Study on influencing factors over the existing user friendly car parking system and a forecasting model for "Micro-Location" in Sri Lanka

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Declaration

We declare that this thesis is our own work and has not been submitted in any form for another degree or diploma at any university or other institution of tertiary education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

Name of the student	Signature of the student
……..	…….
	Date: ……

Supervised by:

……

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Sri Lanka.

Date: ……

Affectionately dedicate this book to the one who is going to utilize this system and modify this approach for further studies and implementation in future……!

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Abstract

In the developing world people are very hurry to jump over their responsibilities within the allocated time which is obviously known done to achieve their mission, effectively. And also, transport is one of the mode makes people to feel easy and comfort to promote the rate of efficiency in the quality as well as quantity where it contributes more on the development of the nation in the economic basis. As a developing country, Sri Lanka has needs to perform on a dynamic growth and development throughout the easiest mode of newly introduced parking system to neglect the wastage of time, traffic jam and ensure the convenience of the passengers where it has the scope on the increased contribution of National GDP by the individuals. Therefore, present study was focused more to understand the factors which influence more on the gap between the owners who has car as their major transporting mode and the goal which they need to accomplish within a short while. For that, study was conducted in Colombo District where 250 respondents were randomly selected for understanding the satisfactory level of both manual and automatic existing car parking system and finally, the results were correlated with the assistance of SPSS (version 22) software for further concerns in order to indicate the accurate location (Micro-Location), as well.

According to the results gained from the survey; education level, age and income level were focused more into the fundamental information (personal) over the forecasting model for Micro-Location adjoined Car Parking System where the education level (ICT) had a positive significant relationship ($p<0.01$, $r=0.745$) with the level of perception and willingness of the respondents. Not only that, but the income level also determined the incorporation of new technologies which showed the direct link on their payment through postpaid mobile accounts or the accounts on banks ($p<0.05$, $r=0.645$). Access and understanding the technologies such as Image Processing ($r=0.789$), sensor application ($r=0.568$), GPS and IOT ($r=0.690$), Mobile Applications ($r=896$), Web Application ($r=0.658$) and Payment Transaction ($r=498$) had the positive significant relationship ($p<0.05$) with the youngsters and the knowledge which they possess with. More than 90% of the respondents mentioned that those techniques are common in existing Car Parking sites. However, nearly 89% of the respondents preferred to affix Geo-fencing and Distance Matrix for the Micro-

location with the existing one. It was evidenced by the respondents (92%) that they are interested on finding the parking avenues in tiny deviation spotted by Distance Matrix. Though they knew well (79%) about Geo-fencing, more than 67% of the respondents were poor on understanding the Distance Matrix where the knowledge showed the positive significant relationship (r= 0.868) with its application and adaptation as well. And also, Parking Administrators also showed the same responses as Car Owners did at the study. This system was welcomed by the Car owners (89%) as being more accurate on finding the parking location too. As the whole, existing user friendly Smart Car Parking System which was incorporated with Geo-Fencing and Distance Matrix was elected as the forecasting model via the pre-tested questionnaire survey among the car owners.

Key words: Distance Matrix, Geo-fencing, GPS, Micro-Location

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Abbreviation

01	GSM	Global System for Mobile Communication
02	GPS	Global Positioning System
03	SMS	Short Message Service
04	PGI	Parking Guidance Information
05	IoT	Internet of Things
06	RFID	Radio Frequency Identification
07	PGIS	Parking Guidance and Information System

Chapter 1

1. Introduction

1.1 Background of the study

Advancement of Technology has led the people to make easy and comfort of their livelihood nature where the adaptation has also reached the peak of sense in all especially in Automobile Industry all over the world. Additionally, this conditions are quite lower in most of the developing countries where people are very reluctant to adapt those due to their lack of knowledge and awareness regarding the techniques. However, trend has been increased in the way of transportation where number of contributes on the growth of economy has also been reached peak. Due to the innovative techniques man is prominently trapped to a contented life. However, these progressions have become troubles to the person who bound with the comfortable zone. With the rapid growth of economy and increased living standards, vehicle has become an inevitability of people' routine life which make the increased quantity of vehicle in the surroundings. It brings accessibility to individual, yet parking causes severe problems because of the poor management in most of the available parking sites [1]. It was obvious that there is a wide variation between traditional parking management and the efficiency, security and performance of the Administration and the Car Owners.

Recognising the parking areas are becoming universal problems and ever growing at an alarming rate in every major city. Lot of research and development is being done all over the world to implement better and smarter parking management mechanisms [2]. According to the finding from previous reports; vacant spaces, improper parking, and poor management are some of the parking slot' problems in the Urban Area. Further, parking is restricted in most of the big capitals in the world. However, increasing population cause the increased usage of vehicle in most of the cities where it is concentrated more on the roads. Hence this leads to annoying issues for the drivers to park their vehicles as it is very difficult to find the parking slots [3]. It is common that the drivers often waste their times and efforts on finding the locations

which is safer and convenient. As the results, it ends up with the space on streets with full of vehicle and quite common during the peak hours and the festive seasons.

In whole world, especially in the developed countries parking systems are better however it is not in the optimal elucidation in most of the cities which is being supposed there. Further, it is not provided with the economic benefits over the time consuming and lack to provide large scale services where the resources are limited in the whole terrestrial natures. Plenty of technologies have been risen in the cities with the Parking Guidance Information (PGI), physical objects such as Smartphones, GPS Locations and Cloud Based Servers in all the Parking Administration [4]. Sri Lanka is one of the Developing Countries where the adaptation of technology is lack in its view. The contribution of the percapita income is compulsory to promote the country from the developing to developed status. Therefore, each of the citizens has the responsibilities to make sure their contribution within the time frame with the support of limited available resources. Because of the lack of land availability for parking sites in Sri Lanka, commercial purposes are stagnated in the circle where time saving and advance reservation of parking are the only solution in an efficient way.

According to Kianpisheh *et al*., (2012) 86% of Car Owners have mentioned the difficulties in finding a parking space in multilevel parking slots. Finding spaces during weekends or seasonal days or public holidays can consume more about 10 minutes for about 66% of visitors. Shopping malls are crowded at peak periods and difficulty in finding vacant slots at these places has been known as the major problem for customers. Lack of identification of car park spaces lead to traffic jamming and annoyance to drivers. Improper parking can happen when a driver is not concerning about another driver's rights and needs. Sometimes inappropriate parking occurs due to the poor administrations when a driver parks on or a quite outside of the border of a parking avenue [1].

1.2 Problem Statement

Recognizing the parking locations for car has become a serious issue in most of the Urban Areas of Sri Lanka due to the tremendous increase of private and government vehicles. Currently, sketching the available parking slots and its information are the

emerging problems while the person moves far from his demographic locations. However, at the present scenario management is done with the support of human resources where they can ensure few information which is ineffectively continued in most of the situations, as well. There are many chances that the drivers need to find parking for their private vehicles which lead them to waste of time and can causes the inconvenience at the time. As a developing country, Sri Lanka has needs to perform on a dynamic growth and development through the easiest mode of newly introduced parking system to curtail the wastage of time, traffic jam and ensure the convenience of the passengers where it has the scope on the increased contribution of National GDP by the individuals. Moreover, using GPS alone in the Mobile App comforts the User to access of parking areas, easily. However, Mobile View of GPS is complex as being all the routes are available at a time. Therefore, Geo-fencing can be incorporated with GPS to select the parking areas within the radius. In this scenario, all the routes beyond the radius also are visible to the user as the GPS Tracking.

Therefore, the current study was formulated to develop a parking system while facilitating the Mobile App with Micro-Location which has been merged by both Geo-fencing and Distance Matrix for the accurate site selection. Here, the system much be beneficial as being all the routes beyond the radius would be disappeared once the user select the desired radius. Therefore, Owners can get satisfaction on nearby location without time delay and available slots can be pre-occupied in an advance. And also, ensuring the early reservation allows the payment transaction through the Post Paid Mobile Service where quick SMS notification would be received by the person who engaged with the system adjoined with Geo-Fencing and Distance Matrix Car Parking System in Sri Lanka.

1.3 Objective of the study

The study was designed in order to have the better understanding on incorporation of Geo-Fencing and Distance Matrix in Mobile App for both manual and automated existing Car Parking System in Sri Lanka.

1. To study the current parking techniques (traditional parking/manual parking) and to upgrade the sources utilized up to now at the study location of Sri Lanka.

2. To understand the perception and willingness of the Parking Administrators and Car Owners over the incorporation of Geo-Fencing and Distance Matrix in Mobile App for locating Car Parking areas in Sri Lanka.

3. To forecast a model with the incorporation of Geo-Fencing and Distance Matrix in Mobile App for existing Car Parking System in most of the Urban Areas of the country.

4. And to explore the benefits of incorporated model with Geo-fencing and Distance Matrix at the Car Parking System.

Chapter 2

2. Review of the literature

2.1 Introduction

At the very first (Chapter one) a comprehensive description of the overall project has been described with the problem statement and objectives. Therefore, this chapter provides a critical review of the literature in relation to the developments and benefits on incorporating Geo-Fencing and Distance Matrix for Micro-Location with existing Car Parking System. For this purpose, the review of the past researches have been presented under three major sections named as Early Developments, Achievements and Research Gaps. At the end, this chapter provides the gaps between current parking systems and the improvements which are needed to be done in the future. In addition, Geo-Fencing and Distance Matrix are merged for the accuracy on finding car parking sites in a minimum distance.

2.2 Review of Sensor Techniques in Car Parking System

Parking Guidance and Information (PGI) System for the efficient utilization of Parking is available in most of the places where PGI provides the information on reservation which leads the Users to know the empty slots in an effective way [5]. Internet of Things (IoT) can be incorporated with the Cloud Based Smart Parking System where Smart Phones, GPS and servers relevant Cloud based System can be connected together as the Physical Objects and forms the network where it functions as the automatic system with the use of Radio Frequency Identification (RFID) Technology [7]. Moreover, RFID reader is a sensor used to read the tags of RFID and authenticates for the information of Car Owners in terms of user attributes. Not only that, but each park in the Sense of Parking network deals with the IoT [7] which is connected to the other parks located nearby through the Internet Sources (WIFI).

At the very first Parking Administrators are expected to register their park in the Cloud Server where login occurs in one common server. Hereafter, this administration can provide their services to the Users with the registration in their Smart Car Parking System where RFID Tag Number is common and unique to the User who receive their services. As the result, User can download the application for

reserving the slots in the Parking Avenues. Mobile Apps (Android Apps) are commonly then utilized to book the slots with the assistance of Types of Vehicle and Location where the User need to reach which have been already updated in the Cloud Servers.

In addition, User can get the information such as minimal length between User need to travel and the Car Park where the allocation can be done by the administration quickly as possible. Therefore, user would be sent with the data relevant to the parking at the time of login in the Mobile. Not only that, place of destination is periodically updated by the GPS location with the support of Cloud Server. At the last, destination of the User to the particular park would be read by the RFID Reader via the RFID Tag and can be fixed with the allocated slots. Further, the information is saved in the cloud and is recognized by the neighbour park. Once the User leave this current park, cloud server function again and updates the further information regarding the parking sites until the particular User reaches his destination. Therefore, combination of Sensor Application with GPS (location from home to destination) is incorporated in the System of Cloud solely where identification of slots and reservation are done successfully [3].

In an advance, various approaches have been continued for locating the car parks where Wireless Sensor and Vision Sensor are adapted successfully in order to detect the slots. Here, User can identify the Coordinates and the Parking System. As the results, sensor is compulsory to install in each of the places to enhance the effectiveness. However, it is higher cost than the GPS based parking systems solely. In the contrast, GPS system which is used to trace the locations is cost effective and simple to accept [8]. Those above are due to the increasing living standard of the people demands to buy Private Car and creates the demand day by day for parking spaces. As the supportive to the RFID Tags, Meng Li *et al*., (2015) mentioned that tangible time network release the information for empty Parking which are adjoined with the physical equipment especially GPS Navigation which is utilized to update the information of arrival time of car to the parking slot, tag identification, guidance of vehicle further to destination, as well [9].

In few circumstances, Sensors especially the External Sensors are not necessary to the Users for leading purposes. Real Time Parking is an evolving concept among the administrators to modify their parking sites without External Sensors. Here, Car Owner can quickly fond their nearby slots for parking and would be expected as one of the efficient system within the limited cost and parking area. It is simply reached to the Users by their Mobile Devices which actually comes under the Intelligent Parking System, as well. And also, this system is combined with the Software for the information on Registration (of Users), release of Empty Parking (vacant), Real Time Parking, GPS Navigation, guidance of Indoor Parking, Delay and Reservation, Payment through Online. While focusing on the overall above systems with or without sensors, GPS is common in all the navigation followed by most of the owners where it is considered as flexible on assisting the information of locations. Most of the Users feels that the GPS System is effective for releasing the information, maintaining the effective information towards the Users as well as to the Internet in the Process of Operation [9].

2.3 Review of Image Processing Techniques in Car Parking System

Studies have been separately done regarding the implementation of technologies especially in Automated Smart Car Parking System. Simultaneously recognition of Number Plates of the Cars is done with the name of Image Processing. Vehicle Detection is mainly based on the recognition of Number Plates where own numbers of the vehicle is succeeded through which. In the development of technology, identification of the Real Time Number Plates plays an important role to safeguard the Traffic Policies [10].

Further, basic knowledge of Image Techniques, Artificial Intelligence and Design and Approach of Computational are essential for Pattern Recognition. Therefore, feature extraction techniques are included into the details of capturing the length and height of the vehicle where fitness of vehicle during parking is compared with the class of vehicle for further accuracy, as well [11]. Not only that, Video Image Processing is carried out with the support of Camera at the entrance of the Parking Avenue. However, all those are depend on the cost beneficial and capability of the Administrations. Here the Image detection is obtained through the steps of System

Initialization, Image Acquisition, Image segmentation, Image Enhancement and Image Detection [12][13].

Further, increased productivity of the Nation through the safety transportation has the direct impact on the people's life where Licence Plate Recognition (LPR) plays vital role in many aspects including Parking Slots, Entrance of both Public and Private Administrations, Controlling the border, etc. [14]. Edge Analysis, Colour Analysis and the Adaboost Training are incorporated to the Number Plate Recognition System [12]. In this Licence Plate Recognition, Image Processing and Technology of Character Recognition are efficiently utilized for reading the plates automatically. Therefore, Extraction of Number Plates, Character Segmentation and Recognition of Character are supposed with LPR [15]. Here the segmentation is followed by the extraction of Number Plates and segmentation is done by which of vertical and localization on the Binary Image [16].

2.4 Comparison of Traditional and Smart Parking System

According to the project results revealed from the Ahteshamul huq osmani *et al*., (2016) Pre-existing Parking systems are mainly called as Traditional Parking System which commonly approaches with the techniques of Ultrasonic Sensors, Camera or Sensors especially Infrared rays sensors. There are many Smart Parking System including the random parking, Billboard Advertising Parking and Greedy Parking are popular three [18].

2.5 Automated Multi-Level Car Parking System

By combining all the technological approaches with the Multi-Level Car Parking System, resources are encountered to be utilized successfully. As known from the previous researches, combination of both Automation and the Multi-level parking, it was evidenced with the cost effective and beneficial to the Users on finding the slots within the confinements [18]. This fast parking approach suggest the drivers to find different slots for their needs of parking. And also, drivers are not expected to find their location whereby lift of different layer lift them automatically to the next layer.

If the layer is three, then there would be two sensors in each floor and two sensors on the lift (elevator). The lift is supposed to carry the vehicle to each floor with the controlled approach of Programmable Logic Controller (PLC). While receiving the

signal from the sensor of vacant slot, it would be stopped automatically. Further, space is sensed with the light signals means of full on parking; it would be recognized with red in colour unless it is green.

2.6 Street Parking System

This system functions based on the Wireless Sensor Networks with the monitoring of Vacant Space installed especially with the magnetic Sensor [19]. For the enhancement of the accuracy, vehicle detection algorithm is supposed with. At the center of parking space, Sensor Nodes are established where it has the capability of periodical changes on the Earth's Magnetic Fields. While in and out is experienced by the sensor node, router will receive the message as immediately as possible. Base station is responsible for combining different nodes from which data would be travelled to LED Board and server.

2.7 Review of Geo-Fence and Network Proximity

Many of modern location-based services are often based on an area or place as opposed to an accurate determination of the precise location. Geo-fencing approach is based on the observation that users move from one place to another and then stay at that place for a while. These places can be, for example, commercial properties, homes, office centers and so on. As per geo-fencing approach they could be described (defined) as some geographic areas bounded by polygons [17]. It assumes users simply move from fence to fence and stay inside fences for a while. In this article we replace geo-based boundaries with network proximity rules. This new approach let us effectively deploy location based services indoor and provide a significant energy saving for mobile devices comparing with the traditional methods. Geo-fencing enables remote monitoring of geographic areas surrounded by a virtual fence (geo-fence), and automatic detections when tracked mobile objects enter or exit these areas [28].

2.8 Smart Car Parking Management Solutions in Sri Lanka

In Sri Lanka, people waste their time to find out the parking slots and face inconvenience due to the unavailability of the Parking Space, lack of vacant slots, minimum security and maximized parking fees [20]. Likewise, people of Sri Lanka prefer to adapt the Automated Parking System in order to manipulate their services

successfully and are willing to save money than investing more on Parking Sectors. As the results of the available parking sites, Manual Parking Operation is very obvious than the automated one. According to the statistical reports, Usage of Mobile phone and vehicle higher than the previous years. Therefore, there is a need to formulate the Easy Interactive Automated Car Parking in Sri Lanka.

2.8.1 Statistical over View of the Transporting system and mode in Sri Lanka

As the developing country, Sri Lanka has been engaged with the head counts of 20.7 million with the confined area of 62,705 Sq. km. Transport is one of the major sector contributes more on the economic development of the country where the transport sub sector grew by 7.3% in 2014 compared to the valid percentage of 9.4% in 2013. Further, share of transport on the GDP was around 12% in 2014 to the value of 11.9% in past (2013). According to the Central Bank Report (2015), GDP has been grown with the support of transport sector in a very few number and take a great role in the Economic Activity. The following Table 2.1 shows the trend in GDP due to the transportation in Sri Lanka.

Table 2.1: GDP in Transport Sector in Sri Lanka

Year	GDP at Current Prices (Rs.Mn)	GDP at Constant Prices -2002 (Rs.Mn)
2010	656,469	302,983
2011	753,942	337,088
2012	925,764	357,221
2013	1,098,388	390,847
2014	1,244,179	419,428

(Source: Central Bank Annual Report, 2015/16)

The entire road linkage in Sri Lanka is approximately 116,000 km and it embraces of National Highways (A and B class roads) Provincial Roads (C D and E class roads) unclassified Local Authority Roads and other roads maintained by several Government Departments, other state sector agencies and estate roads [23]. These roads are established significantly in all the urban areas as the networks in the country.

Table 2.2: Roads and Bridges under the Purview of RDA

Province	A Class	B Class	Total	Expressways
Western	374.48	1,222.20	1,596.68	89.03
Central	374.48	1,222.20	1,746.98	-
Southern	346.88	1,338.41	1,501.24	71.47
Northern	734.49	524.97	1,259.46	-
Eastern	619.55	551.13	1,170.68	-
North/Western	352.43	701.74	1,193.78	-
Uva	471.04	693.19	1,164.23	-
Sabaragamuwa	415.57	804.18	1,219.75	-
Total	4,215.05	7,992.93	12,207.98	160.5

(Source: Road Development Authority, 2016)

The Table 2.2shows the how the roads are manipulated in the country. As show in Table 2.2, higher number of distribution of Highway Express have been blessed in the Western Province which is followed by the Southern Provinces.

Along with the report of Census and Statistics (2015), the demand for the private vehicle has increased while comparing with the past decades. At the moment, a total of 5.6 million engaged and registered under the Transportation Mode. This was arisen day by day due to the travel who shift their transporting mode from public transport to private transporting modes especially under the circumstances of inefficient and unsatisfactory services provided by the public sectors. The trend of increasing number of vehicle is similar as of the population growth in the Island. And also, application for the driving license increases tremendously where the distribution rate 2.3 times higher than the past decades [21].

As the comparison, population of vehicle reached the peak for 2015 is 5.6 million where this growth is 7.6% in an average than the growth rate of 6.3% prevailed in 2013. Further, usage of Motor Car has been increased by the respected value of 134.8% which is the highest significant range achieved due to the reflection of the personal use. Above Table 2.3 shows the pattern of transport modes in Sri Lanka in a clear basis where each kind of transporting mode has been increased annually.

Table 2.3: Total Vehicle Population

Class of vehicle	2010	2011	2012	2013	2014
Motor Car	410,282	468,168	499,714	528,094	566,874
Motor Tricycle	529,543	667,969	766,784	850,457	929,495
Motor Cycles	2,100,832	2,354,163	2,546,447	2,715,727	2,988,612
Buses	81,050	88,528	91,623	93,428	97,279
Dual Purpose Vehicles	209,228	242,746	280,143	304,746	325,545
Lorries	296,692	311,510	323,776	329,648	334,769
Land Vehicles-Tractors	276,997	297,070	315,520	326,292	333,362
Land Vehicles - Trailers	46,457	49,578	53,020	55,286	57,298
Total	3,954,311	4,479,732	4,877,027	5,203,678	5,633,234

(Source: Department of Motor Traffic, 2015)

2.9 Summary of review

Increasing number of vehicle causes the positive significant approach on the delay of living standard of the person who plays a vital role in the economic activity in the nation. Therefore, every developed countries modify the system of their parking space for making convenient of the individual during the peak time. Technologies such as RFID, Sensor, IOT, Image Processing and Mobile Apps are cooperated in order achieve those. However, this is lack in adaptation in most of the developing countries.

With those attributes, current study is developed to fill the gap between the earlier researches and available techniques. Computer based applications, mobile applications and payment transaction in GSM are combined together into one theme and implemented directly to the Micro-Location added existing Parking System in Sri Lanka.

Chapter 3

3. Materials and Methods

Present study was carried out in order to have the best understanding on present status of Manual or Automated Car Parking System over the Micro-Location adjoined existing Car Parking System in Colombo District, Sri Lanka. And also, proposing a model merged with Geo-fencing and Distance Matrix would be much beneficial since the locations are accurately identified by the Users.

3.1 Location of the study

A baseline study was conducted along with the Car Owners who drives car for their needs of main livelihood activities and the drivers who get employment through the opportunities given by the Car Owners/ Companies/ Institutions/ Banks/ Health Care Centres/ Universities, etc. in Colombo District in order to find out the usage of Mobile Apps and Web Apps with the support of easy innovative techniques for the identification (Micro-Location) of the parking sites.

Based on the preliminary data, three Administrative Sites named as Shopping Complex, Banks and Software Companies were randomly selected for the study among the many where high productivity (Profit Centres) was in concern. And also, those places welcomed most of the people in terms of Local and Foreign countries with the adaptation of new technologies and trends. Moreover, these places were undergone to the sites of proposing this current Car Parking System incorporated with Geo-fencing and Distance Matrix with the facilitation of Service Provider of Post-Paid Mobile Accounts for the parking reservation. Therefore, it is essential to have the baseline study on those implementation for providing the best services to the future generation.

3.2 Data Collection

At the current study, primary and secondary data were collected from the selected Administrative Sites for the further concern (Project Implementation).

3.2.1 Primary Data Collection

A semi-structured questionnaire was designed on Micro-Location adjoined existing Car Parking System where it was divided into four major sections for the various understanding.

The first section supposed with the personal and demographic information such as Gender, Age, Occupation, Education, Income and Residence, etc. The second section was used to collect the information on Car Owners (Beneficiaries) where the Current Trends, Manual Car Parking, Information on the influencing factors and Technologies such as Geo-Fencing, Distance Matrix, Sensor Application, Image Processing, GPS, IOT, Payment Transactions, SMS Alerts and Mobile Apps were focused more within it. In the third section, Parking Administrators were expected to response as the Car Owners.

At last, fourth section was divided into two (2) divisions where both Car Owners and Administrators (the respondents) were asked to rate the statements according to their preferences which was aimed to get the details about the future concerns related to the adaptation of Micro-Location adjoined existing Car Parking System in Sri Lanka. And also, direct interview was carried out with the Owners of the Parking Administrators (Private) for further evaluation.

3.2.2 Sampling Procedure

The survey was carried out in a Random Sampling Method with the sample size of 250 in both Car Owners (200), Parking Administrators (50) and Owners of the Parking Administrators (5) targeting the people who have the Cars as the transporting mode and preferred to adapt Micro-Location adjoined existing Car Parking System at the study location.

3.2.3 Secondary Data Collection

At the present study, secondary data were collected from each of the Administrative Sites, Annual Reports of the Dialog Company, Census and Statistical Report, etc.

3.3 Data Analysis

The collected data was statistically analyzed in order to produce the study's main research questions and objectives. The data collected from the questionnaires were summarized and analyzed by using SPSS (version 22.0). Frequencies and descriptive statistics were carried out to summarize main data of respondents to get an overview and to conduct further analysis. Then, Associative analysis one way – ANOVA was carried out among dependent and independent variables to identify the significance at 5% and 1% level. Based on the results, relationship was interpreted.

3.4 Data source and collection methods used in research

The collected data were proceeded as below:

Table 3.1: Data source and collection methods

Source	Data Collected
Documentation	Emails, letters, minutes of meetings, published studies
Interviews	Open ended questions
Questionnaires	Using a questionnaire that was designed to ask questions relating to the variables
Direct Observation	Observed personnel using the technology
Participant observation	The author was involved as a temporary member of staff at the laboratories test bed
Physical artefacts	Print outs and screen shots of the results

3.5 Plan for Micro-Location adjoined existing Car Parking System

Based on the analyzed data, Micro-Location adjoined existing Car Parking System was proposed and developed in order to fulfill the perception of the respondents. In addition, System was fully developed to enhance the productivity in those urban areas of the country.

Micro-Location adjoined existing Car Parking System was proposed and intended to ease the car owner's/driver's problem faced in locating the parking places for their

vehicles and reduce the traffic congestion in cities and urban areas in order to minimize accidents and protection of the pedestrian on high ways and in busy streets. The drivers become aware of the parking place and chose the convenient one through the effective communication as well.

3.6 Project Planning

Along with the data, the gap in the existing Mobile Apps was chosen to fill the gap and especially in finding the parking location in accurate manner. The following Figure shows how the Micro-Location adjoined existing Car Parking System was developed to enhance the accuracy of Micro-Location. In this circumstances, Geo-Fencing and Distance Matrix were merged together to formulate a model as below.

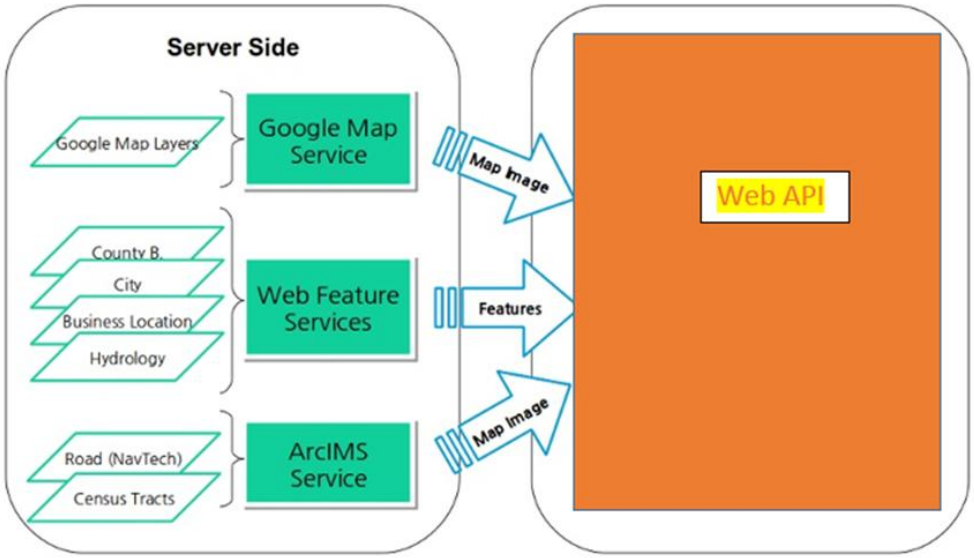

Figure 3.1: Proposed system model architecture for Micro-Location

3.7 The method and the outcome of analysis

The following Table 3.2 shows how the data were interpreted for forecasting the model in design part. Predicted results of experiment were compared with the actual ones.

Table 3.2: The method and the outcome of or analysis

Method	Outcome
Pattern Matching	Predicted results of the experiment and compared them with the actual design
Explanation building	used explanations to analyze the data because the present data was linked to theory
Complex Time Series Analysis	Analysis was complex because current study had one significant finding that did not span over a long period of time
Logic models	Made a partial use of logic models because the experiment looked at the interplay between independent variables (causes) and dependent variables (events). And predicted the causes and then compared them with the actual events

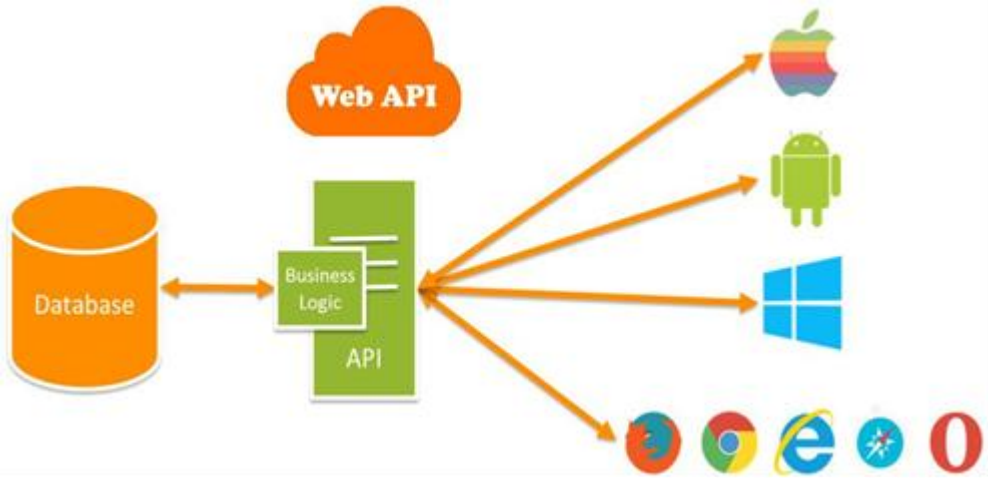

Figure 3.2: Calculate Changes- ArcIMS Service API Architecture

Chapter 4

4. Results and Discussion

Present study (Primary Data Collection) was designed in order to understand the existing user friendly Car Parking Systems which is available in most of the urban areas of the Island and to develop a model/system merged with Geo-Fencing and Distance Matrix to narrow down the gap existed in previous system. Therefore, study was conducted in one (Colombo) of the Districts of Sri Lanka where the density of Human Population is tremendously higher and peak in its concentration which ultimately results with the higher Head Count per unit area.

Along with the primary and the secondary objectives, there was a need to understand the factors which influence more on the existing user friendly car parking systems and personal willingness related with their transporting modes especially Car in the study location. Among the whole, how people face difficulties to find their parking sides which is safer, convenient and the easiest, as well. From the results of this survey, it is expected to outline a model for micro-location with the support of Geo-fencing and Distance Matrix which would be more accurate on finding the parking areas with the individual's minimal effort in Sri Lanka.

4.1 Information on the Car Owners

4.1.1 Personal Information of the Respondents

During the Primary Data Collection; age, gender, education, occupation, monthly income and the residential information were gathered to have the brief idea on the personal information during the study period where it was correlated with the adaptation of the new technologies over the existing car parking systems for their convenient parking avenues too.

At the beginning, respondents who use car frequently for their livelihood activities were gathered with the pre-structured questionnaire (informants). According to that, age (Years) was categorized into different ranges such as 15-25, 26-35, 36-45, 46-55 and above 55 years where the valid responses were resulted as 3%, 30%, 51%, 12% and 4%, respectively. As shown in the Figure 4.1, most of the people in the particular

district drives car who falls within the age category of 36-45 years. And also, 80% of the respondents were male and the rest of the respondents were female, during the study period.

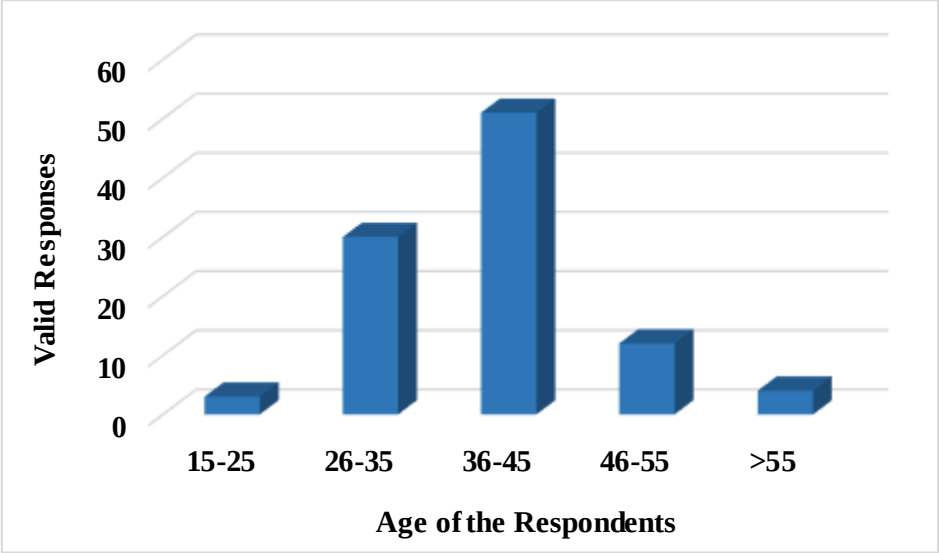

Figure 4.1: Age of the respondents

Further, education is the fundamental rights in our country where most of the Government, Private and Institutions provide its services to promote the nation in the developed way. Moreover, it is compulsory to learn Technological Subjects since 2008 in Sri Lanka where Information Communication Technology is expected to practice in personal life of each for their prosperity [24].

As the supportive, around 61% of the respondents has been succeeded with the Higher Education while 31% and 8% of the respondents with the education of tertiary and NVQ levels. Not only that, but around 52% of the respondents also occupied in private sectors while 16% and 17% with the respected sectors of Government and Business, as well. As shown in Figure 4.2, majority of the respondents (40%) reached the income level with the range of Rs. 50,000 to Rs. 60,000 while nearly 33% of the total receiving the income above Rs. 60,000. However, very few (8%) of the total mentioned their income ranges fell in between Rs. 40,000 and Rs. 50,000. It is quite common that the study location is the capital of the country where the employment opportunity is much higher to other districts [22]. And also, people work in various sectors such as Banks, Institutions, Universities, Software companies, etc. through which their income levels reach the maximum.

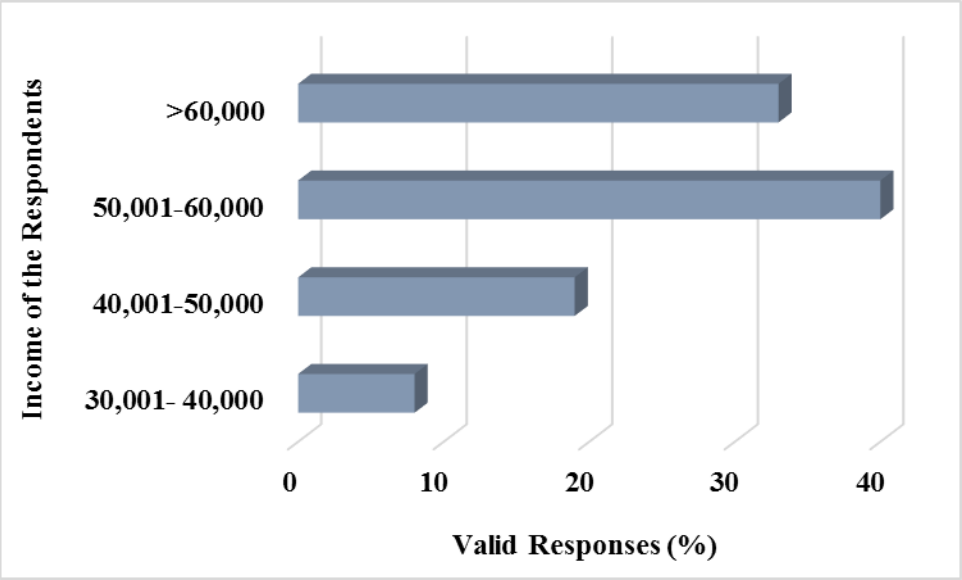

Figure 4.2: Income Level of the Respondents

Another concern of using personal transport facility is based on the residency of people whether they dwell for long or not to that particular place. According to that, respondents were requested to mention about their period that they live in Colombo where approximately 63% of the total had this place as the residential area while 37% of the respondents travelling far from different places within the district, out of the districts and out of the country, as well. Among the 63% of the residential population, 11%, 49%, 30% and 10% live here since birth, below 5 years, 5-10 years and 11-15 years, respectively. This nature motivated the people to have their own transport facilities in order to accomplish their needs and services where majority of the respondents has chosen car as their mode of transport for their livelihood activities.

4.1.2 Willingness of using Mobile App for Micro-Location in Car Parking (Car Owners & Drivers)

In the 2nd section of the questionnaire, car owners and the drivers were undergone with the direct interview for their adapted and updated knowledge on technology. Among the total of 200 respondents, 57% of the total drives their own car and functions as the drivers to their families. However, around 43% of the respondents have been employed as the drivers and provided their services to the particular family, Banks, Institutions, etc. where they actually fixed with.

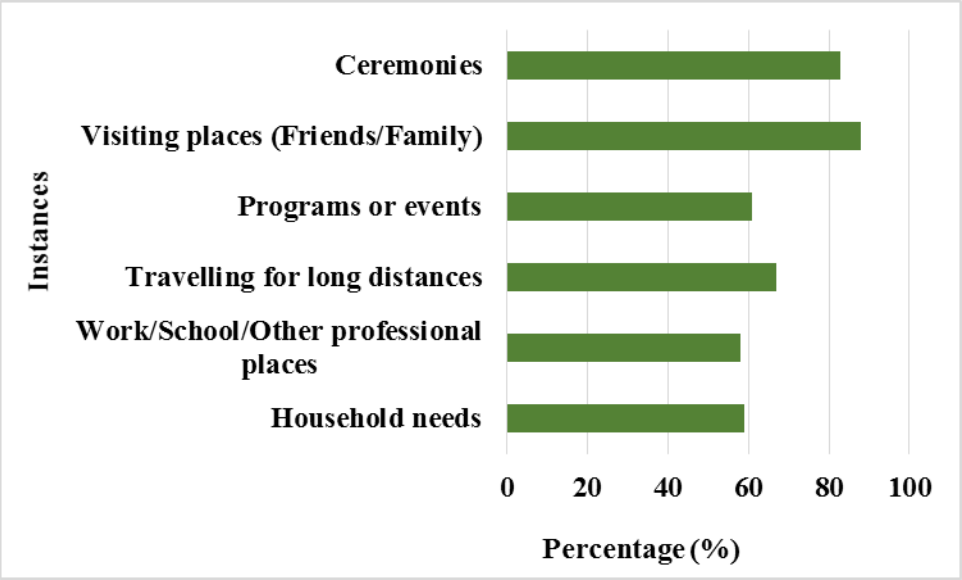

Figure 4.3: Instances for using Car as the mode

And also, 87% of the respondents frequently use the car as their transporting mode for the different aspects such as household need (59%), works/schools/other professional places (58%), travelling for long distances/trips (67%), programs/events (61%), visiting to relatives' or friends' home (88%) and ceremonies (83%). It was evidenced that the people faced difficulties to find their parking places which was inconvenient and time consuming, as well. Therefore, people choose public transports (bus/train) mainly for travelling to longer distances, works and household activities. In most of the situations, people need to travel more than 20 km for the works and ceremonies/functions/events where the parking avenues are unknown and crucial task for the owners. In addition to that, around 32%, 29%, 26%, 9% and 4% with the respected distances of 10-15 km, 5-10 km, 15-20 km, more than 20 km and Lesser than 5 km. Therefore, people are unwilling to travel by car and approach the public services, as well.

Further, Car has been chosen as the tool for the short trails where majority of the respondents (52%) drives it for more than 8-12 times per week while 41%, 4% and 3% were 4-7 times/week, 1-3 times/week and more than 12 times/week, as well. At the study people mentioned the reasons for preferring car due to the convenient, easy for a family trip (for short trips), better facility, efficient and easy access, healthier, easy known parking facilities, no need to waste time for waiting over the public

transports, available in different packages and prices (to buy) and preference by family members.

Respondents were asked regarding the usage of car in the seasonal patterns where 65% of the people did not concern about season while 31% of the respondents used cars in both dry and rainy seasons. It was very few in sole usage (either dry or rainy) of cars at the study location. And also, more than 79% of the total population mentioned about the difficulties in finding the parking places while 21% knew the locations for their better services.

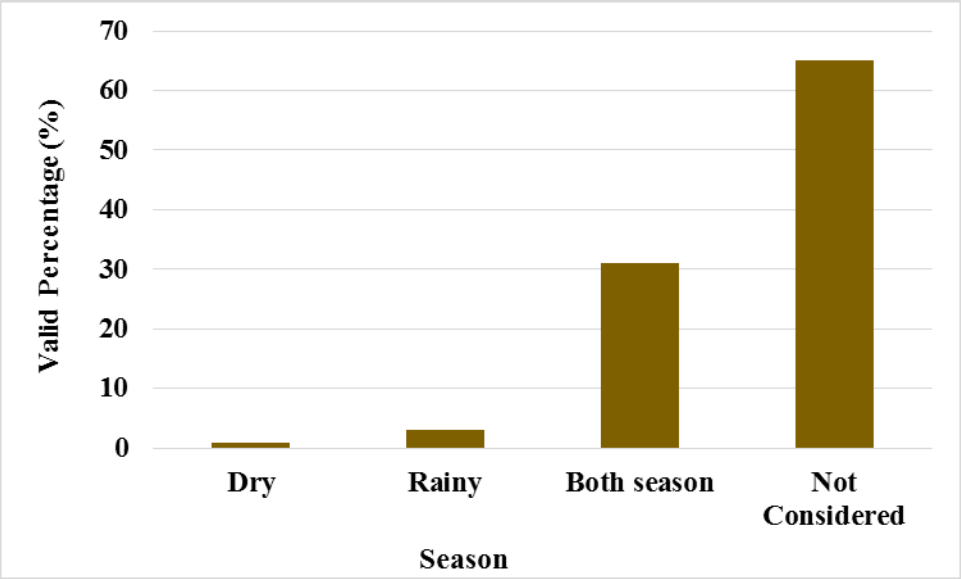

Figure 4.4: Usage pattern in different seasons

Moreover, people were requested that the Agencies/Complex/Banks whom they receive services are always telling the truth about the parking system where 63% of the customers were not aware about the trustiness and only very few (9%) mentioned that they tell the truth regarding the parking payments and locations which is safer until they receive the services at the relevant sectors. In addition, distances from parking to Service Centre such as Bank, Schools, Shopping Complex, etc. were well known through the survey where 75% of the population did not satisfy with the distances during the mesh up times.

Once parking the cars, owners are invited to pay the money where 68% of the total have no any concern on parking payment which is short time or long time services. At the meantime, transaction was immediately done (79%) by the customers in order

to satisfy the parking administrations for that particular time, as well. However, it is quite uneasy that the huge amount of transactions and person who use the Bank Cards are failed to park in those particular side while spot payment is in practices [25]. It is common that the cash transaction (94%) is in practice in most of the study locations.

Not only that people were asked to fill the column where they use Bank Cards such as Master Card/ Visa Card/ Credit for this kind of services. However, around 96% of the total mentioned that they never use those cards for parking administrations. Further, people have the access on online transactions for the billing (pre-paid and post-paid) and for their payment issues [26]. According to the results, all most all the respondents (100%) had the dealing with the "SMS alert" services to complete their mission at least in one of the needful issues such as Cash Deposits and Withdrawal (9%), Online Transactions (12%) and Mobile Payments (3%) where more than 76% of the total has no any concern on the links between the identification of the parking location and the payment issues which is dealt through the SMS services. Therefore, there should be the gap to fill and implement the system to narrow down the gap among Mobile App, Web Apps and Payment Transactions.

However, at the present scenario people have no any awareness with the adaptation of modern technology and payment transactions with more curiosity. Checking and updating the bank balance is done every day (2%), 2-3 times/week (27%), 4-6 times/week (28%), Once/week (21%) and less than once/week (12%). And also, respondents were requested whether they are interested for getting SMS alert on the mobile or nor where more than 90% of the respondents preferred the choices of receiving alerts. Among the total people responded to the survey, total of 96% were using smart phone which is available in all the reasonable prices in all the places.

In addition, people are very interested on identifying fresh locations which are historically very popular, interesting, innovative, new, etc. At those conditions, few technologies can be applicable in order to point out those places, as well [27]. However, the results are very much fixed by 76% of the total where people use GPS Systems while 14% and 10% using the Google Maps and enquiring with the adjutant people from the depicted locations. Tracking the location is mainly done by around 88% of the total with the access of GPS in the particular study location, Sri Lanka.

Not only that, but the terms related with the Technology and Information Communication Technology are also known by 85% of the total respondents. Sources for the technology were plotted out in the survey where the results are given below in Table 4.1 where the peak responses were gain through the friends and college programs.

Table 4.1 Sources for the Adaptation of Technology

Sources	Valid Percent (%)
Government Sources	8
ICT Seminar In College/Universities	22
Advertisement/Television/Magazine	28
Parents/ Family	5
Friends	37
Total	100

4.1.2.1 Technologies and its Adaptation by the Owners

Out lining the current project is mainly focused on identifying the location quicker and safer in accurate manner. Everywhere, slots can be recognized with the support of Internet of Things (IoT). However, micro distances can be eliminated to spot out the right location while the IoT things are lack in usage [7]. Therefore, there are needs to understand the usage of Geo-fencing and Distance Matrix for the accuracy in minor identification [6]. Incorporation of Image Processing, Sensor Application, GPS and IOT, Mobile Apps and Web Applications, Payment Transactions and SMS Notification Services are important where it has been amended to develop and establish those technologies, successfully. According to the results revealed from the survey, the following Figure 4.5 shows the pattern of technology and its awareness of the respondents.

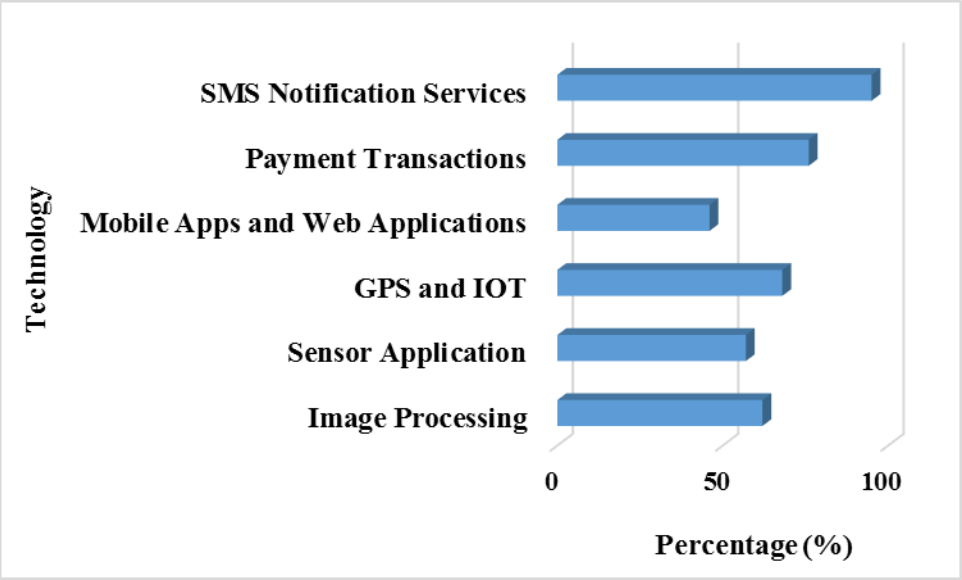

Figure 4.5: Technology and its understanding

Along with the technical approaches, most of the respondents (95%) knew well and had the clear understanding on the SMS notification and the activation ways. Not only that, but the payment transactions also done by the 76% of the total respondents while GPS and IoT, Mobile Apps (Geo-fencing and Distance Matrix) and Web Applications, Sensor Applications and Image Processing were with the valid responses of 68%, 46%, 57% and 62%, respectively. While considering the usage of Geo-fencing, respondents know much about it while the adaptation is pretty lower. Distance matrix concept was known only by 38% of the total while Geo-Fencing concepts were 89%. However, terms such as radius, micro-deviation and micro location were simply understood by 93% of the respondents. This shows that though the respondents had the innovative ideas to merge the concepts together, they did get only few chances to work on it. Therefore, known technologies can be adjoined with newer one to facilitate more on its aspects. More than 50% of the total mentioned that they miss few parking avenues while drivers failing on going deeper into the particular radius on finding its sites.

For that, it could be concluded that combining those Geo-Fencing (79%) and Distance Matrix (88%) into the existing car parking systems, it would be supportive in future where people who dwell in the urban areas are mostly visualized with the micro-parking locations and they can deal directly on finding avenue for their car parking which would be more efficient, effectiveness and accurate too. As the

results, around 77% of the respondents mentioned that combining them together into existing car parking systems, economically they would be safer in future. At the rest, approximately 23% of the respondents had lack of understanding as being lack in the technological approaches. And also, the scale of their (respondents) perception were tabularized as shown in the Table 4.2 as given below.

4.1.3 Effect of Perception on adapting Techniques (Geo-Fencing and Distance Matrix) for Micro-Location in Car Parking System

Study was conducted to determine how the perception prevails towards the incorporated model of micro location (Geo-fencing and Distance Matrix) in the mobile App with the existing one in the selected study location of Sri Lanka. Likert scale (1-5) was used to measure the statements (strongly disagree, disagree, not sure, agree and strongly agree) and obtained mean value for each statement. The statements were designed to analyse the respondents' perceptions towards the existing user friendly Mobile Apps through the assessment of convenience and interests over the addition of Geo-fencing and Distance Matrix for micro-location as well. Average mean score was calculated to obtain the overall perception value over the adaptation of both existing and micro-location outlined one, as well. The following Table shows (Table 4.2) the mean values obtained for each statement from the respondents. One of the factors influencing the customers' perception is that Micro-location added Mobile App is convenient than the existing Mobile Apps too.

According to the Table 4.2, majority of the respondents agree with most of the statements explaining the perception regarding the Micro-Location adjoined Mobile Apps in Car Parking System. In addition to the correlation analysis, perception of the customers was based on the Technology (GPS System) had the positive significant relationship ($p<0.01$, $r = 0.793$) with Micro-Location added Mobile App. It was highly welcomed by most of the respondent while having the negative significant relationship ($p<0.01$) with the places ($r= 0.523$) which is administrated with the existing Mobile Apps too.

Table 4.2: Frequency results of the respondents' perception of Micro-Location Added Mobile Apps over the Existing Mobile Apps in Car Parking System

Statements	Strongly Disagree (1)	Disagree (2)	Unsure (3)	Agree (4)	Strongly Agree (5)	Mean
Micro-Location Adjoined Mobile App in Car Parking System is better than the other Car Parking System, because it doesn't consume much time on finding the parking areas.	1%	6%	13%	35%	45%	**4.17**
It is healthier to adopt Micro-Location Adjoined Car Parking System because it does not have the manual checkup with each owners.	2%	5%	15%	39%	39%	**4.11**
Micro-Location Adjoined Automated Car Parking System is safe to adopt because it does not deal with the Human Errors.	3%	8%	23%	27%	39%	**3.93**
I like Micro-Location Adjoined Car Parking System more because it is efficient than the other Car Parking Systems.	2%	4%	17%	41%	36%	**4.06**
Micro-Location Adjoined Car Parking System can support with the other owners and accurate on finding locations.	3%	3%	9%	45%	40%	**4.16**
Micro-Location Adjoined Car Parking System is not harming the parallel owners as reserving parking places deal with the Apps.	3%	5%	9%	47%	36%	**4.10**

Statements	Strongly Disagree (1)	Disagree (2)	Unsure (3)	Agree (4)	Strongly Agree (5)	Mean
The quality of Micro-Location Adjoined Car Parking System is better since the regulation of is stricter than that of Manual Parking.	6%	20%	41%	22%	11%	**3.14**
It is safer to adapt Manual Parking System because the person who has lack in technology also can deal with the parking attributes.	4%	26%	55%	12%	3%	**2.86**
Technology (Geo-fencing, Distance Matrix, Image Processing, Sensor Application, GPS, IOT, Payment Transactions, Web Applications, Mobile Apps, SMS Notification services) are currently known by the drivers.	3%	4%	6%	43%	44%	**4.23**
Above technologies can be incorporated for the efficient parking system deals with the productivity of the Nation.	4%	4%	8%	34%	50%	**4.26**
Micro-Location Adjoined Automated Car Parking System generate more time consumption than Manual Parking System	24%	62%	9%	3%	2%	**2.01**
Micro-Location Adjoined Automated Car Parking System is more accessible than Manual Parking System.	3%	1%	2%	35%	59%	**4.53**
It is easy to find a Micro-Location Adjoined Mobile App in Car Parking System where I work/study/visit.	71%	26%	2%	0	1%	**1.28**

Statements	Strongly Disagree (1)	Disagree (2)	Unsure (3)	Agree (4)	Strongly Agree (5)	Mean
Manual/existing car Parking System is cheaper than Micro-Location Adjoined Automated Car Parking System.	20%	28%	44%	6%	2%	**2.40**
Micro-Location Adjoined Mobile App in Car Parking System is not as expensive as other Parking System.	3%	0	12%	46%	39%	**4.20**

(Source: Survey, 2017)

As shown in the above Table 4.2, most of the statements were given during the survey regarding the Micro-Location Adjoined Mobile App in Car Parking System where respondents were much interested on adapting the forwarded system, once it is ready for the usage.

4.1.4 Relationship among the factors influencing on adaptation of Micro-Location Adjoined Mobile App in Car Parking System

In this exploration, outputs were undergone to the Correlation Analysis with the most influencing characters where the personal willingness of the Car Owners were indicated along with the factors which determined their priority on adapting New Technologies. Personal Information such as Age, Education, Income Level and the Residency were linked among them which ultimately targeted to the adaptations of the Parking System, as well.

At the study location, education level of the owners determined the types of occupation of the particular respondents where it directly meant the person to select the location as their residential area in the long term aspects ($p<0.01$, $r = 0.558$). And also, how long they should be in those particular urban side was decided by the education level and at the study it was given by the positive significant relationship ($p<0.01$, $r = 0.615$). Particularly, person who owns a car was firm by their confirmation of residential activity where their needs made them to own a car in order to ease their life ($p<0.01$, $r = 0.705$). Further, distance of home to working places/ visiting places/ schools/ bank/ institutions/ universities had made the respondents to hire or drive a car for their professionalism and accessibility ($p<0.01$, $r = 0.659$).

According to the results revealed from the study, parking distances and the working places had the positive significant relationship ($p<0.01$, $r = 0.598$) while the adaptation of Techniques such as Geo-Fencing and Distance Matrix [25] with the existing Car Parking System was quite lower ($p<0.01$, $r = 0.598$). However, it was huge drawback at the available parking sites where there is a need to launch the technological parking system for the car owners to eliminate the traffic jam in the far vision. It was welcomed by the respondents and mentioned that technological

approach in Mobile App is quite easier on finding parking places accurately ($p<0.01$, $r = 0.469$).

In our country, role of gender especially male plays a vital role more than the female on the trend of modern technology while they are young and juvenile. Analysed results agreed with the statements where Age and the Gender with their Education Level promoted the adaptation of Micro-Location Adjoined Mobile App in Car Parking System in Sri Lanka. Role of Gender and Age was significant ($p<0.01$) with the technologies such as Geo- Fencing ($r = 0.657$), Distance Matrix ($r = 0.427$), Image Processing ($r = 0.427$), Sensor Application ($r = 0.527$), GPS ($r = 0.627$), IOT ($r = 0.527$), Mobile Apps ($r = 0.677$), Payment Transactions ($r = 0.827$) and SMS Alert ($r = 0.527$), positively [18]. It was common that those above mentioned technologies have the relationships among them and which can be formulated effectively.

4.2 Information on the Parking Administrations

At this section, Parking Administrations were considered into the overall analysis where number of questions were arranged in an order and were questioned towards the administrators.

According to the results, around 60% of the total succeeded with their tertiary level of education and 30% of the total were with the secondary level of education, as well. It was common in the current scenario where there is no not to expect much on the highest level of literacy to work as the parking administrators. While appointing them with suitable trainings it would be strengthful to handle the variety of customers in its nature. In few cases, level of adapting technology is not based on the level of literacy of the administrators unless they trained for this particular training. And also, only very few (10%) of the owner of parking administrations had succeeded in their Highest Level of education [24].

As shown in the below Figure 4.6, majority of the respondents (65%) fall under the age range of 36-45 while 30% of the respondents were with the range of 46-55. It was quite common that the owner will not be exposed to the administrative sides where they have been occupied with the other employments. And also, only very few (5%) with young age has been engaged with the administrative sectors' of Parking in

the particular study zone. While focusing on the administrative locations, shopping complex took part a great role (55%) which deals with the majority of the respondents as well. However, Banks (35%) and Companies (10%) fall as the second the following of the each.

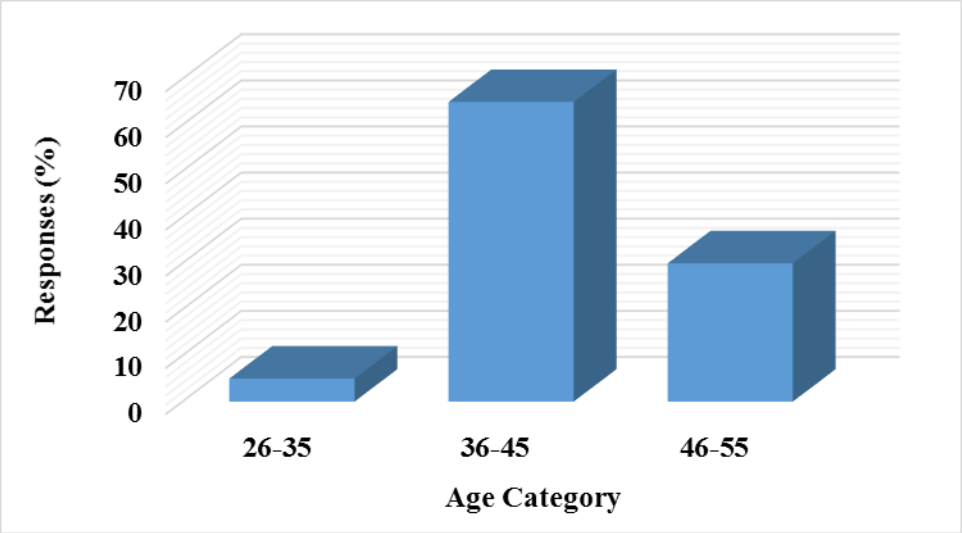

Figure 4.6: Age Category of the Parking Administrators

Therefore, it can be recognized that most of the Shopping Complex are continuously accessed by the majority of the people in the study location of Sri Lanka. Not only that, but the efficient utilization of the resources of parking sites also fairly mentioned by the administrators where the scale showed as Poor (5%), Fair (60%) and Good (35%). Along with their satisfaction level of the administrators on their services to the customers, more than half (>50%) of the respondents were interested on the services provided by their administrations towards their customers who deal with their parking. However, around 50% of the total did not get the satisfaction on their services towards the customers because of the inefficient utilization of the resources, seasonal crowding (over/less), frequent manual support to the owners, lack of separate parking facilities for types of vehicle and too hard to manage. Moreover, around 90% of the parking sites are manually operated to the automated sites. In addition, there was a gap between the knowledge on techniques and the administrators in adapting New Easiest Automated Parking Facilities.

Even though the administrators (75%) had the understanding on the terms of Automated Car Parking, there was a lack in few places. And also, in the present

consequence administrators are very possessive to adapt such kind of technical ways in their parking administrations. This concept was matched with the present study where 85% of the total prefer to follow.

4.2.1 Understanding on Technical Approaches

At this section, awareness of administrators on the technical supports were clearly analysed where it had the direct link on adapting Micro-Location Adjoined Mobile App in Car Parking System in Sri Lanka.

Results from the survey depicted that nearly 90% of the respondents knew the SMS Notification Systems well than the other technological approaches. As shown in the following Figure 4.7, GPS Services took part in the second most important place where 85% of the respondents had the clear understanding on it. However, IoT (25%) and the Web Apps (55%) were taken part in the lower concern of the administrators.

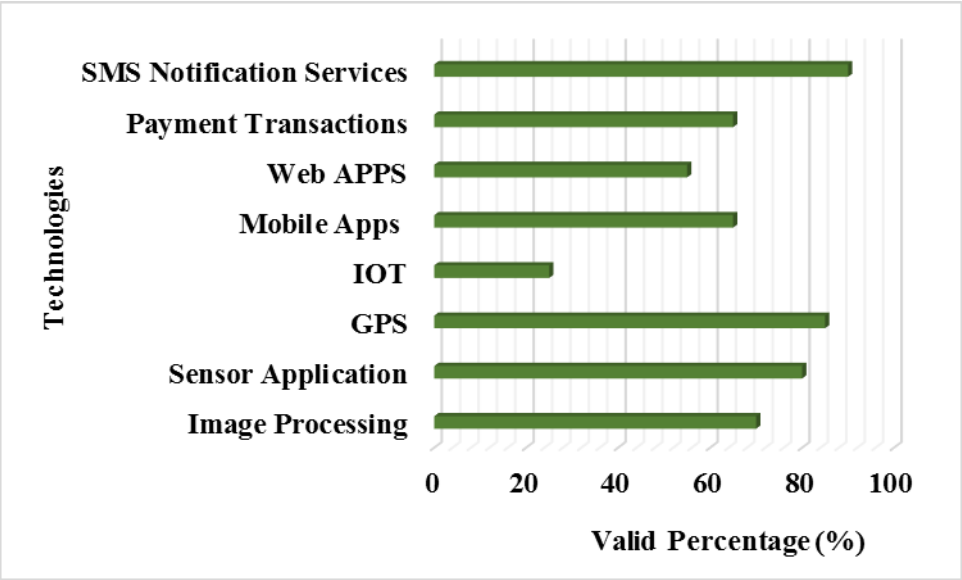

Figure 4.7: Awareness on Technologies

As the whole, administrators were very much interested on the services by combining those into one whole theme where 85% of the total were supported with the Micro-Location Adjoined Mobile App in Car Parking. Here, more than 70% of the respondents mentioned that the adaptation and registration would be easier while using Geo-fencing and Distance matrix in their routes. Further, customers would be

satisfied while administrators assisting them with the right payments for the parking time and the services at the right time.

4.2.2 Effect of Administrators' perception on introducing Mobile App merged with Geo-Fencing and Distance Matrix

Present study was conducted to determine how the perception prevails towards introducing the Micro-Location Adjoined Mobile App in Car Parking System in the selected study location of Sri Lanka. Likert scale (1-5) was used to measure the statements (strongly disagree, disagree, not sure, agree and strongly agree) and obtained mean value for each statement. The statements were designed to analyse the respondents' (Administrators) perceptions towards the Micro-Location Adjoined Mobile App in Car Parking System through assessing the convenience and interests over the other existing parking systems. Average mean score was calculated to obtain the overall perception value in the adaptation of both Micro-Location Adjoined Mobile App in Car Parking System and Manual Car Parking System. The following Table shows (Table 4.3) the mean values obtained for each statement from the respondents.

According to the results, it was greatly welcomed by the respondents to save their money and energy in the satisfactory level. Further, easiness and efficient utilization of the resources such as land and labour can be simplified by the owners and the administrator in order to eliminate the traffic jam in the urban areas where people are very keen on using Car as the transporting mode. Willingness in future is well known through the survey which shows the current trend and technology adaptation well in the scale basis.

Table 4.3: Frequency results of the Administrators' perception on adapting Geo-Fencing and Distance Matrix in Mobile App over the existing Mobile App in parking system

Statements	Strongly Disagree (1)	Disagree (2)	Unsure (3)	Agree (4)	Strongly Agree (5)	Mean
Micro-Location Adjoined Mobile App in Car Parking System is better than Manual or current Parking Technology, because it doesn't have Human Errors.	0	4%	8%	40%	48%	**4.32**
It is healthier to Adapt Micro-Location Adjoined Mobile App in Car Parking System which deals with the Image Processing and Sensor Applications.	0	0	16%	40%	44%	**4.28**
Micro-Location Adjoined Mobile App in Car Parking System is safe to deal because it does contain GPS and IOT Techniques.	0	0	24%	44%	32%	**4.08**
I like Manual Parking System more because it can deal with the drivers who have lack in financial backgrounds and Bank Card Facilities.	0	5%	56%	24%	0	**3.04**
Micro-Location Adjoined Mobile App in Car Parking System does not cause the Traffic Jam.	0	0	12%	52%	36%	**4.24**

Statements	Strongly Disagree (1)	Disagree (2)	Unsure (3)	Agree (4)	Strongly Agree (5)	Mean
Micro-Location Adjoined Mobile App in Car Parking System is not harming the environment because the bottles do NOT causes the stagnation of the cars at the particular places.	0	0	8%	52%	40%	**4.32**
The quality of Manual Car Parking is better because the regulation of is not stricter than that of Micro-Location Adjoined Mobile App in Car Parking System.	4%	16%	32%	16%	16%	**3.40**
It is safer to adopt Micro-Location Adjoined Mobile App in Car Parking System because payment transactions are comfortable.	0	0	16%	60%	24%	**4.08**
Manual Car Parking has no any SMS Notification services.	0	0	8%	40%	52%	**4.44**
Micro-Location Adjoined Mobile App in Car Parking System generate more time wastages than Manual Parking.	24%	56%	20%	0	0	**1.96**
Micro-Location Adjoined Mobile App in Car Parking System is more accessible than the Manual Parking.	0	0	8%	32%	60%	**4.52**
It is easy to find a parking place for the Micro-Location Adjoined Mobile App in Car Parking System when I go out.	20%	64%	16%	0	0	**1.96**

Statements	Strongly Disagree (1)	Disagree (2)	Unsure (3)	Agree (4)	Strongly Agree (5)	Mean
Administrators have much awareness on Mobile Apps and the Web Applications.	0	0	8%	28%	64%	**4.56**
Technology (Geo- Fencing, Distance Matrix, Image Processing, Sensor Application, GPS, IOT, Payment Transactions, Web Applications, Mobile Apps, SMS Notification services) are currently known by the drivers.	0	0	16	68	16	**4.00**
Above technologies can be incorporated for the efficient parking system deals with the productivity of the Nation.	0	0	28	40	32	**4.04**

(Source: Survey, 2017)

4.2.3 Relationship among the variables on adaptation

At this section, what and how are the parameters determining the level of perception was analysed through the SPSS (Version 22) software where the Education level and the training would enhance the usage of Micro-Location Adjoined Mobile App in Car Parking System in Sri Lanka.

At this analysis, satisfactory level of the administrators had the positive significant relationship ($p<0.01$, $r = 0.500$) with the education level of the respondents. And also, while the respondents having the awareness on the new technology it induces the people to adapt those kind of systematic approaches in present as well as in future. These results were agreed with the present survey where willingness and adaptation had the positive significant relationship with the awareness on the new technologies. At these circumstances, there was no any significant influences between the education level and the application of technologies such as Geo-fencing, distance Matrix, Image Processing, Sensor Application, GPS, IOT, Mobile Apps, Web Apps, Payment Transactions and SMS Services from the administrators and they preferred the way of practical approaches. However, this responses were vice versa from the Car Owners. Moreover, adaptation of technologies was positively significant ($p<0.01$) with the Geo-fencing ($r = 0.453$), distance matrix ($r = 0.789$), Image Processing ($r = 0.572$), Sensor Application ($r = 0.762$), GPS ($r = 0.672$), IOT ($r = 0.568$), Mobile Apps ($r = 0.589$), Web Apps ($r = 0.699$), Payment Transactions ($r = 0.559$) and SMS Services ($r = 0.534$).

4.3 Conclusion of the Survey Analysis

According to the results gained from the survey; education level, age and income level were focused more into the fundamental information (personal) over the adaptation of Micro-Location Adjoined Mobile App in Car Parking System by the Car Owners where the education level (ICT) had a positive significant relationship with the perception and willingness of the car owners [24]. Access and understanding the technologies such as Geo-fencing, distance matrix, Image Processing, sensor application, GPS and IOT, Mobile Applications, Web Application and Payment Transaction had the positive significant relationship ($p<0.05$) with the youngsters and the knowledge which they possess with.

It was evidenced by the owners that they are interested on sending request to the required parking place and find out the vacant space via GPS, and make entry to the spot on confirmation. Not only that it was welcomed by the administrators like the same of Car Owners for the adaptation of the Micro-Location Adjoined Mobile App in Car Parking System in Sri Lanka. Therefore, this system can be encouraged in future due to the willingness of the owners and administrators supported with the present pilot study, as well.

4.4 Main Reason to adapt Micro-Location Adjoined Mobile App in Car Parking System

1. Private Parking Areas in the week days is almost with the nature of zero application which ultimately resulting with the wastage of resources (94%).
2. Only very few administrations of the business sites are labelled into the Marker Mapping ranges where update is rarely done. Therefore, owners face difficulties to point out the location for parking (78%).
3. Majority of the existing parking sites using imitation on management which are facilitated with the huge number of personnel with full time management and guides the Users with cash spot payments which ultimately influence on the cost of parking management (69%).
4. Parking of vehicle is not done quickly to the parking slots with the right positions of the vehicles where is followed by the follower in next. Therefore, scarcity of the land for parking is crucial (73%).

Those are the problems were visually detected during the parking time at the study locations. Therefore, this study was pronounced to update the existing Mobile App with Geo-Fencing and Distance Matrix in order to fill the research Gap.

Chapter 5

5 Adapted technologies in recognising parking areas (Micro-location)

5.1 Introduction

This chapter discusses the technologies which were utilized for developing a system based on Geo-fencing and Distance Matrix regards the Micro-Location of Car Paring System in Sri Lanka. Those were the output of preliminary data collection in urban areas of the country. For that, Geo-fencing and Distance Matrix were incorporated with the existing Mobile App.

5.2 Technology Mechanism on Mobile Applications in Car Parking

At the study, willingness of the Car Owners were separately gained regarding the Mobile Applications and the Web Applications were 62% and 32%, respectively. And also, understanding by the Park Admin was 65% and 55%, respectively. In both cases, knowledge on Web Application was quite lower while comparing with the Mobile App, as well.

5.2.1 Geo Fencing

By viewing the GPS, the car parks in the area where the person stand, will be shown by zooming Geo the road maps and car parks could be seen. However, introduction of Geo Fencing Technology merged with Distance Matrix, had not been used for car parking system in Sri Lanka [22]. So far, it is very conducive to implement towards the car owners in convenient way. Location Based Services are sent as the massages to the smart phones which facilitate to locate and identify the car parks available in close by area by the driver of the vehicle when using the GPS and GPS coordinates through the Google Maps. The Administrator is able to set up the Trigger for this purpose when the administrator defined the boundaries on top of the Satellite View of a specific Geographic Area. Therefore, User can locate the suitable car park using Smart Phones. And also, duration of Geo Fencing could be limited by the administrator by specifying expiration where location of the car park could be identified in a wider radius using Geo Fencing. It is adapted in this system of Easy

Interactive Automated Smart Car Parking System due to the lowest power consumption and also User can view it even in the rural area, to locate and identify the parking place which is suitable to the User, as well. In contrast, most of the other data transactions are defining the boundaries by longitude and latitude or through User-Created and Web-based Maps.

5.2.2 Distance Matrix

It is the formula used in the system to track the locations from the Google Map and to subtract the information with the support of HTTP for the clear vision, as well. Additionally, Distance Matrix API based on Google Map is a provision which facilitates the travel distance and time for a matrix of origins and destinations. It is basically done on the basis of recommended route between beginning and lasting distances. At the System of present one, API is connected through the HTTP interface along with the API keys. This technique is simple, native and automatic one in its services and still not utilized in the Car parking Industry in wider basis since being adapted in few developed countries.

Chapter 6

6. Approach on adapting Geo-Fencing and Distance Matrix in existing smart car parking system in Sri Lanka

6.1 Introduction to the Approach

An innovative and unique approach to adapt techniques such as Geo-Fencing and Distance Matrix for identifying location in Micro Deviation along with the existing Car Parking System provides more benefits to both User and Parking Administrators as the solution of identified problems in the previous research activities in Sri Lanka. However, those research approaches have its own benefits while having few inconvenient. The existing parking system uses the IOT, Image Processing and Navigation via the GPS which are easily designable towards the Mobile Applications and Web Applications while those are merged with rare techniques such as Geo-Fencing and Distance Matrix in Sri Lanka and most of the developed and developing countries. This Modern Car Parking System facilitates the space for Users with the minimal charges where the resources of the Parking Administrations also efficiently utilized into services and very much successive to the Nation in future concern, as well.

6.2 Norms for using Mobile App

With the existing model, current model has been added with Geo-fencing and Distance Matrix in the Mobile App. It is common as using GPS however, at the normal situation GPS points out all the parking slots which we look at the current location. All the parking and land marks would be available to the users which is sometimes confuse the User where the person wants to reach. And also, Geo-fencing is one of the techniques which is somehow facilitates the User to search the location within the radius. In that situation also, all the roads and trademarks would be visible to the person and in few situation, it is complex too. Further, Distance Matrix alone solves the problem to divide the area into micro-location where all the shorter distance parking avenues would be accurately found with the mapping.

Though the techniques have various functions, functions can be incorporated beneficially for the common need of all the individuals. At this current parking system, Geo-fencing and Distance Matrix have been merged together for recognizing the parking avenues. Here, User can choose his own radius in the Bar/selection bar where all the GPS track beyond the chosen radius would be automatically deleted from the mobile view. Therefore, User can find their suitable location in simple and convenient manner. As being Distance Matrix is merged together, all the nearby parking slots would be clearly visible to the User where once the User choose one parking avenue; all the other road maps would be disappeared within the selected radius, as well. Finally, only the route would be guided to the User to reach the selected parking place with the advanced reservation.

6.3 Summary of the Approach System

The installation of techniques in Input, Output and process of Micro-location added Car Parking System is beneficial by having non-human violence, security, reliable, minimal cost, free installation of Mobile and Web Apps, scalable and expandable towards the User for the success in parking of available slots, as well.

Chapter 7

7. Analysis and Design of adapting Micro-Location with the existing Parking System

7.1 Introduction to the Design

The previous chapter introduced the whole understanding of the entire solution of the Geo-Fencing and Distance Matrix to the existing Smart Car Parking System. Therefore, this chapter describes the design of solution for the process presented in the approach. Design of Current Car Parking System especially the solution for mobile app is indicated fully in this chapter. Here description is done on top-level architecture of the design by elaborating on the role of each component of the architecture. As the result, research was done for accessing the car owners to find easy and flexible location of car park and navigate them in cities could be extended to the developing town/ municipal areas where traffic consistence are heavily experienced.

7.2 System Overview Design

The Top-Level Architecture of Enterprise Development Applications comprises of three main modules namely, Client, Server and Appliances Control Modules where the following Figure 7.1 illustrates the Top Level Architecture understanding.

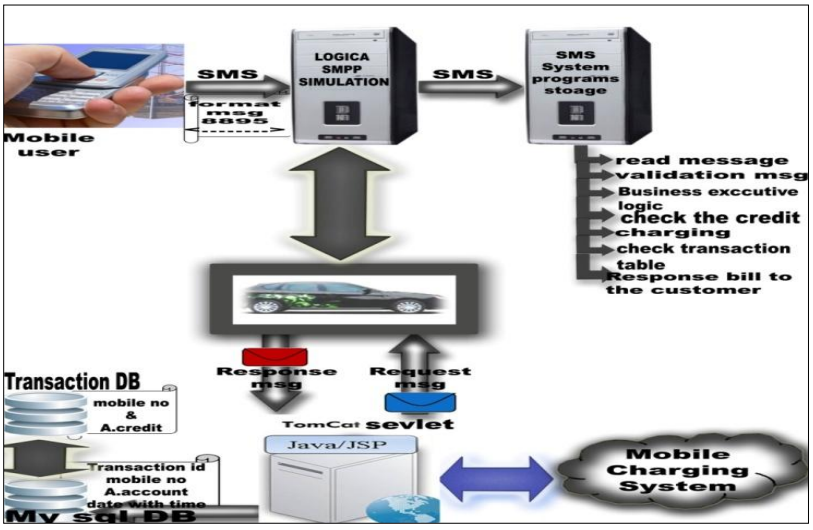

Figure 7.1: High Level Architecture

7.2.1 Interface/ Client Module

This module consists of five sub modules are smart devices and computers. Those sub modules give access to the system. It enables interacting with the system through a desktop client for web application and a smart device for mobile application. Through these sub modules user authentication, secure login, etc. are provided.

The interface module offers facilities for entering inputs and also receiving multiple forms of output information. This module comes as a part of client side software of the solution. The smart phone is provided with an android app to access the overall solution

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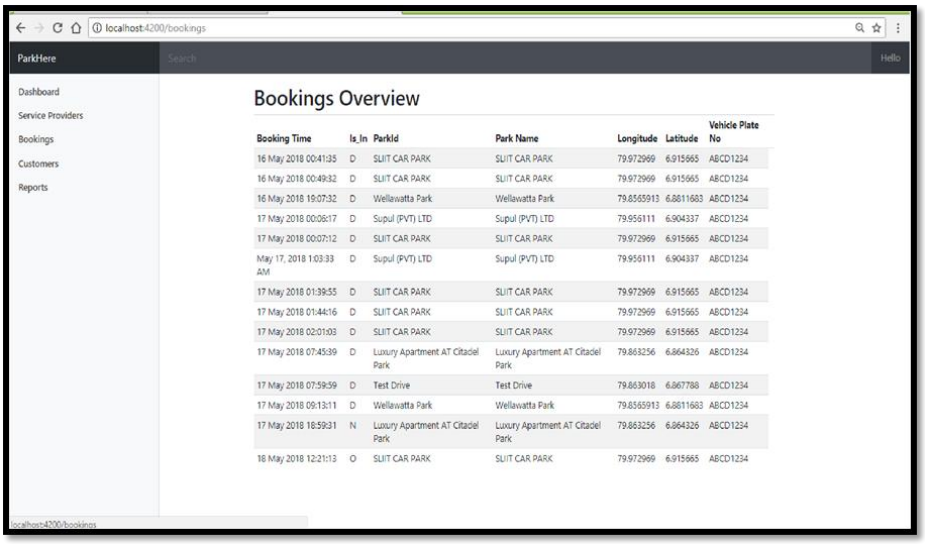

Figure 7.2: Web UI Design

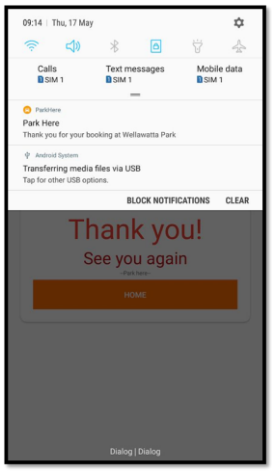

Figure 7.3: Mobile UI Design

Chapter 8

8. Forecasting Model for Micro-Location

8.1 Introduction of Implementation

At this Chapter, implementation of each technological Approaches have been described in clear basis where components and functions of each Designed Approaches are given below. Further, there are several platforms for developing smart phone applications such as Windows Mobile, Symbian, IOS and Android. In the proposed system, the Android Platform App is developed as most of the phones and Handy Devices support Android OS. Java programming language using the Android Software Development Kit (SDK) has been used for the development and implementation of the smart home app. The SDK includes a complete set of development tools such as debugger, libraries, handset emulator with documentation, sample code and tutorials. NetBeans IDE used to develop ASP and image processing codes.

8.2 Implementation of Geo Fencing

The Manhattan Distance is a Grid based approach provides the location accurately as it covers the proper Radius in the Circle area and any of the surface area. Here the Server need to experience too much for loading the coverage area while the User noticing the location for Car Parking. Therefore, performance of the Server decreases and Users have to wait for considerable minutes to view the area.

1. By viewing the GPS, the car parks in the area where the person stand, will be shown by zooming Geo the road maps and car parks could be seen. At the same time, all the routes which has been updated in the Google Mapping would be seen in this tracking. Therefore, using GPS alone in the system will provide multiple idea to the user ultimately it confuses to find out the location towards the User too.

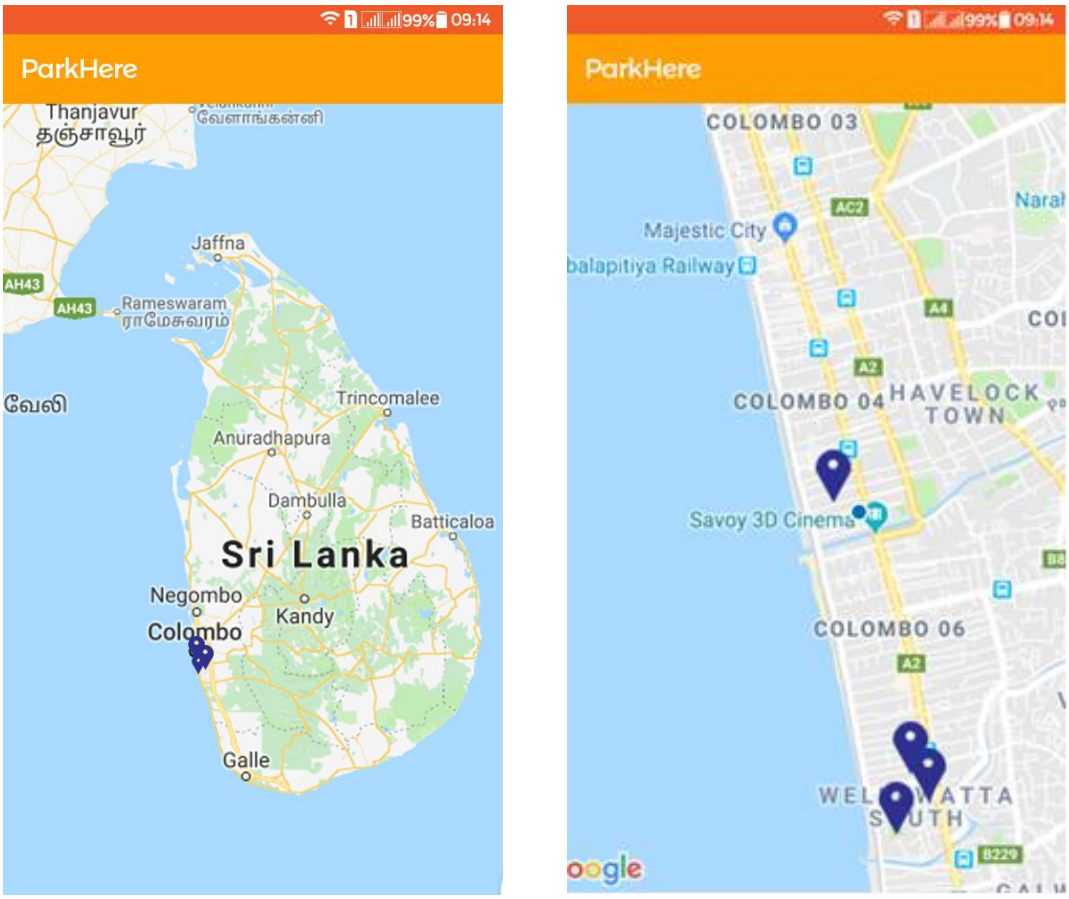

Figure 8.1: Mobile View on Location Identification via GPS

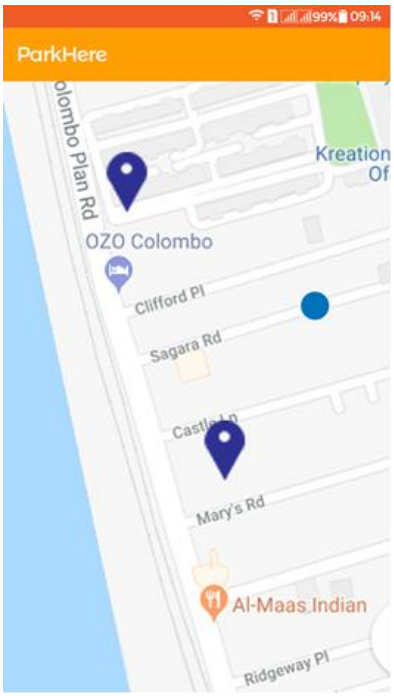

Figure 8.2: Zoomed Mobile View of GPS in parking identification

2. When Geo fencing technology is used in Google maps GPS, the person can be able to search within the radius he preferred, and the area around the radius is indicated clearly with road map and car parks. While adapting Geo fencing technology alone, Mobile view would be much clear than the Google maps GPS where particular radius that the user select would be differentiated with colour and marked for the selection. However, all the maps beyond this radius would also be seen by the User.

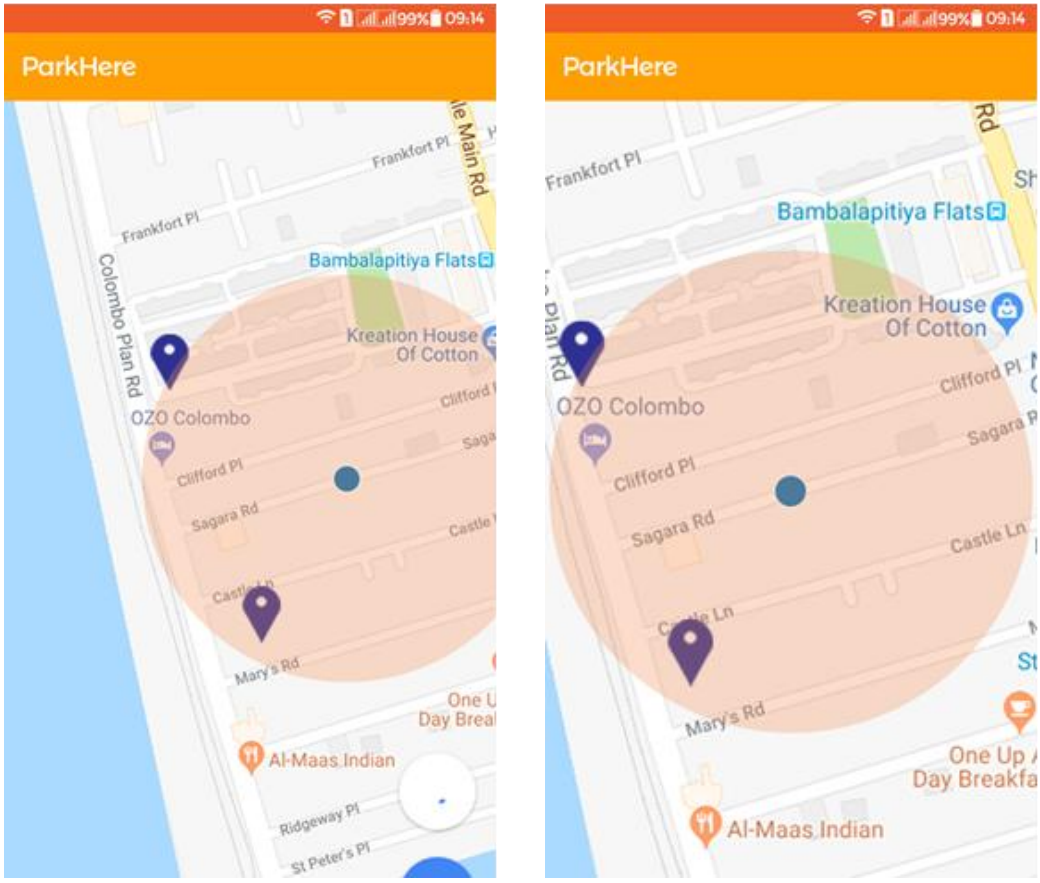

Figure 8.3: Mobile View on Geo Fencing for location identification

Figure 8.4: Mobile View on using Geo-Fencing in parking identification

3. By adding the Distance matrix Technology with Geo fencing GPS maps, the area which have been already indicated from the position where a person stand, the roads leading to all the car parks in the Geo fencing area would be shown.

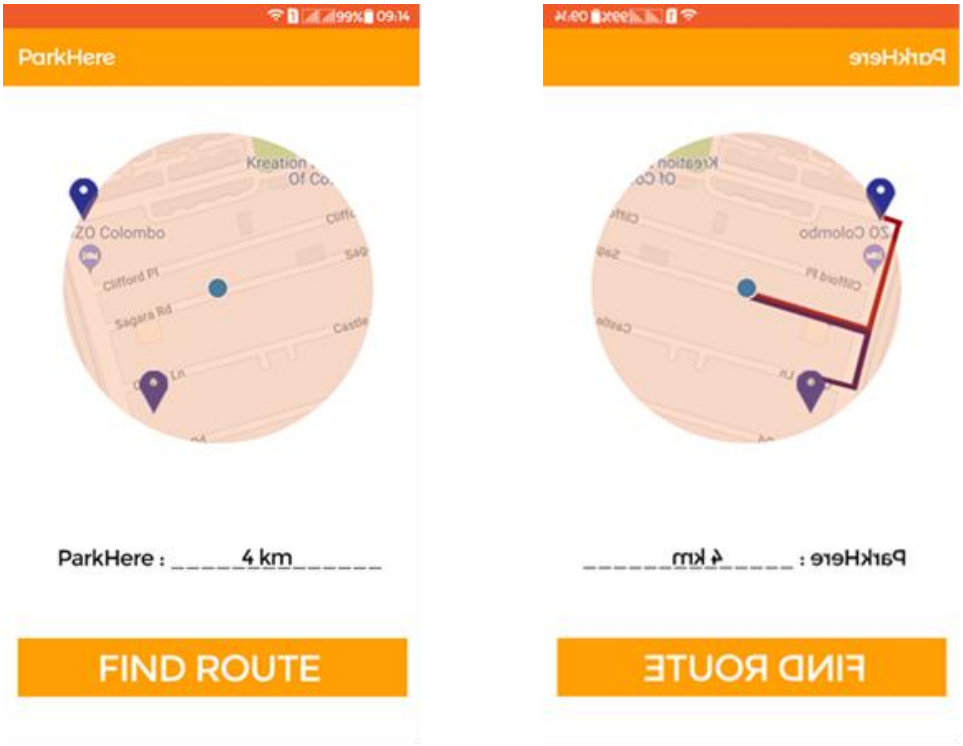

Figure 8.5: Mobile view on Geo-Fencing and Distance matrix adjoined Technology for Micro-Location

Here the current model will facilitate the User to choose the location with the preferred radius and nearby parking locations would be visualized as being shown in GPS and Geo-Fencing Technology. However, the benefit of the current model is User never been get focused the view beyond the radius that he selected. The Figure 8.12 shows the current view over the Mobile App.

4. There is another benefit that once the User select the particular parking location which is nearby his journey, other paths would be disappeared. Therefore, it is much beneficial to the user to reach his destination quickly as possible. This system won't be much complex to adapt too.

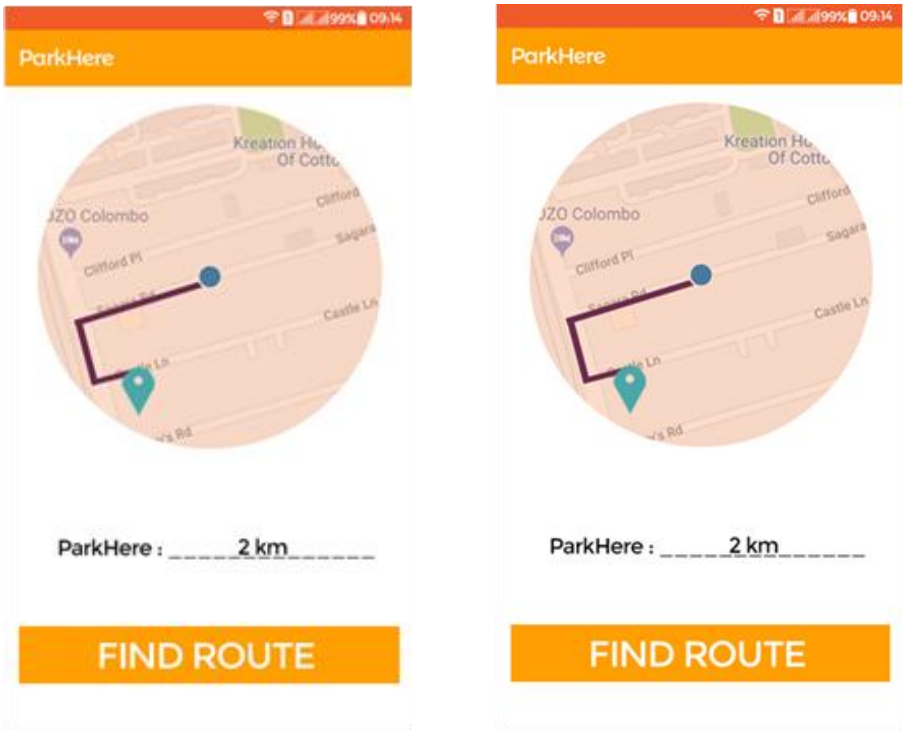

Figure 8.6: Mobile view of merged technologies (Geo-Fencing and Distance Matrix) in choosing Micro-location

However, when look at the Mobile view, the area outside the Geo fencing area too will be viewed and loaded. Due to this the App view user unwanted area other than Geo fencing area creates inconvenience by unwanted focus and considerations. In addition the mobile data is unnecessary wasted, and the phone battery charge is also unnecessary expanded.

In order to avoid the area out of the Geo fencing radius, a new API model in to be introduced, by which the roads and the car parks within the area of the Geo fencing area is distinctly observed. Along with that the shortest route to the car parks a person prefer or selected, the other routes and other car parks will be hidden and only the selected road and car park will be guided as person move. By this, the change of the battery, Mobile data wastage and the inconvenience of the customer is immensely seduced.

It is the easiest way to the Car Owners at their destination and it is denoted and located by the desired car parks, nearby. It is done by giving the weight to each road. Commonly the cost calculation is done by the given weight of each road which the User travel to. Therefore, the road with high weight will not permitted to the car and which is not allowed to play to pay more. As the results, easiest road or the way would be displayed to the User for their Usage as the attempt of beneficial.

8.2.1 PostgreSQL

It is easy to use the Maps and its status which has been already defined in the map and its structure of Data Base Management System. Therefore, it has been incorporated here to adapt in the Geo-fencing and Distance Matrix merged Car Parking System.

8.3 Summary

The above systematic activity via the newly introduced Technology and Techniques, created the much more benefits than the system used up to now in the car Park Industry. Further features can be added in future with the support the Post Questionnaire Survey followed here with. And also, this system is developed in flexible manner which can be modified further according to the willingness of the Owners who use Car as their main transporting mode.

Chapter 9

9. Conclusions

According to the results gained from the survey; education level, age and income level were focused more into the fundamental information (personal) over the adaptation of Micro-Location (Geo-Fencing and Distance Matrix) added Mobile App in Car Parking System where the education level (ICT) had a positive significant relationship with the perception and willingness of the car owners. Not only that, but the income level also determined the adaptation of new technologies which has the link on the prepaid, postpaid or the accounts on banks ($p<0.05$). Access and understanding the technologies such as Geo-Fencing, Distance Matrix, Image Processing, sensor application, GPS and IOT, Mobile Applications, Web Application and Payment Transaction had the positive significant relationship ($p<0.05$) with the youngsters and the knowledge which they possess with.

Further, it was evidenced by the owners that they are interested on sending request to the required parking place and find out the vacant space via GPS, and make entry to the spot on confirmation. The entry and exit are automatically computed and the charges for parking are being recovered by service providers, hence the owner/driver of the vehicle need not pay the money on the spot where techniques such as Geo-Fencing, Distance Matrix, Image Processing, Sensor Application, etc. were carried out to propose the model of the Geo-Fencing and Distance Matrix merged one with the existing Car Parking System in Sri Lanka. And also, Parking Administrators also showed the same responses as Car Owners did in the study at the study location. As the result, system must be taken off as the accurate, comfortable and conducive in the hustle free scenario where beneficial could be arisen over the pollution and health concerns which is advanced than the benefits to both owners and Administrations.

Chapter 10

10. Recommendations

According to the results obtained through the study and implementations of this Smart Car Parking System, there are few needs to launch it in various places in future which is far in its vision, as well.

Study was formulated only to the urban areas as the initiation where the high traffic jam is critically pronounced and influence more on the people' living standard which ultimately reduce the productivity. Therefore, while conducting a case study in all the Sub-Urban and Villages this could be simplified along with the willingness of the residential people.

Secondly, this system can be little modified further to make applicable to the Pre-Paid users and connection can be ensured to the Bank Accounts.

There is a need on adequate training to the user and parking administrators regarding this usage of Mobile App with Geo-Fencing and Distance Matrix in existing Car Parking System to make use of available Modern Techniques in Sri Lanka.

People should be given with much awareness through the workshop/ seminars/ leaflets/ books for ensuring their understanding on the Technologies such as Geo-Fencing, Distance Matrix, Sensor Application, Image Processing, GPS, IOT, SMS Services, Payment Transactions, Mobile Apps and Web Apps, etc. Parking Administrator should be given with the extension services regarding the Easy Interactive Automated Parking Systems and further studies as the Post-Tested Survey should be done.

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12. APPENDIX

Study on influencing factors over the existing user friendly car parking system and a forecasting model for "Micro-Location" in Sri Lanka

"PRE-TESTED STUDY"

QUESTIONNAIRE SURVEY

This questionnaire is designed to collect data for a research project on "**Study on influencing factors over the existing user friendly car parking system and a forecasting model of "Micro-Location" in Sri Lanka- Pilot Study** conduct by Mr. Rajivkanth Sivasithamparam/ M.Sc. in Information Technology/ Assistant Coordinator, Zonal Education Office, Batticaloa District, Sri Lanka. This data will be solely used for study purpose and therefore we request you to support by filling this form in order to collect the data.

Thank you for your assistance.

Yours faithfully,

……..
(Mr. S. Rajivkanth)

Note: “Micro-Location Adjoined Mobile App in Car Parking System” is the system used as the easy and convenient technology in the urban areas in order to utilize the time efficiently, except in rural areas particularly for this research purpose.

Questionnaire No: …… **Date: ……..**

Section -1: Personal Information

1. DS Division: .....
2. GN Division: .....
3. Village/Town: .....
4. Age of the respondent:

   1) 15-25 2)26-35 3) 36-45 4) 46-55 5) Above 55
5. Gender:

   1) Male 2) Female
6. Education:

   1) None 2) Primary 3) Secondary 4) Tertiary 5) Higher education
7. Occupation:

   1) None 2) Government 3) NGO 4) Private 5) Business

   6) Self-employment 7) House-wife 8) Labor 9) Farming 10) Others
8. Average Monthly Income (Rs.):

   1) <30,000 2) 30,001-40,000 3) 40,001-50,000 4)50,001-60,000

   5) > 60,000
9. Are you a resident of this place?

   1) Yes 2) No
10. How long have you been living here?

    1) Since birth 2) < 5 years 3) 5-10 years 4) 11-15 years 5) > 15 years

Section -2: Willingness of the mobile App with Micro-Location in Car Parking System (Car Owners & drivers)

1. Are you the owner or driver of the vehicle?

   1) Owner & Driver 2) Driver

2. Do you frequently choose car as the transporting mode?

   1) Yes 2) No

3. If yes, in which instances you use the Car?

1	Household needs	
2	Work/School/Other professional places	
3	Travelling for long distances	
4	Programs or events	
5	Visiting places (Friends/Family)	
6	Ceremonies	
7	Others…….	

4. Distance you mostly travel from your home?

   1) <5 Km 2) 5-10 Km 3) 10-15Km 4) 15-20 Km 5) >20 Km

5. How many times you travel far (among traffic) per week?

   1) 1-3 times 2) 4-7 times 3) 8-12 times 4) more than 13 times

6. What are the reasons for choosing car as the mode?

1	Convenient	
2	Easy for a family trip	

3	Better facility	
4	Efficient & Easy Access	
5	Healthier	
6	Easy Parking Facilities	
7	No need to waste time for waiting over the public transports	
8	Available in different packages and prices (To buy)	
9	Preferred by the family members	
10	Climatic problems (flood, drought, etc...)	
11	Popular	
12	All the above	

7. What is your preferred brand of Cars?

   1) Mitsubshi 2) Toyota 3) Nissan 4) Lamborghini 5) Range Rover 6) Ferrari

   8) Porsche 9) Mercedes

8. What is the most important factor that determine your preference?

   1) Easily Available 2) Design 3) Automatic Gear 4) Controlled driving

   5) Trustiness (the longer period the brand is available)

9. At which season you use the Car mainly?

   1) Rainy season 2) Dry season 3) Both seasons 4) Not considered

10. Is it easy to get the parking facilities at your places?

1) Yes 2) No 3) No idea

11. Are you sure that the people/Agencies/Complex/Banks whom you receive services are always telling you the truth about the parking system?

    1) Yes 2) No 3) No idea

12. Whether serving agencies/shops are in convenient distance or not?

    1) Yes 2) No 3) No idea

13. Do you feel that you pay the reasonable rupees to receive the services during parking (Parking Tickets)?

    1) Yes 2) No 3) No idea

14. Do you pay your money on the spot?

    1) Yes 2) No 3) No idea

15. If No, How do you pay?

    1) Through Bank 2) Post Paid Mobile Account 3) Pre-paid Account 4) Cash

16. Do you use Bank cards such as Master Card/ Visa Card/ Credit Cards for charging as the compensation of your money needs for parking?

    1) Yes 2) No

17. If yes, what kind?

1	Master Cards of Banks	
2	Visa Cards of Banks	
3	Credit Cards of Banks	
4	Cards of any Shopping Complexes (eg: No limit shopping cards)	
5	Mobile Bills (Post -paid/pre-paid)	

18. If you use Bank card, do you get alert to your mobile in every services?

1) Yes 2) No 3) No idea

19. How often do you check your bank book unless you receive message alerts?

1) Everyday 2) 2-3 times/week 3)4-6 times/week 4) Once/week 5) Less than once/week 6) Other _____

20. What kind of alerts you automatically receive on your mobile?

1	Cash Depositing/ Widrawals	
2	Online transaction	
3	Mobile payments via online	
4	News and current affairs	
5	Deduction of money for car parking	
6	All the above except “5”.	

21. Do you think it would be easy if you get alert on your mobile for parking charges while using bank cards?

1) Yes 2) No 3) No idea

22. Do you use smart phones?

1) Yes 2) No 3) No idea

23. How do you identify the location while travelling far and looking for parking?

1) Asking people 2) Using Mapping Books 3) Using GPS system

24. Do you frequently use GPS for tracking the locations?

1) Yes 2) No 3) No idea

25. For how long do you Google Service?

1) On the very first day of driving 2) once using smart phones 3) No idea

26. Do you familiarize with the term of Technology related with Information Technology?

1) Yes 2) No 3) No idea

27. How do you know/ gain those knowledge?

1	Government pamphlet	
2	Information Technology or any Technology related class/seminar in college	
3	Advertisement (TV, magazine, internet, etc.)	
4	Parents/family members	
5	Friends	
6	Books/articles	
7	Other _____	

28. What are the technology that you learned from these sources?

1) Image Processing

2) Sensor Application

3) GPS and IOT

4) Mobile Apps and Web Applications

5) Payment Transactions

6) SMS Notification Services

29. Do you feel while combining those above 6 applications in Car Parking System would be useful?

1) Yes 2) No 3) No idea

Any Other Comments: ……

Section 3: Information on Parking Administrators

1. Education:

   1) None 2) Primary 3) Secondary 4) Tertiary 5) Higher education

2. Age of the Respondent:

   1) 15-25 2)26-35 3) 36-45 4) 46-55 5) Above 55

3. What is your primary administration on parking?

   1) Shopping Complex 2) Banks 3) Company 4) Institutions

   5) Hotels 6) Restaurants 7) Apartments 8) Parlors 9) any others

   10) Combination of …….&…….

4. How would you rate the overall efficient utilization of parking sides?

   1) Very Poor 2) Poor 3) Fair 4) Good 5) Excellent

5. Are you satisfied with your Parking Administrations?

   1) Yes 2) No

6. If not, then why?

1	Resource is not utilized	
2	Over crowd/ Less crowd	
3	Need an employee to administrate the parking	
4	Have no any separate parking for types of vehicle	
5	Too Hard to manage	
6	Others. (specify)	

7. Do you have Manual Car Parking or Automated Car Parking System?

   1) Manual 2) Automated 3) No Idea

8. Have you familiarized with the Term of Automated Car Parking System?

   1) Yes 2) No 3) No Idea

9. Are you willing to adapt Automated Car Parking System?

   1) Yes 2) No 3) No Idea

10. Are you much aware about the new technologies?

    1) Yes 2) No 3) No Idea

11. What are the technology that you learned from your experiences?

    1) Image Processing

    2) Sensor Application

    3) GPS and IOT

    4) Mobile Apps and Web Applications

    5) Payment Transactions

    6) SMS Notification Services

12. Do you feel that car drivers/owners and the administrators would be satisfied if there is any technology for the right payments for their parking time and places?

    1) Yes 2) No 3) No Idea

13. If Yes, check the reason(s) why you do you dislike the current technology:

1	I am not satisfy with the current technology deal with the transactions	
2	Owners feel it is too expensive while they spend few minutes	
3	Payments are not safer unless it is checked regularly in banks	
4	I am aware of the modern techniques but lack in adaptation	
5	Too inconvenient	
6	Not Healthier	

Any other comments: ……..

Section 4a: Perceptions (Owners/Drivers)

A range of opinions exists about the Manual Car Parking vs. Easy Automated Car Parking System. Please indicate the extent to which you agree or disagree with each of the following statements by using the scale below

5- Strongly Agree
4- Agree
3- Undecided or unsure
2- Disagree
1- Strongly Disagree

No	Statements	1	2	3	4	5
1	Micro-Location Adjoined Automated Car Parking System is better than Manual Car Parking System, because it doesn't consume much time.					
2	It is healthier to adopt Micro-Location Adjoined Automated Car Parking System because it does not have the manual checkup with each owners.					
3	Micro-Location Adjoined Automated Car Parking System is safe to adopt because it does not deal with the Human Errors.					
4	I like Micro-Location Adjoined Automated Car Parking System more because it is efficient than the Manual Car Parking Systems.					
5	Micro-Location Adjoined Automated Car Parking System can support with the other owners.					
6	Micro-Location Adjoined Automated Car Parking System is not harming the parallel owners as reserving parking places deal with the Apps.					
7	The quality of Micro-Location Adjoined Automated Car Parking System is better since the regulation of is stricter than that of Manual Parking.					
8	It is safer to adapt Manual Parking System because the person who has lack in technology also can deal with the parking attributes.					
9	Technology (Geo-fencing, Distance Matrix, Image Processing, Sensor Application, GPS, IOT, Payment Transactions, Web Applications, Mobile Apps, SMS Notification services) are currently known by the drivers.					
10	Above technologies can be incorporated for the efficient parking system deals with the productivity of the Nation.					
11	Micro-Location Adjoined Automated Car Parking System generate more time consumption than Manual Parking System					
12	Micro-Location Adjoined Automated Car Parking System is more accessible than Manual Parking System.					
13	It is easy to find a Micro-Location Adjoined Automated Car Parking System where I work/study/visit.					
14	Manual/existing car Parking System is cheaper than Micro-Location Adjoined Automated Car Parking System.					
15	Micro-Location Adjoined Automated Car Parking System is not as expensive as Manual Parking System.					

Section 4b: Perceptions (Parking Administrators)

No	Statements	1	2	3	4	5
2	Micro-Location Adjoined Automated Car Parking Automated Car Parking System is better than Manual or current Parking Technology, because it doesn't have Human Errors.					
3	It is healthier to Adapt the Micro-Location Adjoined Automated Car Parking Automated Car Parking System which deals with the Image Processing and Sensor Applications.					
4	Micro-Location Adjoined Automated Car Parking System is safe to deal because it does contain GPS and IOT Techniques.					
5	I like Manual Parking System more because it can deal with the drivers who have lack in financial backgrounds and Bank Card Facilities.					
6	Micro-Location Adjoined Automated Car Parking System does not cause the Traffic Jam.					
7	Micro-Location Adjoined Automated Car Parking System is not harming the environment because the bottles do NOT causes the stagnation of the cars at the particular places.					
8	The quality of Manual Car Parking is better because the regulation of is not stricter than that of Micro-Location Adjoined Automated Car Parking.					
9	It is safer to adopt Micro-Location Adjoined Automated Car Parking System because payment transactions are comfortable.					
10	Manual Car Parking has no any SMS Notification services.					
11	Micro-Location Adjoined Automated Car Parking System generate more time wastages than Manual Parking.					
12	Micro-Location Adjoined Automated Car Parking System is more accessible than the Manual Parking.					
13	It is easy to find a parking place for the Micro-Location Adjoined Automated Car Parking System when I go out.					
14	Administrators have much awareness on Mobile Apps and the Web Applications.					
15	Technology (Geo- Fencing, Distance Matrix, Image Processing, Sensor Application, GPS, IOT, Payment Transactions, Web Applications, Mobile Apps, SMS Notification services) are currently known by the drivers.					

Please leave any comment you have:

……

THANK YOU VERY MUCH FOR YOUR ASSISTANC

Correlation of Administrations

	Education	Age	Place	Efficient	Satisfaction	Type	Adopt	Aware of technology	Image	Sensor	GPS	IOT	Mobile Apps	Web Apps	Payment	SMS	Useful
Education	1	0.000	-.100	.030	.500*	.111	-.327	-.042	-.454*	-0.478	-0.568	-.454*	-.454*	-.454*	-0.578	-.454*	-.093
Age		1	.035	.251	.280	.155	.065	.000	.244	.244	.244	.244	.244	.244	.244	.244	.065
Place			1	.362	.075	-.274	.073	.149	.024	.024	.024	.024	.024	.024	.024	.024	-.136
Efficient				1	0.000	-.180	-.226	.180	.169	.169	.169	.169	.169	.169	.169	.169	.478*
Satisfaction					1	.333	-.420	-.250	-.314	-.314	-.314	-.314	-.314	-.314	-.314	-.314	.140
Type						1	-.140	-.167	.105	.105	.105	.105	.105	.105	.105	.105	.327
Familiarized							-.243	.000	.061	.061	.061	.061	.061	.061	.061	.061	.081
Adopt							1	.490*	.572**	.762**	.672**	.568**	.589**	.699**	.559**	.534**	.216
Aware of technology								1	.419	.419	.419	.419	.419	.419	.419	.419	-.210
Image									1	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	.279
Sensor										1	1.000**	1.000**	1.000**	1.000**	1.000**	1.000**	.279
Useful																	1

*. Correlation is significant at the 0.05 level (2-tailed).

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

Correlation of Car Owner

	Occupation	Monthly. Income	Resident	How long	Owner	Mode. Of. Car	Household	Work	Trip	Program	Visiting	Ceremony	Distance
Age	.030	-.297**	-.023	-.101	.046	.112	-.135	-.018	-.137	-.094	-.078	-.041	.025
Gender	.106	.038	.072	.006	.071	.030	-.112	-.030	.138	.010	.046	-.093	-.010
Education	.300*	-.135	.052	.615**	.165	.052	.104	.072	-.150	-.086	.175	.083	.262**
Occupation	1	-.241*	.558**	.250*	.034	.152	.298**	.057	-.147	-.136	-.082	.120	.591**
Monthly Income		1	-.062	-.164	-.201*	.041	-.159	.026	-.062	-.072	-.193	.039	-.009
Resident			1	.037	.705*	.173	.176	-.149	-.009	-.152	-.099	.016	.032
How long				1	.155	-.003	.351**	.134	-.213*	-.182	.088	.045	.314**
Owner					1	.025	.138	.125	-.207*	-.032	.177	.037	.235*
Mode. Of. Car						1	.101	-.093	-.171	-.187	-.051	-.175	.204*
Household							1	.133	-.150	-.333**	.193	.110	.659**
Work								1	-.123	.057	.065	.061	.156
Trip									1	.169	.063	-.079	-.344**
Program										1	.146	.075	-.253*
Visiting											1	-.003	.213*
Ceremony												1	.098
Distance													1