	Yes	Yes	Yes	Yes	Yes	In mobile its good. I can t	Yes
6	10/16/2020 22:49:25	Yes	No	Yes	Yes	Yes	Yes		Yes
7	10/16/2020 22:49:40	Yes	Yes	Yes	Yes	Yes	Yes		Yes
8	10/16/2020 22:50:22	Yes	Yes	Yes	Yes	Yes	Yes	yes, easy to use	Yes
9	10/16/2020 22:50:48	Yes	Yes	Yes	Yes	Yes	Yes	easy to read content	Yes
10	10/16/2020 22:51:18	Yes	Yes	Yes	Yes	Yes	Yes	easy to recognize in mob	Yes
11	10/16/2020 22:51:29	Yes	Yes	Yes	Yes	Yes	Yes	Highly satisfied	Yes
12	10/16/2020 22:56:44	Yes	Yes	Yes	Yes	Yes	Yes	Very good	Yes
13	10/16/2020 22:58:04	Yes	Yes	Yes	Yes	Yes	Yes		Yes
14	10/16/2020 22:58:19	Yes	Yes	Yes	Yes	Yes	Yes		Yes
15	10/16/2020 22:58:43	Yes	Yes	Yes	No	Yes	Yes		Yes

Figure 3 – Result sheet

In above sheet provide how the designs got marks from elders. Also 80% got success marks because now they can easily use these type of designs for their use. They can easily understand the website. From this research found, there is other 20% elders, the most common problem is they haven't proper knowledge about smart apps and websites. Also we can get that crowd using some tips, like can include some most popular contents and topics to site. Original sheet url is attached in below.

Sheet URL:
https://docs.google.com/spreadsheets/d/1rjH5_X0ZhOfKqOPmN81cxMSXP4MVERDIFWJPX3TMc3Q/edit?usp=sharing

Data Analysis and Discussion

In this project main idea is give better user experience for elder people. Project is based on this improve user experience in elder people idea. Using this idea anyone can apply this methods and data to their project. The main focus is improving their user experience for web applications and systems, because elder people can do their works easily using this techniques. This project is done by using researches and actual data.

Considering about research data firstly the main source is internet because this project is based on user experience for internet. The all research data is collected by using articles research websites and research pdfs. Considering about project objectives firstly I need to find what is the current situation of this main topic. And how people face currently for this situation. Looking about that data and actual examples I found lots of problems and issues in this area. That's the main thing I do this project. Because 600+ million elder people in out there they faced lots of problems and issues. All the people are focus younger generation for provide there services. In that case elders has lots of issues and problems. Then I focused what are the most common issues they faced in using new technologies, websites overall internet. I found two main types of problems and issues mental and physical. Talking about mental issues they have lots of problems I discus that issues deeply in above conversations. Talking about briefly they have some fears, limited understandings, knowledge about computers or mobile like this, considering about physical problems this is very important because after age 60 all the elders has some kind of physical problem. Talking about briefly them some of them have eye

problems, memory issues, some kind of body issues (hands) like this. According to my research and project these most of the issues and problems we can avoid using some special techniques. As example some banks provide some special account types for their elder customers and they also provide some special application for their mobile, also they provide separated website for that. Also hospitals provide some special applications for elders. But this kind of applications provide only some companies only, but elders need other services they need order foods, they need check news, use social media. If we can collect data and develop some structure for their applications and websites they can easily use that their needs.

From this questionnaire found important data for improve the designs and user experience. Mainly identified what they need exactly and what they like to do. That questionnaire got most common issues elders facing and got all-around data for improve this design.

Conclusions and Recommendation

When considering questions and answers, can get a final idea about websites and applications. If we can use these methods and techniques for the elder's applications it's very important for their acceptance. And also they used the internet normally 2-3 hours per day that is a good improvement because if we can improve UX more times, they also accept that and they will use another 30min – 1h and they increase internet browsing time.

In our feed backlist, most of the users have eye issues then the application design is improved with a bigger font size. Also, some of them have motor skill issues in these designs created for most of the time avoid scrolling functions and other functions. Also create a very easy design for users, most of the requests are got in understanding issues and knowledge issues. Most of the time that issues avoid by these designs. In the final idea is this application and designs are made for specially elder users with their requirements. Recommendations are these application methods can use any kind of application for elders.

Future enhancements

In future will planned to develop this concept to high-level, that means develop apps for elders using these methods. Also got important data for analyze and can apply to various projects.

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SEASONAL VARIATION OF LEISHMANIASIS IN POLONNARUWA DISTRICT (2016 – 2019): A SPATIAL & SOCIO DEMOGRAPHIC TREND ANALYSIS

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Abstract

Geographical Information Systems (GIS) is a useful tool to identify the spatial & socio-demographic trend of the people. Leishmaniasis spreading more than 88 countries in the world and putting 350 million people at risk. In Sri Lanka, it spreads in almost 25 districts. However, 90% were reported from the dry zone. Therefore, key focus was drawn to find out the spatial & socio-demographic trend association and seasonal variation of Leishmaniasis in Polonnaruwa district which belongs to the dry zone. Clinical reports, spatial, socio-demographic statistics and district climatic information during 2017-2019 were used as the data sources. Rainfall, humidity and temperature was used as testing variables along with the incidences of Leishmaniasis. Rainfall_station_layer, District_boundary_layers and Land_layers were subjected to analysis using ArcGIS and statistical analysis was conducted using R studio. Based on geographical parameters and incidence, with hotspot and IDW analysis it showed high number of patients clustered to central while spreading to north western and south western areas in Polonnaruwa district. Further, lower rainfall, high population and high paddy cultivation identified as characteristics of study area. Periodical clinical-case reporting showed peak in April-June and August-November. Grounded on statistical analysis the humidity *(P-value = 0.00370)* and Temperature *(P-value = 0.02357)* have a significant impact($P<0.05$) with no. of patient. While Rainfall *(P-value = 0.07589)* did not show any significant impact ($P>0.05$) with it. Therefore, it is proved that the either pathogen or vector of the leishmaniasis is temperature and humidity sensitive and the most prominent recorded season was summer.

Key Words: Leishmaniasis, Geospatial, Polonnaruwa district, Spatial & Socio Demographic

Introduction

Leishmaniasis is a globally spreading vector borne disease which will turning in to a life treat of individuals irrespective of their age or gender and generally, there are three forms of Leishmaniasis: Visceral Leishmaniasis, Mucocutaneous and Cutaneous Leishmaniasis. In Sri Lanka, Leishmaniasis has been started to appear in 1992 and earlier it was identified as an exotic disease for quite a long time. As per the Siriwardana *et al*., (2007), in 1992 first evident for transmission detection was reported from southern Sri Lanka and there were only few cases were identified up to 2008 (Siriwardana *et al*., 2007). Recent studies conducted-in Sri Lanka demonstrated that the distribution of Leishmaniasis has an endemic in north-central, north-western and southern regions of Sri Lanka. People living at low latitudes and close to paddy fields and forests have a high risk of acquiring the disease. Temperature, humidity and wind speed contribute to transmission of leishmaniasis in endemic regions and analysing their distribution to show whether they are clustered, dispersed or randomly distributed (Galgamuwa *et al*., 2018) (Amarasinghe & Wickramasinghe, 2020). The different forms of Leishmaniasis can be diagnosed with the several clinical testings such as serological tests, microscopic

demonstration of parasites, culture or PCR. The infected areas of Visceral Leishmaniasis, can be diagnosed at primary health care facilities or in rural district hospitals using the rK39-based testing, which can derive the results within 30 minutes (Siriwardana *et al*., 2007) (Abeygunasekara, 2009). After the 2018 it has reported high level of Leishmaniasis patients around the country, to find out a reason for this particular situation the researchers have performed many studies about factors effecting on leishmania in Polonnaruwa district, which shows that it based on demographic and spatial characteristics, for example, gender and age, humidity, climate conditions in that area (Galgamuwa *et al*., 2018).

With the purpose of population tracking and GIS system Polonnaruwa district has been selected as the base for conducting the research. This information method had highly contributed for several studies dealing with measures of spatial and socio-demographic factors. Also, this study focuses on demographic, spatial and seasonal characteristics as independent variables to investigate the possibility of these variables affecting leishmania spread in Polonnaruwa District of Sri Lanka. Thus, GIS has not been implemented and used in Polonnaruwa District. Therefore, the main aim of the present study was to identify and evaluate the contribution of GIS in control of Leishmaniasis in Polonnaruwa district, Sri Lanka. Further, to identify the trend and hotspot of the disease spread and prevent and control the disease. Furthermore, to assess the risk of cutaneous Leishmaniasis, to assess the distribution of vector and the Leishmaniasis patients in Polonnaruwa, Moreover, to determine the epidemiological features of the disease and to create geographical map of clinical information over three years (2017-2019) and yearly reporting cases over four years (2016- 2019).

Methodology

Independent variables (Demographic factors, Spatial Distribution, Seasonal variations) were considered for geographical analysis and statistical analysis. For this study mainly target on secondary data such as books, articles, diaries and blogs, hospital records since the details are accumulated directly from the records (spatial data, existing maps, GPS data, demographic and population data). Geospatial analysis mainly used the 2017 - 2019 Leishmaniasis patients' layers, Polonnaruwa district layer, MOH layer, rainfall station layer, paddy and chena cultivation layers, build up and land use layers, tank and streams layers, forest and archaeological reservation layers to determine geographical impact. Moreover, to clearly show the patients occurrence rated of Leishmaniasis across Polonnaruwa districts' MOH areas used IDW (Inverse
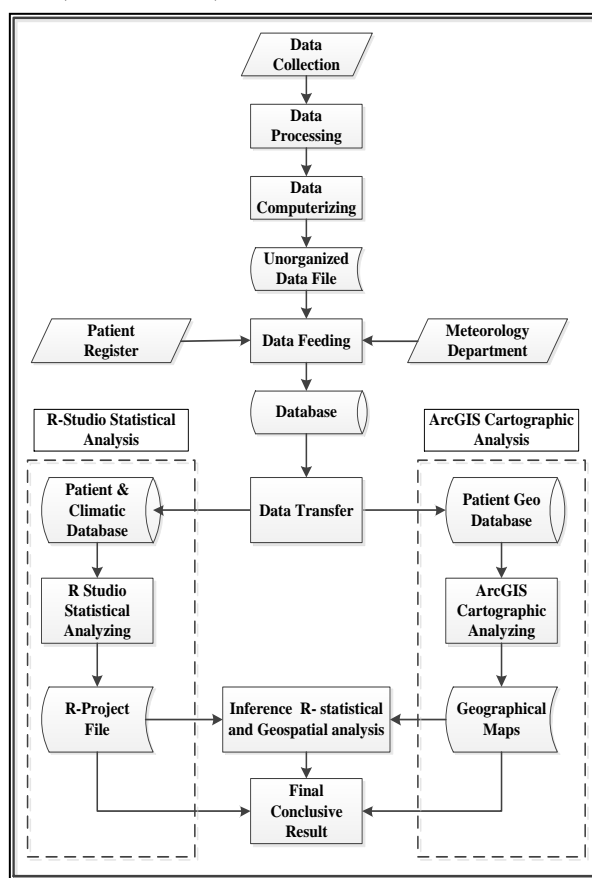
Figure 1: Conceptual Model

Distance Weighting) interpolation. In addition to that all the geographical analysis was conducted through using ArcGIS extensions and Statistical analysis as done using R- studio software. In the process of complication of data processing considerable amount of intermediate results-oriented files are generated as seen on the conceptual model of the research (Figure 1).

Results and Discussion

Total number of reported Leishmaniasis patient in 2018 was significantly ($p < 0.05$) higher than the Leishmaniasis patients reported in 2019. The result of 2017 – 2019 clustering hot spot in Polonnaruwa district show hot spots of Leishmaniasis area located in south western and north western quarters and around the district central. Hot spot (Red Clusters) show *Getis-Ord-Gi Z score > 0.85 (P < 0.05)*. Lower quarter of south western and south eastern show the cold spot. It clearly shows the expanded of central and North western hot spot size and south western and south eastern lower quarter show the shrink of the cold spot as shown in the Figure 2. Accordance with the Leishmaniasis disease it displays the lowest rate of incidence reporting in south eastern and south western areas. With the risk analysis it helps to control the low risk and use measures to keep the area safe and free from Leishmaniasis. From 2017 – 2019, as per the figure 3 it shows risk of Leishmaniasis spread to the southern areas.
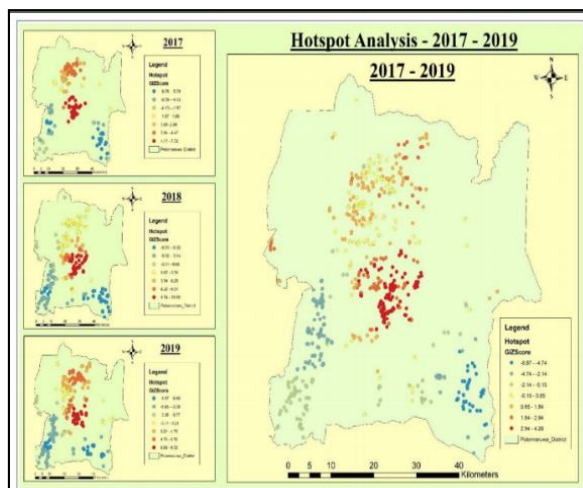
Figure 2: Hot spot analysis - 2017 - 2019
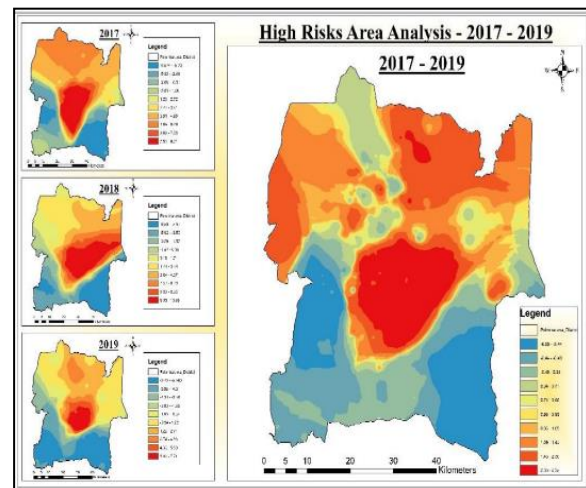
Figure 3: Risk Area Analysis

When referring to the results of this study, the start-up of the study period it clearly shows Thamankaduwa, Hingurakgoda, Medirigiriya and Elahara MOH areas has the high occurrence rate and with the time it spread to Dimbulagala MOH as well. (Figure 4)
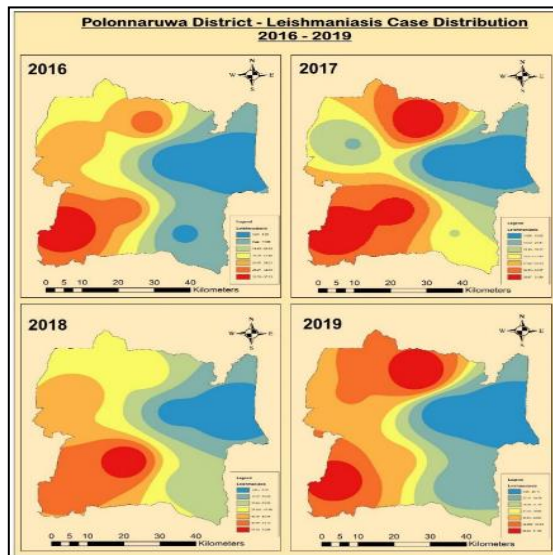
Figure 4: Case Distribution 2016-2019
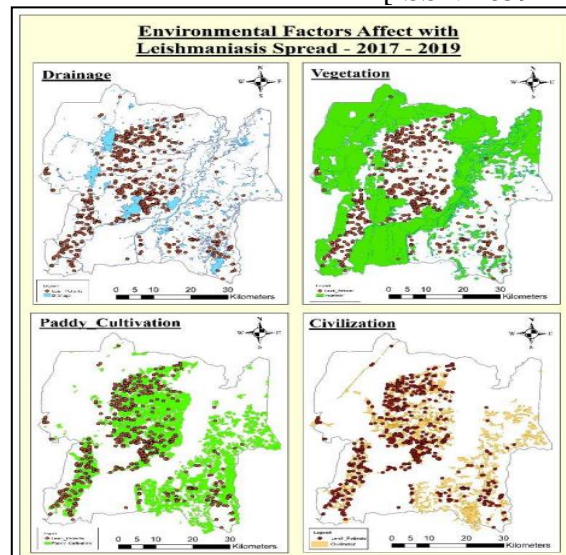
Figure 5: Environmental Factors with Leishmaniasis spread
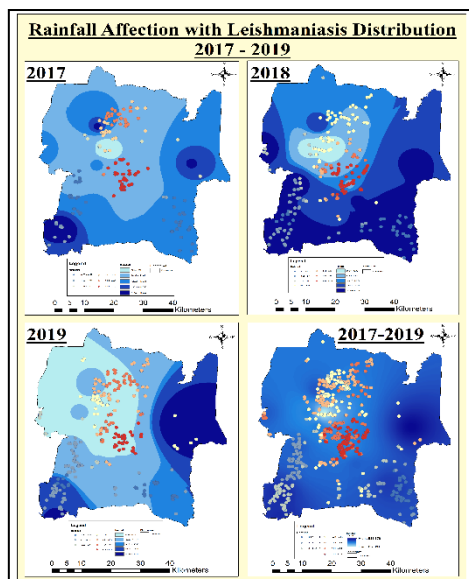
Figure 6: Rainfall with Leishmaniasis spread

As per the figure 5 central, north western and south western quarters contain with higher land area of agriculture fields and rural area with natural water resources. With patient distribution with these prove the connection between patient reporting and Paddy cultivation, rural development and Irrigation.

Figure 6 shows Leishmaniasis incidence increased in lower rainfall areas and lower number of patients reported in high rainfall areas.

The summary statistics provide an understanding of the influential factors in disease spreading. Since the factors affecting severity are mostly numerical except year, month and quarter, to reflect the data, for that it uses histogram charts. However, it noted that precipitation variables and the number of instances is extremely correctly distorted. Through any unique pattern, temperature and humidity tended to be similarly distributed. As per the summary statistics (Table: 1) suggests, the gap between the mean and median of rainfall is very high compared to the gap distance of other variables.

Table 1: Summery Statistics

Variable	Min	1st Qu	Median	Mean	3rd Qu	Max
Rainfall	0.00	16.43	79.5	122.20	152.10	595.10
Humidity	47.00	56.75	66.00	65.90	75.00	83.00
Temperature	25.10	26.89	29.15	28.76	30.60	31.90
No of cases	3.0	10.0	17.0	18.1	24.0	58.0

Table 2: Poisson Regression

	Estimate	Std.Error	z-value	P-value
(Intercept)	-3.3858412	2.2267335	-1.521	0.12837
Rainfall	-0.0007620	0.0004293	-1.775	0.07589
Humidity	0.0299004	0.0103005	2.903	0.00370
Temperature	0.1370256	0.0605225	2.264	0.02357
Year2017	0.3477640	0.1136557	3.060	0.00221
Year2018	0.6338882	0.1125604	5.632	1.79e-08
Year2019	0.7991414	0.1048400	7.622	2.49e-14
Quater2	-0.2591441	0.1852137	-1.399	0.16176
Quater3	-0.1343228	0.1819485	-0.738	0.46036
Quater4	0.2359269	0.1234860	1.911	0.05606

Based on Poisson regression (Table:2), it shows that the humidity and temperature *(P < 0.05)* have a significant impact with patient distribution. With Geographical and statistical analysis can highly justify that this disease developed in higher land area of agriculture fields and populous area with natural water resources. However, considering the rainfall factor Leishmaniasis disease reporting increased in lower rainfall areas and lower number of patients reported in high rainfall areas. So, it is imperative to declare that there's no relationship with rain fall and Leishmaniasis disease.

Conclusions and Recommendation

The statistical findings show that humidity *(P-value - 0.00370)* and temperature *(P-value - 0.02357* have a significant impact with patient distribution. Furthermore, Leishmaniasis patient in 2018 was significantly *(p< 0.05)* higher than the Leishmaniasis patients reported in 2019. Though the reported patients are getting increased over these years.

The case reporting by months showed peak in April to June and August to November. It is the summer climate (low rainfall high temperature) and those periods related with paddy cultivation. Therefore, Leishmaniasis vector could be sensitive to temperature and rainfall. Because Leishmaniasis incidence increased in lower rainfall areas and lower number of patients reported in high rainfall areas. Most of Leishmaniasis incidence are reported in the summer season and it clearly shows it is spread in most populous areas and where the paddy cultivation is high. Which is verified, climatic and geographical features are affect to Leishmaniasis spread in Polonnaruwa district.

As recommendations, it is important to consider obtaining accurate GIS base spatial distribution graphical information output this can track each and every patient's information and geographical information. For that the researcher recommends on implementing mobile and web base application to develop. Through the help of PHI, PHM and PHFO, it can operate remotely and track every patient's details. As well it reduces bookkeeping and misplacing documents.

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THE SIGNIFICANCE OF USING COMPUTER SUPPORTED COLLABORATIVE LEARNING SYSTEM (AR AND VR) IN MUSEUMS.

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Abstract

The main objective of this thesis is to evaluate the use of Computer supported Collaborative learning system (CSCL) such as Virtual Reality (VR) and Augmented Reality (AR) for learning in museum context. I have chosen Museum industry to evaluate the use of AR and VR because of some existing problem. And I believe the museum education industry is suitable and a unique candidate to experiment the use of CSCL systems because instructions and lessons are already in place written or placed in the form of information displays. Quantitative methodology has been used in this research. Perceived Enjoyment was included in the TAM as a key variable for the acceptance of AR and VR in museums. A survey instrument was developed using Likert scale based on the modified TAM. The findings of this research suggest that the modified TAM is a good predictor of visitors using intention of AR and VR in museums for learning.

Key Words: Augmented Reality, Perceived Enjoyment, TAM, Virtual Reality, Extended Reality

Introduction

Museums are institutions that accumulate, store, study and exhibit collections relevant to various study fields including history, art, folklore, industry and natural sciences, and carry out activities to enrich civic and public culture, research activities and entertainment for educational purposes. As museums are an important entity to the society it's important for the museums to adopt for new technologies to keep up with the trend. Or Simply saying it's important for the museums to evaluate Computer supported collaborative learning systems for museum education. Various studies all around the world indicates that there is an increasing amount of people losing interest on history in all fields. So, this hits museums around the world really hard in terms of revenue as museums are experiencing a drop in visitors. And many museums are on a brink of closing down permanently. UNESCO and the International Council of Museums report that nearly 13% of museums around the world — an estimated 1 in 8 museums — may never reopen in 2020. (Schild, 2020) . A drop in visitors is also because of the current modes of presenting information. which is usually done by a field guide or information is already written on the information displays so that everyone can read it, so this way description is limited. As museums are less likely to invest on new technologies and methods to present information, this may bring down the engagement, satisfaction and motivation of learners. Studies prove that changing modes of presenting instruction and information can enhances a person's learning and engagement.

Objectives

The primary objective of this research is to see and evaluate the intention of using AR and VR in museums for learning. The secondary objectives include identifying the effects and the

relationship among the variables of our modified TAM specially between Perceived Enjoyment and Intention of Use.

Significance of The Work

As the museums industry is in decline and as museums play an important role in the society it is important to do a research on implementing computer supported collaborative learning systems such as virtual reality and Augment reality (VR and AR) in museums to increase visitor's engagement and motivation on museum education thus increasing visitor's satisfaction which will lead to more visits to the museums. this research can guide museums to adopt new technologies to increase visitors.

Literature on How AR and VR Increases Motivation and Engagement

The research on Virtual reality and augmented reality devices and application on the field of education are still at early stage but there is enough research out there we can take as reference to evaluate and understand the impact of using VR and AR devices and applications and how it affects learning engagement and motivation on learners.

In the research "The Impact of Augmented Reality Application on Learning Motivation of Students" (Tasneem Khan, 2019) researchers measured and evaluated the difference on student's motivation before and after using the AR mobile application. A total of 78 undergraduate health science students at the University of Cape Town participated. And the researchers found out that there is a significant increase in students learning motivation after using Augmented reality application. The theories they have used to measure motivation are the intrinsic motivation theory, ARCS model and the instructional materials motivation survey. Intrinsic motivation theory can be described as a type of motivation of doing an activity without expecting any external reward and ARCS model is a method used to measure learning motivation in relevance to Attention, Relevance, Confidence and Satisfaction

Conceptual Framework and Hypothesis of The Study

TAM was developed by Fred Davis and Richard Bagozzi in 1986 (Lai, 2017) and it is one of the widely used user acceptance technology model. I have modified TAM by including Perceived Enjoyment for Ease of Use because AR and VR are mostly used for entertainment purposes like gaming and movies. So, based on this discussion I have created a modified TAM by including Enjoyment as a variable for this study.
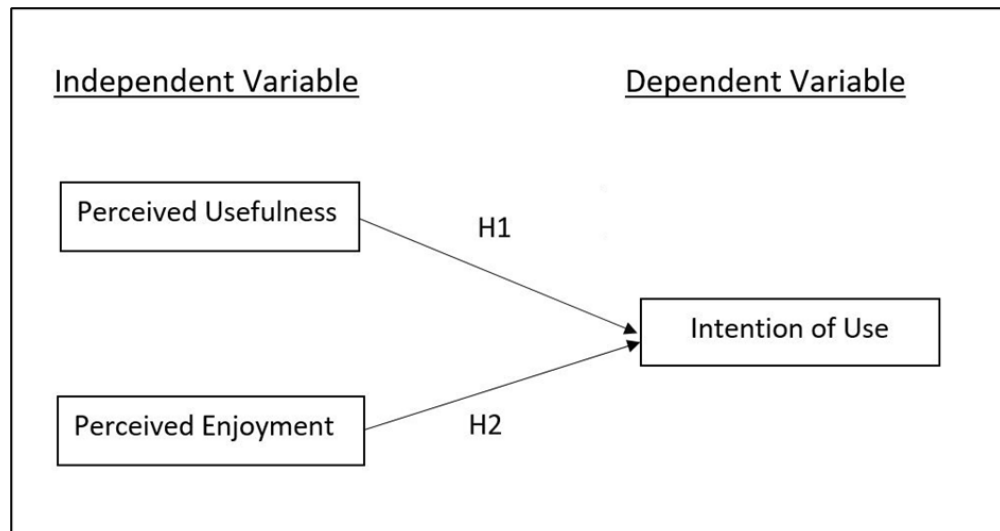
Figure 1 - Conceptual Model

PU can be described as an individual's belief or probability to which that person believes that using a particular information system will be beneficial and increase their productivity (Davis, 1989). PE can be described as an individual's belief or probability to which that person believes that using a particular information system will be enjoyable regardless of any performance consequences. And IOU can define as a measure of the strength of one's intention to use a specific technology related to the research being addressed, in this case its AR and VR. So, based on this idea the following hypothesis was proposed.

Hypothesis 1: Perceived Usefulness and Intention of Use

$H1_0$: Perceived Usefulness has no significant positive impact on Intention of Use
$H1_1$: Perceived Usefulness has significant positive impact on Intention of Use

Hypothesis 2: Perceived Enjoyment of Use and Intention of Use

$H2_0$: Perceived Enjoyment of Use has no significant positive impact on Intention of Use
$H2_1$: Perceived Enjoyment of Use has significant positive impact on Intention of Use

Methodology

Explanatory Research is used in this thesis to help us define and understand the problem more efficiently. In this study I have attempted to clarify how and why there is a relationship between independent variable and dependent variable. Random sampling was used in this project as it is less biased and more generalized. The population of this study is 505838. This number is based on the number of annual visitors who visited all 8 National museums in Sri Lanka in the year of 2018 according the annual performance report published by (Department of National Museums, 2018). To determine the sample size needed for this research a confidence level of 99% and a confidence interval of 10 has been used, the sample size needed for this research was 166. As I have opted for quantitative research, data was collected from the responders using online surveys. The design of the survey was typical, most of the question uses multiple

choice answer to see how strongly the responders agree or disagree with each statement that comes under the variable.

Results and Discussion

The dataset was considered as reliable as all three variables has a Cronbach Alpha value of more than 0.7000

Table 1 - Reliability Test Summary

Variable	Item No.	Cronbach's Alpha	Cronbach Alpha for the variable
Perceived Usefulness	PU1	0.8272	
	PU2	0.8094	
	PU3	0.8248	0.8519
	PU4	0.8240	
	PU5	0.8221	
Perceived Enjoyment	PE1	0.6224	
	PE2	0.6812	
	PE3	0.7452	0.7418
	PE4	0.6865	
Intention of Use	IOU1	0.7989	
	IOU2	0.7944	
	IOU3	0.7591	0.8319
	IOU4	0.7988	

Regression analysis

Regression analysis for the hypothesis 1 was done to identify if there is a relationship between Perceived Usefulness (PU) and Intention of Use (IOU) and the results are shown in Table 2.

Table 3 -Regression analysis summary for hypothesis 1

Sample 1	Sample 2	Correlation	% of Variance	P-Value
Perceived Usefulness	Intention of Use	0.532	28.31 %	0.000

Correlation is 0.532 which is considered as a moderate positive linear relationship. So, this indicates that if the Perceived Usefulness increases the Intention of Use also increases. Because PU has a significant positive impact on IOU, we can reject the Null Hypothesis (H1$_0$) and go with the alternative Hypothesis (H11).

Regression analysis for the hypothesis 2 was done to identify if there is a relationship between Perceived Enjoyment (PE) and Intention of Use (IOU) and the results are shown in Table 3.

Table 4 -Regression analysis summary for hypothesis 2

Sample 1	Sample 2	Correlation	% of Variance	P-Value
Perceived Enjoyment	Intention of Use	0.693	48.06 %	0.000

The correlation is 0.693 which is considered as a moderate positive linear relationship. So, indicates that if the Perceived Enjoyment increases the Intention of Use also increases. Because

PE has a significant positive impact on IOU, we can reject the Null Hypothesis ($H2_0$) and go with the alternative Hypothesis (H21).

Conclusions and Recommendations

This study mainly investigates the acceptance of CSCL systems like AR and VR for museum learning based on perceived usefulness and enjoyment from the user's perspective in general. I believe the results of this project might allude or call attention to the implementation of computer supported collaborative learning system in museums such as AR and VR aimed at improving visitor's satisfaction thus increasing more visitors which I believe can revive the museum industry from declining in terms of revenue and visitors. The results also indicate it is necessary to make learning more enjoyable to promote a student's acceptance of a technology.

Summary of the contribution

An important contribution of this research is the testing and validation of metrics for understanding people's intention of using VR and AR in museums. The results of this thesis were similar to previous study that was conducted on the use of other learning systems in education. Although researchers have identified and placed an importance for Perceived Usefulness only a few researchers have acknowledged the importance of Perceived Enjoyment which can be used as a tool to increase learners' motivation and satisfaction. when we summarize the results of this research the attitude towards using VR and AR had a positive impact by both PU and PE but PE had a greater impact thus this model can be used for further studies on the use of VR, AR, Mixed Reality and Extended Reality in general. And another contribution of this research is that the results if this project will guide software developers and application developers to develop more VR and AR based contents for museums and similar entities that preserves history, art, culture, and folklore as there are little to no contents available at all.

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ARTIFICIAL INTERLIGANCE APPLIED PRIORITIZATION APPROCH FOR MANUFACTURING OVER CRITICAL PATH PLANNING (CASE STUDY – TRISCHEL FABRICS)

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Abstract

This research was done for a fabric manufacturing company to change the planning process from Critical Path Method (CPM) to Priority based planning. Prioritization of a production order depends on several uncertain factors which impacts on several section. Therefor identifying the criticality of each factor is important. Simple computerized systems do not allow to work with such uncertain factors. Therefore, complex computations and training process will be required. So, Artificial intelligence (AI) system can be used to achieve this task. AI systems uses several techniques to do complex calculations. For this process, past data may require training the system and those data should gathered with the knowledge of the final purpose, else not be able gather all the required data. When work with uncertain factors continues calibration also required to get higher accurate data since uncertainty depends on time factor. Continues calibration helps to manage time variable.

Key Words: Critical Path Planning (CPM), Artificial Intelligence (AI),

Introduction

Due to the requirements of humans, several products are manufacturing in the world. Among them, (Mike Sosteric, 2019) shows seven indispensable needs. Garments are one of them which was categorized under physiological needs, to fulfil this need, several countries manufacture garments, Asian countries are in top positions for exporting garments according to the (Tuteja, 2019). Sri Lanka is looked top brands as a cheaper option as per the (Chandran, 2016). According to the (Masakorala, 2019) apparel industry subsidizes 20 percent for the Gross domestic product (GDP) of Sri Lanka, where GDP uses to measure the economic strength and growth of a country.

MAS holdings is one of the top Apparel manufacturing company in Sri Lanka, (masholdings, 2019) shows that, 75% of the MAS holding factories are situated in Sri Lanka among 53 factories all-over the world. Production of a Garment as a Finish Good requires collaboration of several functions and raw materials. Fabrics are one of the most important raw material among them. Therefore, rather than Garments MAS manufacture fabric. TRISCHEL Fabrics (PVT) Ltd is the fabric manufacturing plant of MAS holdings. It produces fabrics for top brands. TRISCHEL fabrics is a knitting and dye-based production factory.

Production Material Control (PMC) unit is an administration unit which handles raw material sourcing to capacity utilization until Finish Good (FG) moves to FG Warehouse. According to the (SAFONOV, 2017) time management allows to prioritize the available resources among the workers in the most effective way. There for the main target of this research is to identify the importance of the priority while plan the production capacity.

Process flow of TRISCHEL Fabrics (PVT) Ltd

Raw Material WH

Knitting Department

Warping

Weft Knitting

Warp Knitting

Finishing Department

Wash range

Preset

Dye department

Jet Dye

Beam Dye

Finishing Department

Finish

QA Department

Inspection

Colour Check

Testing

Finish Good
Warehouse
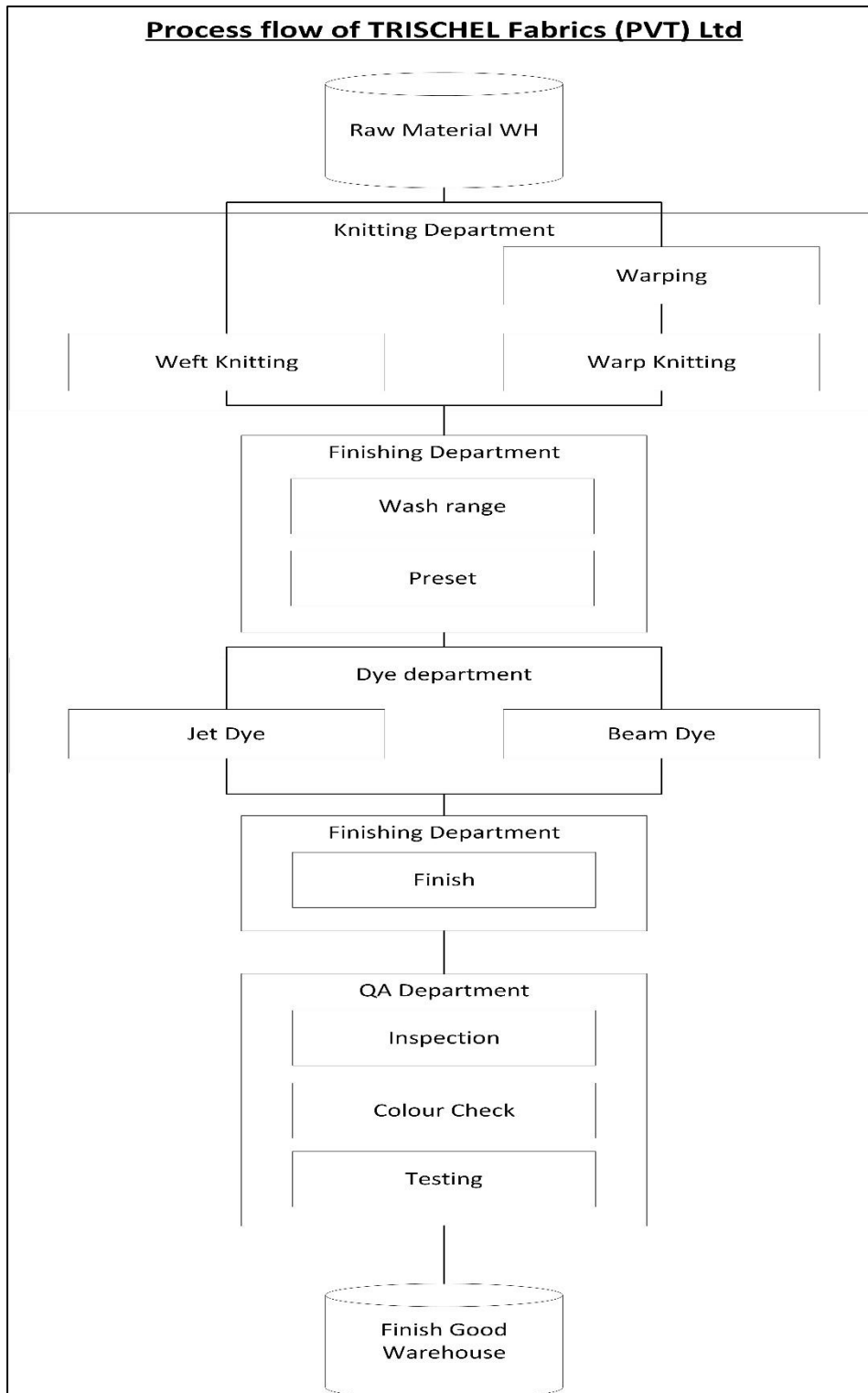
Figure 1 (Production Process in TRISCHEL Fabrics)

Objective

- To gather issues in current planning tools
- To provide priority-based model to production planning
- To identify artificial intelligence method which can used for production planning

As mentioned in the above section current planning method [Critical Path Method (CPM)] have some gaps which leads to inefficiencies in production process. Hens some requirements of the

customers are not fulfil. The significant issue in the factory was on-time delivery failure which happens due to quality concerns and incorrect order confirmation, which is doing with the use of the CPM. Delivery confirmation do not consider about the quality as its variable. Most of the times it is expressively difficult to predict quality of the output since higher number of variables involves in each process. CPM even not helps to manage the resources which are available in the factory. It just considers only about the capacity, this was the cause to issues, while resources were not enough to meet the estimated time of the process. CPM leads to consume resources by non-significant orders. Because of above reasons current planning mechanism is not practical even to minimize the on-time delivery failures and other production issues.

Methodology

When collecting data for a research there are several approaches. As per the (Chetty, 2016) data collection approach can be further divided as qualitative and quantitative approach. In qualitative approach of a research usually uses data which are in words rather than numbers as per the (Maxwell, 2005). Therefore, qualitative researches uses Interviews, Observations and documentations to collect data further in the study of (Maxwell, 2005) says that in the cases where it is difficult to identify separable activities or entities the most practical method is to use qualitative approach.
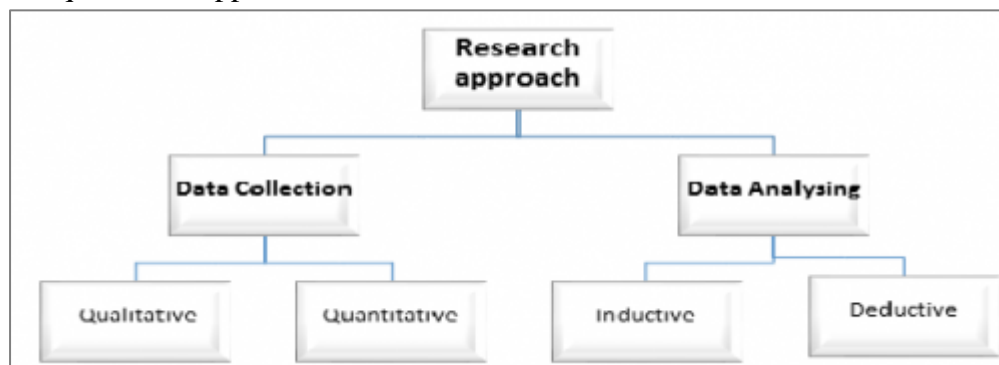
Figure 2 (Research Approaches) (Chetty, 2016)

(Boyd, 2013) has been shown that quantitative based researchers generally deal with the rational and goal. Quantitative researches and statistical analysis have many similarities as per the above researcher. It seems that qualitative data collection approaches are required as an explementary path. So qualitative data collection method is suitable for this research.

The next important thing is to recognize the most suitable data analyzing approach for a research. Since this deal with capacity and machines it is easy to get the practical data first and then need to identify how it happens, that means inductive data analyzing approach is the most suitable data analyzing approach for this research.

Size of the Sample

Convenient sample of planners in department of Planning, the executives directly responsible for production output, who helps to provide details to prepare the plan and all the department managers in each production departments.

Sample category	Sample size
Planners + Managers + Assistant Manager	11 + 2 + 1 = 14
Production executives + Managers	3*4+4 = 16

Total	30

Data Collection

In that case target population is little bit small and from that smaller sample was selected. Then following two data collection methods were used to gather data related to research.

- Interviews
- Observation

Results

Priority factors were identified via the interview and observation method were summarized using Table 151.

Table 15(Priority factor identification)

Factor	Data Collection Method	No of Responders	Final Rank
Management Decisions	Observation/ Interview	30	1
Raw material ready date	Observation/ Interview	17	2
Delivery Date	Observation/ Interview	30	3
Customer Priority	Observation/ Interview	23	4
Ship to Part	Observation/ Interview	18	5
Order quantity	Observation/ Interview	16	6
Follow up process	Interview	12	7
Profit	Interview	7	8
Technical constraints	Observation/ Interview	5	9
Customer Stability	Observation/ Interview	3	10
Customer Push	Observation	1	11
Capacity visibility	Observation	1	12

Final rank for the above data was given using by applying following formula to the data collected.

$$Rank\ Of\ The\ Factor = \sum TR \times (X - FR)\ ; Where$$

$TR = Type\ of\ the\ Responder;$
$X = No\ of\ Priority\ factors\ mentioned\ by\ the\ Responder\ or\ Observer;$
$FR = Rank\ Given\ by\ the\ responder\ or\ Observer;$

Further for the type of the of the responders following values were given

Table 2 (Final Value of the Responders)

Identity	Type of Responder	Value
Pro.E	Production Executive	1
Pln.E	Planning Executive	3
Pro.M	Production Manager	3
Pln.AM	Planning Assistant Manager	4
Pln.M	Planning Manager	5
Obs	Observer	6

Before giving the values for each responder type following criteria were considered

Table 3 (Value Responders)

Type of Responder	A	B	C	D	Total
Production Executive	0	0	1	0	1
Planning Executive	1	1	1	0	3
Production Manager	0	0	3	0	3
Planning Assistant Manager	1	1	2	0	4
Planning Manager	1	1	3	0	5
Observer	1	1	1	3	6

- A – Knowledge on planning principles and constraints – 1
- B – Allocated Department
  - Planning   - 1
  - Oher   - 0
- C – Managerial Level
  - Executive   - 1
  - Assistant Manager   - 2
  - Manager   - 3
- D – Knowledge on the Research
  - Have Knowledge   - 3
  - No Idea   - 0

Marks for the above factors were given based on the observational data gathered, user experience also involved when giving marks for those.

Note

- *Going forward will use Identity name in the* **Error! Reference source not found.Error! Reference source not found.** *to mention each type of responder.*

Discussion

Due to the highly involvement of the uncertain factors it is little bit difficult to prioritize a production orders in a production plan via an AI but with the continues learning process objective can be achieved. Time to time priority of the priority factors may change, therefor continues calibration is required to take accurate outputs from the AI model.

In the study of (Hontoria, 2020) says that simple decision trees are common technique that uses for the production planning process using AI. In the study of (Yuldoshev Nuritdina, 2018) described some Artificial intelligence approaches which can be used to planning. Following are some of them neural networks, genetic algorithms, ant algorithm.

However, it is impossible to achieve 100% accurate planning system using AI**.** According to the (K.M.Passion, 2007) all the actions that planners perform to create plans are not possible to perform using an AI since factors such as uncertainty, dynamical and time-critical are difficult to formulated in to mathematically.

Conclusions and Recommendation

Since any production industry requires planning process for the Garment and fabric manufacturing also required proper planning mechanism to achieve its KPIs. Generally, most of the companies uses Critical path planning process to execute their production. Further some researches had been shown rather than CPM method PERT method also used for planning in

some instances. But there are less researches talks about priority-based planning process. At the same time the past researches had shown that CPM method fails since that process do not provide a method to utilize resources. Priority based planning method provides solutions for that. It shows how the available resources should utilize for the orders. When prioritizing an order key factor recognition is much important and key factors may different according to the production type but factors such as Customer importance, FIFO production, Order confirmation, Lead time required for production and the available stock are key factors for any production system.

However, as the approach for the research explementary qualitative method is selected. Interview and observation data collection methods were used to collect data, since sample size is small and observe was easy. Since collected data was qualitative descriptive analysis was used rather than building a mathematical model. Finally, AI approaches that can be used to achieve the final object were described. But it may not be an 100% accurate system since several factors such as Uncertainty, dynamically and time-constraints are involved for planning. But continues calibration may help to improve the accuracy of priority-based AI planning systems.

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MANAGING CORPORATE MOBILITY IN SRI LANKA: IMPACT OF ONLINE TAXI-BOOKING APPLICATIONS ON EMPLOYEE SATISFACTION

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Abstract

Employees are major assets of a company as they determine the growth and success. Methods to retain employees must be carefully administered for this purpose. Employee satisfaction is closely related with employee performance which is vital to the productivity and timely deliveries. However, employees in Sri Lanka are facing various issues when commuting, business-travelling and performing night work. This research attempts to find the main dimensions of employee satisfaction related to transport facilities and to analyze using regression analysis and correlation if mobile applications that provide online taxi-booking services are able to resolve these problems. According to findings, time, safety, convenience and expenses have a significant impact on employee satisfaction. A survey was carried out and it was found that some features of online taxi-booking applications can enhance employees' travelling experience.

Keywords: Employee, Mobility, Regression, Taxi, Transport

Introduction

Corporate world comprises of organizations that have adapted to varying strategies for achieving business goals. This research focuses on three main areas of work-related activities that employees need to travel for: overtime work, local business-travelling and night-shifts, while brushing on the concerns with regard to commuting.

Background

Popular strategies used by businesses to increase productivity is providing overtime facilities for employees (Barnes, et al., 2016). Another trending strategy is approaching potential clients to pitch their ideas on improving and transforming their businesses. According to Aguilera (2008), face-to-face communication has proven to have a better effect on persuasion rather than other means. However, this research does not limit to any particular reasons for travel but rather considers local business-travelling of corporations as a whole.

There are organizations that provide customer service around-the-clock (Patel, 2006) which demands employees to be travelling during different parts of the day. GPS Technology that comes with taxi-booking mobile apps are ideal for location tracking and provide great security (Sham, et al., 2019). Employees can switch to using taxi services using mobile apps as a resolution for time issues as taxis are faster (Shaaban & Kim, 2016), and their standard charge rates prevent the issue of overcharging (Clewlow & Mishra, 2017). Taxi-apps also have features that allow logging travel reasons as far as the organization has partnered with its services (DailyFT, 2020).

Significance of the Study

This study is proposed to explore how time, safety, convenience and expenses affect job satisfaction of employees.

Following objectives are to be achieved during the research:

- To understand how commuting time may depend on mode of travel
- To evaluate safety levels associated with various travel modes & night-time travelling

- To assess the effect of convenience-related factors on employees' travelling experience
- To identify issues related to expenses when travelling for work-related activities
- To identify if mobile taxi-booking apps can improve travelling experience

The findings of this research can be used as a business proposal on the prospect of transportation facilities being used as a mechanism to retain employees.

Methodology
Dimensions of the research have been determined based on previous literature from which measurements are extracted. These measurements were turned into a question which made up the final survey that was distributed among a sample of corporate employees.

Conceptualization
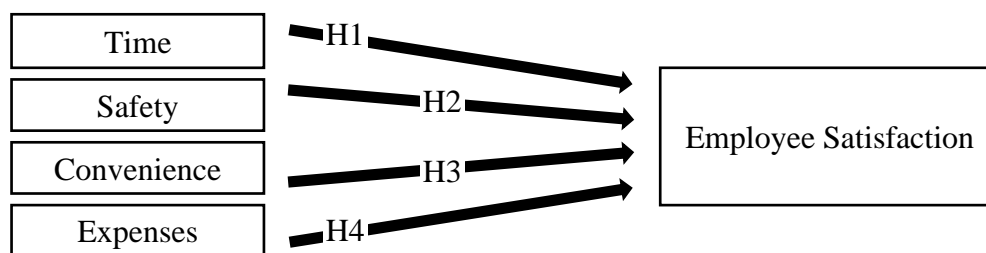
Independent Variables   Dependent Variables

Figure 1: Conceptual Framework
Based on the variables in conceptual framework on Figure 2.1, following hypotheses have been formed for analysis. Null hypothesis is denoted by '0' subscript and alternate hypothesis is denoted by '1' subscript.
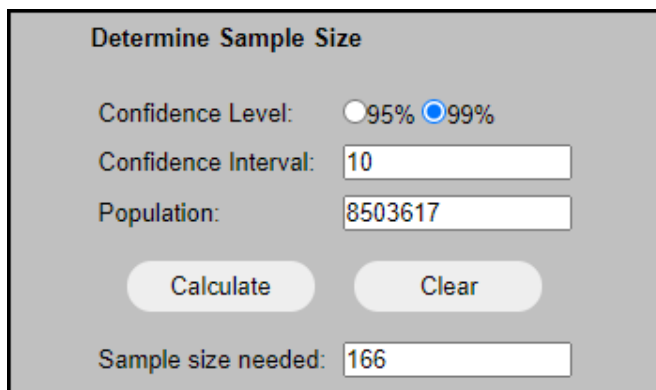
Hypotheses:
- H1: Impact of time taken to travel on employee satisfaction
  - $H1_0$: Time taken to travel does not have an impact on employee satisfaction
  - $H1_1$: Time taken to travel has an impact on employee satisfaction
- H2: Impact of safety of travelling on employee satisfaction
  - $H2_0$: Safety of travelling does not have an impact on employee satisfaction
  - $H2_1$: Safety of travelling has an impact on employee satisfaction
- H3: Impact of convenience of travelling on employee satisfaction
  - $H3_0$: Convenience of travelling does not have an impact on employee satisfaction
  - $H3_1$: Convenience of travelling has an impact on employee satisfaction
- H4: Impact of travel expenses on employee satisfaction
  - $H4_0$: Travel expenses do not have an impact on employee satisfaction
  - $H4_1$: Travel expenses have an impact on employee satisfaction

Sampling
Simple random sampling method was used to distribute a questionnaire to collect data required for the study. This probabilistic sampling technique was chosen for the research as its randomness makes the results much accurate. Random participants who are employees of companies belonging to different industries were chosen to fill the questionnaire. The

population of employees in Sri Lanka is 8,503,617 as per the Department of Census and Statistics website (Department of Census and Statistics, 2020). The research sample targeted 200 random corporate employees for better accuracy although the calculated sample was only 166.

The sample size was calculated (as shown in Figure 2.2) by inputting the population size with the confidence interval as 10 and a confidence level of 99%.

Figure 2: Determine Sample Size

Data Collection

To examine and analyze the hypotheses formed, a questionnaire was developed where measures were identified during operationalization stage. The questionnaire contained 24 questions created with a 5-point Likert scale ranging from 'Strongly agree' (5) to 'Strongly disagree' (1). These were broken into 5 sections representing each variable.

Method of Analysis

Linear Regression technique was used to examine the linear relationships between each independent variable with the dependent variable. Hypotheses were verified at a Significant level (α): 0.01 (1%) and a Confidence level: 0.99 (99%). To test the hypotheses formed, Pearson's correlation coefficient (r) was identified to be the ideal testing methodology for the dataset. It was calculated to identify if there's a strong correlation between each independent variable with the dependent variable as well as the direction of the relationship (positive or negative).

Results & Discussion

Data Distribution

Table 3.1 shows that the number of employees that use public transport for travelling is 132 in total. This proves that majority of employees mostly use public transport for commuting. It must also be noted that 136 of the respondents also agreed/strongly agreed that their current night-time travelling facilities are insufficient.

It can be observed that companies are more willing to provide transport facilities for business-travelling than for commuting. However, only 83 out of 178 respondents that travel received facilities for business-travelling.

Table 1: Count of Employees for Different Modes of Travel

Mode for Travel	Business Travel	Commuting
Public Transport only	19	74
Public Transport and Others	35	58
Taxi cabs only	33	10
Taxi cabs and Others	41	44
Transport Facilities only	39	11
Transport Facilities and Others	44	16

Table 3.2 shows that 65.5% of the employees had knowledge on the existence of such apps however only 37.5% of them have such facilities from their workplaces. More than half of the respondents who took part in this survey have not experienced the benefits of corporate packages of taxi-apps.

Table 2: Statistics of Employee Awareness of Taxi Packages

Inquiry	Count	Percent
Knowledge on Corporate Packages of Taxi Mobile Apps	131	65.5
Current Use of Taxi Packages in the Organization	75	37.5

Reliability
Variable-wise Cronbach's alpha was calculated in order to test the reliability of dataset.

Table 3: Reliability Statistics

	Time	Safety	Convenience	Expenses	Employee Satisfaction
Cronbach's Alpha	0.7292	0.7731	0.7388	0.7434	0.7037
Mean	4.246	4.1788	4.2363	4.2038	4.0102
Outliers	6	1	3	-	-

A Cronbach's alpha value of 0.7 or above is an acceptable amount to ensure internal consistency of data collected by the questionnaire (Taber, 2018). Therefore, data collected through the survey for all 5 variables can be taken as valid.

Unusual values of a dataset can be useful for calculations as they reflect deviations of an actual population (Frost, 2020). Therefore, outliers were not removed from the dataset.

Hypothesis Testing
Hypothesis 1

$H1_0$: Time taken to travel does not have an impact on employee satisfaction

$H1_1$: Time taken to travel has an impact on employee satisfaction
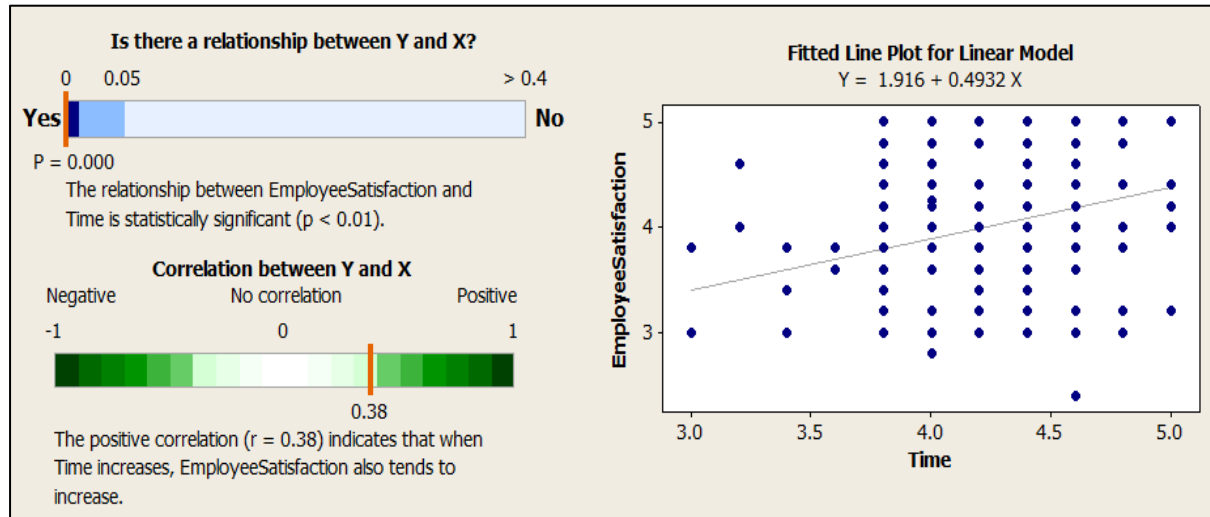
Figure 3: Hypothesis 1 (Impact of Time on Employee Satisfaction)

Result: Reject $H1_0$ and accept $H1_1$ at 99% confidence.

Hypothesis 2

$H2_0$: Safety of travelling does not have an impact on employee satisfaction

$H2_1$: Safety of travelling has an impact on employee satisfaction
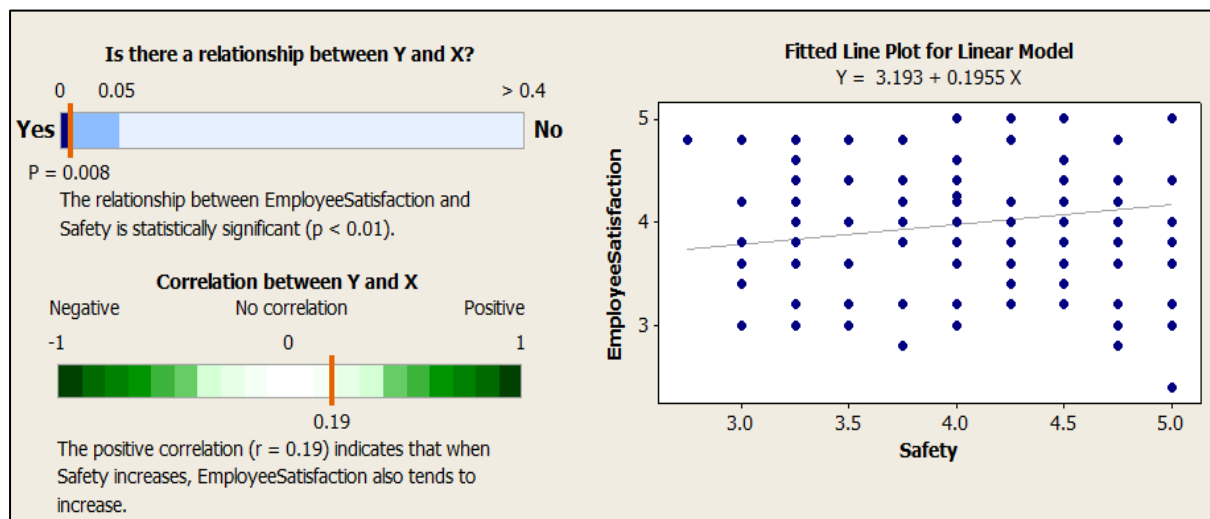
Figure 3: Hypothesis 2 (Impact of Safety on Employee Satisfaction)

Result: Reject $H2_0$ and accept $H2_1$ at 99% confidence.

Hypothesis 3

H3$_0$: Convenience of travelling does not have an impact on employee satisfaction

H3$_1$: Convenience of travelling has an impact on employee satisfaction
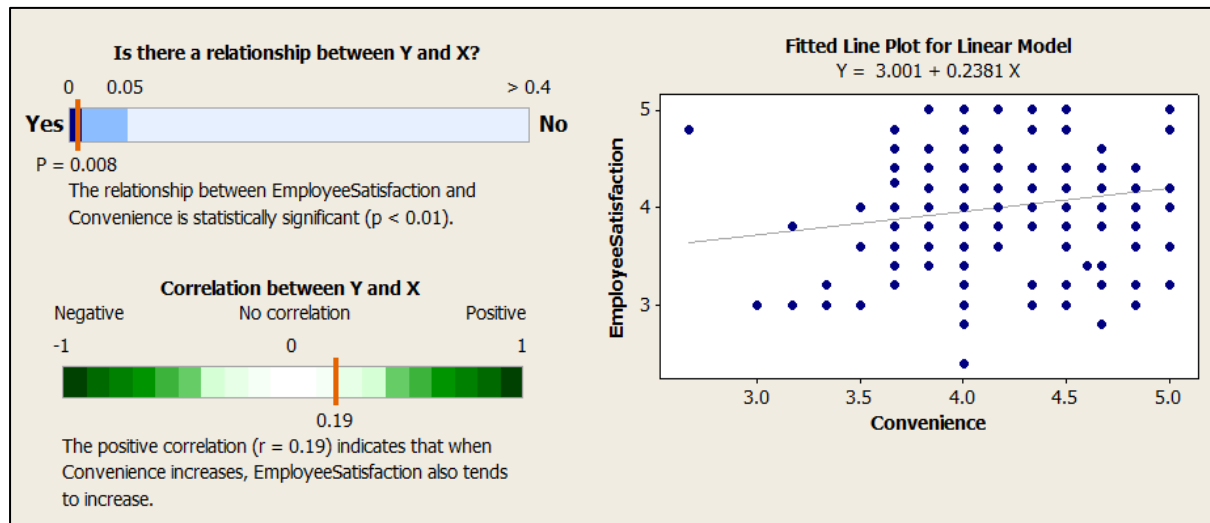
Figure 4: Hypothesis 3 (Impact of Convenience on Employee Satisfaction)

Result: Reject H3$_0$ and accept H3$_1$ at 99% confidence.

Hypothesis 4

H4$_0$: Travel expenses do not have an impact on employee satisfaction

H4$_1$: Travel expenses have an impact on employee satisfaction
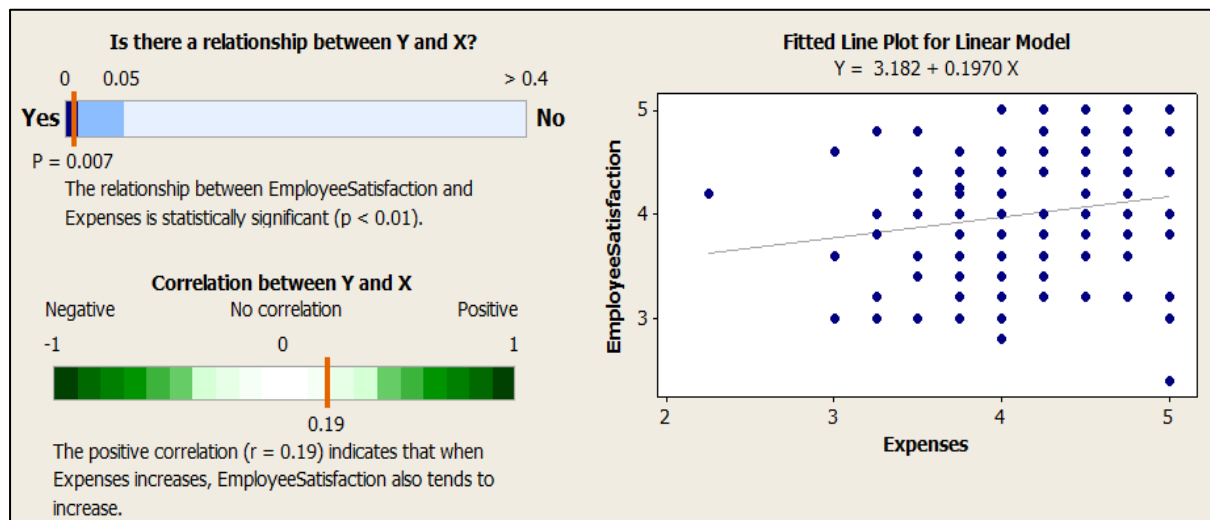
Figure 5: Hypothesis 4 (Impact of Expenses on Employee Satisfaction)

Result: Reject H4$_0$ and accept H4$_1$ at 99% confidence.

Conclusion & Recommendations

Conclusion

Commuting by public transport often lengthens the time taken to travel due to traffic congestions during peak-hours. Therefore, mode of travel has a visible dependency on time taken for travelling.

Employees traveling at night by transport modes that expose them into more human contact makes it more likely to get victimized by crimes. Cleanliness of public transportation is also a persisting health risk for travelers. This analysis suggests that higher numbers of passengers increase safety concerns. Lack of transport options and criminal activities in addition to overcrowding are also critical issues travelers face during night-time.

Overcrowding is highly inconvenient for many public transportation users. This is due to lesser transport facilities during night-time and more travelers during peak-hours. As a result, respondents prefer taxis over public transport. They also prefer using mobile apps to book taxis rather than hailing taxis from the street as it is more convenient.

On the context of expenses, public transport is the most common mode of travel as it is cost-effective. However, research suggests that expenses have a more significant impact on employee satisfaction than other factors as employees prefer to travel using public facilities despite the downsides.

Survey participants show strong agreement regarding importance of transport facilities indicating that it is a rising requirement for employees. Majority has considered features like recording travel logs, quick transportation, location tracking, standard charges of taxi-apps to be beneficial for their travelling experience.

Recommendations

Travelling Time

Compared to public transport facilities, booked cabs take lesser time as literature suggests. The results also showed that taxis are faster than public transport. Employees can switch to using taxi services using mobile apps to travel faster.

Safety Measures

GPS Technology that comes with taxi-booking mobile apps are ideal for location tracking and provide great security. Employees who do not own personal vehicles can choose taxis to ensure maximum, possible safety.

Expense Management

The standard rates of taxi-booking mobile apps prevent the issue of overcharging. Expense management from both employees' and organization's perspectives can be facilitated using these apps.

Convenience of Transportation

The findings show that employees find transportation to be an important factor for job satisfaction. Certain taxi-apps and their features that allow logging travel reasons enable businesses to motivate more employees to join positions that require travelling while ensuring transparent expense management.

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CREATING AN IMPACT ON THE SRI LANKA TOURISM INDUSTRY ESTABLISHING USER CONVENIENCE ON GUIDANCE THROUGH A COMMUNITY-BASED APPLICATION

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Abstract

Tourist traveling to a country and roaming with a printed guidebook is not an efficient way of making the vacation enjoyable. Outdated information within the printed guidebook may lead of misinformation to the tourist who ever visit any country. Unmaintainable applications with outdated data which are managed by the administrators of the application is another major issue. This paper is based on developing an Android application with community-based data. Along with many features which are useful for travelling such as Weather forecast, exchange rates, holidays. The distance calculation using OSM map server will reduce the cost maintaining the application.

Key words : Tourist guide app, Community-based application, OSM map server, AR

Introduction

Tourism is the strongest and largest industry in the global economy. It has played a significant role in boosting the city's economy and social employment according to the study (Shi, et al., 2010). The tourist arrival to Sri Lanka is growing yearly according to the report by Sri Lanka Tourism Development Authority (Emigration, 2019). The study is based on a tourist guide application with community-based data along with cost optimized distance calculation using OSM map server and AR technology. Using of AR technology and other latest technologies in tourism industry will create competition between destinations and companies, and it plays an important role (Emrah, 2019). The usage of smart phone users is also rapidly increasing. (SILVER, 2019)

A study has been carried out in the year of 2013 and the proposed solution was an Android application with important places located, a voice-based information provider, a location identifier, and a map-based path selection function (Wijesuriya, et al., 2013). The methodology used in the application communicates with the web service through the Internet using XML and SOAP messages. The study furthermore describes the mobile application is much more convenient than using a booklet since the tourists can easily install the application and use it without much difficulty. It replaces the traditional tour guides by providing important services for the tourists. Giving printed handbook for a tourist lead to outdated information about the place and navigation is a major issue as per studies mentioned above. And the technologically SOAP protocol used in above application is lack flexible and resource consuming (Cortuk, 2019) which may affect performance of the application. Content of the application is added by the admin to the application. The research is based on those issues are addressed.

Objectives

The objectives are based on achieving virtual tourist guide android application. The primary objective of the research is to grow data of the application from the public community. The secondary objective to securely store data of publicly entered and reducing cost for calculating the distance based on user's current location. The open street map service was used to achieve

the secondary objective rather using Google Maps API. Thirdly preventing duplicate data entering by community users. Querying nearby places when adding new place through the mobile application to reduce duplication data being added. And using VPTree python algorithm it's used to reduce exact duplication of images.

Methodology

The research is driven by an applied approach where descriptive (trying to establish variables involved in the situation) and correlational approaches are used to achieve the goals of the research (to identify the relationships on the aspects of the situation). Since the analysis deals with primary data, a question-based Google Forms survey was used to conduct data collection theory in a quantitative process. This survey fully described what are the problems that they faced, and it shared among the general public who regularly travel throughout their leisure time.

Results

What is the most required feature in a travel mobile application?
66 responses

- Hotels
- Attractive places
- Cities
- Nearby places to visit
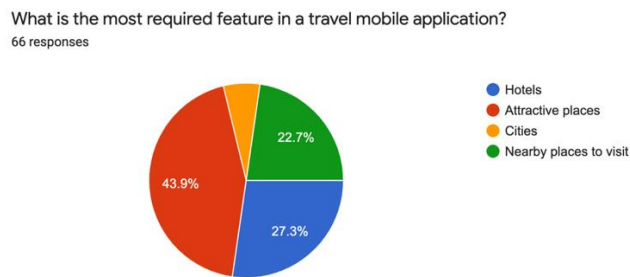
Figure 1 - Pie chart (Most required feature in travel mobile application)

The most required feature was "Attractive places" therefore the system is included with the feature with the calculation of users rating. Attractive places are dynamically changed with the community-based data gathered through the application.

Row Labels	Count of Which of the following devices do you own?
Android	34
Android;iOS	8
Android;iOS;Other	1
Android;Other	2
iOS	18
Other	3
Grand Total	**66**

Figure 2 - Smart phone operating system usage

As per the above Pivot Table majority of the users in the considered sample owns Android (or similar devices that featured Android). Only 27.27% of the individuals are using devices which features iOS and comparing with the devices that featured Android this portion is significantly low. Thus, the development of the application needs to consider the devices that featured Android.
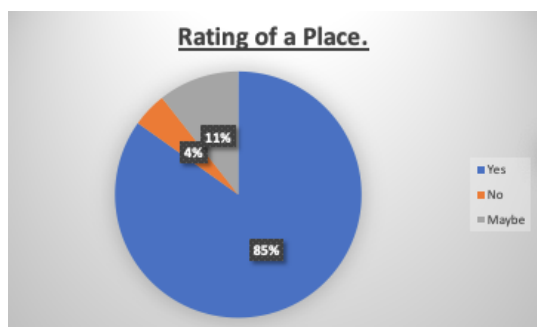
Figure 3 - Rating of place pie chart

The importance of the rating of the travel destination makes a huge impact to decide the holiday destination. As per the above frequency chart & the Pie Chart illustrated 85% of the responses are recorded that the application needs to illustrate the rating of the travel destination in order to determine the destination. Therefore, the Rating of the places needs to be added to the application.

Discussion

"A location-based mobile tourist guide" (Curran & Smith, 2005) paper show that the GPS is a strong measurement for larger distances. Accurate directions using online mapping services provide user along with Wi-Fi hotspots adoption to the tourism application. Usage of multiple third-party providers to deliver data to the user is not a better approach. The location of the place may be different in both platform and may lead the user to be confused and the cost of the service for delivering specific place information from both services may double the cost of the usage.

"Developing a Location Based Tourist Guide Application" (Simcock, et al., 2003) came up with solution for "Tourist Guide" application with user's current location using GPS technology. The application was developed for PDA handheld device. The application implementation has been done with Windows CE and Visual C++. Creating of application and updating data to the system is a signification requirement. Researches came up with that the GPS accuracy is sufficient for the application. The paper mainly focused on researching how the GPS and Wi-Fi technology can be used for a tourism mobile application.

Traditional tourist guide services issues can be overcome with the high demand intelligent tourist guide system as the "Research Design of Intelligent Tourist Guide System and Development of APP" (Huang & Zhu, 2015) paper mentions . Android application and web server are the key components of the application. The android application is aided on location of the GPS signal. As above mentioned, research papers focused on location-based information delivery system. and information about the places are managed by the system administrators which is a major disadvantage of having limited information to tourist.

Scope of the research

Dashboard

Managing the whole system plays major role within the system. Managing of Countries, Cities, Places, Users and notifications are handled within the application. Managing of inappropriate reviews and community-based data are handled with the dashboard.

Mobile application

An android application to solve the problems addressed in previous studies. The application includes the user to easily travel around the country with community-based rating and data to make a better decision. The application consists of weather forecast, holidays, exchange rates and updated data by the community-based data. The user is able to add new places, images, reviews to the system which are helpful to other tourists. The AR feature is used to navigate and find direction of specific place using real world view.

System Architecture
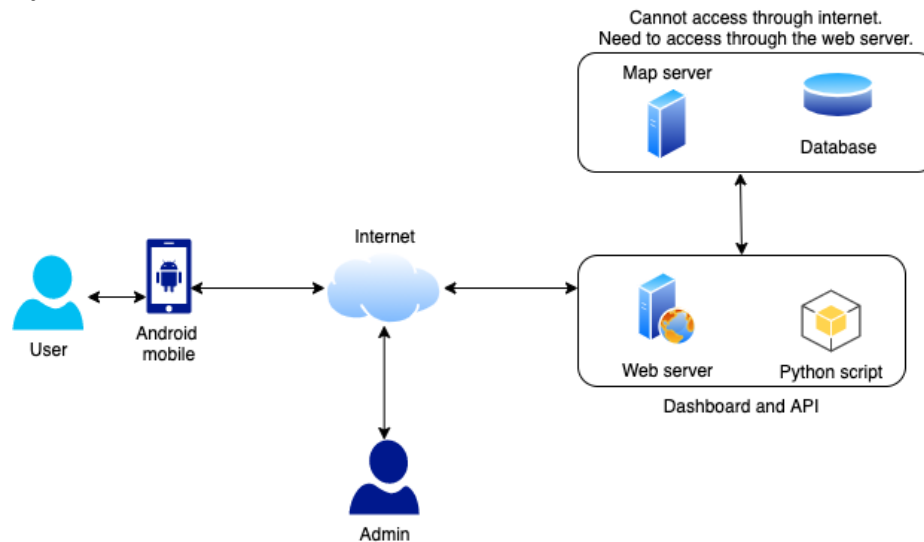
Figure 4 - System architechture

As the architecture diagram user will communicate with the android device. The android device and admin should have internet access for the services. The android application and dashboard will be communicating with the Web server through a domain or IP. The web server will communicate the Map server which is the OSM map server which is an open source which will reduce the cost of running the application (Peter Mooney, 2017) is configured and as a security measurement, the MySQL database will be deployed on the same server which prevents outside users to access the database directly through the internet.

The python script which is used for the image similarity is deployed and running on the Web server (Rosebrock, 2019). The user uploaded images are stored in the Web server therefore the training process needs to access the local directory.

Conclusion and Recommendation

The paper is based on the development of a community-based data tourism application. As this paper research is focused on that the user can add places, images through the application. Which will give more value to the application as well the tourist to explore more places around the country. As any prevention the places and images need to be manually reviewed by the administration to make sure the content is appropriate for being public in the application. The study given an overall better tourist guide application with AR technology and community-based data to be alive in the application. The research-based approach for a tourism application would help the tourist to spend their leisure more effectively.

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FETAL DISTRESS CLASSIFICATION WEB APPLICATION WITH ECG SIGNAL FILES CONVERTER

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Abstract

In today, Fetal Death rate is as high as 40% in some developing countries and over 2 million neonatal deaths worldwide every year. There are several reasons effect for the Death rate. Doctors face several challenges during the delivery. The knowing the live condition of the fetus (unborn child) is a major challenge before the delivery.

Now, doctors are doing FHR and UC require continuous monitoring during the intrapartum period. It was very time consuming for that task. Other problem is, every expert has his own unique understanding of the FHR and UC signal depending upon his experience. This becomes as a problem of standardization and it puts innocent lives at a huge risk. And also, it is very time consuming for doctors that doing these interpretations of these signals manually.

This research has been done considering the current problems in fetal delivery. Then suggest the "Fetal distress classification web application with ECG signal file converter" as a solution to overcome these current identified issues that have in fetal delivery. So, main aim of this project is to develop a web application for doctors by giving a proper way to classify and identify the current fetal distress according to their FHR and UC data during the intrapartum period and save innocent lives. Because, current manual method of this process is at a huge risk.

Key Words: Fetal Death rate, Fetus, FHR (Fetal Heart Rate), UC (Uterine Contraction), CTG (Cardiotocography), ECG (Electrocardiography), Intrapartum period, Standardization, interpretations, fetal delivery, save innocent lives, Fetal distress classification, ECG signal file converter.

Introduction

The fetal distress term can be described as when the fetus does not receive the enough amounts of oxygen during the pregnancy period. The doctors detect it as the abnormal fetal heart rate. So, it is important for the doctors/physicians to monitor the fetus during pregnancy period. One of the most widely using ways for fetal monitoring is electronic fetal heart rate (FHR) monitoring and Uterine Contractions (UC) monitoring. Currently, doctors use their own unique understanding of the signal depending upon his experience and these things are doing in manually. This poses a problem to standardization and puts innocent lives at a huge risk.

These FHR monitoring have the some identified benefits. But, FHR monitoring has a huge risk including an increasing probability of having a cesarean due to misinterpretations of the results by FHR monitoring. And also Interpretations of these signals are subjective and vary from expert to expert and guideline to guidelines. Every specialist has a unique understanding of the signal based on his or her experience. Every expert has his own unique understanding of the FHR and UC signal depending upon his experience. This becomes as a problem of

standardization and it puts innocent lives at a huge risk. And also, it is very time consuming for doctors that doing these interpretations of these signals manually.

All the above problems can be solved by using the Deep Neural Networks to this project. The main aim of this research project is to automate the process of fetal distress classification based on the FHR and UC signals to find the current status of fetal health with high accuracy.

Methodology

2-D CNN (2-dimentianal Convolutional Neural Network) has been used to ECG arrhythmia classification. Two time series data taken as inputs and classified them as Normal, Suspicious and Distress.
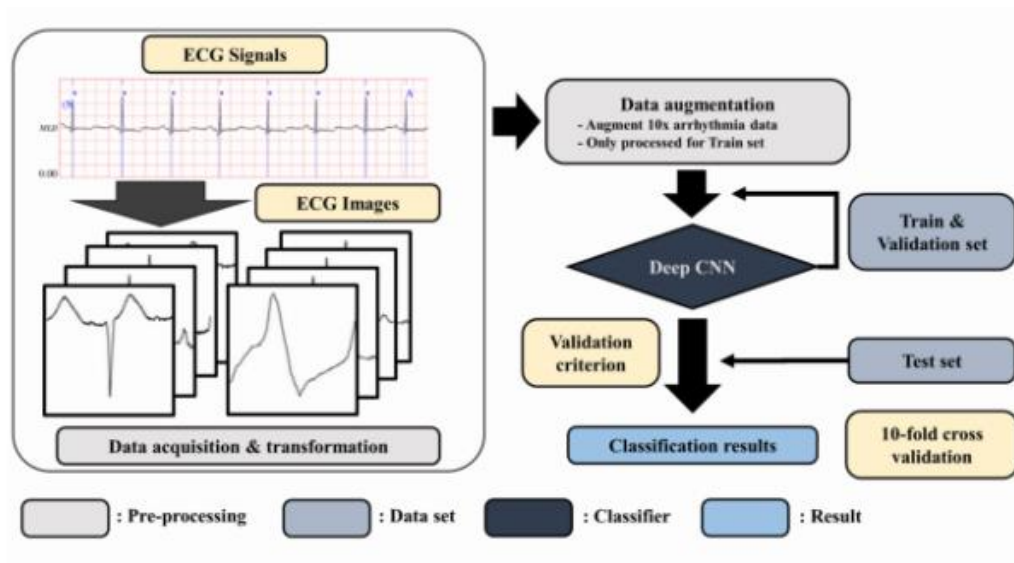
Figure 1- Summary of the approach taken
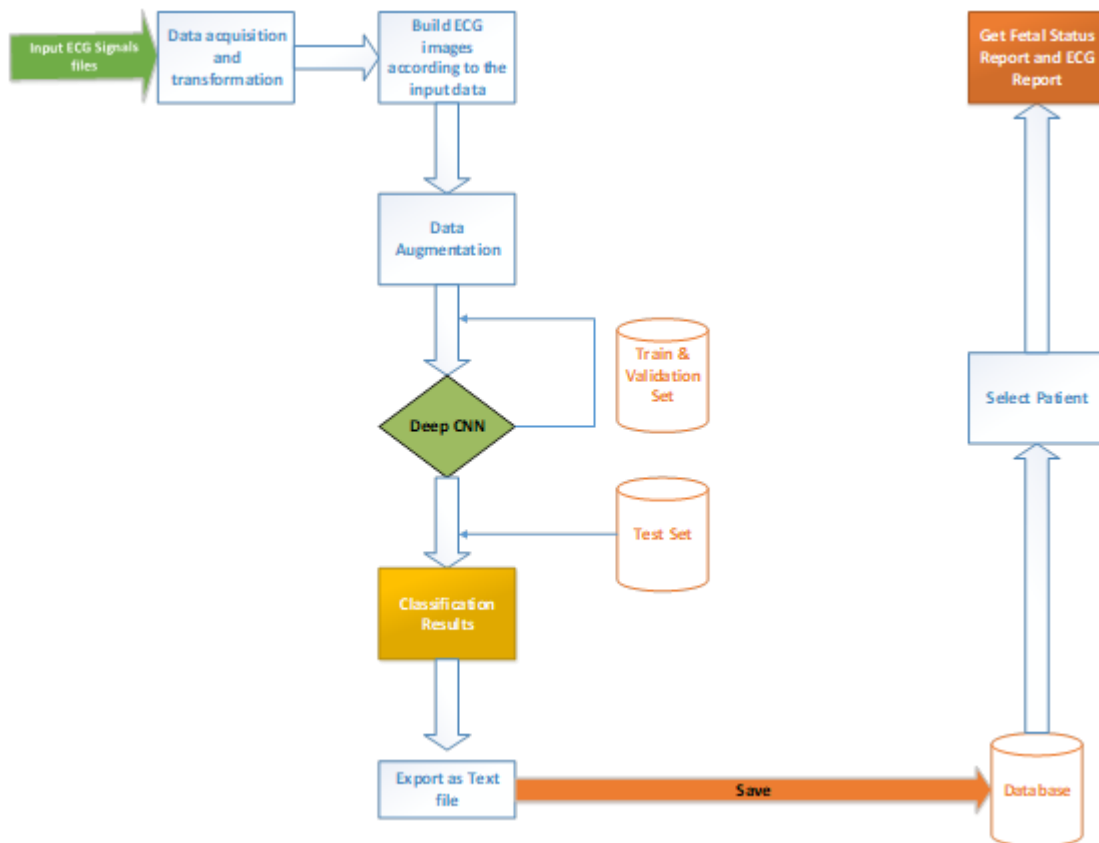
Figure 6- System Architecture Diagram

L1   L2   L3   L4   L5   L6   L7   L8   L9   L10   L11
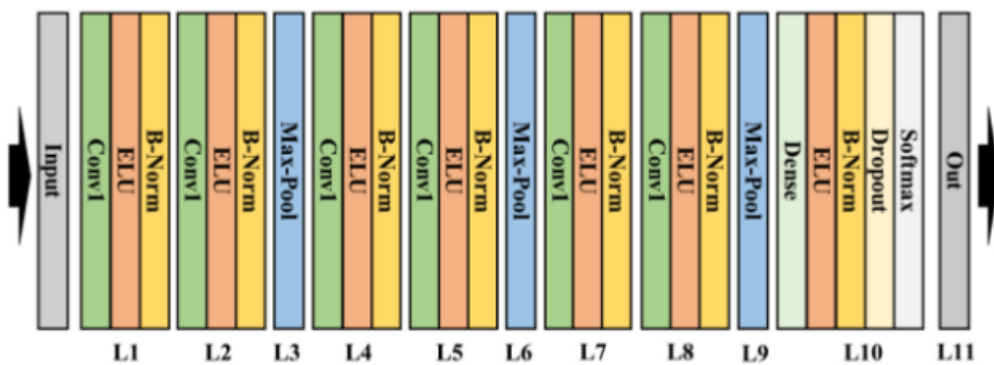
Figure 7- Architecture of the CNN model

The main AI model of the proposed system is used to convert the ECG signals files to the readable text format. This model consists the 11 layers and each layer has to do a unique task. The main structure of the model is very similar with the VGGNet. The CNN model use the Xavier initialization for all layers. The exponential linear units (ELU) have used for the activation function. Rectified Linear Unit (ReLU) has been used in VGGNet.

Dataset

The CTU-UHB Intrapartum Cardiotocography Database that publish by the Czech Technical University in Prague is used as the Dataset for the training and testing of the system. The clinical data that include in the dataset is; delivery descriptors, neonatal outcomes, fetal and neonatal descriptors, and some information about the mother and possible risk factors.

This dataset contains 552 CTG recordings that carefully selected from the 9164 recordings between the years of 2010 to 2012 from the University Hospital in Brno.

When considering one recording of the sample, it starts no more than 90 minutes before from the actual delivery and each recording is 90 minutes long. Each recording contains the fetal heart (FHR) and Uterine Contraction (UC) with the considered time series. And also, each recording sample at 4Hz.

When considering the FHR and UC of the each patients are stored in a binary files (*.dat) and each patients clinical information's are stored in header files (*.hea).

Then the final CTU-UHB database clinical data were exported from relational database and then need to convert in to the readable text format.

Results

Percentage of the patients count with each pH level

79.5289855072464 %
12.5 %
7.97101449275362 %
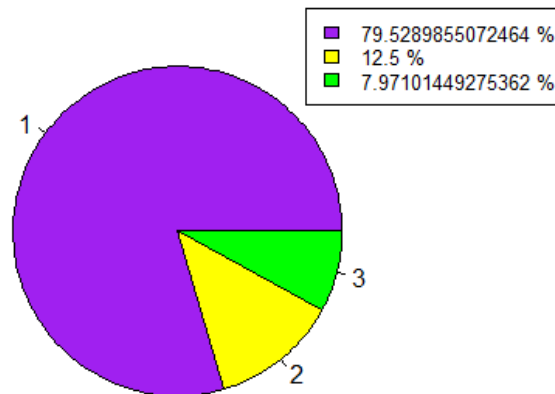
Figure 8- Created pie chart of the percentage of patients count with pH level

According to the above pie chart, 1st pH level (no hypoxia) has nearly 79.5% of the total patients count, 2nd pH level (middle hypoxia) has 12.5% of the total patients count and 3rd pH level (serve hypoxia) has nearly 7.97% of the total patients count.

According to this, there is a high percentage of patients count having the 1st pH level (no hypoxia) and there is a low percentage has the 3rd pH level (serve hypoxia).

Hypothesis

- H0 (Null Hypothesis) - The correlation coefficient does not differ significantly from 0. There is no significant linear relationship between the variables on the x axis and the y axis. (Among variables of pH level and pH value hasn't a significant linear relationship)

- H1 (Alternative Hypothesis) – The correlation coefficient differ significantly from 0. There is a significant linear relationship between the variables on the x axis and the y axis. (Among variables of pH level and pH value has a significant linear relationship)

Correlation Analysis

- H0 (Null Hypothesis) - The correlation coefficient does not differ significantly from 0. There is no significant linear relationship between the variables on the x axis and the y axis.

- H1 (Alternative Hypothesis) – The correlation coefficient differ significantly from 0. There is a significant linear relationship between the variables on the x axis and the y axis.

```
> cor.test(pH_level,pH_value)

        Pearson's product-moment correlation

data:  pH_level and pH_value
t = -33.674, df = 550, p-value < 2.2e-16
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval:
 -0.8461141 -0.7913432
sample estimates:
      cor
-0.8206041
```

Figure 9- Result of the Correlation analysis

According to the above figure of the Pearson correlation test, r value of the correlation coefficient variance is -0.8206041. It means that value is less than the 0. Then it will be indicates the strong negative of linear relationship. In here, p value of the test is 2.2e-16. It means that the p value is less than the 0.05 (significance level). Then null hypothesis will be rejected and the alternative hypothesis will be accepted. Because the correlation coefficient will be significantly differ from the 0. So, considering the results of these correlation analysis, can be clearly stated that among variables of pH level and pH value has a significant negative linear relationship.

Summary of the 2-D CNN Model

```
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_1 (Conv2D)            (None, 70, 120, 64)       7808

elu_1 (ELU)                  (None, 70, 120, 64)       0

batch_normalization_1 (Batch (None, 70, 120, 64)       256

conv2d_2 (Conv2D)            (None, 62, 112, 128)      663680

elu_2 (ELU)                  (None, 62, 112, 128)      0

batch_normalization_2 (Batch (None, 62, 112, 128)      512

max_pooling2d_1 (MaxPooling2 (None, 31, 56, 128)       0

conv2d_3 (Conv2D)            (None, 25, 50, 128)       802944

elu_3 (ELU)                  (None, 25, 50, 128)       0

batch_normalization_3 (Batch (None, 25, 50, 128)       512

conv2d_4 (Conv2D)            (None, 12, 24, 256)       295168

elu_4 (ELU)                  (None, 12, 24, 256)       0

batch_normalization_4 (Batch (None, 12, 24, 256)       1024

conv2d_5 (Conv2D)            (None, 6, 12, 512)        524800

elu_5 (ELU)                  (None, 6, 12, 512)        0
```

Figure 10- Model Summary of the 2-D CNN 1

```
batch_normalization_5 (Batch    (None, 6, 12, 512)    2048

flatten_1 (Flatten)             (None, 36864)         0

dropout_1 (Dropout)             (None, 36864)         0

dense_1 (Dense)                 (None, 32)            1179680

elu_6 (ELU)                     (None, 32)            0

batch_normalization_6 (Batch    (None, 32)            128

dense_2 (Dense)                 (None, 16)            528

dropout_2 (Dropout)             (None, 16)            0

dense_3 (Dense)                 (None, 2)             34
================================================================
Total params: 3,479,122
Trainable params: 3,476,882
Non-trainable params: 2,240
```

Figure 11- Model Summary of the 2-D CNN 2

Above figures are shows the summary of the 2-D CNN that use for training the dataset and building the model.

For analysis and training CNN, have been use 80-20 training-testing split the label of each class. The 10-folds cross-validation technique is being applied to check the performance of the classification model. The label for a signal is obtained by classifying individual smaller parts and combining the result.

In one of the published research articles states that this CTU-UHB dataset ECG data have been provided to the 9 experts panel that have at least 15 years of experience in medical industry for manual interpretations of these signals. Finally, the researchers get expert panel accuracy as 64.8% (Vaclav, et al., 2014).

By surpassing that accuracy they obtained, through the developed method is above 70% accuracy based on comparing predicted labels to pH value ranges.

Below figure clearly indicates the accuracy with each pH ranges (Accuracy of the pH labels).

Class	pH Range	Interpretation	Split	Accuracy
1	pH > 7.15	Normal (no hypoxia)	351+88 (439)	61/88 (70%)
2	7.15 ≥ pH > 7.05	Suspicious (mild hypoxia)	55+14 (69)	10/14 (71.4%)
3	pH ≤ 7.05	Pathological(severe hypoxia)	34+10 (44)	7/10 (70%)

Figure 12- Achieved model accuracy

According the above figure, range of pH> 7.15 (no hypoxia) obtained the accuracy as 70%, range of 7.15>pH>7.05 (middle hypoxia) obtained the accuracy as 71.4% and range of pH<7.05 (serve hypoxia) obtained the accuracy as 70%.
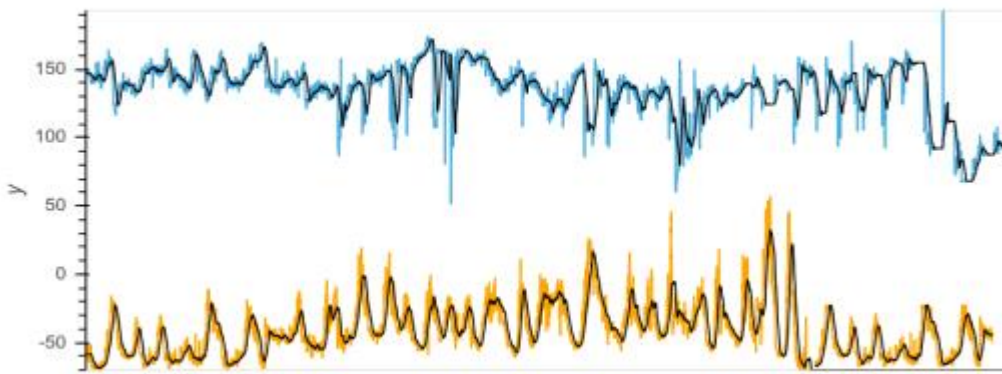
Figure 13- FHR and UC signals produced by CTG

Library of HoloViz	Functionality
HvPlot	It helps to quickly generate interactive plots from your data.
HoloViews	It helps in making all of the data instantly visualizable.

Figure 14- Used Libraries of Holo Viz

Data have been visualized to get the nature of the signals. The data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data.

Discussion

CTU-UHB database has been used for the fetal-distress classification. The data is visualized using Holoviz with two main libraries HvPlot and HoloView that help in the better visualization of the signals. To classify FHR and UC signal, the deep convolution neural network is being used which automatically filters the noise. Also, feature selection and extraction are done automatically. The main advantage of CNN is data augmentation which was not achieved in the other model. Finally, the model with three classes is defined where Label-1 represents the class with no hypoxia having a pH value greater than 7.15, Label-2 defines the class with mild hypoxia having a pH value between 7.05 to 7.15 and Label-3 defines the class with severe hypoxia with pH value less than 7.05. The accuracy achieved using this model is 70% or above.

And also, this proposed model uses CNN in which feature selection and classification are performed in a single phase. Further, Spilka et al tried to perform feature selection and classification at a single stage but it suffers a major drawback as LS-SVM does not support data augmentation. But this model supports data augmentation and its response is also faster.

In comparison to the work of which uses linear features for FHR analysis, this model outweighs in a better way as uses CNN for the classification purpose which helps in better analyzing the FHR signals and it is faster in processing. The accuracy achieved by above model is far better than achieved by the model defined in the research paper.

Conclusion and Recommendation

Classification of Fetal Distress is the main focus of research in this project. Fetal distress is caused due to the inadequate supply of oxygen and is one of the main causes of newborn deaths. Cardiotocography which is mainly used to analyze FHR and UC signals to check the fetus positioning. Finally the solution has been developed to classify the fetal current distress based on their FHR and UC signals. CNN has been used for classification which achieves better accuracy than the traditional methods mentioned in the literature. For evaluation and testing of the model, the CTG-UHB database has been used. One unique feature is visualizing the signals to get a better view and it helps in achieving better results for classification. This scheme can be applied to the medical robots which can help the doctors to identify hypoxia more precisely. Through this project, target accuracy was above 70% and it is surpassing by the 15 years experienced experts panel accuracy as 64.8%. And also, other research objectives, target outcomes and the functionalities can be achieved as expected. This system saves the innocent lives and reduces the fetal mortality rate. And also, through this web application doctors can save their time and it provides the accurate, efficient way for fetal distress classification.

Future Recommendations

One web application can be suggested instead of two applications. It is much better and it is easy for the doctors and physicians. And also, android application can be recommended for the patients to see there fetal current status from home and no necessary to meet the doctor for evaluation of fetal reports. The online payment gateway is recommended for this application, and then patients can pay for this service by online.

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IDENTIFYING FACTORS IMPACT ON SOFTWARE PRODUCT QUALITY: A CASE STUDY BASED ON SRI LANKAN SOFTWARE DEVELOPMENT INDUSTRY

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Abstract

The software development industry in Sri Lanka has a continuously rapid growth when considering about the past few years. Software product quality becomes the most important as well as most efficient part throughout the entire project. However, software product quality failures have become a more related concern that underlies the software development industry. This influence causes to the project failures much of the time. Failures of quality in the software will results loss of sales revenue in the future and higher cost in software development life cycle. This research is to determine the factors affecting software product quality in the software development industry of Sri Lanka. This will allow most of the companies which engaged in software projects to deliver the project to a satisfactory level by enhancing the quality of the software product. According to the identified situations in software development industry, this research is focused on the identification of factors which affects to the quality of the software products in Sri Lankan software development industry.

Keywords: Software Product Quality, Software Development Life Cycle, Software Development Industry in Sri Lanka, Independent Variables,

Introduction

Background of the research

Nowadays most companies are selecting the technological solutions according to their specific path ways to boost the productivity and raise their living standards for the purpose of saving time, money and potential as much as possible. With the invention of electronic computer in 1950 and the spread of internet the entire world stepped up to a global village in 1980. People shared their knowledge and information through information system.

The software industry in Sri Lanka is growing in a broad scope. With the growth of software industry, it eventually provides more currencies to the Sri Lankan economy and increase the number of job opportunities inside the country. When the Sri Lankan software industry is rich with skillful employees and new technologies it is easy to give a competition to global market in other countries providing them mature software. Presently Sri Lankan software companies and IT service providing organizations are more than 300 companies and it includes banking, financial services, healthcare systems, educational online app systems, clothing and apparel, travel, merchandising, transportation and much more.

Sri Lanka is showing a remarkable upward trend in the yearly ICT export rate. In the time period of 2016 to 2017 the ICT sector's export revenue increased to USD 900 million to USD 968 million. This comprises more than 80,000 of the labor force. This has a significant impact on the growth of the Sri Lankan economy with well-paid and value-added jobs of over 90% percentage.
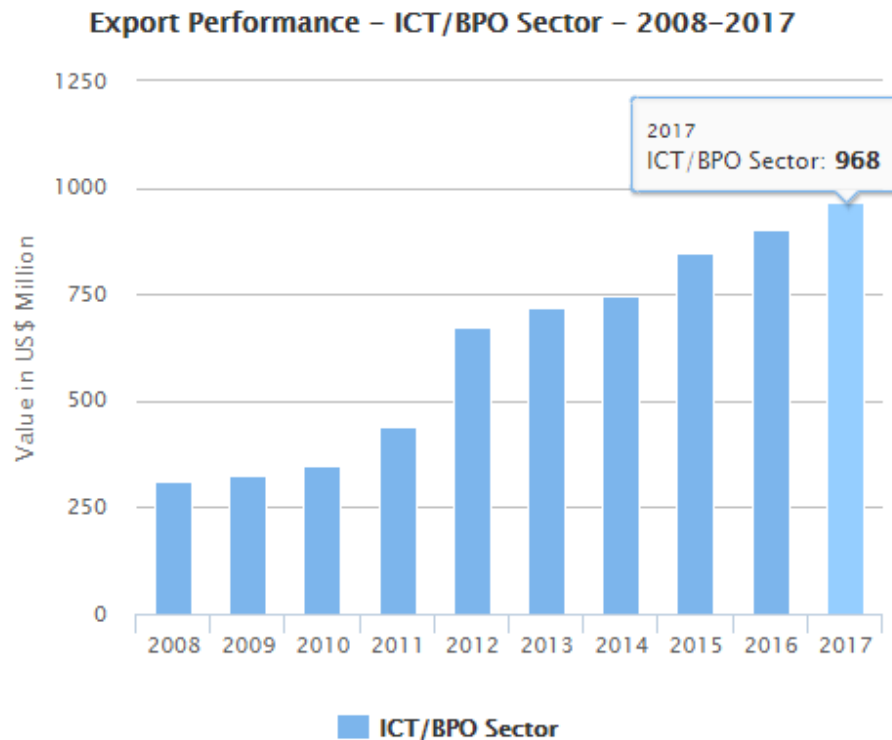
Figure 15 ICT - BPO Export Performance
Source: SriLankanbusiness.com,2019

Problem statement

The cancellation and failure rates of software projects increase day by day (Emam and Koru, 2008). 11% of software projects cancelled before being delivered due to the critical quality problems with the software (Emam and Koru, 2008). Several factors affect software failures. The lack of quality is one of the main causes of software failures (Baccarini, Salm & Love, 2004).

Since the late 1990s, the software industry in Sri Lanka has experienced massive growth, but it is under excessive demand to meet the specifications of customers.

Not only the global economy, but the local software industry is also facing the same scenario. Most of the software development companies failing their products due to quality issues. They are wasting their effort, time, and money spent.

Table 1 : Examples for Local Software failures

Year	Product	Failure
2015	Motorsport Racer Portal (Software application to manage Motorsport Tournaments in Sri Lanka)	After delivering the project, client has rejected the project due to some unmet and misunderstand requirements at the beginning of the project. The financial loss for the company was 2 million rupees and 6 months of time and effort has wasted.

2016	Online shopping application (Web application designed for retail business)	This was 1 million rupees valued product which reported issues by customers after delivering the product. The company dropped the relationship and trust of the customer and took almost two months of continuation to fix the customer reported issues.
2017	Time & Expense Portal (Online application to report time and expanses of onsite employees)	Due to unclear specifications and weak in the analysing phase, the project is resuming for two years. The company is wasting time, cost, and effort which can allocate to another product development.

Research Objectives

- To identify the current level of failures in software in Sri Lankan software development industry and figure out what can be done to minimize those failures.
- To recognize the existing challenges to improve the software product quality and how to overcome them.
- To identify the factors which impact to the quality of the software product.
- To find suggestions and recommending strategies to gain a higher number of advantages by improving the software product quality.

Significance of the study

With the rapid increase in the number of software product failures, this study is valuable to the software product development industry. One of the main problems facing many companies in the software development industry today is how to provide quality software that meets customer expectations by saving time and money. This research study determines how a lack of product quality depends on internal and external factors. Then, this study explains how these factors affect Software Development Life Cycle. Finally, this study will suggest recommendations that apply and will be very useful in preventing software quality problems.

Methodology

Methodology conducted through the research and development of conceptual frameworks based on literature review summary. Hypotheses formed according to the individual variables identified according to the literature review, which has a potential relationship with the software project quality. To identify the measurable factors to be tested, the table of operationalization formed. The Sampling technique used to sample selection for the research conducted. Moreover, the chapter addresses the data collection techniques carried out the analysis.

Software industry in Sri Lanka is very large therefore a sample has been taken considering the western province of Sri Lanka. Using sample calculator, the sample size has been calculated by giving confidence level of 99% with the confidence interval of 10 and to the 80000-population identified from IBM report. The actual needed sample size count is 166 and researcher has collected 173 responds. The conceptual framework has been created according

to the identified independent variables; Process maturity, Productivity of the team, Stakeholder engagement and the Technical excellence of the team and the dependent variable as software product quality. These variables have been identified from Previous literature reviews.

Conceptual Framework
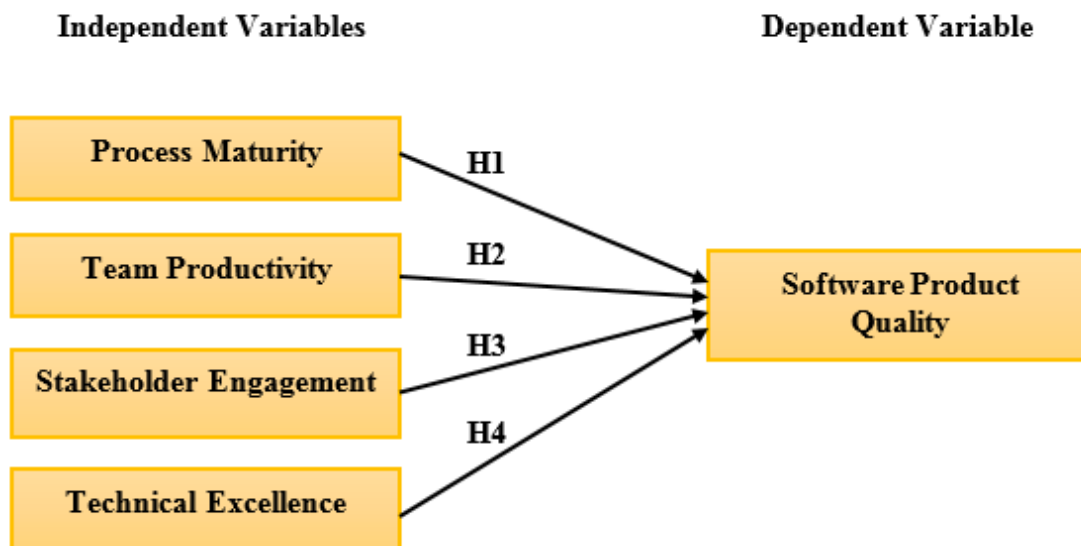
Figure 2 : Conceptual Framework

Hypothesis

H1_process maturity and software product quality

> $H1_0$- There is no linear relationship between "Process maturity" and the "software product quality"
> $H1_1$ – There is a linear relationship between "Process maturity" and the software product quality

H2_Technical excellence and software product quality

> $H2_0$ - There is no linear relationship between "Technical excellence" and the "software product quality"
> $H2_1$ – There is a linear relationship between "Technical excellence" and the "software product quality"

H3_Team productivity and software product quality

> $H3_0$- There is no linear relationship between "Team productivity" and the "software product quality"
> $H3_1$ – There is a linear relationship between "Team productivity" and the "software product quality"

H4_Stakeholder engagement and software

H4₀ - There is no linear relationship between "Stakeholder engagement" and the "software product quality"

H4₁ – There is a linear relationship between "Stakeholder engagement" and the "software product quality"

Results

Results of this research has been classified considering generalized information gathered from questionnaire which distributed among software development industry professionals as Highest educational qualification of the respondent and their job category.
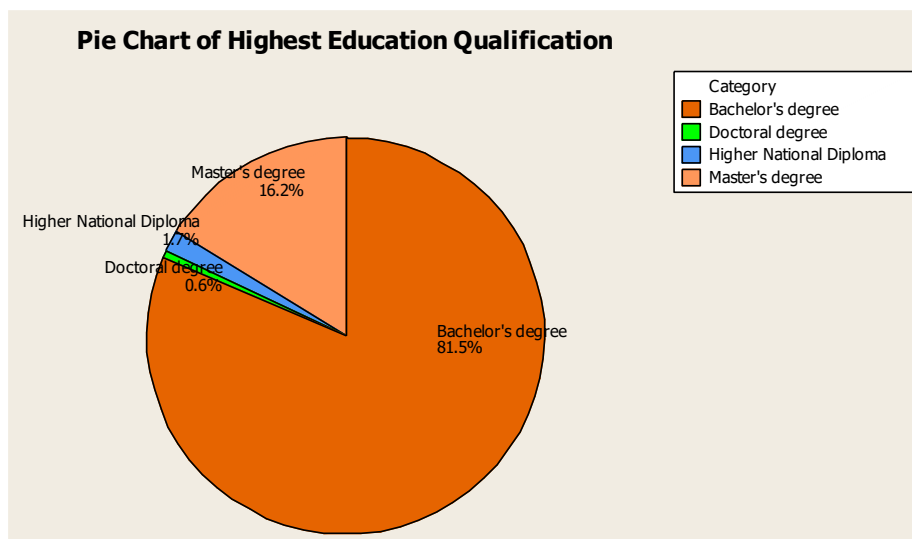
Figure 16 Pie chart of Educational qualification
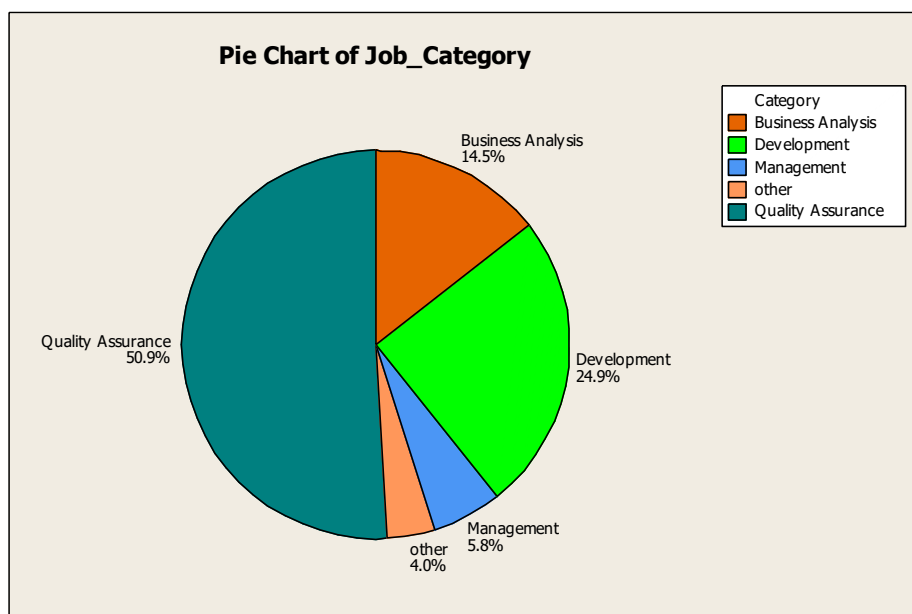
Figure 17 Pie chart of job category

Reliability of the data set

By calculating the Cronbach's alpha, the reliability of the data collected was measured and got a value above 0/7 for each independent variable and overall Cronbach's alpha is 0.9108 which indicates a better Cronbach's alpha value.

Descriptive Analysis

The descriptive analysis is done to analyse decoded data effectively. To get the descriptive statistical summary researcher has been considered mean, standard deviation, variance, 1st quartile, 3rd quartile and the Inter quartile range.

```
Descriptive Statistics: Process_Matu, Technical_Ex, Team_Product, ...

Variable                 Mean    StDev  Variance      Q1      Q3     IQR
Process_Maturity       1.7059   0.3298    0.1088  1.6250  1.8750  0.2500
Technical_Excellence   1.7838   0.2999    0.0900  1.6000  2.0000  0.4000
Team_Productivity      1.7327   0.3682    0.1356  1.5000  2.0000  0.5000
Stakeholder_Engagement 1.7808   0.3230    0.1043  1.7500  2.0000  0.2500
Software_Quality       1.7611   0.3839    0.1474  1.6667  2.0000  0.3333
```

Figure 18 Descriptive Analysis summary

Histograms

Histograms have been used to show the data distribution gathered from the data sample and following histogram graphs demonstrate how the skewness of data has been spread according to the graphs.
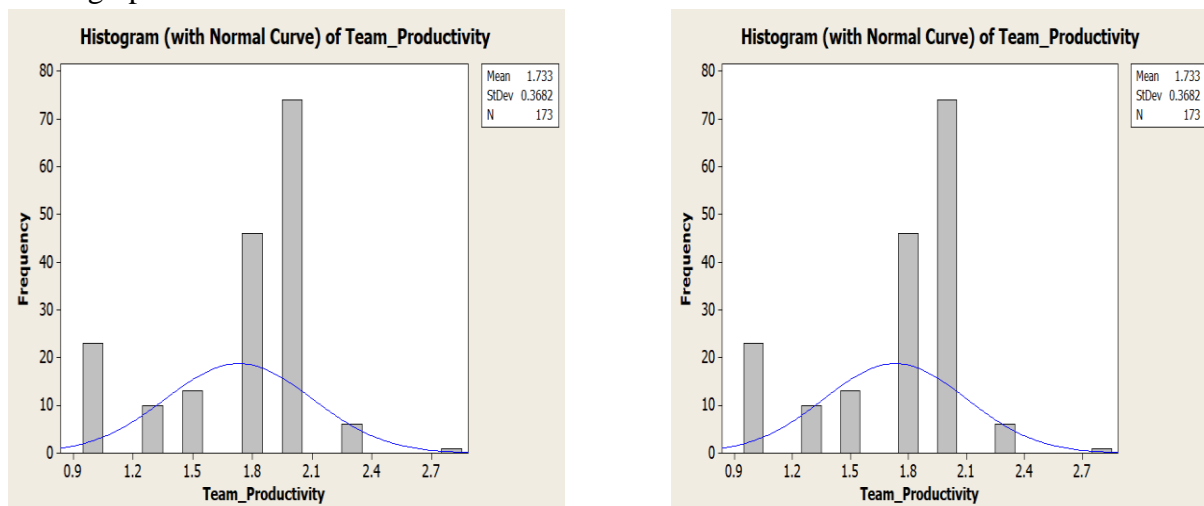
Hypothesis Testing

Hypothesis Testing is based on Pearson correlation testing. Correlation will indicate whether or not variables are strongly linked and how it has been connected.

Since the p value is less than alpha; 0.01, there is an enough evidence to proof that first independent variable "process maturity" and the dependent variable "software quality" has a linear relationship with 99% level of confidence. So that it clearly shows **H1₁** alternative hypothesis is accepted and null hypothesis (H0) is rejected. The positive correlation (r=0.54) indicates that when process maturity increases, software quality also tends to increase.

Based on the findings from regression analysis and correlation analysis the results clearly show there is no linear relationship between the remaining independent variable and the dependent variable. So that alternative hypothesis is accepted and null hypothesis is rejected.

Summary of the Hypothesis results

Hypothesis	Accept / Reject
$H1_0$- There is no linear relationship between "Process maturity" and the "software product quality"	Reject
$H1_1$ There is a linear relationship between "Process maturity" and the software product quality	Accept

Hypothesis	Accept / Reject
$H2_0$ - There is no linear relationship between "Technical excellence" and the "software product quality"	Reject
$H2_1$– There is a linear relationship between "Technical excellence" and the "software product quality"	Accept

Hypothesis	Accept / Reject
$H3_0$- There is no linear relationship between "Team productivity" and the "software product quality"	Reject
$H3_1$– There is a linear relationship between "Team productivity" and the "software product quality"	Accept

Hypothesis	Accept / Reject
$H4_0$ - There is no linear relationship between "Stakeholder engagement" and the "software product quality"	Reject
$H4_1$ – There is a linear relationship between "Stakeholder engagement" and the "software product quality"	Accept

Discussion

As the way ISO/IEC 25010:2011 has stated; software quality attributes approach is one of the best procedures to /figure out about product quality in each and every phase in software development life cycle. Due to the failures of the software product quality, technological failures, lack of consumer acceptance, a smaller number of people participation in management software project failure and cancellation rates are rapidly growing daily (Emam & Koru, 2008). According to a research article published by two previous scholars Fenton and Neil (1999) they have been stated that quality of the software should be maintain from the beginning of the project. The process of devising and developing technical solutions to a particular issue can be identified as software design. Scacchi (1991) demonstrates that "The approach that can be used to solve the general problem is able to find within software process." The productivity of

software tools would also be calculated in conjunction with Scacchi (1995) to increase the pace of software development, decrease the time and costs which takes to develop the software and increase the quality in product delivery. This will straightly impact the future of the entire company, as the aim of any software business enterprise is to achieve the highest team efficiency to minimize costs and improve profitability (Sudhakar, 2012)

Conclusion and Recommendation

As determine in the problem identification, Software development industry in Sri Lanka also facing the problems of product failures and cancellations due to quality issues as well as the Global software development industry. It is important for software companies to know that what are the factors affecting poor software quality which affect to the revenue of the companies and for the industry as well which discussed under the research problem.

In this study, since the factors selected giving only 47.7 percentage to the quality of the software products. So that it is worth identifying the other factors which directly impact to the quality of the software product. Furthermore; additional study could be performed and analyzed diverse industry verticals, on assistance purposes for organizational decision making.

Following are the recommendations, along with the respondents' opinions according to questionnaire which distributed among some selected industry professionals under each independent variable.

To improve the Process Maturity further, recommended that to perform the planning and designing in proactive ways. Planning plays a very significant role in achieving time project completion, organizing and arranging resources, processes for this purpose. To improve the Technical Excellence further, properly structured development phases, monitoring, and ownership of different phases must be effectively distributed. Recommend using proper documentation practices with the use of commonly accepted documentation standards in the industry. Allows evaluating the need for engineering trade-off (ex: Using a more maintainable design pattern which will compromise product performance). In a long-term project, it is good to use dev strategies. To improve the Team Productivity further, Effective communication among members is a necessary aspect of improving team productivity. Once a cycle is over, the team should get together and analyze the fails and succeed situations in the previous cycle and do necessary changes to improve the next cycle. Accurately gathering the requirements gives the exact inputs as well as a clear vision of endpoint to be achieved. Therefore, increase the level of customer engagement when implementing software. Help product owners to groom their requirement and helps find a balance between technical feasibility and the requirement.

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SOCIAL SCIENCES

ATTITUDES OF SRI LANKAN GOVERNMENT AND PRIVATE SECTOR HEALTH CARE PROFESSIONALS ON SELF-HARM

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Abstract

Self-harm being one of the major critical psychological issues across the world can lead to adverse effects such as death if neglected or attended inappropriately. Therefore, it is critical that they get adequate medical attention and therapeutic support. Hence, the attitudes of the health care practitioners are crucial for it. This quantitative study was designed to assess the attitudes held by nurses on self-harm in Sri Lanka, the association between attitudes and their age and attitude variances between government and private sector nurses. Attitudes towards Deliberate Self-Harm Questionnaire (ADSHQ) by Margaret McAllister et al., 2002, was administered (N=80) on nurses from both government and private sector and the data were analysed using the Statistical Package for the Social Sciences (SPSS) version 20 for Windows 7 through Descriptive and T-tests. A significantly positive attitude was revealed in the analysis with a mean score of 94.11 (SD 5.6, range 21) it was also found that there is no relationship between the age and the attitudes of the nurses (r=0.051, n= 80, p=0.653) and that there's no significant difference between the attitudes held by nurses of government sector (M= 94.9, SD=5.15) and private sector (M=93.32, SD=6.005) towards self-harm; t (78) =1.259, p=0.212.

Key words: ADSHQ, Attitudes, Health Care professionals, Self- Harm, Sri Lanka

Introduction

Psychological issues are seen to be growing wider day by day and self-harming is one of the major issues in prevalence irrespective of age across the globe. Yet, Sri Lanka is still in the opening of the path of addressing self-harming and other psychological issues as the stigma around psychological disorders are quite thicker.

Deliberate self-harm could be identified as an intentional act that cause injury to the self and not necessarily aimed at ending life, with the full awareness that the particular behavior has its capacity to inflict harm. (Crawford, et al., 2003) And thus the willingness of the victim to undergo self-inflict pain is evident even though the causes that lead to it can vary and remain debatable and subjective.

The exact reason as to why a person would choose to harm themselves deliberately can vary from person to person and therefore is highly subjective and broad that makes it difficult to frame into one or two specific cause, but still the fact that they cause it intentionally is a common factor. Most of the people credit it to the account of ways of coping with severe anxiety, frustration, depression or distress. (Klonsky, 2007) For some people it is a way out of disturbing feelings of alienation, isolation or dissociation, a means of punishing own self or sometimes a silent cry for help. (Schoppmann, et al., 2007) How so ever, it's a commonly accepted fact that people who self-harm experience acute feelings of isolation and loneliness and are more susceptible to kill themselves in suicide. (Hawton, et al., 2003)

Self-Harm stands on behalf of all harming behavior including cutting, burning, attempted hanging, attempted drowning and self-poisoning which are considered to be the most common methods. (Conlon & O'Tuathail, 2012)

As mentioned above, self-harm has never been an appealing topic in the background of Sri Lanka and therefore, there's only a limited amount of census and researches available. Even the demographic and health survey - 2016 by Department of Census & Statistics of Sri Lanka does not consist of a section on self-harm separately but suicides only. According to the Demographic and Health Survey 2016 of Department of Census & Statistics of Sri Lanka – which is the latest among published data in Sri Lanka- at least one person has even attempted suicide in less than one percent of the households in the year before the census was carried out. (Department of Census & Statistics of Sri Lanka, 2016)

It has also been estimated that the rate of self-harm is at least 10-20 times larger than a country's suicide rate. (Silva & Seneviratne, 2003) According to the data available, based on the census of 2016, the mortality rate of suicide in Sri Lanka was 16.6 per 100,000 of population (Wijesiri, 2018) and thus 166-332 per 100,000 of population were in the risk of self-harm.

Therefore, it is essential that health professionals practice a cordial and a positive therapeutic relationship that makes the victim comfortable enough to seek medical care and to share his/her thoughts and feelings running to the root of their problems. (American Psychiatric Association, 2003) Any unpleasant occurrence between medical professionals and the victims can discourage victims from seeking medical care in the event of major injuries in the future and that can lead to adverse effects such as losing interest in sharing their anxieties and worries and even to death as well.

On the given backdrop, the attitudes of the professional in the health care industry is crucial in identifying, assessing, controlling and providing support for the victims seeking treatment as it is extremely important for victims come forward to seek help for most of these self-harming behaviors stay hidden until it bursts into a tragedy.

Some of the early findings demonstrate that the number of people who sought medical assistance in the event of self-harm is 17 times much ordinary compared to the number of victims who succumbed to death. (Calof, 1994) Moreover, as the existing studies show the suicide risk after self-harm is 50 times greater than in the ordinary society and it is even greater in the immediate weeks after leaving the hospital from getting treated for self-harm injuries. (Dower, Donald, Kelly, & Raphael, 2000)

Therefore, it is of great importance for the clinicians to deal with self-harm positively and gently as there's an established significant relationship between self-harm and suicide. (Beck & Covacs, 1979)

Generally, it is the nurses that make the initial encounter with patients who present themselves seeking medical attention irrespective of the cause. Hence, the attitudes of health professionals are expected to be "respectful, compassionate, understanding and excludes moral judgment about self-harming behavior. (National Institute for Clinical Excellence, 2004) Therefore, they are entailed to practice a friendly and positive therapeutic relationship that makes the sufferer able to share his/her disturbing thoughts and feelings. (American Psychiatric Association, 2003) Therefore, it's important to maintain a sound and respectful encounter that encourages them to seek medical attention as much as possible.

Studies also show that the negative attitudes of medical professions on self-harm can significantly hinder the care they show towards victims thinking that it as a waste of time and of no use. (Sanders, 2000) A study done based on a leading hospital in Brisbane in Australia demonstrates that the number of young individuals who found medical professionals to be of

support and understanding was less than half of those who had had sought medical attention in the occurrence of self-harm. Moreover, one-third had expressed that they were of no use at all as well. (Dower, Donald, Kelly, & Raphael, 2000). Literature claims that the situation in United Kingdom has also been the same. (Clarke & Whittaker, 1998)

On the other hand, since health care professionals are considered with value and respect, they carry a potential influence on the social images and stigmas. Their attitudes on sensitive issues of this nature can also make a significant impact on how the immediate society regard it as well.

Therefore, in a background where there's a lack of research and social interest in Sri Lanka, this study will support to bridge the gap of information deficiency while bringing about an opportunity for the health care workers to assess their attitudes, training and development needs and the people with authority to device innovative strategies to provide better support and control these behaviors as well.

Thus, this research further intends to find out,

- How health care professionals respond to patients who present with Self-harm, the training needs in terms of handling Self-harming patients, if there's a difference in attitudes held by health care professionals in government sector and private sector and also the association between age and attitudes of nurses.

The research will be conducted based on the below hypotheses:

- H_0: The health care professionals do not respond to patients who present themselves with self-harm positively.
- H_1: The health care professionals respond to patients who present themselves with self-harm positively.
- H_0: There is no significant difference between the attitudes of government and private health care practitioners.
- H_1: There is a significant difference between the attitudes of government and private health care practitioners.
- H_0: There is no significant relationship between age and positive attitudes of nurses.
- H_1: There is a significant relationship between age and positive attitudes of nurses.

Methodology

This study is a survey based research with a quantitative, descriptive and correlational design using the Attitudes towards Deliberate Self Harm Questionnaire (ADSHQ) by Margaret McAllister et al., 2002.

Sample

The study sample consists of nurses from two leading hospitals in the city of Galle in Sri Lanka: Teaching Hospital, Karapitiya, Sri Lanka (governed by the Ministry of Health, nutrition and indigenous medicine of Democratic Socialist Republic of Sri Lanka) and Asiri Hospital - Galle, Sri Lanka (a private hospital under the Softlogic Holdings; administered and registered under the Private Health Services Regulatory Council of Democratic Socialist Republic of Sri

Lanka). A total of 80 participants (N=80) were recruited from the two hospitals: 40 nurses from each through purposive sampling.

The sample consisted of nurses between the ages of 21 years and 56 years and the mean age of the sample were fund to be 35 years. A majority of 87.5% of the total sample were females. A proportion of 37.5% of the sample had clinical experience between 0-5 years and 26.25% of the sample had more than 16 years of clinical exposure.

Data Collection

The researcher obtained permission from the respected authorities of the hospitals and met the nurses in their wards and units, briefed them about the study and recruited the participants out of their personal willingness with informed consent taken in writing. The questionnaires were gotten filled under total privacy and confidentiality without hindering their work commitments to the least. A sheet of demographic data were also gotten filled for analytical purposes apart from the ADSHQ.

The instrument: the Attitude towards Deliberate Self-Harm Questionnaire (ADSHQ)

The Attitude towards Deliberate Self-Harm Questionnaire (ADSHQ) was developed by Margaret McAllister et al., in 2002 in order to measure the attitudes of nurses in the emergency departments in Australia on individuals who self-harm.

The respective questionnaire includes 33 questions in total and has been developed under a four-point Likert scale that ranges from 1(strongly disagree) to 4 (strongly agree). The overall score varies between 33 and 132: the more the score, higher the attitude is. Moreover, a score between 33 and 82 was regarded as negative and a score between 83 and 132 were treated as positive. One-third of the total number of questions is composed as negatives so as to decrease the response bias. (McAllister, Creedy, Moyle, & Farrugia, 2002)

As sixteen of the total thirty-three questions in the questionnaire were negatively phrased, they were subjected to reverse scoring in which the marked responses such as 1, 2, 3 and 4 were scored 4, 3, 2 and 1 while the rest of the responses to other questions were scored as it is and then calculated the total sum.

Data Analysis

The obtained data were inserted into a password protected computer and later analysed via the Statistical Package for the Social Sciences (SPSS) version 20 for Windows 7 through Descriptive tests, Pearson correlational tests and independent samples T-tests.

Results and Discussion

Out of the total sample of which 87.5% were females *(table 1)*, a larger proportion of 63.7% had not undergone any training in handling self-harming patients *(table 2)*. It was also found out that 41.3% of the sample had received some kind of training in handling patients with any psychological issue *(table 03)* even though 40% of them encountered a patient who self-harm at least once a week *(table 4)*.

Table 1
Gender Analysis

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	F	70	87.5	87.5	87.5
	M	10	12.5	12.5	100.0
	Total	80	100.0	100.0	

Table 2
Training on Handling Self –Harmers

Training (self-harm)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	51	63.7	63.7	63.7
	Yes	29	36.3	36.3	100.0
	Total	80	100.0	100.0	

Table 3
Training on Handling Patients with Any Mental Issue

Training (mental illness)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	47	58.8	58.8	58.8
	Yes	33	41.3	41.3	100.0
	Total	80	100.0	100.0	

Table 4
Frequency of Encounter with Self-Harming Patients

Frequency of encounter

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Daily	17	21.3	21.3	21.3
	Once a week	32	40.0	40.0	61.3
	Once in two weeks	13	16.3	16.3	77.5
	Once a month	18	22.5	22.5	100.0
	Total	80	100.0	100.0	

Apart from that that the average age of the sample was 35 years and 37.5% of them had clinical experience between 0-5 years. Moreover, 61.3% of the total sample were from various service backgrounds other than the Emergency Treatment Unit (21.3%) or the Mental Health Care unit (17.5%).

Table 5
Service Background of the Health Care Practitioners

Service background

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ETU	17	21.3	21.3	21.3
	MHU	14	17.5	17.5	38.8
	OTH	49	61.3	61.3	100.0
	Total	80	100.0	100.0	

Note. ETU = Emergency Treatment Unit

MHU = Mental Health Unit

OTH = Other

The analysis of the data obtained through ADSHQ revealed a mean score of 94.11 (SD 5.6, range 21) indicating a significantly positive attitude of the nurses over the patients who self-harm according to the scoring guidelines of the questionnaire.

As it was shown in the results, the practitioners who score high in the questionnaire tend to feel positive and healthy attitudes towards the self-harming individuals and therefore it directly has a strong impact on the therapeutic relationship.

Table 6

Mean Score of the Questionnaire

Statistics

TotalScore

N	Valid	80
	Missing	0
Mean		94.1125
Std. Deviation		5.61642
Variance		31.544
Range		21.00

A Pearson correlation test administered to examine if there's a significant relationship between the age and the attitudes of the nurses towards self-harming patients and it was found out that there is no relationship between the age and the attitudes of health care professionals about self-harm. (r=0.051, n= 80, p=0.653)

Thus, it is distinct that the age of the health care practitioner has no impact in their attitudes towards self-harming. Even though we generally believe that maturity comes with age, in the background of this study the sample had a more matured perception on a sensitive issue like self-harming, which is considered an asset to a nursing officer.

Yet, study done based on an emergency care department in Northern Ireland show that the older and experienced nurses tend to hold more positive attitudes compared to those who are young in age and the years of clinical exposure. Anderson (1997) in one of his studies has also claimed that the age and years of clinical exposure are positively correlated with the positive attitudes of nurses towards self- harm.

Independent samples T-test administered to observe if there's a significant difference between the attitudes on self-harm between nurses from government sector and the private sector showed that there is no significant difference between the attitudes held by health care professionals in the government sector (M= 94.9, SD=5.15) and the private sector (M=93.32, SD=6.005) on self-harm; t(78)=1.259, p=0.212

Table 7

Association Between Age and General Attitudes

Correlations

		Age	Total Score
Age	Pearson Correlation	1	.051
	Sig. (2-tailed)		.653
	N	80	80
Total Score	Pearson Correlation	.051	1
	Sig. (2-tailed)	.653	
	N	80	80

Table 8

Attitudes Between Government Sector Vs. Private Sector Nurses

Group Statistics

	Governmentorpvt	N	Mean	Std. Deviation	Std. Error Mean
TotalScore	Government Hospitals	40	94.9000	5.15304	.81477
	Private Hospitals	40	93.3250	6.00593	.94962

Table 9

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
						Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
		F	Sig.	t	dff				Lower	Upper
TotalScore	Equal variances assumed	1.390	.242	1.259	78	.212	1.57500	1.25125	-.91605	4.06605
	Equal variances not assumed			1.259	76.239	.212	1.57500	1.25125	-.91695	4.06605

Conclusion and Future Recommendations

On the given backdrop, Sri Lankan health care practitioners do not have hostility towards the self-harming individuals irrespective of their age and service context and background. Hence, patients are more likely to have a compassionate experience at the hospitals as the analysis revealed a significantly positive mean score of 94.11 (SD 5.6, range 21).

Moreover, even though the sample ranged between 21 to 56 years of age with an average of 35 years, the analytical tests revealed that there is no significant relationship between the age and the attitudes of the medical professionals (r=0.051, n= 80, p=0.653). Apart from that, the finding of the fact that there's no significant difference between the attitudes held by nurses in the government hospitals (M= 94.9, SD=5.15) and private hospitals (M=93.32, SD=6.005) towards self-harm t (78) =1.259, p=0.212, can be considered as a suggestion that the attitudes across the Sri Lankan society towards self-harming may have grown more positive than it was. It was also found out that more than half of the sample had not undergone any training in handling such sensitive psychological issues on a background of nearly half of the sample make an encounter with a self-harming victim. Therefore, this study can act as a suggestive document for the respective officials to broaden the psychological training and development opportunities of the medical officials as well. It can in turn raise the positivity of the attitudes of the medical officials in the country and later in the society.

Moreover, this study can act as a motivation for upcoming researchers to investigate more on self-harming population and even a broader design of this study could be used to observe the training and development needs and the attitudes of health care professionals other than nurses across the island in order to create a much clearer view.

Moreover, it will also be helpful to examine the factors contributed to create a positive attitude among health care professionals while the general connotation on self-harm is negative in Sri Lanka; any significant training, past experiences of own-self or someone close by with related to self-harming or other psychological disorders etc.

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STATISTICAL ANALYSIS OF COVID-19 IN SRI LANKA

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Abstract

COVID-19 is an infectious disease that became the highlight of the year 2020. In March, the World Health Organization (WHO) has declared COVID-19 outbreak as pandemic as it affected many countries and territories. There are 45,510,455 confirmed cases worldwide while there are 1,188,661 fatalities reported globally. In Sri Lanka; the number of reported cases has risen to 11,060 with 20 deaths. This analysis has been conducted based on data obtained from the Epidemiology unit of the Ministry of Health and Indigenous Medicine. Data analysis was performed with the Statistical Package for Social Sciences (SPSS) software. The data provided includes the confirmed infected, death and recovered cases in Sri Lanka, for the period of 28th of January to the 1rst of November. The aim of this research is to understand the scale of COVID-19 outbreak in Sri Lanka and to check whether the current countermeasures being taken are efficient at controlling the spread.

Key words: COVID-19, Forecast, Sri Lanka.

Introduction

COVID-19 is an infectious disease that is caused by the latest type of human coronavirus, which has been discovered in Wuhan, China in December 2019. Respiratory infections such as common cold to more severe diseases such as Middle Eastern Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) have been caused by coronaviruses, which are a large family of viruses that are zoonotic, meaning they are transmitted between animals and people (Mcleod, 2020). So far, 2019-nCoV is the seventh member of the family of coronaviruses that infects humans. Different processes, such as coughing, sneezing, vomiting, speaking and breathing can cause the emission of the droplets from the infected individual (Da Silva, 2020). By the 1st of November, the virus has spread to 199 countries worldwide reporting more than 46,000,000 cases and more than 1,200,000 deaths (Al-Balas, 2020).

Currently, after the encounter of the first patient that was infected within Sri Lanka, for almost 6 to 7 months the spread of the novel coronavirus was under control. However, as the recent past reports of the newly identified infected patients, an unexpected raise can be seen (Epidemiology Unit, 2020). As the COVID-19 cases were decreasing around August to September, the government-imposed quarantine curfews were lifted and the general public started their day-to-day activities back. This can be seen as a drawback as the public started to act irresponsibly by neglecting the safety guidelines in regards to social distancing and wearing masks.

Mathematical modeling has been used as part of the planning process during outbreak response by governments worldwide. Statistical analysis assist experts in predicting the trajectory of the pandemic in regards to the rate of new cases and deaths being reported and monitor the effectiveness of preventive measures taken (Overton et al., 2020).

The main objectives of this research are to analyze the spread of COVID-19, the safety measures and drawbacks that have been faced before and after the current spike of new confirmed cases in the country and determine whether new countermeasures must be introduced. The findings of this research provide an insight into the efficiency of the strategy that has been adopted by Sri Lanka and how social distancing and other measures contributed in controlling the ongoing pandemic at its early stages in the country.

Methodology

The data used for the analysis was obtained for the daily reported confirmed cases of COVID-19, recoveries and deaths from the 28ᵗʰ of January 2020 till the 1st of November 2020 from the website of the Epidemiology unit of the Ministry of Health and Indigenous Medicine. The new confirmed cases and deaths each month were represented using a bar chart in order to highlight the months affected with many COVID-19 events. A comparison between the sources of confirmed cases was illustrated using a pie chart, allowing identification of major sources of confirmed cases. A line graph was used to compare the rates of recovery and emergence of new confirmed cases. A forecast for the projected new confirmed cases for 30 days was obtained based on data of present day, this was accomplished by using time series forecasting module of IBM SPSS software, where a model can be obtained to predict future events based on known past events. Different charts were utilized to analyze the spread of COVID-19 from different perspectives.

Results
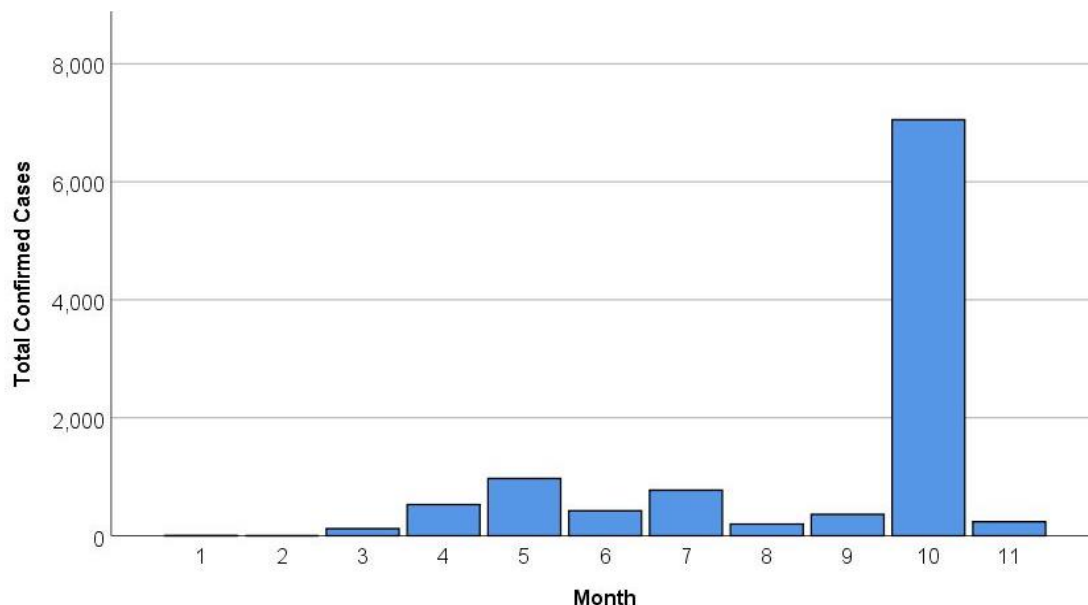
Figure 1 - Distribution of total confirmed cases
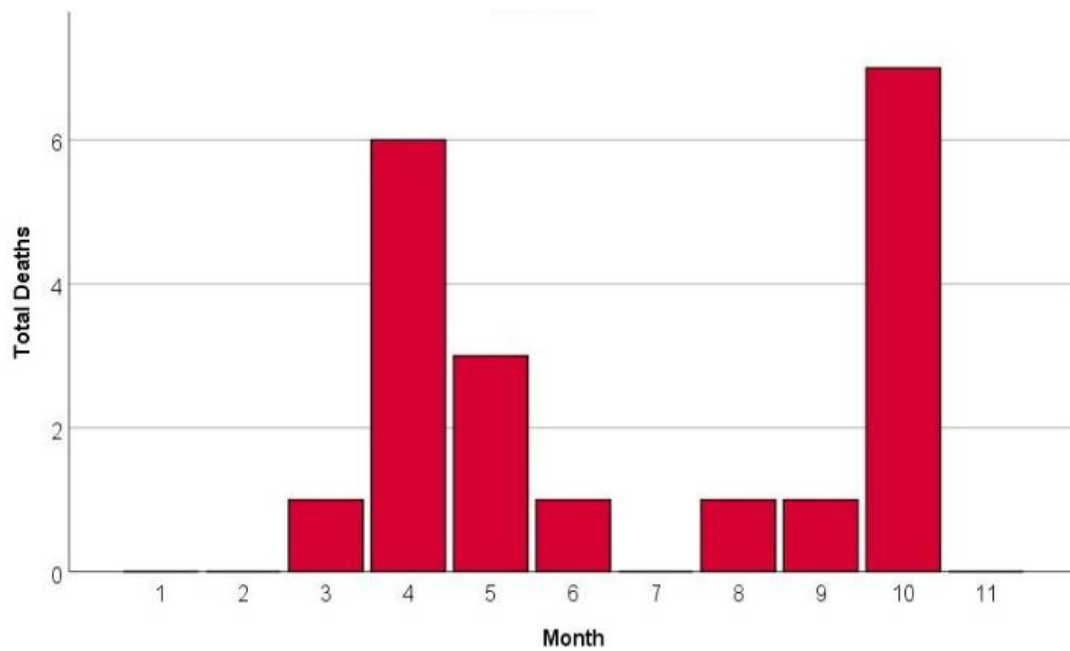
Figure 2 - Distribution of total deaths
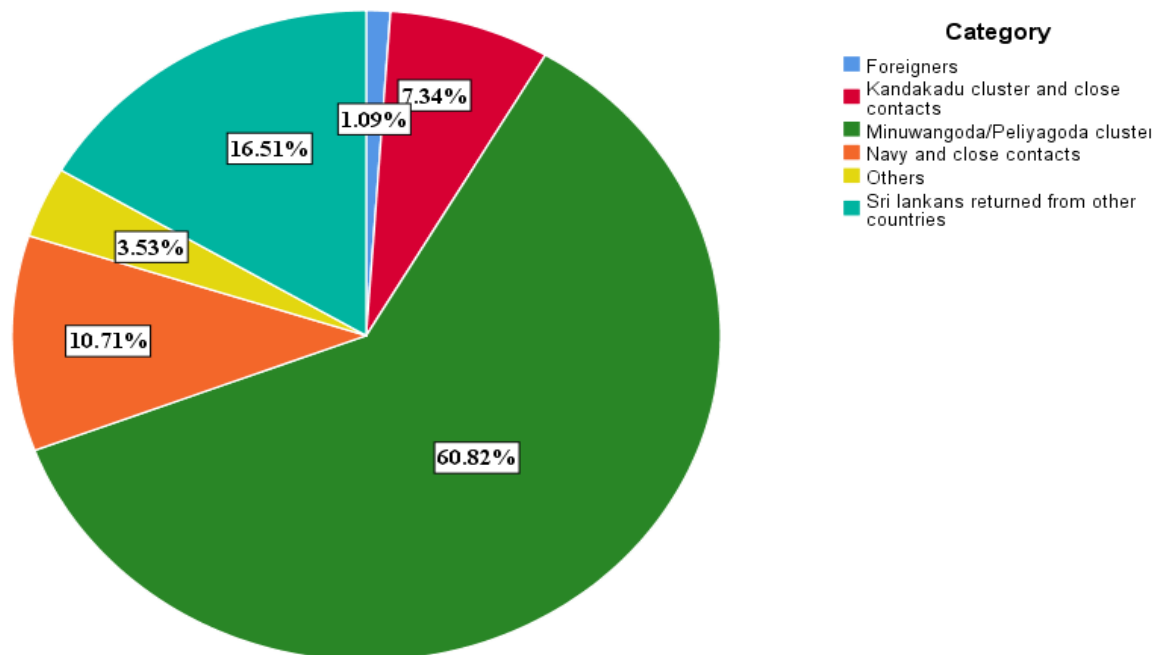
Figure 3 - Current sources of new confirmed cases
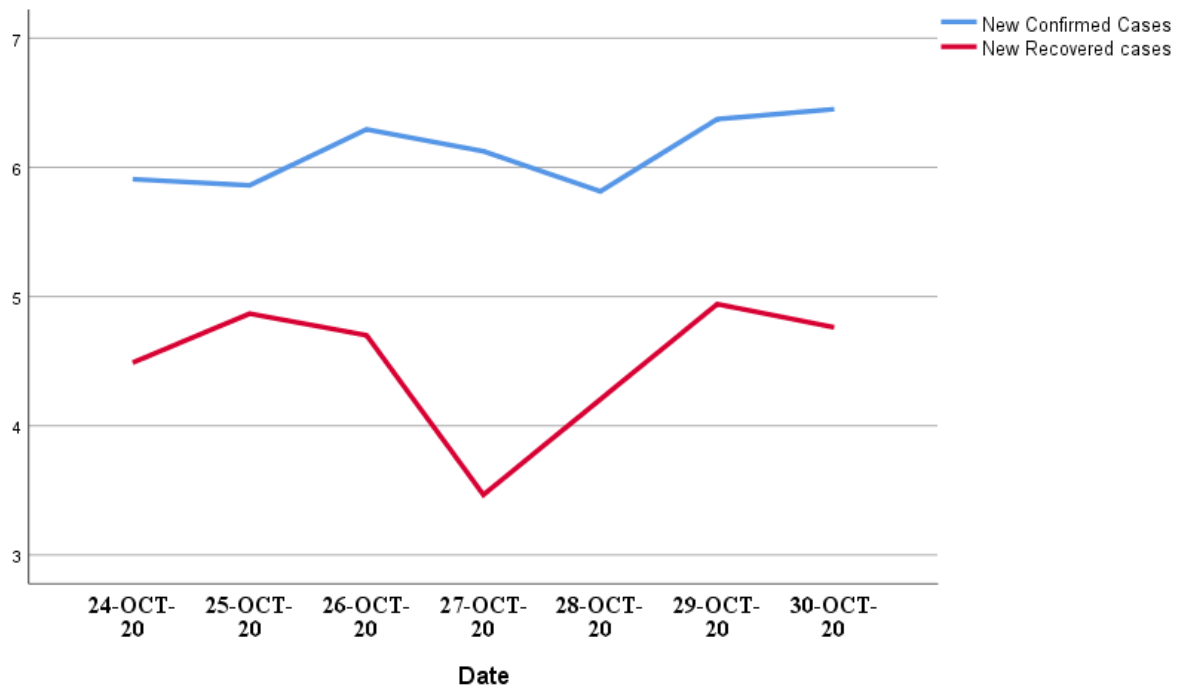
Figure 4 - Daily new cases and recovery cases for last 7 days
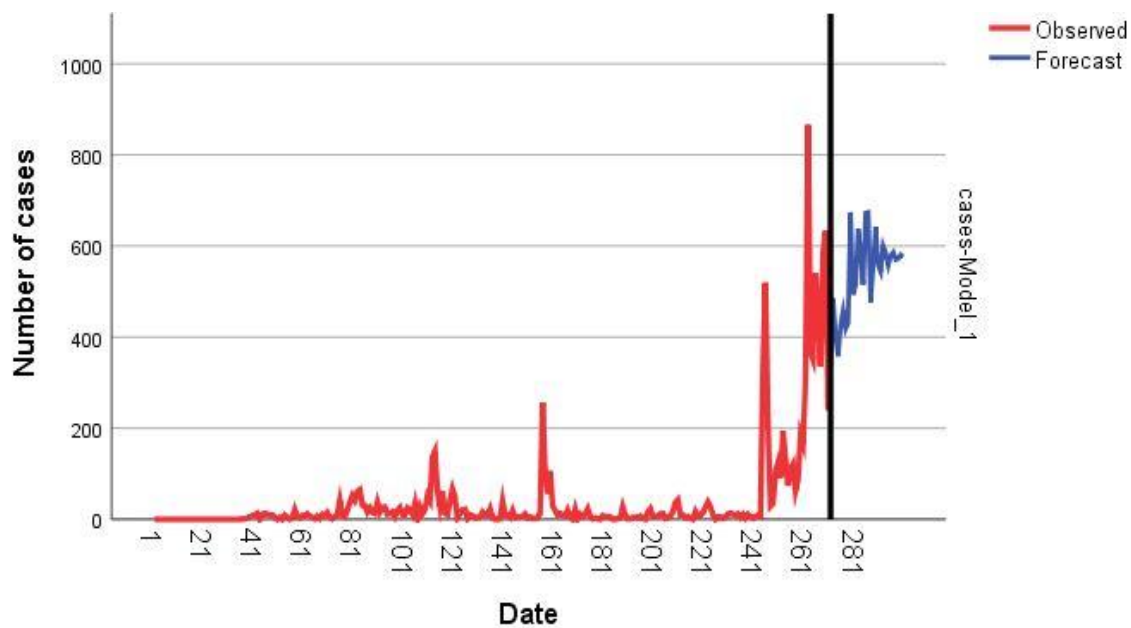
Figure 5 - Forecasting emergence of new cases for a month

Discussion

The first COVID-19 case was reported on the 28th of January. As of the 1st of November there are 11, 060 confirmed cases reported. The first fatal case was reported on the 29th of March, by the end of October there were 20 deaths reported (Epidemiology Unit, 2020). The bar cart in figure 1 shows the number of cases reported monthly, the number of cases reported till August were relatively low as the authorities were able to successfully control the spread in Sri Lanka

by the implementation of a strict lockdown which involved the closure of schools and non-essential workplaces, a ban on social gatherings, and severe travel restrictions by imposing an island-wide curfew (Herath et al., 2020). The implementation of such measures at the beginning of the outbreak enabled the country to limit the spread of the disease with a comparatively less reported confirmed cases with a very low mortality rate. The Navy and Kandakadu clusters were easily identified and controlled as hospitals and quarantine centers had facilities to accommodate the new cases reported. By September, the number of confirmed cases began to surge rapidly with 7,050 cases being reported in October. The bar chart in figure 2 shows that the highest number of deaths is currently reported in October. The surge in both number of confirmed cases and deaths can be attributed to easing of restrictions and the public negligence in following the health guidelines. New cases are being reported from varied sources from different places in the country. As hospital resources are getting exhausted, limitations in PCR testing facilities, overburdening of quarantine centers are thus forcing the General Medical Officer's Association (GMOA) to modify their current COVID-19 exit strategy known as the Hammer and Dance mechanism that was successful in curbing the spread during the initial stages of the outbreak. This mechanism previously recommended a mix of at least 80% of social distancing, minimizing travel between cities, and isolation of confirmed cases, 80% contact tracing, widespread testing, and minimizing travel to common places, effective treatment and closure of port of entries (Perera, 2020).

The pie chart in figure 3 represents the main sources of COVID-19 cases in Sri Lanka. The Minuwangoda/ Peliyagoda cluster and their close contacts are 5,395 (60.82%) of the total cases. This cluster is the cause behind the current surge of cases experienced in Sri Lanka. 1,464 (16.51%) Sri Lankans who returned from other countries have been infected and 97 (1.09%) foreigners were found to be infected. The number of cases reported from the Navy and Kandakadu cluster with their closely contacted people is 950 (10.71%) and 651 (7.34%) respectively. The source of the remaining 313 (3.53%) cases of COVID-19 infected patients, who are undergoing treatments, is yet to be identified.

A comparison between the rates of recovery and emergence of new cases is illustrated using a line graph in figure 4. According to the past 7 days from the 24th of October to the 30th of October, an increment in rate of recovery can be observed, however as the graph shows peaks and troughs, the recovery rate cannot be said to be high or low however as higher recoveries were observed on the 25th and 29th, this trend is expected to continue as long as identification of the infected is done at early stages. As of the 1rst of November 4,905 recoveries were reported. The rate of emergence of new cases is rapidly increasing as many new clusters have been found, additionally more PCR tests are being performed on a daily basis and the authorities are able to trace immediate contacts of the infected.

When dealing with pandemics, researchers use forecasting techniques to design better strategies and take productive decisions (Kalamkar et al., 2020). Forecasting helps in predicting the upcoming months, thereby allowing improvement in the management of economical and public health issues. As there is no knowledge available in regards to when the pandemic will cease, forecasting is vital as new strategies can be adopted and preventative countermeasures against COVID-19 can be further improved. Previous statistical analysis studies involved the use of forecasting techniques such as single exponential smoothing and Holt linear trend method, in this study forecasting using time series is utilized. Figure 5 shows a forecasting

graph for the number of new cases reported in Sri Lanka. The forecasting shows that the number of new cases reported will decrease before experiencing a surge in case there are no new counter measures introduced, thus it is vital that that the current COVID-19 strategy be revised to control the current surge in cases.

Conclusions and Recommendations

Statistical analysis of COVID-19 events helped greatly in analyzing the impact of the disease and helps to determine the patterns of pandemic spread, therefore playing a huge role in establishing an understanding in regards to the necessary steps required for making new countermeasures against the ongoing pandemic. The analysis can be used to check whether the current countermeasures being taken are efficient at controlling the spread. As more tests are being conducted; the detection of COVID-19 at its early stages can take place hence the treatment process can become shorter and the rate of deaths occurring due to complications, that arise in the serious stage of the disease can be reduced, thus ultimately increasing the recovery rate.

Following safety guidelines including maintaining social distancing will lead to a reduction in the spread of COVID-19 and furthermore implementation of another island wide lockdown is not feasible as the country is still recovering from the economic damage experienced during the previous lockdown therefore it is vital that the public stays updated with local health announcements and abide by the given health guidelines.

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WAGE DETERMINANTS OF THE SRI LANKAN LABOUR MARKET: A STUDY IN FOUR MAIN DISTRICTS

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Abstract

The emphases on wage determinants have been evolving since Jacob Mincer's Earnings Function in 1958. Accordingly, the objective of this study is to analyse the determinants and differentials of hourly wages in Sri Lanka using data from Labour Force Survey in 2017 for Colombo, Gampaha, Kalutara and Kandy districts. It utilizes the Ordinary Least Squares method to obtain statistical inferences and estimates provided by this study demonstrate a cross section of society. Gender, Education, Age, English Literacy, Vocational Training, Ethnicity, Type of the Earner, Locality and District are the main independent variables of this study. It concludes that apart from Type of the Earner, other variables indicate a significant impact when determining hourly wages and depicts opposite results compared to previous studies. Evidently, it is vital for policy makers to identify these variables and their importance in order to ensure an equal income distribution among individuals of a nation.

Keywords: Determinants, Earnings Function, Ordinary Least Squares, Wages

Introduction

With major advancements in technology, innovation, and the concept of globalization, labour economics have experienced a significant transformation over the last half century. From aggregate measures of human capital during Theodore Shultz, to Jacob Mincer's pioneering earnings distribution model in 1958, economists have been attempting to identify and model human earnings for an extensive period of time (Polachek, 2007). Evidently, the incentive for these researchers to understand individual earnings can be seen in the fact that it directly links with an individual's wellbeing. It is thereby, vital to identify the determinants of wages of individuals in order to develop and design mechanisms to promote an adequate standard of living, reduce poverty and finally, bring forth a course of equal and inclusive growth and development.

The Mincer Wage Equation can be identified as the theoretical framework that commonly influences wage related studies. The Mincer equation has been employed not only when attempting to measure wage returns with regard to education, but further, for wage inequality literature as well. By treating school and occupation as forms of investment, Mincer introduced an econometric specification which has now been distinctively identified as a log-linear earnings function (Polachek, 2007). This paper attempts to follow the theoretical concept set forth by Mincer and is driven by one major objective of identifying basic wage determinants among the labour force. As the discipline of labour economics become more complex, comprising of various theories to understand wage determinants and their impacts it is important to ensure such knowledge is compatible and considered in policy directives owing to the significant role wages play in estimating social and economic wellbeing of individuals.

Significance and Problem Statement

A vast amount of empirical evidence suggests that wages are affected by variables such as gender, age, education, and sector of employment. Nevertheless, it is important to comprehend the impact of these variables for a country like Sri Lanka, while further considering the variables such as English Literacy, Ethnicity and Vocational Training, because Sri Lanka has always been considered as a country with high levels of literacy and different ethnic groups. Thereby, attempting to investigate their potential impact on wages may be important for policy purposes.

Methodology

Data Description and Sample Profile

This study utilizes Ordinary Least Squares (OLS) method to estimate and predict regression results employing StataMP13 software. The research is sourced from a secondary cross sectional data sample obtained from the Labour Force Survey in 2017. A total number of 5462 observations have been considered in this study, of which, 81.3 percent are monthly wage earners and remaining are daily wage earners. The sample consists of individuals who are above the age of 15 years, which is defined by the Department of Census and Statistics (2017) as the Labour Force. Among them, 74 percent of the respondents work in the private sector while, 20 percent in the government and 6 percent in the semi-government sector, approximately. With regard to the educational profile of the sample, majority (45.39 percent) of individuals have completed their secondary education. Evidently, 62 percent of the respondents are from the rural sector, followed by 35 percent and 3 percent from the urban and estate sectors, respectively. Respondents are from Colombo (35 percent), Gampaha (32 percent), Kalutara (17 percent) and Kandy (16 percent) districts.

Model Specification

The following framework was employed to identify the impact Gender, Age, Education, English Literacy, Vocational Training, Ethnicity, Sector, Type of Employment (Monthly/Daily), Locality such as urban, rural or estate, and District have on the hourly wages of respondents. Moreover, as stipulated in previous literature, age is utilized as a proxy for labour market experience in this study. The model is constructed in a log-linear format due to empirical evidence from previous studies which utilize the Mincerian function and further, in order to obtain a normal distribution for the dependent variable. Furthermore, both age and the squared value of age are incorporated within the model to identify both the relationships between age and the dependent variable, and to understand the variation in wages as the respondents' age changes.

$$lnWages_i = \beta_0 + \beta_1 Gender_i + \beta_2 Age_i + \beta_3 Agesq_i + \delta_P Prim_i + \delta_I Int_i + \delta_S Secon_i + \delta_T Ter_i + \beta_4 Englit_i + \beta_5 VT_i \quad \delta_{SL} SL\_Tam_i + \delta_{IN} In\_Tam_i + \delta_M Muslim_i + \delta_B Burger_i + \delta_R Remain_i + \delta_S Semigvt_i + \delta_P Pvt_i + \beta_6 Type\_earn_i + \delta_E Estate_i + \delta_R Rural_i + \delta_G Gamp_i + \delta_K Kalu_i + \delta_{KA} Kandy_i + \varepsilon_i$$

A Description of each variable is detailed in Table 01 below.

Table 01: Description of Variables

Variable	Description	Variable	Description
$lnWages_i$	Log Hourly Wages	$\delta_B Burger_i$	Burger (Burger=1; Other=0)
$\beta_1 Gender_i$	Gender (if Male=1)	$\delta_R Remain_i$	Remainder of Race (Remain=1;Other=0)
$\beta_2 Age_i$	Age	$\delta_S Semigvt_i$	Semi-Government (Semigvt=1;Other=0)
$\beta_3 Agesq_i$	Squared Value of Age	$\delta_P Pvt_i$	Private Sector (Private=1;Other=0)
$\delta_P Prim_i$	Primary Education (Prim=1; Other=0)	$\beta_6 Type\_earn_i$	Type of earner (Monthly=1)
$\delta_I Int_i$	Intermediate Education (Int=1; Other=0)	$\delta_E Estate_i$	Estate Sector (Estate=1;Other=0)
$\delta_S Secon_i$	Secondary Education (Secon=1; Other=0)	$\delta_R Rural_i$	Rural Sector (Rural=1;Other=0)
$\delta_T Ter_i$	Tertiary Education (Ter=1; Other=0)	$\delta_G Gamp_i$	Gampaha District (Gamp=1;Other=0)
$\beta_4 Englit_i$	Literacy in English (if Yes=1)	$\delta_K Kalu_i$	Kalutara District (Kalu=1;Other=0)
$\beta_5 VT_i$	Vocational training (if Yes=1)	$\delta_{KA} Kandy_i$	Kandy District (Kandy=1;Other=0)
$\delta_{SL} SL\_Tam_i$	Sri Lankan Tamil (SLTamil=1;Other=0)		
$\delta_{IN} In\_Tam_i$	Indian Tamil (In_Tam=1;Other=0)		
$\delta_M Muslim_i$	Muslim (Muslim=1;Other=0)		

Source: Authors generated from STATA

Hypothesis

- **Hypothesis 1:**

H0: Hourly Wages has no relationship with Age

H1: Hourly Wages has a positive relationship with Age

- **Hypothesis 2:**

H0: Hourly Wages has no relationship with Gender

H1: Hourly Wages has a relationship with Gender

- **Hypothesis 3:**

H0: Hourly Wages has no relationship with Residential Sector

H1: Hourly Wages has a relationship with Residential Sector

- **Hypothesis 4:**

H0: Hourly Wages has no relationship with Highest Level of Education
H1: Hourly Wages has a relationship with Highest Level of Education

- **Hypothesis 5:**

H0: Hourly Wages has no relationship with Ethnic Group
H1: Hourly Wages has a relationship with Ethnic Group

- **Hypothesis 6:**

H0: Hourly Wages has no relationship with Sector of employment
H1: Hourly Wages has a relationship with Sector of employment

- **Hypothesis 7:**

H0: Hourly Wages has no relationship with District
H1: Hourly Wages has a relationship with District

- **Hypothesis 8:**

H0: Hourly Wages has no relationship with Vocational Training
H1: Hourly Wages has a relationship with Vocational Training

- **Hypothesis 9:**

H0: Hourly Wages has no relationship with English Literacy
H1: Hourly Wages has a relationship with English Literacy

Findings and Discussion

Table 02: OLS Regression with Coefficients (General)

Dependent Variable: lnWage	
Independent Variable	
Constant	3.517*** (0.126)
Age	0.047*** (0.004)
AgeSq	-0.001*** (0.000)
Gender Female = (Reference Category)	
Male	0.212*** (0.017)
Residential Sector Urban = (Reference Category)	
Rural	-0.056*** (0.010)
Estate	-0.097*** (0.023)
Level of Education No Schooling = (Reference Category)	
Primary Education	-0.050 (0.098)
Intermediate Education	0.138* (0.129)
Secondary Education	0.339***

	(0.098)
Tertiary Education	0.768***
	(0.013)
Ethnic Group Sinhalese = (Reference Category)	
Sri Lankan Tamil	-0.069*
	(0.040)
Indian Tamil	-0.112*
	(0.061)
Sri Lankan Moor	-0.147***
	(0.036)
Burger	0.236
	(0.100)
Other	-0.038
	(0.076)
Sector (Government = (Reference Category))	
Semi-Government	0.104***
	(0.037)
Private	-0.059***
	(0.023)
District (Colombo = (Reference Category))	
Gampaha	0.009
	(0.022)
Kalutara	-0.066***
	(0.029)
Kandy	-0.091**
	(0.034)
Vocational Training Hadn't = (Reference Category)	
Had	0.107***
	(0.022)
English Literacy Hasn't = (Reference Category)	
Has	0.213***
	(0.020)
R^2	0.411
Adj- R^2	0.408
Root MSE	0.522
No. of Observations	5,462

Note: "t statistics in parentheses"; *$p<0.1$, **$p<0.05$, ***$p<0.01$

Source: Authors generated from STATA

When attempting to analyse the relationship between Wages and Gender, this indicates that for every additional hour of wage earnings, males earn 21 percent more compared to their female counterparts, considering other factors remain constant. Theoretically, this wage differential can be attributed to the level of education and literacy. However, this is not the case when analysing educational attainment between men and women within this sample. Evidently, 48

percent of women have received secondary education, while only 44 percent of men have received the same level of education. Further, this sample exhibits that women have received tertiary education 9 percent more than men. It is then refutable that educational attainment is the cause for wage differentials. Thus, a gender bias in wage earnings can be seen in this sample. This can be commonly seen in the current labour market and may be accentuated by misconceptions that women may not be educated adequately or by ideas of women as home makers.

Moreover, when analysing the relationship between Age and Hourly Wage Earnings, it can be interpreted as, hourly wage earnings will increase by 4 percent as the respondents' age increases by an additional year, while other factors remain constant. However, the squared value of age concludes that the increasing rate of hourly earnings as age increases diminishes when the respondents become older. Thus, the intensity of the relationship between hourly wages and age falls, as is evident through this model. As proxy for labour market experience, these results prove that an individual's hourly wage earnings will increase by 4.7 percent as labour market experience increases by an additional year.

When considering the relationship between Wages and Education, respondents who have received a secondary level of educational attainment earn an hourly wage earning which is 13 percent more than those who have not schooled, 33 percent for those with intermediate and 76 percent for those with tertiary education compared to no schooling respondents, while other factors remain constant. Thus, a positive correlation between wages an education can be easily established. When analysing the reference group, it is evident that 48 percent of no schooling respondents were recorded from the rural locality, thus indicating that policies should be focused on improving educational access to all localities. The insignificant relationship between primary educational attainment and wages can be attributed to small percentage of respondents with primary education within the sample. Finally, the statistically significant coefficients of Literacy and Vocational Training indicates that, hourly wage earnings will increase by 21 percent if respondents are able to read and write in English, and hourly wage earning will increase by 10 percent if respondents have undergone any form of vocational or educational training.

This study further investigates the relationship between Hourly Wage Earnings and Race of the respondents. Evidently, Sri Lankan Tamil, Indian Tamil, Muslim respondents all receive fewer wage compared to the reference category of Sinhala in this five-vector dummy variable. Thereby, Sri Lankan Tamils receive 6.9 percent less than Sinhalese respondents, Indian Tamils receive 11 percent less, and Muslims receive 14 percent less than the reference category, while other factors remain constant. These results may indicate a racial bias within the labour market depicted in this sample. Sri Lanka being a country with a majority from the Sinhalese race, seemingly favour the majority in comparison to its minority races. In spite of Colombo being the metropolitan of the country, existence of a racial bias in the labour market requires immediate policy attention.

Furthermore, the employees in semi-government sector tends to earn 10 percent more than the employees in the government sector, and those in the private sector recorded hourly earning 5 percent less than that of the government sector, while other factors remain constant. Once again, this finding coincides with the results of Kumara (2015), which show the government sector employees with the secondary and intermediate educational attainment as their highest

attainment earn more compared to their private sector counterparts. However, private sector earnings increase for those who have tertiary or higher attainments, as concluded by Kumara (2015). This trend can be witnessed in this sample as well. A majority of 45 percent of respondents have received up to secondary level of education, and thereby, earnings within the government and semi-government sectors tend to be high.

Conclusion and Recommendation

The primary objective of this study was to determine the determinants of wages. As discussed above, Gender, Age, Education, Literacy, Vocational Training proved to indicate a statistically significant relationship with the dependent variable. Consequently, the categorical variables such as Race, Sector, Locality and District were also revealed as the vital factors that determine the level of hourly wage earnings. The regression results clearly indicate Gender, Locality, District, and Race influence in determining wages. It is thereby important to direct the policy instruments towards providing equal educational access to all regions in order to reduce wage inequalities among localities and districts. Further, the gender disparity in wages must also be addressed through policy alternatives and awareness programs should be organized in order to reduce the existing gender bias, preconceptions and strengthen the women empowerment. Hence, through the effective use of policy tools in the studies conducted on wage determinants, it can be ensured the equity and equality in wage distribution among individuals.

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LIFE SATISFACTION AMONG HEALTHCARE WORKERS: A CROSS-SECTIONAL STUDY IN PRIVATE HOSPITALS IN RAGAMA, SRI LANKA

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Abstract

Life Satisfaction is a central part of human well-being. In our lives, various factors affect life satisfaction. This cross-sectional study aimed to investigate the level of life satisfaction and associated factors among 210 healthcare workers employed at Ragama private hospitals. A survey with four instruments, including a demographic questionnaire, Satisfaction with Life Scale (SWLS), Multidimensional Scale of Perceived Social Support (MSPSS) and The Workplace Stress Scale (WSS), was utilised for the data collection. The hypotheses were analysed by one-way ANOVA test and Spearman's rank-order correlation test. Overall, the participants reported an average level of life satisfaction, and among them, the main healthcare workers had the highest life satisfaction, and it was least among the minor staff. Job type, age, education level, income, perceived social support, and work stress were significantly associated with healthcare workers' life satisfaction.

Keywords: Healthcare workers, Life satisfaction, Private hospitals

Introduction

Life satisfaction (LS) among healthcare workers has been a topic of interest for researchers for several years. However, there is still much research that needs to be done in this field, particularly in the private healthcare sector in Sri Lanka. Many assume that healthcare workers have higher LS as their service involves caring for others' lives and helping them get better. However, studies indicate that healthcare workers in Sri Lanka are often dissatisfied due to various factors, including low wages, inadequate facilities, and lack of opportunities for professional development (De Silva et al., 2013). Due to this, there has been a growing trend where healthcare professionals immigrate to developed countries for better job opportunities, higher salaries, and a better quality of life.

It has been observed that several factors including job type, age, level of education, income, perceived social support and work stress, are significant predictors of healthcare workers' LS. For instance, studies show that the LS of main healthcare workers, especially doctors and consultants, tend to be higher than the other workers, as those occupations are considered highly sought-after and prestigious professional careers (Martin, 2019).

It shows that younger healthcare workers have lower satisfaction due to low salary and relatively longer working hours which is associated with less work experience (Teixeira-Poit et al., 2017). On the other hand, older healthcare workers often have greater work experience. Therefore, they have higher stability and confidence in medical practice. Besides, they have a relatively higher autonomy in their careers, resulting in higher LS. Also, studies imply that healthcare workers with higher educational qualifications and higher-income often have higher job security and, they have access to better facilities which could again lead to greater LS (Himmelstein and Venkataramani, 2019; Singh, Parashar and Lal, 2018).

Moreover, studies conducted on social support indicate that social support increases LS by improving both family and work environment, mental health, and job satisfaction (Hou et al.,

2020). Also, it has been found that high work stress decreases LS as it causes psychological and physiological strain among healthcare workers (Mahmood et al., 2019).

The present study explored life satisfaction among healthcare workers in Ragama private hospitals, with six other previously observed socio-demographic and psychosocial factors.

Objectives
1. To investigate the LS levels of healthcare workers in Ragama private hospitals.
2. To investigate the association between healthcare workers' LS and six other factors: job type, age, education level, income, perceived social support, and work stress.
3. To fill the gap in the literature in relation to LS in all types of healthcare workers in the private sector in Sri Lanka, with a focus on identifying the associated factors.

Hypotheses
$H1_a$: The main private healthcare workers (consultants, medical officers, and paramedical specialists) have significantly higher LS levels than other private healthcare workers.
$H2_a$: The mean LS of at least one job type is significantly different.
$H3_a$: The mean LS of at least one age group is significantly different.
$H4_a$: The mean LS of at least one education level group is significantly different.
$H5_a$: The mean LS of at least one income group is significantly different.
$H6_a$: There is a significant association between perceived social support and LS.
$H7_a$: There is a significant association between work stress and LS.

Methodology
Sample
This study employed a cross-sectional study design. As participants, 210 healthcare professionals in all 4 private hospitals in Ragama were selected using the purposive sampling technique. All the workers who participated in this study were above 18 years old without significant physical and mental disabilities.

Materials
1. Demographic Questionnaire
2. Satisfaction with Life Scale [SWLS] (Diener et al., 1985)- This is a 5-item questionnaire with a 7-point Likert scale, 1 being 'strongly disagree' and 7 being 'strongly agree'. Scoring: 30-35= very high/ highly satisfied; 25-29= high; 20-24= average; 15-19= slightly below average; 10-14= dissatisfied; 5-9= extremely dissatisfied. Internal reliability for the scale was previously determined as a Cronbach's alpha of 0.87 (Pavot and Diener, 2009).
3. Multidimensional Scale of Perceived Social Support [MSPSS] (Zimet et al., 1988)- This is a 12-item questionnaire with a 7-point Likert scale, 1 being 'very strongly disagree', and 7 being 'very strongly agree'. The mean score was calculated for each participant. Scoring: 1-2.9= low support; 3-5= moderate support; 5.1-7= high support. Internal reliability for the whole scale was pre-determined as a Cronbach's alpha of 0.91 (Zimet et al., 1990).
4. The Workplace Stress Scale [WSS] by the Marlin Company and the American Institute of Stress (1978)- This is an 8-item scale with a 5-point Likert scale (never = 1, rarely = 2, sometimes = 3, often = 4, and very often = 5). Item numbers 6, 7, and 8 are reverse scored.

Scoring: < 15= relatively calm; 16-20 = fairly low stress; 21-25= moderate stress; 26-30= severe stress; 31-40= potentially dangerous level of stress. Pre-determined Cronbach's alpha reliability coefficient is 0.80 (Soltan et al., 2020).

Procedure

Data collection was done through a paper-pencil survey. All the statistical manipulations were done by SPSS version 20. Hypotheses 1, 2, 3, 4 and 5 were analysed by the one-way ANOVA test. Hypotheses 6 and 7 were analysed by the Spearman's rank-order correlation test. The significance level was set at $p < 0.05$.

Table 1. *Characteristics of the Sample*

	N	%
Job Type		
Main Healthcare Workers	59	28.1
Nursing Staff	83	39.5
Associated Healthcare Workers	20	9.5
Minor Staff	48	22.9
Age		
18-35	99	47.1
36-55	77	36.7
>56	34	16.2
Level of Education		
Ordinary Level	24	11.4
Advanced Level	76	36.2
Diploma	47	22.4
Undergraduate Degree	21	10
Postgraduate Diploma/Degree	42	20
Income/Monthly Salary (LKR)		
< Rs.30,000	62	29.5
Rs.30,000-Rs.60,000	83	39.5
Rs. 60,000-Rs. 90,000	18	8.6
> Rs. 90,000	47	22.4

Results

Overall, participants reported a mean LS of 24.71 (SD= 4.85). Among them, the main healthcare workers had the highest LS (M= 27.80, SD= 4.19) followed by the nursing staff (M= 24.01, SD= 4.74), the associated healthcare workers (M= 23.75, SD= 4.74) and the minor staff (M= 22.52, SD= 4.09).

Table 2. *One-way ANOVA Results*

	F(df)	Sig.
Job Type	14.343 (3,206)	.000
Age Group	18.237 (2,207)	.000
Education Level	11.987 (4,205)	.000
Income	18.449 (3,206)	.000

Job Type & LS

LS was significant only for main healthcare workers, [F (3,206) =14.343, p < .001]. The main healthcare workers had significantly higher LS than the other job types. Therefore, H1$_a$ and H2$_a$ were accepted.

Age & LS

LS was significant only for 18-35 age group, [F (2,207) =18.237, p <.001]. 18-35 age group had a significantly lower LS than other age groups. Therefore, H3$_a$ was accepted.

Education Level & LS

LS was significant only for post-graduate diploma/degree group, [F (4,205) =11.987, p <.001]. Post-graduate group had a significantly higher LS than other education level groups. Therefore, H4$_a$ was accepted.

Income & LS

LS was significant only for '>Rs. 90,000' income group, [F (3,206) =18.449, p <.001]. '>Rs 90,000' income group had a significantly higher LS than other income groups. Therefore, H5$_a$ was accepted.

Table 3. *Correlations*

		PSS Score	WS Score
LS Score	Spearman's rho	.363**	-.320**
	Sig. (2-tailed)	.000	.000

Perceived Social Support & LS

There was a significant weak positive correlation between perceived social support and LS (r_s= .363, p <.001). Therefore, H6$_a$ was accepted.

Work Stress & LS

There was a significant weak negative correlation between work stress and LS (r_s= -.320, p <.001). Therefore, H7$_a$ was accepted.

Discussion

Based on the SWLS, participants had an average level of LS. Consistent with (Martin, 2019), the main healthcare workers reported a significantly higher LS than other workers. Also, it was noticed that most participants in the main healthcare worker category rated comparatively higher for three out of five statements in the SWLS.

It was found that the youngest age group (18-35) had a significantly lower LS compared to other age groups. Although no significant difference was found among other age groups, results indicate that LS increases with age. This has been supported by Teixeira-Poit et al. (2017).

The results showed that healthcare workers with post-graduate diploma/degree qualifications had significantly greater LS than less academically qualified workers. This was in line with Singh, Parashar and Lal (2018) findings. As indicated by Himmelstein and Venkataramani (2019), the present study also revealed that healthcare workers who earned a higher income (>Rs. 90,000) had significantly higher LS than their lower-income counterparts.

Findings show that LS increases with perceived social support. This is consistent with Hou et al. (2020). Participants' mean PSS score was 5.35, which is considered high support based on the MSPSS. Given that Sri Lanka has a collectivistic culture, this finding was somewhat expected.

Similar to Mahmood et al. (2019), this study also shows that LS decreases with work stress. Work stress was highest among the minor staff, and it was least among the main healthcare workers. This could be due to main healthcare workers having more freedom to utilise their skills, fewer rigid schedules, and higher autonomy than other workers.

It should be noted that all the participants in the '> Rs 90,000' income group were main healthcare workers. Except for one participant, all the others who had post-graduate qualifications were main healthcare workers as well. In addition, they had comparatively higher perceived social support and lower work stress. Hence all these factors might have been responsible for main healthcare workers having a significantly higher LS.

This study is subjected to limitations, such as inability to draw conclusions for causation, response biases, inequality of participants in some groups, and added stress due to the COVID-19 pandemic (bias towards the decreased quality of life).

Conclusions and Recommendations

Healthcare workers who participated in this study had an average level of LS based on the SWLS. Among them, the main healthcare workers had the highest LS, followed by the nursing staff, the associated healthcare workers, and the minor staff. Findings also inferred that being a main healthcare worker, having post-graduate qualifications, an income above 90,000 LKR, and perceived social support were associated with higher LS, whereas being younger (18-35) and having work stress were associated with lower LS. Future studies are recommended to address the limitations and investigate more factors that determine healthcare workers' LS.

For hospitals, this information will be useful in implementing practical solutions (e.g., professional development/conflict resolution/stress management programs, payment system like 'pay-for-performance') to improve working conditions to increase the LS of the hospital

staff, thereby improving the quality of care and client satisfaction, as well as increasing the employee retention and reducing the emigration of these essential workers.

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MAPPING CRIMINAL MIND: UNDERSTANDING CONTRIBUTING FACTORS TO FAMILICIDE PHENOMENON

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Abstract

Murder can be defined as numerous possible expressions of human motivations. Majority of murders indicate no inhabitations in activating his unconscious impulses. The concept of familicide challenges psychological and sociological understanding of murder. Relatively familicide received less attention in researches and emerged as byproduct in extensive. The study focused in ten familicide case records which have been issued by criminal courts. Perspective sampling was utilized to collect the materials.

Four main contents were found: criminal profiling, nature of killing, socio- cultural factors and legal illustrations.

Familicide is a rare phenomenon comparing with domestic violent and other homicides. Monopoly of men is visible in familicide. High intelligent was demonstrated in planning the crime. In contrast to previous studies unemployment and sudden provocation was low in the present study.

Key words: familicide, family violence, annihilation

Introduction

History carries proofs of murder since early 1600s. Act of murder express numerous sub pressed motivations. Mapping the mind of murderer would be the key to understand the phenomenon of murder (Podolsk, 1954). However, every phenomenon consists its own answers for the question "why?" Psychology is the science that study about mental process and behavior. Research of criminal behavior in social and psychological perspective manner would be an exclusive approach in mapping criminal mind.

"Familicide" is a rare and brutal catastrophe which can represent the dark portion of human kind. Killing one or more members in the family by another family member (Malmquist, 1980, p. 298) is a pathetic situation which has been subject to limited researches. Researchers can be sensitized to think of the possibility, but such rare events make prediction precarious. Unpredictability and continuousness of familicide indicate the essentialness in its in-depth investigation.

According to the statistics of Sri Lanka police, 271 murder incidence has been reported in the first six months of 2019 averaging 45 per month, excluding deaths of Easter Sunday attack. . Statistic Department of Sri Lankan Prison stated that the number of accused that has been sentenced to death for murder was 211 while perpetrators that has been impressment under homicide were 110 per year of 2018 ("Department of Prisons Srilanka", 2020).

Since, The Department of Statistics maintains murder crimes statistics only under classification of homicide and suicide, it is not possible to indicate the number of familicide cases that has been occurred in the country. The present study has narrowed the concept of murder into murders that conducted in family context. Further, study has focused on how does inter-related factors in familicide such as stressful family life, unemployment, deprivation and lack of educational opportunities etc. lead till a murder. This research will investigate of collaboration in external factors such as sexual relationships, socioeconomic status, traditions and legal

system effect on criminal mind along with internal factors such as motivations and triggers. Final result of this study will attempt to answer the question "why people commit murder in family context" by analyzing the causes to the phenomenon in a psychological perspective. The study pays special attention in psychological and sociological contributing factors which are unique to Sri Lankan context in familicide. Moreover, the impact that can be done through the legal system of a country in criminal mind.

Methodology

The research is a qualitative study done by using case records issued from criminal courts of Sri Lanka. Ten case reports of convicted familicide murders were selected through purposive sampling method. Pedicide, uxoricide, parricide and annihilation were included in the sample.
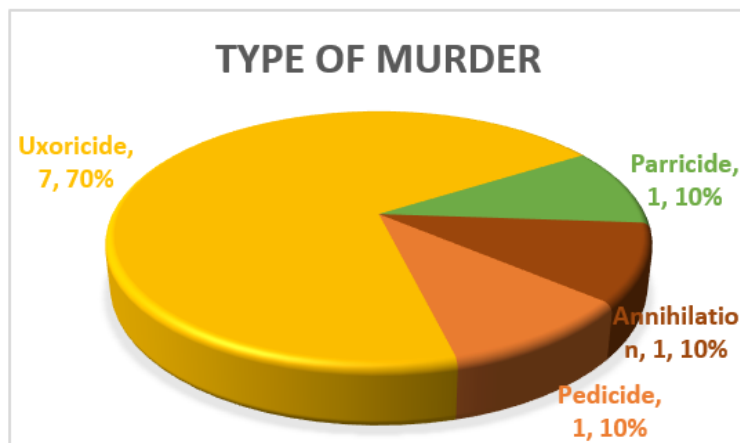
The data was extracted from case records in relevant criminal courts. This includes provincial high courts, appeal court and Supreme Court of Sri Lanka. Case records represented different geographical areas in the country.
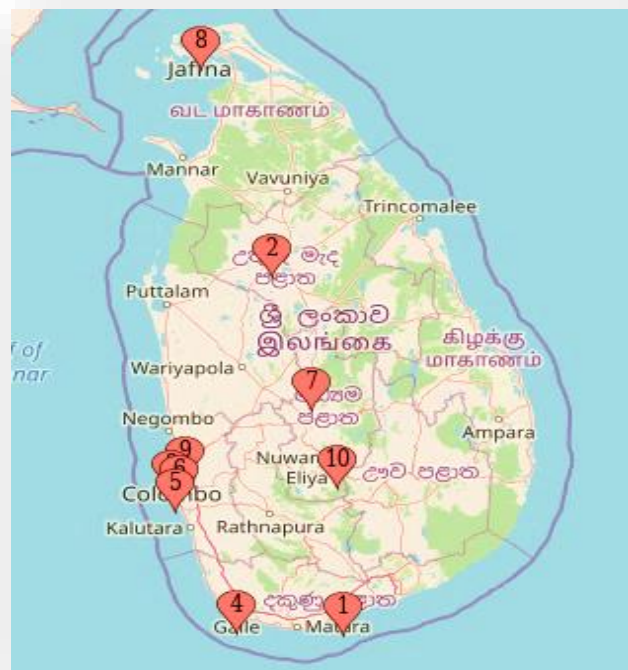
The documents used in this study are considered to be public records since these are part of evidence given in the trial. The case records utilized in this study contain information of perpetrator such as medical and criminal history, statements of relevant people such as eye witness and family members or relatives and details of crime such as crime location and killing method.

Moreover, many authorized parties such as police investigators, post mortem officers and psychiatrists have certified the information that document consists. In order to protect confidentiality all data in the sample was made anonymous. Content analysis has been selected as the most appropriate method to the present study.

Results

The results section will present the attempt of answering research question "what are the contributing factors to familicide incidents?" The result regard to profile of perpetrator, nature of crime, influences to crime and legal back ground will be discussed systematically.

Ten codes were emerged during the first stage of coding such as low self-esteem, stress/trauma, loneliness, power/control, sexual issues, peer influence, cultural impacts and elicit affairs. Finally, four major contents has been selected to proceed. The final contents were criminal profiling, socio –cultural factors, murderous intention and legal illustration.

Distribution of gender was 90% of male and10% of female. In seven cases, one partner has been killed by the other partner, one case reported as father has killed his children, another case reported as son-in- law has killed his mother-in-law while he has attempt to kill his wife and another one case reported as annihilation where father has killed the entire family.

Table1. Characteristics information

Case No.	Profile	Pre behavior	Post behavior	Motivation	Feature
01	**Self-righteous:**	Family quarrels	Surrended to the police	Illicit affairs of victim	Custody and property case
02	Paranoid / disappoint	Domestic violent	Hand over the body to police	Protection of daughter	Harassment over wife and daughter
03	Mentally ill	Fraud to spouse	Denied the crime	Illicit affair of accuse	Previous murder related to current
04	Disappointed	Separation and murder threats	Surrended to the police	Family break down	Maintenance case
05	Self-righteous	Peaceful marriage	Setting fraud fire	Illicit affair of accuse	Set up a fraud fire
06	Disappointed	Previous quarrels	Moved the body	Mental distress	Intoxication / interconnection with siblings
07	Self-righteous	Peaceful marriage	Informed about the crime	Illicit affair	Involvement of paramour to the crime
08	Anomic	Previous quarrels	Mislead the police	Financial distress	Victim was 9 months pregnant
09	Self-righteous/ disappointed	Domestic violent	Barry the body with a friend	Illicit affair	
10	Self-righteous	Separation	Denied	Illicit affairs	Adaptation of step children

All 10 crimes were planned for considerable time of period. Most utilized method was strangulation. Majority (80%) of crime location was own residence of victims. Characteristics of perpetrator covered many information of the crime.

Most significant fact that emerged in nature of killing was the creativity and differentiate of killing method which is unique to each perpetrator.

Table 2. Nature of killing

Case No.	Method of killing	weapon	Injury or fatal act	location	Planning
01	Stabbing	Vegetable knife	3 blows	Near hospital	Buy a knife
02	Cutting	Sickle	Killed and hidden	Own premises	
03	Poisoning	Medicine	Over dosed drugs caused brain damage	Vicarage	Buy large amount of drugs
04	Cutting	Baber's razor	Attacks to mother and wife	Bus stand	Coming to meet wife with razor in pocket
05	Strangulation	Manual	Setting a fire	Bed room	Re-marriage plan with paramour
06	Strangulation	Lingerie	Break scull into 63 pieces	Stairs of apartment	
07	Stabbing		Attempt of injecting drugs	Own premises	Bring insulin and knife
08	Strangulation	Manual	Strangulation with drowning	Water stream near house	
09	strangulation	Manual		Own premises	Body found after 6 months
10	Battering and drowning	Manual	Extreme bleeding	Own premises	

Out of 10 convicted murderers 8 were sentenced to death and other two were imposed 7 years of 7 year rigorous impressment.

Discussion

Concomitant of the fact that familicide more often committed by men, the majority (80%) of victims were adult female who were married or had long term relationship with the perpetrator. Similarly, study done in Finland stated 87%-100% victims were adult female. Children who were murdered in the sample cannot be identified as the primary victims of familicide. They have been killed due to inability of killer to identify them separately from the spouse. This condition has been previously explained by Lehti and co-authers (2012). In parallel, domestic

violent was visible in 80% of the sample and 60% of perpetrators has made murder threats before commit the crime. This finding can support by the study done by Hamilton and Colleagues (2013) that stated 62% had threatened to kill the adult victim before they act. Opposite to results of Liem and Koenraadt (2008) which stated familicide offenders more often has personality disorder or mental illness, present study indicated only 10% of the sample has mentally ill situation.

In contrast to many previous studies, present study do not report any unemployment of perpetrators. In fact, 30% of the sample was belong to upper class. Although 20% of the sample indicated about financial difficulties, all ten perpetrators were employed. However, 40% of the sample was belong to low socio economic level which is close to the results of a Fiji study (Adinkrah, 2001). Since, Sri Lanka has strict law in fire arms the results of killing weapon is contrast to many previous results which has been done in Western countries.

Conclusions and Recommendations

Relationship problems, mental distress and financial difficulties can be identified as triggers to familicide. Killing process is depending on psychological profile of the perpetrator. Domestic violent and murder threats can be identified as risk factors to familicide. The planning and disposal of body indicates that most of perpetrator were aware of legal system and has taken precautions against their punishments. Although it's not possible to know how many cases preventive steps have been successful to some extent, the fact familicide continue to occur suggest that these precautions could still be developed.

Since generalizability of present study is low further research of quantitative familicide can be conduct. Further, as main source of this study did not include any information about childhood of perpetrator, further study focusing on childhood would be beneficial.

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ABSENTEEISM AMONG FEMALE TEA PLUCKERS IN SRI LANKA: A QUALITATIVE STUDY

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Abstract
The study has been done to investigate causes for absenteeism among female tea pluckers in a selected estate in Badulla region, Sri Lanka. A qualitative approach was used with semi structured interviews to collect data from seventeen participants including female tea pluckers and estate staff selected judgmentally. Thematic data analysis approach showed that responsibilities of female tea pluckers towards family members mainly child care issues, self-health related issues mainly menstrual pains avoid them from attending to work. It could be identified that their culture is more connected to each other. Many sociocultural events such as attending age ceremonies, weddings, funerals of family members and neighbours, Kovil Pooja plays a major role in their life. Few other minor areas raised by them were about household activities, lack of support of family members, financial difficulties, field that are far. The findings contribute the management to develop policies to reduce absenteeism of female tea pluckers.
Key Words: Absenteeism, Estate worker, Female, Sri Lanka, Tea plucker.

Introduction

Tea is the principal agricultural export crop which contributed averagely 217 billion rupees to the country's economy in last three years (Statistics Department, Central Bank of Sri Lanka, 2019). This industry is highly labour intensive (Tea Research Institute of Sri Lanka, 2019). Most agricultural works such as pruning, weeding, fertilizing are done by male workers. Female workers are entrusted solely for plucking. Tea plucking is the major labour intensive operation and attributes 40% - 45% of the cost of production. Even though other countries use plucking machineries, most plantations in Sri Lanka are unable to introduce it due to capital investment as well as conventional single-row planting system. Tea plantations are facing a severe labour shortage at present. In addition to the shortage, they face a severe absenteeism rate of employees (Tea Research Institute of Sri Lanka, 2019; International Labour Organization, 2018).

The aim of this study is to analyse the reasons behind absenteeism by female tea pluckers in a leading estate in Badulla area. Internal records for last 05 years, shows a gradually declining female outturn to work, lesser crop being harvested when compared with the budget and increase in number of pluckers not qualified for attendance bonus. Few studies have been done within the last ten years to identify factors affecting absenteeism of tea pluckers by neighbouring country India (Goswami, 2011; Kumara, 2019). There are studies done in Sri Lanka about absenteeism in plantation sector workers (Nisanth, 2014; Justus, 2016) as well as about tea plantation workers by Karunarathna (2017) specially tea pluckers in Badulla by Rathnayake (2015). Due to the research gap related to the specific plantation selected and

further to explore these causes for absenteeism, the research question and objectives of this study were developed as follows:

Why there's absenteeism among female tea pluckers in the selected estate does occur more than the expected level?

Specific objectives:

■ To explore the lives of female tea pluckers living on the estate with an intention of identifying causes for their absenteeism for tea harvesting sessions.

■ To present pragmatic suggestions for improving attendance level of these tea pluckers.

Methodology

Inductive approach was used with data in qualitative nature. Data were collected through semi structured interviews with 11 female tea pluckers out of 186, selected judgmentally who have worked the least number of days on the estate in 2019. Interview guideline was prepared based on previous literature. Interviews held at estate office with presence of a female estate official. Further, interviews were done with six estate staff namely an administrative officer, senior clerk, estate medical practitioner, welfare officer, child development officer and school principal. The aim of the interviews had with them was to add their experience of dealing with these female tea pluckers and to verify emerging themes of the interviews had with female tea pluckers. Each interview took approximately 45 minutes. Interviews were conducted in Sinhala language as a common language for both interviewer and interviewee. All interviews were recorded and transcribed. Thematic approach was used in data analysis and was reported in a narrative style.

Results & Discussion

Female tea pluckers' age was in between 24 to 57 years. Majority of the respondents have studied up to grade 5 level (45%), more than 10 years of experience (55%), with three children (45%) and lived as an extended family (64%). The other six administrative officials' experience were in between 20 to 36 years.

The majority talked about days they got absent due to the responsibilities towards family members. Mainly they face child care issues. *"..My son gets sick very often (sigh). I have to be with him on those days and take him to hospital..".* They admit children's health care matters as well as their education matters. *"..But sometimes I go 3 times. As they give a separate day for each child for school meetings".* Most of them talked about a parents meeting, which they have to attend frequently. School principal stated that meetings are held at the beginning of every term and a monthly meeting is held only for primary section. "*Some teachers were conducting class meetings every month, because of children's poor attendance to school or they weren't studying..".* Children's misconducts has made these females to attend school meetings frequently. Majority (45%) of them are with three kids. This increases the frequency of absence due to education matters. They also face care issues of other family members. One female talked about her husband's illness. *"..Sometimes twice, thrice a month..I don't go to work..because I have to take him to weda mahaththaya".* Most of them (64%) live with their in laws which gives them the care burden on them. An administrative officer who has 21 years' experience said. *"..When the children get sick, mostly women attend to that matters (..) Also it*

is their responsibility in looking after their parents (..) specially husbands parents(..) This is their culture (..)".

Job related accidents were common self-illnesses identified. One said *"When I was pulling them (..) I slipped and sprained my leg".* Some were suffering from non-communicable diseases. *"I also have pressure and gastritis (..) I go to the hospital to get the medicine (..) days like that, I can't work (..)".* Bhadra (1985) found that cholera, malarial fever and chikungunya were deceases that were common among plantation workers which wasn't in this case. This may be due to periodic checks and programs done by health officials. Menstrual pain was another common issue. *"..That was payday ..eer.. my stomach.. every month..I haven't gone to work for 2 days".* This respondent didn't attend due to this even on the payday, the day they consider as important. This wouldn't be a reason for absenteeism for a desk job. But the posture of plucking, lack of hygienic facilities at states lead for absence. However, these respondents were reluctant to openly talk about this and this wasn't a finding in previous studies.

Another finding was sociocultural events which was a major cause identified in previous studies (Kanakaraj & Aravind, 2019; Goswami, 2020; Kumara, et al. 2019). They mentioned about religious events usually participate in Kovil. *"If puja is in the morning .. I don't go to work".* Other social events such as funerals, weddings play a major role in their lives, *"If the Funeral is about a family member (..) then 7 days (..) If it is our neighbours, then 3 days (..) If it is someone else's (..) we go in the evenings".* As estate residents live in a single building consisting of many rooms arranged side by side called line rooms or in individual units located in very close proximity, had an impact when a funeral occurred. *"It isn't nice to go to work passing their house (..)We all live in the same line know".* Another said *"For things like these we stay about 21 days".* Those things mean here her daughter's attended age rituals. It is customary for the mother to be with daughter for 21 days.

Another cause was financial difficulties. International Labour Organization (2018) also reveals that they find difficult to apply for formal bank loan schemes as their jobs aren't permanent. As a result, they obtain small loans from informal sources whom take high-interest rate. They used to not to work on the dates that money lender was to come to them. Senior clerk of the plantation confirmed that workers in general have taken loans and on most occasions they go for casual jobs as they are paid at least 1500 rupees on the same day which is above the current day's wage of the plantation. This has an effect on their attendance.

Assigning fields that are far was another reason for fewer respondents highlighted. *"(..) if I feel it's too far (..) like no. 10 or 12 (..) then I don't go".* One woman said *"Now of course, as I'm old (..) I can't go that far (..) So on those days I don't go to work".* Majority (58%) of the workers are above 45 years. There's less participation of younger generation in the plantation work which was again a concern of International Labour Organization (2018). This old age working cadre can be the reason for the occurance of health issues as the most frequent repeating theme. Household activities such as cleaning house, collecting firewood, washing clothes and lack of support of family members for those were also reasons for them to get absent to work.

Conclusions and Recommendation

This research found that many personal, social reasons affect absenteeism of female tea pluckers in the selected estate. The qualitative approach followed by semi structured interviews revealed that dependent care issues of married women such as children's education matters, kids health issues, other family members' specially parents in law's health issues are barriers to work. Self-illnesses mainly due to job related accidents, to get medicines for non-communicable diseases and menstrual cycle affects them to stay at home. Sociocultural events such as attend age rituals, funerals of family members/ neighbours, Kovil Poojas are again playing a major role in their lifestyle. Finding alternative casual jobs for facing financial issues, fields that are far, household activities and lack of support of family members were also reasons for them to get absent to work.

The above findings are useful for the administrative authority to develop policies to reduce the absenteeism. Introducing flexible working hours, a prorate payment system would be suitable for them to manage both plucking sessions and their dependent care issues. Conducting regular medical campaigns for employees as well as to their family members will be an aid for upgrading their fitness for working. Giving awareness to planning officers to consider physical fitness in scheduling workers will reduce the frequency of absenteeism due to fields that are far. Further, rewarding schemes to improve attendance, collaborating with formal financial institutes to deal with the financial needs are some pragmatic suggestions for improving attendance level. A quantitative study can be designed to generalize these findings. However the most suitable recommendation to face this issue is introducing technology. Barriers of introducing such technology may be union actions, management perception, financial barrier can also be studied.

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CHALLENGES FACED BY EDUCATORS IN AN ALTERNATIVE SCHOOL SETTING

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Abstract

Educators are individuals who help students to achieve knowledge (Hattie and Donoghue, 2016). An alternative school setting follows approaches that is non-traditional; presenting a wide spectrum of educational theories and design. Educators face challenges at alternative school settings that affect quality of their work and life (Goodwin, 2019). The aim of the study was to investigate the challenges faced by educators in relation to elements that link to the challenges in a sample of educators working in 2 different alternative schools.The hypothesis of the study was that educators in an alternative school setting are more likely to be stressed. This was a qualitative study. A number of 10 educators were chosen from 2 different alternative schools in Sri Lanka, 5 each. A purposive sampling method was conducted. Interviews were conducted that comprised 12 questions educators answered; this was audio-recorded and transcribed (Face-to-Face Interviewing, 2011). The six-step approach thematic analysis proposed by Braun and Clarke was implemented to analyze data (Braun and Clarke, 2006). Four themes were identified through the analysis; Educator work choice and desire to change, educator adaptations and consequences, management expectations, and stressful educator exposures. Most educators experienced challenges in connection to stress and time consumption that affected their quality of work and life. The findings of the study suggest that educators of alternative school setting face challenges which affect their personal lives and decrease work quality due to stress and involvement in time consuming work. This is in keeping with findings from similar previous studies. Management should be aware of the snag educators experience and create a better work environment for better educational outcome.

Keywords -Alternative Schools, Educators, Students, Challenges, Stress, Time.

Introduction

Students have requirements that cannot be met by the traditional conventional schools and some students are considered unfit for these schools, an alternative school focuses on a specialized construct to accommodate these demands (Denton and Connor, 2017). The alternative school setting serve students of different kinds and levels, those with behavior characteristics and average achievement (Aron, 2006). The school has programs for students who are expelled, violent, and also for those at risk; their programs accommodate students who are gifted remarkably in various criteria and for those who have talents (Schwab et al., 2015). Alternative schools have different themes and models and types. The benefit students receive through alternative schools are exceptional (Hobbs and Power, 2013); however, educators who work for these schools face various challenges and can be overwhelming. Previous research on the challenges faced by educators is not confined to Sri Lanka. Educators face different forms of demands; the alternative schools in Sri Lanka did not have students with extreme misconduct, however, majority of the situations were involved with students who had learning and financial difficulty and the educators had to adjust and arrange to cater to these exigencies, which is a task that involves stress and time. Alternative schools have a small student to teacher

ratio (Bowman-Perrott et al., 2007); however, this is a challenging endeavor for the educator as they require a great deal of endurance in terms of identifying and reaching to each student and has to assist additional necessities to support in learning.

The purpose of this study therefore is to investigate the challenges faced by educators in alternative schools in Sri Lanka in regards to managing stress when handling student needs confined to behavior and psychological needs; time with relevance to implementing skilled-based curriculum or in respect to fulfilling management requirement. This study is thought to bring sufficient information that will anticipate in achieving required interventions to make educator lives less testing and stressful, which will in turn help them to deliver better work quality. The fundamental research question that this study will aim to answer is that if educators working in alternative school setting face challenges in terms of stress and time and if anything has been done to improve the quality of their lives which will help them to deliver a better output and endure contentment inside and outside the school.

This study aims to answer sub questions such as: Are educators working in an alternative school likely to be stressed? Do educators working in an alternative school have the need to keep educating themselves? Do educators stick to these schools because they have ties? Do educators spend a lot of time trying to meet management expectation and preparing activity-based curriculum? Is anything being done to improve the quality of these educator's lives?

Methodology

Participants

The participants in this study were 10 educators from 2 different alternative schools in Sri Lanka. The sampling method followed for the study was purposive sampling, in which educators were with a range of experience, age and gender; selected on a voluntary basis. The interview was recorded using an audio recording machine. Verbal and written consent was received from the participant before the interview commenced.

Table 1. *Demographic details of participants*

Participant	Gender	Experience in Teaching	Experience in teaching at alternative school
1	Female	13	2
2	Female	5	4
3	Female	2	2
4	Female	14	2
5	Female	6	6
6	Female	5	3.5
7	Female	6	5
8	Female	16	2
9	Male	18	5
10	Female	2	2

Design

This is qualitative study through thematic analysis in which 10 participants were involved. This was a face-to-face interview-based research. A potential technique that is used for synthesis of

research was recognized as thematic analysis and found to be effective and therefore used in most qualitative studies (Thomas and Harden, 2008).

Procedure

On conformity of participation following ethical approval, consent forms were sent to educators via email and educators who wished to participate on voluntary basis were approached. Each educator was approached and a face-to-face interview was conducted at the school premises or via video call. The open-ended interview questions covered various aspects linked to school, co-worker, work load, family and relationships, vacation, and management requirements. Saturation of information will be more productive and meaningful when data collection is through open-ended questions (Weller et al., 2018).

Data Analysis

With the help of the audio tape recordings, the transcript was formulated. The six-step approach was used for the thematic analysis of the transcripts which is the common method to describe, analyze, and report themes and patterns in data (Braun and Clarke 2006, 2012, 2013). The steps of the analysis are summarized in the Table 2.

Table 2. Steps and description in thematic analysis

Steps	Description
Identification and Familiarization	Read data and familiarize the data type and content, check credibility of data by looking for any mistakes in data collection.
Code identification Theme identification	Identify interesting components and document them. Look for and document themes and look for data that is related to the themes generated.
Theme finalization	Finalize themes and theme names and identify data that falls into the themes.
Review themes	Check credibility of themes reviewing and ensuring that no data is missed and that they have a definite identity.
Analysis documentation	Document data after analyzing the data and ensure that resultant themes are analyzed and deduction is made ensuring that no data is left unanalyzed.

Results

The qualitative findings arose from the interviews conducted and data analysis produced many themes and codes. Substantiation and formulation gave rise to four themes: stressful alternative educator exposure, educator adaptation and consequences, educator work choice and desire to change, and management expectation that were linked to the key theme: stressful alternative educator exposure. Table 3 shows the subthemes connected to the themes.

Table 3. Subthemes in relation to themes

Themes	Sub Themes
	Work choice
Educator work choice and desire to change	Work Continuation

	Change of work place
Managerial expectations	Keep educating yourself
	Motivation
	Co-worker relationships
Educator adaptations and consequences	Personal life change
	Psychological stability
	Tough situations
Stressful alternative educator exposure	Stress
	Factors contributing to stress
	Work quality

Discussion

Contentment and desire to continue to work in alternative schools; agreement with alternative teaching methods; adapting traditional teaching methods would be difficult (Jordan, 2013). To the surprise, keep educating yourself programs required time and did not suit all educators; yet educators were motivated as it helped them to adapt to alternative teaching methods. Great team work and co-worker relationships was a plus point (Bascia and Rhiannon, 2016). Adaptability to handle tough situation – a challenge. Some educators dealt with it, others gave up. Educator personal lives - positive and negative consequences. Ability to develop critical thinking and problem solving skills, yet affected their family life due to lack of work life balance. Psychological stability – termed essential to handle students at risk and convincing parents and to tackle teaching methods. If educators had a traditional mindset, it can be psychologically stressful (Tune, 2013). Multi-tasking, extra screen time, high expectations, constant novel goals and targets to achieve, full time tables, improper break before new academic year, access to facility, lack of time leading to imbalance in work and life, device competency were factors contributing to stress and work quality. Educators agreed that keep educating yourself programs helped them to improve work quality. However; time, better working space and access to facilities was something that the alternative school setting have to provide educators for improved quality. Previous studies on teachers of traditional schools revealed similar challenges in terms of stress and work life balance (Agai–Demjaha et al., 2015); (Luk et al., 2010).

Conclusions and Recommendations

The findings of this study revealed that educators in an alternative school setting face challenges which affected their personal lives and decrease work quality due to stress and work that is time consuming. This is in keeping with findings from similar previous studies. Further larger studies are recommended to explore this area additionally in Sri Lanka; which can lead to the growth of alternative education which is fruitful as well as make life easy for the educators as they desire to work in this education system as they find contentment through this and are in agreement to the system. Management should be aware of the snag educators experience and create a better work environment for better educational outcome.

Recommendations for future research could be a quantitative or a mixed study with equivalent genders of participants to indentify challenges of educators in alternative schools or alternative

schools of Asian countries. Another suggestion for future research would be management opinion with regard to challenges faced by educators.

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