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THE IMPACT OF COVID-19 PANDEMIC ON THE TOURISM INDUSTRY OF SRI LANKA

V. Kanagasingam, PhD

ABSTRACT

Over the past three decades, tourism industry around in Sri Lanka has faced various crises including civil war, political instability, economic crises and terrorist attacks. In fact, as far as tourism industry in Sri Lanka is concerned, coronavirus pandemic is the second external trauma that hit the Sri Lankan tourism industry within the last 12-month period, while the Easter Sunday bombings of April - 2019 was the first crisis which affected tourism. A qualitative analytical approach in this study has been used as it oriented towards exploration and discovery. Multiple data collection techniques including eleven semi – structure interviews and document analysis have been employed. Snowball sampling techniques was also employed to recruit various stakeholders. Stakeholders were recruited for interviews by using a Snowball sampling technique. Data collected using different techniques in this study have been analyzed by using discourse analysis. This research concludes that there is no doubt that Sri Lanka tourism has been severely disturbed by COVID – 19 because tourism industry is extremely vulnerable and trends of the industry is determinant by several macro and micro environmental factors.

Keywords: COVID – 19; Tourism transformation; Pandemic; Source market; Re- profiling, Tourism industry

INTRODUCTION

In the contemporary world, the term of coronavirus has become a significant catchphrase since diagnosis of the first COVID – 19 diseased person in December 2019 at Wuhan, the capital of Hubei province in China. Through international transport network, particularly air travel the coronavirus spread to most parts of the world by mid – March 2020 (Gössling et al., 2020, p. 1), resulting in continuous suffering all over the world; that is why we all turn to focus on it. At the time of writing this research paper, European Centre for Disease Prevention and Control (2020) reported that 6,028,135 people have been infected and around 368,944 people have died. In the globalized world, we have to guess the impact of this pandemic beyond mortality statistics. However, historically, the world faced many crises including terrorist attacks, civil war, Tsunami and economic crisis in different periods of time (Garau-Vadell et al., 2018). These crises had divergent effects on the economic and social progress in the world (Speakman et al., 2012).

The COVID -19 and its prevention mechanism has globally created many complicated economic and socio – psychological issues. While designing the controlling mechanism for pandemic spreads, policy makers have to consider cultural and social behaviours of people (Koon, 2020). However, it is not possible to compare the impact of COVID – 19, with other global crises and their consequences. Many countries have globally been locked down for all activities except essential services. From the

medical perspective, controlling the spread of pandemic should receive priority (Chinazzi et al., 2020) but from the socio – economic perspective, this approach created a complicated scenario with the changes of demand and supply pattern of countries. The global supply chains' activities have been interrupted, impacting all business activities around the world (Cheer, 2020). Further, people reduce their consumption and their consumer behavior undergoes change resulting in international shortages of some commodities in the business organizations and leisure and travel businesses became unsought.

Now it is evident that COVID-19 has an impact not only on tourism industry but also on the global economy which can easily be mentioned (Romagosa, 2020). But questions may arise while measuring it. How is it possible to measure the impact of this crisis in the short – and long – term? An argument at tourism literature is that the effects of tourism development in a community are hard to evaluate in a quantitative manner. Referring to the impact measurements in the tourism sector, Ashley et al. (2009) argue that is difficult for policy makers and practitioners to measure the economic contribution of the tourism sector to host communities; because of this holistic calculation systems are employed. This approach measures the effects of the tourism sector through summation of the contributions of sub – sectors of the industry (hotels, travel agents, restaurants and all tourism – related businesses). The ideology is more apposite given that, in the case measurement of the effects of this crisis on tourism industry. Gössling et al. (2020,

p. 2) believe that international, regional and local travel restrictions immediately affected national economies, including tourism systems, i.e. international travel, domestic tourism, day visits, and segments as diverse as air transport, cruises, public transport, accommodation, cafés and restaurants, conventions, festivals, meetings, or sports events.

Beyond economic collapse, this health crisis and its prevention that became a route for socio-economic transitions will have a remarkable effect on travel and tourism industry globally. As it is known change in human mobility behaviour, entertainment and leisure activities, changes the face-to-face interaction and even food habit changes (Romagosa, 2020).

In the second decade of the twenty – first century Sri Lanka is considered a developing country. Sri Lanka's economic development, including the tourism sector, has progressively increased. However, after COVID-19, the Central Bank of Sri Lanka has released a report in March 2020 which indicated that the COVID – 19 spread pandemic is destroying the ailing Sri Lankan economy. This is the second setback within 12 months. After the Easter Sunday attacks – April 2019, 4.5 – 5 per cent economic growth was expected due to the political stability subsequent to the Presidential elections. But now it is difficult to meet this expectation. In Sri Lanka, manufactures and service industries are going from bad to worse. This will be the trend up to this year. The COVID-19 spread has strong impact on private business organizations including small and medium enterprises and investment throughout the year 2020. The fall in investor sentiment globally, along with their own home country challenges, will negatively impact the prospects for attracting foreign direct investments in Sri Lanka during 2020 (Central Bank of Sri Lanka, 2020). Further, the unexpected expenditure of the government has continuously increased due to medical expenditures and the granting of relief measures. Without touching the Sri Lankan tourism industry, it is not possible to mark the Sri Lankan economy because before the 1960s, Sri Lankan economy was heavily reliant on three major plantation products – tea, rubber, and coconut. The collapse in the market for these three export products forced the establishment of other strategies, particularly tourism development. As the result, Sri Lanka became one of the most well – known tourist destinations within Asia with tourism blossoming into one of the countries faster – growing industries and the third largest foreign exchange earner (Sivesan, 2019). But COVID – 19 has crippled the tourism industry. Sri Lanka Tourism Development Authority (SLTDA) has a target of getting 3.5 – 4 million tourists and earning \$ 5 billion in 2020 (Ministry of Tourism Development and Christian

Religious Affairs, 2016). Presently, it is not possible. This research explains how COVID – 19 negatively influences Sri Lanka's tourism and how should tourism industry be re- profiled itself in the world market?

COVID-19 pandemic and tourism transformation

The term pandemic, which has customarily been used to describe a new disease or at least connected with existing unorthodox permutation organisms (Doshi, 2011), “has less commonly been used to describe presumably noninfectious diseases” (Morens et al., 2009, p. 1019). As noted by Hall and his colleagues, pandemics and new diseases have long had a transformational effect on environments and societies (Hall et al., 2020, p. 2). Historically, the tourism industry has passed through various vulnerable stages. However, the present health crisis has a wide range of impact on tourism and travel industry (Cheer, 2020; Stankov et al., 2020).

As pointed out earlier, many countries worldwide have announced travel bans, regional and national lockdown. These measures created many complex and complicated issues from the socio economical point of view. Many recent researches on post – COVID-19 and institutional reports describe effect of travel bans and restrictions, and lockdown. Worldwide the tourism and hospitality industry has dwindled as indicated by number of cancellations of international flight services and cruises. For example, Romagosa (2020) notes that in addition to that global tourist product supply chains have been totally disturbed, and this is creating spillover effects throughout various levels of producer and supplier networks. Gössling et al. (2020, p. 3) argue that tourism as a system has been resilient to external shocks. However, there is enough evidence that the impact and recovery from the COVID-19 pandemic will be unprecedented. IATA (2020) reported that many airlines' companies met a financial catastrophe. Meanwhile, some governments paid compensation to some airlines including Scandinavian Airlines, Virgin and Singapore Airlines). Hoque et al. (2020) reported that the Coronavirus (COVID – 19) is a very stern mounting hazard not only to the Chinese economic growth but also to the global economy. Since in December 2019, the first Coronavirus disease person was diagnosed, the progress of China's economy including tourism sectors has slowed down. Further, Hoque and his colleagues highlighted clearly that many tourism destinations throughout China are closed down without tourist attendance, and also much tourism related business events including Conferences, cultural programmes and trade fairs are being called off, resulting in a larger number of employees losing their jobs.

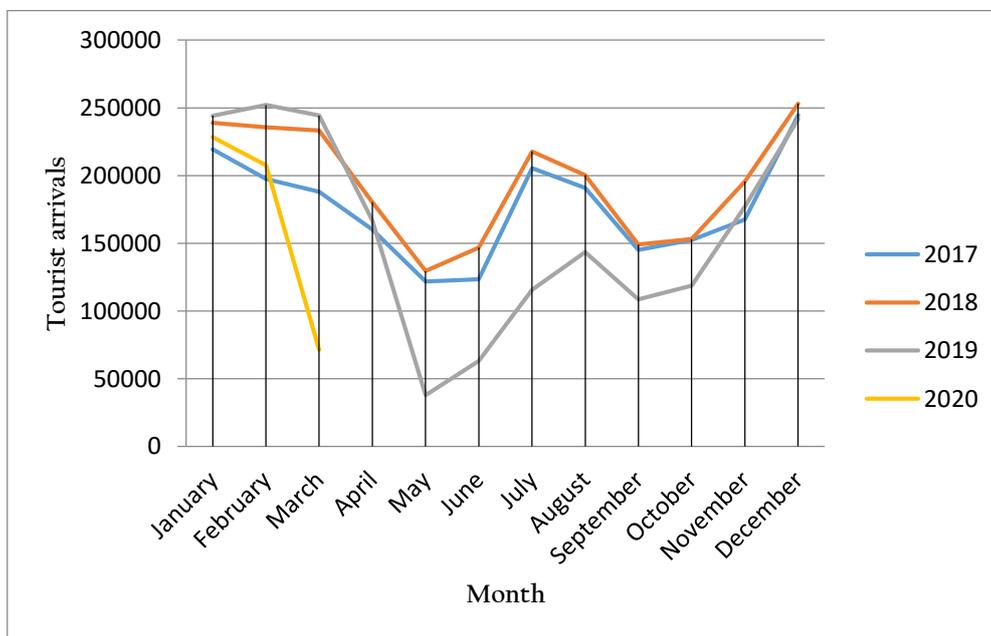
A part from that it would be believed that tourism contribution to GDP will substantially decline. COVID-19 has had a wide range of negatively impacted collision on the day – to – day activities of the key stakeholders of tourism and hospitality industry. It could lead to a severe economic crisis. Many researchers believe that present crisis situation generated the unprecedented atmosphere to the investors as well as host community. For example, Mostafanezhad (2020) articulates that all manufacturing and services industrial activities have collapsed, and in consequence the tourism and worldwide travel industry involving many employees is closing down. Thus, the well – being of the host community and employees has been affected. However, (Cheer, 2020, p. 8) indicates that “the economic wreckage that the crisis has instigated has given more than a glimpse of what life might be like in economic contraction, and for many, economic dystopia”. Gössling et al. (2020) pointed out that the contemporaneous slump has occurred unexpectedly, dashing the each and every corner of the world, and thus threatening every stakeholder in various ways. In the globalized and strongly interconnected world, the outcomes of this health crisis are not limited to a country or a person. Beyond it, it has strongly been

linked with all human activities. That is because the world has been fastened by a broad range of effective transport networking and a high level of technological development.

Research setting and Research Framework
Tourism Industry in Sri Lanka

After the civil war, the tourism industry in Sri Lanka has been transformed through rapid expansion and diversification to become one of the largest and fast-growing industries, despite many issues and challenges. The development of tourism in Sri Lanka has been characterised by political instability (including civil war), maladministration, ineffective public policies (particularly in tourism), and periodic economic crises (Cochrane, 2010; Sivesan, 2019). However, longitudinal data reveals that tourist arrivals increase continuously from a mere 18,969 when the industry was formally institutionalised in 1966 to 1,913,702 in 2019 (Sri Lanka Tourism Development Authority, 2020). It is the lowest compared with arrivals in 2018 due to Easter Sunday attacks. In 2019 from July onwards tourist traffic to the country rose continuously until February 2020 due to Novel COVID-19 spread. The following figure illustrates monthly tourist arrivals.

Figure 1: Monthly Tourist Arrivals



Source: Sri Lanka Tourism Development

In early June – 2019, in a leaked confidential assessment of the economic damage by the Easter Sunday attacks, the Central Bank of Sri Lanka claimed that loss of government revenue from indirect tax as VAT was approximately Rupees 26 billion for the year. It cited major impact on the

country’s trade deficit of balance of payments, which would be affected badly due to the negative impact on tourism. It stated further that many foreign direct investments have been postponed. Consequently, Sri Lanka was promoted as the upper middle income earning country from being a lower middle income

earning country according to the updated classification of the World Bank. The Sri Lankan hospitality sector is in the rebuilding process and on the verge of returning to normalcy with increasing number of tourist arrivals in June. Sri Lanka is one of

the most well – known tourist destinations with one of the country’s faster – growing industries and its third largest foreign exchange earner since 2016 (Reeves & Sivesan, 2017). The following table shows the important economic indicators

Table 1: The key economic indicators

	1966	1970	1980	1991	2000	2010	2015	2019
Total contribution to GDP	1.4	1.6	1.7	2.1	2.6	2.7	2.7	3.1
Total employment	N.A	12,078	47,900	64,507	37,973	132,055	316,436	402,607
Tourism receipts (US\$ mn)	1.3	3.6	110.7	156.8	252.8	575.9	2981	3606
Arrivals	18,969	46,247	321,780	317,703	400,414	654,476	1,798,380	1,913,702

Source: Sri Lanka Tourism Development Authority and Central Bank of Sri Lanka

Tourism contribution to the balance of payment accounts at the early stage was minimal. With the growth of tourism, the contribution increased from 2 per cent to 10 per cent in 2019. As a labour incentive industry, tourism has accounted for almost 15,037 jobs in 1971 to more than 402, 707 by 2019 (Sri Lanka Tourism Development Authority, 2020). The Tourism industry has generated, and continues to generate, the largest amount of foreign exchange but it fluctuates. The receipts were restricted until open economy policies were introduced, and the civil disturbances settled from 1977 onwards. Thereafter the liberalized environment was conducive for all sectors of the economy to grow; especially the tourism sector. Facilities were regulated and upgraded with systematic marketing and promotions effected to maximize visitor spending.

The development of tourism industry in Sri Lanka dates back to the British era. In fact, by the mid – nineteenth century, Sri Lanka was viewed as an important winter resort by middle – class Europeans due to inexpensive costs, climate, and the built in environment: a legacy of 450 years of colonialism by different European countries (Winter, 2016), resulting in, the growth in tourism, in the five decades to 2000, was largely driven by countries from Europe which was the dominant market region contributing as much as two – thirds of the total arrivals (Wickramasinghe et al., 2009). Asia was the second largest source region contributing 20 – 30 per cent of arrival. However, from 2000 onwards, Asia became a major tourist generating region to Sri Lanka and followed by Europe.

Table 2: Sri Lankan Tourism Source Market

	1980	1985	1991	1995	2000	2005	2009	2015	2018
North America	4.0	4.0	3.0	3.6	4.3	8.5	5.6	4.7	5.00
Asia and Pacific	25.7	33.8	32.5	31.9	26.5	46.1	44.8	49.7	49.8
Europe	67.8	60.6	62	63.2	66.8	43.1	43.8	38.0	39.8
Middle East	1.2	0.7	1.7	0.9	1.1	1.9	5.3	5.6	4.5
Others	1.1	0.9	0.8	0.4	1.3	0.4	2.0	2.0	0.9

Source: Sri Lanka Tourism Development Authority

Research Framework

In this research, a qualitative analytical approach is used as it is oriented towards exploration and discovery. Through the use of qualitative methods in this research, it is possible to explore the ideas and opinions of stakeholders as they appear throughout

the research process. For this analysis, multi-data collection methods have been employed. It is utilized to meet richness and depth to research throughout the data collection. In this research, as mentioned earlier, multiple data collection technique including interviews and document analysis are employed. This study has been developed based on primary and

secondary data. Secondary data has been derived through document analysis of relevant documents such as annual reports of Sri Lanka Tourism Development Authority. Further, primary data has been collected through interviews. The sample size of the interviews was eleven and the format was that of semi structured interviews undertaken with the key stakeholders. This conforms to other researches Lew (2014), Daskon et al. (2010) and (Becken, 2013) who have also used the qualitative methods and analysis data collection in order to find the views of different stakeholders.

During the period from March to April - 2020, data was collected through interviews, which were conducted through Zoom, based on the convenience of the participants. Snowball sampling technique was used for stakeholders. The following stakeholders were interviewed: executive officers from the Sri Lanka Tourism Development Authority, academics from Sri Lankan Universities and tourism entrepreneurs including the hotel industry, travel agents, tourist guides and transport service providers. This approach enabled a discourse analysis methodology to approach interviewees. This means that respondents are able to discuss their thoughts on the role of COVID -19 on Sri Lankan Tourism. The interviews also enabled more extended responses where interviewees discussed their experiences, attitudes and understanding of the impact of COVID – 19 on the industry.

Results and Discussion

COVID -19 and Sri Lanka Tourism Industry

Historically, Sri Lanka tourism has experienced many man – made crises and natural disasters. From these crises, the industry has gradually recovered (Buultjens et al., 2016), from the trauma of the civil war, tourism industry in Sri Lanka has been seen as one of the key economic drivers. Fernando et al. (2013, p. 708) confirmed that “ there is no doubt that the Sri Lankan tourism sector can play a vital role in the post – war inclusive development strategy in terms of generating much needed foreign exchanges, poverty alleviation via employment generation, accelerating economic growth and uplifting living standards of all Sri Lankans”. In Sri Lanka, tourism industry, for example has recruited many people as direct and indirect employees. For instance, in 2018 and 2019, 169,003 and 219,484 people were recorded as direct and indirect employees respectively (Sri Lanka Tourism Development Authority, 2020). As of now, larger numbers of employees have temporally lost their work due to the closure of most tourism – related business including restaurants, hotels and tourist airline service and travel agents. It led to the damage of livelihoods of many small and medium entrepreneurs. Respondents indicated in interviews that many tourism related businesses particularly,

cultural and heritage industries such as crafts and the performing arts have been considerably affected by the COVID – 19. Generally these shops in the surrounding tourist destinations are also homes to families engaged in enterprises. Many of them, who live at below the poverty line, are struggling to address their basic needs in the current scenario. A participant from the hotel industry said:

Tourism industry is a highly labour oriented services industry but monthly a large amount of money is needed to pay for all benefits. Within a year, the industry has faced two severe crises which have a wide range of effects on the industry in terms of net profit earning (Participant -06).

As a result of it, many hotels and restaurants began retrenching employees, and also to terminating the services of casual and temporary workers. Actually, it imposed a heavily economic burden on people who have lost their jobs in the crisis situation. A couple of questions arise “what is the role of labour Act? How does it work? What are the compensations?” By answering these questions, the reputation among stakeholders can be rebuilt. Tourism industry in Sri Lanka has been seen as vulnerable, because investors also have the same thinking. By 2009, after the civil war, investment in the tourism sector received more attention from national and international investors because the foreign investment has been opened and foreign investment policies were liberalized and this stimulated the sector. The main reason for a large investment in Sri Lanka tourism sectors particularly, in resorts and hotel in the Southern and Eastern parts of Sri Lanka which is an economic advantage. As mentioned by Sharpley et al.(2014), normally, tourism can generate economic advantages with a comparatively small amount of investment when compared to other business investment options. Sri Lankan failed to promote small and medium scale hotel industry which during the in current crisis period is ideal to follow social distancing measures. An interview participant indicated:

The instructions to commercial banks and non - banking sectors have been made by Government and Central bank of Sri Lanka. They are issuing a debt moratorium period on interest but it cannot be a long – term remedy for the recovery of industrial establishments lost (Participant 02).

Throughout the world, revenue from all tourism related businesses have continuously declined. Interview feedback confirmed that backward linkages particularly the interrelationship between tourism businesses and the host community in Sri Lanka has deeply been affected by COVID-19. Tourism – related business operators purchase items

(agriculture supplies and other domestic products) from domestic suppliers to fulfill tourist requirements; local manufactures (inland suppliers) supply most of the raw materials to the tourism industry. An hotelier indicated:

If local products are used in service delivery process, we can offer tourists products at lower price. Meanwhile, the income earning capacity of local manufactures and livelihoods of local people can be promoted. However, currently since no tourist arrivals, no income is derived in the island. As a result, local supply chain is scrapped (Participant -03).

From the host communities' viewpoint, the opportunity for backward linkages in the tourism industry previously offered positive economic and social benefits, creating high demand for domestic products, ensuring sustainable livelihoods and motivating the economic independence of the host community. As the result of the present health crisis, above mentioned all benefits enjoyed by host communities have socioeconomically been damaged. A major question for all stakeholders is that when will the tourism industry return to normalcy (Gössling et al., 2020). Many interviewees opined that Post – COVID-19, tourism development in Sri Lanka should be rescheduled. The spread of pandemic and epidemic used to generate so many social and economic problems. The effects and trends of them, however, have to be considered when making policy decisions because it is not possible to escape from the impacts of COVID – 19.

Government and Sri Lanka Tourism Development Authority realized that the industry could totally collapse unless measures are implemented soon. But people are anxious that pandemic may spread through the reopening of the international transport networks and removal of travel bans to promoting the tourism industry (Participant 10).

The first two cases diagnosed were closely connected with tourism industry. The first person was a Chinese's tourist and other was a tourist guide. However, economical perspectives, the post – COVID-19 era, tourism promotional activities are remarkably welcomed by the key stakeholders. But from the medical perspective, people's ardor to focus on health care activities than enjoying the monetary benefits from tourism industry is laudable. People are conceived that disease would be spread by increasing the international tourist traffic in Sri Lanka. The post – COVID-19 research illustrates that tourists and travelers have been viewed as probable sources for carrying the virus (Romagosa, 2020). Many tourist

destinations listed by the UNESCO have in the past, suffered by over tourism related activities. Currently, tourists and tourism activities are absent in many tourist destinations in Sri Lanka.

Recognizing the value of the domestic tourism market and catering it could contribute to the realization of the ultimate goal of long - term viability of tourism industry. However domestic tourism development has received less attention from policy makers and practitioners. The main reason for it being that, foreign exchange cannot be earned through domestic tourism. Buultjens et al. (2016) believed that domestic tourism development makes a substantial contribution to promote intercultural understanding and socio – cultural connection. Further his study revealed that in the post war context, this domestic tourism has been used as a tool to build peace and social harmony among minority and majority communities in Sri Lanka.

Sri Lanka tourism used to pay more attention to positioning itself as an important winter resort for middle – class foreigners, particularly Europeans, due to inexpensive costs, climate and the built environment; a legacy of 450 years of colonialism by different European countries (Reeves et al., 2017). Over the last two centuries, Sri Lanka was heavily dependent on Western – European markets, especially the United Kingdom and Germany which alternated between the first and second most important trading partners in the early years (Samaranayake et al., 2013). The travelers from India, China and Maldives dominate the contemporary Sri Lankan tourism market.

According to past experience, Sri Lankan source market was severely affected during the past crises situations. For example, as noted earlier, Sri Lankan tourism market before 2000 was dominated by European countries. During the civil war, many western countries including UK and Germany issued warning to their citizen not to travel to Sri Lanka, resulting in the structural change on source market. Many wars affected countries including Cambodia and Vietnam, had enjoyed the structural changes in the tourism market. Further, those countries' source markets were a swinging and unpredictable source for tourism. The changes in tourism source market would usually be held based on several factors such as geopolitical issues and destinations safety (Richter, 1999; Volo, 2008).

As the tourism destination Sri Lanka is blessed with a vast variety of natural, cultural heritage and social assets, Sri Lanka is universally perceived as providing valuable satisfaction for tourists. From the political and socio - cultural angle, Sri

Lanka has a strong link with Asian Countries (Participant -06).

During the last two decades, neighbouring countries including India, China and Maldives became the large tourist – generating sources. In the present health crisis situation, the proximity of the neighboring countries source market can be used as the way to rebuild Sri Lankan tourism market. When we look at present crisis situation in Sri Lanka’s Top – 10 source markets, most of them have critically been hit by COVID-19 pandemic. In table -03 the

total number of COVID-19 affected people, the number which recovered and the death toll of the top ten Sri Lankan source markets are given. Globally, China retained its position as the largest international tourism source market. Meanwhile, China has successfully controlled the present pandemic. If China could remove the travel bans, the concerns of air pollution and overcrowding in China are more compelling reasons for those with the means to travel abroad, and this can be to Sri Lanka’s competitive advantage.

Table 3: The total number of COVID-19 affected people, the number which recovered and the death toll of the top ten Sri Lankan source markets

Countries	Total affected	Total death	Total recovered	Death ratio %	International tourist arrivals			
					Tourist Arrivals 2017	Percentage Share 2017	Tourist Arrivals 2018	Tourist Arrivals 2018
India	267,249	7,478	129,215	2.8	384,628	18.17	424,887	18.2
China	83,043	4,634	78,351		268,952	12.7	265,965	11.3
UK	288,797	40,597	N/A	14	201,879	9.53	254,176	10.9
Germany	186,233	8,792	170,200	4.7	130,227	6.15	156,888	6.7
France	154,188	29,209	71,062	19	97,282	4.59	106,449	4.6
Australia	7,267	102	6,719	1.4	81,281	3.84	110,928	4.7
Maldives	1,916	08	925	0.5	79,371	3.75	76,108	3.3
Russia	485,253	6,142	242,397	1.3	59,191	2.80	64,497	2.8
USA	2,026,597	113,061	773,505	5.57	57,479	2.72	75,308	3.2
Netherlands	47,739	6,016	N/A	12.6	51,148	2.42	57,160	2.4

Source: COVID - 19 Situation update worldwide and Sri Lanka Tourism Development

In the medical perspective, when compared with most of the above countries, Sri Lanka is successful in controlling the spread of COVID – 19 with a lower death ratio and a high recover ratio. It shows that the success of health care services which will create a positive image to the Chinese tourists that Sri Lanka is a safe destination for travel because tourists are typically disinclined to take risk and are very keen to protect themselves from diseases and other unwanted threats. Volo (2008, p. 84) discussed that “more than any other economic activity, the success or failure of a tourism destination depends on its ability to provide a safe and secure environment for visitors, safe from all forms of controllable risks including both natural disasters and human-induced disasters such as disease, political unrest, armed conflict, and terrorism”. As a tourism destination Sri Lanka have a capability to provide a secure environment for travelers and tourists.

Implications the future of tourism

As investigation of history of the post crises faced by Sri Lankan tourism industry and recovery strategies implemented by Sri Lanka to overcome those crises situations would indicate that Sri Lankan government and stakeholders have responded in an effective way to rebuild the tourism industry. Previous researchers Bultjens et al. (2016) and Fernando et al. (2013) mention that after the civil war tourism has been successfully rebuilt, the evidence for that, a two-digit growth rate in both arrivals of international visitors and tourism revenue has been recorded. However, as noted in the introduction, the current health crisis situation provides various experiences top. Sri Lanka tourism, which compared with gained experiences from past sever crises faced by Sri Lanka tourism industry, are varied but strongly integrated with global issues. Currently throughout Sri Lanka, for example, most of the tourist destinations are suffering

from zero income and zero tourism. While making changes, global trends and global transformation have to be considered. In fact, tourism is strongly interrelated with global business and geopolitical scenario than other business (Sofield, 2006). Many researchers including Faulkner (2001) point to the globally mounting number of crises that affect the tourism industry. However, reacting effectively to a crisis can offer gainful results and create a platform reshape the industrial transformation towards future endearment. As noted by Buultjens et al. (2016) Sri Lanka, implemented post war development strategies to make a substantial contribution for promoting innovative and creative tourism industrial development with structural transformation as well as enhancing the resilience capacity of the industry. Therefore, proper tourism development strategies are necessary in the present context but as Ritchie (2004, p. 680) mention that flexibility and continual monitoring are required by organizations and destinations to design and implement effective strategies to deal with chaos and changes. It is the right time to re - profile Sri Lanka tourism. This study highlights how COVID – 19 impacted on tourism industry in Sri Lanka. Further this study provides some different strategies and tactics to overcome the problems faced by tourism industry due to the current health crisis and their consequences. In this case, recovery strategies should be implemented at two different phases, with stakeholders’ participation. Stakeholder participation has been encouraged by many researchers and international organizations. As described by Carroll et al. (1997, p. 47), “stakeholders are those individuals and groups which have a valid stake in the organization”. It is important that stakeholders with a common mindset regarding tourism management and also the tourism development process should be brought together.

Let’s discuss recovery strategies. Phase -01 has to be considered a short –run recovery mechanism. Pre – COVID – 19, Sri Lanka tourism targeted the higher spending capacity tourists throughout the world but in line this attempt, this current climate teaches us about some significant health requisition when compared with the implementation of new marketing strategies. One significant question has arisen in the minds of valuable stakeholders: How can it be possible to re – open the tourism industry with global network”. Actually, it is a big challenging question to address. But it is possible to meet it when some basic health care requisitions are taken. SLTDA should step to work with the Ministry of Health and Indigenous Medical Services in the following terms: Issuing certificate to hotels to ensure health and safety mechanism of the hotel staff, tourists and host community as well as safety and sanitary arrangement at airports

1. Preparing detailed guidelines to establish quarantine hotels with employee safety
2. Ensuring health safety measuring of tourist guides and tourism related business

As pointed in the results and discussion, tourist particularly international tourists have been viewed as virus carriers by most of the tourism stakeholders. Sometimes it may be considered as an attitude related issue, but scientifically, if the spread of virus should be controlled, we have to find remedies for that. Medical researchers suggested Polymerase Chain Reaction (PCR). Every traveler should undergo this test. At all terminals of international airports and harbours, this test should be conducted at free of charge. This approach is one sure way to control further spread in Sri Lanka through travelling and would create confidence among the host community in the context of tourism development and health care services. Positive vibration could be gradually spread towards the tourism industry after COVID-19. This will have a positive impact on rebuilding tourism industry in Sri Lanka with close collaboration of the stakeholders and various international and national funding agencies

Phase – II focuses on the long – run recovery approaches. Region based international tourism and domestic should be encouraged. Domestic tourism sector has a significant impact on the sustainable tourism development in the country (Sivesan, 2019). Sri Lankan tourism should pay more attention to develop domestic tourism in the post COVID-19 periods. That is because domestic tourism is a stabilizing force for the industry. While arrivals of international tourists can be affected by many uncontrollable factors like, international market conditions (Richter, 1999), civil war and terrorist attacks (Chheang, 2008; Lee, 2006) and geopolitical changes (Sofield, 2006) and crises (Ritchie, 2004) can affect domestic tourism. However, generally, domestic tourism lends support during these types of unavoidable circumstances. Gössling et al. (2020) believed the “domestic market can be anticipated to recover first. Sri Lanka as the tourist destination has great opportunities to extend their market within the island. However due to ethnic conflicts and some other crises including terrorist attacks and the tsunami, during the last three decades domestic tourism industry has received limited support from government. Today, the significance of domestic tourism development in Sri Lanka has been perceived. Although introducing diversified tourist products to the domestic market, promoting a wide variety of leisure activities to drawing attentions of domestic tourists, encourage Visiting Friends and Relative (VFR) which are necessary to extend. The market and can help to build resilience capacity of the industry. After post - COVID - 19, international tourism will take place within the region. As the

tourist destination, Sri Lanka will surge forward to strengthen regional tourism source market. Currently Sri Lankan source market is dominated by Asian countries like India, China and Maldives which claims 32.8 per cent of total traffic to the country. Generally, after crises, the demand for tourism used to come from neighbouring countries. During the post - Tsunami era and War, many tourists from neighboring countries visited Sri Lanka (Fernando et al., 2013; Robinson et al., 2008). So Sri Lankan tourism can target the Asian countries. Globally, China retained its position as the largest international tourism source market. Meanwhile, China has successfully controlled the present pandemic. If China will remove the travel ban, the concerns of air pollution and overcrowding in China are more compelling reasons for those with the means to travel abroad, and this can be rooted in Sri Lanka's competitive advantage. Top – ten Chinese outbound tourism source markets (Thailand, Japan, Singapore, Vietnam, Indonesia, Malaysia, Philippines, America, South Korea and Maldives) have been crippled by COVID-19. From the medical perspective, compared with most of above countries, Sri Lanka is successful in controlling spread of COVID-19 with the lower death ratio and a high recovery ratio. It shows that the health care services can create a positive image to Chinese tourists via Sri Lanka as a safe destination to travel because tourists are typically disinclined to take risk and are very keen to protect themselves from diseases and other unforeseen threats. Further, the geopolitical climate against China has changed. Some European and American leaders have given controversial statements against China. It will have an impact on China's tourism market. As pointed out earlier China is one of the leading countries to supply tourists to the world. It has a big outbound tourist market and great socio – economical, cultural and religious linkage with Sri Lanka. Such situations can be used at the optimum level to bring large number of Chinese tourists to Sri Lanka in the future. Today, in this health crisis situation, relaxations are necessary for all. So wellness tourism has to be developed with all health care services. As noted by Mueller and Kaufmann (2001, p. 5), "...wellness is seen as a new market segment and is being strongly encouraged through imaginative package deals". Sri Lanka offered, and offers the best Ayurveda, Siddha and Indigenous medical spa services for travelers. These places should be inspected to see whether they conform to the health and safety conditions of staff and tourists. If so, a new segment of tourists may be targeted.

Conclusion and Future Research Directions

This research has confirmed that there is no doubt that Sri Lankan tourism has been severely disturbed by COVID – 19 because the tourism industry is extremely vulnerable and a trend of the industry is

determined by several macro and micro environmental factors. In Sri Lanka tourism history, for the first time, the industry faced zero income and zero tourists. It brought many undesirable consequences like reduction in the size of labour force. However, the pathetic situation opened the eyes of policy makers and key stakeholders who are currently keen to see it as an opportunity to re - investigate Sri Lanka tourism' strategies and also re-profile Sri Lankan tourism. Finally, this research emphasizes that in the post – pandemic era, Sri Lankan tourism should pay more attention to attract the regional tourists like Asians in Sri Lanka. It would be useful to recover the industry from this pathetic situation. There is also a need to research COVID-19 related issues. It would be helpful to improve our understanding of impact of COVID-19 and its consequences which are associated with the tourism industry, including: case study approaches are importance to understand the ground situation in the Sri Lankan tourist destination. In fact, this approach will definitely offer additional information to create and draft marketing and tourism development strategies to uplift the industry throughout Sri Lanka.

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COMPARISON OF FINANCIAL MODELS FOR STOCK PRICE PREDICTION WITH SPECIAL REFERENCE TO COLOMBO STOCK EXCHANGE, SRI LANKA

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ABSTRACT - Time series analysis of daily stock price and building predictive models are important and complex. The successful prediction of a stock's future price will maximize investor's gains. This paper presents a comparative study and predictions for stock prices of companies listed on the Colombo Stock Exchange (CSE) using three different methods; namely, Auto-Regressive Integrated Moving Average (ARIMA), Fractional Brownian Motion Process with Adaptive Parameters (FBMAP), and Artificial Neural Network (ANN). Each of the methods was used to build predictive models using historical stock data from January 2012 to June 2018. The main objective of the study was to investigate whether stock prices follow the Random Walk Hypothesis (RWH) and to compare three major forecasting methods. To check RWH, we used Chi-square Test, the Runs Test, and the Auto-correlation Test. The Augmented Dickey-Fuller Test (ADF Test) was used to verify the stationarity of the data set. In the first phase, the best fitted ARIMA model was found using Akaike Information Criteria (AIC), Root Mean Squared Error (RMSE) and Mean Absolute Percentage Error (MAPE). In the second and third phases, FBMAP and ANN were used to predict future stock prices. Finally, the output from each of the models was compared with the actual stock price. The findings showed that the ARIMA and the FBMAP models provide a better approximation for stock price prediction compared to the ANN model. Moreover, the simulation results showed that the FBMAP model is more suitable for forecasting daily closing prices than the ARIMA model.

Keywords: Stock price; Auto-Regressive Integrated Moving Average; Artificial Neural Network; Stochastic process- Fractional Brownian Motion Process with Adaptive Parameters

1. Introduction

The stock market is one of the most vital areas of a market economy, because it provides companies with access to capital by allowing investors to buy shares of ownership in a company. The Colombo Stock Exchange is the capital stock market in Sri Lanka which consists of 20 highly capitalized firms. Listed stocks are openly traded by the public at the stock exchange through stockbrokers. The stock prices of these stocks rise and fall. When buying a stock, the investor anticipates that the price will go up. There is no guarantee that this will happen, since the stock price can also fall [1]. Investors want to take advantage of this volatility to make money out of the stock market. Therefore, if it is possible to provide a better model for the stock prices which can enable the investors to predict the prices in advance, it would help the investors as well as keep stability of the national economy. This study is an effort towards that direction. To achieve this task, first we have to check whether is past stock prices reflect on future stock prices and finally, we must produce accurate statistical/mathematical method that provide better forecasting. In the literature,

researchers in finance portrayed considerable interest in modelling stock price behavior and testing existing models. The product of their research efforts include the Random Walk Hypothesis (RWH) developed by Kendall (1953) and Fama (1965) who hypothesized that stock price movements are irregular and past prices are of no use in predicting future movements. The majority of studies on the RWH model focused on developed economies, where majority of the stock prices follow the random walk [2]. But on the other hand, research studies on Shanghai and Shenzhen stock markets and Less Developed Countries (LDCs) stock markets reject the RWH. However, Urritia (1995) provided mixed evidence for Argentina, Brazil, Chile and Mexico. Autoregressive integrated moving average (ARIMA) is one of the most popular and widely used statistical techniques for making predictions using past observations (Meyler et al. 1998). In spite of having great popularity in making predictions, this method has some limitations such as seasonality, non-stationarity, and other factors (Tambi 2005). In contrast, artificial neural networks (ANNs) are one of the most accurate and widely used forecasting models for forecasting, pattern recognition, and image

processing (Khashei and Bijari 2010). Neural network models have become more popular in forecasting over the last decade in business, economics, and finance [12]. In addition to the above two methods, stochastic modeling that uses Fractional Brownian motion to predict the stock price is very popular [9]. There are many researchers using the three basic techniques: ARIMA, ANN, and stochastic models to predict stock prices [10]. However, in the literature, there are no comparisons of using each of the three models to predict prices of Colombo stock. Most of the researchers compared performances of the two models ARIMA and ANN in stock price predictions [14], but not all of the three methods. Therefore, in this paper, we build predictive models using all of the above three modeling techniques and compare the models' performance for stock price predictions.

2. Materials and Methods

2.1 Data

The research was carried out on the basis of secondary data, which were obtained from CSE, annual report of Central Bank of Sri Lanka. The sample period spans from January 2012 to December 2017. Data from 2018 January to 2018 June have been used to validate the forecasted models. On the basis of Standard and Poor's rating, a sample of 20 companies were selected for this study. All the predictive models were used to predict the future daily closing price for the first quarter of 2018 on the basis of the present day's daily closing price. R statistical software, version 1.2.1335 was used for the data analysis.

2.2 Autoregressive Integrated Moving Average Process

The ARIMA modelling procedure is explained by identifying rejection or acceptance of RWH [1]. To examine the hypothesis, first we checked Normality of data using Chi-Square test and later checked Independency using Autocorrelation test and Runs test. If the data follows RWH, it indicated that we can forecast future stock prices. A generalized ARIMA (p, d, q) model can be written as

$$Z_t = \varphi_1 Z_{t-1} + \varphi_2 Z_{t-2} + \dots + \varphi_p Z_{t-p} + e_t + \theta_1 e_{t-1} + \theta_2 e_{t-2} + \dots + \theta_q e_{t-q} \quad (1)$$

Where $\varphi_1, \varphi_2, \dots, \varphi_p$ and $\theta_1, \theta_2, \dots, \theta_q$ are the autoregressive and moving average parameters, respectively, and e 's are the white noise. The autoregressive AR(p), order p, and moving average MA(q), order q, are determined from the analysis of the autocorrelation function [5]. The number d indicates the number of differences applied to the

time series to remove the trend. The autoregressive parameters φ 's and moving average parameters θ 's is estimated from the model based on p, d, and q. Building Steps: 1) Identification: Using graphs, statistics, Autocorrelation function (ACF) graphs and Partial Autocorrelation function (PACF) graphs, transformations, etc. to achieve stationary and tentatively identify patterns and model components. 2) Estimation: Determine coefficients and estimate through software application of least squares and maximum likelihood methods, 3) Diagnostics: Using graphs, statistics, ACFs and PACFs of residuals to verify whether the model is valid. If valid then use the decided model, otherwise repeat the steps of Identification, Estimation and Diagnostics. 4) Forecast: Using graphs, simple statistics and confidence intervals to determine the validity of the forecast and track model performance to detect out of control situation [5].

2.2.1 Chi-Square Test

The Chi-square Test was employed in this study to verify the normality assumption [6]. To apply the Chi-Square Test for Normality to any data set, let null hypothesis be that the data is sampled from a normal distribution and apply the Chi-Square Goodness of Fit Test. Following formula is used to find the chi-square statistic in this study.

$$\chi^2 = \sum \frac{(Observed - Expected)^2}{(Expected)} \quad (2)$$

2.2.2 Runs Test

A Runs Test is commonly used to check the independence in a stochastic process. Runs Test hypothesizing mutual independence of successive price changes [4]. Acceptance or rejection of the hypothesis will indicate whether the series is random or not. Assuming a random series, the mean number of runs should equal the numerical value of runs observed to detect independence. In this case, randomness implies independence whereas non-randomness in a sign of dependence [4]. Once we have the data, the mean (μ_r) and the standard deviation (σ_r) of the mean are calculated by using the formula given below

$$\mu_r = \frac{2n_1 n_2}{n_1 + n_2} + 1 \quad (3)$$

$$\sigma_r = \sqrt{\frac{2n_1 n_2 (2n_1 n_1 - n_1 - n_2)}{(n_1 + n_2)^2 (n_1 + n_2 - 1)}} \quad (4)$$

Here n_1 and n_2 are number of positive price changes and number of negative price changes respectively.

2.2.3 Auto-Correlation Test

Autocorrelation is measures the correlation coefficient between a series of returns and lagged returns in the same series. A significant positive autocorrelation leads us to believe that a relationship exists in the tested trend.

$$p(k) = \frac{\text{cov}(X_t - X_{t-k})}{\sqrt{\text{var}(X_t) \sqrt{\text{var}(X_{t-k})}}} = \frac{\text{cov}(X_t, X_{t-k})}{\text{var}(X_t)} \quad (5)$$

Where $p(k)$ refers to the serial correlation coefficient of the given time series X_t and $X_{(t-k)}$ denotes the log return of the index at time t , and k is the lag of the period. Hence $(X_t, X_{(t-k)})$ is the covariance between the return of the index, over time period $(t, t-1)$ and lagged return $(t-k)$ periods (earlier) and $\text{var}(X_t)$ is the variance of return on a security over time period $(t, t-1)$ [5].

2.3 Stochastic Model Fractional Brownian motion with Adaptive parameters

In the general accepted model, the randomness of stock price is modelled by Brownian motion process [7]. A stock price process $(X_t, t \geq 0)$ is represented by the stochastic differential equation (SDE) as shown

$$dX_t = X_t (\mu dt + \sigma dW_t) \quad (6)$$

Parameters μ and σ are the rate of return and the volatility, respectively. The process $(W_t, t \geq 0)$ in (6) is a standard Brownian motion process. The stochastic differential equation (6) is driven by the Brownian motion process $(W_t, t \geq 0)$. In the real world, μ and σ in (6) are not constant at any time [7]. Hence these parameters in the research are the adaptable parameters based on time. But in practice, the dynamics of stock price have a long memory (long range dependence). The Brownian motion with Adaptive parameters model in (6) is not suitable to describe the dynamics of stock price [7]. Therefore, the driving process of model (6) is replaced by a fractional Brownian motion process. In this case, the model can be represented by the SDE as shown in

$$dX_t = X_t (\mu dt + \sigma dB_t^H) \quad (7)$$

The $(B_t^H, t \geq 0)$ is a fractional Brownian motion process. In the study, model (7) is called a FBMAP. Alos et al. have proposed to use the process $(B_t, t \geq 0)$ instead of $(B_t^H, t \geq 0)$. So the process $(B_t, t \geq 0)$ has long range dependence. Hence, the model (7) can be considered as shown in

$$dX_t = X_t (\mu dt + \sigma dB_t) \quad (8)$$

The rate of return and volatility contained in the FBMAP are adaptive parameters based on time [7]. Therefore, these parameters are not constant. Therefore, the rate of return and volatility of prices are estimated using following equations

$$\mu_j = \frac{252}{M} \sum_{i=1}^M R_i \quad (9)$$

$$\sigma_j = \sqrt{\frac{252}{M-1} \sum_{i=1}^M (R_i - \bar{R})^2} \quad (10)$$

Where R_i is the return of stock price which can be computed by $R_i = (X_{(i+1)} - X_i) / X_i$, \bar{R} is the average of return R_i , and M is the number of returns [7].

2.4 Artificial Neural Network

ANN a field of Artificial Intelligence (AI), is a popular way to identify unknown and hidden patterns in data which is suitable for share market predictions [10]. The idea of ANN came from the structure of the animal brain, more specifically, from the human neural system. Fundamentally, the ANN mechanism has three layers—input layer, hidden layers, and output layer. Each layer

$$Y_t = W_0 + \sum_{j=1}^q W_j \cdot g(W_{0,j} + \sum_{i=1}^p W_{i,j} \cdot Y_{t-i}) \varepsilon_t \quad (11)$$

where, $W(i, j)$ and $W(j)$ for $i = 1, 2, \dots, p, j = 1, 2, \dots, q$ are known as connection weights [11]. The parameter p and q are the number of input and output nodes respectively. The input layer consists of a total of seven nodes which are daily Open, Close, High, Low, Average, Volume, and Return. Daily return was calculated by the formula $r_t = \log X_t / X_{(t-1)}$, where X_t is the daily closed price. The output layer has only one node that corresponds to the predicting variable daily close price. The best fitted ANN was selected by considering Root Mean Squared Error (RMSE), Mean Absolute Percentage Error (MAPE) and adjusted R^2 values [12]. The ANN model consist with least RMSE and MAPE values considered the best model with highest R^2 value random walk hypothesis and forecasting daily closing price for selected firms from Colombo Stock Exchange.

3. Results and Discussion

3.1 ARIMA Model Result

Since there are 20 companies, only the first company, Access Engineering PLC used to explain the process of the data analysis. The daily closing price is a time series process $\{X_t\}$, analyzed to build the ARIMA model. The process $\{X_t\}$, is not a stationary process, if we see the following graphs

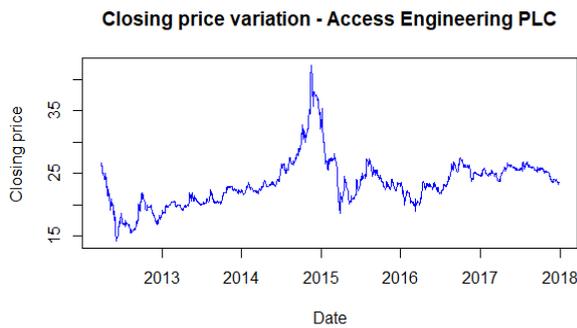


Figure 1. Time plot of the raw data – Access Engineering PLC

By inspecting the sample autocorrelation plot from Figure 4, it is clear that the Auto Correlation Function (ACF) dies down very slowly.

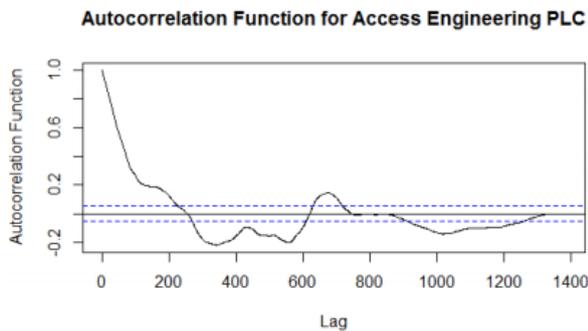


Figure 2. Sample autocorrelation plot

The autocorrelation functions given in above figures reveals the autocorrelation function of selected firm have significant correlation coefficients, so it confirms that CSE stock prices are not independent. This means that technical analysis can be used by investors. The autocorrelations for stationary series are large for low order autocorrelations but die out rapidly as lag length increases. If the series is trended, autocorrelations at low lags are very high, and decline slowly as the lag increases. So we concluded that this data set is not stationary and there is a trend. These facts ensure the process is non stationary. To make the process stationary, we transform the $\{X_t\}$, series to the $\{Y_t\} = \{\log Y_t\}$ series.

Figure 3 is the window plot of the log transformation of lag one difference for stock price. From this plot, the data looks stationary and randomized. Stationarity confirmed from the ADF test with a p value of 0.01, where the alternative hypothesis was the time series data are stationary. The autoregressive and moving average orders p and q determined from the PACF and ACF plot from Figure 3.

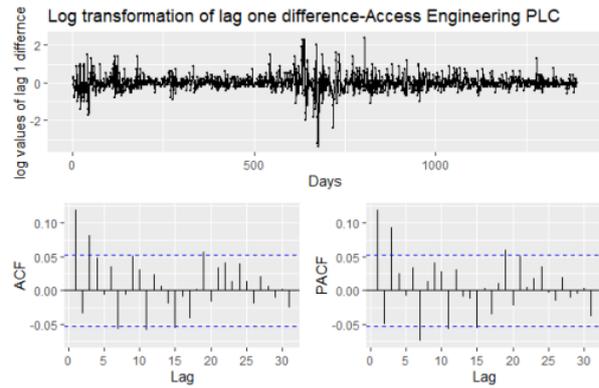


Figure 3. Log transformation of lag one difference – Access Engineering PLC

The data clearly fluctuated around zero; thus, they considered as stationary data. This finding indicated that the log transformation on the lag 1 difference is sufficient and further data treatments are unnecessary. The table 1 shows the ADF Test results for original data. It shows p-value is not significant so we can reject the null hypothesis. That is original data are not stationary. To validate that log transformation on the lag 1 difference is sufficient to make data stationary, we can do ADF Test for transformed data. The table 2 shows ADF Test results a p-value of 0.01, which indicates that lag 1 difference logarithmic transformed data is stationary with 5% level of significance. ARIMA model identification was done by considering the ACF and PACF for the stationary time series data.

Dickey-Fuller	-2.9574
P-value	0.173
Lag order	11

Table 1. ADF Test for original data Access Engineering PLC

Dickey-Fuller	-10.383
P-value	0.01
Lag order	11

Table 2. ADF Test for transformed data

The fitted ARIMA models chosen by considering Akaike Information Criteria (AIC) values of each model. The ARIMA models consist with lower AIC considered as most suitable models and among that the model consist with least RMSE and MAPE is the best model. The “auto.arima” function in RStudio software gave the output of the best ARIMA model corresponding to given data set. From Table 3, the ARIMA (1, 1, 1) model has the lowest values which fits the Access Engineering PLC daily closing price data most perfectly.

ARIMA Model	AIC Value	RMSE	MAPE
ARIMA (3,1,0)	1550.10	0.4217242	1.146771
ARIMA (3,1,1)	1551.29	0.4216016	1.145384
ARIMA (3,1,3)	1551.95	0.4210915	1.149543
ARIMA (1,1,1)	1550.23	0.4209653	1.144331

Table 3. Most appropriate ARIMA models for Access Engineering PLC

As with standard non-linear least squares fitting, the primary tool for model diagnostic checking is residual analysis. The residual analysis is a convenient graphical technique for model validation in that it tests the assumptions for the residuals on a single graph.

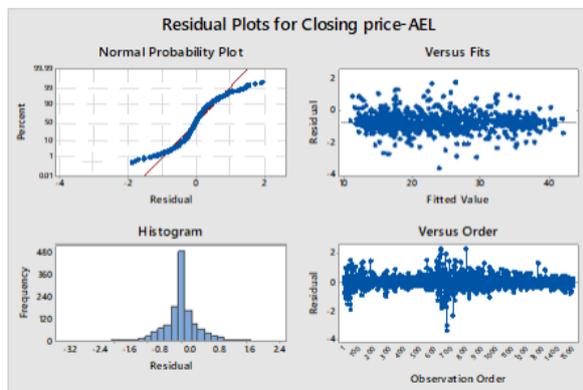


Figure 4. Residual plot – Access Engineering PLC

The residual plots followed normal distribution and constant location and scale. Most were in the range (-1,1). The histogram and normal probability plot indicated that the normal distribution provide an adequate fit for this model. In addition, the autocorrelation plot and partial autocorrelation plot of the residuals from the ARIMA (1,1,1) model generated. The autocorrelation and partial autocorrelation plot showed that for the first 31 lags, all sample autocorrelations except those at lag 30 fall inside the 95% confidence bounds indicating the residuals appear to be random. Next applied the Box-Ljung test to the residuals from the ARIMA (1,1,1) model to confirm whether residuals are random. The Box-Ljung test showed that autocorrelations among the residuals are zero (p-value = 0.01412), indicated that the residuals are random and that the model provides an adequate fit to the data. Thus, we concluded that the residuals are not distinguishable from a white noise series. Overall, we concluded that the ARIMA (1,1,1) is the best model to forecast future closing price for Access Engineering PLC. Same procedure followed

for all other 19 companies and total 50 trading days predicted by the selected ARIMA model is showed in Table 4 with prediction error calculated by the formula,

$$error = \frac{actual - predicted}{actual} * 100 \quad (12)$$

No	Company	Predicted
1	Access Engineering PLC	23.11
2	Aitken Spence PLC	40.58
3	Asiri Hospital Holdings PLC	24.48
4	Cargills (Ceylon) PLC	201.81
5	Ceylinco Insurance PLC	1688.59
6	Ceylon Cold Stores PLC	941.32
7	Ceylon Tobacco Company PLC	1017.26
8	Chevron Lubricants Lanka PLC	118.15
9	Commercial Bank of Ceylon	136.5
10	DFCC Bank PLC	120.16
11	Dialog Axiata PLC	13.09
12	Distilleries Company of Sri Lanka	201.62
13	Hatton National Bank PLC	247.15
14	Hemas Holdings PLC	123
15	John Keells Holdings PLC	159.82
16	LOLC PLC	118.25
17	NDB PLC	136.34
18	Nestle Lanka PLC	1719.55
19	People's Leasing & Finance PLC	12.11
20	Sampath Bank PLC	322.92

Table 4. Prediction by ARIMA models

3.2 Stochastic Model FBMAP Result

The model proposed in Equation (8) used to predict future daily closing price for each company and total 50 trading days predicted. Predicted average values are shown in Table 5, and the errors calculated by the same formula (12).

No	Company	Predicted
1	Access Engineering PLC	22.3
2	Aitken Spence PLC	41.1
3	Asiri Hospital Holdings PLC	24.6
4	Cargills (Ceylon) PLC	200.15
5	Ceylinco Insurance PLC	1684.18
6	Ceylon Cold Stores PLC	935.52
7	Ceylon Tobacco Company PLC	1025.45
8	Chevron Lubricants Lanka PLC	116.58
9	Commercial Bank of Ceylon	139.06
10	DFCC Bank PLC	120.05
11	Dialog Axiata PLC	13.24

12	Distilleries Company of Sri Lanka	203
13	Hatton National Bank PLC	246.83
14	Hemas Holdings PLC	122.96
15	John Keells Holdings PLC	161.58
16	LOLC PLC	118.17
17	NDB PLC	136.59
18	Nestle Lanka PLC	1726.53
19	People's Leasing & Finance PLC	12
20	Sampath Bank PLC	322.4

Table 5. Prediction by FBMAP model

3.3 Artificial Neural Network Result

Predicted average prices by ANN models are displayed in Table 6.

No	Company	Predicted
1	Access Engineering PLC	21.15
2	Aitken Spence PLC	38.85
3	Asiri Hospital Holdings PLC	23.98
4	Cargills (Ceylon) PLC	198.56
5	Ceylinco Insurance PLC	1682.48
6	Ceylon Cold Stores PLC	930.05
7	Ceylon Tobacco Company PLC	1002.87
8	Chevron Lubricants Lanka PLC	106.78
9	Commercial Bank of Ceylon	131.06
10	DFCC Bank PLC	122.46
11	Dialog Axiata PLC	11.92
12	Distilleries Company of Sri Lanka	198.62
13	Hatton National Bank PLC	242.03
14	Hemas Holdings PLC	119.87
15	John Keells Holdings PLC	152.36
16	LOLC PLC	116.08
17	NDB PLC	138.23
18	Nestle Lanka PLC	1699.85
19	People's Leasing & Finance PLC	13.06
20	Sampath Bank PLC	318.78

Table 6. Prediction by Artificial Neural Network model

3.4 Comparison

In this section, the combined output from the three models above is discussed. Table 7 shows the empirical results obtained from the models.

No	Company	Actual	ARIMA	FBMAP	ANN
1	Access Engineering PLC	22.66	23.11	22.3	21.15
2	Aitken Spence PLC	41.09	40.58	41.1	38.85
3	Asiri Hospital Holdings PLC	24.54	24.48	24.6	23.98
4	Cargills (Ceylon) PLC	200.65	201.81	200.15	198.56
5	Ceylinco Insurance PLC	1685.09	1688.59	1684.18	1682.48
6	Ceylon Cold Stores PLC	937.76	941.32	935.52	930.05
7	Ceylon Tobacco Company PLC	1052.66	1017.26	1025.45	1002.87
8	Chevron Lubricants Lanka PLC	114.76	118.15	116.58	106.78
9	Commercial Bank of Ceylon	138.18	136.5	139.06	131.06
10	DFCC Bank PLC	119.65	120.16	120.05	122.46
11	Dialog Axiata PLC	13.57	13.09	13.24	11.92
12	Distilleries Company of Sri Lanka	202.49	201.62	203	198.62
13	Hatton National Bank PLC	246.57	247.15	246.83	242.03
14	Hemas Holdings PLC	122.8	123	122.96	119.87
15	John Keells Holdings PLC	160.98	159.82	161.58	152.36
16	LOLC PLC	118.01	118.25	118.17	116.08
17	NDB PLC	136.79	136.34	136.59	138.23
18	Nestle Lanka PLC	1746.33	1719.55	1726.53	1699.85
19	People's Leasing & Finance PLC	11.92	12.11	12	13.06
20	Sampath Bank PLC	320.9	322.92	322.4	318.78

Table 7. Results from the models ARIMA, FBMAP and ANN

4. Conclusion

In this study we made an attempt to develop a prediction model for forecasting the stock market trends based on the technical analysis using historical time series stock market data. RWH does not hold true in the context of CSE and it is obvious that the successive price changes are not random. Therefore, past daily closing prices can be used to predict future daily closing prices. Then this study represents a comparative study of three financial models ARIMA, ANN, and FBMAP to predict the next-day stock prices. The experimental results obtained demonstrated the potential of ARIMA model and FBMAP model to predict the stock price indices on short-term basis better than the artificial neural network models. With the results obtained from comparison of the three models, FBMAP model can compete reasonably well with emerging forecasting techniques in short-term prediction than ARIMA model. This could guide the investors in the stock market to make profitable investment decisions whether to buy/sell/hold a share.

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AN EMPIRICAL ANALYSIS TO IDENTIFY THE MAJOR FACTORS AFFECT THE HOUSEHOLD INDEBTEDNESS IN SRI LANKA

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ABSTRACT -

Households play a vital role in an economy and over the past few years the overall Sri Lanka's household debt portfolio has seen a sharp increase. The main objective of this study is to investigate the major factors associated with household indebtedness in Sri Lanka with special reference to Kandy District. For this purpose, primary data was collected through a structured questionnaire. All households who have obtained loans in Kandy were selected as the population while 200 households were selected as the sample by using quota sampling technique. A quota was given for each divisional secretariat division in Kandy District and simple random sampling method is used to select the desired number of households from each division for the sample. This study employs multiple regression analysis to explore the determinants associated with household indebtedness in Sri Lanka. The results revealed by the data analysis, identified that the most influential factor affect the household indebtedness as an intention of maintaining the social status by borrowing durable and luxurious goods. Furthermore, the study found that low-income families, financially illiterate, unemployed households and women-oriented households are living at higher risk for accessing to credit. Therefore, based on the empirical finding of this study, it could be recommended to formulate the policies to empower the poor to rely on their own income with the help of community development programs.

Keywords - Household Indebtedness, Low Income Families, Unemployed Households, Women Oriented Household

1. INTRODUCTION

Households play a vital role in an economy because they make consumption decisions and own factors of production. Similarly, through their deposits households supply liquidity to the banks. In recent decades' household borrowing has increased significantly with respect to household incomes and they can obtain credit from banks through various credit schemes. Furthermore, household decisions are being made to maximize their utility both now and in the future. To achieve this goal household can meet their future needs by borrowing loans from their current consumption. Household sector loans consist with two main elements. Such as household loans and mortgage advances. Further, household credit can be divided into credit cards, auto loans, student's loans, personal loans at bank and lease agreements.

In recent decades the level of household indebtedness has grown significantly in many developed and developing countries. Considering the developed countries, United States household indebtedness has increased due to a significant drop in the rate of household savings and bankruptcy is associated with increased household indebtedness in United Kingdom and Germany (Jappelli et al., 2013). A

study of Catherine & Mainal (2016a) concluded that emerging Asian countries have a higher rate of household debt relative to the income of individuals. They are primarily focused on the five developing Asian countries, the Philippines, Malaysia, Indonesia, Thailand and Singapore to identify the factors that affect household debt behavior.

Wijayathunga et al. (2019a) explained overall Sri Lanka's household debt portfolio has seen a sharp increase over the past few years and it is timely to identify the factors that affect the overall household indebtedness. Failure in Sri Lanka's neo-liberal economic model pushes multilateral and bilateral creditors towards public debt and focuses on household indebtedness as a means of repaying their low incomes. Like many other economies, in Sri Lanka microfinance seeks to increase household debt and thereby raise huge profits by pushing the poor into a debt trap and worsening their living standards.

With special reference to rural Sri Lankan economy, debt has been recognized as one of the most infamous obstacles to rural development. Because it is associated with poverty. Uneven distribution of economic resources also leads to indebtedness among rural households. Lower living standards of Sri

Lankan households can be seen due to rapidly rising debt burden over the past few years. Also, Sri Lanka has a deeply expanded formal and informal financial system with a population of around 21 million. Microfinance is one of the fastest growing businesses in Sri Lanka which is directly related to household indebtedness level.

When considering the current situation in Sri Lanka 2020, island-wide curfews have hit working peoples' economies since mid-march. That means millions of working people in Sri Lanka could not work. Meanwhile, their debt continues to rise. Central Bank of Sri Lanka Annual Report of 2019 reported that 73 per cent of households in estate sector are in debt while 61.1 per cent of households are in debt in rural sector. Meanwhile, their debt continues to rise. Therefore, this study focuses on a crucial point in an economy and it is household indebtedness.

In Sri Lankan context, there have only a few studies been conducted to determine the factors that affect the indebtedness level in Sri Lanka. According to Wijayathunga et al. (2019b) identified 10 factors include both micro and macro-level factors which are determining the household indebtedness level. Gunasekara et al. (2016a) identified the employment, income, expenditure as the dimensions of household debt. Therefore, literature reviews conducted in Sri Lanka so far have not paid much attention to the impact of socioeconomics and demographic factors such as households' intention to purchase social status, level of employment, accessibility to the financial and non-financial assets, household size, gender, marital status etc. on household indebtedness. Therefore, this study is done to fill this gap.

When conducting the literature survey, it is found that Gross Domestic Product (GDP), Consumer Price Index (CPI), Housing Price Index (HPI), Interest Rate etc. are associated with household indebtedness. But this study only considers how socioeconomic factors and demographic factors affect household indebtedness. In this study, the researcher tries to identify the factors associated with household indebtedness and examine whether demographic factors and socioeconomic factors are most likely to affect it. Moreover, this study is important for the government to understand the major factors that affect household indebtedness in the decision-making process related to poverty alleviation strategies. In addition, it is important for the bodies of authority to identify the factors that have the most impact on household indebtedness. Through that, it is providing ability to identify what factors should be more concerned by the bodies of authority to influence household indebtedness in positive manner. It also enables the authorities to influence household attitudes to balance income and expenditure levels. Through this study, households are more aware of the

concept of indebtedness and the importance of maintaining a balanced lifestyle.

2. LITERATURE REVIEW

2.1 An overview of household indebtedness

Households are considered as the primary agent of the economy, and they demand goods and services as well as provide the labor force. Furthermore, household's savings and consumption decisions have significant consequences for the economy. Therefore, household indebtedness is one of the most important decisions that every household must make in the decision-making process (Attanasio & Weber, 2010). According to a study conducted by Wijayathunga et al. (2019c), household debt in Sri Lanka has grown rapidly over the past few years. It has led to a decline in the living standards of Sri Lankan borrowers. According to them, Matale, Galle, Gampaha and Colombo districts account for more than 50% of household debt. The next section will discuss Alternative explanations of household indebtedness.

2.2 Alternative explanations of household indebtedness

The four most generally used theories to explain household debt are the Permanent Income Hypothesis, the Life-Cycle hypothesis, the theory of credit rationing and behavioral finance theory (Nomatye & Phiri, 2017). The first two hypothesis based on neo-classical economic theories, namely the permanent income hypothesis and the life cycle hypothesis were introduced by Friedman in 1957 and Modigliani in 1966 respectively. According to Laibson (1997), Behavioral financial theory has also showed that people with low financial literacy do not have self-control. Therefore, they constantly underestimate their debt burden and it is also known as the concept of "hyperbolic discount" behavior.

2.3 Socioeconomic factors effect on household indebtedness

2.3.1 Level of employment

Unemployment has a significant impact on household wages. According to Debelle (2004a), indebtedness occurs when households are unemployed because it is very difficult to pay off mortgages and loans. Furthermore, with rising unemployment in Scandinavia and the United Kingdom in the early 1990s, rising interest rates have put families in a severe financial crisis. In his opinion, the chance of getting a job again is very rare in such a situation where there is a large amount of household indebtedness. Hong & Meng (2015a) stated that unemployment is a key factor in explaining

Australia's rising household indebtedness. In line with Debelle's idea, Hong et al. (2015b) said that when households are unable to pay their mortgages due to unemployment, they become debtors.

2.3.2 Status of borrowings and savings

According to Debelle (2004c), the vast majority of household debt in every country related to home loans. Dynan et al., (2007a) explained the liquidity creates an important motivation for households to save. It can also have helped to roughly compute the level of precautionary savings of households. They further added that, if households make less precautionary savings, they are absolutely more likely to be in debt.

2.3.3 Households' major/ minor income

According to Crawford & Faruqui (2012), households' income has been a major factor influencing household indebtedness. In many cases, the household sector responds more sensitively to changes in household income. Factors that can cause unexpected changes in income contain changes in family structure, spending on medical treatments, rising interest rates, divorce, the death of a family member, or the addition of a new member to the family. Poverty is often the intention for the increase in household debt. As a result, the cost of living is so high and households are unable to make a living. Girourard et al. (2007) noted that low-income households are more likely to become debtors because they are unable to maintain their debt services.

2.3.4 Intention to maintain social status

Mishkin (1976) examined the relationship between durable commodity consumption and household debt and revealed that consumer consumption has a positive relationship with household debt. Also, the researcher examined that households take out home loans to maintain their social status. McCarthy (1997) found that as housing debt increases, the cost of durable goods decreases. According to the classical economic theory put forward by Keynes (1936), current income is a very important factor in determining household consumption.

2.3.5 Accessibility to the financial and non-financial assets

Household indebtedness often arises when buying loans, assets and services. Rani et al. (2017) revealed if the debt to asset ratio of a household is more than one, it means that more of the household assets must be used to pay off the debt. Thus it is advisable for households to maintain a very low debt to asset ratio. If that value is equal to one, households have to pay

the same amount of debt as assets. When this rate goes down, families are less likely to go bankrupt.

2.4 Demographic factors effect on household indebtedness

2.4.1 Household heads' level of education

The level of education has contributed to the increase in overall household debt. Dynan et al. (2007b) pointed out that highly educated households have steeper life cycle income sources. Therefore, the higher the level of education, the more the youth community borrows. In contrast to this idea, Brown & Graf (2012) revealed that the use of debt has decreased with the level of education. However, the study suggested that in addition to the level of education, other factors affecting debt should also decrease in order for households' debt levels to decrease.

2.4.2 Marital status

Sullivan et al. (1995), Family breakdown and family divorce are directly linked to the housing loan crisis. Heads of households suffer from stress and depression due to inability to repay loans. This has become a major factor that can lead to misunderstandings in the family. As a result, family breakdown and divorce are common. Further, Catherine et al. (2016b) revealed that lack of self-confidence, poor communication skills and lack of friendship with neighbors can be studied in debt-ridden residents.

2.4.3 Household heads' age

Nizar (2015) pointed out that according to a report by the Malaysian Department of Liquidity, about 60 Malaysians go bankrupt every day. Most of them are young people, all between the ages of 18 and 35. According to the Malaysian Insolvency Department (2016), most bankruptcy victims in Malaysia are between the ages of 25 and 44. Many young people have taken out loans to buy a car after completing their degree without considering their ability to afford it. Because of these circumstances, they will go bankrupt at a young age. The age of households can be used to determine the level of debt of the households and household indebtedness tends to increase during youth and it gradually declines with the age (Yilmazer & Devaney, 2005)

2.4.4 Household size

Household size plays an important role in determining the amount of household indebtedness. Jianakoplos & Bernasek (1998) believed that if a family has a large number of children and non-working adults, the amount of debt that the family

will have to pay is relatively high. The study further said that the indebtedness of a household is determined by the number of economically active household members, the number of dependent children and the number of unemployed in the family.

2.4.5 Household heads' gender

Another factor influencing the availability of credit is the gender of the household heads. Keese (2010) stated that after controlling the debt service rate, women are more likely than men to be financially stable. Lusardi & Mitchell (2017) investigated that if the borrower in the household is a woman, she will inevitably in debt. In contrast, Dunn & Mirzaie (2012) said that a survey of household debt in the USA did not show that households' gender had any effect on debt.

3. MATERIALS AND METHODS

3.1 Operationalization

This study is primarily based on household indebtedness, which is the dependent variable of this study. Also, socio-economic factors such as level of employment, status of borrowings and savings, households major/ minor income, intention to maintain social status, accessibility to the financial and non-financial assets, as well as demographic factors affecting household indebtedness, such as household heads' level of education, marital status, household heads' age, household size and gender can be identified as independent variables.

3.2 Population and Sampling

The population of this study has been identified as all households in the Kandy District who obtained a loan in 2018 from the Bank of Ceylon (BOC) Head Office in Kandy. According to the data, all households in the Kandy District are connected to 20 Divisional Secretariats namely; Akurana, Delthota, Doluwa, Ganga Ihala Korale, Harispattuwa, Hatharaliyadda, Kandy Four Gravets & Gangawata Korale, Kundasale, Medadumbara, Minipe, Panvila, Pasbage Korale, Pathadumbara, Pathahewaheta, Poojapitiya, Thumpane, Udadumbara, Udalalatha, Udunuwara and Yatinuwara. A total of 200 households were selected from the population to obtain the data required for this study. A questionnaire is used to obtain study related data. And the sample was selected using quota sampling technique. A quota is given for each divisional secretariat division based on the percentage of the households in that division. Also, simple random sampling is used to select the desired number of households from each division for the sample. The equation used to select the sample is as follows.

$$\text{Sample} = \frac{\text{households in each D.S division}}{\text{total households in kandy district who obtained a loan from BOC}} * 200 \quad (1)$$

3.3 Method of data analysis

Based on the characteristics of the data collected through a questionnaire, it was analyzed and encode using SPSS 22 computer software. The researcher used multiple regression model of time series analysis to identify the impact of ten independent variables on the dependent variable. The equation for the regression model is as follows;

$$\hat{Y} = \beta_0 \pm \beta_1 X_1 \pm \beta_2 X_2 \pm \beta_3 X_3 \pm \beta_4 X_4 \pm \beta_5 X_5 \pm \beta_6 X_6 \pm \beta_7 X_7 \pm \beta_8 X_8 \pm \beta_9 X_9 \pm \beta_{10} X_{10} + \epsilon_i \quad (2)$$

Where,

\hat{Y} = Household indebtedness = (Total amount of loans per month/Monthly income)

$\beta_0, \dots, \beta_{10}$ = Regression coefficients

X_1 = Intention of maintaining the social status by purchasing durable/luxurious goods

X_2 = Status of borrowing and savings

X_3 = Households' major income /minor income

X_4 = Availability and accessibility to the financial sources

X_5 = Status of employment

X_6 = Household heads' age

X_7 = Household heads' gender

X_8 = Household size

X_9 = Household heads' level of education

X_{10} = Marital Status

ϵ_i = Random error term

4. RESULTS & DISCUSSION

4.1 Multiple Linear Regression analysis

Table 1: Regression output of multiple regression analysis

Model	Unstandardized Coefficients		Sig.
	B	Std. Error	
(Constant)	5.643	.028	.000
Intention to maintain social status (SOC)	.704	.028	.000
Borrowing saving status (BSA)	-.025	.028	.374
Availability to the financial / non-financial sources (FNF)	.012	.028	.673
Household marital status (MS)	-.021	.028	.452
Household heads gender (HG)	.068	.028	.016
Household size (HS)	.038	.028	.181
Household heads educational level (EDU)	-.092	.028	.001
Household major / minor income (INCO)	-.057	.028	.042
Household heads age (HA)	.016	.028	.573
Employment status (EMP)	-.056	.028	.046

a. Dependent Variable: Household indebtedness

Source: Survey data (2020)

$$\hat{Y} = 5.643 - 0.56 \text{ EMP} + 0.68 \text{ HG} - 0.92 \text{ EDU} - 0.57 \text{ INCO} + 0.704 \text{ SOC} \quad (3)$$

H₁ – Intention of maintaining social status positively impacts on household indebtedness

This hypothesis was supported by the results obtained from the regression analysis. According to the results, the intention to maintain social status has a positive effect on household indebtedness (intention to maintain social status = 0.704). Since the output p value (0.000) is less than the critical p value ($p < 0.05$), the output results are statistically significant at 95% confidence level and H_1 is accepted. This hypothesis also confirms that indebtedness gradually increases as a household increases its consumption of luxury goods and durable goods to maintain their social status.

H₂ – Borrowing and saving status positively impacts on household indebtedness

According to Table 1, the p-value of borrowing and savings status is 0.374, which is greater than 0.05. It therefore shows that borrowing and savings status have no effect on household indebtedness. H_2 should therefore be rejected at 95% confidence level as the

dependent variable is not significantly predicted by the borrowing and savings status.

H₃ – Household major / minor income negatively impacts on household indebtedness

When analyzing the data for household major / minor income, it is justified that, Household major / minor income negatively impacts on household indebtedness (Household major / minor income = - 0.57). The findings of the study found that, p-value of the household major / minor income is less than the critical p-value ($0.028 < 0.05$) and this is statistically significant under the 95% confidence level. If households have major and other sources of income, they are less likely to become debtors. That is, there is an inverse relationship between household income and indebtedness. Therefore, H_3 is accepted.

H₄ – Availability and accessibility to the financial / non-financial sources positively impacts on household indebtedness

According to the regression analysis, the researcher found that household indebtedness at 95% confidence interval had no significant impact from Availability and accessibility to the financial / non-financial sources. This is because the p value is not significant ($0.423 > 0.05$). Therefore, based on multiple regression analysis, the researcher concluded that household indebtedness had no effect from financial / non-financial sources and that H_4 should be rejected.

H₅ – Employment status negatively impacts on household indebtedness

When considering the p-value of the employment status, it is less than the critical p-value ($0.046 < 0.05$) and zero is not lying in between the lower and upper limits. Also, it has a negative value of - 0.56. Therefore, employment status inversely affects household indebtedness. That hypothesis emphasizes that as households' employment status gradually increases, they are less likely to become debtors. Furthermore, H_5 should be accepted at a level of 95% confidence interval as the dependent variable is significantly predicted by employment status.

H₆ – Household heads age negatively impacts on household indebtedness

In considering regression analysis, the p value (0.564) of the age of the household heads is not statistically significant at 95% confidence interval. This is because the associated p-value is higher than the critical p-value ($0.564 > 0.05$). Therefore, the researcher rejected the H_6 hypothesis.

H₇ – Household heads gender positively impacts on household indebtedness

According to the results, the gender of the head of the household has a positive effect on the household indebtedness (gender of the head of the household = 0.068). Since the output p value (0.016) is less than the critical p value ($p < 0.05$), the output results are statistically significant at 95% confidence level and H₇ is accepted.

H₈ – Household size positively impacts on household indebtedness

According to Table 1, the p-value of the Household size is 0.181, which is greater than 0.05. Therefore, it emphasizes that the size of the household does not affect the household indebtedness. Therefore, the H₈ hypothesis should be rejected at a level of 95% reliability. This is because it does not significantly predict the dependent variable through the household size.

H₉ – Household heads educational level negatively impacts on household indebtedness

It has been identified that the household heads educational level adversely affects household debt (level of household educational level = -0.092). The findings of the study showed that the level of education of household heads is less than the critical p-value ($0.001 < 0.05$) and this is statistically significant at a level of 95% confidence. This assumption means that if the head of the household has a high level of education, he or she is less likely to become indebted. That is, if a household has a professional skill or degree, they are less indebted. The hypothesis H₉ is therefore accepted.

H₁₀ – Household marital status positively impacts on household indebtedness

The p-value of the household marital status is 0.452, which is greater than the critical p-value of 0.05. It therefore shows that household marital status has no effect on household indebtedness. Therefore, H₁₀ should be rejected at a level of 95% confidence interval as it does not significantly predict the dependent variable by household marital status.

5. CONCLUSION

With a special reference to the households in the Kandy District, as a whole, this study concludes that the intention to maintain of social status, the major / minor income of households, the employment status, the gender of the head of the household, the level of education of the head of the household significantly affect the household indebtedness and other factors such as accessibility to the financial / non-financial

sources, age of the head of the household, size of the household, and marital status do not have a significant impact on household indebtedness. Therefore, the researcher has successfully achieved the main and specific objectives of the study. Moreover, an overview of the household indebtedness situation in Sri Lanka can be obtained from the results of this study conducted on the household indebtedness situation in the Kandy District.

5.1 Recommendations

- Households should be aware of their rising cost of living and minimize the use of credit facilities as wage substitutes to finance the rising consumption that is positively linked to household indebtedness. That means it need to develop a strong policy of protecting households rather than relying on credit to meet consumer needs.
- Policies need to be introduced to improve the consumer credit market and educate households on how to better manage services without incurring heavy debt.
- Financial literacy programs can be included in the school system curriculum to improve the financial management skills of households and prevent them from becoming bad creditors.
- Since employment is closely linked to household indebtedness, policies that promote employment or entrepreneurial opportunities are essential to improving the earning potential of households.

5.2 Limitations and implications to future research

There are several limitations to this study that future researchers should pay attention to. This particular study explored only ten variables to identify factors related to household indebtedness in Sri Lanka with a special reference to Kandy district. When considering the literature survey, it was found that gross domestic product (GDP), consumer price index (CPI), housing price index (HPI), interest rates, etc. were associated with household indebtedness. But this study considers only how socioeconomic factors and demographic factors affect household indebtedness. Therefore, only those ten independent variables are included in the developed model. However, future researchers can consider different aspects and different factors in studying household indebtedness and develop the model in a better way. Another limitation of the present study is the sample size. Also, the selection of the sample for this study is limited to households in the Kandy District. But this sample does not include all households in Sri Lanka. Therefore, future researchers can further expand the sample and provide more reliable results.

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DISTANCE DETERMINATION OF NITRATE AND NITRITE IN GUNSHOT RESIDUE BY SUPPRESSED ION CHROMATOGRAPHY

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ABSTRACT- Gunshot residue (GSR) is commonly analyzed in forensic criminal cases and important to solve issues related to forensic caseworks. The quantity of this cloud is deposited on a target varies with the distance between the target and the muzzle end. The residues found around a hole of clothing is used to investigate the muzzle-to-target distance. Nitrate and nitrite ions is used as screening tools for investigating residues. Distance determination using nitrate and nitrite concentration in gunshot residues by suppressed anion exchange chromatography was developed. The test samples were prepared by firing into white fabric with different distances. Same square portion was removed from the target material using the bullet hole as the center. When increasing the muzzle end to cloth distance up to 2.0 feet, both nitrite and nitrate ion concentrations were decreased. For all extracted samples, nitrate concentration is much greater than nitrite concentration and there is no high difference of nitrite ions between zero and 0.5 feet from muzzle to target distance (1.28 and 1.22 mg/L respectively). Nitrate and nitrite ions between 0 to 2.0 feet from muzzle end, vary from 5.5 to 2.4 mg/L and 1.3 to 0.5 mg/L respectively. Test fires beyond 2.0 feet, nitrite and nitrate ions are not significant in target material. This method was carried out with 0.38 Special Arminius HW38 revolver with Federal 0.38 special, non-jacketed, lead bullet cartridge. Therefore, that is suitable for determine muzzle to target distance within 2.0 feet.

Keywords: Gunshot residues, Anion exchange chromatography, Muzzle-to-target distance, Nitrate, Nitrite

1. Introduction

When a weapon is fired, a great volume of incandescent gaseous material is produced. The gaseous material is mainly the combustion products from the propellant and consists of carbon dioxide, carbon monoxide, water as steam and oxides of nitrogen. In amongst of this vast cloud of gases are also partially burnt and unburnt propellant particles and combustion products from the primer compound. These solid particles are collectively called Gun Shot Residue (GSR). They are also referred to as Firearms Discharge Residues (FDR), Cartridge Discharge Residues (CDR). These residues are very important in an investigation, because when attempting to prove that a person has fired a weapon, the detection of gunshot residues can be used as evidence. They can be deposited on any surface nearby, including the face, hand, hair or the clothing of the shooter. When a firearm is being fired, burned gun powder residues make a circular pattern around the gun shot entry hole. Gunpowder contains a smooth mixture of charcoal, sulphur and potassium nitrate. The mixture is highly explosive and burns rapidly producing volumes of gases and hot solids which can be used as a propellant in firearms.

The mixture of primer is kept in a primer cap, usually at the base of ammunition. Lead styphnate, azides and fulminates are the common explosives that

are sensitive to explosion. Additionally, oxidisers such as barium nitrate and potassium chlorate, as well as the fuel such as antimony sulfide, calcium silicide and aluminum powder are the main chemical components in ammunition primers. The organic components of GSRs are nitrocellulose (NC), nitroglycerine (NG).

There are some analytical methods established for organic compounds and metallic GSR identification. Such as Inductively Coupled Plasma Mass Spectrometry (ICP-MS), Neutron Activation Analysis (NAA) with the Scanning Electron Microscopy coupled with Energy Dispersive X-ray Spectroscopy (SEM-EDX), Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC), and Capillary Electrophoresis (CE). These techniques enable identification of GSR particle morphology as well as elemental composition. For these techniques, analysis times are often lengthy, therefore residues may be lost through molecular volatility, degradation or physical transfer. Mainly, it is not possible to speciate anionic counter ions with these techniques. Most forensic laboratories focus on the detection of spherical GSR- specific micro-particles which are largely metallic in nature and not quantify anions consists of GSR. And also, a lack of published work exists on the determination of muzzle to target distance using non-metallic anionic species in GSR by ion chromatography.

The goal of this research is to develop a sensitive suppressed anion exchange chromatography method to quantify nitrates and nitrites in GSR from fired cloths with different distances. These residues can be useful in determining a muzzle-to-target distance. By comparing the levels of nitrates and nitrites in fired cloths with different distances, can provide valuable forensic evidence in crime investigation in order to establish the exact distance where fired.

2. Experimental

2.1 Instrumentation

Analytical balance with accuracy of 0.0001 g was used to measure the weight of the chemicals. Ultrasonic bath (DAIHAN SCIENTIFIC- Ultrasonic Cleaner) was used to extract the ions from the fired cloths and cartridges to the ultrapure water for 30 minutes holding time. Ion chromatographic separations were performed on a 940 Professional IC Vario Metrohm ion chromatographic system. The separations were performed with Metrosep A Supp 5 (4 mm × 250 mm) anion column. The optimized method using the Metrosep A Supp 5 was set at a standard flow rate of 0.7 mL/ min. Column composition contain carbonate/ bicarbonate aqueous mixture for mobile phase and quaternary ammonium groups for stationary phase. This column was characterized with high capacity of 107 μmol (Cl^-). The eluent composition was 3.2 mM Na_2CO_3 + 1.0 mM NaHCO_3 . MagIC Net v. 3.2 was used for instrument control, data collection and processing. In order to achieve acceptable anion sensitivity, the injection volume was 20 μL . Total run time was set at 35 min after the system was come to equilibrium. Ultra-pure water delivered from a Millipore Milli-Q water ultra-purification system.

2.2 Chemical & materials

Cotton twill fabric cloth used for test fired and sealed polythene bags were used to collect samples. Ultrapure water was used to prepare all eluents, standards, samples and stock solutions. Ashless filter papers (Whatman, 41) was used to filter the extraction. Phosphoric acid (85- 90%, Sigma-Aldrich, Switzerland) was used to prepare the eluent. Sodium carbonate AR (99.9%, Research-lab Fine Chem Industries, Mumbai, India) and sodium hydrogen carbonate AR (99.5%, Techo Pharmchem, Bahadurgarh, India) were used to prepare eluent for anions. Micro filters (0.45 μm , 25 mm Nylon, Syringe filters, Agilent Technologies) were used to remove suspended particles before inject samples to the IC. Nitrite (part number 21371) and nitrate (part number 21311) standards were prepared from 1000 ppm (EDT, direct-ion) high purity standards. The glass wares used in this study were washed with nitric acid and ultrapure water.

2.3 Reagents

For both cations and anions eluents, 6.9 mL of H_3PO_4 solution was pipetted into a 1000 cm^3 volumetric flask and the volumetric flask was topped up with ultrapure water for prepared the 100 mM solution. For anion eluent, a 0.3390 g of Na_2CO_3 and a 0.0840 g of NaHCO_3 were measured for prepared the 3.2 mM Na_2CO_3 and 1.0 mM NaHCO_3 solution. Then those were dissolved in ultrapure water in 1000 cm^3 volumetric flask and it was topped up with ultrapure water.

2.4 Standard solutions

100 ppm standard nitrite and nitrate solutions were prepared using 1000 ppm standard stock solutions and then 10 ppm standard nitrite and nitrate solutions were prepared using 100 ppm standard solutions.

2.5 Sample preparation

The study was carried out in the ballistic section in the Government Analyst's Department (GAD). As the firearm, 0.38 Special, Arminius (Brand name), HW38 (Model number), Germany revolver and as the cartridges, Federal 0.38 special, non-jacketed, lead bullet available in the GAD were used for the experiment. Cotton twill fabric cloth was used for test firing with different distances (0 feet, 0.5 feet, 1 feet, 2 feet, 3 feet, 5 feet, 10 feet from the muzzle end of the revolver). This procedure was done triplicate. Then, those pieces of fired cloths and cartridge cases were collected separately in sealed polythene bags.

The test samples were prepared by firing into a piece of white cotton twill cloth. Then 25.0 cm^2 portion were removed from the target material using the bullet hole as the center of the sample portion. Those portions of the cloths were again cut into small pieces and put them into each 100 cm^3 beaker with 7.0 ml ultra-pure water. The samples were ultrasonicated for 30 minutes to extract residue from the fired cloth samples. The extract solutions were filtered using filter papers and washed with ultra-pure water in several times. The extracted solutions were collected to the 10.00 cm^3 volumetric flasks and then topped up with ultra-pure water. Finally, the extract solutions were filtered using 0.45 μm filters prior to inject on to IC to remove suspended particulates. Then prepared extractions were analyzed by IC.

3. Results and discussion

3.1 Results of nitrate and nitrite concentration in extraction samples

The test samples were prepared by firing a 0.38 special Arminius HW38 Germany revolver at

perpendicular to the target. The extraction of gunshot residues from the fired cloths used for prepare the test solutions. Those were then analyzed for the presence of nitrate and nitrite using the standard procedure. The data were collected and below tables were prepared relating the concentration of the nitrate and nitrite present in the samples to the muzzle-to-target distance.

3.1.1 Analysis of nitrite ions

Sample Name	Retention Time (Min)	Peak Area [(μ S/cm) \times min]	Peak Height (μ S/cm)	Concentration (mg/ L)
Cartridge	10.85	0.678	2.860	3.627
Blank Cloth	10.88	0.013	0.054	0.073
0.0 Ft	10.86	0.221	0.948	1.281
0.5 Ft	10.86	0.240	1.026	1.234
1.0 Ft	10.86	0.141	0.611	0.767
2.0 Ft	10.86	0.086	0.369	0.469
3.0 Ft	10.86	0.003	0.015	0.021
5.0 Ft	10.86	0.009	0.034	0.050
10.0 Ft	10.87	0.007	0.028	0.042

Table 1: Mean values of data for nitrite ions

From the data in Table 1 show mean nitrite concentration that contain in cartridge cases, pure cotton twill fabric and cotton twill targets from distances of 0 -10 feet. And also, it can be seen that the mean values of retention time, peak area and peak height of nitrite ions in extracted samples. For sample extracted from Federal 38 cartridge case showed high concentration levels of nitrite (3.6 mg/L) and pure cotton twill fabric contain 0.07 mg/L levels of nitrite. For 0 feet (close contact) and 0.5 feet, nitrite levels were approximately similar. There were no larger concentration gap between them. When muzzle-to-target distances were increased as 0.0, 0.5, 1.0 and 2.0 feet, nitrite concentration of the samples were decreased. (1.281, 1.234, 0.767, 0.469 mg/L respectively). However, for muzzle-to-target distances greater than 2.0 feet, the nitrite concentration of the sample could not be determined. Therefore, for distances greater than 2.0 feet this method was not sensitive enough to give accurate results for 0.38 Special Arminius HW38 revolver firearm.

3.1.2 Analysis of nitrate ions

Sample Name	Retention Time (Min)	Peak Area [(μ S/cm) \times min]	Peak Height (μ S/cm)	Concentration (mg/ L)
Cartridge	15.17	2.918	9.901	16.779
Blank Cloth	15.03	0.140	0.475	0.903
0.0 Ft	14.99	0.901	3.073	5.464
0.5 Ft	14.99	0.740	2.520	4.495
1.0 Ft	14.99	0.524	1.787	3.204
2.0 Ft	15.00	0.382	1.303	2.356
3.0 Ft	15.02	0.121	0.409	0.789
5.0 Ft	15.02	0.129	0.436	0.836
10.0 Ft	15.03	0.121	0.410	0.791

Table 2: Mean values of data for nitrate ions

From the data in Table 2 show nitrate concentration that contain in cartridge cases, pure cotton twill fabric and cotton twill targets from distances of 0-10 feet. And also, it can be seen that the mean values of retention time, peak area and peak height of nitrate ions in extracted samples. For this analysis, it can clearly be seen that the nitrate concentration of samples were greater than the nitrite concentration of samples. For sample extracted from Federal 38 spent cartridge case showed high concentration levels of nitrate (16.779 mg/L) and pure cotton twill fabric contain 0.903 mg/L levels of nitrates than nitrites.

For 0.0 feet and 0.5 feet, nitrate levels were approximately similar like nitrite levels. There were no larger concentration gap between them. When muzzle-to-target distances were increased as 0.0, 0.5, 1.0 and 2.0 feet, nitrate concentration of the samples were decreased. (5.464, 4.495, 3.204, 2.356 mg/L respectively). However, for muzzle-to-target distances greater than 2.0 feet, the nitrate concentration of the sample could not be determined. Therefore, for distances greater than 2.0 feet this method was not sensitive enough to give accurate results for 0.38 Special Arminius HW38 revolver firearm.

3.2 Anion chromatograms of nitrite and nitrate ions

Metrosep A Supp 5- 250/ 4.0 column was used for anion separation of all the samples. Below chromatograms were obtained after injected samples to the Ion chromatography under standard conditions. It contains chromatograms of standard nitrite and nitrate solutions, anions in spent cartridge case sample, cotton fabric (blank) sample, zero feet (muzzle to target) sample, 0.5 feet sample, 1.0 feet sample, 2.0 feet sample, 3.0 feet sample. 5.0 feet sample and 10.0 feet sample.

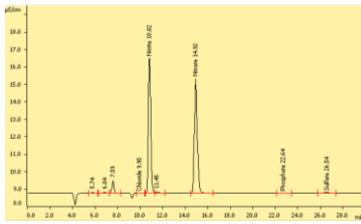


Figure 1: Chromatogram of standard nitrite and nitrate sample

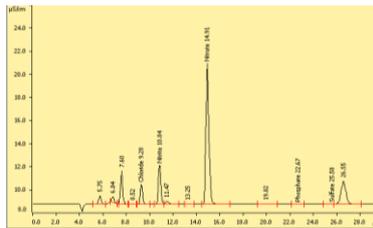


Figure 2: Chromatogram of anions in cartridge case sample

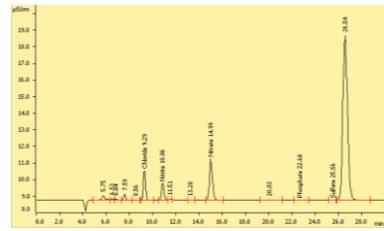


Figure 3: Chromatogram of anions in cotton fabric (blank) sample

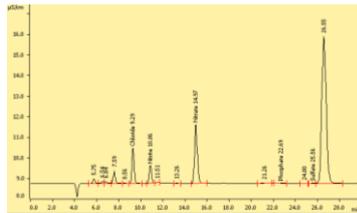


Figure 4: Chromatogram of anions in 0.0 feet sample

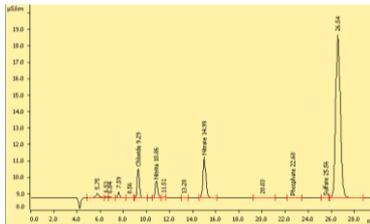


Figure 5: Chromatogram of anions in 0.5 feet sample

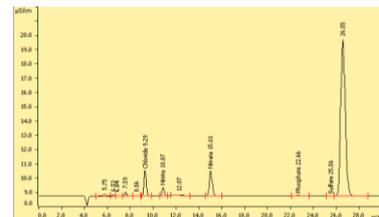


Figure 6: Chromatogram of anions in 1.0 feet sample

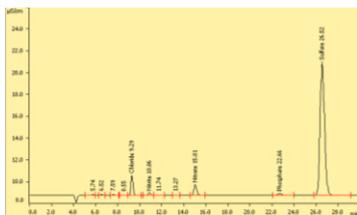


Figure 7: Chromatogram of anions in 2.0 feet sample

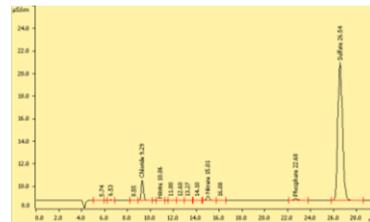


Figure 8: Chromatogram of anions in 3.0 feet sample

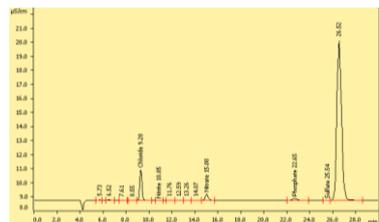


Figure 9: Chromatogram of anions in 5.0 feet sample

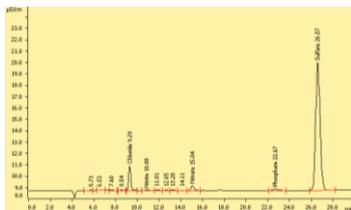


Figure 10: Chromatogram of anions in 10.0 feet sample

Figure 1 used for identify the retention time of nitrite ions and nitrate ions (For nitrite ions retention time was around 10.8 min and for nitrate it was around 14.9 min). Figure 2 shows anions present in spent cartridge case contained sample. It shows nitrite and nitrate ions are specifically present in the sample with high concentration peak. Figure 3 shows the anions present in fabric sample (Blank). It shows low concentration amount of nitrite and nitrate ions present in cotton twill fabric. And also, it shows specifically high concentration peak of sulfate ion. Figure 4 chromatogram shows the anions present when muzzle to target is 0.0 feet. This shows some

high concentration nitrite and nitrate peak present in sample. Figure 5 shows the anions present when muzzle to target is 0.5 feet. This shows low concentration nitrite and nitrate peak present in sample than 0.0 feet. Figure 6 shows the anions present when muzzle to target is 1.0 feet. This shows low concentration nitrite and nitrate peak present in sample than 0.5 feet. Figure 7 shows the anions present when muzzle to target is 2.0 feet. This shows low concentration nitrite and nitrate peak present in sample than 1.0 feet. Figure 8,9,10 show low concentration peaks of nitrite and nitrate ions.

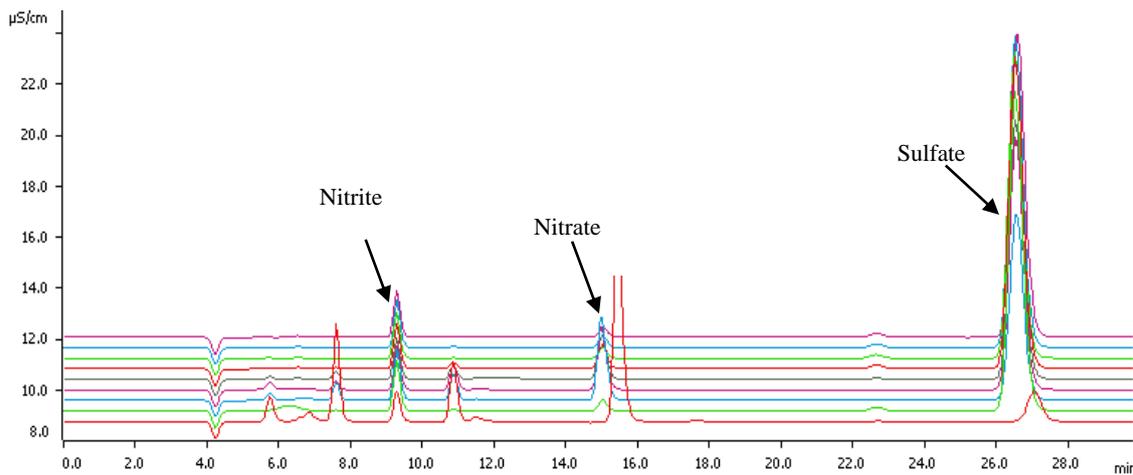


Figure 11: Overlay chromatogram of anions for all samples

According to the results obtained by this method show that when increase the muzzle end to cloth distance up to 2.0 feet, both nitrite and nitrate ions concentration decrease. Specifically for all extracted samples, the nitrate concentration is much greater than the nitrite concentration ($\text{NO}_3^- > \text{NO}_2^-$) and there is no high difference of nitrite ions for zero and 0.5 feet from muzzle to target distance (1.28 and 1.22 mg/L respectively). The nitrate and nitrite ions between 0 to 2 feet from muzzle end to target vary from 5.5 to 2.4 mg/L and 1.3 to 0.5 mg/L respectively. Test fires beyond 2 feet nitrite and nitrate ions are not significant in the target material. The test results beyond 2 feet from the muzzle end of this type of revolver is not great evidence in forensic investigations Therefore, 0.38 Special Arminius HW38 revolver with Federal 0.38 special, non-jacketed, lead bullet cartridge is suitable for determine muzzle to target distance within 2 feet.

4. Conclusion

The main objective of this study is the distance determination with nitrite and nitrate concentration in gunshot residues. Consequently, convenient and validated method was developed for the identification of muzzle to target distance in fired cloth using 0.38 Special Arminius HW38 revolver with Federal 0.38 special, non-jacketed, lead bullet cartridges. This method uses an anion exchange column with carbonate / bicarbonate eluent and suppressed conductivity detection.

The concentration of nitrite and nitrate cases are suitable for muzzle to target distance determination. Anions from gunshot residues can be separated and identified using with this suitable selectivity and sensitivity method. The method described in this

study have the potential to be further adapted for use in other type of firearms.

Acknowledgement

The authors would like to thank the Ballistic and Explosive section of Government Analyst's Department, Sri Lanka for giving this valuable opportunity, continuous encouragement, spending lot of valuable time and endless help to the success of this research.

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OUTERWEAR WITH EMBEDDED SHAPEWEAR ELEMENTS: WHAT DO SRI LANKAN FEMALE CONSUMERS THINK?

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ABSTRACT

Since ancient times women have been using shapewear designed to be worn underneath the outer garment to reshape their bodies in a bid to have a fashionable figure. Many clothing brands have now introduced outerwear with shapewear properties that were previously available only with innerwear. However, these novel product types have not become popular in the Sri Lankan market yet. Therefore, this study focuses on finding out exactly what Sri Lankan female consumers think about outerwear with shapewear elements embedded in them. A questionnaire survey and shop visits were the main data collecting methods employed in this study. The findings showed that 50.8 percent of respondents used tummy tuckers, while 44.3 percent used high waist briefs. However, 80.3 percent of participants were not satisfied with the available shapewear products due to low comfort, poor breathability, and high compression level. Though outerwear product types with embedded shapewear elements are not available in the Sri Lankan market yet, 68.9 percent of respondents expressed a preference for office wear with shapewear qualities, while 65.6 percent preferred occasional wear with shapewear functions, and 59 percent preferred casual wear with shapewear functions. The findings of this study will prove beneficial for strategic planners as it will guide them to devise strategies to deal with the new product type. Fashion designers would also be able to design better outerwear with shapewear qualities and cater to the potential demand. The retailers too will be able to expand their product lines by introducing this novel product.

Keywords: *Consumers, Female, Outerwear, Shapewear, Shapewear elements, Sri Lanka*

1. Introduction

The enthusiasm for enhancing the natural curves to gain a shapely and fashionable figure had always preoccupied women since ancient times [1]. Therefore, the ancient women went to extreme lengths to acquire a perfect figure by wearing a garment known as 'shapewear' underneath the outerwear. Even today, most women prefer to improve their body shape and they achieve this through the garments they wear [2]. Therefore, the demand for shapewear has rapidly increased even though concerns have been raised about this practice of wearing tight, uncomfortable, layered clothing that can cause welts on the skin [3,4]. In addition, the popularity of shapewear among fashion icons and celebrities has strongly influenced the consumers' tastes [5]. With the increasing trend in shapewear use, new shapewear brands have emerged globally while prevailing brands have expanded their product range [6]. Currently, some of the most popular players in the global shapewear market are Spanx Inc. (US), Jockey International Inc. (US), Hanesbrands Inc. (US), Miraclesuit (US), Contourglobal PLC (UK), Triumph International (UK), Leonisa (Colombia), Ann Chery (Colombia), CPS Shapers Pvt. Ltd. (India), and Swee Shapewear Pvt. Ltd. (India) [7].

Nowadays, shapewear manufacturers have gradually shifted their focus from innerwear to outerwear. Wearing a shapewear designed as an outerwear (with shapewear elements embedded in it) is becoming a modern trend. This works because the outerwear has built-in shapewear functionalities [8]. Spanx, Heist, Commando, and Yummie are some of the international brands that are producing and marketing outerwear with shapewear elements embedded in them [3,9,10].

1.1 Objective of study and research questions

The international brands have introduced outerwear with shapewear elements embedded in them but there are no Sri Lankan brands that have utilized this concept to date. The local brands are still trying to come to grips with this novelty. Therefore, this study focuses on finding out what the Sri Lankan female consumers think about shapewear elements embedded in outerwear. Thus, the research attempts to answer the following questions:

1. What are the shapewear and outerwear product types with embedded shapewear elements currently available in the Sri Lankan market?

2. What do female consumers think about the available shapewear and outerwear product types with embedded shapewear elements?

The findings of this research could be of great value to fashion designers who wish to introduce new product types as well as retailers who want to expand their current product lines.

2. Literature review

Shapewear refers to undergarments designed to improve the wearer's shape by enhancing the natural curves of the body to produce a more fashionable and appealing figure [11]. Figure 1 illustrates how shapewear has evolved over time.

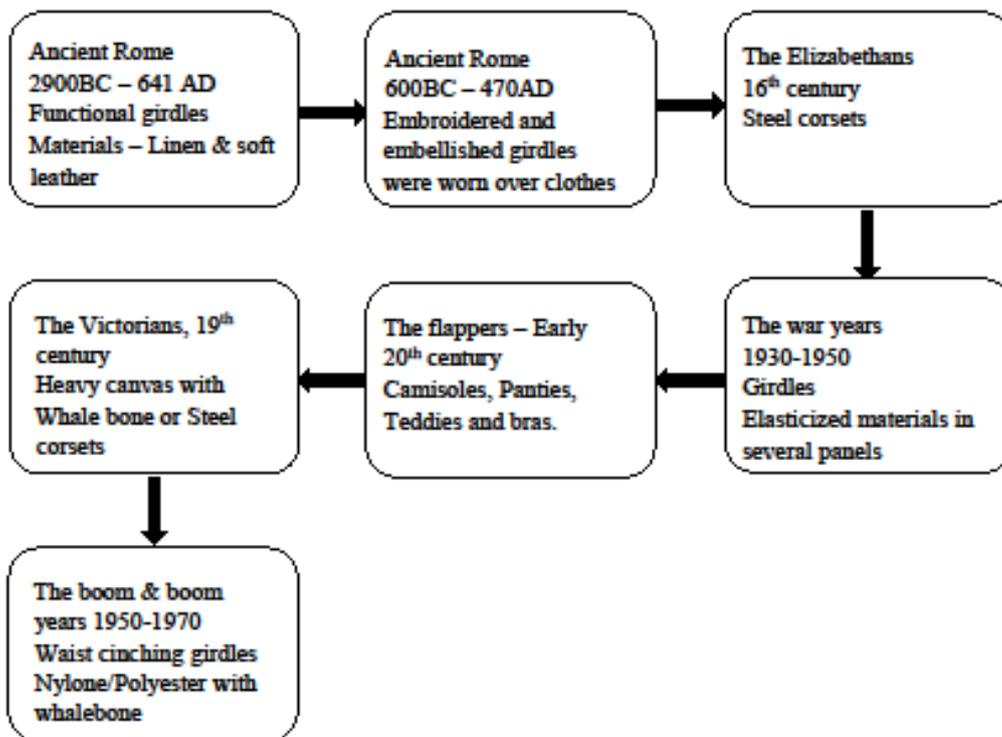


Figure 1: The evolution of shapewear [12,13]

2.1 Shapewear categories

Different types of shapewears are available in the market to shape different parts of the body [14]. Shaping vests, camisoles, and tummy tuckers are some examples of upper body shapers, whereas girdles and waist nippers shape the waist area [14,15]. High waist leg shapers, control pants, half-

slips and control thighs are some types of shapewears used to shape the lower part of the body, while full body suits and control slips fulfill all the functions performed by upper and lower body shaping shapewear [14, 15]. Table 1 shows some of the shapewear categories, fabrics, functions, and elements.

Table 1: Shapewear categories [16, 17]

Category	Fabric	Function	Elements
Control Bodysuits	Nylon/ Spandex	Controls and shapes waist/ tummy/ thighs/ back.	
Under-bust Shaping Slip	Nylon/ Spandex	Sculpts the waist/ tummy/ thighs/ back.	
Leg shaper	Nylon/ Spandex	Flattens the tummy, shapes the waist, back, Hips and lifts the rear.	Diamond shaped lined tummy panel, lace bottom, contour bands
Waist cincher	Natural Rubber/ Cotton	Improves posture by shaping the waist and controlling the tummy without compromising on comfort.	The double row of hooks & eyes offers adjustable compression levels to provide a perfect fit
High waist leg shaper	Nylon/ Spandex	Shapes the waist, tummy, hips, back, and derriere. High waist smooths away midriff bulge and will not allow rollover.	Power knit lace with exclusive contour circle shaping bands
High waist smoother skirt slip	Nylon/ Spandex	Provides extra control on tummy. Non-slip grip tape prevents the rolling of waistband and hemline.	Bonded shaping panel at the tummy Non-slip grip tape Clean-cut edges

2.2 Shapewear brands

Table 2 indicates popular brands in the shapewear market and their product types

Table 2: Shapewear brands [9, 18]

Brand	Spanx	Maidenform Flexees	Leonisa	Wolford	Commando
Silhouettes	<ul style="list-style-type: none"> • Open bust full slip • Arms & thighs • Extra-firm control high waist shaper • Lace bodysuit • High-waisted brief • Strapless cupped bodysuits • Higher power shorts • Skinny britches capri 	<ul style="list-style-type: none"> • Thigh slimmer • Waist nipper • Tights • Body briefer bodysuit • Lift cup slip bra • Half slip • Plunge body briefer 	<ul style="list-style-type: none"> • Braless body shaper • High waist shapewear • Control tummy panty • Tummy sculpting sheer boy short shapewear • Arm shaper • Butt lifter • Open bust mid-thigh bodysuit • High waist slimming cincher 	<ul style="list-style-type: none"> • Tummy control top tights • Leg support tights • Contour forming top • Forming thong body • Sheer touch control panty • Opaque natural forming dress • Contour forming body • Sheer touch forming skirt • Tulle control string high waist 	<ul style="list-style-type: none"> • Classic control bodysuit thong • Butter control short • Two-faced tech strapless slip • Half slip • Classic control high waisted short/brief • Sexy + smooth bodysuit
Fabrics	<ul style="list-style-type: none"> • Nylon/ Spandex • Microfiber/ Nylon/ Spandex • Lace/ Mesh/ Nylon/ Spandex • Elastane/ Microfiber/ Nylon • Cotton 	<ul style="list-style-type: none"> • Nylon/ Elastane • Polyamide/ Elastane • Nylon/ Spandex 	<ul style="list-style-type: none"> • Polyamide/ Elastane/ Cotton • Polyamide/ Elastane • Cotton 	<ul style="list-style-type: none"> • Nylon/ Elastane • Cotton/ Elastane 	<ul style="list-style-type: none"> • Polyester/ Elastane • Butter modal • Lace • Microfiber • Nylon/ Spandex

2.3 Outerwear Brands with Embedded Shapewear Elements

Brands such as Commando and Heist have introduced outerwear bodysuits with built-in

shapewear qualities. Table 3 shows some brands that have introduced various types of outerwear with shapewear properties.

Table 3: Outerwear brands with embedded shapewear elements.

Brand	Yummie[10]	Commando [19]	Heist[20]
Silhouette			

3. Methodology

Two different data gathering techniques were employed in this study to find the answers to the research questions. Shop visits were made to assess the shapewear market in Sri Lanka, and identify the available shapewear product types, techniques employed, and prices. Five shops in the Colombo City area selling women’s shapewear were visited. The observations were recorded under three themes, namely type of shapewear, techniques employed, and price range.

The questionnaire survey was conducted to find out what Sri Lankan female consumers think about outerwear with shapewear elements embedded in them. In order to decide the sample size, the female population in Colombo district was taken as 1,247,000 [21]. The total sample size was then determined as 90. The questionnaire was sent through the Internet to a randomly selected sample of 90

women in the Colombo area. 70 completed questionnaires were received, which were used for the analysis.

4. Findings and discussion

4.1 Types of shapewear and outerwear products with embedded shapewear elements available in the Sri Lankan market

The shop visits revealed that different types of shapewears are available in the Sri Lankan market. However, only international brands of shapewear and outerwear with embedded shapewear elements are available in the Sri Lankan market. Shops B and D sell their products for Rs.5000 and above while the prices range from Rs.500 to Rs.4000 in shop C. Table 4 presents the shapewear product types available in the Sri Lankan market, the techniques/ elements they employ, and their price range.

Table 4: Product types available in the Sri Lankan market

Retail Shop	Shapewear/ outerwear with embedded shapewear elements – product types	Techniques/ Features/ Elements	Price range
Shop A	High waist long leg High waist briefs	Bonded hem Elastic waist Mesh lining Zigzag seaming Clean-cut hem	Rs.3000 to Rs.5000
Shop B	High waisted thigh slimmer Shaper briefs Shape skirts	Silicone tapes at hem Elastic at waist with silicone tapes Bonded panels for compression areas Mesh for the butt enhancing pads	More than Rs.5000
Shop C	Tummy tuckers High-waisted shorts Padded shorts	Wellborn is used Removable pads Paneling with style lines	Rs.500 to Rs.4000
Shop D	Tummy toner Bodysuits	Strappy back Knot details	More than Rs.5000
Shop E	Bodysuits	Surplice neckline	Rs.1000 to Rs.3000

4.2 Customer awareness of shapewear and buying behavior of this product

Majority of participants (52.5%) who answered the questionnaire survey belonged to the 20-30 age group while 44.3 percent of the respondents were in the 30-40 age group. 50.8 percent of respondents were single women and 49.2 percent were married women. When analyzing the occupation of the respondents, it was found that 57.4 percent were engaged in the private sector. 21.3 percent were undergraduates whereas 16.4 percent were other students.

According to the results of the questionnaire, 90.2 percent of respondents appeared to be aware of shapewear garments. Of them, 70.5 percent perceived a need to wear shapewear while the remaining 29.5 percent did not feel the need for this type of clothing.

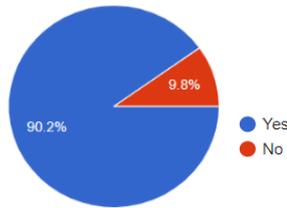


Figure 2: Awareness of shapewear

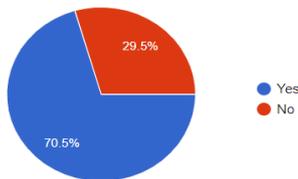


Figure 3: Perceived need to wear shapewear

Figure 4 illustrates the purchasing pattern for shapewear. The highest number of respondents (44.3%) purchase shapewear once a year while 36.1 percent of respondents purchase them several times a year. Purchasing shapewear once a month is the least common purchasing habit of the consumers. Further, more respondents (78.9%) prefer to buy from regular shops where they can check for proper fit compared to shopping online (21.1%). Past studies have also established that fitting on while shopping is the most common purchasing habit in the international market [7].

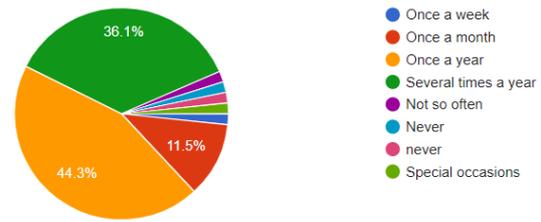


Figure 4: The purchasing pattern

An analysis of the spending power of consumers revealed that 32.8 percent of the participants spend Rs.1000-2000 per garment while 26.2 percent of the participants spend Rs.2000-3000. 21.3 percent of participants spend Rs.3000-5000, 14.8 percent spend Rs.500-1000 while only a small number of participants spend above Rs.5000 for a shapewear garment. Figure 5 shows the spending power of the consumers.

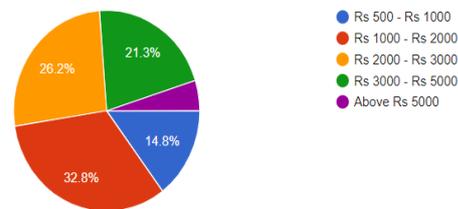


Figure 5: The spending power of consumers who buy shapewear

As per the results of the questionnaire survey, 50.8 percent of respondents use tummy tuckers and 44.3 percent wear high waist briefs. However, 80.3 percent of participants were not satisfied with the available shapewear products with only 18 percent of participants expressing satisfaction with the current products. According to the respondents, the reasons for not being satisfied with the shapewear in the market are:

- comfort-related issues
- breathability issues
- compression level

4.3 Customer perception on outerwear with embedded shapewear elements

Analyzing the preference for outerwear with embedded shapewear elements revealed that 85.2 percent of respondents preferred outerwear with shapewear qualities (Figure 6).

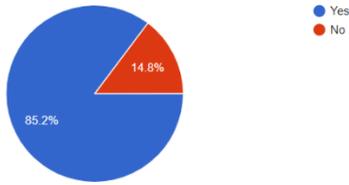


Figure 6: Preference for outerwear with embedded shapewear elements

63.9 percent of the participants preferred to have the functionality of shapewear (e.g. reshaping the body,

smoothing out lumps, and toning up the muscles) in the outerwear. That is due to the fact that shaping the figure is the main desire of the customers. However, outerwear products with shapewear functions are not available in the Sri Lankan market.

Figure 7 shows the preferred outerwear products with shapewear functions. The highest percentage (68.9%) of respondents prefer office wear with shapewear functions, 65.6 percent prefer occasional wear with shapewear functions while 59 percent prefer to have casual wear with shapewear functions.

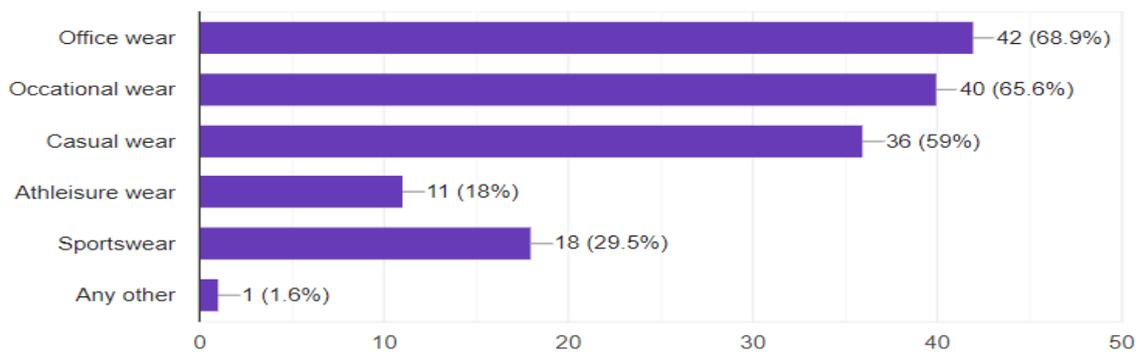


Figure 7: Preference for outerwear product types with shapewear functions

5. Conclusion

Based on the findings of the shop observation it can be concluded that tummy tuckers, high waist briefs, high waist thigh slimmer, body suits, shaper briefs, and shape skirts are the shapewear and outerwear (with embedded shapewear elements) product types available in the Sri Lankan market.

The following conclusions were drawn based on the results of the questionnaire survey.

- 50.8 percent of respondents used tummy tuckers, while 44.3 percent had a need for high waist briefs.
- 80.3 percent of participants were not satisfied with the shapewear products on offer due to comfort-related issues, breathability issues and compression level.
- 85.2 percent of respondents preferred outerwear with shapewear qualities.
- Outerwear product types with embedded shapewear elements are not available in the Sri Lankan market.

- 68.9 percent of respondents prefer office wear with shapewear functions, 65.6 percent prefer occasional wear with shapewear functions, and 59 percent prefer casual wear with shapewear functions.

These findings lead to the conclusion that the local market for shapewear and outerwear embedded with shapewear elements is lagging far behind the international market, resulting in a large market gap for these products in Sri Lanka. Therefore, this study will prove beneficial for fashion designers by guiding them to design new products through learning from the findings. Retailers too would find this knowledge useful when introducing new items to expand the product line-up in their outlets. In the above context, the consumers too will have access to new product types that can raise their confidence level by allowing them to exercise greater control over the shape of their bodies. After all, it is an inescapable fact that every young woman is rather self-conscious about her figure!

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ASSESSMENT OF EFFECTIVENESS OF THE PROCUREMENT SYSTEM IN UNIVERSITY SYSTEM IN SRI LANKA WITH SPECIAL REFERENCE TO THE UNIVERSITY OF MORATUWA

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ABSTRACT - Although the Public Procurement has increasingly become prominent in the public sector expenditure in Sri Lanka, very limited scientific research has been undertaken to examine the factors that influence the procurement performance in the Public Sector institutions. Since, the state sector universities of Sri Lanka are also run by the government expenditure measuring and reporting the effectiveness of procurement has become a very important aspect, mainly because, complaints exist insist that the public procurement process is characterized by delays, poor quality and non-cost-effective delivery. This study attempts to analyze the procurement process in achieving effectiveness of public procurement in the university system in Sri Lanka with special attention to the University of Moratuwa.

This study gives the reader an example of an approach on how to measure and report the effectiveness of the procurement process work as the dependent variable through different independent variables namely procurement policies, competency of the staff and available resources. The methodology choice was quantitative. The survey was used as a method to collect quantitative data and the unit of analysis was the Administrative Officers of the University of Moratuwa. Analyzing of the data was done by using empirical statistics. Bivariate correlation analysis was conducted to examine the interrelationship of each independent and dependent variable of the study. The results showed that there were positive relationship exist between effectiveness of the procurement process and the procurement policies, competency of procurement staff and availability of procurement resources. The most significant result identified was the competency of staff which mostly influences the effectiveness of the procurement process.

The study recommends that initiating a proper policy framework, enhancing the competency levels of the procurement staff and assurance of the availability of resources are essential for increasing the effectiveness of the procurement process.

Keywords: *Public procurement, Procurement performance, Government expenditure, Effectiveness*

Introduction

This section will discuss the public procurement system in Sri Lanka and specially the procurement process in universities and the factors affecting the effectiveness of the procurement system in universities. Additionally, this will discuss the problem statement, objectives of the study, limitations and the expected benefits of the study.

1.1 Public procurement system in Sri Lanka

Government/Public procurement is the procurement of goods, services or constructions on behalf of a public authority. Over the past few decades, public procurement has had to evolve conceptually and organizationally in the face of unrelenting budget constraints, government downsizing, public demand for increased transparency in public procurement, as well as greater concerns about efficiency, fairness and equity. Procurement professionals have also had to deal with a changeable climate produced by

emerging technology, environmental concerns, and tension between complex regional trade agreements and national socioeconomic goals. (Thai, 2017) public procurement often constitutes the largest domestic market in developing countries. Depending on how it is managed, the public procurement system can thus contribute to the economic development of these countries. Indeed, public procurement is the principal means through which governments meet developmental needs such as the provisions of physical infrastructure and the supply of essential goods, services and medicine. Many governments use public procurement to support the development of domestic industries, overcome regional economic imbalances and support the minority or disadvantaged communities. (Ayoti, 2012)

1.2 Problem Analysis

At present the universities of Sri Lanka experiences lots of delays in public procurement and this will result in failure of activities and most of the time the

funds provided for procurement of goods or services sent back to the Treasury without using them for the budgeted financial year due to delay in the process. The outcome of the result is ultimately not achieving the goals and objectives of a university individually and collectively not developing the higher education system as a nation.

1.3 Research Questions

The study will try to answer the following research questions.

- I. What are the barriers in the existing public procurement system?
- II. What are the recommendations to overcome the above deficiencies?
- III. What are the identified systems to implement the above recommendations?

1.4 Objectives

1.4.1 Overall Objective

To identify the problems, exist in the procurement system in Sri Lankan Universities with a view to give recommendations to make the process more effective.

1.4.2 Specific Objectives

- To identify the barriers in the existing public procurement system
- To give recommendations to overcome such deficiencies
- To identify systems to implement recommendations

2. Research Methodology

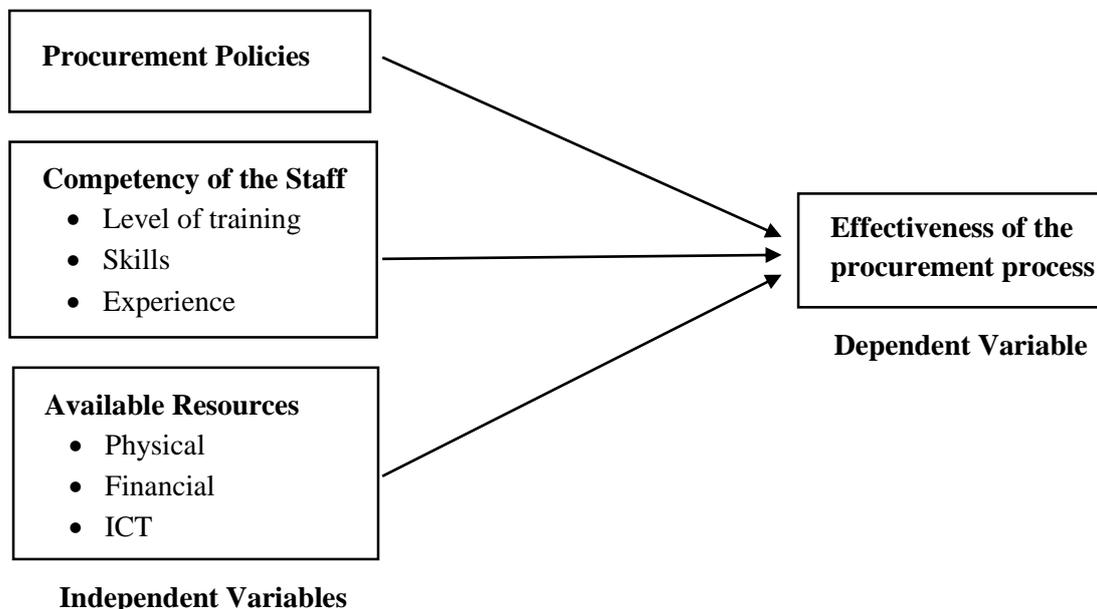
2.1 Research Design

A survey questionnaire was used to gather the data from the representative sample to determine the current status of that population with respect to the variables.

The population defined as the administrative/ executive officers of the university system while the sample selected is the Administrative/Executive personnel of the University of Moratuwa.

2.2 Conceptual Framework

A conceptual framework refers to conceptualization of the relationship between variables in the study and it is shown diagrammatically. In this study the dependent variable is ‘the effectiveness of the Procurement process’ while the independent variables are ‘procurement policies’, ‘competency of the staff’ and ‘the available resources.’



OS Figure 1: Conceptual Framework

2.3 Data Collection Methods

The method conducted for collection of data is the survey questionnaire. Since, module questionnaires were unavailable to the relevant study the researcher developed the questionnaire with the help of literature review.

3. Analysis and Findings

The data collated were entered into a computer and analyzed using Statistical Package for Social sciences (SPSS). Descriptive analysis was used to describe the sample being tested. It describes the profile of the respondents.

3.1 Relationships between independent and dependent variables

For further analysis, scores for the dependent variable and three independent variables were computed, based on the Likert scales responses for each question. Factor analysis technique was used to reduce the dimensions of the collected data into those main variables, namely, Procurement policies, Competency of the staff, Available Resources and Effectiveness of the Procurement Process.

3.2 Pearson Correlation Analysis for dependent and independent variables

Bivariate correlation analysis was conducted to examine the intra-relationships of each independent and dependent variable of the study.

		Effectiveness of the Procurement Process	Procurement policies
Effectiveness of the Procurement Process	Pearson Correlation	1	.642**
	Sig. (2-tailed)		.000
	N	30	30
Procurement policies	Pearson Correlation	.642**	1
	Sig. (2-tailed)	.000	
	N	30	30
**. Correlation is significant at the 0.01 level (2-tailed).			

OS Table 1: Relationship of effectiveness of procurement process with procurement policies

3.3 Correlation between Effectiveness of the Procurement Process and Procurement policies

According to the Table 1: the Pearson correlation coefficient (r) between Effectiveness of the Procurement Process and Procurement policies is 0.642 suggesting a slight positive relationship between those two variables at 0.01 significance level (p value = 0.000).

Therefore, according to the correlation analysis, it can be concluded, that Procurement policies have a positive effect on Effectiveness of the Procurement Process at 0.01 significance level.

3.4 Correlation between Effectiveness of the Procurement Process and Competency of the staff

According to Table 2: the Pearson correlation coefficient (r) between Effectiveness of the Procurement Process and Competency of the staff is 0.757 suggesting a strong positive relationship between those two variables at 0.01 significance level (p value = 0.000).

Therefore, according to the correlation analysis, it can be concluded, that Competency of the staff has a strong positive effect on Effectiveness of the Procurement Process at 0.01 significance level.

		Effectiveness of the Procurement Process	Effectiveness of the Procurement Process Competency of the staff
Effectiveness of the Procurement Process	Pearson Correlation	1	.757**
	Sig. (2-tailed)		.000
	N	30	30
Competency of the staff	Pearson Correlation	.757**	1
	Sig. (2-tailed)	.000	
	N	30	30
**. Correlation is significant at the 0.01 level (2- tailed).			

OS Table 2: Relationship of Procurement process and competency of the staff

3.5 Correlation between Effectiveness of the Procurement Process and Available Resources

According to the Table 3: the Pearson correlation coefficient (r) between Effectiveness of the Procurement Process and Available Resources is 0.678 suggesting a slight positive relationship between those two variables at 0.01 significance level (p value = 0.000).

Therefore, according to the correlation analysis, it can be concluded, that Available Resources have a strong positive effect on Effectiveness of the Procurement Process at 0.01 significance level.

3.6 Regression Analysis

To ascertain how much of a variance in the dependent variable is explained by the independent variables, a regression analysis was performed.

The R value in the Table 4: represents the simple correlation and is 0.742, which indicates a high degree of correlation. The R² value indicates how much of the total variation in the dependent variable, Effectiveness of the Procurement Process, can be explained by the independent variables, Procurement policies, Competency of the staff and Available Resources. In this case, 71.2% can be explained, which is significantly higher value

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.861 ^a	0.742	0.712	0.53632276
a. Predictors: (Constant), Available Resources, Procurement policies, Competency of the staff				

OS Table 3: Relationship of Procurement process and available resources

		Effectiveness of the Procurement Process	Effectiveness of the Procurement Process Competency of the staff
Effectiveness of the Procurement Process	Pearson Correlation	1	.678**
	Sig. (2-tailed)		.000
	N	30	30
Available Resources	Pearson Correlation	.678**	1
	Sig. (2-tailed)	.000	
	N	30	30
**. Correlation is significant at the 0.01 level (2-tailed).			

OS Table 4: Regression Analysis between independent variables and procurement process

3.7 ANOVA test

The Table 5: is the ANOVA table, which reports how well the regression model fits the data.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	21.521	3	7.174	24.94	.000 ^b
	Residual	7.479	26	0.288		
	Total	29	29			
a. Dependent Variable: Effectiveness of the Procurement Process						
b. Predictors: (Constant), Available Resources, Procurement policies, Competency of the staff						

OS Table 5: ANOVA test reporting the fitness of the regression model with the data

Table 5: indicates that, according to the regression model, the independent variables have significant effect on the dependent variable well, since the significance value is 0.000, which is less than 0.05. Hence it can be identified that this regression model statistically significantly predicts the Effectiveness of the Procurement Process in terms of Procurement policies, Competency of the staff and Available Resources.

3.8 Coefficients

The Coefficients table provide with the necessary information to predict Effectiveness of the Procurement Process from Procurement policies, Competency of the staff and Available Resources, as well as determine whether Procurement policies, Competency of the staff and Available Resources contribute statistically significantly to the model the Effectiveness of the Procurement Process.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.20E-16	0.098		0	1
	Procurement policies	0.355	0.111	0.355	3.187	0.004
	Competency of the staff	0.424	0.134	0.424	3.175	0.004
	Available Resources	0.285	0.129	0.285	2.209	0.036
a. Dependent Variable: Effectiveness of the Procurement Process						

OS Table 6: Coefficients of independent variables

According to the individual significance values provided in the below table, it can be ascertained that Procurement policies, Competency of the staff and Available Resources have effect on Effectiveness of the Procurement Process at 5% level of significance. Moreover, since the Beta values for Procurement policies, Competency of the staff and Available Resources are positive values, it can be stated that Procurement policies, Competency of the staff and Available Resources have positive effect on Effectiveness of the Procurement Process at 5% level of significant.

4. Conclusion

According to the findings Pearson correlation coefficient (r) between the Procurement policies and the effectiveness of the procurement Process is 0.642 suggesting a positive relationship between those two variables. Hence, it can be said that if there're effective policies with regard to procurements including proper planning, monitoring, progress review, management support, records management system, adhering to NPGs etc.; will lead to effective Procurement Process.

4.1 Recommendations for improving the Effectiveness of the procurement Process of the universities.

From the results of the study the researcher recommends to the management of the universities, taking actions to initiate a proper policy framework with regard to procurement. The said framework shall include a proper planning mechanism, supervision & close monitoring and regular progress review with regard to Procurements.

4.2 Recommendations for further research

The researcher suggests that further research be conducted on; investigating the impact of ethical practices in procurement process and how it affects the universities, a similar study may also be carried out in other universities and other public institutes to establish Whether the findings are similar as those generalized in this study and investigating on other factors that influence the effectiveness in other universities and other public entities.

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A STUDY ON FACTORS AFFECTING CONSUMER PURCHASE INTENTION OF GREEN PRODUCTS AND SERVICES IN SRI LANKAN EVENT PLANNING INDUSTRY: FROM EVENT PLANNERS' PERSPECTIVE

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ABSTRACT - A qualitative approach was applied in this study to determine the underlying influences on event planners' perceptions about eco-friendly events in Sri Lanka. Additionally, the impact of the perception of consumers about the green concept related to the events was explored in this study from the event planners' point of view. The Semi-structured in-depth interviews were conducted among the 05 most reputed event planners in Sri Lanka to derive research data and the narrative analysis method has been adopted as the data analysis method in this study. The event planning industry in Sri Lanka is less concerned about the environment. Most event planners do not attempt to implement green concept as a strategy because it is not something to demonstrate prestige. The factors that influenced the perception of event planners in Sri Lanka were identified through the insights. Specially, these insights were depicted that awareness, environmental concern, green advertising, green washing, green product attributes, social norms and income were identified as key factors for generating the perception of event planners in Sri Lanka. Findings of the study show that awareness, environmental concern and green advertising mostly impact on the consumers' green purchase intentions. Further, social norms, product attributes and income were identified as factors which impact the green purchase intentions of consumers to a considerable extent. These insights will be fruitful to event planners to adopt more green marketing strategies to gain market share in the Sri Lankan event planning industry.

Keywords: *Eco friendly products and services, Event planning industry, Green concept, Green marketing, Green purchase intention*

1. Introduction

Forests and greenfield destruction, toxic contamination, habitat extinction, and land degradation are some of the issues that have arisen as a consequence of the harms caused by so many technical and corporate developments (Durmaz & Yaşar, 2016). Changing consumer patterns, rising overcrowding, and an environment pollution as a result of advancing technology have all put public health and the natural environment in jeopardy (Durmaz & Yaşar, 2016). Despite considerable focus in the 1970s, the concept of sustainable marketing did not develop until the late 1980s, and discussions about the quick rise in green consumerism were sparked by early academic studies of green marketing, which predicted a move toward sustainable purchase decision (Peattie & Crane, 2005). The ecofriendly marketing tactic is comparable to environmental marketing, environmental and economic marketing, and long-term marketing. Green marketing is defined as meeting the requirements and desires of customers in

an ecologically responsible manner (Durmaz & Yaşar, 2016).

Green marketing is used by several sectors as promotional tool. From the beginning to the finish of the procedure, companies employ the greenery idea. Because of the growing awareness of the green idea, clients are gradually preferring to connect with environmentally friendly companies (Karunarathna et al., 2020). Not alone in other sectors, but also the event management sector, are concerned about the environmental sustainability and eco-friendliness. Green events are those that include an environmental policy or sustainable practices into the event planning and execution procedure (Wong et al., 2015). As per event management sector organizations, 83% of industry professionals have already implemented environmentally friendly green procedures (Wong et al., 2015).

Green marketing strategy and the notion of greenery are progressively gaining traction in the Sri Lankan event management sector organizations. Customers appreciate outdoor activities that take place in a

natural setting. To satisfy customer requirements who are more concerned about environmental issues, the event management business attempts to use recyclable items. However, event organizers in Sri Lanka have yet to put together a green concept event. They put a small emphasis on using recyclable items. The event management business decided to establish events outside and in environmentally friendly settings in response to circumstances and weather conditions. Green marketing had not previously been deemed prestigious by Sri Lankan event organizers. Sustainable events have piqued the interest of academic academics and practitioners in the field, as they play an important role in corporate performance (Wong et al., 2015).

The goal of this study is to figure out what variables affect people's inclinations to buy environmentally friendly sustainability product and services in the event planning sector. This study differs from others in terms of contribution for three major reasons. There are Significant academic study has not been undertaken in the Sri Lankan context this research, based on data obtained, will help to close this gap. Moreover, environmental events are well-known across the world, and many companies have adopted green tactics to keep up with the competition. Sustainable strategies, ideas, and themes are being adopted by international corporations to reduce these harmful side effects. This study will be relevant on environmental protection, and event organizers will be able to use the green idea as a strategic advantage in the Sri Lankan event management sector.

Finally, industrial practitioners in Sri Lanka have not yet implemented a green marketing idea in event planning. As a result, the aim of this research is to see how green marketing may assist to reduce waste and organize environmentally friendly events more effective and efficient manner by raising knowledge and concern about the environment among event organizers and customers. These results can be useful to researchers, university students, event organizers, nature enthusiasts, creative thinkers, and marketing teams in their future researches. Humans can also learn things from this to become even more aware of the sustainable environment in the event management sector and to become ecofriendly buyers interested to purchase ecofriendly products or services in order to safeguard Natural Environment. The remaining sections of the study are organized as follows: research topic, objectives, theoretical considerations and empirical evidence, methodology, results and discussions, and conclusion.

2 Research Problem

Changes in climate, which would be caused by human-generated carbon dioxide emissions and fossil fuel burning, is already happening and posing

a significant threat to everybody on the planet (Rezai et al., 2013).

In each and every industry all over the world, the green idea has become a massive phenomenon. At the moment, the event industry is the most popular. In Sri Lankan businesses such as apparel, groceries, and tourism, the ecofriendly idea is prevalent. However, most individuals in the event planning business are unaware with the notion of green marketing. By generating non-recyclable, non-zero carbon emission, non-ozone friendly, non-zero trash products and services, the event planning business contributes considerably to environmental degradation. Global event coordinators utilize this sustainable marketing approach to attract prospective customers while also safeguarding the environment as a social responsibility. The event planning industry in Sri Lanka, on the other hand, is less concerned about the environment.

In Sri Lanka, on the other hand, the event planning sector is less worried about the environment. And it is not something to display status, most event coordinators do not seek to adopt this notion as a strategy. The event planning industry in Sri Lanka has been less worried about the environment. It's the performance difference that was discovered through secondary research. However, when it comes to the context of Sri Lanka, going green in the event planning sector has gotten little attention. In Sri Lanka, there haven't been enough research performed yet. It is an empirical gap that has been discovered in previous literatures.

3 Objectives

Main objective

- To determine the factors that affect customer intentions in the event planning sector to purchase eco-friendly green products and services.

Sub objectives

1. To determine the impact of awareness on green purchasing intention
2. To determine the impact of environmental concern on green purchasing intention
3. To determine the impact of green advertising on green purchasing intention
4. To determine the impact of green washing on green purchasing intention
5. To determine the impact of product attributes on green purchasing intention
6. To determine the impact of social norms on green purchasing intention
7. To determine the impact of income on green purchasing intention

4 Theoretical considerations and empirical evidence

The study is mostly concerned with the marketing sector, and it focuses on how green marketing influences customer green buying intentions in the event management sector. From 2001 to 2021, a literature survey was performed based on previous investigations completed by predecessors. Green marketing, event planning in a local and global context, awareness, environmental concern, green washing, green advertising, green attributes, social norms, and income were all included during the search process.

The green approach has become a global trend, with businesses using it as a way of ecologically responsible marketing to safeguard the environment. Going green in marketing refers to the practice of selling goods and/or services based on their environmental advantages. These goods and services are ecologically friendly and may be produced in an environmentally responsible manner. Various firms are leading the charge in the field of green marketing as part of their corporate social responsibility. Some environmental organizations believe that these green practices may spark interest in firms that have not yet adopted the green idea (Medhi, 2015).

Green event management is sometimes referred to as green event management or event greening. According to Zamzuri et al., (2013) eco-friendly event management is the organization of an event while keeping environmental, economic, and social problems in mind. As per the researcher, ecofriendly event management shows the worries of the responsibility of the organization towards environmental sustainability. The Albertville Winter Olympics in France were held in 1994 with a specific focus on the environment. This is regarded as the first function at which green event management was used (Gold & Gold, 2013). From then on, the universe Olympic activities were planned with an emphasis on environmental sustainability. On the other hand, sporting events, weddings, parties, and car exhibitions, among other things, might be included in Sri Lankan events. Sports and competitions have progressively become superordinate goals for governments all over the world, including Sri Lanka, as a result of the emotional connections that sporting events may produce. The use of the green idea as a new strategy for event management has the potential to revolutionize the Sri Lankan event management sector.

4.1 Green purchase intention

In marketing, purchase intention is a crucial notion (Chen et al., 2014). The aim of green purchasing is defined as a person's desire to purchase ecologically

friendly things and services over traditional goods and services. Currently, event planning is frequently done with the intention of marketing. Many companies are concentrating on creating green items as more consumers begin to use environmentally friendly products. As a result, the event management sector has shifted its attention to a new level of green marketing. Studies have demonstrated the value of focusing on green marketing in terms of increasing client buying intention.

When doing this research, attempt to persuade consumers to buy green products and services at events. We refer to several papers in this section, and we give facts regarding previous research that is relevant to our study topic. The factors that are independent variables in this study include awareness and environmental, green advertising and green washing, product characteristics, societal norms, and income. We explain the link between buying intention and these factors by utilizing them, and these variables were chosen based on previous research.

4.2 Awareness (A)

Green awareness is associated with enterprises' view of their environmental responsibilities when they meet consumer expectations, demand and satisfaction (Ar, 2012). Green awareness is also described as a user's understanding that buying ecofriendly items helps to offer excellent value to the nature (Rahmi et al., 2017). According to another research, Green Brand Awareness is strongly linked to the purchase of eco-friendly products. It refers to a consumer's willingness to recognize and remark that a brand is concerned about the nature. When a brand with a green idea becomes successful among the public, it naturally raises public awareness of the notion. (Tariq, 2014). Ecofriendly items are much more likely to be purchased by people who are care about concern for the environment. (Siddique and Hossain, 2018). In addition, this rise in consumer knowledge has a significant influence on customer behavior. The enthusiasms are the growing variety of natural groups known as green customers. (Rahmi et al., 2017). In the Sri Lankan background, we have found a lack of knowledge among people about this ecofriendly idea and its usage in the event sector.

4.3 Environmental Concern (EC)

Environmental concern is characterized as the degree of understanding and desire of customers to contribute directly to solving global issues (Kirmani and Khan, 2016). According to another research, environmental concern is explained as the extent to which individuals are aware of environmental concerns and actively participate in efforts to resolve

them or express a desire to directly assist to their resolution (Ali and Ahmad, 2016). Other study, shown that environmental concerns may not always imply a favorable attitude toward green products. As a result, we must investigate if it has an influence on people's ecofriendly buying intention in order to have a clear picture. (Kirmani and Khan, 2016). Environmental concern has a significant link with buying intention (Junior et al., 2015). We may deduce from these that ecofriendly consumers' intentions to buy greenery items are impacted by their environmental concerns.

4.4 Green Advertising (GA)

Green advertising is now one of the key aspects to consider in marketing, due to the rising nature of natural disasters and need for environmental protection. Many clients are drawn to environmentally friendly items with relation to increasing awareness between societies (Ankit & Mayur, 2013) The impact of ecofriendly advertising on social media on customer intent to purchase items was investigated. According to this research, green advertising has no direct and apparent influence on client buying intention (Luo et al., 2020) however that, it has the potential to have an indirect influence on the details provided in advertising. Furthermore, the research concluded that green advertising is frequently deceptive owing to hyperbole and inaccuracy. People's decisions to buy items related to green advertising, on the other hand, are mostly dependent on their own perceptions of environmentally friendly products and services. When it comes to Sri Lanka, people aren't very worried about sustainability and eco- friendly products (Abeysekara & Kuruppu, 2017).

Event planning and green advertising have a strong connection. The majority of companies in the business world utilize an event as a marketing strategy (Tih *et al.*, 2016). Donors and participants at an event might be the company's most important partners and supporters. As a result, event management based on the green advertising idea may motivate corporate employees who are really engaged in environmental issues.

4.5 Green Washing (GW)

Green washing is the technique of providing consumers with misleading information about how ecological beneficial the products of a firm. "The phrase 'green washing' usually refers to the practice of constructing an activity as ecologically friendly rather than ecologically favorable" (Wehr and Lippert, 2013). It's mostly utilized as a marketing ploy to get customers to believe in spreading lies.

Green washing has raised customer cynicism and, as a result, their faith in environmentally friendly products and services has gradually eroded. As a result, demand for environmentally friendly products and services falls. Simply said, green washing reduces customer purchasing impulses by instilling mistrust and causing boycotts of environmentally friendly products and services. (Wang, Walker and Barabanov, 2020). When it comes to environmentally friendly products and services, today's customers are more cautious. They examine the green goods' components before deciding whether or not to buy them. (Jog and Singhal, 2020).

When it comes to the event management business, it is usually advised to prevent green washing because it might harm an organization's reputation. (Griese, Werner and Hogg, 2017). It has the potential to influence clients' buying intentions directly.

4.6 Product Attributes (PA)

When examining a product, there are a number of characteristics that assist to distinguish it from other similar products and services. Product characteristics are additional aspects of a product. Size and color are examples of product attributes. People's perceptions of the environment have a big influence on how they evaluate ecofriendly product qualities and how they feel about them. According to several research, marketers should devote more time to the entire qualities of a product and transmit them to their target consumers rather than depending simply on establishing an eco-friendly image of the product and business. Managers are working on a product's green qualities should also provide new tools that include factors like product design, quality of the product, price, and so on (Thoo et al., 2018). Over time, an increasing number of organizations have shifted to a wealth circular economy. The attributes of green products have a significant impact on the purchase intentions of consumers. In the decision-making process of green consumers, analysis shows the value of product attributes (Sharma and Foroapon, 2019).

4.7 Social Norms (SN)

Social norms may be defined as a collection of ideas that a particular society adheres to in a variety of areas. Social norms may have a significant influence on how individuals think, act, and react in many circumstances (Luo *et al.*, 2019). Social norms, particularly those of peers and those with a close relationship to buyers, have a significant impact on consumers' ecofriendly buying decisions. (Joshi and Rahman, 2015). As a result, there is a significant link between customers' buying intention and societal standards. Customers will be attracted to products that they are more familiar with. (Melnik *et al.*, 2019). Trends in buying intentions are always created

by social norms. (Ham, Jeger and Ivković, 2015). Some businesses rely on societal conventions to boost client buying intent. They sometimes utilize advertising to establish societal standards. Negative marketing is used on occasion to build societal norms, either to sell a product or to divert buyers' attention away from a product. As a result, social norms may be employed to enhance buying intention in either a good or bad way.

Establishing social norms is critical in the event planning sector. However, everybody now does it as part of their daily routine, and it has become well-known. This is an effective way of creating social standards. In the start of such societal standards, there is opportunity for a lot of new goods. (Kian *et al.*, 2017)

4.8 Income (I)

The degree of income impacts what customers and the prospect for money can afford. People with similar professions tend to like music, clothes, and entertainments (Tanja Lautiainen, 2015). Earnings may be seen as one of the most significant variables affecting the purchase behavior and intents of customers (Lehtonen, 2016). There is a distinct client base that is based on the pricing of a product. To put it another way, consumers purchase various versions of the same product based on their price range.

“According to several studies, “buying intention of OGPs is expected to grow as customers' income rises.” As a result, higher-income families are more likely to experience positive OGP purchasing intentions since they can earn enough to pay price premiums.” (Dettmann and Dimitri, 2010).

The event management sector is also linked to earnings. (Kitchin, 2012). The event planning industry can have customers from different social classes. The delivery of the service has to be dependent on the social class of different customers. Usually, the budget for a project is calculated on the allocated and affordable budget of the customer. Awareness of the clients' financial situation is crucial to consider when offering items or services to them throughout the function planning phase. If a customer's financial status is not correctly identified, it may have a detrimental impact on the customer's perception of the sector. (Katherine E. Holley, 2001).

5 Propositions of the Study

Researchers have developed following propositions to determine the impact of factors on green purchase intention. In this literature review, following research propositions are put forward:

Proposition 1: Consumers with awareness are more into green purchasing

Proposition 2: Consumers with environmental concern are more into green purchasing

Proposition 3: Consumers with green advertising are more into green purchasing

Proposition 4: Consumers with green washing are more into green purchasing

Proposition 5: Consumers with product attributes are more into green purchasing

Proposition 6: Consumers with social norms are more into green purchasing

Proposition 7: Consumers with income are more into green purchasing

6 Methodology

Researchers in this study want to look at the elements that influence consumer buying behavior for environmentally friendly goods and services in the Sri Lankan event management sector from the perspective of event organizers. The authors would do a qualitative analysis to accomplish this main objective and sub-objectives that support achieving it. This can be indicated through 3 stages as selecting a research philosophy and research approach, selecting a strategy, techniques, and procedures, and selecting a research choice and time horizon. By reviewing Saunders's research onion, researchers selected interpretivism as the research philosophy for this investigation. As interpretivism, the researchers tried to give practical answers for the problem that has existed. The inductive approach will be adopted by researchers for this research. The researchers selected this approach because a theory is not based on continuing the study especially since it's a qualitative one.

As the strategy of this qualitative study, researchers selected the action research method since it helps researchers in identifying challenges or flaws in relationships in the real world. When considering this study, 5 number Sri Lankan reputed event planners' have been conducted to gather information for the study. As the research choice, one to one interview was conducted. Each and every participant interviewed using the same set of questions and researchers could be able to gather various answers, suggestions, and details according to their perception. After gathering those data, the next part will be analyzing and obtaining the accurate results for the study. The narrative analysis took place as the analysis of the test, which is about analyzing how stories and ideas were told (Reissner, 2005). And this research, used propositions instead of hypotheses since it is a qualitative study.

Researchers will be adopted the Mono method as the research choice from Saunder's research onion since the obtaining information will be qualitative. This

research will be conducted only using qualitative data. According to the above paragraph, the action research method will be conducted among the selected subjects and data will be collected in detail since this research is qualitative research to find which factors affect the purchasing intention of consumers in the event planning industry under the event planners’ perspective. The information obtained as the type of qualitative within longitudinal time horizon and then the collected data analyzed and interpreted. Information was collected from participants between the months December and February of this year to examine which factors had significantly impacted consumers according to the opinion held by subjects of the research.

7 Results and Discussion

Because the eco-friendly event idea is new to Sri Lankan consumers, the goal of this research was to look into the elements that impact customers' green purchasing intentions in the event planning sector. The information was obtained through semi-structured in-depth interviews with five event management businesses. These five event management businesses expressed their thoughts on the green idea and the elements that affect consumers' sustainable purchase intentions in the event management sector. The ecofriendly approach, according to these event management businesses, is now a trendy and developing concept in the Sri Lankan event management market. When asking the questions, we were able to uncover several particular elements that impact the green purchase intention of event organizers. They agreed on several variables that influence consumer ecofriendly buy intentions, both strongly and partially, and we were able to identify those elements that have a substantial impact effect on green purchase intentions for green products and services connected to the events .The findings of the interview sessions have been presented to illustrate the degree to which event organizers agreed on the displayed variables that affect consumers' green purchasing intentions in the Sri Lankan event planning sector.

Table 1. Consumers' green purchasing intentions are influenced by various factors.

Companies	A	EC	GA	GW	PA	SN	I
A	●	●	●	○	●	●	●
B	●	●	●	○	●	○	●
C	●	●	●	○	●	●	●
D	●	●	●	○	●	●	●
E	●	●	●	○	●	●	●

Note: - Strongly Agreed ● Partially Agreed ●
 Not Mentioned ○

A- Awareness, EC- Environmental Concern, GA- Green Advertising, GW- Green Washing, PA- Product Attributes, SN- Social Norms, I- Income

As per the event organizers' perceptions in this survey, awareness is the most significant element on customers' green purchasing intentions. The first sub-objective was to investigate the effect of customer awareness on their green buying intention. Every one of the event organizers agreed and indicated that raising awareness has a significant influence and pushes customers to purchase green products and services in the event planning sector. All the participants stated that “consumers who have a high awareness about the green concept are more likely to adopt the green concept in their events to protect the natural environment”. We can see that customers know of the benefits of the green concept and the advantages of eco-friendly events, and this awareness has a significant influence on consumer buying behavior. The findings highlight the significance of customer knowledge in terms of green purchasing intentions. Then there was the possibility of determining the influence of environmental concern on customer green buying intentions. According to the findings of the interviews, three event management firms strongly agreed and stated that “consumers are increasingly worried about the environment, and they prefer sustainable events that are more ecologically friendly”. And the other two event planning businesses concurred, to a lesser extent, that customer green purchasing intentions are influenced by environmental concerns. When it refers to the two aspects of awareness and environmental concern, event organizers think that awareness has a greater influence than environmental concern.

The third objective of this research is to see how green advertising affects customers' ecofriendly purchase behavior. Consumers' green purchasing intentions are slightly influenced by green advertising, according to two event management businesses. Whereas, consumers' green buying intentions are highly impacted by green advertising, according to three event planning businesses. Advertising, they claim, is one of the most effective marketing techniques for influencing eco buy intentions. Advertisement, in their opinion, motivates customers to buy green goods and services in the event planning sector. Green advertising, as per them, has a significant but limited influence on green purchasing intention. One of those two event management firms has determined that concern for the environment has a greater influence than green advertising on consumers' ecofriendly purchase behavior. Researchers noted that no one highlighted the green washing aspect while determining the influence on customers' ecofriendly purchasing intentions, which was a sub-objective of this study.

Furthermore, the features of environmentally friendly products and services in the event planning sector affect customer ecofriendly purchasing intentions. The results may be reinforced by pointing out that there isn't a substantial link between product characteristics and customer green purchasing intentions. All of the event organizers felt that product features do not have a significant influence on consumers' green purchasing intentions in the event management sector. In this research, social norms were regarded as one of the elements that influence customers' green purchasing intentions. When comparing to product attributes, one of the event planning businesses believed that social norms had a large influence on customer green buy intentions, while three participants somewhat agreed and perceived the positive link between social norms and consumer ecofriendly purchasing behavior. The event planner who strongly believe that the social norms have a great influence on green purchase intentions stated that "social norms influence the views of consumers about green events and persuade them to include more green items and services than artificial stuff in the events". The addition of green product qualities to event-related products and services will assist in remaining competitive and distinctive in the business. One of the interviewees didn't even bring up the influence of social norms on consumers' ecofriendly purchase behavior in the event planning sector. Finally, we might mention that, in the opinion of event planners, income is one of the influencing elements on customers' ecofriendly purchase behavior. All of the event planning firms agreed that income had a significant influence on consumers' ecofriendly purchase behavior. Furthermore, two of the participants highly agreed, while the other participants somewhat agreed, that wealth influences customers' ecofriendly purchase behavior in the Sri Lankan event planning sector, according to the event organizers' viewpoint.

8 Recommendations and Conclusion

This research has the potential to have a significant influence on the Sri Lankan event sector, as there are currently no truly green procedures in place. The elements of awareness, environmental concerns, income, social norms, and green characteristics have a substantial influence on customer purchasing intentions, according to the sub-objectives and results from semi-structured in-depth interviews. As a result, event planners may be able to find possibilities to further develop new strategies for their company by combining these factors. They may create new green event packages based on the clients' income levels. Also, because the knowledge element has such a large influence, event organizers should undertake awareness activities to raise client understanding of green products and services. Customers are not interested in or seek for eco-friendly services and

goods in this business due to a lack of understanding. To raise awareness of green events, advertising might be employed. When it comes to launching and advertising environmentally friendly products, planners should focus on the packaging of the items as well as the quality of the services they provide, ensuring that the green idea is appealing in each product.

Some Sri Lankan buyers are now prepared to pay more for environmentally friendly items. As a result, the authors of this study address the variables influencing consumer buying behavior of environmentally friendly goods and services in the event planning sector from the perspective of event organizers. This study takes a qualitative approach, with the goal of determining which factors have the most impact on green buying intentions. Consider variables like environmental concern, green advertising, green washing, green product attributes, social norms, and income in this section. The authors discovered that the awareness element affects green purchasing intention as per event organizers' perceptions after conducted semi-structured one-on-one interviews with five reputable event planning firms. When it comes to the environmental concern element and green advertising, three event planning firms are unanimous in their belief that this aspect has an impact on green purchasing intent. There is no mention of the green washing element by any of the firms. The five event organizers were only partially in agreement on product characteristics, which has an impact on green buying intentions. The authors suggest that awareness, environmental concern, and green advertising had a greater impact on green buying behavior than other factors, based on their data. By understanding the interviews as tales, the storytelling analysis approach was used as the data analysis method in this research. By examining these characteristics, this research will assist event planners in developing appropriate tactics to get a competitive advantage over their competitors. It will encourage the event planning sector, as well as other industries, to embrace the green idea.

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DERIVING INSIGHTS THROUGH OCRED JOB ADVERTISEMENTS VIA NLP

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ABSTRACT - One of the major problems in the Sri Lankan labour market is lack of availability of demand side information. This lack of information has created a gap between supply and demand of labour. This novelty approach of using Job advertisements would provide a wide range of real-time information about aspects, such as skills and qualifications that are in demand for Sri Lanka. The objective of this research is to create a structured dataset of job vacancies in Sri Lanka using publicly available job advertisements and derive insights. A total of 3500 images of job advertisements were scraped from Sri Lankan English newspapers and job websites and converted into text form using Optical Character Recognition (OCR). Next, a structured dataset was created by extracting information, applying a combination of rule-based and deep learning approaches in the Natural Language Processing (NLP) domain. The created structured dataset was then used to derive insights by using visualizations. This kind of insight would provide huge value to employers, job seekers and policymakers, providing an inside look into the current standpoint of the labour market.

Keywords: *Bidirectional Encoder Representations from Transformers (BERT), Information Extraction, Labour Market Intelligence, Named Entity Recognition (NER), Natural Language Processing (NLP), Optical Character Recognition (OCR)*

1. Introduction

Underemployment and Unemployment has become a major issue in Sri Lanka, the main cause of these issues is the skill mismatch prevailing in the labour market. According to the statistics obtained by reference [1] the unemployment rate and the underemployment rate of Sri Lanka currently is 4.8% and 2.7% respectively. The main cause for skill mismatch is the gap between the skills demanded and skills in supply. According to a study on management graduates passed out during 2005-2010 they found out that only 54% of the graduates were doing jobs in par with the qualifications while the rest were vertically mismatched [2]. Having information about what employers want, may help to reduce this mismatch to some extent. What better source to know what exactly they want than job adverts? The amount of access to job related data has increased as a result of the increase of job postings that are posted online. According to research in reference [3] they found that information scraped in the internet were more detailed and up to date than the job vacancy data collected using the survey methods. However, in considering the past literature, it clearly depicts the necessity of having new research approaches. Considering the prevailing situation, this research is

designed to address the literature gap locally and come up with a new dimension of the labor market. Therefore, having a source where candidates and employees alike can refer to would be beneficial in updating themselves whereby it would help bridging this gap. Furthermore, it will be more beneficial for the education providers and policy makers on updating themselves with the present scenario.

There are mainly three objectives in this research. They are,

1. To create a textual dataset of job vacancies (Image to text representation)
2. To create a database that includes all job vacancies and related required skills
3. To derive insights about the labour market demand using the created database.

Publicly available job postings for all types of jobs from Sunday Times and Sunday Observer newspapers and Top Jobs, job listing site in Sri Lanka were used in this research. The time period considered was from October 2019 to September 2020 and over 3000 job postings were collected. The reasons for deciding on such a scope was because the mentioned data was publicly available

and these sources were the ones that were mostly referred to by the job seekers. In this research paper the following topics are being discussed, how the job advertisements were scraped, the use of optical character recognition to convert the advertisements into a textual format and the use of classical approaches and deep learning methods to extract pre-determined information and deriving insights on the Sri Lankan Labour market using the extracted information.

Due to the highly resilient nature of the job market jobs, skills and qualifications in demand change swiftly. Therefore it is very important for both employees and employers to be updated on what's happening in the job market. Job postings are posted on traditional modes such as newspapers and on digital modes such as Job portals, LinkedIn etc. making it hard for both employees and employers to identify new trends. This study will help both parties by bringing all the information into one place and giving access to relevant information. Thereby job candidates would be able to optimize their skill-set and learn new skills to maximize their value. This would be highly beneficial for policy makers in terms of identifying which areas are suffering from labour shortages and the areas which can result in economic growth. This would also be beneficial for employers as they would be able to see what other employers are pursuing and seeking. And for academic institutions to prepare up to date curricula directly based on job market trends.

2. Literature Review

The labour market flexibility is the key to a successful economy. Therefore, the need to study the labour market has been growing since the early 90 and the worldwide labour market research is being advanced as times goes by. In recent years, some factors have dramatically changed the behaviour of the worldwide labour market. Furthermore, using real time data on labour market offers will provide a better analysis on the labour market dynamics and trends [3]. The use of AI algorithms to study the labour market by classifying online job vacancies [4] resumes [5] has now become a prominent method.

In considering to the Sri Lankan labor market research, it is mostly addressing the areas such as employment rates, unemployment rates and demographic factors in labor market. [6] Limited number of researches have addressed the skill mismatch and other perspectives [7] In addition to that most of the studies were conducted based on the secondary data that are almost published reports. Furthermore, research conducted based on primary data is very limited.

In comparison with the global research context, it has taken a further step in comparison to the local context. In the modern research approach, researchers have used unconventional approaches in data collection such as web scraping, job advertisements and job description analysis. In that case, configuring the global research the results that have arrived from that research were remarkable in the labor market [8]

Reference [9] performed a content analysis using both popular local and national newspapers in the UK. The findings of the research were used to identify new trends in the labour market. Jackson found that jobs were based on meritocratic criteria and not based on social class or power. [10] Carried out a similar analysis in Austria using newspapers. Analysis of Job advertisements enables you to carry out a historical analysis, where it is not possible to do so with surveys as data is only available for a particular point in time. [11] Carried out an analysis to identify skills required by IT personnel in the UK by using a web spider to extract job vacancies from a UK job site called Monster.com. [12] Also used Monster.com to analyse the job market from an employer's perspective. Author used job descriptions to understand aspects such as company branding and how marketing is done in human resources to attract candidates for jobs. [13] Carried out a study on gender discrimination in the Chinese job market using data from the third largest job portal in China.

Extracting information from unstructured data is known as Information Extraction under Natural Language Domain. Widely used technique to perform information extraction is entity extraction. This is also known as Named Entity Recognition (NER) [14].

Hence, it can be said that the process of extracting data from unstructured text and sorting into categories such as person, number, location, year is Named Entity Recognition [15] Named entity recognition is a highly challenging task as it needs high knowledge in this area to get greater performance [16], [17]. The term Named Entity was first introduced by Ralph Grishman and Beth Sundheim in 1996 [18]. They introduced mainly two main categories, ENAMEX and NUMEX. PERSON, ORGANIZATION and LOCATION were introduced under ENAMEX and TIME, MONEY or DATES were introduced under NUMEX.

Earlier studies used the classical approach to extract information [14]. The classical approach uses various rules to extract relevant information. A Brill rule inference approach was introduced by Kim in reference [19]. Rules are automatically generated based on the part of the speech tag under this method. Most of the studies used predefined keywords or

dictionaries such as International Standard Classification of Occupations (ISCO) [20], [21].

In the recent past, the trend moved from using machine learning algorithms to neural networks. Deep learning algorithms have the ability to discover hidden features within the text automatically. It can learn complex features, underline useful representation from text through non-linear activation functions and without any aid from domain expertise and feature engineering skills [22]

The encoder of the transformation model is the base of BERT. What authors of reference [23] have done is, they have taken off the decoder portion of the transformation model and have added additional encoders to the encoder portion to create BERT. BERT base has 12 encoders and BERT large has 24 encoders.

What makes BERT the state of art model is because of the way BERT has been train. BERT uses two methods to train itself.

1. Masked Language Model (MLM)
2. Next Sentence Prediction

Encoders of the transformer architecture are the base of BERT. Transformers have been widely used in language modeling [24] Transformer encoders have a mechanism called attention. Attention is used to make the model focus on the important parts of a given sequence. Therefore, when processing a given word, the model can focus on other input words which are similar to the word that is being processed. In transformers, multi head attentions are being used to do attention computation in parallel.

In the initial encoder layer, word embedding for the input sentence X is multiplied with weight matrices to get the query, key and value vectors and the succeeding encoders use the output of the previous encoder as its input. As the NER problem is a multiclass classification problem, a softmax layer is added after the pre-trained model. The final hidden state of each input token is fed to the softmax layer. The entity class which has the highest probability will be assigned to that particular token. Based on the loss, the model will fine tune the weights of the new layer and existing weights of the pre-trained model.

3. Methodology

3.1 Data Gathering

At present, job advertisements are not advertised only in newspapers; they are published in e-learning and online job portals. Hence, there are many sources available to accumulate enough data to analyse the job market. To accomplish the first objective of this

research, 3535 job advertisements were scraped for the time period from October 2019 to September 2020. Google Vision API and Beautiful Soup were used for converting image to text and for scraping, respectively.

Using only one source leads to biasedness; to avoid this, multiple sources were used. These sources were online newspapers (e- papers) and online job portals. Sunday Observer and its sister newspaper Daily News were selected as newspapers due to the availability of data.

Sunday Observer is an English Sri Lankan Newspaper that includes a separate section of job vacancies. Most managerial and executive job vacancies are advertised in this newspaper, and Sunday observer is famous for Job vacancy advertisements in Sri Lanka [24]. Top Jobs was chosen as the online job portal as it is the leading online job site in Sri Lanka. It includes advanced labor market information system data and has partnerships with around 1500 leading organisations in Sri Lanka.

3.2 Information extraction

The mechanism of extracting useful information from unstructured data is defined as information extraction. The information that is to be extracted was identified by analysing the extracted job advertisements.

Two main approaches were used to extract information in this research; the classical and deep learning approaches.

3.3 Classical Approach

A set of predefined rules are used to extract information under the classical approach method. The standard tools that are used to define rules are regular expressions, phase-matcher and dictionaries. This approach is widely used in the information extraction domain due to its ease of implementation.

Entities with definite patterns, such as email telephone numbers, were extracted by writing regex patterns. For example, telephone numbers are mainly represented as a ten-digit number. Hence, a regex pattern can be written to extract any number which has ten digits. Keywords are used to represent some entities, for example, Job title and preferred gender. These were extracted by initialising a dictionary and finding matches based on it. Finally, the phrase matcher was used to extract entities that had similar word patterns.

For example, most of the company names are succeeded by “LTD” and “PLC”. For such instances,

a rule can be written to extract words before “LTD” or “PLC”. Table 1 summaries the main three methods used to extract each entity. Responsibilities and skills were not extracted using the classical approach as both entities neither follow a specific pattern nor have common keywords.

Information Extraction	Approach
Job title	Dictionary
Company Name	Regex pattern
Responsibilities & Skills	-
Education Level	Dictionary
Years experienced	Phrase-matcher
Salary	Phrase-matcher
Age Limit	Phrase-matcher
Location	Dictionary
Address	Regex pattern
Gender	Dictionary
Telephone No	Regex pattern
Email	Regex pattern

Table 1. Approach used to extract each entity 3.4

Deep learning approach

Alternative to the classical approach, deep learning algorithms can be used to extract information from unstructured data. One popular technique is Name Entity Recognition (NER). NER can be defined as the function of finding entities such as name, location and organisation in text. This approach is used in this research as some specific information could not be extracted using the classical approach due to the nature of it being represented.

In order to custom train the NER model, BERT deep learning algorithm was used. First, the test dataset was converted to the IOB format. After converting the data into the IOB format, the second step is to convert the input data into the BERT friendly format. Sentences cannot be fed to the model as it is. They should be split into words, and these words should be represented in some kind of mathematical format. Hence, the first thing that is done to a given sentence is, it gets tokenised. Tokenisation can be done in three ways; 1. Word-based, 2. Character-based, 3. Sub word-based. Bert has been trained using a sub-word token approach. Hence, it expects the input to be tokenised in that particular way when fine-tuning for downstream tasks.

The underlying principle of subword tokenisation is that common words are kept while uncommon words are split into smaller sub-words. The subword-based tokenisation algorithm used in BERT is called WordPiece [25]. There are mainly two ways a given word will be tokenised using WordPiece tokenisation, one-to-one tokenisation or one-to-many tokenisation. In cases where the given token is present in the vocabulary, a single WordPiece represents a particular token. This is called one-to-one tokenisation. One-to-many tokenisation is used when the token is not present in the vocabulary.

When using a pre-trained model, it is important to use the particular tokenized which was used when training that chosen pre-trained model. As the pre-trained BERT model will be fine-tuned, BertTokenizer will be used to tokenize the input words. When a sentence is given to the tokenizer, a dictionary is returned with three keys namely; “input_ids”, “attention_mask”, “token_type_ids”.

The key ‘input_ids’ are the corresponding indices to each token in the input sentence. Tokenizer adds two special tokens when returning the input sentence, [CLS] and [SEP]. As mentioned before, these special tokens indicate the beginning and the end of each sentence respectively. When multiple sentences are fed to the model to make sure that all the sequences have the same length, padding or truncation is done. As [PAD] tokens do not add any additional value to the sentence, ‘attention_mask’ is used to distinguish the tokens that model should pay attention to and which should not. ‘token_type_ids’ are used to distinguish between two sentences. However, this is not applicable to NER as single sequence is used.

When the WordPiece tokenization splits a word into sub-words, a mismatch of the total number of tags will arise as there is only one tag present for each word in the dataset. One method to handle this is by training only the first sub-word tag label in such splits. Huggingface transformer library will set other subwords’ labels to -100 so that model will know which tokens should be ignored and which should not. Furthermore, [CLS] and [PAD] tokens will be set to 100 as well. For an example word “Venerable” will be tokenized as [‘V’, ‘##en’, ‘##er’, ‘##ab’, ‘##le’] and -100 will be set to sub-tokens as [3, -100, -100, -100, -100].

In order to fine-tune the model, ‘Trainer’ was used. It is an API provided by Huggingface Transformer library to fine-tune or train a model easily using PyTorch python library. Huggingface Transformers library provides an API with class name ‘Trainer’ to train or fine-tune a model easily using PyTorch. Followings are the configurations used to train the model.

BERT model used	Bert-base-cased
Number of epochs used	3,4,5,6,7
MAX_LEN	50
Training batch size	25
Optimizer	AdmW
Training set size	5000 sentences
Testing set size	1000 sentences
Learning rate	2e-5

Table 2. Configurations used to train a custom NER model using BERT

4. Results

4.1 Classical Approach

To assess written rules two metrics were used: Coverage percentage and Accuracy percentage. Table 3 shows the coverage percentage and the accuracy percentage of using the rule-based approach.

The coverage percentage shows how many advertisements containing that particular entity were extracted. This figure was calculated by dividing the number of extracted results by the number of advertisements. A value of zero was given if either the entity was not present or the entity was not extracted from that advertisement and a value of 1 was given if the entity had been extracted from that particular advertisement. The accuracy figure shows how accurate the extracted information is. It was calculated by dividing the number of accurately extracted results by the number of extracted results. A value of 1 was only given if the extracted information is correct. In case the extracted information was only correct to a certain extent, or it is not correct at all, a value of zero was given. Both figures were calculated manually for each entity.

The highest coverage percentage is for email extraction. Both telephone-number and email have high accuracy percentages. Even though salary has a low coverage the extracted salaries are 90% accurate. The entities which did not follow a certain pattern have low accuracies.

Entity	Coverage Percentage	Accuracy Percentage
Job title	68%	56%
Company Name	65%	56%
Education Level	84%	82%
Years Experienced	68%	59.45%
Salary	62%	90%
Age Limit	70%	70%
Location	73%	80%
Address	74.60%	61.70%
Gender	77%	96%
Telephone Number	82%	100%
Email	93.33%	100%

Table 3. The coverage and accuracy of each entity extracted

4.2 Deep learning approach results

Using the Bert algorithm and different epochs following results were derived.

Number of epochs	3	4	5	6	7
Accuracy	0.8933	0.8978	0.8996	0.9019	0.9005
F1	0.6586	0.6737	0.6883	0.6926	0.6920
Precision	0.61022	0.6365	0.6449	0.6510	0.6539
Recall	0.7154	0.7155	0.7378	0.7399	0.7347

Table 4. Accuracy values for each model

The optimum epoch number is 6. Table 5 shows the entity wise accuracy for 6 numbers of epochs.

Entity	Precision	Recall	F score
title	0.5789	0.7312	0.6462
Education level	0.6677	0.844	0.7455
specialization	0.6282	0.6926	0.6588
qualification	0.7777	0.6959	0.7345

Responsibilities and Skills	0.6454	0.73082	0.6855
Number of years	0.8641	0.8701	0.8671
Seniority	0.6046	0.6753	0.6380
Company	0.600	0.6688	0.6329
Post number	0.6315	0.6122	0.62176
Location	0.7467	0.8635	0.8009
Gender	0.7121	0.8545	0.7768

Table 5. Entity wise results for the model trained using 6 epochs

From the above table it can be seen that entity no years has the highest F1 score and entity post number has the lowest F1 score. The entities such as responsibilities and skill, company, title, education level, specialization which are hard to write rules have fairly good F1 score.

4.3 Third Objective

4.3.1 Education Qualifications

Following are the educational qualifications and their frequencies identified from job advertisements.

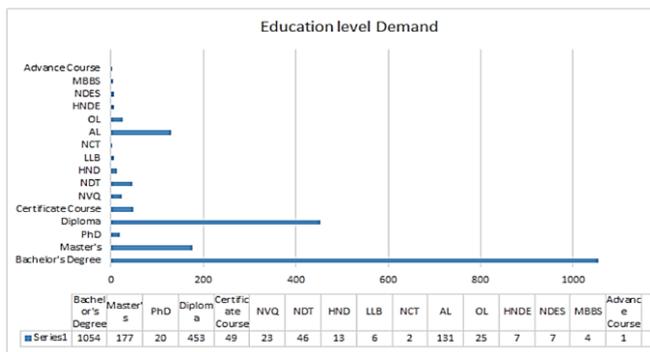


Figure 1

4.3.2 Professional qualifications

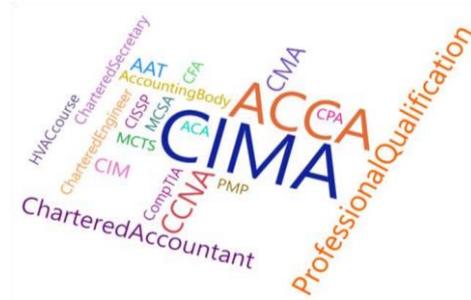


Figure 2.

Above are professional qualifications found in job advertisements. CIMA is the most demanded professional qualification then ACCA and Chartered accountancy. Many of the professional qualifications mentioned were related to the finance sector and some qualifications targeting the IT sector were also found in job advertisements (ex: CISSP, CCNA, MCSA, MCTS etc.) some only just mentioned professional qualification without mentioning any particular qualification.

4.3.3 Job Title

Since extracted jobs across many industries study was able to extract many job titles covering many sectors. Out of the job titles the most demanded job title was Assistant and Manager with 100 and 76 job opportunities respectively. You can identify various job positions available based on sector by referring to our final dashboard.



Figure 3

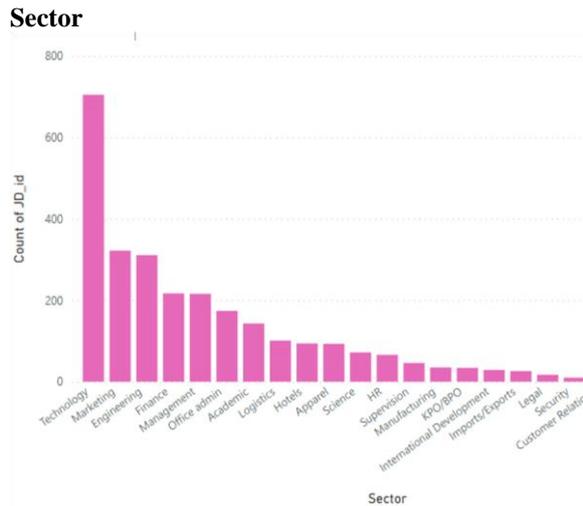


Figure 4.

Looking at the sector distribution it can be observed that the technology sector has created the most jobs in the market. Many job opportunities are available for candidates in that particular sector and then areas of marketing, engineering and finance sectors contribute the most to the job market.

5. Limitations and Future Work

There were several limitations in this study. The first limitation was the limited availability of data. As mentioned before, the period that was taken into account while scraping advertisements is one year. Many English newspapers did not have proper archives maintained and most of the papers which have maintained archives did not give free access to the public. Hence, the job advertisement database had very limited information and it was not well diversified. Another limitation of this study was not having a proper tool to convert the images to text format accurately.

There were several limitations in extracting these entities using the classical approach such as some patterns were not available in our pattern database, some advertisements were not properly converted and some advertisements were unique and represented information in a different way making it hard to write a particular pattern for entities. The main reason why accuracy is lower than expected for the BERT model is due to class imbalance present in the dataset. Another limitation faced while making structured dataset was the imbalanced representation of entities in a given advertisement.

Another limitation faced when training the models, is the unavailability of high capacity hardware to train the model to its full potential. Due to limited hardware capacity, the number of word embeddings used were restricted to one or two. Putting more word embeddings could have improved the accuracy of the

models. Therefore, in future using proper hardware would help to increase the accuracy of all four deep learning models.

This can be expanded to a longer period of time, by scrapping daily data for a significant amount of time. After accumulating a considerable amount of data for which represents a longer period of time, it can be used to carry out a trend analysis on the Sri Lankan job market. Furthermore, a custom word embedding which has a vocabulary unique labour market terms can be created using advertisement text corpus. Additionally, this information extraction system can be used to extract information in real time. A dashboard can be published using real time information to assist each relevant party to make their decision based on the prevailing situation in the labour market. The sources of this research can be expanded to social media platforms such as LinkedIn, Facebook job search. Using such sources will help to capture more diverse job opportunities. Finally automating the entire process from scrapping the job advertisements to extracting information can be done, creating a business opportunity to be a host which provides real time labour market intelligence.

6. Conclusion

This research has tried to fill the gap which has been created due to the unavailability of demand side information in the Sri Lankan job market. Two approaches were used to extract relevant information from job advertisements; classical approach and the deep learning approach. Entities which had a common pattern were successfully extracted using the classical approach while complex entities were extracted using a custom train NER model. This research contributes to literature by building an automated information extraction system to extract information from Sri Lankan job advertisements.

A final database was created using two approaches, to analyse the demand side of the labour market. To the best of our knowledge currently there is no database present which consists of information related to job descriptions in the Sri Lankan context. By analyzing the extracted information, we were able to derive some useful insights. The fast growing industries, most demanded education level, qualification for each job category, most demanded skills in each sector, discrimination present in the labour market are some of the key findings.

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A STUDY CONDUCTED ON THE PROBLEMS FACED BY THE PRIMARY MATHEMATICS TEACHERS WHEN MAKING AND USING TEACHING AIDS

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ABSTRACT

This research explores the Teaching Aids used in the 21st century Primary Education sector in Sri Lanka: Identifying problems faced by the primary mathematics teachers and providing solutions, as well as a broad idea on teaching aids and its needs for students. To accomplish the aim of the research, the closed ended questionnaires were used to collect the required data and Questionnaires were given as Cluster sample: from grade 1 to 5 sections in a private school in Sri Lanka. The information gathered via online questionnaires, online interviews and online observations. The collected data analyzed and represented in the percentage distribution of pie and bar graphs. The analysis of the data indicated that the majority of the primary mathematics teachers had positive perceptions on Teaching Aids but faced difficulties when making and using teaching aids. This finding will help to get an idea on the fact that mathematics is a vital subject and its teaching and learning as well as students' poor academic performance has become a source of concerns to all stakeholders. The problem of the study has investigate the effects of using of teaching aids to enhance the both primary school mathematics teachers and students' performance in order to provide a quality primary education. Teaching aids are an integral component in any classroom. The many benefits of teaching aids include helping learners improve reading comprehension skills, illustrating or reinforcing a skill or concept, differentiating instruction and relieving anxiety or boredom by presenting information in a new and exciting way.

Keywords: *Academic Performance, 21st century education system, Perception and Problem faced by Primary mathematics teachers, Primary mathematics teachers, Teaching Aids, Teaching learning process.*

1. Introduction

1.1 Research Background

Primary education is the incubator for the next generation of leaders, thinkers, and innovators. The main challenge for primary mathematics school educators is to prepare young minds and using that knowledge to develop instructional strategies to keep students involved in curriculum materials. Especially Primary school educators are responsible to deliver standardized learning to meet established standards of education. For primary education providers, it is very easy to see the learners as unique individuals. There as primary mathematics teachers plays a major role in their lives. To make a quality and effective learning teaching process, as teachers we need to spend some time on delivering quality education. One major part is using teaching aids in their lessons which will help the students to: improve reading comprehension skills, illustrating or reinforcing a skill or concept, differentiating instruction and relieving anxiety or boredom by presenting information in a new and exciting way, motivating students to engage their learning, students will be able to get clarification on

difficult/complex contents, Classroom Live and active, students are able to obtain direct experience etc.

And also as 21st century educators we should know the difference amongst Teaching, Aid and Material. As per www.dictionary.com, "material used by a teacher to supplement classroom instruction or to stimulate the interest of students." "As per Merriam Webster, "Teaching Aid is an object (such as a book, picture, or map) or device (such as a DVD or computer) used by a teacher to enhance or enliven classroom instruction" and "Material denotes or consists of physical objects rather than the mind or spirit."

The purpose of this research is to find out the problems that why primary mathematics teachers are reluctant to use teaching aids in their teaching learning process and the problems that they face when making and using teaching aids in the learning teaching process in the 21st century education – primary sector in Sri Lanka.

1.2 Statement of the Problem

This study attempts to find out the problems why the primary teachers are reluctant to use teaching aids in their teaching learning process and the problems that they face when making and using teaching aids in the teaching learning process. In spite of the 21st century education system, with the fact that the primary subjects are very vital subjects and its teaching and learning as well as students' poor academic performance have become a source of concerns to all stakeholders. The problem of the present study is to investigate the effects of using of teaching aids to enhance the both teachers and students' performance in primary education in order to provide a quality education in Sri Lanka.

1.3 Research Questions

1. What are the primary mathematics teacher's perceptions and attitude towards using teaching aids in the learning teaching process?
2. Why primary mathematics teachers are reluctant to make teaching aids in their learning teaching process?
3. What are the problems faced by the primary mathematics teachers when making and using teaching aids in the learning teaching process?
4. What are the suggestions to overcome the problems faced by the primary mathematics teachers when making and using teaching aids in the learning teaching process?

2. Research Methodology

2.1 Research Design and Method

The research design adopted for this study are both qualitative and quantitative research designs which is called as a mixed research method with the help of referring case studies, articles, journals and researches. Data analyzed descriptively and statistically (Graphs, pie chart, bar chart, tables etc.).

2.2 Participants

Sample / Participants: Cluster sample: from grade 1 to 5 sections – five teachers from each section were analyzed with the total number of 25 teachers from grade 1 – 5.

2.3 Data Collection Techniques

Online questionnaire, online interviews and online observations.

3. Analysis and Interpretation of Data

a.) Primary mathematics teachers' perceptions on using teaching aids in the teaching learning process.

According to the online responses, the findings are viewed in regard to the understanding of primary mathematics teachers, 70 % of the total samples perceive teaching aids are resources used to implement and facilitate the lesson.

Statements	Responses (%)
Yes, I strongly believe	72
Not very much essential	12
No, I do not think it is essential	12
I do not have any idea about it	4

Table 1. Primary mathematics teachers' perception on importance of using teaching aids

As Table 1 shows majority (72%) of primary mathematics teachers strongly believe that using teaching aids is important while 4% of the sample has no idea about it. 52% of the teachers from the sample have stated that they use teaching aids most of the time and 44% use teaching aids rarely while 4% do not use teaching aids at all. The reasons for not using teaching aids at all are lack of real objects to use and some other reasons are in Table 3.

The following Figure 1 illustrates the different ways the primary mathematics teachers considered when making teaching Aids.

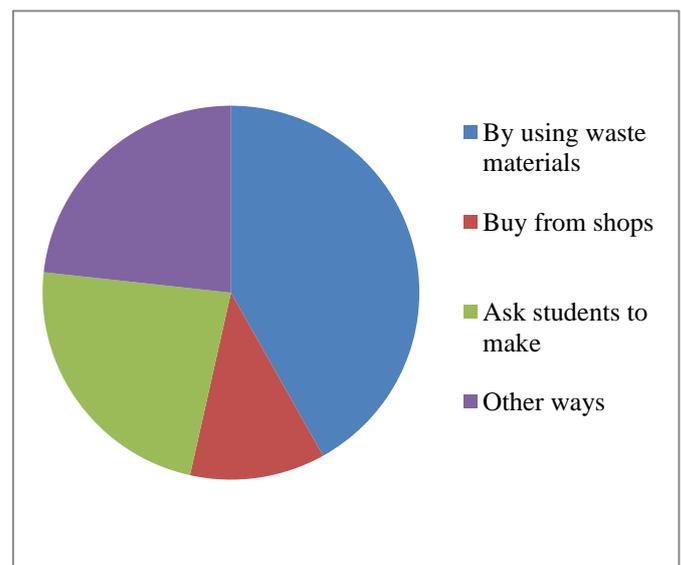


Figure 1. Different ways of making teaching aids by primary mathematics teachers

According to the above Figure 1 it could be identified that the main ways of making teaching aids by the primary mathematics teachers were using waste materials to make teaching aids and asking students to make. Still 32% of teachers from the sample - buy teaching aids from shops. It shows that although many primary teachers like to use teaching aids some teachers still do not prefer to make teaching aids by themselves. In addition, it could be revealed that some the primary mathematics teachers find other ways such as using materials provided by the school, borrowing teaching aids from the resource room or from other teachers.

Purposes	Responses (%)
To explain the facts more clearly	100
To facilitate active learning	96
To maintain good attention	92
To increase students motivation	80
To give more opportunities to self-learning	84
To maintain liveliness in the classroom	80
To manage time	76

Table 2. Purposes of using teaching aids by primary mathematics teachers

The above Table 2 shows the purposes of using teaching aids by the primary mathematics teachers in the teaching learning process. The purposes are stated according to the preferences given by the total sample. It could be identified that majority of the sample use teaching aids to explain the facts clearly. This further provides an evidence for the finding that the primary mathematics teachers had a positive perception of teaching aids and its importance.

As Figure 2 given below indicates it could be identified the mostly used teaching aids by the primary school mathematics teachers were the teachers pictures, cards, photos and black board, Text books, magnetic board respectively whereas the least used teaching aids by the primary mathematics teachers were story books, magazines, articles, computer, DVD, CD, cassettes, structures and models.

It also showed that the primary mathematics teacher’s most common teaching aids are visual teaching aids and the least interest in using audio visual teaching aids such as computers, YouTube videos, cassettes and DVDs is still at the lower level, while these teaching aids can bring more imagination and innovation to the teaching learning process. Among the most popular teaching aids the pictures, cards and photos take the highest score which further reveals that primary mathematics teachers more often use iconic teaching learning experiences for primary school children.

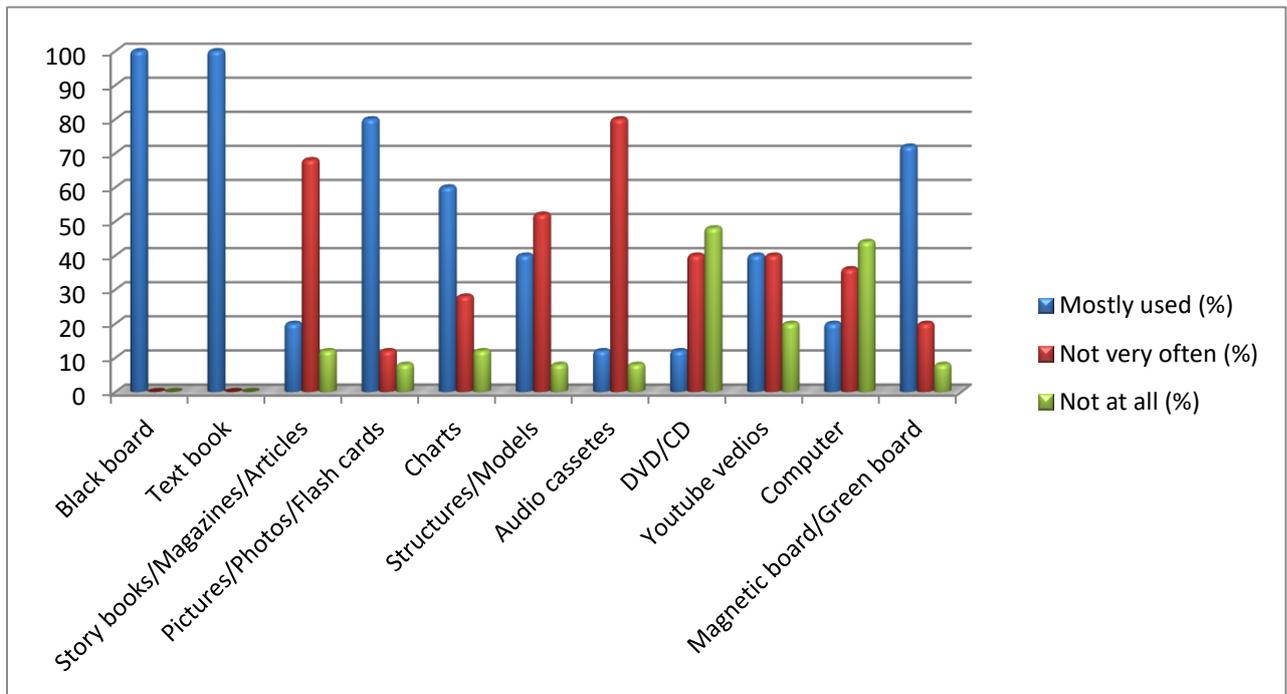


Figure 2. Mostly used teaching aids by the primary mathematics teachers

b.) Problems faced by the primary school mathematics teachers when making and using teaching aids

Problems Responses	(%)
Expensiveness of materials	68
No time to make for each lesson	92
Difficulty of transportation	68
Storage difficulty	20
Lack of ICT knowledge	80

Table 3. Problems of making teaching aids

According to the data shown in Table 3, finding time to make teaching aids for each lesson is the key problem faced by primary mathematics teachers when making teaching aids. These further states that sufficient time has not been allocated in their work duties for teacher preparation, particularly for making teaching aids. In addition, primary mathematics teachers also feel that expensiveness of materials and difficulty in transportation make problems for them to make different effective teaching aids when teaching. Further teachers don't find storing difficulties as a huge problem that they had faced. The reality is that many schools have limited space and sometimes subject teachers must often share classrooms, or worse yet, travel from room to room.

Also, according to the data showed in the Table 3 the second main problem faced by the primary school teachers is lack of ICT knowledge to make teaching aids for each lesson.

Although the use of technology in the classroom has increased dramatically in recent years, educators are still struggling with it, feeling left behind and not understanding how to include it in their teaching. The worst thing is that there are several educators who simply refuse to use any technology for education. First, it's important to understand the reasons behind the teachers' reluctance to implementing technology in their classrooms and then come up with solutions to help them get past it.

Here are a number of what I believe is the real reasons so many primary mathematics teachers are reluctant to use technology in the classroom: lack of training, wrong kind of training – technical rather than pedagogical, lack of syllabus integration. Technology can't be an add-on or extra work. It has to be integrated into and help them with the material they have to cover in the classroom with their students, Lack of infrastructure at school, not enough effort goes into training, teachers don't realize its

advantages and they don't understand the value of ICT knowledge, they don't know how to use it, They're very traditional.

Problems faced when using teaching aids	%
Do not Know how to relate teaching aids to the lesson	28
Do not know how to use teaching aids technically	56
Lack of knowledge on teaching aids	48
No proper training to use electronic materials	60
No sufficient space to store the teaching aids	40
Teaching aids are not attractive and big enough	16
Teaching aids does not cater to all the students in the classroom	32
Teaching aids are not to the proper standards	12
Lack of resources in the school	40

Table 4. Problems faced by primary mathematics teachers when using teaching aids

According to the Table 4 lack of special training on using electronic materials such as computers, Lack of knowledge on how to use teaching aids technically are main problems faced by primary teachers and lack of space in the classroom to keep teaching aids and limited resources in their schools could be identified as other main problems the teachers faced when using teaching aids in the classroom respectively. In addition, not adequate for all children and lack of knowledge to relate teaching aids with the lesson could be identified as other problems the teachers faced. Whereas less attractiveness and poor standards are the least problems they faced when using teaching aids and a connection between the two findings could be identified when compared to the teachers' rarely used teaching aids and the major problem they faced when using teaching aids. It could be shown that either teachers rarely use audio visual teaching aids such as computers because they do not have adequate training on using them or because they do not have adequate training, they very rarely use those teaching aids in the classroom.

4. Conclusion and Recommendations

4.1 Summary and Conclusion

According to the findings the following conclusions were made in this study. The study concluded that majority of the primary mathematics teachers possesses a relatively broad perception on teaching aids and its significance in the teaching learning process.

From this research following conclusions have been drawn;

The research concluded that using visuals aids as a teaching method stimulates thinking and improves learning environment in a classroom, effective use of teaching aids substitutes monotonous learning environments, students develop and increase personal understanding of the areas of learning when they experience a successful and pleasant learning in the classroom, students find visual aids sessions useful and relevant when it has some direct relation to the course content and the present research gave insights on teachers' perception and opinions on the use of teaching aids and resources. However, it is also imperative to redirect teachers' opinions, perceptions, experiences, failures and successes while using teaching aids resources.

Moreover, the study concludes that though the primary mathematics teachers are aware the functions and significance of using teaching aids, they limit the teaching aids to visual aids most often in the actual classroom due to the problems they faced with regard to lack of training of other audio visual teaching aids as well as lack of time for preparation of teaching aids. The study further concludes that due to the problems they faced in relation to preparation and use of teaching aids the emphasis given on using teaching aids has been decreased.

The findings of the study have direct implications for teaching - learning process.

- a) The instructions on how to make and use teaching aids should be explained in detail in the education programs for teachers. As such, it would help the primary mathematics teachers and students engage efficiently and effectively in the teaching-learning process.
- b) Seminars, workshops, teacher development programs should be conduct by school management for teachers on teaching aids so, that the teachers would motivate in making teaching aids for the students benefit.

- c) School management should provide space: especially for subject teachers who go to one class to another class to teach so, that the teachers would motivate in making teaching aids if they have space to store.
- d) Both school management and education programs institutes should conduct ICT sessions, so that the teachers could match with 21st century education system which would help the primary mathematics teachers to use modern teaching aids.
- e) School management should consider on time management so, that primary mathematics teachers would be motivated to make teaching aids.
- f) The finding of this research would motivate the primary mathematics teachers who are reluctant to use teaching aids and will provide better understanding on the diversity of teaching aids and as such, develop more effective methodologies in teaching their subject matter for better understanding of students. The study will guide teachers and all educators who always have the desire to see their students perform well by using the appropriate teaching aids in their teaching learning process.
- g) Also, the study would help to imply the government to provide the needed teaching aids and facilities to motivate students to enhance the development of good academic performance of primary education students, which really important.

Teaching is an art that requires learning, presentation, and propagation and, above all, every aspect of paralinguism. Teaching needs broad knowledge of subject matter across all horizons, a full curriculum with expectations, a constructive and compassionate attitude with excitement, a passion for classroom management learning and strategies and a desire to make a difference in young people's lives. I am sure that nobody will deny the fact that a teacher is an aid and the activities used by the teachers are materials in the classroom. The life of materials is fully dependent on teachers' imagination and creative ways.

4.2 Recommendations

In the study majority of the total sample suggested that to overcome the problems they face when making teachings, they need to share teaching aids among other teachers, make them only for selected lessons, use waste materials. To overcome the problems faced by the primary school teachers when using teaching aids in the teaching learning process, majority of total sample suggested arranging

seminars, workshop to provide special training on using teaching aids effectively, making teaching aids that are durable, allocating a proper place to store teaching aids, create new teaching aids and mainly to provide ICT skills.

Add three main components in the Teacher Development Programme:

- a) Time management
- b) Teaching aids
- c) ICT

Provide guidelines for Teaching Learning Aids:

Littlejohn and Windeatt says, “Materials have a hidden curriculum that includes attitudes toward knowledge, attitudes toward teaching and learning, attitudes toward the role and relationship of the teacher and student and values and attitudes related to gender, society, etc.” Materials have a basic instructional viewpoint, approach, method, and content, including which provide linguistic and cultural information.

In terms of style, user friendliness and longevity, materials should be alluring. If any material has these features, then all students will readily use the material wholeheartedly, which will certainly yield good results in the classroom. Materials should also be versatile in order to use the material in many places, such as an image, to teach parts of speech as well as to improve spoken skills, even that picture can be used to develop writing skills by the change of instructions. Materials should be authentic also by which the acquirement will be better and faster and the students feel successful over their achievement because the skills that they acquire make them feel that they can handle the situations in the real life too. Teachers should be very cautious while choosing the materials because the students can be demoralized if the materials are higher than the level of the students.

How to Work with Reluctant Teachers?

Here are few helpful tips on how you can get reluctant teachers to work with you if you have found yourself in this situation.

- a) Begin with a relationship
- b) Obtain support from other Teachers
- c) Make the discussion confidential
- d) Use data/information to drive the conversation

Provide ICT skills

A. School management can boost teacher confidence and motivation:

- a) Few teachers are confident ICT users.

- b) ICTs motivate (some) teachers at least at the start.
- c) To encourage effective teacher participation in continuing professional development incentives must be developed.
- d) Access to ICTs is the most significant factor in whether teachers use them.

B. Teacher professional development:

- a) On-going instruction and support for teachers are essential to the effective use of ICTs in education. Teacher professional development is a process, not an event.
- b) Introducing ICTs increases the needs of teachers for on-going professional growth.
- c) Effective professional development models for teachers can be split into three stages.
- d) Successful professional development for teachers can model productive teaching practices. Training in assessment methods is vital.
- e) Substantial preparation requires successful professional growth.
- f) On-going, frequent teacher support is critical.

C. Other factors:

- a) Technical infrastructure is (obviously) essential to working.
- b) It takes time to implement ICTs. Communities of practice can be important tools to support teacher professional development.
- c) Lessons learned from introducing ICTs in education need to be shared.

Instructions for Designing Effective Teaching aids:

As per Dr Anshul Chandra and Ch. Charan Singh stated that the subjects, themes, and facts of the language should be contextualized for teaching aids. Teaching aids should provide the ability to generate interest among students, even outside the classroom, with each other. This could be a way of progress. Teaching aids should have self-assessment opportunities that will establish their own style of learning and strategies. Teaching aids should link teacher and students to develop a communication skills, understanding and also give opportunities for better learning. The aid must be impressive. Selecting teaching materials is not a haphazard decision but making effective decisions for the benefit of the students.

A. Strategies of using teaching aids:

Strategies should be trained for the correct use of teaching aids; since it is the most effective way to do

things better. The teacher should obey simple rules in the class for the improvement of learning skills for students.

- a) There should be a range of teaching questions available in the class. In the classroom, students should feel at ease, which allows them to learn more in less time.
- b) Teaching aids should be according to ability, back ground and class room situations.
- c) Two or more teaching method should be integrated to bring variety, attractive presentation and appealing content. Relevant and useful aids should be introduced in the classroom. Help students to make efficient use of the teaching aids which help them to self-discover. Enable them to draw attention to language characteristics in order to become conscious of the difference between the first and second languages.
- d) It is important to use various learning modes such as audio, video, traditional, experiential at the same time. Students' belief, motives and emotions should be discussed in the class room as it affects the learning rates.
- e) Feedback must be taken from the students.

B. Developing Effective Teaching Aids:

A significant part of the training programme is teaching aids. Successful teaching relies on practical, appropriate and motivating aids, and when aids are designed according to the needs, desires and aspirations of students, these criteria are met. We may also suggest that teachers should aspire to improve their students with the most effective and suitable teaching aids. The integration of both logic and creative processes is proposed by the material designer. In this respect, Low (cited in Johnson, 1989) states that "designing appropriate materials is not a science: it is a strange mixture of imagination, insight, and analytical reasoning".

Classroom Storage Tips:

- a) Milk Crate Storage and Student Supply Bins
- b) Hanging Storage and Wall Folders

To make teaching aids:

- a) Ask Your School First (Start by talking to your principal if you need classroom supplies).
- b) Run Your Own Fundraiser

Time Management Tips for primary mathematics Teachers:

- a) Ask students to help when making teaching aids
- b) Make durable and last longing teaching aids (Bristol board work, flash cards etc. are long lasting and can be used for future academic too)

Therefore, the study recommends providing more emphasis on enhancing use of more teaching aids by providing proper awareness and training on using different types of teaching aids in the classroom effectively. Further the study can recommend encouraging teachers to prepare effective durable and creative teaching aids by allocating more time from their work schedule and using alternative materials.

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INFLUENCE OF PESTER POWER OF YOUNG CONSUMERS' ON PARENT'S BUYING DECISIONS WITH A FOCUS ON THE SRI LANKAN FAST MOVING CONSUMER GOODS INDUSTRY

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ABSTRACT

Pester Power is a growing trend in the global food and beverage industry. Many studies have explained that the adolescent plays the most important role in the family unit. Today's Fast Moving Consumer Goods (FMCG) market has made the shopping process for families even more social, enabling families to buy goods together. This family unit purchasing activity has provided a forum for young consumers to pester their parents about goods, even though it is not a requirement. Children under the age of eighteen are constantly targeted in advertising and promotions. Most businesses use child-targeted marketing campaigns to increase brand recognition and create a customer base with a higher customer lifetime value. As technology advances, companies have benefited from digital marketing tools like social media, which enable them to target their goods and brands to particular customer segments. Using naive theories such a theory of reasoned action and consumer socialization theory, this paper represents a concept indicator model of factors that impact the genesis of pester power. The model was created by analyzing previous literature and indicating three key variables: demographic, psychographic, and informative. To summarize what has already been said, this research study will inform the reader about the type of phenomenon that exists in the Sri Lankan Fast Moving Consumer Goods (FMCG) industry, as well as the factors that have influenced its emergence.

Keywords: *Fast Moving Consumer Goods (FMCG), Pester power, Nagging behavior, Advertising, Marketing, Parent's purchase decision*

1. Introduction

Marketing strategies are being influenced by the importance of modern families in enacting, planning and socializing consumption patterns. It has allowed young customers to persuade their parents to buy expensive items on the basis of belonging to a family unit and modern societies (Sondhi and Basu, 2014).

Advertising may activate the so-called "pester power" phenomenon, resulting in persuasion behavior that alludes to a youngster's negatively exerting behavior.

Chaudhary, (2018) investigated how a youngster uses a range of persuasion techniques to acquire a variety of things. In fact, marketers claim that in order to thrive in this cutthroat sector, they must engage in pester power marketing. The FMCG industry, where their parents are educated, hopeful and disposable has reflected this materialistic fixation. This is a one-of-a-kind quality that has yet to be spoiled and communicated over the world. It has,

however, piqued the interest of marketing and public relations professionals. It has allowed the business to quickly market its parents. Other research on parental pester power have concentrated on the ability of the parent to approve or disapprove a purchase. It's also possible that a child has his or her own money to spend on the items and that the child's interaction with parents is centered on obtaining permission to spend it in a specific manner. Our current notion of pester power may be one-dimensional if parents are content to buy the item without causing a fuss or if children are allowed to buy the item with their own money. The purpose of this study is to look at the nature of children's interactions with their parents, focusing on the elements that influence their behavior rather than the inconsistent aspects that have been researched previously. Because there are few studies from South-East Asia, especially Sri Lanka and different studies have interpreted the global singularity differently, this study will aid in the discovery of common mechanisms that drive child behavior.

2. Methodology

The authors conducted a thorough literature review to find factors that influence a child's behavior. Publications published between 1967 and 2020 were found using Science Direct, Emerald Insight, Elsevier, Springer, JSTOR and Research Gate. Keywords like child-influence and buying behavior were used to find articles. Following that, a screening method was used to identify the most relevant publications that met the review's requirements. At each level, the number of studies detected, stored and removed.

3. Results

According Dikcius et al., (2017), a family purchase necessitates significantly more work and time. Consumers, according to marketers, share a budget and buy the majority of items. Many factors influence family and individual decisions. The children have a wish list. To more deceitful and emotive sales pitches. The impact of children on household consumption is investigated. Emotional (e.g., positive and negative affect expressions) and persuasive tactics are not allowed (e.g., taking independent action). Influence strategies have been established. Indirect approaches function by making the recipient believe they are unaware of the outcome. Child influence may be affected by birth position and age (John, 1999). With age, a child's influence on decision-making changes (Levy and Kwai-Choi Lee, 2004). Family purchasing participation is influenced by age, social status, the number of siblings and family wealth (Flurry and Veeck, 2009). When items are less expensive, children are seen as more influential or relevant." Children are natural observers with high levels of imagination and impulsivity to some extent. Children's ages have a significant impact on how they develop and behave as customers. Children's buying decisions are influenced by a variety of circumstances. Parents' educational attainment, family wealth and the age, gender and socialization of their children. The influence of children develops as they get older. Females, according to Elliott, (2009), prefer goods that trigger sentimental memories or sentiments. Aesthetic appeal, mental pleasure and emotional attachment are all factors in female meal selection. Males, unlike females, place a higher emphasis on physical characteristics than utility. Marketers exploit this to appeal to both men and women. Consumer income, according to Ramya, (2016), may influence purchasing patterns. People's purchasing habits are influenced by their family's income. Families' earnings extra household income is earned after fundamental necessities are covered. In contrast to poor households. According to Batounis-Ronner et al., (2007), a child's purchasing power grows with the family. They are less reliant on their

parents in the family group. They're also more likely to irritate their siblings. Consumer socialization was studied using a variety of family communication styles. Parental love and financial resources may have an impact on materialistic impulses. Children's moral development is "preconventional," oriented on their own desires, until they reach the age of nine. Materialism says, "I want it; obtain it." Materialism is a new value system that encourages people to acquire things early in life. Peer pressure arises when a group of people agrees on a course of action. Children's behavior is also influenced by peer pressure. Others may join to put you to the test. Some children may overlook their own judgment because "everyone does it." Parents' influence on adolescent consumption and finances. Parental support and adolescent consumerism self-regulation Adolescents with low self-esteem require their parents' rejection in order to develop a positive self-image (Lien et al., 2018). When a teen's purchases are disapproved by his or her parents, the teen is more inclined to lie. Child-centric marketing is defined by Lee et al., (2007) as an increase in consumption among children. Advertisers target children because they are thought to be the primary decision-makers in families. When young consumers have purchasing power, they are encouraged to buy the brand, which is unethical because their thinking is still developing. Marketers can exploit children's movies and movie characters to advertise their products.

Marketers use mass media and social media to reach out to teenagers. Visual cues can entice toddlers to vibrant colors and encourage them to think creatively. Marketers have employed packaging techniques to influence the pester power of young consumers, which in turn influences their parents' purchasing decisions. Marketers can use child-friendly packaging to lure young customers who will subsequently pester their parents to acquire the items (Nicholls and Cullen, 2004). Colors, graphics and brand logos are used to encourage parents to buy a product. Using kid-friendly packaging might increase the pestering behavior of your target group. Packaging has the ability to interest and enchant young customers.

4. Conclusion

The purpose of this work was to create a concept indicator model (figure 1) that might depict the most likely pathways via which components affecting pester power emerge. Examining these variables aids in the development of models. The naive notion was examined in the context of consumer socialization theory, which posits that children can influence their parents' purchasing decisions. The study then conducts a thorough review of the literature on this social phenomena. Studies on the social phenomena of pester power in Westernized countries around the

turn of the century have come up with contradictory results. The variables that lead to the development of age, gender, household income and family structure. Materialism and peer pressure were discussed as sub-factors. Third, information was conveyed by advertising and packaging. According to the model, these three elements determine the emergence of a young consumer's pester power, which influences the

pester power were described as demographic, socio-psychographic and informational. First, we looked at parent's decision to purchase Sri Lankan FMCG products. More research is needed to confirm the above-mentioned relationships in terms of pester power. Given the scarcity of studies in Asia, this study will aid in identifying the prevalence in the aforementioned market.

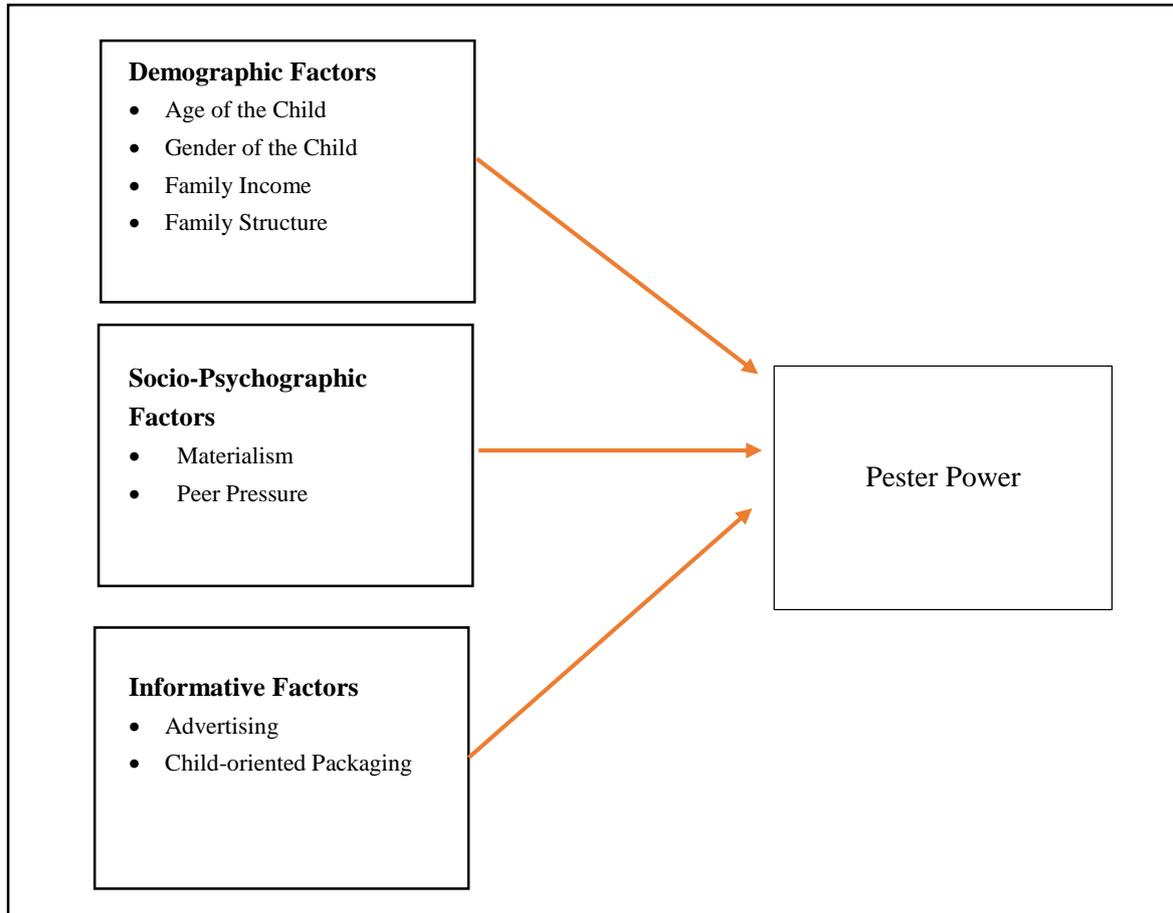


Figure 1 Concept Indicator Model (Source; Authors Creation)

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OPTIMIZATION OF HOT WATER EXTRACTION OF *MORINGA OLEIFERA* LEAF POWDER AND DEVELOPMENT OF AN INSTANT COFFEE MIX WITH EXTRACTED *MORINGA OLEIFERA* POWDER

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ABSTRACT

Development of healthy instant beverages with health benefits has a great potential in the local and international market since there is a high consumer preference for healthy food products. Therefore, the objectives of this research project were to develop an instant coffee mix with *Moringa oleifera* leaf powder and investigate its properties. Optimization of hot water extraction of *Moringa oleifera* leaf powder was conducted using response surface methodology with two responses: total phenolic content (TPC) and yield and three factors: temperature, time, solid-to-liquid ratio. Optimized conditions for hot water extraction were 60°C of extraction temperature, 25 minutes of extraction time and 1:10 of solid-to-liquid ratio. The maximum TPC and yield values were 95.92 mg GAE/g of powder and 0.28 g/g of dry powder, respectively in the optimized conditions. New product was developed with the combination of freeze dried powder of moringa extract, sugar, milk powder and instant coffee powder. Based on the sensory evaluation sugar and milk powder were the most preferred sweetener and the creamer, respectively. The formulations which contain 2.5% and 5% of Moringa extract powder were the best formulations with respect to the physicochemical properties, sensory evaluation and antioxidant potential.

Keywords: Antioxidants; Instant beverages; *Moringa oleifera* leaf powder; Sensory evaluation

1.0 INTRODUCTION

Moringa oleifera is commonly known as drumstick tree which is distributed widely throughout Africa, Saudi Arabia, Southeast Asia, the Caribbean Islands, and South America [1]. *Moringa oleifera* plant possesses anti-inflammatory effects, anti-microbial, anti-hyperglycemic activity, antioxidant, anti-tumor, anti-cancer and anti-clastogenic properties [2]. Leaves are the most nutritious part of the tree as they are significant source of B vitamins, vitamin C, beta-carotene as pro-vitamin A, vitamin K and manganese [3], phytochemicals such as phenolic and flavonoids [1] and all of the essential amino acids which is unusual for a plant source [4]. Because of these nutritional and health value people tend to consume *Moringa oleifera* leaves in different ways such as brewed Moringa tea, addition to curries, fresh leaf drinks etc. One rounded tablespoon (8 g) of leaf powder will satisfy about 14% of the protein, 40% of the calcium, and 23% of the iron and nearly all the vitamin A needs for a child aged 1-3 while six rounded spoonful of leaf powder will satisfy nearly all of a woman's daily iron and calcium needs during pregnancy and breast-feeding [4].

As a result of this consumption trend, there are different commercial Moringa products such as moringa leaf powder, moringa leaf tablets, moringa capsules, moringa oil, moringa tea, moringa energy bars, moringa gum powder, moringa drops and moringa oil cake are appeared in the market and those products have large market share in both local and international market. Moringa products will register a CAGR (Compound Annual Growth Rate) of 8% over the forecast period 2020 to 2026 and the value projection for year 2026 by the Moringa products is 8400 million USD. [5].

As a result of busy lifestyles people tend to consume instant products and instant hot beverages are one of the main instant products that have gained the preference of the consumers. However, consumers are also looking for healthy food products because of the increased health awareness. Instant health drink premix tends to become dominant in the market, registering a CAGR (Compound Annual Growth Rate) of 6% over the 2021. Therefore, it would be a preferable if there are products which can comply with busy lifestyle and expected healthiness of food. Even though there are healthy instant hot

beverages available in the international market, only a few products are available in the local market of Sri Lanka. It was identified that there is a market gap for healthy instant hot beverages and addition of Moringa powder to instant hot beverage mix can be a potential food product which will fulfill this market gap. Therefore, the objectives of the research study were to development of an instant coffee mix with *Moringa oleifera* leaf powder and investigation of physicochemical properties and sensory attributes of the developed instant beverage mix.

2.0 MATERIAL AND METHODS

2.1 Materials

Moringa leaf powder and packaging materials were provided by the HJS Condiments Ltd., Biyagama, Sri Lanka. Moringa leaf powder was prepared by oven drying the fresh leaf at 50°C, milling and sieving with 50 mesh sieve. Milk powder (Ratti™ Brand), Commercial creamer/Coffeemate™ (Nestle™ Brand), Soy milk powder, Sugar, Artificial Sweeteners (Diabetasol™, Lo-kal™) and Instant Coffee (Nescafe™) were purchased from a reputed super market in Kandy. All chemicals and solvents used for laboratory testing purposes were of analytical grade and used without any further purification.

2.2 Optimization of the hot water extraction of *Moringa oleifera* leaf powder

Extract was prepared using dehydrated *Moringa oleifera* leaf powder and distilled hot water in a water bath (Model:D-91126 Schwadach FRG, Memmert, Germany) at different temperatures, time and leaf powder: water ratio as shown in Table 2. Extracts were filtered using filter paper and used for analysis within the same day. Optimization was based on total phenolic content (TPC) and dry yield. The total phenolic content of prepared hot water extract of *Moringa oleifera* leaf powder was determined by the Folin-Ciocalteu reagent method [6]. Yield was determined as follows: five milliliters of the prepared extract was placed in previously weighed dry evaporating dish. Evaporating dish was placed in an oven (Model: Memmert 854, Schwabach, Western Germany) at 105°C until constant weight was obtained.

2.2.1 Experimental design

Extraction temperature, time and ratio were identified as the conditions that affect the extraction process. Box-Behnken design (Table 2) was developed in order to obtain optimized extraction conditions for higher total phenolic content and extraction yield. The three selected independent variables used in this study were extraction temperature (A), extraction time (B) and solid-to-liquid ratio (C). The experimental design consisted of 15 experimental points with 3 replicates in place

of center point. Experimental points (each run) were triplicated to avoid the unexpected variations. Data were analyzed using a quadratic polynomial regression model.

2.3 Development of Moringa incorporated instant coffee mix

Moringa incorporated instant coffee mix was prepared using different combinations of ingredients: Moringa extract powder which was prepared according to the optimized conditions, instant coffee (Nescafe™), sweetener selected from sensory evaluation: sugar and creamer selected from sensory evaluation: milk powder. Five formulations were formulated through preliminary studies as shown in Table 1. The net weight of one formulation was 20 g.

Formulation No.	Moringa content (g)	Instant coffee content (g)	Sugar Content (g)	Milk powder content (g)
0 (Control)	0	2	8	10
1	0.5	1.5	8	10
2	1	1	8	10
3	1.5	0.5	8	10
4	2	0	8	10

Table 1: Prepared formulations

2.4 Sensory evaluation

A ranking test was conducted to select the most acceptable sweetener, creamer and the best formulation considering the preference for sensory attributes such as color, aroma, mouth feel, flavor and overall acceptability. Three types of sweeteners: sugar, Diabetasol™ (sucralose), Lo-kal™ (aspartame) and three types of creamers: milk powder, Coffeemate™ and soymilk powder were used for the selection of most acceptable sweetener and the creamer. Five formulations which were selected through preliminary studies shown in Table 2 were used for the selection of best formulation based on the sensory evaluation. Thirty untrained panelists from Faculty of Agriculture, University of Peradeniya were used for the sensory evaluation. Beverage was prepared by reconstituting the each formulation with boiled water in 1:7.5 ratio for the sensory evaluation.

2.5 Analysis of physicochemical properties

Bulk density, pH, water solubility index (WSI) and water activity of the formulations were determined as the physicochemical properties. Bulk density was determined by measuring the volume of a known mass of prepared formulation using a measuring cylinder [7]. pH was measured by a digital pH meter (Model: extech pH 100) at the range between 28°C and 30°C. Water solubility index was determined according to Obilana et al, (2014)[8]. This test was performed in duplicates for each formulation. Water

activity was measured using a hygrometer (Model: HygroLab 3) at 30°C. Each property was determined in duplicates for each formulation.

2.6 Analysis of antioxidant potential

Total phenolic content of different formulations of *Moringa* incorporated instant coffee mix were determined by Folin-Ciocalteu reagent method according to the method of Mahdi et al., (2016) [6].

2.7 Statistical analysis

Statistical analysis of the response surface method model was done using analysis of variance (ANOVA) to identify the significance of the model and independent variables using the Design Expert Software (Version 12.0.7.0, Stat-Ease Inc., Minneapolis, MN 55413, USA). Results of the

ranking test were analyzed by Friedman test and mean separation was done by Wilcoxon sign rank test using SPSS Software (Version 16.0). Data was statistically analyzed using SAS version 9.0 software. One-way analysis of variance (ANOVA) and Duncan’s multiple range tests were used to determine the significant difference among the treatments at the significance level of 0.05. The results were presents as the mean values with the standard deviation.

3.0 RESULTS

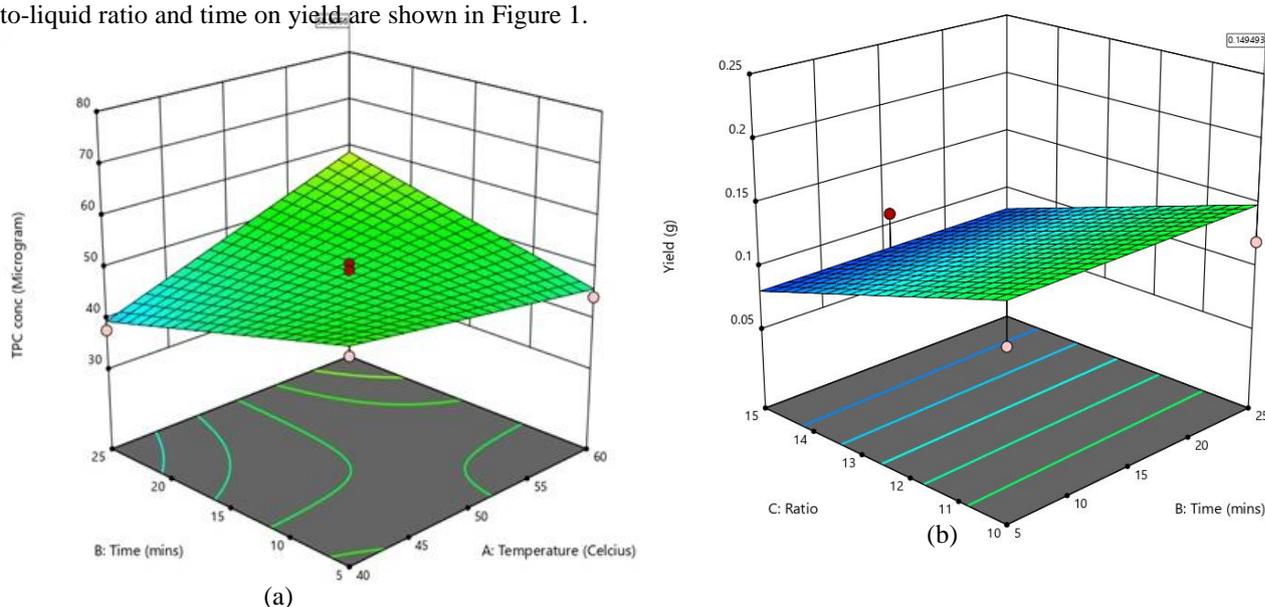
Experimental data of three factor-three level Box-Behken design is shown in Table 2.

Run	Factor A Temperature (°C)	Factor B Time(mins)	Factor C Solid-to-liquid Ratio	TPC (mg GAE/g of powder)	Yield (g/g of powder)
1	50	5	15	84.43 ±6.32	0.21±0.03
2	60	25	10	91.65±4.27	0.24±0.04
3	50	15	10	72.87±4.51	0.32±0.05
4	60	15	5	48.32±0.37	0.23±0.01
5	50	5	5	53.83±9.31	0.23±0.01
6	60	15	15	85.3±3.69	0.33±0.00
7	50	15	10	81.57±4.51	0.26±0.05
8	40	15	15	76.7±0.00	0.22±0.02
9	50	25	5	52.87±2.35	0.23±0.02
10	60	5	10	70.96±4.67	0.23±0.01
11	50	15	10	79.30±4.51	0.22±0.05
12	40	15	5	50.22±1.17	0.24±0.03
13	40	25	10	60.35±3.02	0.25±0.04
14	50	25	15	84.78±4.96	0.24±0.06
15	40	5	10	89.91±1.48	0.25±0.09

Table 2: Three factor, three level Box Behken design used for RSM and experimental data obtained for the RSM1

¹ All data represent the mean of triplicate measurements

Three-dimensional response surface plots for extraction of *Moringa oleifera* showing the effect of (a) extraction time and extraction temperature on TPC, (b) solid-to-liquid ratio and extraction temperature on yield, (c) solid-to-liquid ratio and time on yield are shown in Figure 1.



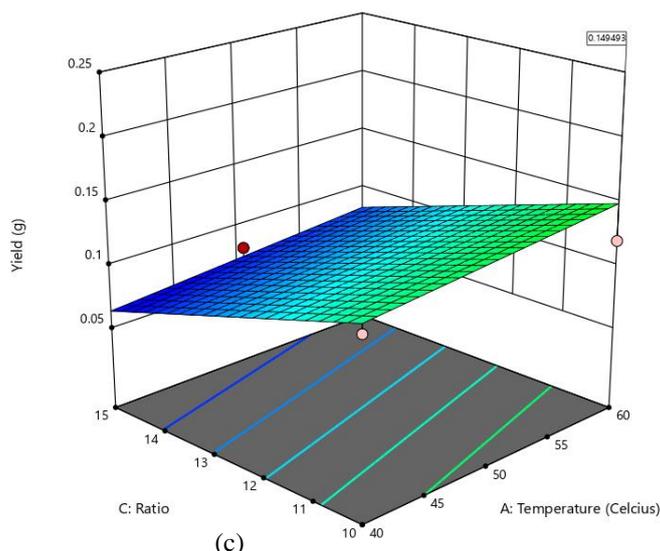


Figure 1: Response surface plots for extraction of *Moringa oleifera* showing the effect of (a) extraction time and extraction temperature on TPC (b) solid-to-liquid ratio and extraction temperature on yield (c) solid-to-liquid ratio and time on yield

Results of the sensory analysis of five formulations are given in Figure 2.

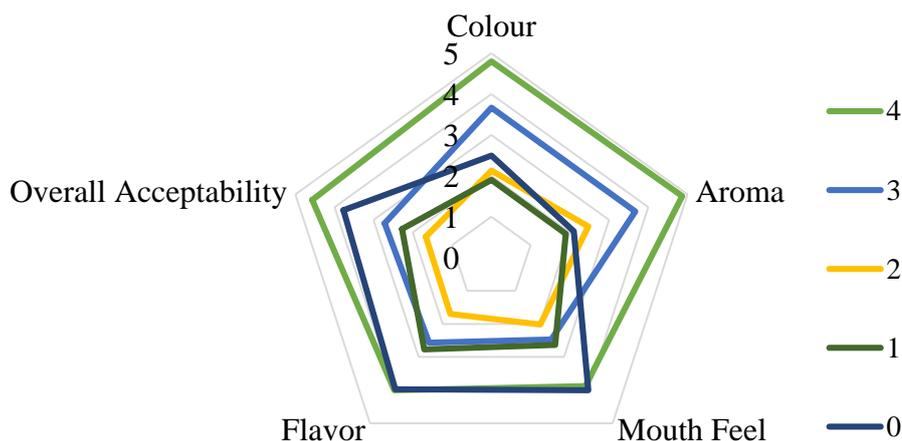


Figure 2: Radar chart of sensory attributes of different formulations in ranking test

Obtained results of physicochemical properties and total phenolic content are shown in Table 3.

4. DISCUSSION

4.1 Optimization of hot water extraction *Moringa oleifera* leaf powder

4.1.1 Fitting the model

Response Surface Methodology (RSM) was used to optimize the extraction conditions of the hot water extraction of *Moringa oleifera* leaf powder. RSM was commonly used for optimization because it allows evaluation of the effects of multiple factors and their interactions on one or more responses. Extraction temperature, extraction time and extraction ratio were the selected conditions for

optimization since quality and quantity of plant extract is highly affected by extraction conditions [6]. The experimental design was consisted of 15 treatment combinations with three center points. Results of the experiment are shown in Table 2. Fitting the models is essential in interpreting the precision of the mathematical models of response surface methodology for predictions of the TPC and yield of the dried extract. Fitting the model for linear and quadratic terms independent variables were done using regression analysis and analysis of variance was used to determine the significance of independent variables; temperature (°C), time (mins) and ratio on the responses. In this study, the relationship between the response variables (TPC and extraction yield) and the extraction conditions (temperature, time and solid-to-liquid ratio) was

successfully identified by Box-Behnken design. As suggested by the Design Expert Software, 2FI (two factor interaction) model and linear model were selected and fitted for relationship of total phenolic content and extraction yield with the extraction conditions respectively.

The RSM model coefficients were validated by analysis of variance (ANOVA) of the response

variables. For each response (TPC and yield) the models were significant as probability values were low ($p < 0.05$). In addition, the coefficient of determination (R^2) of the models was 0.9822 and 0.8542 indicating that 98.22% and 85.42% match between the values of predicted model and the values obtained from the experimental data

Formulation	Bulk density (g/cm ³)	Water activity	pH	WSI%	TPC mg GAE/g of powder)
0	0.51±0.01 ^a	0.62±0.01 ^a	6.17±0.06 ^a	89.14±1.75 ^a	1513.04±11.50 ^b
1	0.52±0.01 ^a	0.56±0.00 ^b	6.11±0.04 ^a	90.06±1.04 ^a	1976.81±33.28 ^a
2	0.54±0.02 ^a	0.58±0.01 ^b	6.11±0.01 ^a	88.96±0.21 ^a	1291.30±30.43 ^c
3	0.56±0.00 ^a	0.54±0.01 ^c	6.09±0.00 ^a	91.13±0.18 ^a	1006.52±12.10 ^d
4	0.56±0.01 ^a	0.51±0.02 ^c	6.08±0.01 ^a	92.00±0.35 ^a	337.68±30.54 ^e

Table 3: Bulk density, Water activity, pH, WSI and TPC of five formulations

¹Means with different superscripts in a column differs significantly at 5% level of probability ($p < 0.05$)

The probability values for the lack of fit of models were 0.7559 and 0.6345 indicating that lack of fit of models were not significant ($p > 0.05$). Hence the results indicate that models were sufficient for predictions within the design space.

4.1.2 Effects of temperature, time and ratio on TPC and yield

Three-dimensional surface plot of effect of time and temperature on TPC where ratio was fixed at its center point is shown in Figure 1(a). It showed that simultaneous increase of extraction temperature and extraction time increased the total phenolic content within the studied range which indicates the time-temperature interaction. TPC content in the extract significantly increased with the increasing temperature from 40°C to 60°C indicating that positive relationship between extraction temperature and TPC. In contrast solid-to-liquid ratio showed a negative relationship with TPC as lowest ratio gave the highest TPC throughout the studied temperature range. Lowest solid-to-liquid ratio gave the highest TPC throughout the studied time range which indicates the significant decrease of TPC content in the extract as solid-to-liquid ratio increased from 1:5 to 1:15. The effect of extraction temperature on TPC was significant ($p < 0.05$) and within the studied temperature range TPC increased with the increasing temperature. Increase in extraction temperature could soften the matrix and break protein-polyphenol and polysaccharide-polyphenol linkages, thus facilitating the migration of polyphenols into solution (Fombang and Saa, 2016). A previous study revealed that TPC in hot water extracts of plant materials increases around 60°C due to the polymerization of phenols at 60°C temperature [9]. Another study supported this

study results revealing that maximum TPC was around at 65°C in plant extracts [10] However the higher temperature conditions lead to reduction in TPC which can be due to the thermal degradation of phenolic compounds [9]. In the present study effect of extraction time on TPC was not significant ($p > 0.05$). The duration of extraction is a function of the extraction temperature which influences the diffusion of extraction materials into the solvent [11]. However, with the prolonged extraction time TPC concentration may decrease due to the structural changes and decomposition of phenolic compound and increase the chance for occurrence of oxidation on phenolic compounds [12]. Increase of solid-to-liquid ratio (1:5<1:10<1:15) significantly ($p < 0.05$) decreased the TPC content in the extract as TPC content in the extract get diluted with increased water amount. Figure 1(b) and 2(c) showed the three-dimensional response surface plots for the influence of extraction temperature, extraction time and solid-to-liquid ratio on extraction yield. There were no interaction effects between extraction conditions on extraction yield as it showed a linear relationship between the extraction yield and the extraction conditions. There was no significant ($p > 0.05$) individual effect of extraction temperature and time on yield. With the increase of solid-to-liquid ratio from 1:10 to 1:15 yield significantly ($p < 0.05$) decreased indicating a significant effect of solid-to-liquid ratio on extraction yield. Highest yield was extracted at 60°C temperature and 25 min time with lowest solid-to-liquid ratio (1:10) and always lowest ratio gave the highest extraction yield. Hence, according to these figures only solid-to-liquid ratio causes a significant effect on extraction yield which could drastically affect the extraction process in terms of extraction yield.

The optimum extraction conditions predicted using desirability function method were 60°C of extraction temperature, 25 min of extraction time and 1 g/10 mL of solid-to-liquid ratio. The maximum TPC and yield values were 95.92 mg GAE/g of powder and 0.28 g/g of dry powder respectively in the optimized conditions. A study which was performed with the Moringa powder obtained by drying at $45 \pm 2^\circ\text{C}$ for 14 h and sieving through a 500 μm sieve showed that optimum conditions were a solid to liquid ratio of 1/20 mg/mL, a temperature of 97°C and time of 35 min with optimal yields of 56.96 mg/100 mL for TPC for water extraction [11]. These variations can be due to the difference of the dry powder making process.

4.2 Sensory evaluation of developed formulations

Preference for the formulation with milk powder was significantly ($p < 0.05$) higher than the soy milk and Coffeemate™ regarding the aroma, flavor and overall preference. Therefore, milk powder was selected as the creamer. This may be due to the familiarity of milk powder as a creamer among the Sri Lankan population. Wilcoxon sign rank results showed that preference for the formulation with sugar was significantly ($p < 0.05$) higher than the Diabetasol™ and Lo-kal™ regarding flavor and overall preference. Therefore, sugar was selected as the sweetener. Friedman's test showed that developed five formulations were significantly different ($p < 0.05$) for the preference of color, aroma, mouth feel, flavor and overall acceptability. Preference on color and aroma for the formulation 1 was significantly ($p < 0.05$) higher than the other formulations. Formulation 1 had darker color and stronger coffee aroma than the formulation 2. This could be the reason for formulation 1 got highest preference for color and aroma over other formulations. However, formulation 2 got the second-best preference for color and aroma. Preference on the mouth-feel, flavor and overall acceptability for formulation 2 was significantly ($p < 0.05$) higher than the other formulations. Hence, formulation 2 was selected as the best formulation based on the sensory evaluation.

4.3 Physicochemical properties

Obtained results for physicochemical properties were shown in Table 3. Statistical analysis of formulation 0 - 4 revealed that they were not significantly ($p > 0.05$) different regarding bulk density, pH and WSI while they were significantly ($p < 0.05$) different regarding water activity. Physicochemical properties such as pH and WSI mainly have effect on the sensory quality of the final product. pH affects the flavor and mouth-feel of the drink while WSI affect the appearance and mouth-feel of the drink. Water activity affects the microbiological changes, non-enzymatic browning changes and lipid oxidation changes which are important for predicting and

controlling the shelf life of a food product The water activity of five formulations ranged from 0.51 to 0.62. Critical water activity levels for non-enzymatic browning reaction, minimum lipid oxidation and bacterial growth were 0.6-0.7aw, 0.2-0.3aw [13], 0.9aw [14], respectively. Therefore, higher lipid oxidation can be expected as the formulations are high in milk powder content. As well non enzymatic browning also will be occurred while bacterial growth will be restricted in each formulation.

4.4 Antioxidant potential (Total Phenolic Content)

In terms of the total phenolic content, five formulations were significantly ($p < 0.05$) different from each other. Formulation 1 showed the highest total phenolic content compared to other formulations. The formulation (Formulation 2) selected as the best based on the sensory evaluation had lower TPC content than the second-best formulation (Formulation 1) as shown in Table 3. Formulation 1 has higher total phenolic content than formulation 0 since formulation 1 contains a mixture of Moringa powder and instant coffee powder. However, it cannot be explained that formulation 1 has the highest antioxidant potential only depending on the total phenolic content because all the phenolic compounds do not possess the antioxidant activity and there is other antioxidant compound that do not belongs to phenolic family.

5.0 CONCLUSION

Optimized conditions for hot water extraction of *Moringa oleifera* leaf powder were 60°C of extraction temperature, 25 min of extraction time and 1 g/10 mL of dry powder: water ratio. The maximum TPC and yield values were 95.92 mg GAE/g of powder and 0.28 g/g of dry powder respectively in the above-mentioned optimized conditions. Instant beverage was developed combining the extracted Moringa powder with milk powder, sugar and instant coffee powder. Milk powder and sugar were selected as creamer and sweetener respectively based on the sensory evaluation. Based on the evaluation of physicochemical properties, sensory evaluation and total phenolic content it can be concluded that formulations which contains 2.5% (formulations 1) and 5% (formulation 2) of Moringa extract powder were the best formulations.

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SOCIODEMOGRAPHIC, AMPUTATION AND REHABILITATION STATUS OF TRAUMATIC UNILATERAL LOWER LIMB AMPUTEES IN SRI LANKA

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ABSTRACT- Traumatic injuries are worldwide the main causes of limb amputations; South and East Asia having the highest prevalence. Sri Lanka has about 160,000 amputation patients as mere result of 30 years of civil war. We focus here on sociodemographic, amputation and rehabilitation data of a study sample of persons with > 6 months traumatic unilateral lower limb amputation, as part of a broader study. An observational cross-sectional study under 48 patients (70.8% male) from the Kandy Centre for Handicapped. Stump condition was good. Occupational engagement was reduced from 81% to 54% after amputation; 34% continued the original job but 67% worked less hours. Nine participants (19%) were engaged in forces before amputation; their monthly income was significantly higher ($P=0.000$) than those who had civil occupations and they also had got significantly longer rehabilitation ($P=0.01$). Thirty-three persons (69%) suffered from phantom pain, but there was no significant relationship with time since amputation or functioning. Thirty-four persons (71%) are using their prosthesis 'always'; 69% with high level of satisfaction. This was significantly associated with below knee amputation, as were mobility hours per day. Twenty-six persons (54%) were using predominantly crutches for mobility. This study sample concludes 27% job reduction, and in 67% less working hours. In general, a below knee leg amputation was related with higher mobility, more satisfaction with prosthesis and more prosthesis usage than above knee amputation. The subgroup of 9 military persons was better off than the civil persons in income and rehabilitation program.

Keywords: *Unilateral, Lower limb amputation, Traumatic injuries, Rehabilitation*

1. INTRODUCTION

Amputation is surgically removal of full or part of the limbs to protect the other parts of the body (Porter, 2003). Though there might be 3 to 44 per 100,000 amputees in Spain, Japan and India (Ubayawansa, 2016), according to the manual for the rehabilitation of people with limb amputation there is no true statistics about the number of amputees in the world (World Health Organization [WHO], 2004). Traumatic injuries are worldwide the main causes of limb amputations; South and East Asia having the highest prevalence (McDonald, 2020). Sri Lanka has about 160,000 amputation patients as mere result of 30 years of civil war but there is no statistics on prevalence rate of amputees in Sri Lanka (Institution of Mechanical Engineers, 2014). Limb amputation makes massive changes of homeostasis due to reduction of body mass, vascular system, static and dynamic functions. Rehabilitation of the patient is the key task after the amputation surgery and is mainly focusing on improving patients' general health and psychological level, reducing the pain, caring of stump and skin, fitting of the prosthesis, and helping amputation patients in regaining their functioning and activity participation (Porter, 2003). Prosthetic

fitting and achieving functional outcome with the prosthesis is the next step of rehabilitation which depends on the patient age, level of amputation, amputee limb and stump condition and cardiorespiratory functions (Kurdibaylo, 1994).

Individuals' with lower limb amputation will face more limitations of functional activities than upper limb amputees (Esfandiari et al., 2017). Since unilateral lower limb amputation is more common than other amputation surgeries in Sri Lanka (Ubayawansa, 2016), this study was conducted to assess the rehabilitation status of patients with unilateral lower limb amputation who engaged in rehabilitation and to evaluate the impact of their amputation status and socio-demographical characteristics.

2. METHODOLOGY

Observational cross-sectional study was conducted at the Centre for Handicapped, Kandy, Sri Lanka as this is the one of the biggest and functional rehabilitation centre which provides artificial limbs and rehabilitation service for lesser amount of costs. A high number of patients from different areas of the

country is visiting this centre in order to get rehabilitation. Data of 48 participants aged between 20 to 60 years with amputation due to traumatic injuries or congenital impairments, were collected from September 2019 to February 2020, using convenience sampling method. All these participants were interviewed face to face and self-constructed and therapist administrative questionnaire was used to determine the medical and rehabilitation status and the relationship with the socio-demographical characteristics. Individuals who underwent the amputation surgery 6 months before the study and who do not have any injury or paralysis to the sound leg were considered as inclusion criteria. A prior history of cardiovascular and respiratory diseases and Diabetes Mellitus (DM) were exclusion criteria for the study.

3. ANALYSIS

Descriptive analysis was conducted to find out the mean, median, standard deviation (SD), percentages of socio-demographical status, and Amputation and Rehabilitation status. Independent sample t test, and Mann-Whitney U test were conducted to find associations between socio-demographical and the amputation data at the one hand and the final rehabilitation status at the other hand.

4. RESULTS

4.1 Socio-demographical Data

Table 1. Descriptive statistics of socio-demographical data

Variable	Mean ± SD	Range
Age (Years)	43.27 ± 11.36	21 - 60
BMI (kg/m ²)	22.70 ± 3.71	14.9 - 32.3
Monthly income (LKR)	21125.00 ± 24331.81	0 - 76000
Years of schooling (Years)	9.59 ± 3.46	3 - 22

LKR– Sri Lankan Rupees, n- number of participants, SD- Standard Deviation

Socio-demographical data is presented in the Table 1 with mean, SD, minimum and maximum. Thirty four (70.8%) males and fourteen (29.2%) female has participated for the study and monthly income (Rs. 57888.89 ± 17996.142) of the participants those who worked in forces before amputation is significantly higher (P = 0.000) than the monthly income (Rs. 12641.03 ± 16434.459) of the participants those who engaged in civil occupations. More than 80% of participants were married and 65% of them have educated up to secondary and above levels. All the participants had engaged in occupation where 81% of individuals engaged in civil occupations and 19% engaged in forces and it has reduced up to 54% after amputation. Among those 26 persons with a job (54% of total sample), 18 (69%) were not able to work the same number of hours as previously and only 8 persons are continuing in the same occupation as before the amputation. From those who have a job, 12 of them have to sit only (Figure 1).

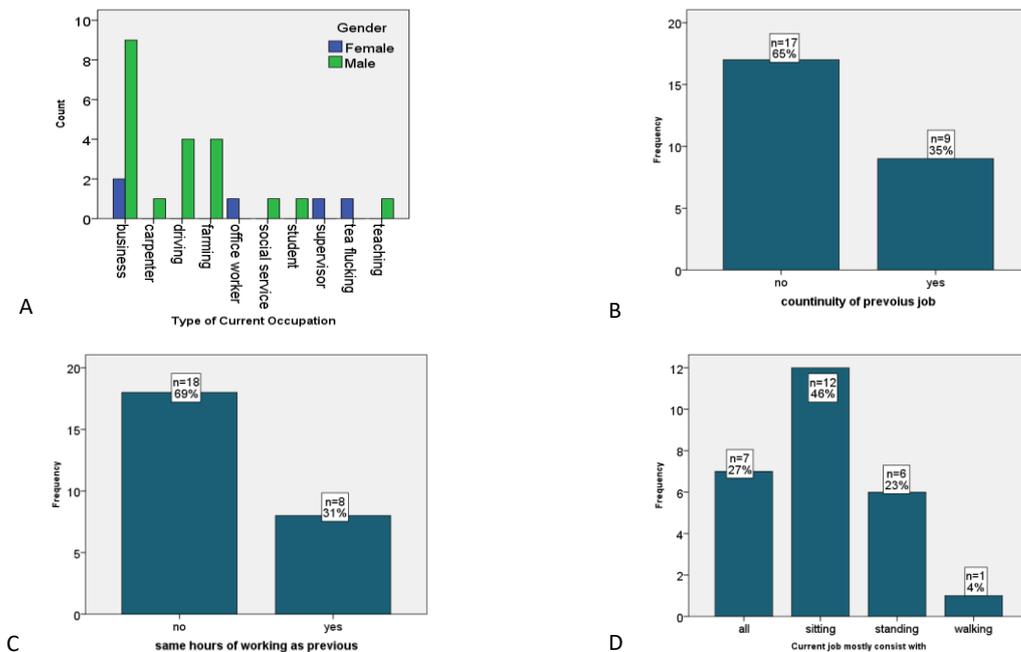


Figure 1. Occupational status of amputees; A: Type of the current occupation, B: Continuity of previous job at present, C: Presentation of engagement of same working hours as previous, D: Activity level of current job

4.2 Amputation Status

4.2.1 Amputation and rehabilitation data

Among genders and participants who worked in forces have got significantly ($P = 0.01$) longer rehabilitation ($6 \text{ months} \pm 12.25$) than those in civil

occupations ($0.5 \text{ months} \pm 0.5$). Road traffic accidents (RTA) appeared to be the main cause of amputation and in this sample are relatively more males with above knee amputation (Figure 2). There are significance differences in median time since amputation, wearing prosthesis and rehabilitation.

Table 2. Descriptive statistics of amputation data

Variable	Female (n=14) (29.2%)		Male (n=34) (70.8%)		Mann-Whitney U test (p value)
	Median \pm IQR	Range	Median \pm IQR	Range	
Time since amputation (Years)	17 \pm 11.07	2-43	7.5 \pm 9.09	0.5-35	0.011*
Duration of wearing prosthesis (Years)	14.5 \pm 9.48	1.5-35	5.5 \pm 8.74	0.02-34	0.014*
Time interval between surgery and admission for rehabilitation	1.75 \pm 2	0.5-9	1 \pm 1.5	0.5-8	0.089
Duration of rehabilitation (Months)	0.5 \pm 1.46	0.25-6	1 \pm 5.38	0.25-24	0.033*

n-number of participants, IQR- Inter Quartile Range, *- variables with significance difference, at 5% significant level

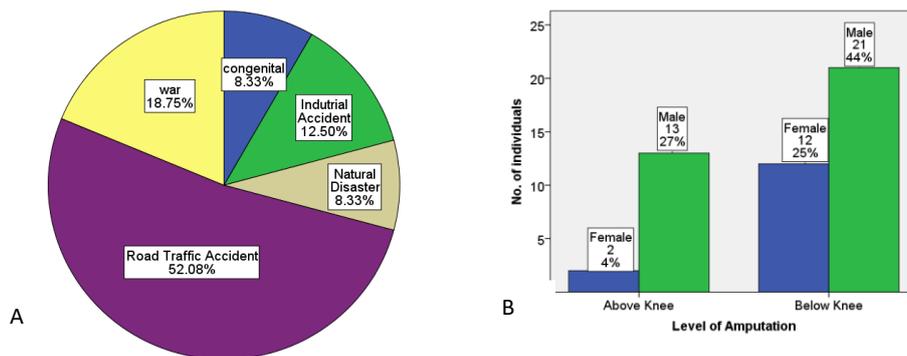


Figure 2. Amputation data; A: History of injury, B: Level of amputation by gender

4.2.2 Stump condition

Data were analyzed to find the condition of the stump such as shape, swelling, scar condition and presence of blisters of the amputation patients and results show that more than 96% of patients have good conditions of all the parameters.

4.2.3 Phantom pain

There is no significant difference of pain severity among genders (Table 3) and presence of the phantom pain do not significantly depend on the years of amputation or monthly income (Table 4) or gender ($p=0.72$ with χ^2 value 3.234).

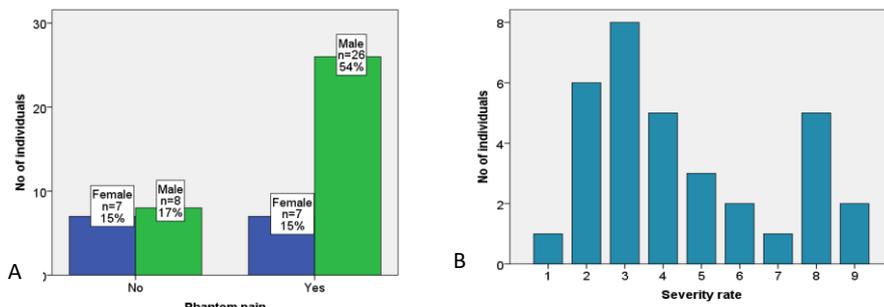


Figure 3. Analysis of Phantom pain; A: Phantom pain by gender, B: Severity rate of individuals based on VAS score

Table 3. Severity of phantom pain

Variable	Female (n=7) (21.2%)		Male (n=26) (78.78%)		Independent sample t test (p value)
	Mean ± SD	Range	Mean ± SD	Range	
Pain severity	4 ± 2.236	2-8	4.65 ± 2.449	1-9	0.529

n- number of participants, SD- Standard Deviation, *- variables with significance difference, at 5% significant level

4.3 Hygiene Level

Hygiene level of the individuals was analyzed based on cleaning of the stockings, stump and cleaning of the prosthesis and results conclude that individuals are having average level of knowledge and recommended hygiene practices after amputation are: daily stocking washing (35%), stump cleaning with soap and warm water (8.3%) and cleaning of prosthesis at least twice a week (60%).

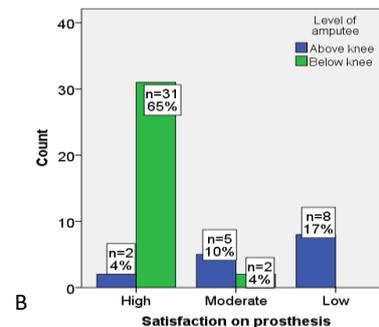
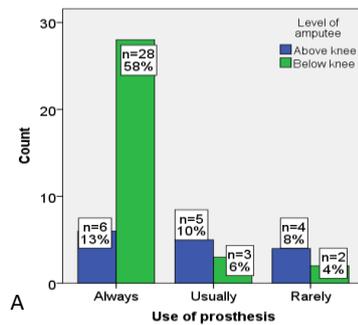


Figure 4. Prosthetic usage; A: Prosthetic usage of individuals based on level of amputation, B: Satisfaction of prosthetic usage based on level of amputation

Table 5. Relationship of prosthetic usage with satisfaction, gender and level of amputation

Variables	Chi squared value	p value
Prosthetic usage ~ satisfaction	25.071	0.000*
Prosthetic usage ~ gender	0.688	0.709
Prosthetic usage ~ level of amputation	10.068	0.007*
Prosthesis usage ~ Phantom pain	1.58	0.454
Satisfaction of Prosthetic usage ~ gender	2.652	0.265
Satisfaction of Prosthetic usage ~ level of amputation	32.606	0.000*

*- variables with significance difference, at 5% significant level

Table 6. Comparison between Phantom pain severity and prosthesis usage

Testing variable	Grouping variable Prosthetic usage (Mean ± SD)			ANOVA test (p value)
	Always (n=22)	Usually (n=7)	Rarely (n=4)	
Phantom pain severity	4.23 ± 2.39	4.71 ± 2.75	5.75 ± 1.71	0.501

n- number of participants, SD- Standard Deviation, *- variables with significance difference, at 5% significant level

Table 4. Comparison of phantom pain and years of amputation

Variable	Phantom pain present (n=33)	Phantom pain absent (n=15)	Mann-Whitney U test (P value)
	Median ± IQR	Median ± IQR	
Time since amputation	8 ± 8.70	15 ± 12.28	0.095
Monthly income	20000 ± 30500	1500 ± 22500	0.092

n- number of participants, IQR- Inter Quartile Range, *- variables with significance difference, at 5% significant level

4.4 Prosthesis Usage

34 (71%) individuals are using the prosthesis always; 69% with high level of satisfaction and this is significantly related to the (lower) level of amputation (Figures 4: A and B).

4.5 Mobility Level

Figure 5 shows average 2-3 hrs./day mobility level with or without prosthesis and Table 7 shows that persons with below knee amputation show significantly more mobility hours per day.

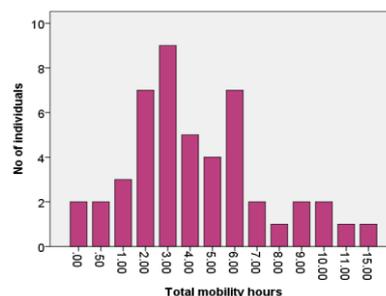


Figure 5. Total mobility hours per day with and without prosthesis

4.6 Walking Aids

14 (54%) individuals are always using external appliances and 19% are using these when engaged in activities at home without the prosthesis (Figure 6).

Table 7. Descriptive statistics of total mobility level with and without prosthesis

Testing variable	Grouping variable (n)		Mean ± SD	Independent sample t test (p value)
Mobility hours per day with prosthesis	Gender	Female (14)	4.43 ± 2.62	0.436
		Male (34)	3.53 ± 3.92	
	Level of amputation	AK (15)	1.67 ± 2.97	0.004*
		BK (33)	4.76 ± 3.46	
Average total mobility hours per day	Gender	Female (14)	4.82 ± 2.42	0.595
		Male (34)	4.28 ± 3.44	
	Level of amputation	AK (15)	3.13 ± 2.55	0.053
		BK (33)	5.03 ± 3.26	

n- number of participants, SD- Standard Deviation, *- variables with significance difference, at 5% significant level

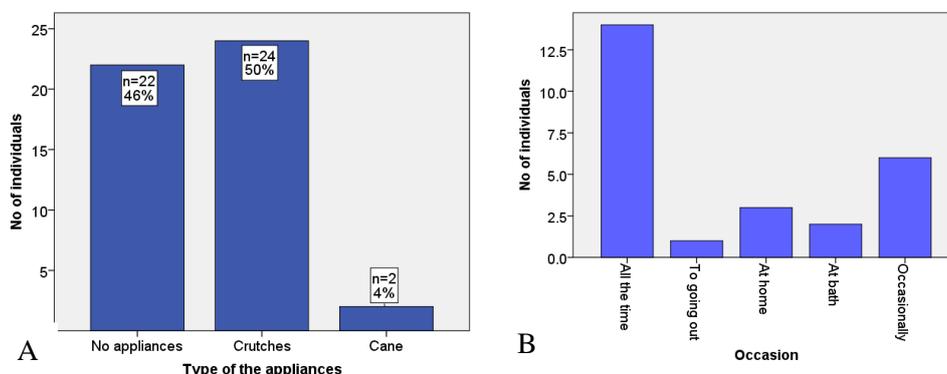


Figure 6. Usage of external appliances; A: Type of external appliances, B: Occasion of usage of external appliances

5. DISCUSSION

In the present study, the socio-demographical, amputation and rehabilitation status of a sample of 48 unilateral amputation patients are studied in order to find mutual associations in those who engaged in rehabilitation and prosthetic fitting. The study found that 81% of participants are married and continue happily even after the amputation. Culturally, marriage take a most important place and people are bound to their family. Sri Lanka have free education system and more than 90% of literacy rate that can be the reason for having good level of education. Similarly, Amtmann, Morgan, Kim, & Hafner (2015); Chernev & Chernev (2020) found that about

73% of participants in their studies have good level of education. Most of participants are self-employed since there are no proper government social services to provide disabled individuals employment although they might have a good education level. Nevertheless, the fact that most of them are self-directed to rehabilitation may be due to this good education.

Eighteen percent of the study participants have worked in forces before the amputation and they have satisfactory level of income based on pension scheme. Nevertheless, other participants who engaged in civil occupations before the amputation have significantly lower income level

compared to those who worked in forces. Only 34% of individuals were able to continue their job after the amputation as policies and legislations in government and private sectors are not well implemented. As it is stressed in the international classification of functioning and disability (ICF), the end-goal of rehabilitation is that make individuals actively participate in society, especially by having an occupation and be economically self-sufficient. Steps should be taken to improve those aspects within the country as many of the study sample are used to sit down and have no ability to work the same hours as previous. Most of our study participants have engaged in rehabilitation as early as possible which is a good trend. As forces hospitals provide longer rehabilitation programs, government hospitals and centers also need to take actions to improve their rehabilitation programmes. Around 96% of the sample showed a good stump condition which is good sign of early rehabilitation, but we found a low to moderate level of hygienic practices which indicates a lack of medical-social education.

Esfandiari et al. (2017) found in persons with an average of 22 years since amputation, a prevalence of phantom pain in 63%. This equals with our study findings but other studies mentioned phantom pain prevalence at early stage of amputation only (Ammann et al., 2015; Houghton, Nicholls, Houghton, Saadah, & McColl, 1994). Other studies shows that phantom pain and its' severity impact on their monthly income or the usage of prosthesis (Heszlein-lossius et al., 2019; Kahle et al., 2016) which contrast to our study findings. Hip and knee, flexion and extension occur simultaneously during normal gate cycle. Prosthesis that are available for above knee amputees within the country do not have that mechanism and most of the participants showed circumduction gait with hip hiking while walking. This may be the key factors for their refusal to use the prosthesis always and the reduction of satisfaction level compared to below knee amputees. Many individuals are mobile for 3 hours/ day with or without the prosthesis and above knee amputees have lesser mobility hours. Most of the individuals have a predominantly sitting job with less mobility. Most of them experience participation restriction by the current (non-inclusive) attitudes of the society and no barrier free environment. Due to those facts, they are in high risk of developing comorbidities in future. However, the sustainable development goals (SDG) in Sri Lanka includes goals for inclusion of the all people in development, make barrier free environment for everyone and to improve everyone's participating in the society. Due to those facts, they are in high risk of developing comorbidities in future.

Due to the unstable political situation as well as COVID-19 pandemic within Sri Lanka the sample size of the study is relatively small, what may have impact on the significance of the results and validity of the conclusions. The study recommends to analyze not only the walking ability but also deviations of gait via biomechanical gait analysis as future steps to improve medical and rehabilitation process and to emphasis the importance of proper gait training after prosthesis fitting. Further we recommend to conduct studies by in-cooperating both the individuals who engaged in continuous rehabilitation and prosthetic fitting as well as who are not engaged, in both rural and urban areas as this study only consider the patients who engaged in rehabilitation and visited the rehabilitation centres frequently. As there are very few studies on patients with amputations in Sri Lanka, we recommend to conduct more research with large numbers of participants to get more generalizable conclusions which may help rehabilitation aspect in Sri Lanka.

6. CONCLUSION

The study concludes that, in general those who are engaged in rehabilitation have good sociodemographic background and those who are retired from forces after amputation have better socioeconomic status and engaged in better rehabilitation programs compared to civil people. Though, below knee leg amputation was related with higher mobility, more satisfaction with prosthesis and more prosthesis usage than above knee amputation, overall mobility and participation in the society is low among everyone. Further a sub-optimal level of medical-social education, rehabilitation guidance as well as rehabilitation process such as prosthetic fitting, advanced walking training and accessibilities were found as challenges. Therefore, the government of Sri Lanka have to take steps forward in order to improve rehabilitation processes, the mobility of the patients with amputation and also their active participation in the society, since all persons should have equal opportunity to engage in rehabilitation and to improve their quality of life.

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THE BARRIERS TO THE SUCCESS OF ONLINE EDUCATION IN THE PRIMARY GRADE STUDENTS

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ABSTRACT- The entire world had to undergo a paradigm shift to face educational challenges due to the Covid 19 pandemic which hit the world since December 2019. Online education became the only solution to provide an uninterrupted educational service from Pre-school to tertiary education. This research is conducted to identify the barriers to the success of online education in Primary grade students, to identify good practices and what subjects' students mostly enjoy in the virtual school. A case study method was used to conduct this study to get a comprehensive and in depth understanding of the topic discussed. The primary section of a leading Girls' International School was used for the study. Data collected through three surveys, focus group discussions, interviews, artifacts and observations were analyzed quantitatively and qualitatively based on the nature of data. The research results revealed that lack of students-teacher interaction, peer interaction, motivation, emotional imbalances and schedule changing, device and network connectivity issues were identified as major barriers for the success of online education in the primary grade students. The good practices followed by the school were analyzed based on teachers' and parents' perspectives and the subjects that the students enjoyed in the virtual school was identified by comparing their performance, survey results and observations. There was clear evidence to state that maximum administration support and a well-organized training programme for teachers on digital literacy, designing, planning and preparation is essential to minimize the barriers for the success of online education in the primary grades in a pandemic like Covid-19.

Keywords: Online Education, Barriers, Primary Grades, Student Motivation

1. INTRODUCTION

The success of primary education depends on the attainability of the competencies expected from a primary grade student. According to the major features identified by the NEC report on curriculum development in general education in Sri Lanka, [8] a child is required to acquire seven basic competencies.

According to UNICEF

'Education doesn't just start in Grade 1. There is a global consensus that early childhood education for children aged 3 to 6 years is crucial for learning and brain development. This does not mean academic learning – the development of "non-cognitive skill" such as intellectual curiosity, perseverance, social skills and emotional stability during childhood and the adolescent years are just as important for children's success in lifelong learning, social integration, personal development and latter employability.' [23]

It is clear that primary education is utmost important for a child to develop & build upon. This

global pandemic Covid-19, connected teacher & students digitally to attain the educational expectations. Demand on online education has been increased tremendously. Due to online learning, students as well as teachers have been adapting themselves to the virtual learning environment seek for success while ensuring safety for both teacher & student. It is clear that no option other than going online.

The challenge was not only for teachers to make their students achieve the expected learning outcomes but also the support, commitment & cooperation from the parents were essential for the success of primary education. This research problem is based on this contemporary issue in primary education.

Knowing the challenges for the success of online education in the primary grade students will lead to steer the wheel to the success path, minimizing harmful impacts of online education.

Some of the major barriers of the success of online education in primary grade students will be focused on this research

2. METHOD AND MATERIALS

The data collected for the study using 5 main methods. Since, a case study design was selected more data required to do an in-depth study of the problem to give validity and reliability to the study. According to the 3 main research questions focused on this study the techniques, methods of requirements gathering and their aims are stated in detail to emphasize the process.

2.1 Case studies and Literature Review

The case study approach chosen for this study, therefore attempted to provide understanding of the concepts of barriers for the success of online education in the primary grade students. In the view of the fact that this study is considered to be small scale, the case study approach was considered most suitable in generating results from a natural environment.

Focus Group Discussion with Administrative staff

Brainstorming sessions with sectional heads, grade coordinators & selected teachers added firsthand knowledge regarding the issue addressed. Their personal opinions, experiences and different ideas were discussed through this method, to emphasize on good practices.

Surveys

Three different questionnaires used to collect data from teachers, parents and students of Grade 5 and Grade 6.

The questionnaire for teachers aimed on finding out the teachers' experiences and view on online teaching and learning process. To identify the challenges that they face to successfully implement educational objectives via the online platform and the good practices that help students interest in learning. The questionnaire for parents aimed to identify challenges that the parents encounter due to the complete shift of education from school to home. What is their perspective on the domain discussed, the good practices that the school follows and their suggestions on improving learning through the online platform. The questionnaire for students of Grade 5 and 6 aimed on identifying what they really enjoy learning in the virtual school and what are their feelings on the entire shift from face to face learning to distance learning.

Interview with heads of subjects – English, Mathematics, Science

Formal interviews were arranged to gather information from responsible parties to the success

and feasibility of the system. Qualitative data regarding the main problem and solution was collected by presenting mainly targeted questions and getting most accurate opinions.

The interviews mainly focused on their subject specific approaches to enhance students learning through online. What were their main strengths and what was the most challenging part in the process. Gathering quality data from domain professionals with their firsthand experience.

Artifacts and Observations

Observing day to day problems in online education. parents' complaints, students attendance, students work samples, video clips on practical work, time table scheduling, student's depression and other specific barriers for the success of online education were the other data collected in this method to get a good understanding about the day to day functions and issues related to online education in the primary grades.

2.2 Sampling

Convenient sampling techniques used for interviews and focus group discussions to identify most important professionals to be used to gather rich and valid information.

Random sampling technique used for parents' survey as it was based on parents' wish and consent. 698 parents participated in the survey.

All 448, Grade 5 and Grade 6 students participated in the students' survey, which is a rich source of information to see what mostly effective in students' perspective on online education.

All 102, primary grade teachers participated in the teachers' survey with the aim of giving value to this study and to see the result of this research findings.

Attendance of all students from June 2020 to March 2021 gathered to understand the interest of students to attend the classes, as it is a motivating factor.

The sectional heads daily feedback forms from July 2020 to March 2021 collected to identify day to day issues and what good practices implemented to overcome challenges.

2.3 Validity and Reliability of the instrumentation

The content and face validity of the 3 questionnaires were reviewed by doing a pilot test with a small sample of subject experts. Necessary modifications and deleting of some questions were done to reach the final valid version of the tools.

The tools were tested for reliability by measuring their internal consistency using Cronbach's alpha coefficient method. This turned to be ($\alpha = 0.494$) for questionnaire 1 – ‘*The barriers to the success of online education in the primary grade students*’, for

teachers ; ($\alpha = 0.723$) for questionnaire 2- ‘*Parents’ view on virtual school for primary grade students*’, for parents ; ($\alpha = 0.882$) questionnaire 3 ‘*My online school*’ for students of Year 5 and Year 6.

3. RESULTS

3.1 The Barriers for the success of online education in primary grades

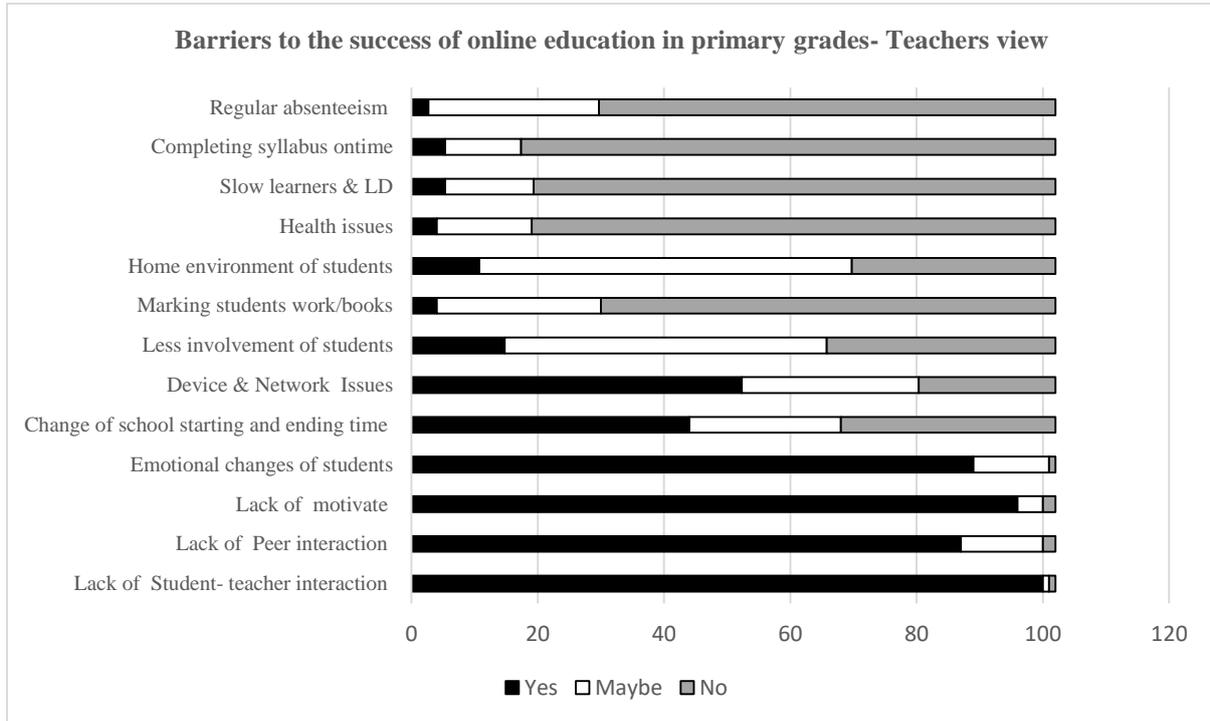


Figure 1- barriers to the success of online education in primary grades- Teachers view

102, primary grade teachers participated in the survey and more than 50% of them stated that lack of student- teacher interaction, lack of peer interaction, lack of motivation,

emotional imbalances of students and device and network issues are the major barriers for the success of online education in the primary grade students.

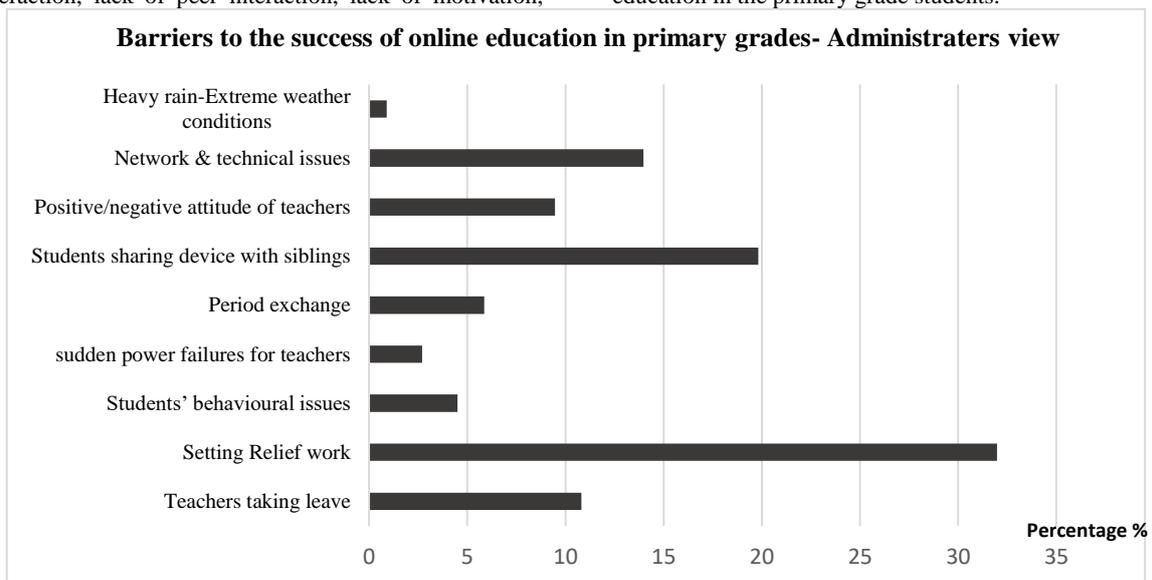


Figure-2 Administrators view on barriers for the success of online education

According to figure 2 the major issues the administrators identify as teachers taking leave so that setting of relief work has become a barrier and devices shared by siblings were identified as hindrance for the success of online education in primary grades

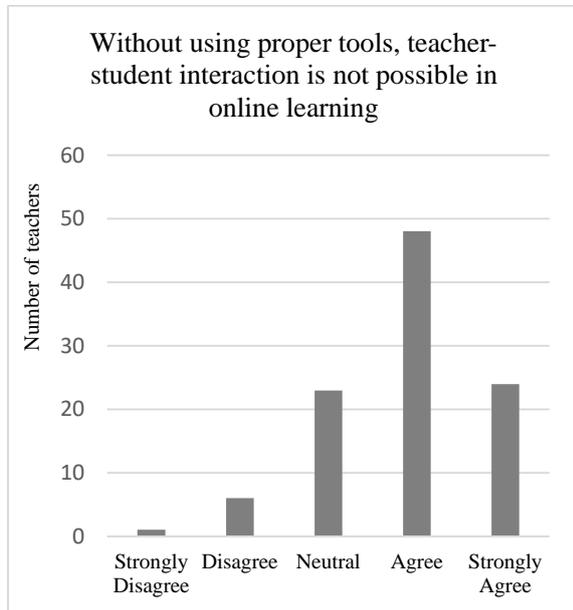


Figure 3-Teachers' view on using proper tools for interaction

The Figure 3 represents 48 out of the 102 participants agree and 24 participants strongly agree that without using proper tools, the teacher-student interaction is not possible in online education. 23 participants were neutral and 7 participants were not agreed.

This reveals the importance of requirement of digital literacy for teachers to use the online platform effectively for the success of online education.

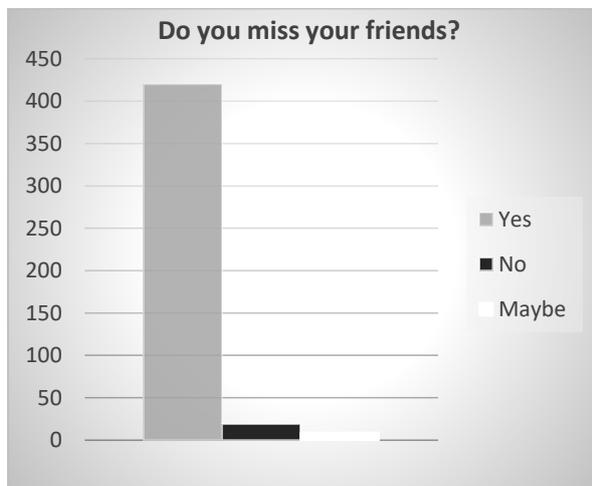


Figure 4-Students' survey results on peer interaction

Out of 448 students participated in the survey 420, which is 93.75% (grey) miss their friends in the virtual school. 19 (black) students say No and 9 (white) students were not very sure.

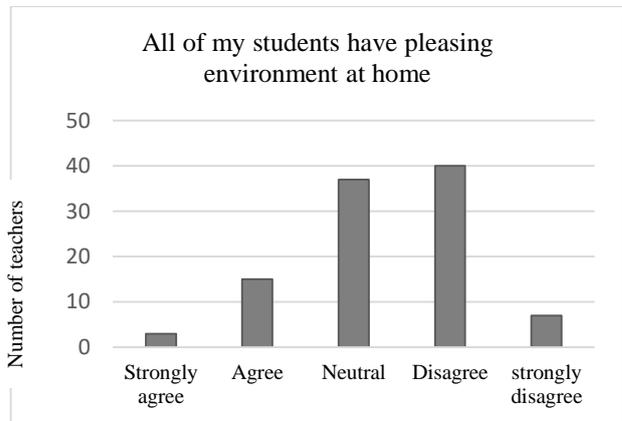


Figure 5-Teachers view on students' home front

According to the data obtained from the 102 teachers, the Figure 5 gives clear evidence that majority 40 out of 102 teachers think that the students do not have a pleasing environment at home to participate in the online sessions without any distraction. 37 teachers have neither agree nor disagree to the statement.

The qualitative data obtained from teachers through the Focus group discussions and the subject coordinators interviews, the instances where the teachers' have experienced different mood swings of students being discussed and recorded, these data too revealed that the students feel scared and embarrassed when the home environment is not supportive while the lessons are in progress. Sudden quarrels of the people who are at home, disturbances due to young siblings, parental harassment to compete with the peers and always pushing towards unachievable goals were stated at the interviews as major reasons encountered in students with emotional imbalances.

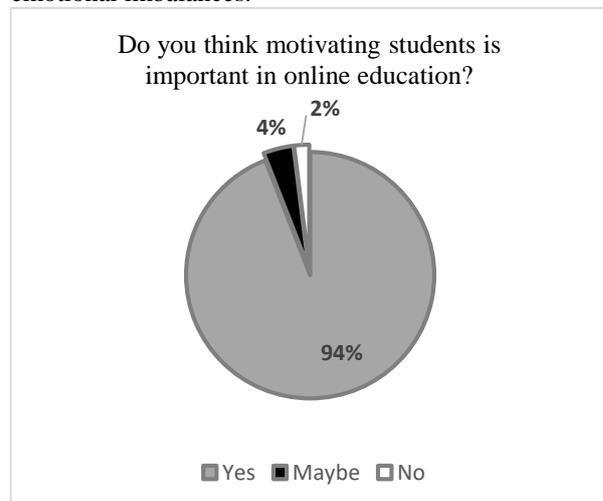


Figure 6- Teachers' view on importance of motivation

The Figure 6 represents the teachers’ survey result for the question on motivation, 94% (grey) of the teachers accept that it is important to motivate

students in the online platform for the success in education.4% (black) and 2% (white) feels maybe important or not important, respectively.

Is lack of motivation is a barrier to the success of online education?		Count	Table N %
Have you ever felt that your daughter lacks interest in participating in online sessions?	No	175	25.1%
	Sometimes	303	43.4%
	Yes	220	31.5%
Which statement best suits the reason for lack of motivation in students' online learning?	The teacher is not following up in person, the child doesn't feel motivated	123	17.6%
	The work is too much for them to cope with	121	17.3%
	They feel sad when their names are not called	1	0.1%
	They feel sleepy when working alone	341	48.9%
	They feel that they are left out	111	15.9%

Table 1-Reason for lack of student motivation-parents view

The results shows that 31.5% parents have experienced their daughters lack interest in joining the online classes 43.4% have somewhat experienced a similar demotivation in the students’ side to participate in the online lessons.

Results of the second questions revealed that majority 48.9% of the students are lack of motivation due to feeling sleepy when working alone from home. Approximately 17% feels that the students lack of motivation due to too much of work or when teacher doesn’t follow up students in person. 15% thinks that they are left out

3.2 Good practices followed by the school

				Teaching Experience in Years			
				1-5 years	5-10 years	less than 1 year	more than 10 years
				Count	Count	Count	Count
Were you given training at your workplace before initiating online education?	Maybe	What are the grades that you teach?	Pre-Grade - Year 1	0	1	0	1
			Year 2 - Year 3	0	1	0	0
			Year 4 - Year 6	0	0	0	0
	No	What are the grades that you teach?	Pre-Grade - Year 1	0	0	1	0
			Year 2 - Year 3	0	0	0	0
			Year 4 - Year 6	0	0	0	1
	Yes	What are the grades that you teach?	Pre-Grade - Year 1	9	2	1	6
			Year 2 - Year 3	12	8	4	9
			Year 4 - Year 6	15	12	3	16

Table 2- Comparison between teaching experience, grades taught and training provided

This table indicates that almost all teachers were given training before initiating online sessions, there’s no discrimination based on teaching experience or grades been taught.

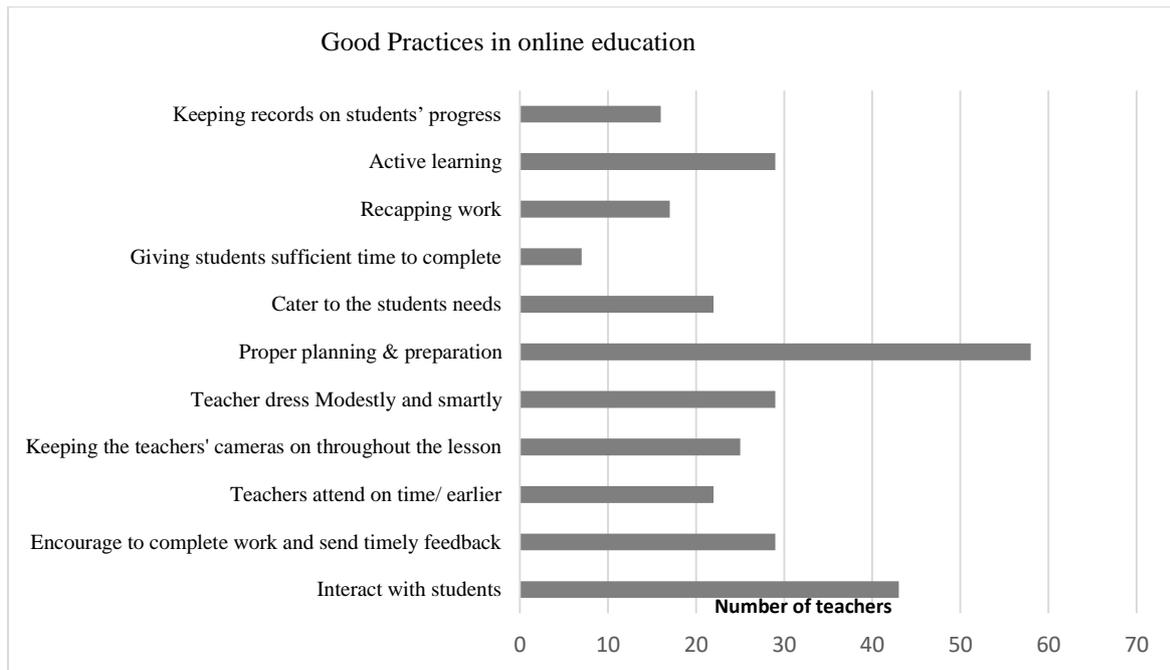


Figure 7-Thematic analyzed data on good practices-Teachers' view

The results revealed through the thematic analysis indicates that proper planning and preparation for the online lesson is a key to success in the online education in primary grade students.



Figure 8-Good practices on online education- parents' view

The results revealed that majority of the parents 502, out of 698 appreciate that the school is following a proper timetable for the virtual school and all sessions are recorded and kept available for students to watch if they miss anything. More than 50% of the participants of this survey indicated that the school is following a well-organized assessment system, the children can see the teacher, teachers are flexible and ready to support and they care for the wellbeing of the students.

3.3 Subjects that mostly enjoyed by students in online school.

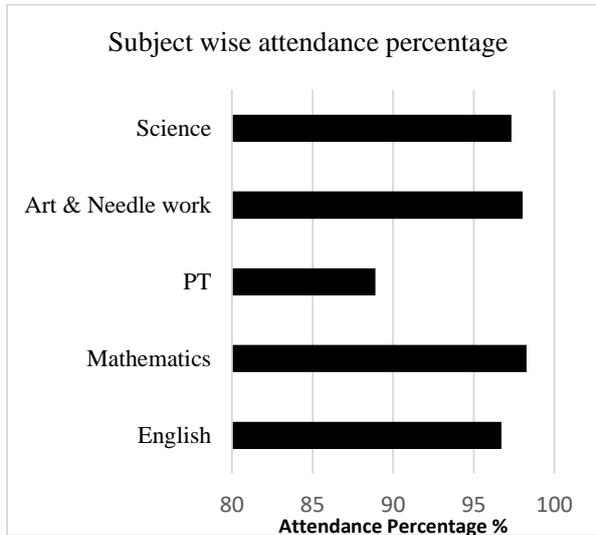


Figure 92-Subject wise attendance percentage

The results revealed that comparatively poor attendance observed for PT subject. Highest attendance 98.3% for Mathematics and 98% Art & Needlework subjects were observed.

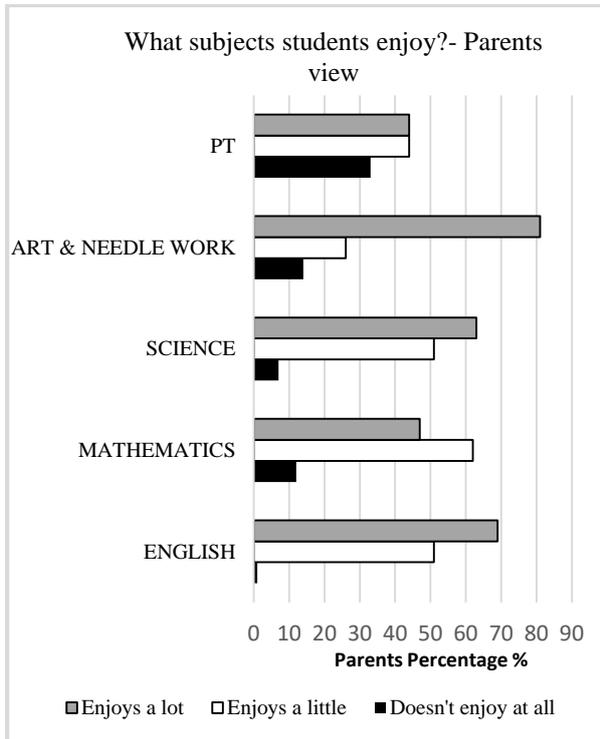


Figure 10-what students enjoy in virtual school- parents' view

Figure 10 revealed that students mostly enjoy Art and Needle work, equally enjoy English and Mathematics and the least enjoy Physical training in the online education platform.

4. DISCUSSION

There are many researches on e-learning and online education on specific educational grades. Most of them explain about the secondary school and tertiary education related points.

Globally, as of 4.57pm CET, 3rd December 2021, there have been **263,563,622** confirmed cases of COVID-19, including **5,232,562** deaths, reported to WHO. As of 2nd December 2021, a total of **7,864,123,038** vaccine doses have been administered. Even though, the daily new cases above 400,000 being recorded globally.[23] These data shows how deadly this disease is & the impact of the disease not only affected peoples' life style & economy but also very badly affected school education around the world.

This current situation lead to the need of alternative educational platforms for delivering to students. Developed & some of the developing countries adopted to online education through Google classroom, teams, zoom and many more online platforms & others used Television & Radio broadcast for the purpose.[21]

This study focuses on the international school education in Sri Lankan context where about 97% of the students & 100% of the teachers have access to required facilities & competency to use technical devices. Therefore, the barriers to the success of online education for primary grades have been focused in this study.

According to many studies reported in the literature, online education & its barriers were mainly focused the tertiary level education, especially in the medical field. [5],[9],[15]

In the study on Obstacle faced by nursing students in Menoufia University, Egypt [14]. The main focus was given to the obstacles faced by nursing students during online lessons & its effects on their attitudes while applying it. The study recommends that necessary measures should be taken to electronic learning & teaching as the students were significantly demotivated on online education due to certain obstacles such as infra-structure & technology, technical & management support & instructors' characteristics.

According to the study on " Barriers to online learning in the time of COVID-19" on medical students in Philippines, the barriers are categorized as technical, individual , domestic, institutional & community barriers. The study recommends that the students should be supported mentally, financially & morally to benefit the higher education & as many

students have barriers in the infra-structure, it recommends to promote more asynchronous learning materials which will minimize the use of data.[5]

Many studies related to the background of this research describes attitudes, technical glitches, motivation, instructional issues & financial status of students that have been identified as major barriers in the online education in the context of higher education in the field of health. It is clear that the practical & clinical skill development through online education is not practical, but alternative method are recommended for continuity of education as the best option for the current scenario to provide an uninterrupted service to the field of education.

This study will fill the gap of research findings on barriers for the success of online education for the primary grade students as primary education is contrast to higher education & its teaching & learning methodologies.

This study was conducted to identify the barriers to the success of online education in primary grade students, to identify good practices and what subjects' students mostly enjoy in the virtual school.

Through this comprehensive study it is revealed that lack of students-teacher interaction, peer interaction, motivation, emotional imbalances and schedule changing, device and network connectivity issues were identified as major barriers for the success of online education in the primary grade students. Thus, all factors mentioned are barriers to the success of online education, using the online platform efficiently and effectively such barriers can be minimized. Maximum administration support and a well-organized training programme for teachers on using digital devices and tools can help teachers to design and deliver lessons effectively across to the students.

The good practices followed by the school were analyzed based on teachers' and parents' perspectives. Teacher training before implementing online education, fixed time table, breaks in between each lesson for interaction, availability of recordings of live sessions, subject wise attendance marking, teachers keeping their video camera on and flexible learning are considered as some of the good practices followed by the school.

The subjects that the students enjoyed in the virtual school was identified by comparing their performance, survey results and observations. Based on the 5 subjects English, Mathematics, Science, Art and Needlework and Physical Training, considered in this study, the students mostly enjoy Art and needle work. They love to use new techniques in art and enjoy drawing. They least like Physical training, though it is another subject which students can

actively engage, the way it is conducted the thinking of parents that PT is not essential might be reasons for students least like for the subject.

5. CONCLUSION AND FUTURE RECOMMENDATIONS

With the revealed results of this research we understand that the teachers should be given a proper training before implementing online education in primary grades to overcome challenges and make the lessons very effective. Digital literacy, designing, planning and proper preparations for the lessons by teachers are vital for the success of online education in primary grades.

Strategies to improve student-teacher interaction, peer interaction, student motivation, to handle students' emotional imbalances and to have back up plans for technical and network issues were identified through good practices followed by the school for the success of online education in primary grades.

Through the results of the research the following recommendations can be made for future studies and implementing effective online education

- Teacher education on digital literacy is essential for the success of online education. It should be well planned and organized for all teachers before the implementation of online education and upgrading the skills through continuous professional development programmes organized in-house.
- To have effective communication between teachers and parents to work together to support students' education through the online platform.
- Further studies of this nature can be conducted to compare different schools how they have implemented the online education and to discuss the pros and cons to learn from others.
- Specific subject development in primary grades through online education can be considered for further studies.
- How to include co-curricular and extra-curricular activities in an online platform in an effective manner could be studied further.

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THE ROLE OF DATA ANALYTICS TOWARDS EFFICIENT CLOUD PLATFORMS: COMPREHENSIVE REVIEW ON EXISTING TECHNOLOGIES AND FURTHER INNOVATIVE APPROACHES

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ABSTRACT—Data Analytics in clouds is beneficial as well as challengeable. Cloud computing as a modern technology gaining many benefits with data analytics. The key intension of this paper is to introduce the advantages of implementation of cloud-based data analytics. It is evident from the literature that many organizations have carried-out data analytics for a long time to fine-tune their methodologies with the aim of expanding their opportunities. Data analytics also tends to solve many crucial problems associated with attempting to understand clients, rather than following basic data patterns to build better business strategies and activities for the sake of discovering certain amount of possible vulnerabilities. Frequent data-analytics perceives existing behaviors in data to help better serve existing clients. It tends to figure out how to attract new clients which is harder than setting up a new business. As with the existing literature, the sub-themes of data analytics includes “Technical”, “Organizational”, “Economical”, “High-performance”, “Efficiency and Security advantages” that encompasses the following categories : “Specific capabilities”, “Technical support”, “High-level capabilities in the Organizational area”, “Organizational cost reduction”, “Relative benefits in Economic field” and “Security Opportunities”. This whole process based on cloud data analytics helps to make businesses more successful. Further the literature giving some evident for union of cloud computing with analytics helps client organizations to store, decipher and measure their huge bundle of data to address their client’s issues in a more accurate and efficient manner. Significant part of the advantage of data analysis comes from its capacity to recognize patterns in a set and make predictions with respect to the past encounters. Typically, the interaction is suggested as data mining that is simply a finding of designs or patterns in data somewhat medium or large data sets with respect to the size. Considering the novel approach of data analytics in cloud computing environments, leads to improve the benefits and opportunities in a vast scale, that significantly improve the efficient use of Cloud Computing Technologies.

Keywords: *Cloud computing, Cost reduction, Data analytics, Operational efficiency, High performance*

1. INTRODUCTION

Cloud Computing is speedily becoming one of the greatest well-known, enhanced, and promising technologies. This paper discusses about the advantages of using cloud computing technology to analyze data [1]. These days business operational environment is considered by a fast pace of transformation, hence the important for organizations to be scalable in order to adjust to change, increasing costs followed by a vital for better resource utilization, better competition followed by a necessity for organizations to be pioneering and a fast pace of high-tech developments. In this multipart and dynamic environment, the potential benefits that cloud computing capabilities is becoming gradually attractive to ensure organizations attain justifiable reasonable value, to accomplish development and safeguard survival of the organization. Apart from business advantages there are technological

advantages as processing, I/O utilization, and scaling. Another big topic related to data analytics in the business world is Business Intelligence (BI) [2]. It refers to applications, practices and technologies for the collection, integration, analysis, and presentation of business information. The primary motivation behind Business Intelligence (BI) is to help better and quicker business decision-making. Organizations are being constrained to capture, understand, and harness their information to help decision-making to improve business activities. In an always-changing business world, numerous organizations presently face developing strain to create and increase their business intelligence endeavors rapidly and for a minimal price to stay competitive. As of late arose distributed computing is changing the way IT services are given by organizations and how businesses and clients connect with IT assets. It represents a paradigm shift that introduces flexible service models that companies can subscribe to on a pay-as-you-use

model. The data in the world is growing exponentially. Big data analytics is an evolving term that describes any huge amount of structured, semi-structured and unstructured data that has the potential to be mined for useful information. Big data is data that exceeds the processing capacity of traditional databases. The data is too big to be handled by a single on-premises (solitary) machine. The developing field of big data analytics analyzes a lot of data to uncover covered-up examples, correlations and different bits of knowledge. Big data technology has become possible with the latest developments in computer technology as well as algorithms and approaches developed to handle big data. In this paper, our aim is to investigate the impacts of cloud computing and big data on businesses and analyze the benefits and challenges it brings to enterprises.

2. BACKGROUND

As per the US National Institute of Standards and Technology (NIST) Cloud Computing, “A model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing and rapidly provisioned resources and services like servers, storage, applications and released with minimal management effort or service provider interaction” [3]. Von Solms [4] defines cloud computing by indicating it as a computing model which grants users to access an IT facility over a network, at the same time keeping them away from technical details of how facility is given. He equates the characteristics of a mutual form of transportation to the utilization of cloud computing. It's like owning a car with on demand transportation services. Thus, one need not stress over insuring, servicing and keeping up the car and is just worried about its availability. A widespread series of literature on cloud computing provisions the fact that smaller organizations, including SMEs (small & Medium enterprise organizations), stand to benefit knowingly from Cloud computing adoption because of their lack of resources and proficiency in IT. Rader [5] concurs that cloud computing will even out the competitive landscape giving smaller organizations an chance to enter in the global marketplace. He noted for a company to grow, but with less resources than its competitors, cloud computing offers the possible to do more with less, thus advancing an agile, strategic adopter of such technology. Cloud turn out to be the new enclosed all over the developing technology. Cloud computing gather all the computing resources and control them automatically. In these days World rely on cloud computing to keep their public as well as personal information. Cloud computing becomes the need for all client and give significant hardware, software and service in manner to the requirement that users put forward. Main components in cloud computing can be further classified as the cloud platform, cloud infrastructure and cloud application.

Cloud infrastructure contains different cloud services such as virtual machines (VM), data storage and communication networks such as “*Amazon's Elastic Compute Cloud (EC2)*”. Considering cloud application, provides well-defined APIs for interaction with the applications such as Google's App Engine and Salesforce.com. Cloud infrastructure plays as the bottom layer which holds cloud applications and web services on top of it. These are the commonly used public interface applications such as the Google's Google Docs. According to a recent survey [6] conducted with more than 800 business decision makers and users worldwide, the number of organizations gaining competitive advantage through high cloud adoption has almost doubled in the last few years and by 2017, the public cloud services market is predicted to exceed \$244 billion. As indicated by Dutta [7], the engaging quality and advantages of cloud computing is identified with the monetary advantages, disentanglement and accommodation of the way processing administrations are conveyed. Furthermore, he specified that these advantages as the key drivers that will accelerate the reception of distributed computing with the desire that it will result in cost decreases, increment productivity and at last make an upper hand in any market. W. Premachandra, C. Rathnawardhana and N. Chathuranga [8] introduced prototypical implementation (A11Y), Early Warning System for Asthma Patients based on IoT and AI, people can use in their own day to day life as a simple wearable gadget. In this Bio informatics related experiment cloud analytics perform a rigorous participation. Though at experimental level signal processing and decision making is done by a laptop/computer, some sensor reading push into the IBM cloud, to IBM Watson IoT Platform for data analytics for make the predictions of whether the patient is in a potential of down to a vulnerability. Cloud data analytics used in education sector also.

R. L. Moore [9] pointing out understanding student learning and behavior is a complex process and one that can be significantly aided by data analytics. In a data-driven approach innovative educational implementation can be introduce use of learning analytics for students by identifying learning behaviors and influence learning pathways. Moore mentioned that in the last decade, there are dramatic increases in the integration of technology within education. It has now become commonplace for K-5 educators to apply learning management systems (LMS) in ways that were previously only seen in higher education contexts. Similarly, on the higher education side, we are seeing a significant increase in online learning evidenced by the growing number of for-profit online colleges and universities. This research work utilizes Khan's Learning Framework to explore the role data analytics can play in

education by looking at the possibilities and limitations of analytics. Big data analytics also provide tremendous support as A. Hadwer [10] mentioned, improves the decision making 205 process and is available for higher education organizations through main cloud services providers. Much of the research on data analytics has roots to the days before the cloud. However, the available research on Big Data analytics centered on technical algorithms of data analytics or system development. This focus of research on analytics techniques and methods has spread out to the studies made on Big Data analytics in higher education as well. There is an apparent focus on how Big Data analytics can be integrated into the field of Learning Analytics (LA) that may allow academic institutions to better understand the learners' needs and proactively address them. There is an apparent lack of studies that suggest frameworks or roadmaps to enable higher education institutes to join the cloud for Big Data analytics. Big Data is not yet fully understood, and what impedes its use in the first place is not the technical challenges. Despite the great benefits BDA offer higher education, it is recommended that more research is carried out to explore in-depth the organizational factors that impedes BDA use and adoption in the higher education as the literature shows that they cause BDA projects failure the most.

2.1 Cloud service models

Main cloud service models [11] can be categorized as follows.

1. *Software as a Service (SaaS)*: This model gives browser-based software applications over the Internet. The client is not allowed to change the Infrastructure (operating systems, servers, storage, and network).
2. *Infrastructure as a Service (IaaS)*: It gives an online administration access to assets, for example, handling disk space, limit, and many others. The client is given the permission to install software in that infrastructure.
3. *Platform as a Service (PaaS)*: In this model, developers are given an environment and platform empowering them to make services and applications accessible via Internet.

2.2 Cloud Analytics advantages over On-Premise Analytics

There are numerous use cases can be found and there should be a discussion of how cloud analytics [12] [13] overcome lots of issues and improve the efficiency of the common business workflow [14].

- *Agile Computing Resources*
 Helps to deliver business queries and reports immediately in cloud computing because the

handling speed and less hassles on delivery time related processes in the premise servers.

- *Better performance in Adhoc Deployment of Resources*

Analytics and data science in cloud can support for business context by scale-up by creating a direct linking between them, reducing the latency and reaction problems to less than a millisecond. It helps to preprocessing data such as cleaning, transform and match, consolidate data in effortless manner. The concept of Real Time Cloud (RTC) gives even more benefits for data analytics and big data such as combine, match and clean data effortlessly with actual access to sources systems and data up-to date and organized, assisting your Operations and Analytics groups' functions (Data Virtualization and semi Virtualization) under the same roof. These facilities tend to provide finer marketing/business decisions and predictions in organization.

- *Accessibility*

Cloud services can visualize data generating analytic reports comparing organizations and sharing them making raw data fingertips away and make them visible for a larger worker base.

- *High Profits on Time Investments*

Services provided by cloud facilitates on-demand data models, uploads, innovative tools for analytics and application servers. Time can be saved in building up a new infrastructure employing Marketing teams. On premise analytics teams in the organization can prediction and fragment your movement plans, leads and the campaign reports produced are available anytime to your sales teams to follow-up, real time customer data and insights from sales and marketing teams helps strategy teams of the organization in predicting game changing decisions or make their support teams informed instantly with consumer queries. By increasing the cooperation, we can expect advanced returns, and an ideal cloud service can deliver it as expected

- *Flexible and Faster Adoption*

Cloud provides high UX experience by supporting self-learning models and have a user-friendly consumer experience unlike the on-premise applications. Cloud infrastructure helps the business growth and can enlarge or amend as your data storage and applications needs growth or lessening without any user interaction (auto-scaling) [5].

- *Affordability*

New tools or applications require minimal IT maintenance and no improvement costs or issues. This retains the business in a continual flow

without any intrusions like the need for improvement the on-premise Infrastructure, and having other time-consuming efforts and to rebuild your combinations.



Figure 1. Amazon Kinesis architecture

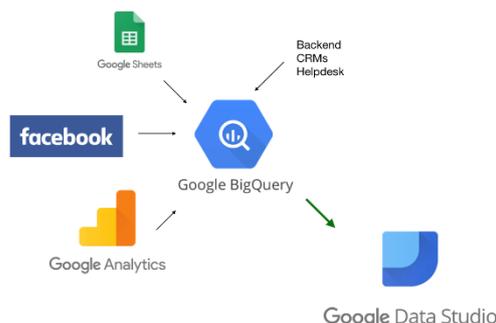


Figure 3. Google BigQuery

- **Security**

In terms of data breach, cloud-based infrastructure (robustly built) is more effective because detecting such security issue by analyzing data and fixing it take less time than on premise security analysis. Since the agility, flexibility, and virtualization techniques, with the help of cloud-based data science services it is best to streamline each of business processes as cloud.

2.3 The Best Uses of Data Analytics

- **Social Media**

A widely used data analytics technique in cloud computing is depicting and compounding social media content. It was very hard to process various social media activities across different sites before cloud drives became available, mainly because of the data storing technique, means different servers use to store data. Cloud drives can examine social media site data simultaneously, so the result generation and quantification can be done quickly and attention and time designate appropriately.

- **Tracking Products**

For tracking products cloud use for ship items anywhere as needed, regardless of items proximity to customers. The good example is Amazon, they use data analytics on cloud drives to track products across wise their series ship items and warehouses anywhere as needed. Red-Shift, “Big Data Analysis Services (BDAS)”, initiative by AWS helps Amazon users for remote analysis of cloud drivers. Alongside redshift gives same provision of analytics tools and storage capabilities for smaller business organizations. It is cost effective for smaller business as it prevents spend money on extensive hardware and related components.

- **Keeping Records**

Disregarding the closeness of servers cloud analytics allows concurrent record-keeping and processing facilities. Companies can track and forecast sales and improve customer relationship management (CRM) based on computational analysis.

C. Leading Cloud Providers Solutions

According to the leading cloud providers as AWS [15] [16], using Amazon Athena, Amazon Kinesis, AWS Data Pipeline, AWS Glue, Amazon Athena, Amazon EMR, Amazon Cloud Search, Amazon Elastic search Service, Amazon Kinesis, Amazon Kinesis Data Firehose, Amazon Kinesis Data Analytics, Amazon Kinesis Data Streams, Amazon Kinesis Video Streams, Amazon Redshift, Amazon Quick Sight, AWS Data Pipeline, AWS Glue, AWS Lake Formation, Amazon Managed Streaming for Apache Kafka (Amazon MSK)

Microsoft Azure also use Cortana Intelligence Suite [CIS] [17], and IBM Watson provide IBM Analytics [18] service. Finally, Google also use services such as Google Data Lake approach and Analytics (GA), Data Studio, Data Lab. Furthermore, Azure Analytics Services [19] provides lots of services as Azure Synapse Analytics, Azure Data bricks, Azure HD Insight, Azure Data Factory, Azure Machine Learning, Azure Stream Analytics, Azure Data Lake Analytics, Azure Analysis Services, Azure Data Explorer, Azure Data Share, Azure Time Series Insights

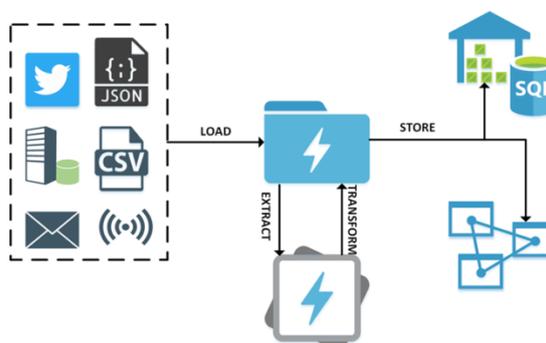


Figure 2. Azure Data Lake Analytics archives

Google also provides analytics services [20], Big Query, Dataflow, Dataprep, Dataproc, Stream Analytics, Marketing Analytics, Data Catalog.

Leading Cloud Providers	Data Analytics and Related Services
Amazon Web Service (AWS)[15]	Analytics Service: <i>Athena, EMR, Data Pipeline etc.</i> Internet Of Things: <i>IoT Analytics, Amazon FreeRTOS etc.</i> Machine Learning [21]: <i>AWS DeepLens, Amazon Polly etc.</i>
Google Cloud Platform (GCP) [22]	Business Intelligence: <i>Google Data Studio, Cloud Dataprep etc.</i> Stream Analytics: <i>Cloud Dataflow, Cloud Dataproc etc.</i> Market Analytics: <i>Cloud Data lab, Cloud Machine Learning Engine etc.</i>
Microsoft Azure [23]	Services: <i>Data Lake Analytics, Azure Analysis Services, Azure Data Explorer, Databricks, Data Factory etc.</i>
IBM Cloud (Former IBM Bluemix) [24]	Services: <i>Analytics Engine, Apache Spark, Decision Optimization, Streaming Analytics etc.</i>

Table 1. Leading Cloud providers and technologies

3. METHODOLOGY

The study design and methodology for this research are described below. Secondary data used for this paper such as journal articles, conference papers and related websites.

A. Research Questions

This study examines the realized advantages of the analyzing data in the cloud finding answers to the subsequent research questions:

1. What are the benefits that the organization has realized in terms of business related in data analyzing process using Cloud Computing?
2. What are the technical related benefits that the organization has realized in data analyzing process using Cloud Computing?

B. Objective

The objective of this paper is to identify the advantages of analyzing data in terms of business and technical perspective in cloud.

4. Review outcomes

This paper discussing the valuable business-oriented benefits that organizations earn by moving into cloud-based data analytics such as on-demand service, high returns on time investments, rapid elasticity, agile computing resources, cost effectiveness, resource sharing, consolidate and clean data effortlessly, accessibility, flexible and faster adoption, affordability and security. In same, technical perspective, organizations gain better performance match in ad hoc deployment of resources, performance improvement in processing data in secure way and it supports data recovery and replication. It supports effective testing methods like A/B testing.

	Data analytics use case
Education sector	(a) Improve Student Results (b) Customize student programs (c) Reduce dropouts (d) Target international recruiting (d) Track learning patterns (e) Improve interactive learning platform
Healthcare Industry	(a) Patient health status prediction (b) Real-time alerting (c) Enhance patient engagement (d) Developing new innovations
Finance	(a) Risk analytics (b) Real-time analytics (c) Consumer analytics (d) Customer data management (e) Financial fraud detection
Movie industry	(a) Audience engagement (b) Streaming platforms (c) Predictive analytics

Table 2. Cloud data analytic use cases

5. Conclusion and findings

This paper discussed the advantages of analyzing data in cloud architecture and describe the leading cloud providers and their solutions to address the data analytics. Furthermore, the basic cloud infrastructure models, IaaS, PaaS and SaaS usage for data analytics. Finally, paper discuss the review questions in business and technical perspective and answers (outcome) for them. Here are the outcomes and findings of this review paper, fully manageable (Consumer can built the infrastructure and to beyond), highly scalable, Security in-built, Cost effective Fast in processing, Easy to interact with (Friendly UX dashboards), Platform based solution (IBM Watson IoT Platform, Apache® Spark™ based analytics platform etc.) High availability as enterprise business need (Hadoop and Spark service backed by 99.9% SLA, AWS monthly uptime as 99.99%.etc),

Automotive, orchestration capability Real-time data stream processing (IoT device communication). Finally, as per the conclusion cloud data analytics supports many advantages over on-premise analytics. In the future, everything is based on “Data”, analytical advantage over cloud computing will make the potential to significantly change in the business and technological worlds.

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KINEMATIC ANALYSIS OF MEDIUM BOWLING

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ABSTRACT- The purpose of this study was to find out whether there was a difference in speed of release among Front-on, Side-on and Mixed-on bowling techniques and determines which of the technique was most important for attaining high ball release speed. The purpose of the study Ten (10) male cricket bowlers from each action namely side on- 10, front on- 10 and mixed on- 10 were selected randomly from Northern Cricket Association Division players. Their age ranged between 18 to 28 years. The bowling performances of the subject were captured by a video using Sony (HDR-XR 550E) camcorder and then the data were collected on the speed of release using KINOVEA motion analysis software. The obtained data were analyzed using the ANOVA (Analysis of variance) among side-on, Front-on and Mixed-on techniques. From the result, it was concluded that Side-on action was the optimal technique for attaining high ball release speed compared to Front-on and Mixed-on action. These results are likely to be useful in both the coaching and choose proper bowling action in the early carrier to medium bowlers.

Keywords: Medium bowling, Side-on action, Release speed

1. INTRODUCTION

Cricket has been a team sport in Britain for hundreds of years. It is a game that is contested playing amongst two teams of 11 which each side made up of bowlers and batsmen. The ability of bowlers to bowl with high ball release speeds contributes to the successful performance of cricket teams by either dismissing or reducing the scoring ability of the opposing batsmen (Portus, Mason, Elliott, Pfitzner, & Done, 2004; R. Portus, Sinclair, Burke, Moore, & Farhart, 2000; Worthington, King, & Ranson, 2013).

The "medium" bowling group, subdivisions related to the speed of delivery are commonly applied: fast-medium, medium-fast, and medium. Medium bowlers are bowlers who bowl at a speed of 110-137 km/hr (Frost & Chalmers, 2014). Fast bowlers are usually the attacking bowlers of the team with the fast-medium and medium-fast bowlers as well as the spinners playing a supportive role (Cloyed, Eason, & Dell, 2018). This is important for the medium bowlers to choose and correct their bowling action initial itself for longevity in the carrier.

1.1 Objective

To find out whether there was a difference in speed of release among Front-on, Side-on and Mixed-on bowling techniques.

1.2 Types of bowling action

Every bowler has their own bowling action, which is influenced by their body type and bowling action. Finding the action is determined by the bowler's level

of comfort when bowling. The medium bowler employs one of two bowling techniques, side-on front-on or mixed bowling, or a combination of both (Elliott, Davis, Khangure, Hardcastle, & Foster, 1993), these three categories refer to the body's position in respect to the target during back and front foot contact during the delivery stride.

1.2.1 Side-on

The 'proper' and most effective bowling action is described as side-on bowling. When the bowler's back foot lands parallel to the popping crease and his shoulder alignment points down the pitch, he is said to be in this position (Bartlett, Stockill, Elliott, & Burnett, 1996).

1.2.2 Front-on

The run-up pace is faster in front-on bowling, and the back foot falls facing the batsman. At the rear foot strike, the shoulders are at an angle greater than 180 degrees, resulting in a more open chested position (Bartlett et al., 1996).

1.2.3 Mixed-on

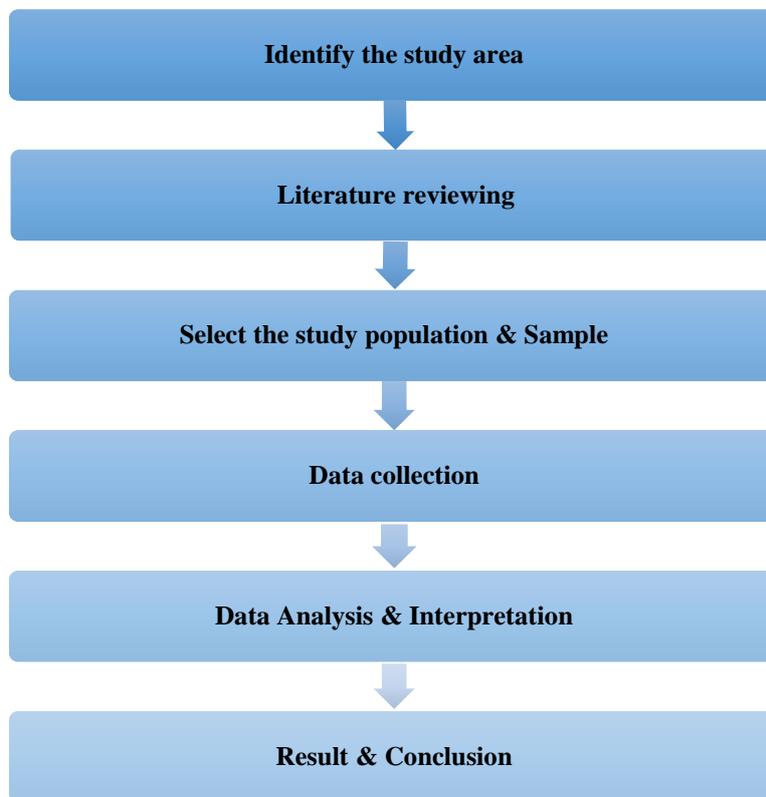
A mixed-on action is one in which the back foot creases at about a 45-degree angle. The mixed action combines the two preceding actions. At rear foot contact, a bowler may adopt a front-on foot and shoulder alignment, which is followed by a side-on shoulder realignment during the delivery stride (Bartlett et al., 1996).

1.3 Phases of bowling action

For the purpose of analysis according to the selected kinematic parameters bowling phases is divided into Pre Delivery Stride (PDS), Mid Bound (MB), Back

Foot Contact (BFC), Front Foot Contact (FFC), Ball Release (BR) and Follow-through (FT).

2. METHODOLOGY



OS Figure 2. Methodology

The purpose of this study was to find out whether there was a difference in speed of release among Front-on, Side-on and Mixed-on bowling techniques. For this purpose 30 male (Front-on -10, Side-on -10 and Mixed-on -10) medium bowlers aged ranged from 18 to 28years, were selected randomly from Northern Cricket Association Division players. All the bowlers were right-handed and written consent was signed by each subject before participation. Each bowler was then asked to bowl six deliveries at maximum effort.

The Sony video camera (HDR-XR 550E) is mounted on a tripod and placed perpendicular to the bowling direction. The camera is placed in a line with a line running between the bowling crease and the popping crease. Video graph analysis for the purpose of this study involves a different task.

In the first phase using the Sony camera (HDR-XR 550E), the bowling action of the title was recorded. In the second phase, a video graph was

played, displayed and analyzed by the movement of the subject. In the third phase, the performance of the subject was viewed in slow motion frame by frame and selected the frame required for measurement of the speed of release (meter/second) Advanced drawing footage was employed through the KINOVEA motion analysis software to measure the variables accurately.

In the fourth step, the analysis is saved as data. The collected data was then mathematically analyzed using ANOVA at release speed (meter / second) between Front-on, Side-on and Mixed-on bowling techniques. Scheffes post hoc test was used to compare which technique is better for attaining high ball release speed for the purpose of analysis 0.05 level of significance was fixed.

3. RESULTS

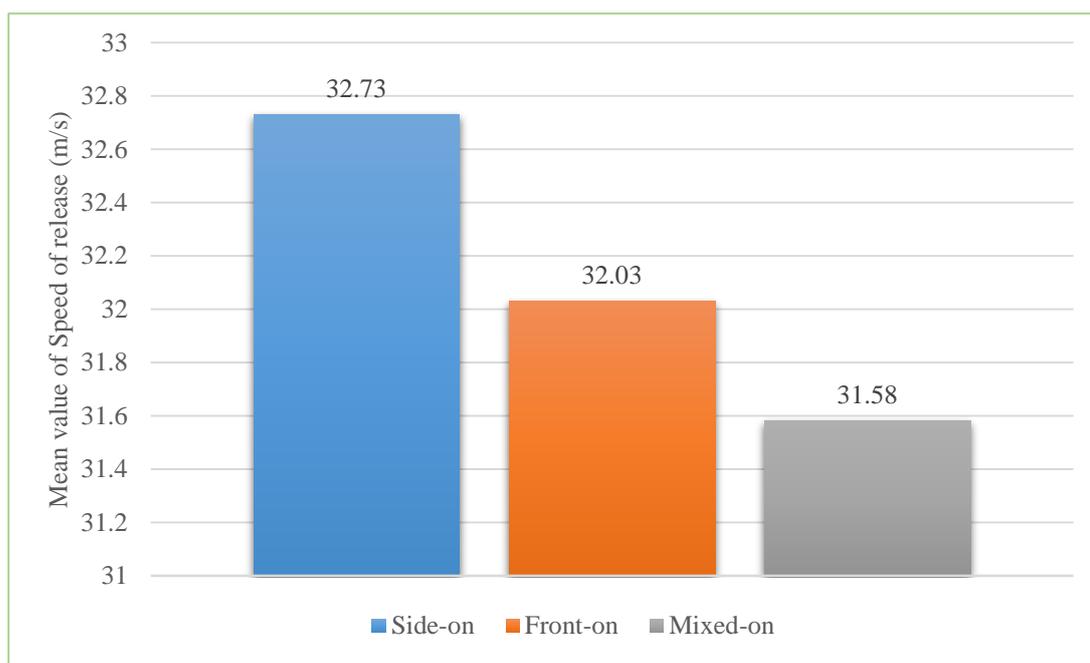
The result obtained in this study of the speed of release is described in the following table.

ANOVA					Scheffes inter group mean				
Source of variance	Degrees of Freedom	Sum of Squares	Mean Sum Squares	F Ratio	Mean Values (meter/second)				CD level
Treatment	02	3.08	1.54	15.75	Side-on	Front-on	Mixed-on	Mean difference	0.04
Error	27	2.64	0.09		32.73	32.03		0.70	
					32.73		31.58	1.15	
						32.03	31.58	0.45	

OS Table 1. Speed release

Significant at 0.05 level, $df = 2.27$ table value 3.35. The table shows that there were significant differences in the speed of release among Front-on, Side-on and Mixed-on bowling techniques. Scheffes

post hoc test shows that the Side-on group is better than Front-on and Mixed-on action in the mean difference of speed of release.



OS Figure 2. Mean value of speed of release

4. DISCUSSION OF THE FINDING

The study addressed this issue by analysed the release speed among front-on, side-on and mixed-on bowling techniques of Northern Cricket Association Division players. The statistical data was analysed through the ANOVA. The results of this study (see OS Table 1- F ratio is 15.75*) show that ball release speed is significantly different among front-on, side-on and mixed-on action. From the result of scheffes post hoc

test (see OS Table 1- CD value 0.04*) side-on technique shows better ball release speed (32.73m/s) than front-on (32.03m/s) and mixed-on action (31.58m/s).

When comparing the mean of speed release of side on and front on the side on has a high mean value. Then comparing the mean of speed release among front-on and mixed-on the side-on has high mean value. When compare the front-on and mixed-on the front-on has a high mean value.

From this result, researcher concluded that side-on technique is the optimal bowling action compare to front-on and mixed-on action for attaining high ball release speed. It is evident that front-on technique is the second optimal bowling action for high ball release speed than the mixed-on action.

5. CONCLUSION

The main aim of the study was to identify that which bowling action contributes to high ball release speed. From the results findings that there was a significant difference in speed of release among Side-on, Front-on and Mixed-on bowling action. The researcher concludes that Side-on action was the optimal bowling technique for attaining high ball release speed. This is useful for the coaches and novice players to select an appropriate technique in the earlier carrier itself. Previous studies also supported that the Side-on technique in the least injury risk than the Front-on and Mixed-on.

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A NOVEL DEEP LEARNING BASED ENSEMBLE MODEL FOR PREDICTING THE BIRTH OPTION TYPE

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ABSTRACT—Conveyance is one of the most significant occasions in women's lives and having a healthy infant is a typical want. The neonatal period is the most susceptible time for an infant. Confusions can emerge during any phase of the labor process that may need immediate attention. For obstetricians, sometimes it is a very sensitive and complicated decision to select the birth option type whether Normal Vaginal Birth or C-Section. Usually the decision is taken based only on the obstetrician experience and manual reading of the CTG signal which might lead to cause labor complications. Through this research it has been introduced a Novel Deep Learning Based Ensemble Model to predict the Birth Option Type. The novelty compared to the other studies because of the forecasting CTG signal, aggregating with clinical obstetric risk factors and final prediction based on ensemble learning approach. As the data set, 552 CTG signal data used from Physio Net's, CTU-UHB Intrapartum Cardiotocography Database. Proposed model scored with Accuracy (ACC) = 0.8763 (~1.0), Error Rate (ERR) = 0.1237 (~0.0), Sensitivity (SN) = 0.83(~1.0), Specificity (SP) = 0.9228 (~1.0), Precision (PREC) = 0.9151 (~1.0), False Positive Rate (FPR) = 0.0076 (~0.0), and for quality measurement Mathews Correlation Coefficient (MCC) = 0.7559 (~1.0) and F-Measure, F (2.0) = 0.8705 (~1.0) and ROC / AUC gives 0.92 (~1.0). For the forecasting models, accuracy tested with MAE, RMSE, shows considerable outcomes (<1.0). Finally, declare the Null hypothesis tested using p-Values. With that outcome, this work concluded aggregating the forecasted CTG signal components with obstetric factors using the hybrid model and predicting Birth Option Type is hypothetically accepted.

Keywords: Birth Option Type, Cardiotocography, Deep Learning, Ensemble Models, Fetal Heart Rate, Uterine Contraction

1. INTRODUCTION

1.1 Complications in childbirth

The neonatal period is the most vulnerable time for a child. Furthermore, the first 28 days of life the neonatal period is the most vulnerable time for a child's survival. Children face the very best risk of dying in their first month of life at a mean global rate of 18 deaths per 1,000 live births in 2017 [1]. Comparatively, the probability of dying after the primary month but before reaching age 1 was 12 and after age 1 but before age 5 was 10. Globally, 2.5 million children died in the first month of life in 2017 alone, approximately 7,000 neonatal deaths every day, most of which occurred in the first week, with about 1 million dying on the primary day and shut to 1 million dying within subsequent six days. The labor and birth process are usually straightforward, but sometimes complications arise which will need immediate attention. Entanglements can happen during any piece of the labor process. Fetal distress and Perinatal asphyxia are most common complication types. A complication of birth is any difficult that is a hazard to the strength of the mother or the child that happens

during birth. There are additionally inconveniences of pregnancy, such as medical issues happening in pregnant ladies or in the creating fetus before work starts. Birth complications happen during work and conveyance of the infant and can have genuine repercussions for both the mother and the child. If the difficulty brings about mind harm to the infant, the kid may wind up being determined to have cerebral palsy. However, birth asphyxia or diminished oxygen levels during birth isn't as basic a reason for cerebral palsy as recently suspected. According to the Eunice Kennedy Shriver National Institute of Child Health and Human Development [2], specialized help is more likely to be needed if a pregnancy lasts more than 42 weeks, if there has been a previous caesarean delivery or when the mother is of an older age.

1.2 Complications due to birth option type

According to the Missouri Baptist Medical Center [3], there are various sorts of birth option types as childbirth, Natural Birth, Scheduled Cesarean, Unplanned Cesarean, childbirth after C-Section (VBAC), Scheduled Induction. This research work is especially specializing in childbirth and Cesarean

option types. According to the Childbirth Connection (Since 1918) publications [3] [4] there are concerns of birth option types. For obstetricians, sometimes it is very sensitive and complicated decision to selecting a delivery type. There are categorizations of concerns having Cesarean section in Baby's perspective. Childbirth Connection conclude that knowing the birth option type related complications are very importance for all pregnant women. It will help to avoid unnecessary cesarean section and assisted vaginal birth.

1.3 Importance of CTG signal analysis

At present, the foremost routinely used method for antepartum and intrapartum monitoring of fetal well-being in clinical practice is cardiotocography (CTG), also referred to as electronic fetal monitoring (EFM), a way for recording the fetal pulse (FHR) signal and contraction (UC) activity. Clinical decisions are made obstetricians by using the visual inspection of CTG traces. However, the most weakness with this approach is poor human interpretation which results in high inter-observer and intra-observer variability. Unfortunately, identification of abnormal medical conditions in antepartum and intrapartum from visual inspection of fetal pulse has been shown to possess limitations, like statistic of different lengths, recording interruptions, and poor quality signal conditions [5]. Therefore, manual analyzing CTG results assist obstetricians in identifying significant pathological outcomes like hypoxia, which may cause serious abnormalities, like such as cardiopulmonary arrest, asystole, brain and vitals damage, cerebral palsy, spastic paralysis, hearing, visual and cognitive defects. Conversely, over interpretation of CTG is common and therefore the direct explanation for unnecessary caesarean sections (CS). In such cases, between 40% - 60% of babies are born with none evidence to support pathological outcomes, like fetal hypoxia and acidosis, congenital heart defect (CHD), and even death. As you'll see in early figures death rate in Sri Lanka also decreasing with the time. In recent decades, many research studies, experiments have attempted to predict the fetal state using FHR signal. Evolution of clinical data science, artificial intelligence and more concentration on bio- informative is that the golden reason behind this reduction. Monitoring the CTG gives important clues [6] into an unborn baby's health status like early pregnancy assessment, assessing heart development, detecting fetal distress and wellbeing. Whilst early as 6 weeks into a pregnancy, assessing the fetal heartbeat can help obstetricians if potential problems with the pregnancy exist. Later within the pregnancy, checking the guts rate helps uncover problems with the placenta, duct, or with the guts itself.

2. RELATED WORK

2.1 Signal processing & ML Related Works

Delivery in the A.Kamat [7] experiment, Implementation of Classification Algorithms to Predict Mode of Delivery is the main objective. They conclude that during pregnancy, the tension associated with the method of conveyance is high. Additionally, there is an increase in the quantity of cases, where doctors recommend C-section conveyance when it is medically not required. The American College of Obstetricians and Gynecologists (ACOG) proposes that a healthcare supplier ought to consider people's specific hazard factors such as age, weight list, growth age and future reproductive plans while recommending the sort of conveyance. In this paper, utilizing information classification algorithms, we have recognized certain parameters which assist us with doing this. We have utilized two classification algorithms Naive Bayes and ID3 to decide the method of conveyance dependent on a few parameters present in obstetric ultra-sonography reports, and blood and pee test reports of pregnant ladies. The outcome shows a high precision and recall subsequently approving the accuracy of these classification algorithms for successful prediction.

S. Pereira [8], introduce data mining approach (DM) which is Predicting Type of Delivery by Identification of Obstetric Risk Factors through Data Mining Utilizing genuine data from Centro Materno Infantil do Norte (CMIN), it was conceivable to demonstrate the reasonability of utilizing (Data Mining) DM models to foresee which kind of conveyance ought to be sought after, through the pregnancy attributes of the pregnant patients. Palatable outcomes were accomplished with respect to measurement measurements, by initiating Decision Tree calculation and utilizing all data for testing through the qualities forming situation 2, accomplishing roughly 88% of sensitivity, 80% of specificity and 84% of exactness, permitting the forecast of cesarean areas and vaginal conveyances. The best model initiated, and the outcomes accomplished will be remembered for the Business Intelligence stage, effectively utilized in CMIN, supporting the doctors in dynamic and the medicinal services unit in keeping away from misbehavior and carelessness with respect to kid conveyance, prompting quality enhancements in maternity care. Future work will fuse new factors in the prescient models and different sorts of data mining methods will be applied. For example, prompting Clustering methods.

2.2 ANN Related Works

Permanasari [9] proposed a method by using pruned decision tree to analyze the cardiotocogram data (FHR pattern) which can use for fetal distress determination

by classifying fetal state class code (consisting of normal, suspicious or pathologic). For the same CTG data set, there were previous works done by researchers as adaptive boosting (AdaBoost), artificial neural network (ANN) approach, discriminant analysis (DA), and DT, supervised ANN, fuzzy c-mean and k-mean clustering, least squares support vector machine (LS-SVM). Rather than using complex methods, experimented of pruned decision tree concluded of increased the predictive values by analysis against to the same CTG data set. Haijing Tang's [10] approach introduced an artificial neural network-based classification algorithm for real-time FHR signal classifying Cardiotocography signals. His design and implementation. Real-time monitoring of fetal wellbeing on compact gadgets has become a critical requirement for pregnant ladies, which assists with ensuring the soundness of the hatchling in a progressively exhaustive way and lessen the remaining task at hand of specialists. For the element securing of the fetal heart rate (FHR) signal, the customary component- based classification strategies need to physically peruse the morphological highlights from the FHR curve, which is time- expending and exorbitant and has a specific level of calibration bias.

Haijing [10] proposes a classification technique for the FHR signal dependent on neural networks, which can stay away from manual element securing and lessen the mistake brought about by human elements. The algorithm will legitimately gain from the FHR information and genuinely understand the constant conclusion of FHR information. The convolution neural network classification strategy named "MKNet" and recurrent neural network named "MKRNN" are structured. The principle substance of this paper incorporates the preprocessing of the FHR signal, the preparation of the classification model, and the exploratory assessment. At last, MKNet is end up being the best algorithm for ongoing FHR signal classification.

2.3 DL Related Works

Paul Fergus research [11], found a deep learning (DL) approach to classify the normal vaginal deliveries using fetal heart rate signals. First, he pre-processes the data and extract the features from raw FHR signals. In Pre-processing cubic Hermite spline interpolation used to removing noise, and missing values. In FHR feature extraction, statistical, higher- order statistical and higher-order spectral features, morphological features and time series features, non-linear features extracted. Re-cursive feature eliminator algorithm (RFE) is use for feature selection. Synthetic minority oversampling technique (SMOTE) use to oversample the dataset. Deep learning classifier use with tan-sigmoid nonlinear activation function. Fishers linear discriminant analysis classifier (FLDA) to classify linear combination of features. Ensemble based,

random forest (RF) introduced to vote on the classification outcome. This works gives significant performance measures with k-fold cross validation. The experiment successfully proved that machine learning can be used to objectively determine when medical intervention is required. Unfortunately, study needs further evaluation using truly independent data to fully assess its value. Except that limitation the proposed method is robust, achieved high accuracy rate and golden contribution to the bio-medical filed. Saeed Saadatnejad [12] introduced a Deep learning approach which is LSTM Based ECG Classification for Continuous Monitoring on Personal Wearable Devices. His objective is to introduce a novel ECG classification algorithm is proposed for continuous cardiac monitoring on wearable devices with limited processing capacity. The proposed solution employs a novel architecture consisting of wavelet transform and multiple LSTM recurrent neural networks. His Experimental evaluations show superior ECG classification performance compared to previous works. Measurements on different hardware platforms show the proposed algorithm meets timing requirements for continuous and real-time execution on wearable devices. Saeed finding concludes that the proposed algorithm is lightweight and highly accurate in contrast to other compute-intensive deep- learning-based approaches, and therefore, brings continuous monitoring with accurate LSTM-based ECG classification to wearable devices.

Paul Fergus [13] and the team introduce a one-dimensional Convolutions Neural Network (CNN) model for early detection of the abnormal birth outcome by modeling segmented CTG time-series signals. This experiment address inter and intra observer variability problem and traditional machine learning problem and proposed a novel CTG analysis methodology that splits CTG time-series signals into n-size windows with equal class distributions, and automatically extract features from time-series windows using a one- dimensional convolutional neural network (1DCNN) and multilayer perceptron (MLP) ensemble. Collectively, the proposed approach normally distributes classes and removes the requirement for handcrafted features from CTG traces. The 1DCNN-MLP models trained with several windowing strategies are evaluated to determine how well they can distinguish between normal and pathological birth outcomes. Proposed method achieved good results using a window size of 200 with (Sens=0.7981, Spec=0.7881, F1=0.7830, Kappa=0.5849, AUC=0.8599, and Log loss=0.4791). The results were compared with a Support Vector Machine (SVM), a Random Forest (RF) and a Fishers Linear Discriminant Analysis (FLDA) classifier, which all failed to improve on the windowing 1DCNN strategy proposed in this study. Paul concludes that his approach helps Gynecologists and obstetricians visually interpret cardiotocography (CTG) traces

using the International Federation of Gynecology and Obstetrics (FIGO) guidelines to assess the wellbeing of the fetus during antenatal care. Alessio Petrozziello [14], introduced a data-driven computational approach, which allows automated evaluation supported large clinical datasets. This experiment concludes a Deep Learning for Continuous Electronic Fetal Monitoring parturient. Alessio investigated of long STM (LSTM) and convolutional neural networks (CNN) in analyzing EFM traces from over 35,000 labors for the prediction of fetal compromise. Of these, 85% are used for training with cross-validation and therefore the remainder are put aside for testing. The results are compared with Clinical practice (the reason for operative delivery recorded as fetal distress) and an earlier prototype system for computerized analysis of EFM (OxSys 1.5), developed on an equivalent data. This investigation demonstrates CNN outperforms LSTM, Clinical practice, and OxSys 1.5 in predicting fetal compromise, with a sensitivity of 42% (30%, 34%, and 36% for the others, respectively), at comparable or lower false- positive rates. This research work concludes that CNN could play a crucial role within the field of automated EFM analysis with necessary optimization techniques.

A. Petrozziello [15], introduce a Deep Learning approach as Multimodal Convolutional Neural Networks to detect fetal compromise during labor and delivery Proposing Multimodal Convolutional Neural Network (MCNN, was the best performing computerized strategy for the recognition of rope pH<7.05 accomplished to date. It outflanked existing electronic and clinical appraisal approaches when tried on inside and outer data. support a Recurrent MCNN, where the system is refreshed progressively (for instance, each moment) with new accessible data and the most recent accessible expectation; Developing progressive/stacked LSTM models, for instance, utilizing the MCNN chance evaluations at various occasions as information sources; Combining profound learning techniques with area explicit information as well as existing calculations that supplement each other to yield chance evaluation for various kinds of fetal trade off. Critically, our profound learning models are presently not appropriate for the recognition of serious fetal injury without rope acidemia – a heterogeneous, little, and ineffectively got gathering. This experiment concluded and recommend that half and half ways to deal with CTG translation in labor, in which distinctive symptomatic models can appraise the hazard for various kinds of fetal trade off, joining clinical information with data-driven examinations, are the most encouraging path forward.

2.4 DL Leading for Time-Series Forecasting Problems

In H. Qin [16] study, Comparison of Deep learning models on time series forecasting, it is as a case study of Dissolved Oxygen Prediction. Study tested of Convolutional Neural Network (CNN), Temporal Convolutional Network (TCN), Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU), Bidirectional Recurrent Neural Network (BiRNN). Though study is having limitations as quality of the raw data and a computational power for moving the window forward. Finally, Qin express that proposed work is a sound comparison of predicting dissolved oxygen between multi- step deep learning models that predict Dissolved Oxygen (DO) levels of the next five hours, given the data of the last five hours. As per the analyzed of the performance of each model through walk-forward validation. It was observed that 1) GRU has the best performance and CNN is the next performer while LSTM has the lowest performance; 2) The attenuation of predicting performance of each model is not linear. The prediction capability of all models falls dramatically after 2.5 hours and 4 hours. That reminds the have to paying attention to the time nodes to prevent possible risks caused by the predictions with suddenly increased error rate. M. Hiransha [17], NSE Stock Market Prediction Using Deep-Learning Models contending the current forecasting techniques which make utilization of both linear (AR,MA,ARIMA) and non-linear algorithms (ARCH, GARCH, Neural Networks), proposed arrangement fit for distinguishing some entomb connection with in the information.

Likewise, it is apparent from the outcomes that, CNN architecture can recognize the adjustments in patterns. For the proposed technique CNN is distinguished as the best model. It utilizes the information given at a moment for forecast. Despite the fact that the other two models are utilized in many other time subordinate information investigation, it isn't beating the CNN architecture for this situation. This is because of the unexpected changes that happens in financial exchanges. The progressions happening in the financial exchange may not generally be in a regular example or may not generally follow a similar cycle. In view of the organizations and the segments, the presence of the patterns and the time of their reality will contrast. The examination of these kind of patterns and cycles will give more benefit for the financial specialists.

3. METHODOLOGY

As the core methodology, proposed the Cross-Industry Process for Data Mining (CRISP-DM) [18] Methodology. It has phases (1) Problem Definition (2) Data Collection (3) Data Understanding (4) Data Preparation (5) Modeling As depicted in below figure,

proposed model created based on Deep learning-based ensemble architecture in machine learning paradigm. As mentioned in early chapters, system inputs will be the Cardio Topographic signal (CTG) which is composed with two signals Fetal Heart Rate (FHR) and Uterine Contraction (UC). Inside the model CTG signal will decompose into the FHR and UC at first then those two signals will be input to two Deep Neural Network models separately.

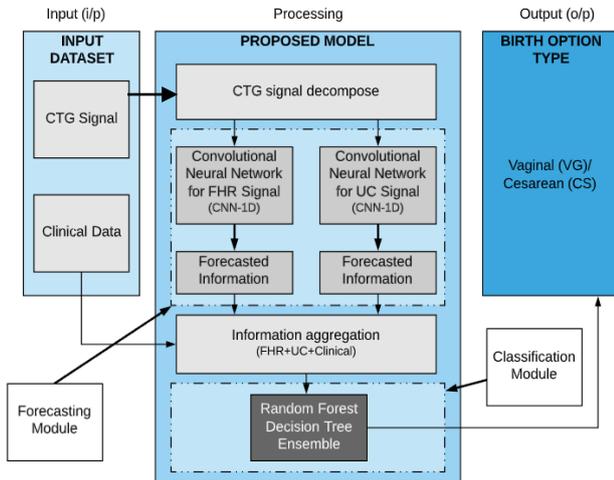


Figure 1. Detailed architecture of the proposed model

Deep Neural Networks functionate as, it generates seven forecasted points for a given number of signal sequence. For $FHR(N): \{FHR_1, FHR_2, \dots, FHR_N\}; N > 0$ and for $UC(M) = \{UC_1, UC_2, \dots, UC_M\}; M > 0$ Where M and N (row signal sequence length) is a pre-defined integer value. In this study $M, N = 7$, Then the generated 14 values aggregated with the clinical data of the patient. That aggregated information classified through an Ensemble model and predict the output (Birth Option Type). In the next topic will depict the deep information of each model. In the figure depicted CTG signal decompose into FHR and UC signal, each of these segregated signals use as inputs to a forecasting module. It is a time series forecasting of the recorded signal.

To perform the forecasting of each signal (FHR and UC), module contains two One Dimensional Convolutional Neural Networks (1D- CNN). As per the literatures [12] [19] [20] [14] [21], CNN is performing well with time series problems compare to the traditional RNN/LSTM and GRU models.

4. FINDING AND ANALYSIS

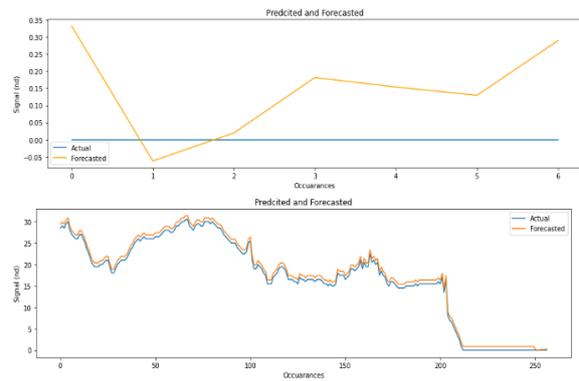


Figure 2. Predicted and forecasted UC signals

A confusion matrix [22] [23] [24](Error matrix) is an outline of forecast results on a classification problem. The quantity of right and misguided predictions is summarized with check regards and isolated by each class. This is often the route into the confusion matrix. The confusion matrix shows the way your classification model is frustrated when it makes predictions. It gives us understanding not simply into the blunders being made by a classifier yet more altogether the kinds of mistakes that are being made. The ROC [25] plot is a model-wide evaluation measure that is based on two basic evaluation measures – specificity and sensitivity. Specificity is a performance measure of the whole negative part of a dataset, whereas sensitivity is a performance measure of the whole positive part.

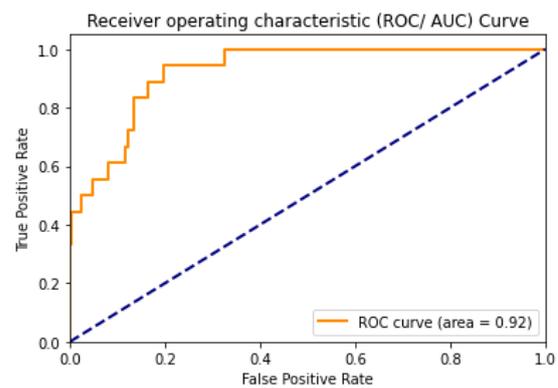


Figure 3. AUC/ ROC curve for ensemble model

The ROC plot uses $1 - \text{specificity}$ on the x-axis and sensitivity on the y-axis. False positive rate (FPR) is identical with $1 - \text{specificity}$, and true positive rate (TPR) is identical with sensitivity. As you can see proposed model scored 0.92 which is a considerable score.

Criteria	Value	Best Fit
Accuracy (ACC)	0.8763	(~1.0)
Error Rate (ERR)	0.1237	(~0.0)
Sensitivity (SN)	0.8300	(~1.0)
Specificity (SP)	0.9228	(~1.0)
Precision (PREC)	0.9151	(~1.0)
False Positive Rate (FPR)	0.0076	(~0.0)
Mathews Correlation Coefficient (MCC)	0.7559	(~1.0)
F-Measure		(~1.0)
F (0.5)	0.2176	(~1.0)
F (1.0)	0.4352	(~1.0)
F (2.0)	0.8705	(~1.0)
AUC/ ROC Curve	0.9200	(~1.0)

Table 4. Accuracy summary table for proposed model

As we so far discussed, forecasting model in this study is a Multi-Step Univariate developed using One Dimension Convolutional Neural Network (1D-CNN). It used the Walk- Forward validation technique and get scores for Mean RMSE and RMSE values for forecasted individual signal points. We can measure forecast accuracy by summarizing the forecast errors in different ways [26] [27]. Best value for Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE) is 0.0. Intermediate models, FHR and UC recorded in the range of 0 and 1. It means those models have considerable fit accuracy.

4.1 Hypothesis testing

In this section, objective is to assess those declared hypothesis using statistically proved approaches. For that I have used to techniques called p-Value test [28] which is consider the statistically significant with Pearson Correlation values to view how feature variables are correlated with the target variable. Statistically significant results for FHR signal as follows, as you can see forecasted both FHR and UC signal points have statistically significant difference as $P < 0.05$.

Null Hypothesis	Declaration	Status
H_0 : FHR → BOT	Forecasted FHR signals have No significant relationship with Birth Option Type (BOT)	Rejected (p-Value < 0.05)
H_0 : UC → BOT	Forecasted UC signals have No significant relationship with Birth Option Type	Rejected (p-Value < 0.05)
H_0 : Clinical → BOT	Clinical information has	Accepted (p-Value

	No significant relationship with Birth Option Type	> 0.05)
H_0 : CO ₂ → BOT	Carbon dioxide (CO ₂) level have No relationship with Birth Option Type	Accepted (p-Value > 0.05)
H_0 : pH → BOT	Umbilical cord artery pH has No relationship with Birth Option Type	Rejected (p-Value < 0.05)
H_0 : BDecf → BOT	Umbilical cord artery Base Deficit in extracellular fluid (BDecf) has No relationship with Birth Option Type	Rejected (p-Value < 0.05)
H_0 : BE → BOT	Base Excess (BE) has No relationship with Birth Option Type	Accepted (p-Value > 0.05)

Table 2. Hypothesis test summary

So, the Null Hypothesis related are rejected. Following are the declared Null hypothesis in Chapter 03: Research Question and Objectives. Now with the hypothesis test results, we can reject or accept the hypothesis declared.

4.2 Research outcome

5.DISSISSION AND CONCLUSION

Proposed Deep Learning Based Ensemble Model having the novelty compared to the other studies because of the forecasting CTG signal, aggregating with clinical obstetric risk factors and final prediction based on ensemble learning approach. The advantage is that proposed model monitoring both FHR and UC signal separately and do the forecasting functionality. Other hand for a human it is impossible to do the prediction and at the same time analyzing two sensitive signals is error prone. So, it is again proof of there is a gap in that context. Through the study models validated and evaluated by various model evaluation techniques like for classification model Confusion Matrix, AUC/ROC and for forecasting models. Further the aggregation of forecasted FHR and UC signals, hypothesis testing can confirm the statistically significant of the forecasted signals and the target value, Birth Option Type. It uses Pearson correlation and p- Value test for calculate the

statistically significant. Finally, proposed model scored considerable accuracy values. Accuracy evaluated against to sample data set of 20 records and model scored 0.90 accuracy which is significant value. Other than that with the train-test split data of 532 sample, model scored with Accuracy (ACC) = 0.8763 (~1.0), Error Rate (ERR) = 0.1237 (~0.0), Sensitivity (SN) = 0.83 (~1.0) Specificity (SP) = 0.9228 (~1.0), Precision (PREC) = 0.9151 (~1.0), False Positive Rate (FPR) = 0.0076 (~0.0), and for quality measurement Mathews Correlation Coefficient (MCC) = 0.7559 (~1.0) and F-Measure, F (2.0) = 0.8705 (~1.0) and ROC/ AUC gives 0.92 (~1.0) accuracy which is a significant value saying the model quality. For the forecasting models, accuracy tested with MAE, RMSE and shows considerable outcomes (<1.0).

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INTERNET OF THINGS ENABLED RECOGNITION BASED ATTENDANCE MANAGEMENT SYSTEM

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ABSTRACT- Attendance management is a very important task for each and every university or an institute. Most of the institutes do the attendance marking manually and it is time consuming. And also it may cause many errors. The purpose of the following research is to design and develop a new system using different technologies together with internet of things concepts. This system uses face recognition and radio frequency identification together to come up with a proper solution. The system is using an online MySQL database to store data required to the system. Python is used to program the system and Open CV is used for face recognition. One main finding of the research is identification of the student with different angles of face after getting the RFID tag value. When the face is recognized correctly, the system checks for the correct time slot for the class. After verifying both student and the time slot, system marks attendance and notification email is sent to the student so that student can know his or her attendance was marked successfully.

Keywords: Attendance management, Face recognition, IOT (Internet of things), Open CV, RFID

1. Introduction.

Managing attendance is a main role of every educational institute. The manual process of attendance management is very difficult, time consuming and error prone. Therefore, many people try to give many solutions to overcome this problem but still they are not able to find the exact solution. Some researchers propose getting attendance using finger print. But it is not practical for university students and places like that. The figure print scanner may difficult to identify finger print if the finger contains water, oil or dust. It is not practical to get finger prints when there is a large number of students. It may create long queues and waste time. Some use RFID technology [5]. Using just RFID technology is not much accurate because one student can bring a friend's RFID tap to represent that friend. In such case, the fake attendance will be marked. Another existing solution is marked attendance using face recognition. Face recognition is a good solution but there are some cases that it is difficult to identify the exact person. The appearance of students may change time to time. They may come up with different hair styles different beard styles. In such cases, the appearance of students may change. So using RFID and face recognition separately is not very accurate. If we use both of them together, then we can come up with a good accurate solution. Although previous researchers use these technologies they use them separately.

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conducted research titled “Attendance System Using Face Recognition and Class Monitoring System” [1]. This system takes the student attendance automatically using face recognition. The authors proposed a method to get the exact attendance using continues observation. This project used computer visual class library (OpenCV) to come up with face recognition [1]. The authors HemavatiSabu, Madhumala Sonawane, Jayashri Patil, Pradnya Vikhar published a research paper titled “Attendance System Based on Face Recognition” [2]. In this system the authors didn't use a special micro controller. Authors used a webcam to capture the images and used Eigen face recognition techniques to recognize faces of students. Viola and Jones face recognition algorithms are used for face recognition. The attendance of each student is marked to an attendance log and this system provides attendance details based on monthly basis and reminds the teachers about continuously absent students if any.

There was another research paper called “Using Real Time Computer Vision Algorithms in Automatic Attendance Management Systems” written by Visar Shehu and Agni Dika [3]. This paper introduces a new way of attendance management using real time face recognition algorithms. This is consisting with a supplemental tool for instructors to mark student's attendance using machine learning and adaptive method to track facial changes of the students by observing them in a long period of time. The system used a method called continues observation to observe students in a long period of time. This system integrates

computer vision and faces recognition algorithms into the process of attendance management. The system implements using a digital camera located in classroom according to the way that the camera can see the entire classroom at once. Then it will recognize the student faces according to the faces stored in the database.

Some researchers tried to give better solution by adding machine learning to face recognition. The research conducted under title “Automated Attendance System using Machine Learning Approach” by Hemantkumar Rathod, Yudhisthir Ware, Snehal Sane, Suresh Raulo, Vishal Pakhare and Imdad A. Rizvi is one example for such research [4]. This system was completely developed on MATLAB. The most steps of this research also same as taking attendance using face recognition. The researchers used eye recognition with the face recognition in this project and a popular computer vision feature descriptor called histogram oriented gradients (HOG) also used.

2. Methodology

This section will describe the methods which were used to achieve some features of the project. The main functionality of the project is to mark the attendance of students after checking his/her RFID card value and recognizing the face of the student. Raspberry pi board is used as the main controller of the project and python is used to program the system. One specialty of this project is, the system developed as a portable device. All the existing attendance management systems need to attach to a specific place and it cannot me move one place to another. The newly developed system has that capability and attendance information can be access through the internet.

The solution based on face recognition and Radio Frequency Identification technology. The system built according to the way that it can be implemented easily on any university or an institute in Sri Lanka. Figure 1 shows an overview of the system.

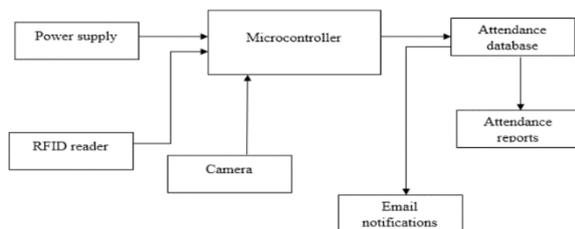


Figure 1. Overview of the system

The main idea is to locate the system near to the entrance of lecture hall or laboratory and first read

the identity RFID tags when students tap their RFID tag on RFID reader. The set of students to participate in the lecture or lab practical will be grouped before students starting to enter the lecture hall. Subjects and time slots that the student going to participate is stored on the database. When a student taps his/her student Id with RFID tag, system check whether the student is on the correct subject and on correct slot. If these details are matched, the system checks the face of a student. Then it ensures the correct student is a presence by checking student image with the saved image of that student. If all of these details are matching, it marks presence for that student on the database. At the same time, it sends notification email for that student. Figure 2 shows the flowchart for the designed system.

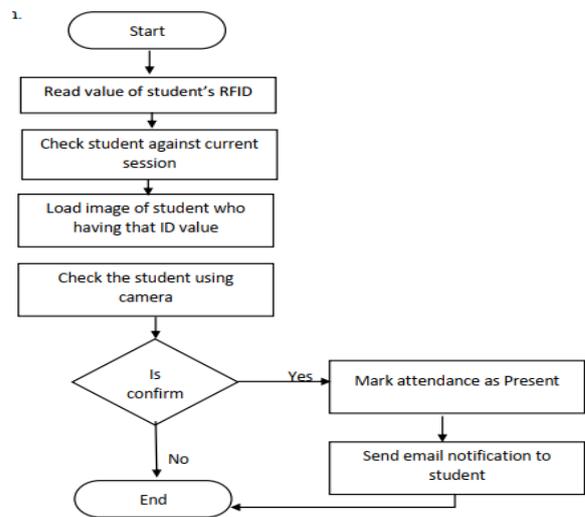


Figure 2. Flowchart for the System

As the first step, the courses and the subjects should be register on the system. Registering subjects is performed using a web site developed for the system. Database of the system was hosted and using that database, it was possible to explore the service globally. The system is an Internet of Things based system. So by hosting the database, many advantages and opportunities can be gain. The system was designed and developed in the way that courses can be registered using web site and reports also can be generated and viewed using that web site. Figure 3 shows the page to enter course details.

Add Course

Details



Figure 3. The page to enter course details.

After registering to the courses, students should register on the system. The student registering process is an integrated process of saving student information on the database, getting images of the student to train them and registering RFID tag for the student. The process starts when the script for registering students is running. At the beginning of the student registration process, the system asks for entering student first name, last name, e mail address and course code. The person who registering students can perform this task. After entering those details that information stored in the online database. It is required to have internet access at the registering process and it will get a small time to upload those data to the database.

When the record is created on the database, the auto generated student id is returned to the system. Then That ID used to identify student uniquely and then the system starts capturing images of the student. The camera turns on and system get 30 images of the student while the student is moving the face. These images are stored and used as data for the training process to recognize the student. After getting 30 images, the system asks to tap RFID tag to register tag for that student. When a tag is placed, system register that tags for the student and finishes registering that student. When one student registered, the system prompt to register another student. Likewise, it is possible to register multiple students continuously. After registering all students, the system should be trained to recognize students using face recognition. Figure 4. Further explain the process of student registration.

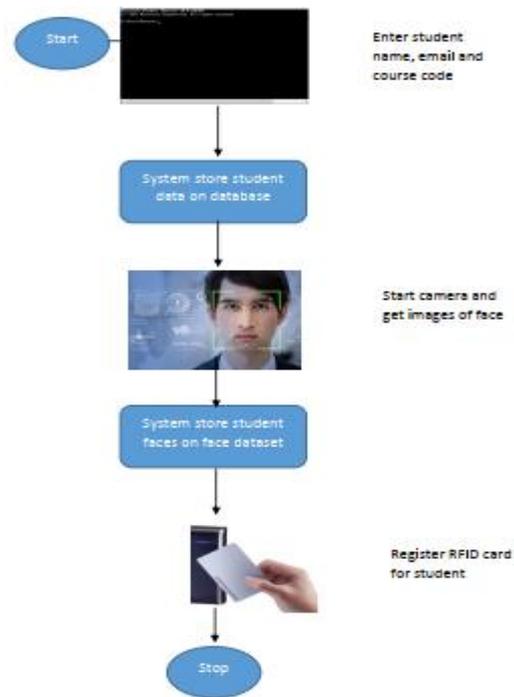


Figure 4. Student registration process

After completing all the registration tasks, the system can be used to mark attendance.

3. Results

The system register courses and subjects using the web application. The next step is registering students. In that process, system prompts and asks some information about students. The system will get First name and Last name of the student, email address and class code (Course code) of the student as shown in Figure 5.

```

pi@raspberrypi:~$ sudo su
root@raspberrypi:/home/pi# cd ~
root@raspberrypi:~# cd rfid_pi_attendance_system/
root@raspberrypi:~/rfid_pi_attendance_system# ls
02_face_training.py      read_extended.py      SimpleMFR0522.pyc
03_face_recognition.py  read_extended.py.save testdb.py
connectionTest.py       README.md             webcam.py
led.py                  Read.py               write_extended.py
MFR0522.py              Read.py.bak          Write.py
MFR0522.pyc             SimpleMFR0522.py     Write.py.bak
root@raspberrypi:~/rfid_pi_attendance_system# python write_extended.py
First Name      :Ravi
Last Name       :Swarnakantha
Email Address   :ravi.s@slit.lk
Class Code     :IT3010
Entering Data to the database....
    
```

Figure 5. Entering student details

After entering that student information to the database, the system starts camera to get captures of student's face. The system enables a video stream and student can look in front of the camera with different angles freely while system capturing images of student's face.

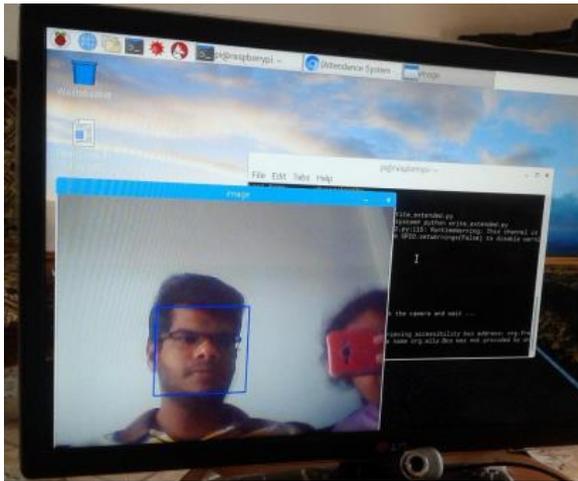


Figure 6. Capturing images of student

Then system stores captured images locally to identify students and ask for the place RFID tag to write. The system will complete that student's registration process after writing to the RFID tag.

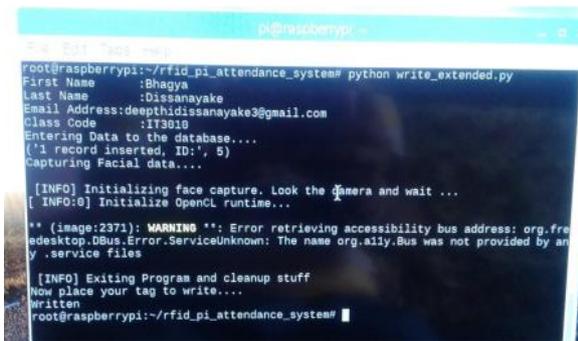


Figure 7. Completing student registration

After completing the registration process, system is ready to mark the attendance. When the attendance marking also finished, the attendance reports can view using the web application. The attendance confirmation notification also sends to the student's e mails.

View Student Attendance Data

✉ ravisupunya@gmail.com

👤 Object Oriented concepts

Get Details



Figure 8. View Student attendance reports

4. Conclusion and Future Recommendations

In this paper, we presented how IOT enabled recognition-based attendance management system designed and developed to reduce the issues and concerns on attendance marking process. Throughout the paper, we presented the overall architecture of the system and how it gains benefits to the attendance marking process. As future works, the developers can think of adding a storage device to the system which has more storage and synchronizes it with a cloud environment in order to give the ability to the system for work offline. Because the system has an online database, some can improve the system to track the student's location and behavior after he or she attended to the campus or institute.

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A NETWORK SCIENCE BASED APPROACH FOR ORCHESTRATING AND GOVERNING MICRO SERVICES DEPLOYMENTS IN CLOUD ENVIRONMENTS

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ABSTRACT— Container based microservices approach is a rising architectural style which revolutionizes software development in the present industrial world. It can decompose an application into loosely coupled, unified components without breaking the integrity of the software. By adopting to it, engineers can develop several lightweight, versatile and self-contained components in geographically disseminated servers. To support the deployment of the architectural style, Container-based virtualization and container orchestration technologies were developed. Microservices does not need a specific integration framework to deploy. The execution and deployment of microservices produces several networking problems as well. Solutions using technologies such as Network Function Virtualization (NFV) and Software Defined Networks (SDN) are used by the engineers for those network related areas. Microservices architecture is now emerging as a robust and efficient model of engineering enterprise level complex applications. Regardless of the usage of technologies related with the microservices architecture, it may be difficult to anticipate the resource usage of each service when the number of microservices deployed in the system, and when new business process workflows are continuously introduced. Currently local and rule based auto-scaling strategies are used to dynamically manage the quantity of microservice instances in a particular deployment. To optimally utilize the existing resources, it is necessary to have the global perspective of how each microservice is utilized. The purpose of this paper is to model a Microservices based system as a Self-organizing network which optimizes the resource utilization process by considering the holistic view of the system through application of some network analysis metrics.

Keywords: Centrality measures, Docker, Kubernetes, Microservices, Network Science, Orchestration

1. Introduction

Monolithic development of applications is the traditional way of developing software which contains a solitary independent unit. For an example, a client-server application is a monolithic entity that executes functions and communicate via HTTP requests. The main disadvantage of such system is the necessity to deploy the entire system even for a small adjustment of the code. Overcoming the above complications, the microservices architecture (MSA) introduced decomposing the single extensive application architecture into a collection of lightweight services and allowing them to communicate with each other utilizing low-cost APIs [1]. Currently some industry driving organizations like Netflix, Amazon, eBay, Twitter began to use MSAs to build their applications [2]. Scalability of the microservices architecture plays very vital role when engineering applications where people cannot completely limit features ahead of time. Lightweight design and simple component update and deployments system increases the

scalability of the architecture. Microservices architecture prompts a gigantic change in software industry towards DevOps and continuous development (CD) [3].

Microservices communicate using properly structured APIs and protocols and resides as standalone application subcomponents. Hence application engineers have freedom to use infrastructures as they desire. Regularly, JavaScript Object Notation (JSON), Extensible Messaging and Presence Protocol (XMPP) or Representational state transfer (REST) which utilizes HTTP and TCP protocols are used to expedite microservices communication. Nevertheless, still there is no institutionalized method to use for the microservice communication [4].

2. Related work

There was an approach done for the API Gateway System runs on Kubernetes to improve the utilization of system resources by considering the

quality and the availability of the containers [5]. But there the introduced workaround is not clearly described and used techniques to measure the quality and the utilization is not directly mentioned.

3. Architecture design

It is vital to deploy a pool of services with load balancing enabled, authentication and monitoring the requests passing each other for the study. Then need the integration of Istio control plane [6] functionality with a sidecar proxy service to deal with all communications happening between microservices as shown in figure 1. With this basic setup work as a set of interconnected services that facilitate automatic metrics, traces and logs for all the traffic in the network, including cluster egress and ingress.

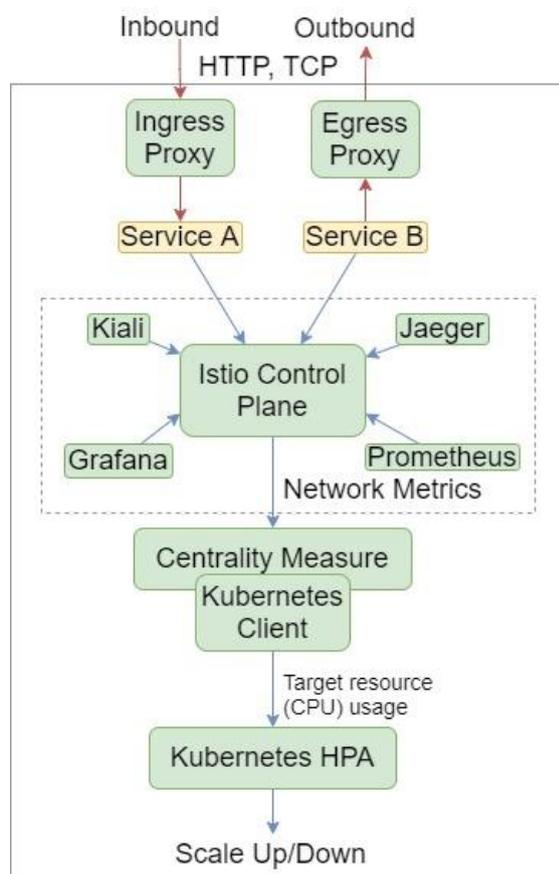


Figure 1. HPA: Horizontal Pod AutoScaler

4. Application

To produce such a co-dependency network, a testbed would be needed where a sizable number of various microservices (for example 50-100) are running where there may be co-dependencies among themselves. Further, the load on the testbed will have to vary over time to derive a dynamic co-dependency network. These services be deployed in

a cluster of hosts that is managed by Kubernetes. Once the real time co-dependency network is available, it may be possible to work on the application mentioned above.

For this study I used Docker as the container framework, Kubernetes as the Docker orchestration framework and deployed the cluster on Microsoft Azure. Additionally, Istio, Prometheus, Grafana, Jaeger and Kiali monitoring tools has integrated into the cluster to extract the metrics from the network. Microservices demo application that reproduces the client confronting some portion of a web-based business site that sells socks. It can be utilized to do testing, QA, client explore and to assess forms for conveying to different holder stages, like Amazon ECS, Kubernetes, Mesos and obviously Docker. It's an open-source and unreservedly accessible on GitHub for you to utilize [7].

The Sock Shop is assembled utilizing Node.js, Go kit and Spring Boot based microservices, MongoDB as a service database, RabbitMQ for the request line and it utilizes NGINX as an edge load balancer in certain configurations.

The AKS cluster runs Istio 1.5.4, released on May 13, 2020, alongside the latest available version of AKS (Kubernetes), client version 1.15.11-dispatcher and server version 1.15.10. I handle the logging with Azure Monitor logs. I retain the external MongoDB Atlas cluster and the external CloudAMQP cluster dependencies.

4.1 Azure setup

Created an Azure account using the Microsoft sponsored student subscription program. Expected to create three virtual machines from Standard_DS3_v2 VM type, but platform limitations allowed me only to create a single worker node using the Azure Standard_DS3_v2 VM type, which will give us a total of 4 vCPUs and 14 GB of memory [8]. Anything smaller and all the Pods may not be schedulable. Instead of supplying an existing SSH key, I let Azure create a new one. SSH is not directly setup into the worker nodes. I am also enabling the monitoring add-on. According to Azure, the add-on sets up Azure Monitor for containers, announced in December 2018, which monitors the performance of workloads deployed to Kubernetes environments hosted on AKS [9].

As there is no custom AKS dashboard. Therefore, Kubernetes Web UI (dashboard) is used, which is installed by default with AKS. According to Azure, to make full use of the dashboard, since the AKS cluster uses RBAC, a ClusterRoleBinding must be created before you can correctly access the dashboard. Then created a proxy tunnel on local port

8001 to the dashboard running on the AKS cluster. This CLI command creates a proxy between your local system and the Kubernetes API and opens your web browser to the Kubernetes dashboard.

The Kubernetes dashboard also provides access to raw container logs. Azure Monitor provides the ability to construct complex log queries, yet for quick troubleshooting, you may simply want to see the raw logs a specific container is outputting from the dashboard.

4.2 Azure portal

Logging into the Azure Portal allows the possibility to observe the AKS cluster, within the new Resource Group. In addition to the Azure Resource Group is created, there will be a second Resource Group created automatically during the creation of the AKS cluster. This group contains all the resources that compose the AKS cluster. These resources include the three worker node VM instances and their corresponding storage disks and NICs. The group also includes a network security group, route table, virtual network and an availability set.

4.3 Istio deployment

After modifying the Kubernetes resource files, we deployed Istio, using the official GitHub repo. Istio resources monitoring can be done using the Kubernetes dashboard running in the istio-system namespace. Guarantee that all resource Pods are running and healthy before deploying the Go-based microservices platform.

4.4 Kubernetes application

Deploy the Go-based microservices platform, using yaml deploy script. The app itself is comprised of various microservices written in Go (with GoKit), Java (with Spring Boot) and Node.js, which likewise utilize supporting services, for example, RabbitMQ, Mongo and Nginx. The entirety of the administrations run in independent Docker containers. Administrations impart utilizing REST over HTTP. It has been planned from the beginning with current microservice and cloud-local prescribed procedures at the top of the priority list. To put it plainly, it would appear to be an extraordinary candidate to shape the premise of a cloud-local reference app.

4.5 Load generation

Testing the Platform with everything deployed, test the platform is responding and generate HTTP traffic for the observability tools to record. Similar to last time, we picked locust [10], an easy-to-use, distributed, load testing tool and a commendable

replacement for JMeter and Tsung. Unlike JMeter, locust is not thread-bound and completely event based and along these lines it is conceivable to facilitate thousands of simultaneous users on a single machine. Underneath, locust directly ran on a Docker container. The tool is simulating 20 concurrent clients, generating a total of 1000 HTTP GET solicitations to the load balancer.

The tool accomplished with 98.89% success rate with all 1000 calls resulting in a HTTP 200 OK achievement status response code. Based on the outcomes, the platform seems to be capable of handling 4 requests per second approximately, with an average response time of 2.56 seconds and a mean time of 2.92 seconds. Almost all that time was the aftereffect of waiting for the response as the details indicate.

5. Data collection

The network consists of several different types of nodes. Every node in the system would be a specific kind of Microservice (for example Login, Account exchange, and so forth.) and the link weights could connote (in addition to other things) the strength of co-dependency among each pair of Microservices, measure by checking the number of requests exchanged within a unit measure of time.

As per the evaluation of the technologies the most recent open source one is Kiali. The need is to gather the request count going among the microservices and make available whenever as a dependency table upon request. What is more, it ought to have an API to get to the data from an application which needs to work for automating the scenario. So Kiali fulfills the entirety of the above necessities and is the reasonable pick. It is always better to be given the facility to coordinate third party oversight solutions into the system.

5.1 Data extraction methodology

First ran the Locust Docker script reproducing 20 clients on 10000 requests targeting the load balancer of the system. Following is the command utilized for the load generation.

```
Docker run --net=host weaveworksdemos/load-test  
-h localhost -r 10000 -c 20
```

Incoming traffic monitoring is done by utilizing Kiali dashboard and then navigating to the graph section. To get the inbound and outbound workloads the service received can be seen using request per second filter in show traffic menu item.

6. Testing plan

Utilizing the data extracted by actualizing above test condition we develop a dependency graph of the whole nodes exist in the system. At that point it is possible to use it in following potential app. Producing an auto-scaling policy (without thinking about the area of occurrence creation) in view of the global importance of a specific Microservice, estimated utilizing the centrality measures, (for example, degree, betweenness, and so on.) applied to the determined codependency network.

6.1 Test execution

I used NetworkX [11] python library to apply above centrality measures [12] upon the extracted data from the cluster. For this numpy [13], pandas [14] and matplotlib.pyplot libraries in addition to networkx. Used Colaboratory by Google for research purposes and Anaconda Navigator with Jupyter Notebook for the core developments of the metric analysis.

Extracted data from the microservices cluster are formatted in to an edgelist file. Every row of that file represents a relationship between two microservices plus the calculated number of requests made as a weight parameter. The edgelist file is converted to a graph using `read_weighted_edgelist()` function available on networkx. The graph contains 14 nodes and 1.5 edges. The basic graph is visualized in figure 2.

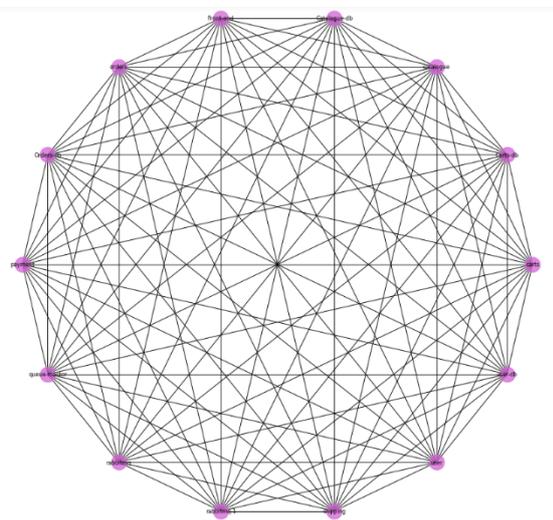


Figure 2. Microservices dependency representation from edgelist file.

By analyzing above visualization, we can clearly identify the existing relationships among the microservices in the network. By tweaking the code, we can straight away extract the nodes having higher relationships by extracting the nodes having more than 1 requests per second. Please see figure 3.

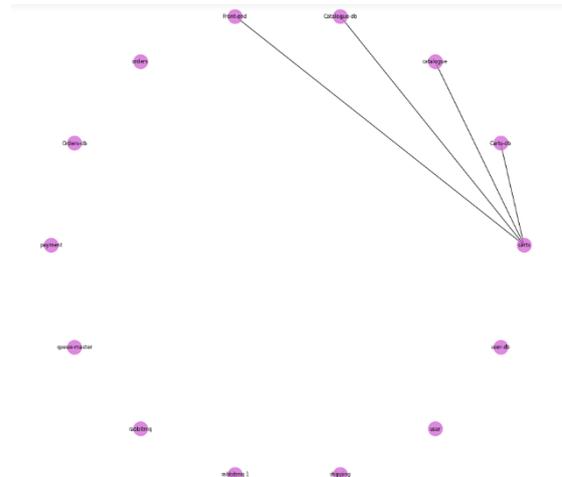


Figure 3. Nodes having more than one requests per second.

If we further drill down into the drawings, can extract what needs to be omitted from the relationship structure.

But this is not acceptable since our aim is to identify the strength of the dependencies among microservices. For that calculated the betweenness centrality using `betweenness_centrality()` function supported by networkx.

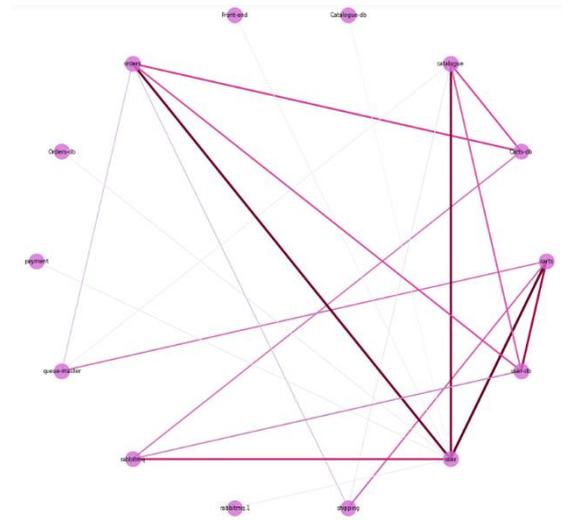


Figure 4. Nodes having lesser number of requests.

6.2 Application of betweenness centrality

This metric revolves around the idea of counting the number of times a node acts as a bridge. A bridge in a social network is someone who connects two different social groups. This allows for the dissemination of information between two social groups to occur [15].

For each node (v) in the network, do the following for each pair of nodes (s, t) where (s) and (t) is not (v),

- Compute the number of shortest paths where the two nodes (s, t) are the ends.
- Out of all those paths, figure out how many of those shortest paths have (v) in them.
- Compute the fraction of (step 2 / step 1).
- Sum all these fractions up across all the pairs of nodes.

Intuition: A high value for a node indicates that it is situated in the middle of a number (higher amount) of shortest paths.

For the process the data in ecgelist format is passed to the `read_weighted_edgelist()` function and create a graph. Using the graph I executed the `betweenness_centrality()` function with `weight` parameter and `normalized` parameter set to `false`. After the execution the results depicted as below

```
[('user', {'bc': 76.0}),  
(('carts', {'bc': 73.0}),  
(('orders', {'bc': 63.0}),  
(('user-db', {'bc': 61.0}),  
(('Carts-db', {'bc': 55.0}),  
(('catalogue', {'bc': 50.0}),  
(('shipping', {'bc': 12.0}),  
(('rabbitmq', {'bc': 11.5}),  
(('queue-master', {'bc': 4.0}),  
(('Catalogue-db', {'bc': 0.0}),  
(('Front-end', {'bc': 0.0}),  
(('Orders-db', {'bc': 0.0}),  
(('payment', {'bc': 0.0}),  
(('rabbitmq.1', {'bc': 0.0})]
```

6.3 Application of closeness centrality

This metric involves computing the shortest path between a node and all the other nodes in the network. Closeness centrality of a node is just the average of all those shortest paths. This can also be computed using the previously mentioned adjacency matrix [15]. See this post if curious.

An interpretation of this metric, Centralness.

The result is.

```
[('carts', {'cc': 1.0}),  
(('Cartsdb', {'cc': 1.0}),  
(('catalogue', {'cc': 1.0}),  
(('Cataloguedb', {'cc': 1.0}),  
(('Frontend', {'cc': 1.0}),  
(('orders', {'cc': 1.0}),  
(('Ordersdb', {'cc': 1.0}),  
(('payment', {'cc': 1.0}),  
(('queuemaster', {'cc': 1.0}),  
(('rabbitmq', {'cc': 1.0}),  
(('rabbitmq.1', {'cc': 1.0}),  
(('shipping', {'cc': 1.0}),  
(('user', {'cc': 1.0}),  
(('userdb', {'cc': 1.0})]
```

So, the centrality metric is the same for all pods in the network.

6.4 Experiment of finding the strength of correlations

Utilizing a dataset with the loads of number of requests passed after some time, the m correlation matrix that would picture with networkx.

Begun by stacking the dataset and making the relating correlation matrix with. corr() .

```
cor_matrix = services.iloc[:,1:].corr()
```

Secondly stored the stocks names, which may help to name the nodes in the graph and convert the data frame to a matrix, therefore it is easier to create a graph in networkx.

```
services = cor_matrix.index.values
```

```
cor_matrix = np.asmatrix(cor_matrix)
```

Then made a graph dependent on the correlation matrix list(G.edges(data=True)) will show all the edges with their relating loads. Sample data set is shown in table 1.

Service A	Service B	Weight
carts	Carts-db	-0.822061943
catalogue	shipping	0.122189516
Catalogue-db	Front-end	0.9065634768
Front-end	orders	0.881807936
payment	user	0.0979315472

Table 5. Weights of correlated data.

Isolating among negative and positive correlations. Presently, made a duplicate from the graph G called H. In H, erased all the edges that are negative if necessary to imagine every positive relationship and the other way around for negative correlations. Figure 5 and figure 6 shows the positive and negative relationships respectively.

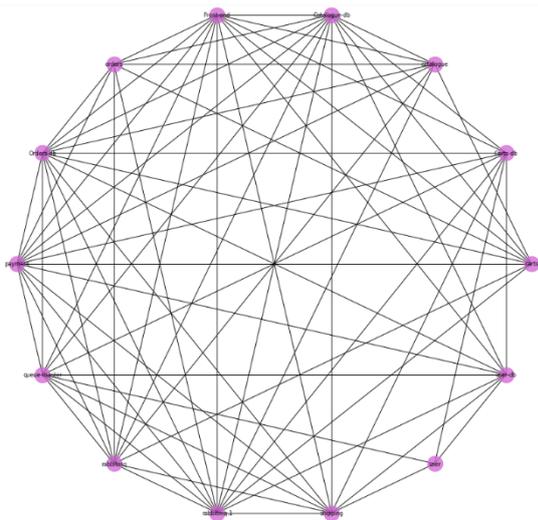
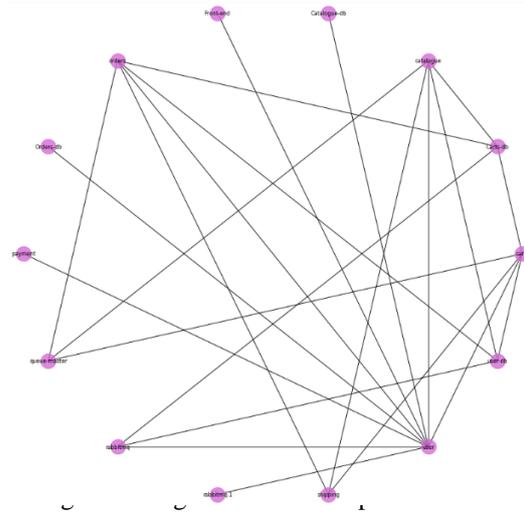


Figure 5. Positive relationships on the cluster.



Applying the weight measurement to the positive and negative correlations graphs are shown in figure 7 and figure 8 respectively.

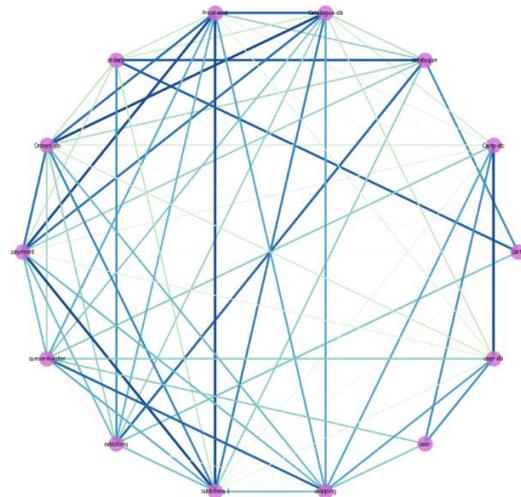


Figure 7. Positive correlations based on their weights.

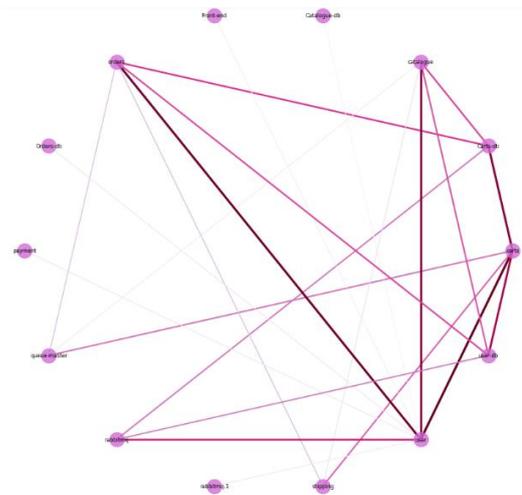


Figure 8. Negative correlations based on their weights.

Finally find the nodes dependent on what number of edges it is connected to (represents the connectivity of the network).

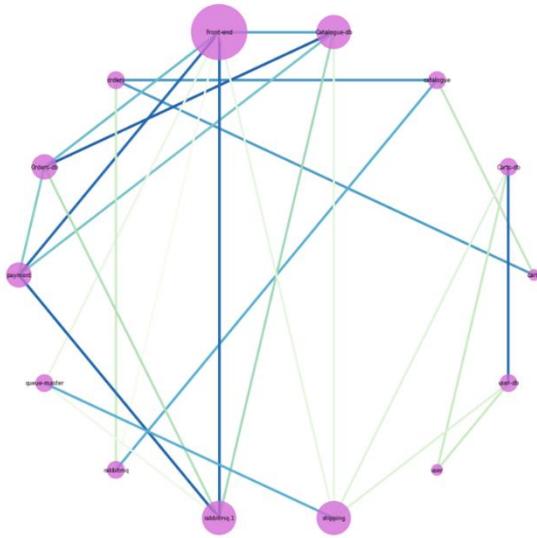


Figure 9. Highly connected nodes in the network.

Now we can clearly identify the most dependent nodes are front-end, Catalogue-db, rabbitmq_1 and shipping.

The least correlated nodes can be found as follows:

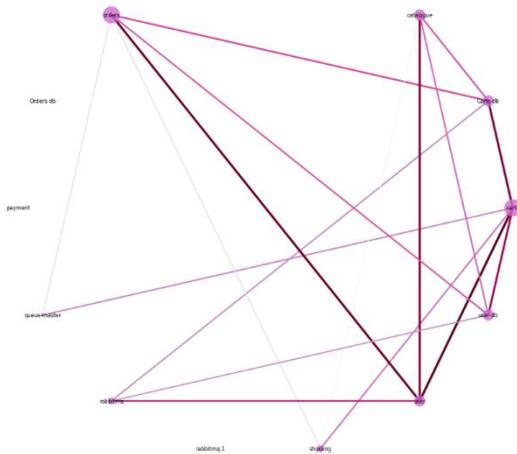


Figure 10. Least connected nodes in the network

So, the least correlated nodes are orders, carts, user and user-db. This is a real example of how the traffic flows on an e-commerce system.

6.5 New study

We have applied two centrality measures on the data extracted from the cluster and used correlation between nodes and the number of requests to extract the dependency table. Apart from that, there is another techniques proved to be more accurate in a

study [16], This paper was motivated by the need for centrality measures to incorporate both the number of ties and their tie weights when applied to weighted networks and to allow researchers to define the relative importance they want to give to each of these two aspects. This is very interesting method they have created by combining closeness and betweenness centrality techniques. It is worth to give it a try and see the accuracy of the outcome.

7. Future work

Utilizing microservices dependency data there is a significant chance of applying the outcome with kubernetes auto scaling system in the following methodologies.

- Horizontal Pod Autoscaler (HPA) [17]

The app will provide the necessary information and will help when taking decisions of which nodes needs to scale up in the network.

- Vertical Pods Autoscaler (VPA) [18]

With the dependency information the system provides, app provides the necessary information to take decisions of which nodes needs to scale up in the network.

- Cluster Autoscaler (CA) [19]

As the system provides metrics of the holistic view of the network, the decision would be more useful when working as a unit for cluster autoscaler.

8. Conclusion

Microservices architecture is now has becoming a robust and efficient model of engineering enterprise level complex applications. Existing literature explained above states the present service deploying tools like Kubernetes not really consider about that they just deploy services in the cluster. While this modular structure is what makes the microservices scalable, the downside is that there is no guarantee that interconnected services are deployed in same node or nearby nodes. The purpose of this work is to explore the possibility of modeling a microservices based system as a Self-organizing network. Network Science is a field of study that attempts to model complex self-organizing systems as abstract networks. Since microservices dependencies too evolve over time without a rigid centralized control, there can be a possibility to apply the concepts and techniques used in network science to address some of the open issues in microservices orchestration and governance.

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PRELIMINARY *IN – VITRO* STUDY OF ANTIMICROBIAL ACTIVITY OF TRADITIONAL MOUTHWASH PREPARATIONS

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ABSTRACT

Antimicrobial agents administered systemically or locally can help suppress periodontal pathogens. In *Siddha* Medicine *Padikkaraneer* (PN), *Pancha thuvarpi kasayam*(PT) and *Mayakaai neer*(MN) have been used as a mouth wash as a general treatment for oral diseases . In this study, the herbal mouthwash preparations (HMP) were tested for its anti-microbial activity (AMA) against oral ulcer causing pathogens viz, *Candida albicans*(Fungus), *Escherichia coli*, *Pseudomonas aeruginosa* (Gram-negative) and *Staphylococcus aureus* (Gram-positive). Recommended guidelines in the *Siddha* texts were used to prepare mouthwashes. AMA of each HMP were checked using agar well diffusion method. Each experiment were done in duplicate and repeated thrice. The significance of differences among HMP were analyzed using mean values and one- way ANOVA. The model is significant (p<0.001), adequate (R square=0.994), interaction is significant (p<0.001) (HMP act differently in different organisms). It was observed that PN was the most effective between the three HMP and positive control tested. It showed a zone of inhibition (ZOI) against tested. MN showed a ZOI against *E.coli*, *P.aeruginosa*, and *S.aureus*. Whereas there was no activity against fungi. PT was found to less effective against both gram +ve, gram-ve bacteria and fungi. Study showed potent *in-vitro* activity of a HMP oral ulcer causing pathogens.

Keywords: Anti-microbial activity, Oral ulcer, PT, PN, MN

Introduction

The oral cavity is inhabited by a diverse micro flora that may include bacteria, fungi, mycoplasma, protozoa and possibly viral flora of which bacteria are the predominant group (Patil S *et al*, 2013). Aphthous stomatitis is a chronic inflammation of the oral mucosa characterized by recurrent ulcerations that affect primarily the non-keratinized mucosa. It is one of the most common oral mucosal disorders, with a prevalence of approximately 2%, although geographical variations in prevalence have been identified (Jurge S *et al*, 2006). *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *E. coli* are involved causing oral ulcers (Marchini L *et al*, 2007). Antimicrobial agents administered systemically or locally can help suppress periodontal pathogens in periodontal sites and in the entire mouth (Slots J, 2003). Effective plants used in the traditional treatment of oral ulcers were found. Some of traditional pharmacological effects of plants and how these plants can be a source for a cure (Shokouhsadat Hamedi *et al*, 2016). In Sri Lanka. The age onset of minor aphthae can start as early as 5 years old whereas major aphthae generally starts after 20 years. (Sunethra R, 2014).In *Siddha* system, *Vaairogangal* related to Oral diseases. Further *Vaairopungal* referred to oral ulcers and is being treated with *Padikkaraneer*(PN) (Sowrirasan M, 2007), *Pancha*

thuvarpi kasayam(PT) (Noinaadal sikitsai Part 1), and *Masikkai neer*(MN) (Kumutharanjan T, 2001), In *Siddha* Medicine *Vaairogangal* diseases (Oral) are classified in to 75 diseases entities .

In *Siddha* Medicine PN, PT and MN have been used as a mouth wash as a general treatment for oral diseases and may have activity against oral pathogens. The ingredients of PN are as follows, *Padikaram / seenakaaram* (*Potassium aluminum sulphate*) and *Kadukkaithol* (*Terminalia chebula*.Retz). There are no known studies evaluating its effects of PN, PT and MN, oral ulcers causing pathogens. The aim is to demonstrate *in-vitro* antimicrobial activity of the herbal mouthwashes such as PN,PT and MN to recover some oral ulcers causing pathogens. (*Candida albicans*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*).

Materials and Methods

Preparation of Padikaaraneer (P.N): 25g of *Potassium aluminum sulphate* salt and 5g of powdered *Terminalia chebula* Retz were mixed with 480ml distilled water. Reduced the volume to 60ml (Sowrirasan M, 2007) .PN was filtered with sterile cotton wool and filter paper. Kept in room

temperature to cool and labeled as *P.N*. Stored in to refrigerator.

Preparation of *Pancha thuvarpi kasayam (PT)*: Each 6g of powered barks *Fiscus bengalensis*, *Fiscus religiosa*, *Fiscus carica*, *Fiscus virens* and *Syzygium cumini* were boiled with 480ml of distilled water. Reduced the volume to 60ml. (Kuppusamy Muthaliyar K N *et al.*, 2016), (Kuppusamy Muthaliyar K N, 2004). Mouthwash sample 2 was filtered with sterile cotton wool and filter paper. Kept in room temperature to cool and labeled as *P.T*. Stored in to refrigerator.

Preparation of *Maasikkaai neer (MN)*: 25g of powered *Quercus infectoria* gall was boiled with 400ml of distilled water. Reduced the volume to 50ml (Kuppusamy Muthaliyar K N *et al.*, 2016), (Kuppusamy Muthaliyar K N, 2004). Sample 3 was filtered with sterile cotton wool and filter paper. Kept in room temperature to cool and labeled as *M.N*. Stored in to refrigerator.

Organisms selected for the study: The following cultures were obtained from culture collection of Division of Microbiology, Faculty of Dental Sciences, University of Peradeniya. *Escherichia coli* (NTCC 10418) and 30 clinical isolates representing each standard organisms were included in the study. The strains were sub-cultured on an appropriate agar plate 24 h prior to every antimicrobial test.

Screening for antibacterial activity:

ABA of each herbal preparation was checked using agar well diffusion method. Fresh bacterial cultures were used to prepare suspensions of McFarland turbidity 0.5 and 3 ml of each suspension was inoculated onto Muller-Hinton agar (MHA). The inoculated plates were swirled evenly to distribute the organisms and excess broth removed using a sterile pipette. Then, 9mm diameter wells were cut using a sterile corkborer in the agar and the bottom of each well was sealed with melter MHA. Finally, 180 µL of each sterilized three herbal preparations was loaded into the well. Commercial control Gentamicin will use as positive control for *Escherichia coli*. Plates were incubated at 37 °C for 24 h. The diameter of the Zone Of Inhibition (ZOI) was measured (Olila *et al.*, 2001) (Gabriela Ulloa-Urizar *et al.*, 2015). Each experiment will be done in duplicate and repeated thrice.

Statistical analysis: The significance of differences among herbal preparations will analyze using mean values and one- way ANOVA (analysis of variance). All the data will process using MINITAB® release 14 statistical software. The difference will consider significant when $p < 0.05$.

Results

Evaluation of suitable sterilization method of prepared herbal mouth washes by measuring ZOI

Marginal Means of zone of diameter between standard organisms.

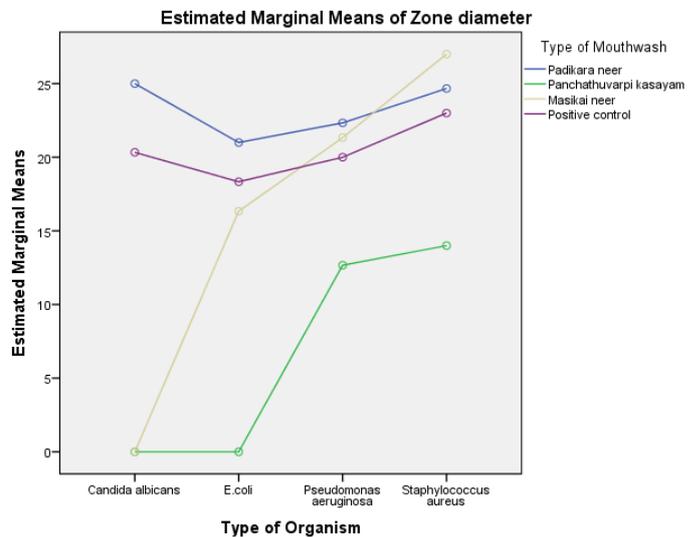


Figure 1: Comparison of Mouthwashes Estimated Marginal Means of zone of diameter between standard organisms.

Univariate ANOVA used. The model is significant ($p < 0.001$), adequate ($R^2 = 0.994$), interaction is significant ($p < 0.001$) (Mouthwashes act differently in different standard organisms). In *Candida*, the *Padikara neer* showed significantly larger zone. In *E.coli*, *Padikara neer* showed significant larger zone. In *Pseudomonas*, *Padikara neer* showed significant larger zone. In *Staphylococcus*, *Masikai neer* showed significant larger zone.

Estimated Marginal Means of zone of diameter between *Staphylococcus aureus*

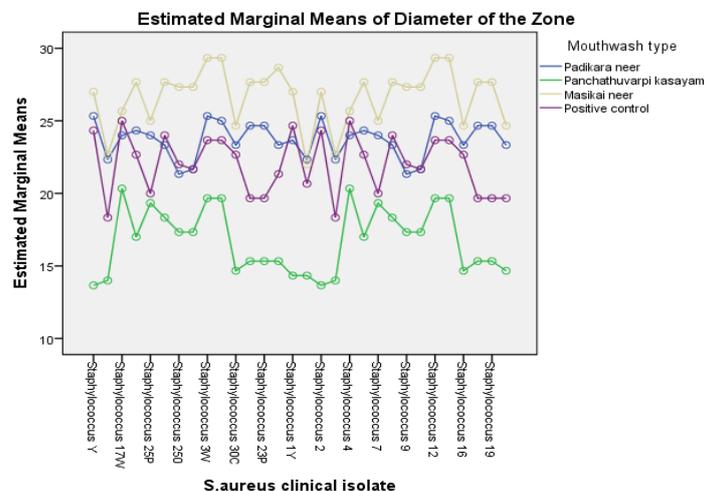


Figure 2: Comparison of Mouthwashes Estimated Marginal Means of zone of diameter between *Staphylococcus aureus*

Univariate ANOVA was used to analyze the model ("Staphylococcus aureus isolate types - mouthwash type" interaction term included). The model is significant ($p < 0.001$) and adequate ($R^2 = 0.968$). The interaction is significant ($p < 0.001$, Different mouthwashes act differently in different isolates. *Masikai neer* shows larger zones than positive control except in 17W, 30C, 18P, 4, & 16. *Padikara neer* shows larger zone than positive control only in 260, 25P, 140Y, 23P, 3, 7, 17, 19 & 20. *Panchathuvarpi kasayam* always show smaller zones than control except in 25P & 7. Overall *Masikai neer* show larger zones.

Marginal Means of zone of diameter between *Pseudomonas aeruginosa*

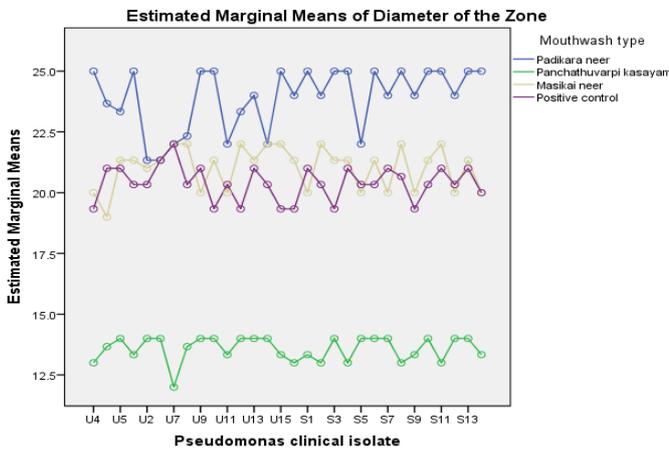


Figure 3: Comparison of Mouthwashes Estimated Marginal Means of zone of diameter between *Pseudomonas aeruginosa*

Univariate ANOVA was used to analyze the model ("Pseudomonas aeruginosa isolate types - mouthwash type" interaction term included). The model is significant ($p < 0.001$) and adequate ($R^2 = 0.968$). The interaction is significant ($p < 0.001$, Different mouthwashes act differently in different isolates. *Padikara neer* showed larger zones than positive control, except U5, U2, U6, U7, U8, U11, U14 & S5. *Masikai neer* showed larger zone than positive control only in U15. *Panchathuvarpi kasayam* always showed much smaller zone than positive control. Overall, ZOI of *Padikara neer* are larger than others.

Marginal Means of zone of diameter between *E.coli*

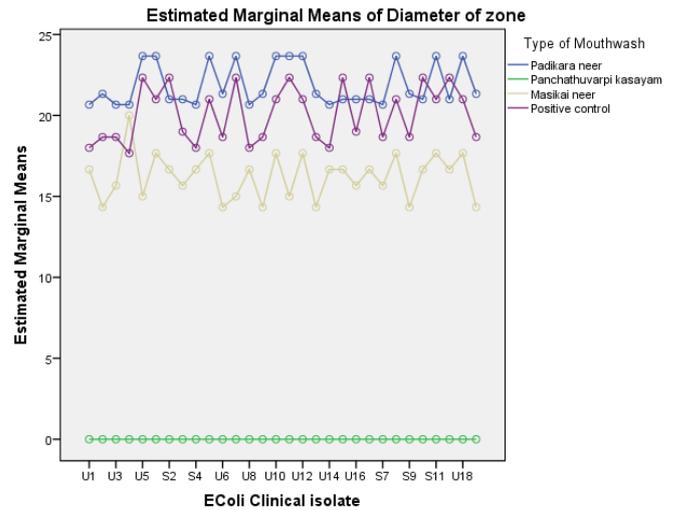


Figure 4: Comparison of Mouthwashes Estimated Marginal Means of zone of diameter between *E.coli*

Univariate ANOVA was used to analyze the model ("EColi isolate types - mouthwash type" interaction term included). The model was significant ($p < 0.001$) and adequate ($R^2 = 0.994$). The interaction between EColi isolates and mouthwash type was significant ($p < 0.001$). *Panchathuvarpi kasayam* did not show any zones. *Masikai neer* showed larger zone than control only in U4, for other isolates it was smaller. *Padikara neer* showed larger zones than control for majority of isolates except for S2, U7, U11, U15, S6, S10 & U17.

Marginal Means of zone of diameter between *Candida albicans*

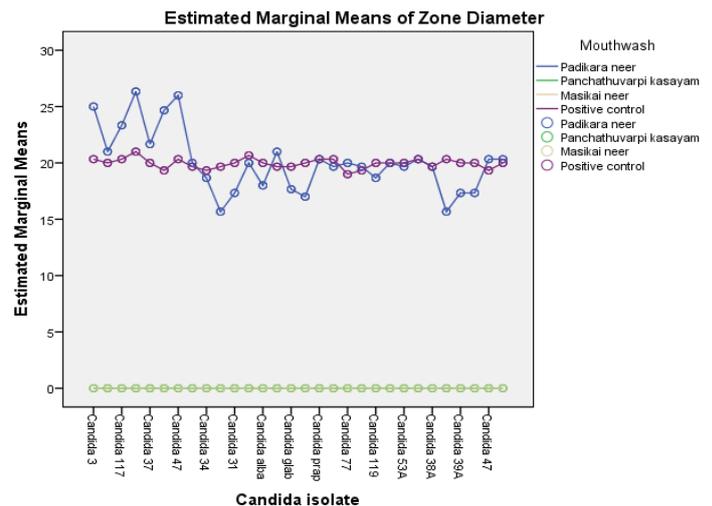


Figure 5: Comparison of Mouthwashes Estimated Marginal Means of zone of diameter between *Candida albicans*

Univariate ANOVA was used to analyze the model ("Candida albicans isolate types - mouthwash type" interaction term included). The model was significant ($p < 0.001$), adequate (R square=0.997). There was a significant interaction between Mouthwash types and Candida isolate types ($p < 0.001$). Panchathuvarpi kasayam and Masikai neer did not show any zones. Padikara neer showed larger zone diameter than the positive control in only Candida 3, 117, 114, 37, 39, & 47.

Conclusion

The result showed potential antibacterial effects of Padikaara neer P.N against all gram-negative (*Escherichia coli*, *Pseudomonas aeruginosa*), gram-positive (*Staphylococcus aureus*) bacteria and fungus (*Candida albicans*) tested, whereas Padikara neer (PN) was effective on all gram-negative (*Escherichia coli*, *Pseudomonas aeruginosa*), gram-positive (*Staphylococcus aureus*) bacteria and fungus (*Candida albicans*). Masikkai neer (MN) exhibited anti-microbial activity against *Pseudomonas aeruginosa* and *Staphylococcus aureus* than positive controls. Panchathuvarpi kasayam (PT) less effective on *Staphylococcus aureus*, *Pseudomonas aeruginosa*. Only Padikaaraneer (PN) was exhibited antifungal activity against *Candida albicans*. Moreover, other parts of the plants need to be studied to evaluate the studied plant extracts as potential antimicrobial agent. Further investigations are necessary to evaluate antimycobacterial, antiviral, and antiparasitic activity.

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OPPORTUNITIES AND CHALLENGES OF SECURITY SECTOR REFORMS IN THE POST CONFLICT CONTEXT

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Abstract

The United Nations have a pessimistic view of Security Sector Reforms (SSR) as a process of assessment, review, and monitoring and evaluation accountability in the post conflict settings. The principle objective of this research is to examine what are the significant opportunities and challenges of SSR and how SSR strengthen to avoid shortcomings in the post conflict context. This research is mainly based on the interpretive research approach. The interpretive approach covers various knowledge about the existing phenomena via understanding. By exploring a wide range of literature on the SSR, investigated that different case studies, strategic management and failures of its practices. The research findings indicate that SSR, it is generally accepted that defence, law enforcement, corrections, intelligence services, institutions, customs and civil emergencies are responsible for border management under security sector. Moreover, the study shows the SSR has a possibility to build a more coherent framework to reducing risk and make a mutual understanding with the government and rebel groups. It is clear that, Security institutions can play an effective role when address legitimacy, democracy and accountability in the post conflict settings. Although, the UNO has a pessimistic view of SSR; nevertheless some scholars argued that implementing challenges of the SSR. The challenges are; mismatch between norms, local practices, lack of coherent strategy and insufficient knowledge to bring changes. Moreover, SSR focus on short-term reforms rather than the long term strategies. In addition to that, some scholars criticized that SSR policy and practices have not effectively supported women's participation in high-level security sector decision-making processes. In fact, lack of respects and protect human rights and low consideration of accountability are prominent challenges in implementing a human rights approach to SSR. Although, the material reconstructions in the post conflict period are important, however, it is not sufficient to create a mutual understanding with each other. The SSR is prominent to build a trustworthy environment between security forces and warring parties before going to the stable solutions in the post conflict settings.

Keywords: *SSR, Opportunities Challenges, Post-Conflict*

Introduction

The principal objective of this research paper is to investigate how the SSR concept can apply to mitigate the burning crisis in post-conflict states. Subsequently, this paper examines what are the challenges of SSR practices and what are the possibilities to avoid its challenges. The concept of SSR is considered for rebuilding post-conflict states since the 1990s. The UNDP report published in 2002, its fourth chapter highly emphasized democratizing security to prevent conflict and build peace (UNDP Report, 2002). Subsequently, in 2007, the Secretary-General established an Inter-Agency **SSR Task Force** and co-chaired by **DPKO UNDP**, with representation from 14 UN entities (United Nations and the Rule of the Law, 2019). SSR is defined by the European Union as follows; "Security sector reform (SSR) is the process of transforming a country's security system so that it gradually provides individuals and the state with

more effective and accountable security in a manner consistent with respect for human rights, democracy, the rule of law and the principles of good governance"(Leboeuf,2017).By and large, there are numerous definitions of SSR, and most SSR definitions are mainly addressed conflict prevention, peace-building activities, democratic governance, and respect for human rights, human security, and dignity. According to the UN perspective of SSR, it is generally accepted the security sector includes defence, law enforcement, corrections, and intelligence services and institutions responsible for border management, customs, and civil emergencies. SSR paper 01, published by Netherlands Institute of International Relations 'Clingendael'(2002) they highlighted that "the transformation of security institutions so that they play an effective, legitimate and democratically accountable role in providing external and internal security for their citizens"(Occasional SSR Paper No. 1,2002). It is clear that at present SSR developed linkages with security and

development. Not only that, SSR redefine its role in the field of security and the SSR considering the establishment of sustainable peace and development. (DCAF). SSR is a political as much as a technical process. The process requires the mobilization of a wide range of actors, donors, countries governments and people (Leboeuf, 2017). In other words, SSR needs long term commitment for both external and local actors, with real financial commitment and significant risk-taking. (Leboeuf, 2017).

Method and Materials

The interpretative analysis is one of the main qualitative research disciplines and it provides the facility to understand the hidden reasons behind the complex. Moreover, interpretive research is shaped by human experiences and social contexts. In addition to that, interpretative research shows reality through a “sense-making” process rather than a hypothesis testing process (Bhattacharjee, 2012). This research applied interpretive research methods to data findings and data analysis. The main research problem of this research is to examine why the SSR approach is important in the post-conflict period and identify its opportunities and challenges. It is clear that a number of the post-conflict states used SSR principles to wipe out some barriers from the context. This research considered the SSR practices, human experiences and satisfactions of SSR. The research encompasses complex and contradictory applications of SSR and people or country satisfaction and grievances. Thus, to find social reality and description of the lived experience of human beings, the interpretative research approach was applied for data collection and analysis. The research mainly depends on secondary data collected by the UNO reports, EU reports, country reports, case studies, books, journals and websites. Most of the collected data is descriptive and data have analyzed according to viewing or experiencing the different post-conflict contexts.

Results

Indeed the EU has been taken a tremendous effort to develop an effective SSR strategy concentrating on current security challenges in the post-conflict settings. The SSR as a process is not apart from the political interests. The EU defined principles of SSR mainly pointed out that commitment to democratic practices, the importance of long-term and holistic approaches tailored to particular beneficiaries’ needs and an emphasis on donor coordination (Helly,, 2006).

The Intergovernmental Approaches to SSR Report identifies the EU ‘potentials for SSR policies implementation (Ozkanca& Vandemoortele, 2012). The European Security and Defence Policy (ESDP)

in 2005 further supported to fulfil of the EU SSR targeted objectives (Ozkanca& Vandemoortele, 2012). Subsequently, in 2007 the European Commission's Instrument for Pre-Accession assists for political reform, particularly institution building, strengthening the rule of law, human rights, protection of minorities, and the development of civil society in countries engaged in the EU accession process (Ozkanca & Vandemoortele, 2012). The EU missions can be seen in Bosnia, Herzegovina, Macedonia, Kosovo, Afghanistan, Herzegovina, and Turkey

As some scholars argued that “Security sector reform, democratization and constitutional reform are intrinsically linked.” (Bisarya & Choudhry, 2020). The constitution changing process is one of the political settlement as well as it helps to reestablish democracy. Moreover, the constitution-building process shows a path towards making a critical forum for negotiations over changes in the relationship between civilian and security sector institutions (Bisarya & Choudhry, 2020). It is important to look at how the constitution changing process and SSR functioning concurrently. Sumit Bisarya and Sujit Choudhry (2020) study “Security Sector Reform in Constitutional Transitions” discussed objectives and characteristics that are relevant to the interdependency constitution changing process and SSR. According to them, the concurrent process should include; inclusive processes of arguing and bargaining, constraining power through the organization and separation of roles and responsibilities, democratic accountability, inclusive ownership of the state, big bang or incremental reform and State effectiveness (Bisarya&Choudhry,2020). Although some scholars had an optimistic view of SSR and constitutional transitions practically it is a dilemma. Kenya is one of the example countries at the same time addressing SSR and constitutional transition. Kenya is an African country inherited by a host of violent conflicts. In 2002 Kenyan presidential and parliamentary elections changed the 24-year rule of Daniel Arap Moi period and the new government of Mwai Kibaki of the National Rainbow Coalition (NARC) The new government invited several social. Political and economic reforms. Kenya to practice SSR accepted US military assistance incorporates counter-terrorism strategies in the country’s defence doctrine (Security Sector Reform in Kenya,2005). US military assistance included International Military Education and Training (IMET) programme and Foreign Military Financing (FMF) funding, which also seek to strengthen Kenya’s border and coastal security as well as its peacekeeping capacity. Moreover, after 2006 FMF funds will be used to procure various military equipment such as patrol crafts, radar systems, communication devices and weapons. Concurrently, the new government faxable

to rewrite a new constitution on behalf of their 1963 constitution. They followed a “people-driven” process to rewrite the constitution and established National Constitutional Conference in May 2003 (Security Sector Reform in Kenya, 2005). The government invited the representative of the government, opposition parties and civil society a consensus 2002 draft for a revised Kenyan constitution. There were some positive including high value on human rights, the rule of law and the principles of transparency and accountability. Nevertheless, the proposed draft reduced the excessive powers of the presidency and on behalf of that encompassed a useful legal foundation for the development and implementation of security sector reform (Bisarya&Choudhry, 2020). Unfortunately, the process collapsed due to disagreements relating to the structure of the executive and the devolution of power.

The effectiveness of SSR opportunities in the post-conflict context is discussed by different stakeholders according to their lessons learnt. The US Department of State, Department of Defense (DOD) and United States Agency for International Development (USAID) practitioners suggested a holistic approach to coordinate effective SSR programs. The process comprised with following principles support host nation ownership, incorporate Principles of good governance and respect for human rights balance operational support with institutional reform, link security and justice, foster transparency and do not harm (Security Sector Reform, 2009). Not only that, they believed the effective SSR requires coordinated assessment, planning, training, implementation and monitoring and evaluation (Security Sector Reform, 2009). Brzoska(2003) defined “SSR promotes greater participation of marginalized and disenfranchised people in the decision-making related to the security sector and its reform, enhances their involvement in the oversight of the security sector and increases access to security and justice”(Brzoska,2003). Nicole Ball (2004) wrote that SSR must “integrate issues of the internal security such as police, administration of the justice and the rule of law with issues relating to the armed forces, the intelligence service, paramilitary forces, and the civilian institutions responsible for managing and monitoring them(Ball,2004) . Similarly (2002) Dyland Hendrickson and Andrzej Karkoszka define SSR as “an attempt to develop a more coherent framework for reducing the risk that states weakness or failure will lead to disorder and violence. It is the transformation of security institutions so that they play an effective, legitimate and democratically accountable role in providing external and internal security for their citizens (Hendrickson & Karkoszka, 2002).

Discussion

SSR challenges are different country to country in terms of their particular issues. SSR challenges may emerge when the process is ongoing. The European Union Institute for Security Studies (EUISS) 2016 explained challenges the EU faces in its SSR activities. Their first challenge was external vs. internal politics. An external stakeholder or actor’s aims to reform the security sector of a country in transition inherently (Tardy, 2016). In contrast local actors/elites often mainly concerned with the status quo and their own prerogatives. Local ownership is another challenge and under that the capacity of local actors to absorb the changes that an operation implies. Thirdly Fragmentation vs. coherence is one of the obstacles in front of SSR implications. SSR policies gain fruitful expected results from wide-ranging and combine in a coordinated effort activities at different levels (Tardy, 2016).

To succeed SSR police reform, criminal justice and anti-corruption are important if neglect collapse the process. The time period is one of the challenges to SSR. Some SSR missions end up lasting a decade or even more and that impacts negatively to SSR operations.(Tardy, 2016) Manual for introducing Introductory Training on Security Sector Reform shows capacity constraints are challenges to both security and justice providers and recipients, as well as those initiating SSR programmes. The report identifies lack of funding; lack of institutional capacity; lack of technical or substantive knowledge; lack of capacity to absorb security sector reforms and insufficient ability to adapt to changed institutional structures (Manual for introduce Introductory Training on Security Sector Reform,2016). SSR hinder situation can create SSR consist of the worsening of bureaucratic competition phenomena between security forces. Moreover, SSR built weak consensus external actors and local government not sharing the same vision of the process (Leboeuf. 2017). It is very clear that there is a gap between the theory and practices of the SSR. In that sense, donors’ agenda and government expectations should not gaps to achieve SSR.

Although, UNO have a pessimistic view of SSR; nevertheless some scholars argued that implementing challenges of the SSR. Atsushi Yasutomi and Jan (2007) show the difficulty of implementing security sector reforms in a post-conflict context is the presence and/or absence of interaction between external and local actors, namely the donor communities (international organisations and individual countries) that implement security sector reform policies in post-conflict states on the one hand; the government, parliament, judicial systems, the media and other civil society organizations of the post-conflict states on the other. Lauren Hutton

(2010) pointed out; several challenges from the Central African Republic and Guinea-Bissau; such as in practice, local ownership has translated into the engagement of a narrow political elite in SSR processes, no national interventions pursued, the mismatch between formal security and justice norms and local practices and difficult to determine if SSR is truly part of the peace-building agenda or if it is just being used as a means to justify and solicit support for building state security agencies. Alice Hills (2010) shows that there is very little chance that a donor-led intervention will achieve fundamental reforms within the security sector. Hills made an argument “It is difficult enough to implement democratic-style police reform in liberal democracies and post -conflict societies where there is a genuine desire for change.”(Hills, 2010). Not only had that, under the SSR Justice Sector reform faced many challenges in the post -conflict backgrounds. Eight key challenges of the Justice Sector are outlined by Kirsti Samuels (2006) according to his analysis ; lack of coherent strategy and expertise, insufficient knowledge of how to bring about change, a general focus on form over function, emphasis on the formal legal system over informal and traditional systems, focus on short- term reforms over long term strategies, emphasis on a wholesale over incremental and context determined to change, insufficient attention to the need for local change agents and poorly designed insufficiently long training and legal education programs and rushed and compromised constitution-making(Samuels,2006). Eirin Mobekk, 2010 raised an argument since SSR practitioners frequently follow Western definitions of civil society when seeking local counterparts, hence, it cannot be involved in SSR. Subsequently he stressed that not always sufficiently underlined when discussing local ownership is that some insiders do not always want to include civil society; frequently, the political, military and police leadership have also worked to exclude it. Furthermore, he explained that; although, on state security and justice actors are important to succeed the SSR; however, SSR practitioners focus mainly on formal security and justice systems (Mobekk, 2010). In contrast, Marina Caparini (2010) stressed that; civil society approaches for SSR are often premised on unspoken assumptions about who or what constitutes civil society and therefore, should or should not be engaged (Caparini, 2010). The Gender Approach to SSR is widely discussed by Jennifer Erin Salahub and Krista Nerland they criticized that SSR policy and practice have not effectively supported women’s participation in high-level security sector decision-making processes. Moreover, they comment that fewer women are trained in the security forces of their home countries; they are also less likely to be represented among the trainers, mentors and policymakers working on SSR issues in conflict-affected states. Subsequently, their argument was “without broadening the access of

women and other marginalized groups to channels of influence over SSR and gender programming, it is difficult to destabilize narrow conceptions of national ownership that dominate the discourse on reform” (Salahub and Nerland 2010). Nicholas Galletti and Michael Wodzicki (2010) argued that human rights should be at the forefront of SSR efforts. Although human rights are foremost in the SSR, Nicholas Galletti and Michael Wodzicki demonstrated three primary challenges when human rights include SSR. As they discuss the first challenge to applying a human rights framework to SSR is political. The second challenge in the security sector that respects and protects human rights is the lack of accountability and the third major challenge to implementing a human rights approach to SSR relates to the respect for economic, social and cultural rights (Galletti and Wodzicki, 2010). William A. Byrd (2010) shows a number of basic linkages and principles relating to the financial dimension of SSR. He declared that financial issues and in particular, the unsustainable fiscal sustainability do not gain fruitful results from the SSR practices (Bard,2010). Alex Martin and Peter Wilson (2010) argued that SSR should still involve capacity building and technical assistance, even as political change is handled in a more sophisticated way and that it is precisely the capacity-building element that creates a demand for the private sector to be involved in SSR (Martin and Wilson,2010). Jeffrey Isima, (2010) identified coordination and sequencing as two essential tools for successful reform of national security systems. Nevertheless, he emphasized that the failure or inability to overcome the difficulties of coordination and sequencing will generate setbacks to achieving the holistic vision of SSR (Isima, 2010).

Conclusion and Future Recommendations

SSR is essential in post-conflict scenarios. However, SSR is critical in terms of the post-conflict situation. In addition to that, local and international stakeholders are keenly looking at SSR practices rather than material reconstructions in the post-conflict environment. Nevertheless, SSR is not an easy task and the process is required to a wide range of components to full fill the process. SSR challenges are critical and hard to address actual issues due to conflict of local and international stakeholders. First of all, essential to find out a way to mitigate their conflicts in the context. Subsequently, if local and international stakeholders involve the SSR process both parties should have honest attitudes to rebuild the country rather than their personal agendas. It is very clear during the conflict time security sectors are directly exposed to the conflict. Not only that their follow strict laws, regulations and actions towards rebellions. However, after the conflict rebellions and people who victim

the conflict, they are not in an optimistic view on security sectors. Hence, security sectors need reform as well as smooth to achieve successful reconciliation in the post-conflict time. SSR is one of the main approaches to reach successful reconciliation in the post-conflict period.

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SURVEY OF HERBAL PLANTS IN SURROUNDING OF DISTRICT SIDDHA HOSPITAL NARUVILIKULAM, MANNAR, SRI LANKA

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ABSTRACT

Medicinal plant survey was carried out in surrounding of District Siddha Hospital Naruvilikulam, Mannar, Sri Lanka for the express purpose of discovering the distribution of herbs and aware the public to fulfill the medicinal requirement and leads to a healthier life through medicinal plants. Ancestors named the village by using abundant herbs habited on this area. *Cordia dicheatoma* (Naruvili) plant abundantly distributed in this area. For the reason that, this village named as Naruvilikulam. There are 153 species belonging to 57 families were recorded. Family Fabaceae ranks at the top having 14 medicinal plants species. Around 27 species can be use as Spinaches and 15 species can be use in diabetic management. Habits such as Herbs(59), Shrubs(19), Torn Shrub(09), Creeper(07), Tree(18), Moderate tree(04), Climber(22), Grass(5), Torn climber and Aquatic plant. Arid zone families that are Euphorbiaceae and Cucurbitaceae (09), Laminiaceae(08), Asteraceae and Amaranthaceae (07), Malvaceae, Areaceae and Solanaceae (06), Acanthaceae and Verbanaceae (05), Zingiberaceae, Apocynaceae and Poaceae (04), Rutaceae, rubiaceae, Araceae and Capparaceae(03) are commonly distributed in this area. *Vernonia zeylanica* is medicinally important endemic plant species abundantly distributed in this area. The present investigation revealed that the medicinal plants still play a vital role in the primary health care.

Keywords: *Nauvilikulam, Fabacea, Arid zone, Spinaches, Plant Survey*

Introduction

Biodiversity depends not only on the diversity of living organisms and ecosystems but also on bio cultural diversity (Maffi and Woodley, 2010). This bio cultural diversity is described by herbalism and ethnobotany, which investigate the relationship between humans and plants (Hoffmann, 2003). Several thousand-plant species have been reported to posse's medicinal properties and around 2000 species are referred in literature. It is estimated that around 8,000 plant species are used in Indian system of medicine and around 25,000 effective plant species based on formulation used in folk medicine.

For thousands of years, medicinal plants have played an important role throughout the world in the treatment and prevention of a variety of diseases. Most people in the world still rely on medicinal plants and most of them have a general knowledge of medicinal plants, which are used as first aid remedies, to treat cough, cold, fever, headache, poisonous bites and some simple ailments (Muniappan and Savarimuthu, 2011). Ethnobotanical information about plants are usually collected from traditional healers, community leaders, and native people of rural and urban areas (Ampitan TA, 2013).

The gathering and use of local resources are still important aspects of the phyto therapeutic traditions

in many regions of Mexico. Plants are also used for ornamental, nutritional (food and fodder), pharmaceutical, aromatic, religious or construction purposes. Aspects such as the richness and diversity of cultures will increase the relative importance and roles (uses) that each plant could have in respective communities (Eduardo Alberto Lara Reimers *et al*, 2019).

The use of herbal medicines in many rural areas of our country has been observed for a long time. In each case, they have seized it, despite obstacles we can scarcely imagine. Medicinal properties of chemicals found in herbs. Medicinal Properties of herbs varies with plant habitat and geography. Mannar District found in the Arid Zone. According the Medicinal plants of the Arid Zones in Mannar district, Research Volume xiii, Published by UNESCO mentioned families of the herbs found in the district are Amaryllidaceae, Asclepiadaceae, Cactaceae, Capparidaceae, Chenopodiaceae, Compositae, Cucurbitaceae, Labiatae, Leguminosae, Liliaceae, Solanaceae and Umbelliferae.

The aim of the present studies is to list the medicinal plant distribution in the surrounding area of District Siddha Hospital, Naruvilikulam, Mannar Sri Lanka. In this district, human life and culture have directly or indirectly been associated with and influenced by the surrounding environment. People

live partly on leaves, tubers and fruits of dry zone plants and use plant drugs as medicines, thereby offering much scope for Ethnobotanical studies. The objective is to establish a documentation of the plants distribution in the surrounding area of District Siddha Hospital, Naruvilikulam, Mannar, Sri Lanka with create awareness to the local communities about the conservation strategies of these valuable genetic resources.

Methodology

Fieldwork was carried out from May to August of 2021 in surrounding of District Siddha Hospital Naruvilikulam, Mannar.



Figure 1

Location of Study area 4.5 Acres .The Mannar district lies on the following geographical coordinates and with a geographical area of 1,996 km².

The map of the study area: Surrounding of District Siddha Hospital Naruvilikulam, Mannar showed in Figure 1.

Average temperatures range from 167°F (July) to 183°F (May). The rainiest months are February, December and November.
Rain fall 25mm-130mm.

Wind 10mile/h – 25mile/h.

Ethnobotanical Analysis

Fieldwork was carried out from May to August of 2021 in surrounding of District Siddha Hospital Naruvilikulam, Mannar. The plants were collected by field visit with the local people of Naruvilikulam. People of this region can easily understand Tamil and can also communicate in that language. In order to document the utilization of medicinal plants, a total field survey was carried out in this area. Field visits were conducted several times.

Intensive botanical explorations were undertaken in selected places of Naruvilikulam to find out various medicinal plants used for different ailments in the form of plant parts such as leaves, stems, flowers, fruits and seeds. Collected knowledge about the plant uses (local names, indication of use, used plant parts, places/methods/rituals of harvesting and administration mode). Also observed during fieldwork. Each of the plant material was assigned a field note books and documented as to Binomials with family, local name, part used and therapeutic uses, plant parts that were identified as having use in ethno botany were collected, compressed, the voucher specimens were collected and identified by referring to standard flora (Gamble 1936; Matthew, 1983).The plant material was collected by the authors and taxonomically identified. The botanical names of the species were verified with The Plant List (2013) (<http://www.theplantlist.org>)

Result and Discussion

In this review, there are 153 species belonging to 57 families were recorded. Among 153 species 103 species naturally habited in this area and 50 species were cultivated

Distribution of Spinaches in the surrounding area of District Siddha Hospital, Naruvilikulam, Mannar

1. *Pisonia grandis*
2. *Trianthema decandra*. Linn
3. *Boerhaavia diffusa* linn
4. *Gymnema sylvestre*
5. *Digera muricata*. Linn
6. *Melochia corchorifolia*.Linn
7. *Aerva lanata* linn
8. *Rungia parviflora*
9. *Alternanthera sessilis* Linn
10. *Centella asiatica* linn
11. *Cardiospermum halicacabum* Linn
12. *Dichrostachys cinerea*
13. *Cissus quadrangularis* Linn
14. *Cleome viscosa* linn
15. *Sesbania grandiflora* (Linn)
16. *Achyranthes aspera* Linn
17. *Mukia maderaspatana* linn
18. *Asparagus racemosus*
19. *Physalis minima*
20. *Spermacoce hispida* Linn
21. *Amaranthus dubius*
22. *Amaranthus spinosus*
23. *Melothria heterophylla*
24. *Marsilea quadrifolia*
25. *Ipomoea marginata*
26. *Portulaca oleracea* Linn
27. *Trianthema portulacastrum* Linn

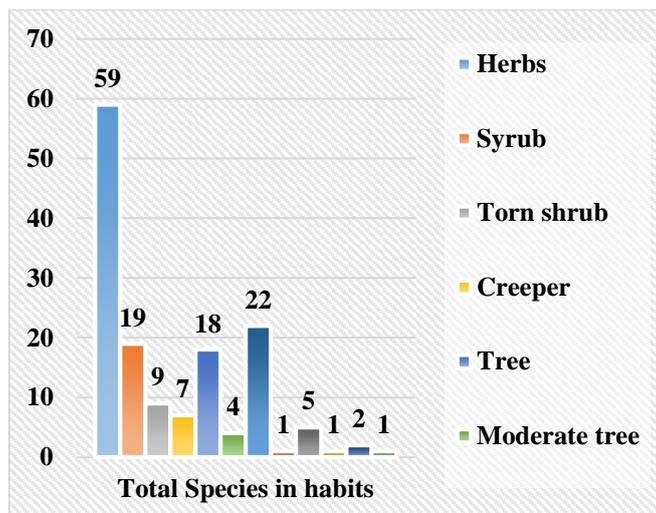


Chart 1: Distribution of Plant habits

The plants documented in this survey belong to the habits such as Herbs(59), Shrubs(19), Torn Shrub(09), Creeper(07), Trees(18), Moderate trees(04), Climbers(22), Torn climber(1), Grasses(5) , Short stem plant(01), Aquatic plant (01)and fungus(01)

Table 1: Distribution of Plant families

Families	Numbers of Species of each families
Poaceae , Apocynaceae, Zingiberaceae	4
Cyperaceae, Phyllanthaceae, Pedaliaceae, Zygophyllaceae, Sapindaceae, Lausoniaceae, Crassulaceae , Crassulaceae, Anacardiaceae , Aristolochiaceae, Muntingiaceae, Caesalpinaceae, Annonaceae, Passifloraceae, Asclepidaceae, Marsileaceae , Aponogetonaceae, Rhamnaceae, Agaricaceae , Commelinaceae, Portulacaceae, Salvadoraceae, Menispermaceae, Molluginaceae, Polygalaceae, Musaceae, Punicaceae, Pandanaceae, Costaceae, Piperaceae, Apiaceae, Violaveae	1
Asteraceae, Amaranthaceae,	7
Fabaceae	14
Rutaceae, Rubiaceae, Capparaceae, Araceae	3
Euphorbiaceae, Cucurbitaceae	9
Arecaceae, Malvaceae, Solanaceae	6
Aizoaceae, Nyctaginaceae, Leguminosae, Boraginaceae, Convolvulaceae, Vitaceae, Liliaceae, Meliaceae	2
Acanthaceae, Verbenaceae	5

There are 153 species belonging to 57 families were recorded.

Family Fabaceae ranks at the top having 14 ethomedicinal plants species, Followed by Euphorbiaceae and Cucurbitaceae each 9 species, Laminiaceae 08 species, Asteraceae and Amaranthaceae each 07 species, Malvaceae, Arecaceae and Solanaceae each 06 species, Acanthaceae and Verbanaceae each 05 species, Zingiberaceae, Apocynaceae and Poaceae each 04 species, Rutaceae, rubiaceae, Araceae and Capparaceae each 03 species , Aizoaceae,

Nyctaginaceae, Leguminosae, Boraginaceae, Convolvulaceae, Vitaceae, Liliaceae and Meliaceae each 02 species and The remaining genera had only one species each.

The collected information indicates that the study area is rich in medicinal plants, and the results contribute to spread their uses. The social importance of the medicinal plants in the community is quite important for the public health and the conservation of traditional knowledge, and good management is required. The plants used have a mostly native origin. Specially Arid zone plant Species distribution was

found. The present study provides information about some beneficial uses of 151 plant species. Plant species are claimed to be quite effective remedies for cutaneous affection of Expectorant, Nutrient, Anti-vatha, Liver tonic, Diuretic, Anti-diabetic, Iron compound, Astringent, For Skin disease, Anti mantha, Anti-dote, Poisonous plants, Febrifuge, For Gynecological, Vermifuge, Anti-hemorrhoid etc. During the research project, it was noted that the *Vernonia zeylanica* is medicinally important endemic plant species abundantly distributed in this area. Some medicinally important plant species are fast dwindling, mainly due to human interference. So, the area needs proper protection for the conservation and survival bio-resources.

Conclusion

Through this ethnobotanical survey, the availability and presence of many medicinal plants have been investigated and verified. The conservation of medicinal plants diversity of these groves is therefore most important for the in-situ conservation and cultivation of these species. The demand of medicinal plants is increasing day-by-day within and outside the country and serious and effective measures are required to meet challenge. Therefore, there is an urgent need for a local inventory of medicinal plants, to identify the species that merit priority and to formulate strategy for the in-situ conservation and cultivation of these species. The safety and efficacy of cited plants needs to be investigated by phytochemical and pharmacological analysis, as it has been previously performed on several other traditionally used plant species. The value of using ethnobotanical information is to initiate drug discovery efforts.

This study also gathered a broad spectrum of information concerning medicinal plants distributed in surrounding area of District Siddha Hospital Naruvilikulam, Mannar. Due to lack of interest among the younger generation of tribal the traditional and conventional knowledge is unable to transfer the new generation. We suggested that these plants can be used as drugs by pharmacologically unexplored areas, which may be utilized for the better human health.

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IDENTIFICATION OF ASSOCIATION BETWEEN NEIGHBORHOOD STREET ELEMENTS AND CHILDREN'S PLAY ACTIVITIES IN NEIGHBORHOOD STREETS: LOW – INCOME SETTLEMENTS IN MORATUWA MC AREA

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Abstract

With the rapid development of cities land uses has been changed and fewer open spaces are remaining for children to use as playgrounds. In city environments one of open space type is streets. Streets are not just spaces; it has potential as places for children to engage in play activities. There are several street elements shaped street corridors and all those elements stimulate children imagination, creativity as well as behavior also. This Study focus on identify how quality of street elements motivate children's play activities in low-income residential neighborhoods streets. This study conducts in two low – income settlements in Moratuwa MC Area in Sri Lanka. These two settlements selected after considering about availability of street elements within these neighborhood streets. For the data collection, researcher used observations, structured questionnaire surveys, semi-structured interviews and cognitive mapping exercise. Descriptive statistical analysis, Relative importance index, narrative analysis and cognitive maps used to analyze those data. In the end of this study, researcher identified that green space is the most influence and supportive street element for children's play activities in neighborhood streets and traffic congestion, unhygienic roads, unavailability of street furniture, insufficient street width is the key barriers for street play activities.

Keywords: *Cities, Neighborhood, Cognitive maps, Unhygienic roads, Street furniture*

Introduction

1.1 Research Background

Children are important for countries as human assets. They obtain their developments and experiences from their living environment (Rakhimova, 2011). Play is one of most important components that children can collect more experiences. When they grow through many stages, their play activities change. Their physical, mental, cognitive and social development based on their supportive environment (Undiyaundeye, 2014).

Street are most extensive, common and important open space type in city environments. There are 5 aspects should have streets as successful open space. Those are, Inclusiveness (people with different race, class and variety of activities), meaningful activities (variety of businesses and foods availability), comfort (shelter, shade and can stay without pay), safety (safety from traffic congestion) and pleasurability (availability of memorable features) (Mehta, 2014). Streets are not just spaces, it has potential as places for children to engage in play activities. In addition, vehicles use streets rather than

pedestrians. So, streets become unsafe & less attractive for children (M. Renée Umstaddt Meyer, 2019).

Nowadays children's play activities are restricted to their houses and normally they don't use outdoor open spaces. Being away from play activities may cause to physical and psychological problems like obesity among children (Oydin Ozdemir Oguz Yilmaz, 2008). On the other hand, children who live in impoverished neighborhoods use outdoor spaces more than middle- and high-income neighborhoods. But with the limited space and high population of those settlements children engage in physical activities on streets & alleyways which are not properly design for children (Dewi, 2012).

Several researchers identify the importance of providing natural environment for well-being of children (Abu-Ghazze, 1998). In the field of planning, planners need to consider about children when they making plans and they have to consider how their decisions impact on children. Hence this research focusses on how quality of street elements motivates children's play activities. Recent studies on street designs and people's physical activities focus on how different street elements affected to physical

activities in different age people like children, adults, and old age people. For instance, Sri Aliah Ekawathi mentioned that *“Street corridors are shaped by some elements, physical and non-physical. All of those elements stimulate children creativity, imagination, knowledge and even their behavior”*. She study about how street elements affected to create children friendly - street designs using a low – income neighborhood (Ekawathi, 2014). Through the studies of health community study team in USA, the relationship between physical activities of youth and street elements was investigated and it focus on how quality of street environment affected on neighborhood and street based youth physical activities (A.T.Kaczynski , 2018).

Even there are various type of studies conduct regarding broader neighborhood factors like street connectivity, land use mix and building density there are a smaller number of studies focus on quality of street environment. In addition, there are least number of research efforts has been conduct to investigate about how street elements impact on children’s play activities in Sri Lankan context. Therefore, in this research it is expected to investigate about “how quality of street elements effects on children’s play activities” in Sri Lankan context. And it will help to create child-friendly streets as a valued part of local environment.

1.2 Research question

- How does quality of street elements contribute to create child-friendly street environment in low-income settlements?

1.3 Research Objectives

- To investigate how quality of street elements motivate children’s play activities in low-income settlements
- To identify the most influence street element that stimulate children’s street play activities

Literature Review

“Child is a young human being below the age of puberty or below the legal age of majority”. (Yusuf S., 2015). Children develop their physical, language thought and emotional ability from their birth to beginning of adulthood. According to the early childhood development literature “Play” is one of childhood development principle. It is an important factor for child development and play environment leads to enhance language and other skills of children. It helps children to socialize, to think, to solve problems, to mature and most importantly to have fun. Play connects children with their imagination, environment, parents, family and the world (Anderson, 2010).

There are several theories discuss about child development. Erikson’s theory of psychosocial

development discusses regarding children’s social and emotional development through their lifestyle using 8 stages. Each and every stage have positive and negative outcomes and those outcomes are determined by surrounding environment. Other than that, Sigmund Freud’s theory explain about child development through psychosexual framework and it consist with five stages. Those are oral, anal, phallic, latency and genital stages. Changes of body zones are explained by each and every stage. Finally, all these theories explained about childhood development through several stages and surrounding environment of children impact on children’s personalities.

There are two requirements require to increase children’s creativity in their play activities. Those are freedom and safety. These two aspects are essential as a tool to assess both physical as well as non-physical aspects.

Children’s play activities can be physically active or physically passive (Sener, Copperman, Pendyala,Bhat). Physically active leisure activities require regular bodily movement and bowling and sledding are included to that. Physically passive play activities normally don’t expenditure energy and singing, talk with friends, arts and crafts are included to that.

Good quality of streets directly influenced for children’s play activities. Especially children use neighborhood streets for their play activities when they don’t have access to playground facilities nearby. The good quality of streets contains with size and layout of street, accessibility, equipment and materials, green space, traffic calming and play space. So. To achieve the objective of this study above mention criteria’s going to be assess.

a) Quality of size and layout of streets

Streets are more than physical spaces and public utilities. Streets are one of the place that sociality can develop (Jacobs, 1971). Quality of size and layout is defined from street width and street definition. Street width should be enough for child play activities and street definition means clear boundary between streets and buildings.

b) Accessibility

The criteria of assessing accessibility is accessibility for pedestrian as well as vehicles. It indicator of this criteria is continuity. Those movements should be direct/shouldn’t block.

c) Equipment and materials

Quality of equipment and materials include paving, street furniture, gates, sidewalks, street lightning as well as canopies. In addition, physical maintenance, position and amount of equipment also important to create quality outdoor environment for children’s play activities instead of indoor activities. Most of

these equipments stimulate children’s play activities.

d) Green space

Green space provide oxygen, shade, beauty as well as comfort for streets. Street trees should be close one to another to create good pathways. Tree branches also important for pedestrians. According to (Jacobs, 1971) most efficient tree spacing is 4-5 meters and 5-7 meters.

e) Traffic calming

People don’t like to live near streets which has high traffic volume. Traffic calming measure speed of motor vehicles. Normally it should be a “desired speed”. On-street parking cause to slow down the motor vehicle speed. Other one is the materials used for streets. Because cobble stones, concrete pavers as well as bricks may cause to slow down vehicular speed. Speed bumps, flat top speed humps also cause to decrease vehicular speed (Fruin, 1971).

f) Play space

Variety and amount of play spaces within street environment can provide opportunities for children. Gardens, roof Terence as well as sidewalks in front of houses are some of those space children can use to play while parents can continue their works. The indicator of this criteria is availability of various play spaces, easy for parents to watch and hygienic.

This study focusses on active play as well as passive play activities. Because these two types of activities occur among children without any supervision.

Structured and unstructured leisure activities occur under the adult supervision and with a relevant time schedule. 5-15 age category of children was selected because within that age period children engage in different play activities and 3-4 years age category of children unable to fully engage in physical play activities. From 16 years old onwards children’s play activities convert to more adult oriented once like weight lifting, driving, and parties as well as after school jobs (Lansky, 1984).

Methodology

Location

This study carried out in two low-income settlements in Moratuwa MC Area. Location and the availability of selected street elements were the justifications for case study selection. After considering above mention indicators Dandeniyaawatta and Baiwatte low-income settlements were selected.

Dandeniyaawatta low-income settlement is located behind the University of Moratuwa. Most of the areas of the settlement bounded by Bolgoda Lake. This settlement establish after 1990 and at the first stage only 94 families were settle down within the settlement.

- Total area – 15 acres
- Total population – 1256
- Number of housing units – 264
- Child population (5-15 age category) – 346

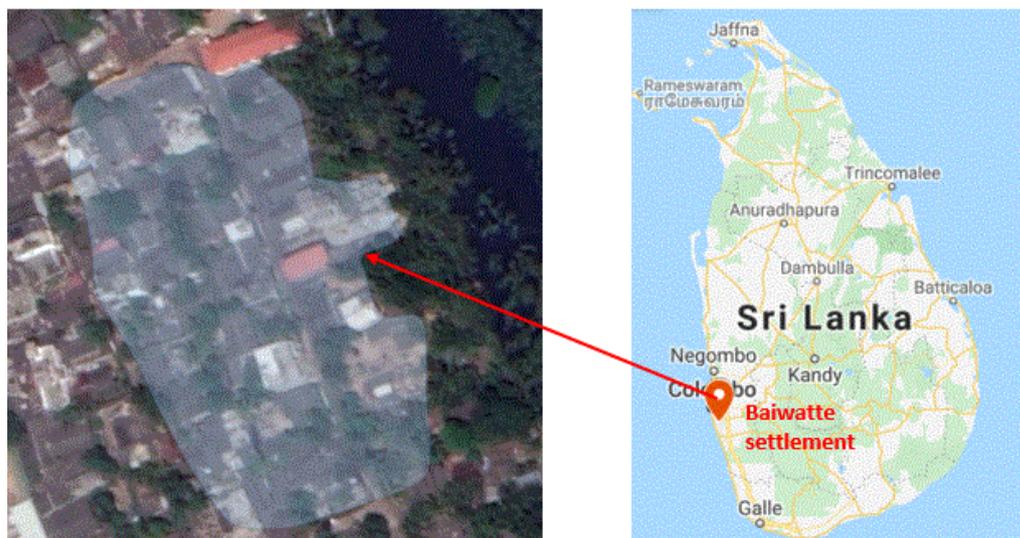
Figure 1 : Location map of Dandeniyaawatta



Baiwatte low-income settlement is located 2.3Km away from the Golumadama junction. One boundary of the settlement bounded by Bolgoda Lake. In addition, basic details & layout map of the settlement is mention below.

- Total area –8.2 acres
- Total population - 1206
- Number of housing units – 166
- Child population (5-15 age category) – 314

Figure 2 : Location map of Baiwatte



Source: Google Map

Population and sample

There are two types of populations were selected for the study. Those are children between 5-15 age category and residents of selected two settlements. Random sampling method used for this study because by using this method it is easier to select children randomly when they engage in play activities.

Table 1 : Sample size selection in selected case study areas

Dandeniawatta low – income settlement	Baiwatte low-income settlement
Children between 5-15 age category - 346	Children between 5-15 age category - 314
Sample size - 60	Sample size - 59
Parents - 15	Parents - 15
Total sample size - 149	

Source: Compiled by author

Data collection

For data collection, researcher used several methods.

- Direct observation and photographs – To identify availability and existing condition of street elements/street play activities.
- Structured questionnaire survey – To identify quality and existing condition of street elements which support for children’s play activities.
- Semi-structured interviews – To collect resident’s perceptions regarding Neighborhood Street play environment.
- Cognitive maps – To collect children’s perceptions and experiences about their street play environments (5-10 years old children)

Data analysis

Quantitative and qualitative methods used to analyze data. According to the research objectives Data analysis methods varied.

- a) To investigate how quality of street elements motivate children’s play activities in low-income settlements
 - Descriptive statistical analysis – It is intended to use this data to identify quality of street elements that motivate children’s play activities in low-income settlements. All charts was prepared using SPSS and MS Excel software.
 - Narrative analysis – For this study narrative analysis use to explain the experiences, ideas and perception of residents especially parent about the street play environments in selected neighborhood streets.
 - Cognitive maps - In this study author’s objective is to identify the children preference. (Most supportive street elements, places, barriers and experiences regarding the street play environments in their neighborhood streets)

b) To identify the most influence street element that stimulate children’s street play activities

- Relative importance index - Relative important index use as tool for ranking variables. According to the (Rashid H. Tikote , 2017) RII use to rank different variables after collecting perceptions, ideas from the selected focus groups. RII calculate using an equation. The Likert – scale questions based on three –point Likert scales. (1 – Poor, 3-Moderate, 5 – Good).

Findings

After data collection, there are several methods use to analyze it. Those are Qualitative descriptive analysis, Narrative analysis, RII and cognitive maps.

Objective 1 - To investigate how quality of street elements motivate children’s play activities

a) The quality of size and layout

It is expected to discuss about quality of size & layout in Dandeniya and Baiwatta settlements. Majority of respondents state that street width of local roads in both settlements have good quality because street width of those roads are 2.5M-4M. 84% of respondents in Dandeniya state that street definition of local streets is in moderate condition because local streets consist with the considerable level of boundary between buildings and streets. But in Baiwatta settlement street definition in a good condition in local roads. Street definition of alleyways in both settlements have a poor condition because in alleys there are several terraces fused with streets.

Figure 3 : The quality of size and layout of local roads & alleys



Source: Capture by author from field observation

b) Quality of accessibility

In here it is expected to discuss about quality of pedestrian as well as vehicular accessibility in selected case study areas. Local roads have a good quality for vehicular accessibility in both settlements. Although local streets are accessible for vehicles when it full with vehicles it could harm the pedestrian

movements. Alleyways are in poor quality of vehicle accessibility. Because only motor bicycles can pass through the alleyways and other vehicles don’t have enough space in alleys (1M – 1.5M). But alleyways have good accessibility for pedestrian movements in both settlements.

Figure 4: The quality of accessibility in local roads & alleys



Source: Capture by author from field observation

c) Quality of green space

Vegetation in streets provide several advantages to the streets. It provides comfort, beauty, shade as well as oxygen to the surrounding environment. Green spaces in streets also important for street play activities. In Dandeniawaththa settlement 52% of respondents respond that variety of green spaces in local streets are in good condition but in alleyways are in moderate and poor condition because alleys consist with some amount of vegetation like small

shrubs. Impact of shade and comfort is one of the essential criteria considered by children. Because children use these places to engage especially passive play activities (carom, chess etc.....). In local roads impact of shade and comfort in a good condition because several huge trees are available either side of roads in both settlements. Although maintenance of the vegetation has a good condition in local roads, in alleyways it is in a poor condition in both settlements.

Figure 5 : Quality of green space in local roads & alleyways



Source: Capture by author from field observation

d) Quality of play space

Variety of play spaces provide several opportunities for children to play and activity development on their neighborhood streets. Parents can provide play opportunities from carry them into playgrounds. But if children use streets near to their houses parents can continue their works while let their children to play on streets.

roads are not hygienic. Because those places are full with garbage. Therefore, children unable to engage in play activities in those places. In Baiwatte settlement 53% of respondent state that hygienic in local roads are in moderate condition because open drainage systems harm for children while they playing. Other than that, local roads are unhygienic because of the pollution occurred from the vehicles.

In Dandeniawatta settlement Majority of respondents testify that (52%) local roads have a good quality for providing variety of play spaces. But in Baiwatte settlement 81% of respondents' response that variety of play spaces in local streets are in a poor condition. Because local roads are full with vehicles and people. In Dandeniawatta majority of respondents' state that most of the places in local

In Dandeniawaththa settlement alleyways are like hidden places. Hygienic of alleyways are in poor condition (94%) because some of alleyways are full with mud and open drainages near the streets also unhygienic. In Baiwatte settlement alleyways also have poor condition under the indicator of hygienic as well as parents face difficulties to watch their children while they play.

Figure 6: The Quality of play spaces



Source: Capture by author from field observation

e) Quality of traffic calming

Traffic calming streets can be explained as the streets which don't have high traffic volume. People neglect such places. On-street parking is one of the strategies which can use to slow-down the vehicular speeds. Different types of street textures (cobblestones, bricks) can be used to slow the vehicular speeds.

In Dandeniawaththa settlement on – street parking in local roads have moderate condition and in alleyways it is in a poor condition. 62% of respondents state that less traffic volume in local roads are in a poor condition and alleyways it is in a good condition. Most of times (Especially evenings) several motorcycles disturb to children street play activities in local roads. When consider about the slope and texture usage 90% of respondents testify that alleys are in poor condition and local roads are in good (40%) and moderate (46%) conditions. Alleyways are in a poor condition because all

alleyways in Dandeniawaththa don't use any material for floor and it always full with mud. 66% of respondents state that availability of speed bumps in a good condition in local roads and 90% of respondents state that in alleyways it is in a poor condition.

In Baiwatte settlement on - street parking in local roads have good condition and 98% of respondents state that in alleyways it is in a poor condition. Because some alleyways are too narrow (less than 1M). 96% of respondents' response that local roads have a high traffic volume and alleyways have a less traffic volume. 71% of respondents state that local streets are in moderate condition under the indicator of proper slope and texture. In Borupana settlement all local roads use concrete pavers as a floor material. 86% of respondents state that local streets have a moderate condition under the indicator of availability of speed bumps. But alleys are in poor condition under that criterion.

Figure 7 :The Quality of traffic calming



Source: Capture by author from field observation

f) Quality of equipment and materials
 Under this criterion in Dandeniyaaththa 60% of respondents state that variety of equipment are in moderate condition in local roads in and alleyways are in poor condition (80%). Maintenance of these equipment in local streets and alleyways are in poor (62% & 98%) condition. When consider about the amount of equipment 92% of respondents' state that alleys are in poor condition because there are two three benches locate in alleys and some of them were cracked.

In Baiwatte settlement 71.4% of respondent state that variety of equipment are in moderate condition in local roads and alleyways are in poor condition (87.8%). There are several wooden benches are exists in local roads. Maintenance of equipment in local

streets are in moderate (53.1%) condition and alleyways are in poor (98%) condition. When consider about the amount of equipment 84% of respondents' state that local roads are in poor condition. Within that settlement street lights are in good and moderate condition in local roads & alleyways. Therefore, it supports for children to do some activities in night time also.

Cognitive mapping exercise

From the cognitive mapping exercise it is expected to identify the children's preferences (5-10 years old age category) and experiences regarding their street play environment.

Figure 8 : Cognitive maps of children



Source: 9 years old boy & 7 years old girl express their experience about street play environment

When consider about the children perceptions which collect through cognitive mapping exercise regarding neighborhood street play environment, it indicate that what children expect from the street play environment and existing barriers they face when engage in street play activities. In here traffic congestion and unhygienic roads can be considered as the main barriers identified by children.

Narrative analysis

This is an important technique which use to identify residents (especially parents) perceptions and the sense of places regarding the street play environment. Respondents express different ideas based on the experiences.

“These streets are not safe anymore. But my daughter likes to do homework under these mango trees which is locate one side of this road... but I only let her to play there when I am watching”

(Parent of a girl aged 7 years old)

“These roads are not suitable for play. In our childhood we played in these same roads. But now I can’t let my son to play here. Some of these houses connect their sewage lines to drainages. So, once rain it overflow through these roads. Therefore, I don’t let them to play because they are getting sick...that’s the issue”

(Parent of a boy aged 7 years old)

According to the findings of the narrative analysis traffic congestion, unhygienic roads, unavailability of street furniture, speed bumps and insufficient street width identify as the key barriers for street play activities within these neighborhood streets. Green space identify as the most important street element which support for street play activities. And alleyways are use by children to play because majority of alleys are free from vehicular movements.

Objective 2 - To identify the most influence street element that influence for children’s street play activities in low-income settlements

Relative important Index

Case study 1- Dandeniawaththa low-income settlement

According to the RII calculations the most influence street element that motivate children’s street play activities is green space (Local roads & alleyways) in Dandeniawaththa. Majority of children engage in street play activities near to green spaces. The main thing they expected from green coverage is shade and comfort. Most of the passive play activities like playing carom, play with toys, drawings occurred near to the green spaces.

Table 2 : Identification of most influence street element in Dandeniawatta

Street Element	Local Roads		Alleyways	
	RII	Rank	RII	Rank
Size and layout of streets	0.72	3	0.34	5
Accessibility	0.73	2	0.56	2
Equipment and materials	0.51	6	0.23	6
Green space	0.88	1	0.59	1
Traffic calming	0.67	4	0.41	4
Play space	0.6	5	0.47	3

Source: Compiled by author

Case study 2 – Baiwatte low-income settlement

According to the RII calculations green space is the most influence street element which motivate children’s street play activities in Borupana settlement

also. Because in that settlement local streets as well as alleyways have variety of vegetation. There are huge trees can be seen either side of local roads. Alleyways also consist with small shrubs and huge trees in few parts of the street.

Table 3 : Identification of most influence street element in Baiwatte

Street Element	Local Roads		Alleyways	
	RII	Rank	RII	Rank
Size and layout of streets	0.89	2	0.34	5
Accessibility	0.81	3	0.58	2
Equipment and materials	0.42	6	0.24	6
Green space	0.79	1	0.59	1
Traffic calming	0.53	4	0.41	3
Play space	0.5	5	0.39	4

Source: Compiled by author

Conclusion and recommendations

This Study focus on identify how quality of street elements motivate children’s play activities in low-income residential neighborhoods streets. Questionnaire survey and semi-structured interviews were conducted in two low-income settlements to achieve above mention objectives.

There are few aspects can be mentioned as the key findings of this research. The most influence street element is green spaces in local roads & alleyways in both case study areas. Shade and the comfort attract more children to green spaces for street play. Accessibility, quality of size and layout of streets identify as the second influence street elements which motivate street play activities among children in low-income settlements. Because wider streets and streets which have good accessibility facilities provide more opportunities for active play activities in streets. In addition majority of previous researches investigate about children’s use pattern of streets and street properties using GIS base methods. They identify that how quality of different street types influence on

children and youth based physical activities in streets. Local roads are the most preferred street type of the residents (73%). It is totally different with the results of the (A. T. Kaczynski , 2018) and that literature reveals that cul-de-sac, dead end roads and one ways are more preferable for children’s street play activities. Finding of this study reveals that traffic congestion of local roads reduce children’s street play activities furthermore. That is similar to previous research finding and it also revealed that majority of child accidents happen in local streets during the street play activity engagements within 500m distance from their homes (Carver, 2008)

In addition, through the observation it is identified that traffic congestion is the main barrier for children’s street play activities in local roads. Alleyways provide better opportunity for children to engage in play activities.

There are several typical conditions among local streets and alleyways in both case study areas. Those conditions can be divided into two aspects like positive and negative. Positive and negative aspects are explained in below table 01.

Table 4 : Positive & negative aspects of street elements

No	Condition	Aspects	
		Positive	Negative
01	Size & layout	Size & layouts of streets wider enough for Children’s street play activities.	
02	Accessibility	Children can get easy access to every places of streets	
03	Quality of equipment and materials		There are no proper street furniture (Benches, chairs) to support for children’s play activities.
04	Green space		Vegetation is not exit in everywhere of streets to support for children’s street play.
05	Play space		Children don’t have proper play places to play. Although they use sidewalks to play those spaces were quit narrow and consist with damaged materials
06	Traffic calming		Vehicular speed normally disturb for children’s play activities.

Source: Compiled by author

As the recommendations of this study it is essential to pay attention on the street play activities in low-income settlements because children in those settlements probably don't have access to recreational facilities within close proximity. Sometimes children have their own ways and imaginations regarding how to use these roads for play activities and sometimes they don't consider about the barriers they face during their street play activities like traffic, unhygienic roads, bad weather, pollution etc... Engage in play activities enhance their skills since childhood. Therefore, through this research author identify what kind of street elements qualities influence for street play activities in low-income neighborhood streets. So, findings of this study will help to planners as well as designers to identify the supportive street elements for children's street play activities and it is government, designers, planners' duty to provide best quality of streets for children within their neighborhoods.

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EXTRACTING INFORMATION FROM REAL ESTATE HOUSING ADVERTISEMENTS OF E-NEWSPAPERS & WEBSITES IN SRI LANKA VIA OCR & NLP

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ABSTRACT - Real estate business is a major business area in Sri Lanka. Here housing property businesses are much popular. Advertisements of these housing properties can be found in new papers, magazines and in different online platforms. But there are no proper sources, where the information about houses is extracted to a one place and given in a structured way. Further there is no proper analysis has been done in Sri Lanka about these real state housing properties. The purpose of this study is to provide information about real state housing properties in a structured way for real estate owners, brokers and property buyers. Furthermore, a proper visualization insight about the extracted information is also given. Here a structured database was created using Optical Character Recognition (OCR) and Natural Language Processing using images from the advertisements in various platforms. Web scraping was also used for scraping data from the internet. Finally, a descriptive analysis and statistical modeling was performed for deriving insights from the extracted information.

Keywords: OCR, NLP, NER, Regular Expressions, Real State, Housing Properties, Web Scraping

1. Introduction

Based on famous housing website. In Sri Lanka Overall House sale prices, apartment sale prices have been changed respectively by 15.6%, 2.64% this year. This research topic has been chosen for giving a simplest way to identify the price differentiation of Housing and property in different places in Sri Lanka

The availability of data in the newspapers were very low level which was found when we were searched data for our research. We could see the advertisers not only using newspapers but also using websites, Radio and Television for their advertising works. We planned to take website advertisements and newspaper classified as our main resources to collect data. Sunday Observer and Sunday Times were selected as the newspapers and hit.ad.lk, house.lk and ikman.lk were selected as the websites. Creating a structured dataset with important variables of housing and property advertisements will help the people to understand the data easily. Property type, Address, Advertiser, contact number, number of bedrooms, number of bathrooms, land size, house size and price are the key variables that have been extracted from the advertisements for this research.

1.1 Objectives

- Convert image data of the Housing & Property advertisements to text using OCR.

- Identifying the needful information from these textual data using NLP & creating a database with this information.
- Finally, web scraping house data from internet.

2. Literature review

2.1 Price indexing of house and properties

In the study of Cohen (2017), important factors which are deciding housing pricing are analyzed and how the national economy will be affected by housing price change were discussed here [1]. GDP, inflation, unemployment, emigration and interest rate were analyzed and they found housing prices aren't determined by inflation, emigration and interest rate but the housing price is highly influenced by GDP. A statistical relationship has been found between inflation and housing pricing. Correlation and regression analysis had been done for this research. By this research 98.75% of the variation in housing price has been discovered.

2.2 Optical Character Recognitions

In the study of Manwatkar and Singh (2015), it says that text recognition and OCR are used by banking, Legal and healthcare for their works. In banks they have used this for process checks without human involvement. This is almost perfectly working for printed checks and fairly accurate for handwritten checks. In the legal industry they use this for saving

all the documents into digital paper for easily locate them to make it easily searchable they used this as digital papers. in health care sector they used this for creating a database for each patient to treat them efficiently according to their reports. This research article is chosen by us because it gives the real-world scenarios on how they use text recognition in different sectors [2].

How we can save time from marking answer sheets manually will be discussed by Sharma et al (2013). An automatic correction and store marks are being focused here. A hardware is assigned to capture images of the front page of the answer sheet which pick and take pictures one by one. After that the captured image is processed by a proposed robust extraction and noise removal algorithm adaptive to environmental conditions [3]. After that OCR has been used to extract textual data then the papers are corrected automatically then it stores the marks to a dataset with initial number. How they use hardware and software together to extract information were clearly mentioned in this research article.

According to Mittal et al (2020), Concept of OCR, explain about the extraction, current research in the area and latest techniques have been used to extract are included in this research paper. Basic steps of extraction are spoken here such as image acquisition, Preprocessing, Segmentation, Feature extraction, Classification, Post-Processing. The 7 stages have been explained briefly. How to use OCR for extraction will be understood by reading this article. The techniques which are used in each stage of this process are mentioned in this article.

2.3 Natural Language Processing

Perhaps in the medical field data is unstructured or semi-structured format. it cannot be used for the decision process by Health sector peoples. therefore, Natural Language processing and regular expression have been implemented by python to make them as a structure format. Clinical texts have been argued by Veena, Hemanth and Hareesh (2019) as they are structured into a label format. In the argument of research, Wordnet is used to obtain the data clinicals and with help of web scrapings, text documents will be extracted [10]. NLP is used as a main role to tokenize words, part of speech tagging, noun singular plural, identify the label (which mean disease types) of extracted paragraphs to prepare for analysis roles. For the conclusion of the authors Natural Language Processing is considered as a main role of extracted data to give it meaningful information for the entire activities of the health sector [11].

Natural Language Processing is proposed as a technique for extracting text information from e-newspapers by Monisha and Sowmya (2014). Time to time news is increased but noises, advertisements and irrelevant materials have been there. Impact of

that, people are not interested in reading whole things. Therefore, A new search engine with help of NLP intelligence to remove noises, advertisement and irrelevant words have been created by the author and created them into an easily understandable format. The technique is used by authors as use the website HTML file to the web scraping engine and identify and summarize the most relevant content of newsies and categories them into a domain.

3. Methodology

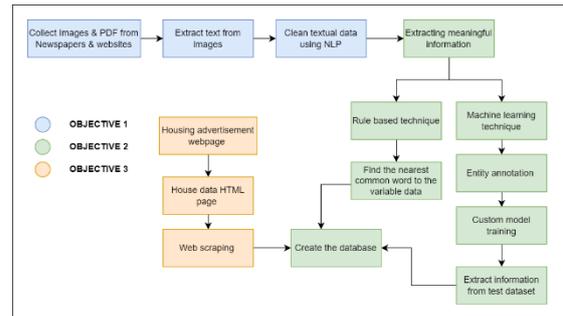


Figure 1. Workflow Diagram

The figure 1 shows methodological study of this research. The technique is used to extract information from classified newspapers using optical character recognition and natural language processing to create a database.

The research was largely presented in terms of quantitative approaches. Therefore, collected observations are focused from newspapers housing property selling advertisements in the Sri Lankan context. Creating a database is considered as main objective because a lack of research has been done for extracting using OCR and NLP techniques in Sri Lanka in this field. Therefore, research has been decided to go that route. The method is divided into three parts to achieve the purpose of research such as image data collection, pre-processing it and extracting information to creating a database using the extracted text file and finally an analysis will be conducted to observe the insights required by the stakeholders.

3.1 Data Gathering

Different type of advertising techniques is available in the market nowadays. For housing property Advertisers using newspapers and websites as their primary advertising tools. For doing good research on this topic, we have to collect data from different sources otherwise it may create a biasedness. Therefore, we decided to collect information from online newspapers and websites.

Sunday observer adz.lk and Sunday times hitad.lk are the main e-newspaper have been chosen for object data collection, because the advertisement availability is high compare to other online websites in Sri Lanka. Next step moved to websites where

ikman.lk, adsme.lk, Lanka property web and house.lk had the greatest number of advertisements and it is being regularly updated their advertisements. The advertisements from 2019 have been collected and we have planned to collect the data until September 2021 for giving you the most recent data. For data gathering have done two different things. One is to download images from online newspapers and websites. Another one is getting data by web scrapping. Ikman.lk, house.lk, adsme.lk and Lanka property web has been chosen for web scrapping. The reason for web scrapping is, the number of object data very less it not enough to do future insights driven analysis from the dataset. therefore, decided to web scrape more data from webpages, entire samples size is around 10,000 including web scrapping data. which samples will be used to compile the database.

3.2 Data extraction

Data extraction is significant part in this research. There are two way here used to extract the data. One is using OCR other one is web scrapping.

3.2.1 OCR tools

For the textual data extracting using OCR tools. there are two ways to do it. One is manually using pytesseract technique other one is online OCR tools like Google vision OCR. In this scenario the collected data is in different types such as PDF files, color images and black and white images. The PDF files are downloaded from hitad.lk. For the question of why cannot web scrape it rather than download as pdf in hitad.lk? The reason for it. In hitad.lk's advertisements are not a given particular formatted way compare with ikman.lk and house.lk. When web scrape the variables pattern information there founded unable to use proper the html path for it. therefore, scraped as object data and convert it into image and extract the information is easiest way to continue the process.

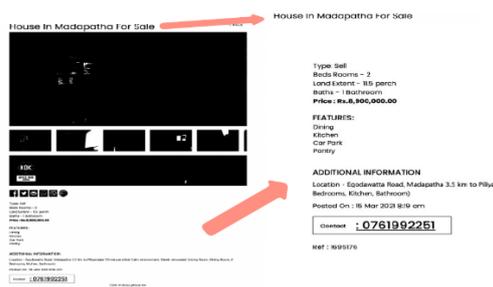


Figure 3. Remove the image noises

The figure 3 shows the filter image. And here pytesseract engine used to extract the textual data into text file.

3.2.2 Web Scrapping

Web scrapping house data from internet is another way to extract the data for analysis, BeautifulSoup

and request libraries were used for this web scrapping. House.lk adsme.lk and Lanka property web are the key websites were used here. When used to extract the data from web page their advertisement's details are not displayed on the front page. We had to click the advertisement title to view the full details of the property. So, a little complicated coding has been used here to web scrap these kinds of advertisements.

After including the base URL and page URL of the website and run the each and every information of housing property from multiple advertisement from multiple pages at a time.

Furthermore, extracted variable information details are Property type, Advertiser, contact number, land size, house size, number of bedrooms, number of bathrooms, and price. Later stored the information in a dataset using the Pandas library.

3.3 Text Cleaning

In real world scenario the data are in dirty format. Before get into analysis, we make sure the data should in clean format. Steve Lohr of The New York Times said: Data scientists spend 50% - 80% of their time to collect data and pre-processing, according to interviews and expert estimates. Here the collected samples were transformed into text form using pytesseract engine. There are a lot of pre-processing had been done to clean the text data. the figure 4 shows what are the information should extract from advertisement. however, before get into information extraction the text should be in cleaned formation.

House for Sale in Kolonnawa

Bright corner unit located in a quite and very safe neighbourhood. **1400 square feet** **3 bedroom** **2 bathroom** solid house located in **12 perches** land closed to Kolonnawa junction. Layout allows adding two more bedrooms. Clear deeds. Convenient location. Cargills, public library, all banks, bus stand, doctor clinic nearby. Mosque, church, temple within 5 minutes walking distance. You don't feel like living in a middle of a busy town. **Price 20,000,000** Call Chandrani at 2539424; **0715656915**; 0778304637. **Contact:** Lal, Sri Lanka **Email:** punyalal@hotmail.com **Date:** 1/08/2021

Variables	Features
1. Property Type	House
2. Location	Kolonnawa
3. Land Size	12 perches
4. Bedrooms	3 bedrooms
5. Bathrooms	2 bathrooms
6. House Size	1400 sqft
7. Advertiser	Lal
8. Contact	0715656915
9. Price	price 20,000,000

Figure 4. Identify the variable in ads

The following example is the extracted textual data from advertisement.

*TWO STOREY HOUSE FOR SALE - NEGONBO \n',
 'Two story air conditioned house for sale\n',
 'at Thushara Mawatha. 2 mins to Negombo\n',
 'Colombo Road. 5 mins to Negombo Town.\n',
 'Lobby, Living, Dinning, -Ki Kitchen Pantry,
 Balcony\n',
 '4 bed rooms, 3 bathrooms; 3000 sq feet, solar\n',
 'power hot water' 'system nmatap water with upper\n',
 '& down tanks, Garbage service 3 times a week\n',
 'Land area 12 perches\n',
 'PRICE - 28000000/= Negotiable\n',
 'TEL: 076 53312545\n',*

In the above sample data there are lots of unnecessary characters and misinterpretation. Therefore, here following steps used to clean the unclean text data.

3.3.1 Removing escaping characters

Words are not in a particular format. Therefore, Lower case (normalize) the texts and removing the new line, HTML characters. After that assigned into list observation wise.

Short form	Contracted word
I'll	I will

Table 1. contraction word

3.3.2 Contractions Replacement

Here Table 1 shows replacing words to long form which were written in a short form.

3.3.3 Punctuation removals

We cannot expect OCR tool to transform image to text with 100% accuracy. There are some unwanted symbols (>, <,"',\\$, £) which should be removed.

3.3.4 Tokenize and stop words removal

Split the paragraph to sentences and sentences into single words. The table 2 shows that English stop words and custom stop words which inappropriate for information extraction.

Stop words	Is, the, not, my
Custom stop words	Beautiful, road, modern

Table 2.

3.3.5 Separate numbers and strings

Some places could see some numbers are joined with strings like (2500sqft). After execute the code these strings split as (2500 sqft).

3.3.6 Spelling Checking

Here enchant used for this operation. If the word has spelling mistakes code will replace with the correct word. set out mistake level as 2 because higher number of mistakes sometimes leads to less accuracy. If the word has maximum of 2 mistakes it will correct otherwise ignore it.

3.3.7 Lemmatizing

This returns the base word of each string.

Word before lemmatizing	Lemmatized word
Bedrooms	Bedroom
perches	perch

Table 3.

3.3.8 Custom word replacement

Table 4 shows the misspelled or short words are replaced to correct format.

Mis spelled word	Corrected words
Mn	million
Sq feet	Sqft

Table 4.

3.3.9 Replacing word numbers as integers

In some advertisements, it has mentioned as numbers in word format. For creating a database needed all output should be in a same category. table 5 refers the difference.

Two	2
fifty	50

Table 5

Following advertisement textual data cleaned texts compare to the earlier extracted text data. Now data prepared to extract meaningful information.

'2 storey house negombo 2 storey conditioned hous e thushara Hiawatha. 2 mind negombo Colombo ro ad. 5 mind negombo town. lobby living dinning ki kit chen pantry balcony 4 bedroom 3 bathroom 3000 sq ft solar power hot water e system water upper tank g arbage service 3 time week area 12 perch price 280 00000 tel 0765331254 '

3.4 Information extraction

From the text data, desirable information has been extracted. There are two types of approaches have been used. One is rule based which is identify the needed information via the common nearest words. Another one is machine learning technique where need to train the model with custom data through entity annotation samples set then it will extract whatever desired information.

3.4.1 Rule based technique

Regular expressions are used to find the information. Where have the common words near to the variable. which has a similar pattern such as contact number, Property type, number of bedrooms, number of bathrooms, land size, house size and price. Below the regular expression has been explained on how we used them to derive desired information.

Pattern	Extracted data
b0[71]?d{8} \b7\d{8}[^0+]947\d{8}	0702093082
\d{0,}\.?\d{1,}\sperch \d+\sps	10 perch
\d\,?\d+\.\d+?\ss[iq]+[ft]?\d+\ssq\d+\,\d + \ssqft	700 sqft
\s\d{1,2}\sbedroom) (bedroom\s\d+?)\sba throom\s[\d+?] (bedroom\s\d+?)\s[^\b]	3 bedroom
?:\d\sbedroom [^m])(\s\d\sathroom) (bat hroom\s\d	bathroom 4
r^\sr\.\s\d+\s?\d+ rupees\s(\d+\.\d+\s?\d+\.\d+\s?\d+)\d+\s?[0]{4,}\d+\,\d+\,\d+	Rs 18500000

Table 6. extracted information using the pattern

Table 6 shows the extracted variables information. Here contact number typically contains 10 digits and it will start with 0 or 94. Based on these criteria, we make the REXEX to find out the contact number. And when extract bedrooms, bathrooms information the 'bedroom and bathroom' as keywords. Typically, counting of it is being mentioned near to name of bedroom and bathroom.

Typically land sizes are mentioned as perches sometimes we could see it mentioned as acres. The RegEx pattern contains perches and acres as keywords and it returns the output related to perches or acres. And house sizes are mentioned in sqft or sqrft (square feet). Therefore, the algorithm find the nearest integer and returned with the output which related to sqrft or sqft. And in advertisements prices are mentioned in several ways such as price 2000000, RS 2000000. which data contains several digits and contains some custom words like Rs, price and rupees.

RegEx is very easy to extract information but the disadvantage is which is not be able to find the name entities like address and name of advertiser. The reason is in this case there is no any nearest common words like other variables to the address and advertiser. And here for the address the only mention the hometown or nearest city of the property therefore unable to find the exact location of address thus machine learning techniques used to name entity recognition (NER). which can identify the data and understand the data according to training of model.

3.4.2 Custom machine learning technique

Name entity model training is little difficult part to recognize the custom words. Before we get into train the model, majority of time should spend to manually create the train text dataset. Before get into prediction we split the data as train and test.

The database variable is selected based on most represented information. There more than 80% observations represent common information that information are represent as variables. here we predict the data using SpaCy library. SpaCy is specifically designed for NER use and enables applications to process and understand the large-scale texts. It can be used to extract information or to create natural language comprehension systems.

There are already many inbuild training models are available in SpaCy but in this case, there has not any research done in Sri Lankan context about geographical area. When preparing train dataset, there needed custom entity annotation for textual data. Here used online annotation tool the name calls prodigy. When annotated the entities the variables such as Address and Advertiser are used as labels, ad When annotate the words should select the word index from starting to end of train dataset sample.

```
(" weligama house located 100 hotel functioned
home stay ayurvedic unit. good reputation 5
bedroom 1 office room 1 car porch 2 bathroom 1
servant bathroom. 10 perch asking price 25000000
highly recommend trip advisor. good small hotel
predeep 0766549519 ",
{"entities":[{"(0,8,"Address"),(233,240,"Advertiser")]}
]),
```

Above sample is annotation of training sample advertisement data. the address location in 0-8 index and advertiser text location index in 233-240.

SpaCy custom model trains the model with custom code using entity labeled data. After that include the non-trained component like advertisement included address and advertiser name, the trained model algorithm predicts the component name is it address or advertiser name?

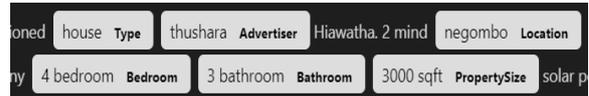


Figure 5. predicted non-trained component

Figure 5 is example of one of non-trained component name entity the model identifies the address of house and advertiser name. The model accuracy is around 70% and which acceptable with compare to rule-based matching when extract the name entity data (address, advertiser). Once extract the all-variable information concatenate the all extracted and web scraped information to database column wise.

Property Type	Address	Area of land	Bedrooms	Bathrooms	HouseSize	Advertiser	contact num	Price
House	Kalagedya Road, Thalawathuppalu	12.5	5+	4	4000 sq.ft.	Sarath Sumanatharanga	+94 777 217 360	14,000,000
House	Thalawathuppalu	11	5+	4	3500 sq.ft.	Sarath Sumanatharanga	+94 777 217 360	38,500,000
House	Kabandula Road, Madabe	7	4	4	2450 sq.ft.	Sarath Sumanatharanga	+94 777 217 360	21,000,000
House	NaN	NaN	NaN	NaN	NaN	NaN	NaN	21,000,000
House	Kottawa	10	2	3	2800 sq.ft.	Sarath Sumanatharanga	+94 777 217 360	22,500,000
House	600 M to Kottawa	8.7	4	4	3000 sq.ft.	Sarath Sumanatharanga	+94 777 217 360	52,000,000
House	Waguru Miv, Acragala, Madabe	19	3	3	1900 sq.ft.	Sarath Sumanatharanga	+94 777 217 360	27,000,000
House	Thalawathuppalu Rd, Hikkadissa, Thalawathuppalu	10	4	4	1508 sq.ft.	Sarath Sumanatharanga	+94 777 217 360	19,500,000
House	M D I Jayawardana, Mawatha, Hikkadissa	8.7	4	3	4 Car parking 10000	Sarath Sumanatharanga	+94 777 217 360	22,500,000
House	GodDermas	21	4	2	3000 sq.ft.	M.Sagar	+94 772 529 250	4,000,000

Figure 6. created database of extracted house data

The figure 6 is the extracted database table. The database contains the information of property type, address of house, land size, number of bedrooms, number of bathrooms, size of house, advertiser name, contact number and price of house. The overall information extracted accuracy is more than 80%. Which is meaningful for insights driven for stockholders.

4. Results

The use of OCR python manual technique and online OCR tools results are similar when compare both. The table 7 shows the overall extracted information score. The score shows how many rows have without any NaN value in every column. Moreover, collected raw data are in unstructured formation therefore much time to concern to clean the text to proper format. The difficulty of this, when correct the spell of words some places important variable information can be converted to wrong meaning like some addresses might not be in the dictionary and addresses predict the wrong results when name of advertiser similar to address.

Variables	Score
Address	97.07%
Contact	89.7%
Area of land	97.08%
Number of beds	93.87%
Number of bathrooms	92.12%
Price	98.23%
Property size	97.08

Table 7. Extracted variables accuracy score

5. Conclusion and Future Recommendations

The research aims to extract information from housing property advertisements using OCR and NLP. In Sri Lanka there are limited newspapers, publish English advertisements therefore, should move to websites as well. More than 10,000 observations used to create database and extract text from the images using OCR, clean the text, Extract information using regular expressions and NER technique. Finally, web scraped house data from internet.

In future preprocess the all data and check statistical relation and comprehensive analysis and visualize the data for insights driven to relevant parties. Finally predict the price of house using various machine learning algorithm to base on the variable data.

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