Masters Project Final Report

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Project Title	**GPS based monitoring with SMS alert system to improve the quality of spare parts delivery process**			
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Please Circle the appropriate	**Master's Program**		**Type**	
	MIT	**MCS**	**Research**	**Implementation**

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GPS based monitoring with SMS alert system to improve the quality of spare parts delivery process

A dissertation submitted for the Degree of Master of Information Technology

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University of Colombo School of Computing
2017

Declaration

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge it does not contain any material published or written by another person, except as acknowledged in the text.

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Signature: Date:

This is to certify that this thesis is based on the work of

Mr. R.M.N.S Rajapaksha

Under my supervision. The thesis has been prepared according to the format stipulated and is of acceptable standard.

Certified by:

Supervisor Name: Dr. K.L Jayaratne

_____

Signature: Date:

Abstract

Customer satisfaction is one of the main aspect that can be taken as a measurement of the success of a company. Diesel and Motor Engineering PLC (DIMO) has a problem with the efficiency of delivering the products to the customers who live island wide which had led to customer dissatisfaction. The main reason for this problem is communication issue among the drivers of delivery trucks and customers as it is done manually. To reduce this problem presently, the communication is occurred with the interference of the coordinators. This project is carried out to provide a solution to the mentioned problem.

This project suggests a Global Positioning System (GPS) based Short Message Service (SMS) alert system for an efficient delivery of vehicle spare parts to the customer shops. According to the current latitude and longitude of the delivery vehicle provided by the GPS/GPRS based data logging device attached to each delivery vehicle, the server application finds the customer shops within 5Km of radius around the vehicle and sends the SMS alert to those shops using the details stored in the database. And each delivery vehicle can be tracked using the GPS/GPRS based data logging device and the location of the vehicle will be updated on the map. So that past records can also be reviewed.

The suggested system is tested with a delivery vehicle and it proved that the intermediate communication of coordinators can be completely replaced with the newly developed system. This system has ultimately improved the efficiency of the delivery process while minimizing the communication cost and time wastage of the client.Notably, SMS alert system is used to reduce the delays and increase the efficiency of delivering goods by making a flow of distributing the products to the shops in the driving toute.

Acknowledgement

I would like to convey my deepest gratitude to those who helped me to make this masters project a success. I specially thank to Lecturer Dr. K.L Jayaratne, University of Colombo who guided me throughout the whole research project and encouraged me by giving necessary instructions to complete this.

Next I would like to express my sincere gratitude to Mr. Asela Ratnayake, Deputy General Manager, DIMO (PLC) who has spent his valuable time to support me and inspire me in his every possible way to make this a success as my advisor. Furthermore I wish to thank my friends in the electronic engineering field, who assisted me by designing the GPS tracking device which is very important for this project. Further I thank all the delivery personnel from whom I got assistance for my data survey.

Finally I am sincerely grateful to my parents, DIMO staff, and my friends who always encouraged and stood behind me.

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List of Abbreviations

DIMO - Diesel and Motor Engineering PLC

GPS - Global Positioning System

GPRS – General Packet Radio Service

SMS - Short Message Service

GSM – Global System for Mobile Communications

SRS – Software Requirement Specification

API – Application Programming Interface

VPS – Virtual Private Server

DBMS – Database Management System

SRS – System Requirement Specification

IC – Integrated Service

IDE – Integrated Development Environment

TTFF - Time-To-First-Fix

SMT – Surface Mount Technology

EDGE - Enhanced Data rates for GSM Evolution

UMTS - Universal Mobile Telecommunications Service

HSDPA - High Speed Downlink Packet Access

CHAPTER 01- Introduction

1.1. Motivation

The majority of the organizations are competing to survive in the volatile and fierce market environment. Performance of the employees is an essential tool for the success of any organization. Therefore, the poor performance, negligence of work and irresponsibility of employees of any working environment will hinder the overall organizational effectiveness, which finally has an adverse effect on the customer satisfaction. Customer satisfaction is a marketing term that measures how products or services supplied by a company meet or surpass a customer's expectations. Customer satisfaction is really important because it provides the business owners with a metric that can be used to manage and improve their business. Thus, increasing the customer satisfaction will be immensely helpful in quickly grabbing the market by the company and also retaining customers with them.

Diesel and Motor Engineering PLC (DIMO) mainly acts as an authorized dealer of some of the world renowned brands. This company supplies and delivers vehicle spare parts to different customer segments while catering their products to the customers who are scattered around the island. According to the data gathered and analyzed hitherto, it has been found that the delivery process of the company should be further enhanced, as it lacks efficiency. Mainly it has been caused by the delay and inaccuracy of details provided by the delivery personnel's (drivers). Though the company has promised to deliver goods to the customers on a particular date and time, it always gets delay to reach the customers due to several reasons. As a result, the coordinators, the middle level and top level managers, who are responsible for the particular stores and the goods, always need to have a clear understanding of in which location the delivery vehicle is next heading of.

Since customers are very important external stakeholders of the organization, managers are highly accountable for what they have said and done in regarding with delivery process of the goods to the customers. Therefore, in order to update them about their goods and the locations where the delivery vehicles are in, mangers should have a thorough understanding and a tracking system to monitor these vehicles of the company. The time taken to get the updated time where the delivery vehicles will reach a customer would vary depending on the situation.

It has been found that the delay and inaccurate communication between the drivers of the delivery vehicles and the customers are the major bases behind this issue, which emphasizes

the need of a proper monitoring system of the delivery process. This has been the key motivation of this project and it is intended to avoid the existing issues of the delivery process hereby.

1.2. Aims and Objectives

The main objective of the suggested system is to increase the customer satisfaction of the customers to whom DIMO vehicle spare parts are distributed island wide. To achieve this main objective, some sub objectives have to be achieved.

- **To evaluate the causes and reduce the additional time taken to deliver the vehicle spare parts to the customers**

  With the current delivery process, the additional time taken to distribute the goods to the relevant customer will be evaluated by the feedback of the customers.
- **To increase the efficiency of vehicle spare parts delivery process**

  After evaluating the causes for the delay of delivering goods, necessary implementations will be done.
- **To increase customer satisfaction through performing transparent delivery process activities of the organization**

  A transparent delivery process will be implemented instead of the existing process, so that the both parties, the company and the customers have a clear awareness of how the things are happening.
- **To minimize the communication costs that are related to the delivery process through the SMS alert system**

  A new system will be suggested to inform the customers of the delivery vehicles. For this, SMS alert system will be used. To identify the positions of the vehicles, a GPS/GPRS data logging device will be used.

1.3. Scope

To increase the customer satisfaction of DIMO and to have a transparent delivery process, this implementation is carried out. The suggested system is enclosed with three main components which are; GPS/GPRS based data logging device, SMS gateway and the server side application. GPS/GPRS based data logging device is developed to identify where the delivery vehicles' current locations and server side application will find the near customer shops within a 5Km of a radius according to the latitudes and longitudes that are provided by the

GPS tracker. With the details of the near customer shops that are inside the database, SMSs are sent to inform that a delivery vehicle is nearby.

1.4. Structure of the Dissertation

The dissertation presents the innermost details of the aforementioned research. Rest of the dissertation is organized as follows.

Initial Chapter provides the introduction for the topic; motivation and the problem domain of the project. Further it emphasizes study area which specifically used to carry out the implementation activities and the objectives that the programmer intends to cover from this project.

Chapter 02 will give a comprehensive overview of the background information and a critical review of similar systems available and technologies available. Chapter 03 describes the analysis and design of the project. Analysis comprises the details that are related to the Software Requirement Specification (SRS) while the design comprises the evidence of the methodical approach to the design of the solution.

Chapter 04 presents the aspects such as selection of implementation technology and the justification for the choices. Description of the software engineering aspects used in the System Implementation is included. Chapter 05 describes user evaluation and the testing of the application in detail. Finally Chapter 6 presents major findings, achievement of objectives and how the work could be extended.

CHAPTER 02 – Background

2.1. Background Description

Diesel and Motor Engineering PLC (DIMO) has analyzed gathered data of the existing delivery system and it has been found that the delivery process of the company should be further enhanced, as it lacks efficiency. Mainly it has been caused by the delay and inaccuracy of details provided by the delivery personnel's (drivers). Though the company has promised to deliver goods to the customers on a particular date and time, it always gets delay to reach the customers due to several reasons. The communication of the stakeholders of this process is done manually. So this has become the major issue of this process. To provide a better service, this system is suggested.

2.2. Used Technology

This project describes how the real time GPS tracker is implemented with integrated Google maps API, in order to monitor the delivery process and to update the customers through a SMS alert system. The system mainly gets the service of few latest technologies such as GPS, Google map API and other web technologies. The stability and simplicity of these used technologies are very helpful in implementing the system effectively.

2.3. Available Similar Systems

Real-time tracking and management of vehicles has been a field of interest for many researchers and developers and a lot of research work has been done for tracking systems. Recently the various anti-theft modules like steering wheel locked equipment, network tracking system and traditional electronic alarm are developed along with client identification and real time performance monitoring.

The hardware and software of the GPS and GSM network were developed. The proposed GPS/GSM based System has the two parts, first is a mobile unit and another is controlling station. The system processes, interfaces, connections, data transmission and reception of data among the mobile unit and control stations are working successfully. These results are compatible with GPS technologies [1]. A vehicle tracking system is an electronic device, installed in a vehicle to enable the owner or a third party to track the vehicle's place. This paper proposed to design a vehicle tracking system that works using GPS and GSM technology. This system built based on embedded system, used for tracking and positioning of

any vehicle by using GPS and GSM. This design will continuously watch a moving Vehicle and report the status of the Vehicle on demand [2].

As described in [3], a practical model for routing and tracking of mobile vehicles in a large area outdoor environment based on the GPS and GSM. The supporting device GPS continuously move with the car and will calculate the co-ordinates of each position and when required by the owner it can be communicated with the help of GSM modem which is installed in both Transmitter and receiver section. GSM modem is controlled by a 32 bit ARM7 LPC2148. The device will collect position to supervised center by the SMS or GPRS and which can be located in the Google Earth and so the current position of the car can be known.

In [4], a google map based monitoring system is evaluated. This tracking system can inform the location and route travelled by a vehicle, and that information can be observed from any other remote location. It also includes the web application that provides the exact location of target. This system enables to track target in any weather conditions. This system uses GPS and GSM technologies. The paper includes the hardware part which comprises of GPS, GSM, Atmega microcontroller MAX 232, 16x2 LCD and software part is used for interfacing all the required modules and a web application is also developed at the client side.

CHAPTER 03 - Analysis and Design

3.1. Analysis

User Personas and Characteristics

Users in the company – These users can monitor the delivery vehicles with the details coming from the GPS/GPRS based data logging device attached to the delivery vehicles. This device is developed to switch on when a ride is started. So that, the company can monitor the delivery vehicles during the drive.

Customers - GPS/GPRS based data logging device sends the GPS data to the web server which is inside the VPS after each 20 seconds. Using the GPS data and the customer details retain inside the database server, the application retrieve the customers who are within the 5Km of a radius of where the delivery vehicle is now and send a SMS alert to inform the customers about the delivery vehicle.

Functional Requirements

This section has specifies all the major functions of the system with respect to the customer supplied specifications.

- Switch on the GPS/GPRS based data logging device.
- Update the position of the delivery vehicle position in 20 second interval, to the web server.
- Retrieve the customer shops within the 5Km of a radius from where the delivery vehicle is now.
- Retrieve the contact details of the customers of the above mentioned list.
- Send SMS alerts to the customers through the SMS gateway.
- Using the GPS data provided by the GPS/GPRS based data logging device attached to the delivery vehicle, draw the route of the vehicle on Google map.
- Check the previous records of each delivery vehicle.
- Calculate the total distance of a drive.
- Add new delivery vehicles to the system.
- Add new customer shops to the system.

3.2. Design

Methods and Techniques

Since this research is on developing a system, waterfall (iterative) approach has been used. Waterfall model was chosen for this system development mainly because the requirement of this research is simple, clear and the duration is only one year of time.

According to Winston W. Royce, the model consists of six main phases. The figure 1 presents the phases of waterfall model [lmarsdd.com, *Waterfall Methodology*]. The research work has been carried out accordingly.

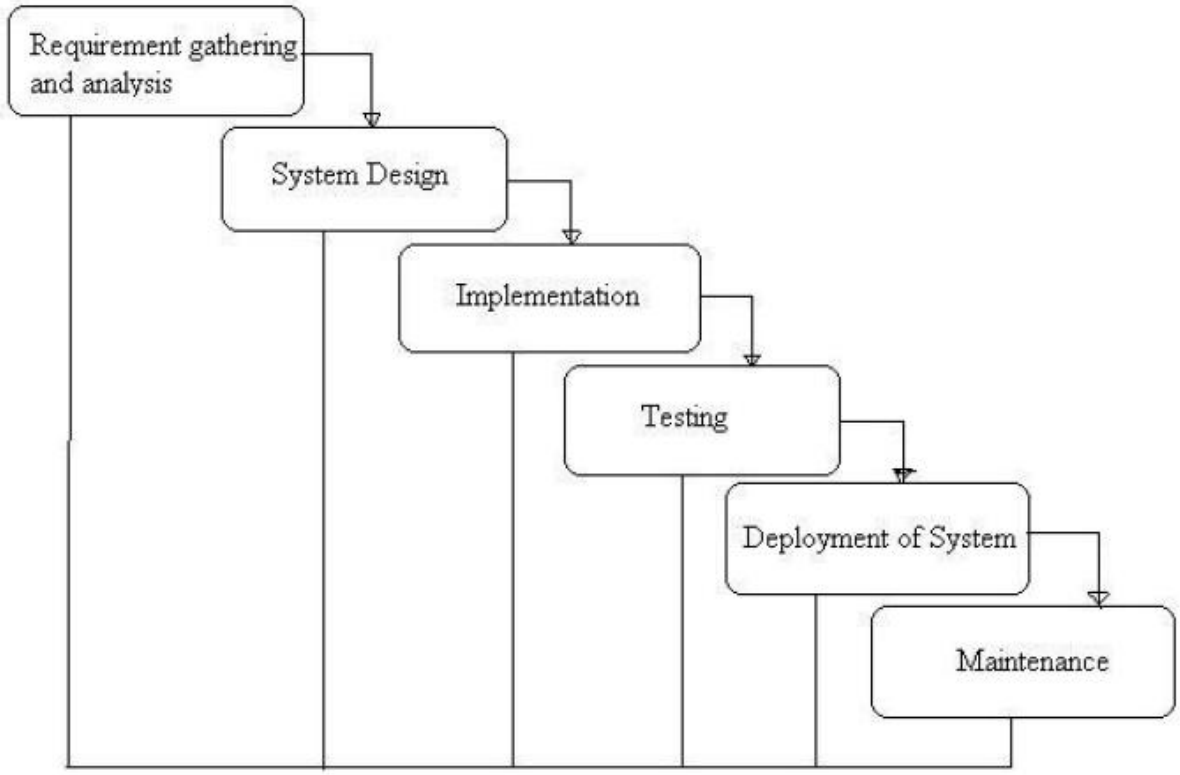

Figure 1-Waterfall Model [6]

Work and activities that should be carried on each phases with respect to the research is mentioned below.

Requirement Gathering and Analyzing

In this phase all the necessary requirements are gathered. There are several types of requirements to be gathered, such as functional requirements, non-functional requirements, constraints and research requirements.

Design

Based on the results found in the Requirement phase high level system architecture is designed. The module structure and other design artifacts are developed and documented.

Development

The system is developed in this phase according to the system architecture using a specific programming language.

Testing

Once the system is developed testing is done in order to verify and validate the requirements. Testing is done in two different ways, testing the system for bugs through Unit testing, Integration testing and System testing and validating the system for correct outputs.

Maintenance

When the system is successfully deployed maintenance phase begins. This will handle the problems arise when the system is in use. Maintenance is related with adoptive maintenance, corrective maintenance and perfective maintenance.

Use Case Diagram

The following use case diagram has captured the dynamic aspect of the system. It has gathered the requirements of a system including internal and external influences.

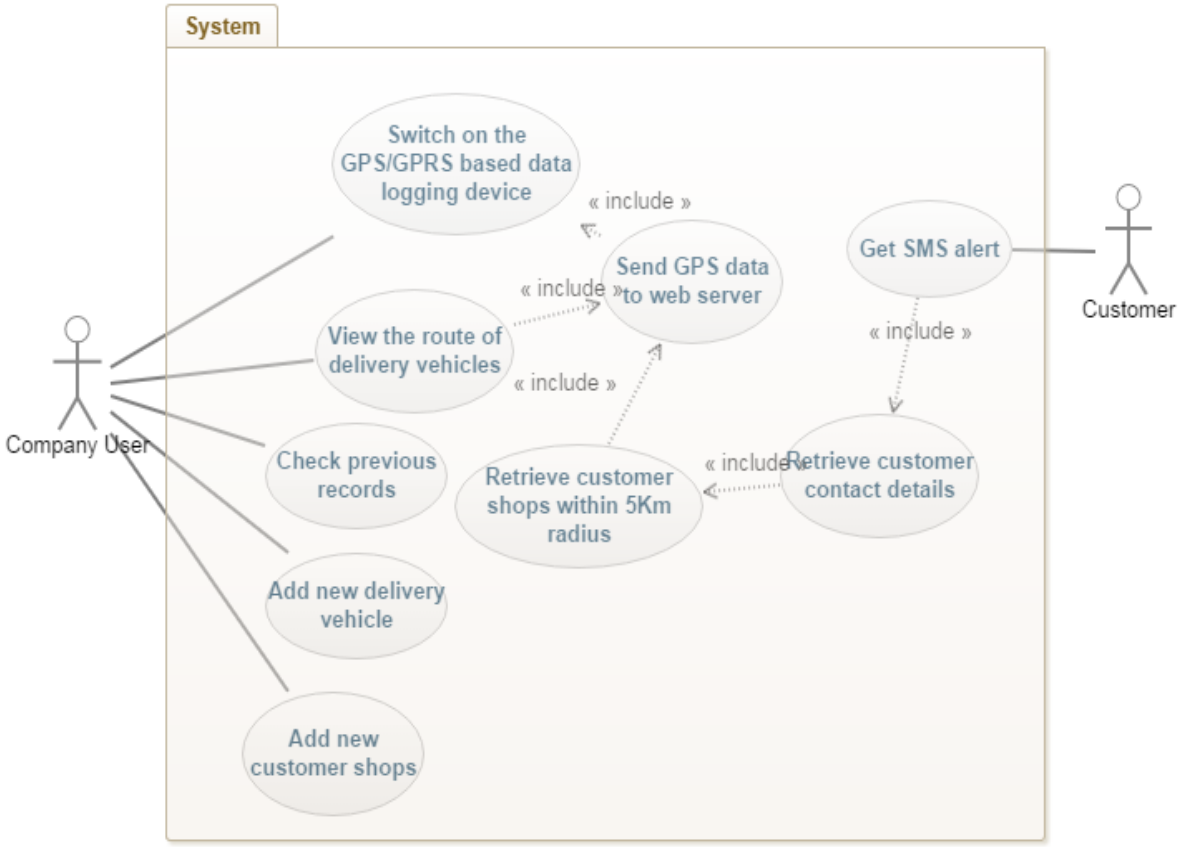

Figure 2-Use Case Diagram

Entity – Relationship Diagram

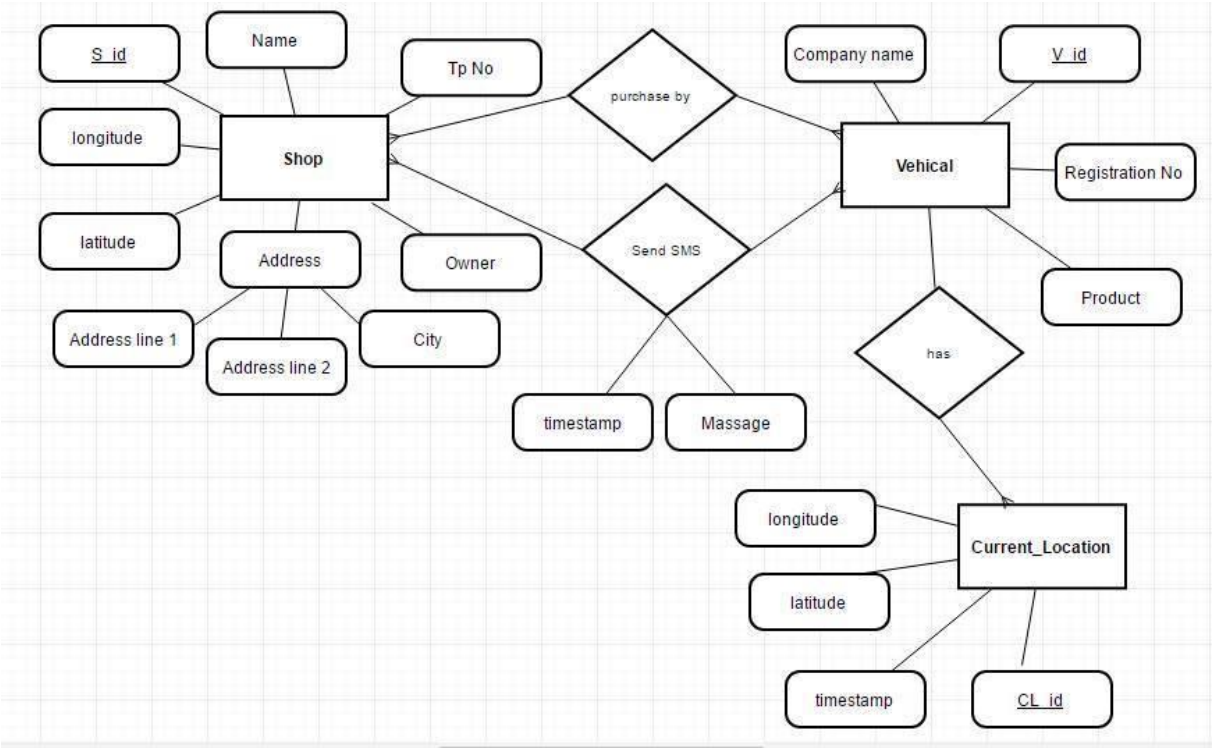

Figure 3-ER Diagram

In the database design of this system, relationships between the tables (foreign key enforcements) have not defined in the database layer, but those have been designed in the application layer. This mechanism is used to ensure the security of data.

High Level Design

This project is intended to enhance the customer satisfaction of the customers of DIMO. The suggested system, GPS based SMS alert system for an efficient delivery of vehicle spare parts to the customer shops is consists of main three components,

- GPS/GPRS based data logging device
- System application
- SMS gateway

The system diagram of the proposed system is given below.

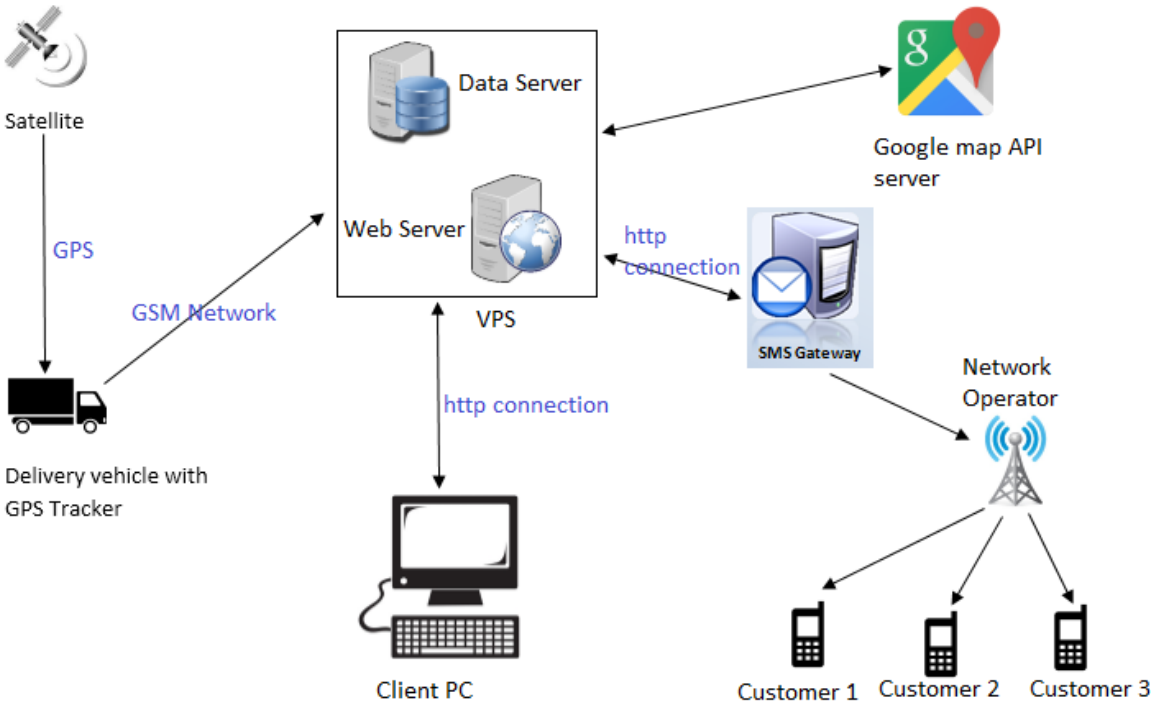

Figure 4-System Diagram

GPS/GPRS based data logging device

Mainly this system consists of GPS/GPRS module driven by a microcontroller, and auxiliary components as well. Main functional blocks and their interactions are shown by this high level block diagram (Figure 5) and each block and its functions are described below.

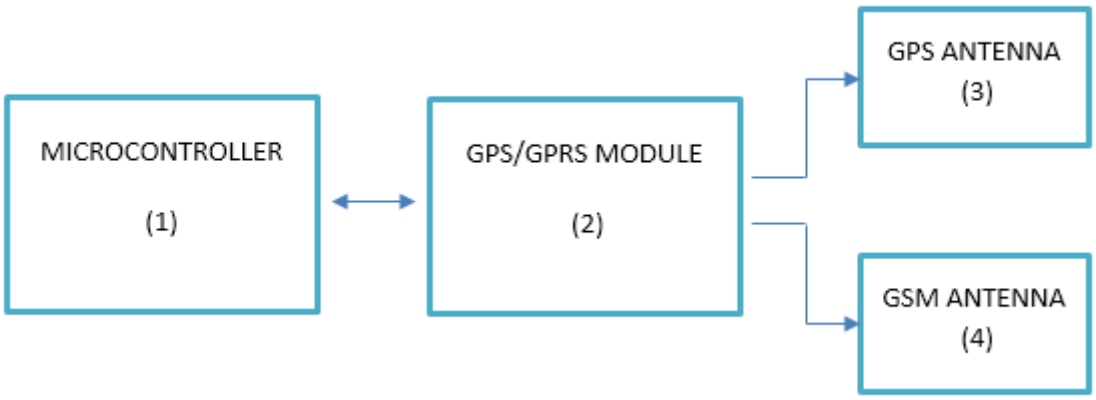

Figure 5-Functional Block Diagram

1. Microcontroller

This integrated circuit (IC) is a programmable device which is used to control the functions of entire system according to the written program. Atmega 328 chip manufactured by Atmel Inc. is high-performance 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory [7] comes with Arduino Uno development platform is chosen for this design. Firmware is written using Arduino language and compiled using Arduino IDE 1.6.13 version. Microcontroller accesses the GPS/GPRS Module (2) through asynchronous serial interface with 9600bps BAUD rate. It gives instructions commonly known as "AT commands" to the module.

2. GPS/GPRS Module

SIM 808 Chip manufactured by SIMCOM Inc. is selected for the design; hence it is the only chip both GPS and GPRS features available in the electronic market. It is complete Quad-Band GSM/GPRS module which combines GPS technology for satellite navigation. The compact design which integrated GPRS and GPS in a SMT package will significantly save both time and costs for customers to develop GPS enabled applications. Featuring an industry-standard interface and GPS function, it allows variable assets to be tracked seamlessly at any location and anytime with signal coverage [8].

Figure 6-SIM808 Module

3. Antennas are a critical part of any GPS receiver design and their importance cannot be stated highly enough. Even the best receiver cannot bring back what has been lost due to a poor antenna, in-band jamming, or a bad RF-board design. GPS signals are extremely weak and present unique demands on the antenna. Hence the choice and implementation of the antenna can ultimately play a significant role in GPS performance. In this application for its dynamic nature the scenario has to be face worsts too far. The design considerations for the selection of correct antenna type are described below.

Figure 7-Ceramic GPS Antenna

A GPS receiver needs to receive signals from as many satellites as possible. Optimal performance will not be available in narrow streets and underground parking lots or if objects cover the antenna. Poor visibility may result in position drift or a prolonged Time-To-First-Fix (TTFF). Good sky visibility is therefore an important advantage. A GPS receiver will only achieve the specified performance if the average carrier to noise power density ratio (C/N0) of the strongest satellites reaches at least 44 dBHz. In a well-designed system, the average of the C/N0 ratio of high elevation satellites should be in the range between 44 dBHz and about 50 dBHz. With a standard off-the-shelf active antenna, 47 dBHz should easily be achieved [9]. Passive Ceramic patch antenna was chosen for the design to match these considerations as shown in figure 7.

4. Like any wireless technology, however, GSM communications are dependent on antennas. That means that GSM services, and later generations of the technology like EDGE, UMTS, and HSDPA, are in constant need of custom antenna designers to help them keep up with customer demand and to introduce new innovations to the marketplace. In this application GSM Antenna is used to transmit the GPRS data to the service provider network.

System Application and SMS Gateway

The system application is mainly divided into two parts**.**

- Server side application
- Client application

GPS/GPRS based data logging device which is attached to the delivery vehicle is switched on for 24 hours**.** When the delivery vehicle started the ride by scheduling the route, an SMS will be sent to the customer stalls which are around that defined route**.** And in each 20 seconds a string generated by the GPS tracker will be sent to the server application which is hosted in a

VPS. The GPS tracker connects to the internet using a GSM network and the generated text string (GPS data) is sent to the server through an http GET request. This string contains vehicle id, device time, latitude, longitude, ground speed, heading direction details. Server side application is developed in server side PHP scripting language. The sent string is splitted using the commas and store inside the database.

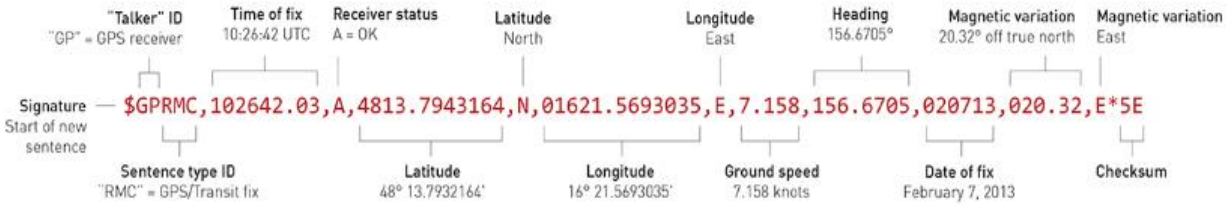

Figure 8-Comma separated text string

The client application gets the updates from the database and using google map API, the live updates of the delivery vehicle are displayed on the google map. The client application is running on a personal computer in the head office. When the delivery vehicle is moving, the customer stalls within the defined range (5 Km) are shown on the map and at the same time the stall ids will be sent to the server side application. The application checks whether each stall is received more than two messages and if it is not an SMS will be sent to the relevant stalls. First message will be sent when the route of the delivery vehicle is scheduled and the second message is sent when the delivery vehicle is within a 1 Km distance. By checking whether a stall id has received more than 2 SMSs, the system ensures duplicate SMSs will not be sent.

CHAPTER 04 - Implementation

4.1. Implementing

Backend of the application is developed using server side PHP scripting language. Notepad++ is used to do the programming. In the data layer, MySQL database management system is used and WAMP server is used to manage data in it.

Frontend is developed using CSS 3, HTML5, JQuery, Java Script and Bootstrap 3 framework. And google map API is used to do the map implementations.

```
5<?php
function distance($lat1, $lon1, $lat2, $lon2, $unit) {
  $theta = $lon1 - $lon2;
  $dist = sin(deg2rad($lat1)) * sin(deg2rad($lat2)) + cos(deg2rad($lat1)) *
cos(deg2rad($lat2)) * cos(deg2rad($theta));
  $dist = acos($dist);
  $dist = rad2deg($dist);
  $miles = $dist * 60 * 1.1515;
  $unit = strtoupper($unit);

  if ($unit == "K") {
    return ($miles * 1.609344);
  } else if ($unit == "N") {
      return ($miles * 0.8684);
    } else {
        return $miles;
      }
}
?>
```

Figure 9-Code 1

The code segment shows in figure 9 shows, how to check the distance between tracking device current location and shops that has been added from the scheduled route section.

```
<?php
$sql ="SELECT
Owner,Tp_no,Product,company,registration_no,latitude,longitude,rs.rs_id
as rs_id,s.S_id as S_id
FROM vehicle as v,route_schedule as rs,area as a,shop as s
where  v.v_id=rs.v_id and rs.a_id=a.aid and a.aid=s.aid and v.v_id='$id'";

$result11 =mysqli_query($conn, $sql);

if (mysqli_num_rows($result11)> 0){
  //output data of each row
    while($row =mysqli_fetch_assoc($result11))
    {
            $distance_to_shop =distance($Latitude,
$Longitude,$row['latitude'],$row['longitude'],  "K");
            echo $distance_to_shop."<br/>";
            if($distance_to_shop <=1)
            {

                  $sql4="SELECT count(S_id)FROM sms_log WHERE
rs_id='".$row['rs_id']."' and S_id='".$row['S_id']."'";
                  $result12=mysqli_query($conn, $sql4);
                  if (mysqli_num_rows($result12)>0)
                  {
                        $row1 =mysqli_fetch_row($result12);
                        if($row1[0]<2)
                        {
                        $msisdn=$row['Tp_no'];
                        $seven_bit_msg ="Dear
".$row['Owner'].",".$row['company']."
".$row['Product'].",".$row['registration_no']." locate withing 1Km";
                        $response =sendsms($msisdn,$seven_bit_msg);

                        if( $response['success']){
                        //print_ln( formatted_server_response( $result ));
                        $sql3 ="INSERT INTO sms_log(rs_id, S_id)
                        VALUES ('".$row['rs_id']."','".$row['S_id']."')";
                                    //echo $sql3;
                                    mysqli_query($conn, $sql3);
                        }
                        else {
                        //print_ln( formatted_server_response( $result ));
                        }
                        }
                        }

                  }
            }
} else {
  //echo "0 results";
}


?>
```

Figure 10-Code 2

The code segment shows in figure 10 shows, how to loop through each scheduled route shop and current location of the tracking device and send the message if the distance below 1 kilometer. If there are 2 messages, which means that has been already sent so, it will not send the message again.

```
<?php
function distance($lat1, $lon1, $lat2, $lon2, $unit) {

  $theta = $lon1 - $lon2;
  $dist = sin(deg2rad($lat1)) * sin(deg2rad($lat2)) + cos(deg2rad($lat1)) *
cos(deg2rad($lat2)) * cos(deg2rad($theta));
  $dist = acos($dist);
  $dist = rad2deg($dist);
  $miles = $dist * 60 * 1.1515;
  $unit = strtoupper($unit);

  if ($unit == "K") {
    return ($miles * 1.609344);
  } else if ($unit == "N") {
      return ($miles * 0.8684);
    } else {
        return $miles;
      }
}

echo distance(32.9697, -96.80322, 29.46786, -98.53506, "M")." Miles<br>";
echo distance(32.9697, -96.80322, 29.46786, -98.53506, "K")."
Kilometers<br>";
echo distance(32.9697, -96.80322, 29.46786, -98.53506, "N")." Nautical
Miles<br>";

echo distance(6.916280, 79.876854,6.915707,79.886093 ,  "K")."
Kilometers<br>";
?>
```

Figure 11-Code 3

The code segment shows in figure 11, checks the distance between two coordinates and return the distance in kilometers

4.2. Application Interfaces

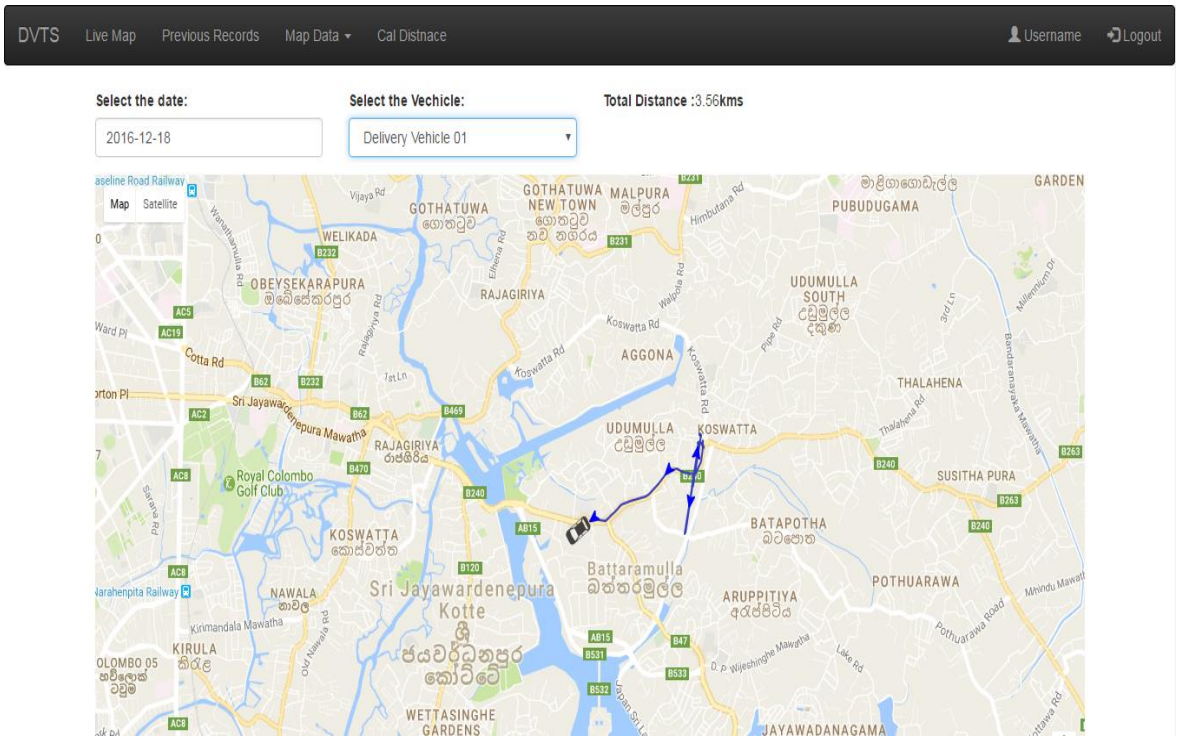

Figure 12- Live updated route of the delivery vehicle

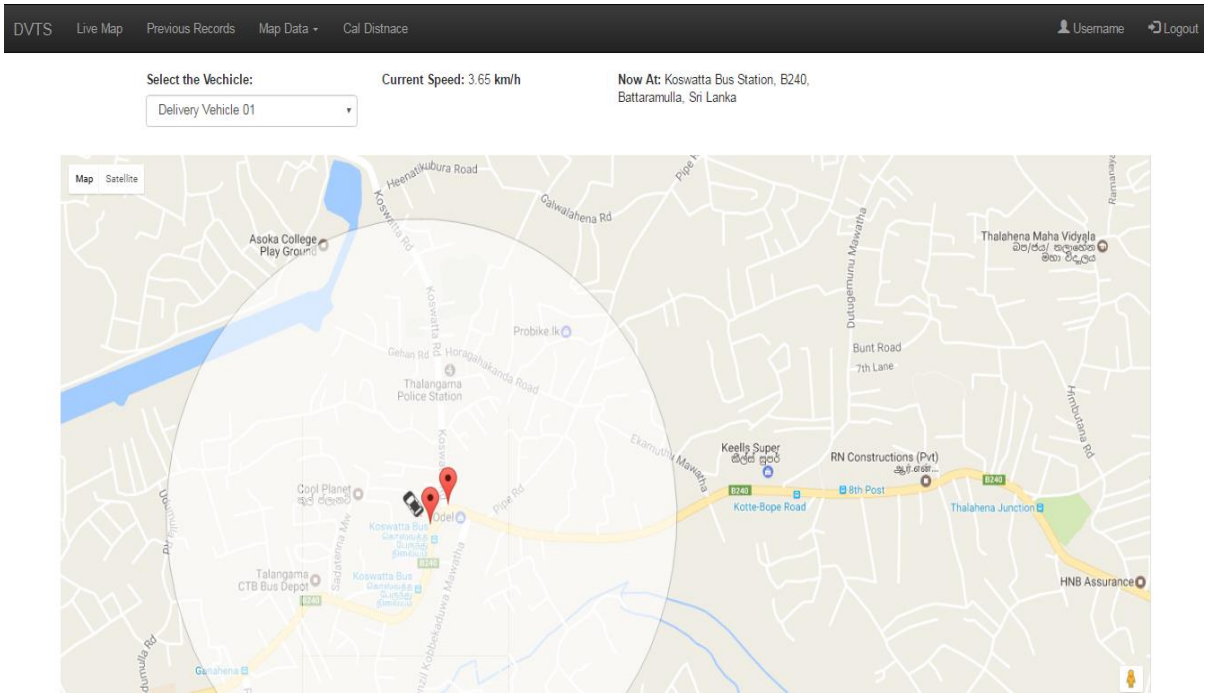

Figure 13-Marking nearby customer stalls to the delivery vehicle

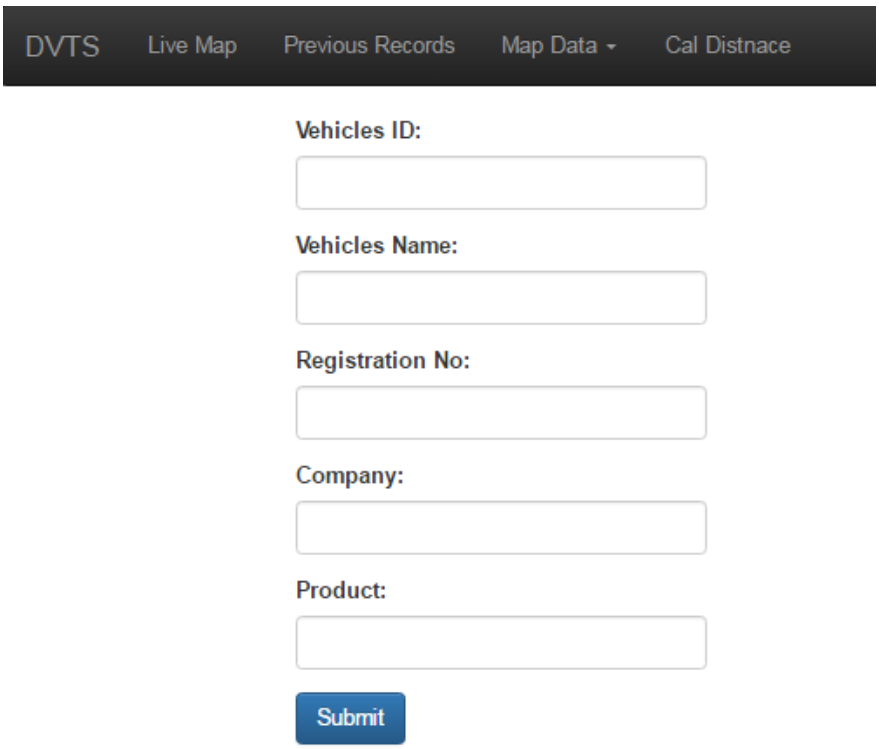

Figure 14-Add a new vehicle

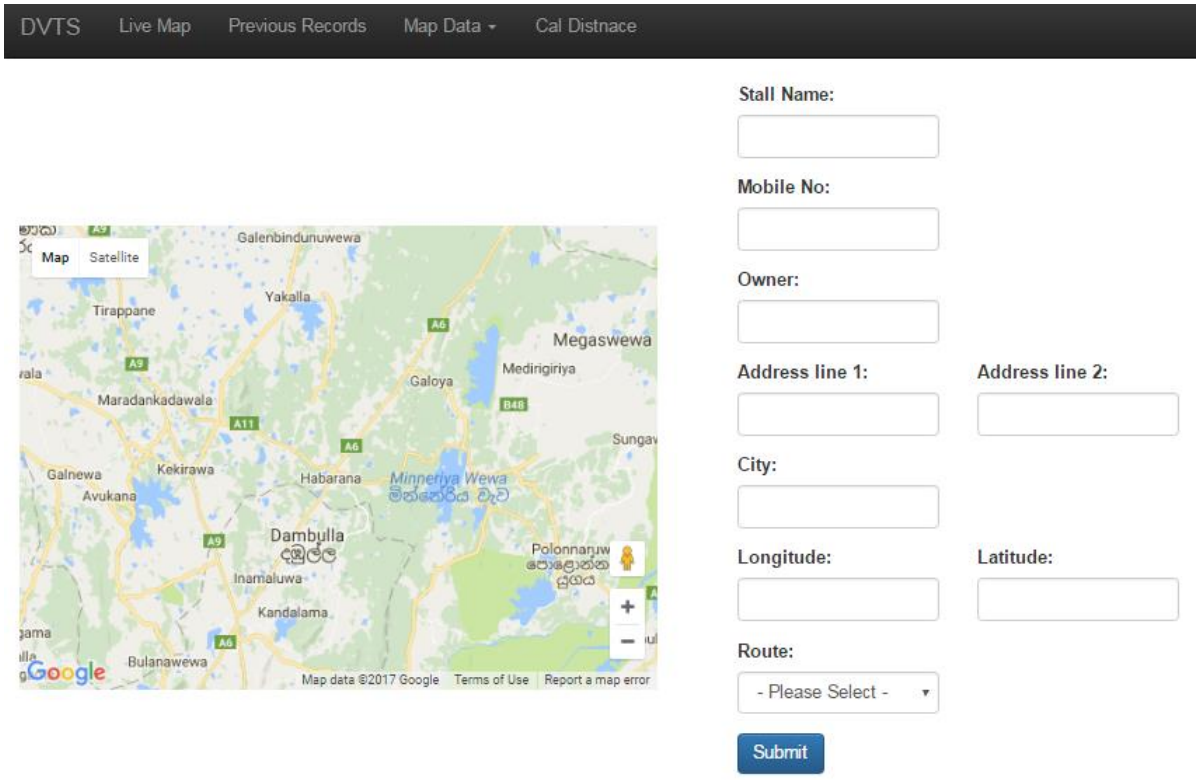

Figure 15- Add a new stall

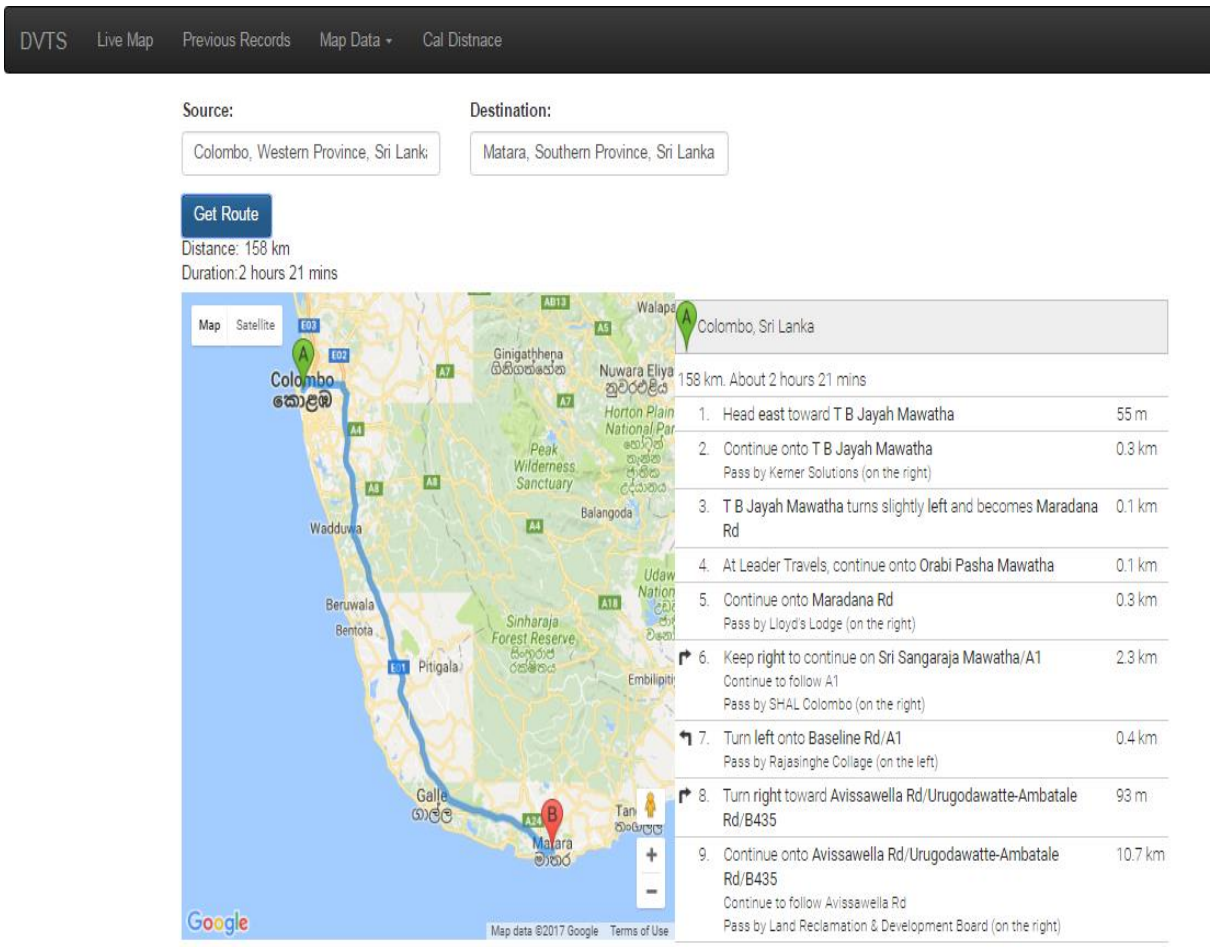

Figure 16-Calculate the distance

4.3. Hardware and Software Requirements

For a successful operation of the developed system, required hardware and software requirements are as follows,

Operating System	Windows 7 and upwards
Computer and Processor	1 GHZ or faster x86 or 64-bit processor
Memory	2 GB RAM (64-bit)
Disk Space	3 gigabytes (GB)
Software	MySQL, Apache Server, WAMP Server

Table 1 - Hardware and Software Requirements

CHAPTER 05 - User Evaluation and Testing

5.1. Unit Testing

System is tested for both verification and validation. Under verification Unit tests, Integration tests and System tests has been carried out. Some of the main test cases for unit tests are shown below.

Test Case ID	Description	Steps	Expected Results	Actual Results	Status
T01	Add a new delivery vehicle to the system.	Insert vehicle details and then press submit button.	Show the insert successful message.	Successful message is given.	Pass
T02	Add a new stall to the system.	Insert vehicle details and then press submit button	Show the insert successful message.	Successful message is given.	Pass
T03	View the previous routes of delivery vehicle.	Select the relevant date and vehicle.	Show the route of the delivery vehicle.	Selected route is displayed.	Pass
T04	View the live route of the delivery vehicle.	Select Live map option.	Show the live updated route of delivery vehicle.	Live updated route is displayed.	Pass
T05	Calculate the distance for selected two places.	Enter Start, destination and select get route.	Diagram is saved in the given location.	Diagram is saved in the given location.	Pass
T06	Add new area to the system.	Enter the area and click on submit button.	Show the insert successful message.	Successful message is given.	Pass

Table 2 - Unit Testing Results

5.2. Questionnaire Results

A sample of 20 customers were selected to distribute the questionnaire regarding the current delivery process and GPS based monitoring with SMS alert system. The results obtained were as follows.

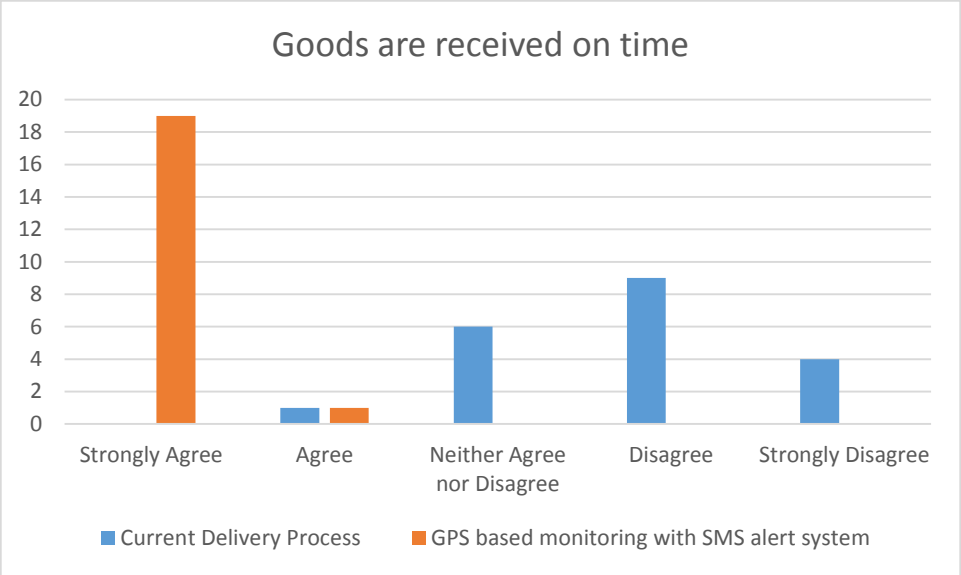

Figure 17-Goods are received on time

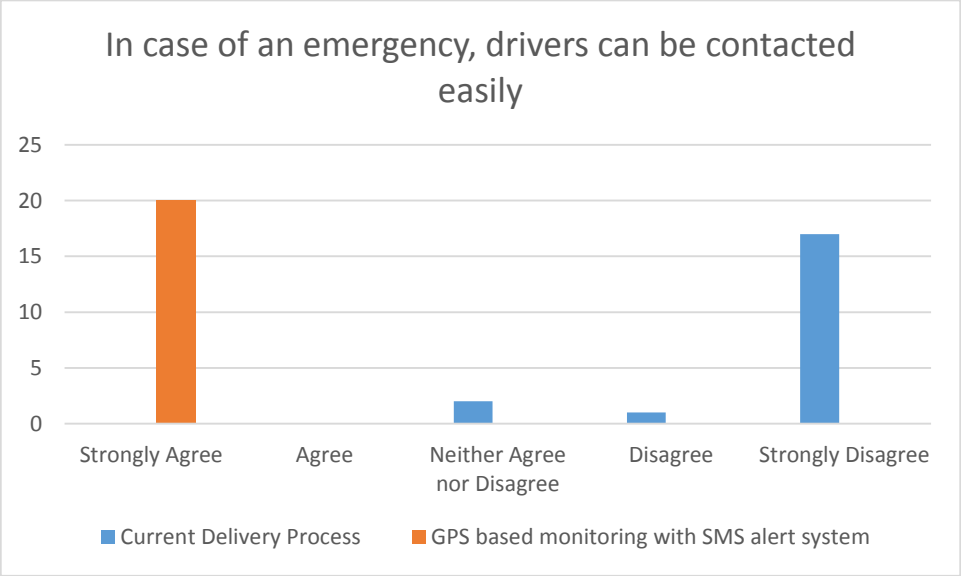

Figure 18-In case of an emergency, drivers can be contacted easily

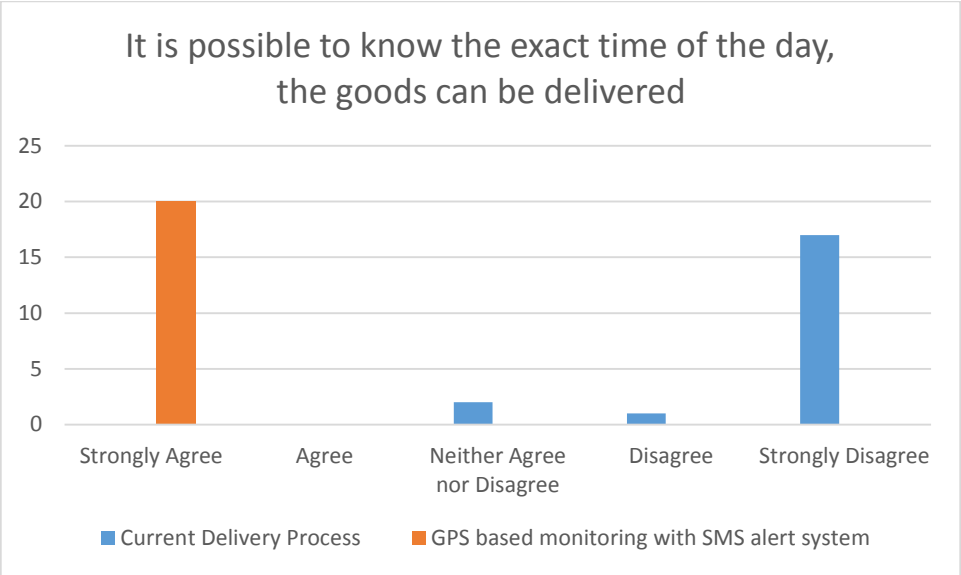

Figure 19- It is possible to know the exact time of the day, the goods can be delivered

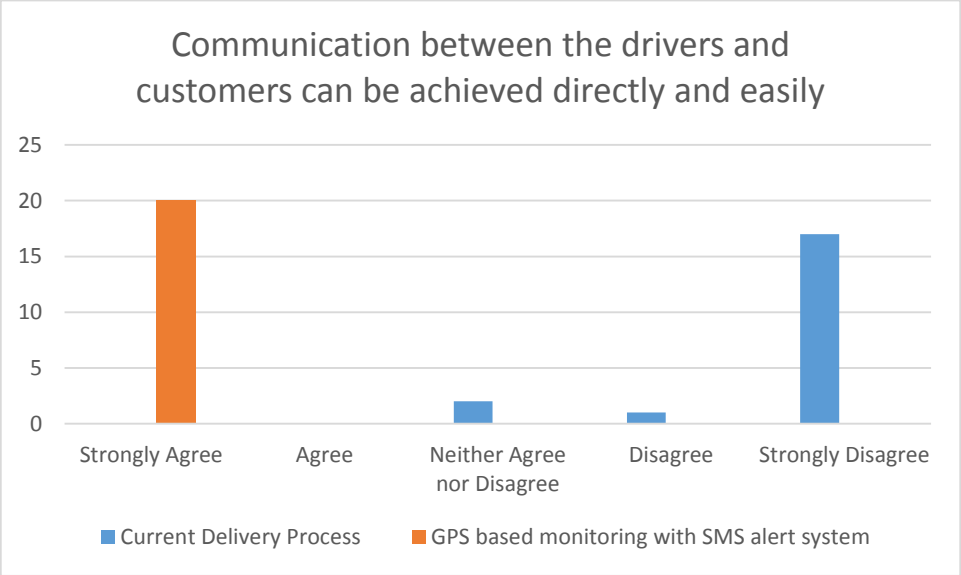

Figure 20-Communication between the drivers and customers can be achieved directly and easily

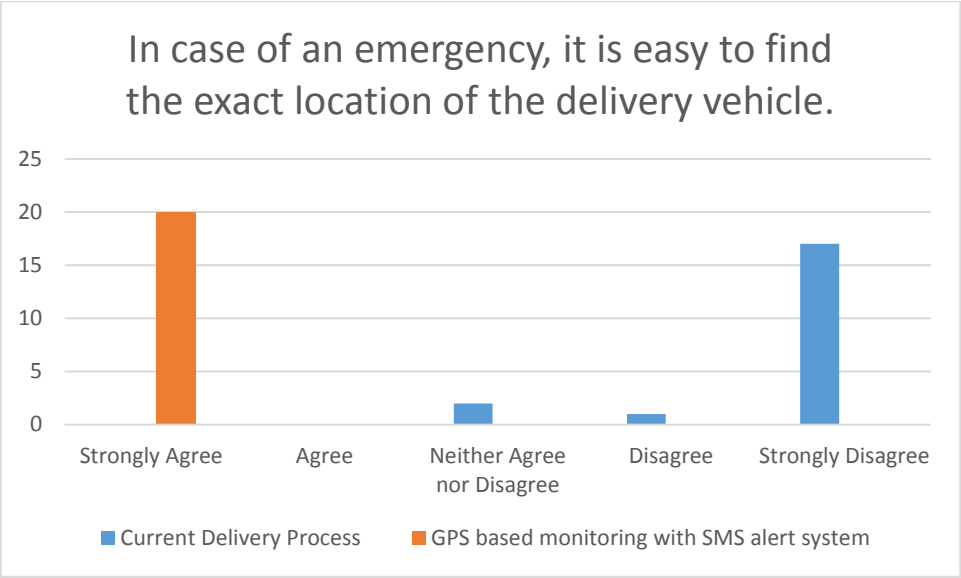

Figure 21-In case of an emergency, it is easy to find the exact location of the delivery vehicle

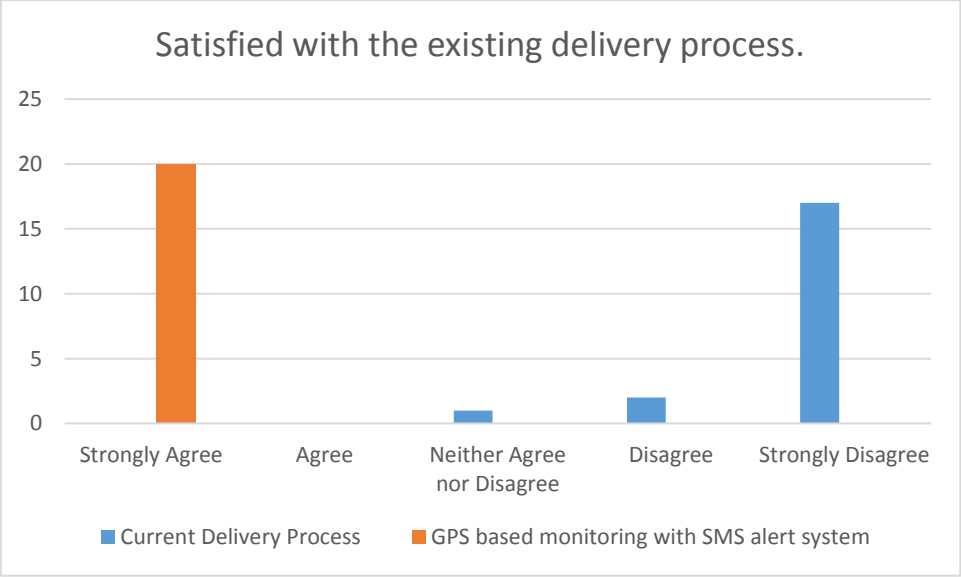

Figure 22-Satisfied with the existing delivery process

According to the questionnaire results, there is a clear difference between the feedbacks. Which means the customers have satisfied with the suggested system.

CHAPTER 06 - Conclusion

6.1. Problems Encountered and Lessons Learnt

Initially, the problem that was found is the customer satisfaction with the existing distributing system is very low due to the main reason of communication problem with the delivery vehicle driver. As a solution to the above problem, this system was suggested. At the beginning of this project, the aim was to increase the customer satisfaction through introducing a GPS based monitoring with SMS alert system.

According to the analyzed the questionnaire results, it has been proved that the suggested system has achieved the main aim. So it is clear that by the proper communication with the customer from ordering goods to delivery of goods, increases the customer satisfaction towards the delivery service of DIMO (PLC). This proper communication is achieved through the SMS alert system used in the developed system.

6.2. Critical Evaluation of the System

The specialty of the developed system is the communication medium with the customers. The existing systems do not use the SMSs to update their customers regarding the place of the delivery vehicle now is at and instead of that, those systems only send an SMS with the details of the route of the delivery vehicle, a calculated time that the delivery vehicle may reach the shop and the driver name. The other issue of the existing systems is that the Distributor can track where the delivery vehicle is but the customer does not have any evidence of where the delivery vehicle is, and expecting the reach of the delivery vehicle on time is the only thing that the customer can do. If the delivery vehicle is late, customers have to contact the distributor through a telephone call and get aware of the time that the delivery vehicle may reach the shop.

So that, the developed system has addressed a number of issues that the distributing industry has confronted presently.

6.3. Future Work

As an extended version of the application, the GPS tracker can be attached to the battery of the vehicle. So that a separate battery would not be needed to activate the GPS tracker and it can be switched on when it is needed.

The SMS can be sent through the GPS tracker itself as a future work.

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