Fleet Management System for Government Ministries in SriLanka.

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ABSTRACT

The government of Sri Lanka has a number of ministries, departments, statutory bodies and semi government institutions. The development and administration programs of these institutes are undertaken by government departments and other institutes. The transportation is playing a vital role in functioning of these institutes effectively.

To facilitate transportation, the government has provided a fleet of vehicles for necessary institutes. Even though most of the Government Institutions maintain a large Fleet of vehicles the fleet management of all the ministries is done manually at present. Thus problems such as data duplication, data inconsistency, lack of integrity, No proper search facility, inefficiency of vehicle allocation, low monitoring and inability of tracking vehicles have become major problems. To overcome the above mentioned problems an IOT based system was implemented.

This proposed system which specially targets the government ministries and institutions provides a better way of optimizing the usage of vehicles which saves fuel usage and the fuel cost. Since the government also has a requirement of a system which handles the fleet efficiently due to the fuel crisis the proposed system would also be a better solution. Since the paperwork has been minimized through the proposed system it follows the Think Green – Think Paperless Concept of the Government

1. INTRODUCTION

1.1 Description about the business organization and the business area chosen

In any government or private institution the transportation is playing a vital role in order to function the institutes effectively. To facilitate the transportation, the government has provided a fleet of vehicles for necessary institutes. 90% of the government institutions have their own fleet of motor vehicles and the rest of other institutes have outsourced the vehicles for their transportation. Most of the time it is considered as the second capital asset. There are various vehicle types including cars, jeeps, double cabs, vans, Lorries and buses in the Government institutions.

1.2 Business process

Even though most of the Government Institutions maintain a large Fleet of vehicles the fleet management of all the ministries is done manually. These institutions do not have a proper system to identify or monitor total number of vehicles, vehicle types, fuel consumption, vehicle routes, vehicle parking location, etc. All the details of the officers, drivers, vehicles, vehicle requests, vehicle and driver assignments for Journeys (Job assignments), vehicle Running Charts, arrivals and departures of vehicles, vehicle Maintenance are maintained manually. Communication is done with all the parties over the phone and in writing.

In each and every year the government allocates approximately 5% of its annual budget on fleet management of Government Institutions, according to the finance report published by the General Treasury. The Government has taken a new policy decision for not purchasing new vehicles for the Government Institutions. Though the general treasury deducts allocation of money on purchasing of new vehicles for the government institutions, the cost that is born for repairs of these old vehicles are marginally high in each year. The reason that the Government Institutions have to keep aging vehicles is due to an investment constraint for the replacement of the vehicles.

It is obvious that an efficient and effective Fleet management system is very important to minimize maintenance and operational cost and it should include policies and procedures on acquisition, replacement, disposal, repair and maintenance of vehicles, record keeping, staff management, Management & Tracking of fleet.

1.3 Problem definition

The following major problems are experienced in the existing Fleet Management system of the Government Institutions.

1. A separate branch has to be handled with more employees, since the existing fleet Management process is maintained manually.

2. There is no proper Vehicle Inventory is managed. Most of the past records of the vehicles are unavailable or difficult to search and the important data like cost, kilometer reading and fuel consumption are not recorded and calculated properly. Fuel vouchers are issued and maintained manually.

3. Renewal date of the license, service date, emission test date and insurance renewal date of vehicles are recorded in several places manually. So, that data cannot be easily accessed when necessary. Since there is no proper preventive maintenance schedule for the vehicles it is hard to identify the vehicles which are under maintenance. Sometimes unnecessary fines are added due to the overdue of renewals.

4. Because of the improper maintenance the vehicles have become less fuel efficient as well. On the other hand, the environmental pollution caused by the emissions of these vehicles is very high. Further, these vehicles cause incomplete combustion. Therefore, they emit more CO_3 (Carbon Monoxide) into the atmosphere. CO_3 is a greenhouse gas that increases global warming and creates health problems for the society.

5. Vehicle request and approval process is done manually using the vehicle request form. Available vehicles are tracked manually over the phone.

6. It is difficult to find the details of an assignment of a driver to a vehicle when necessary.

7. Assignment of vehicles for a journey is done manually and assigning vehicles according to the number of passengers and based on the distance of the journey is not done in a proper manner.

8. Entrance and exit of vehicles are not recorded in a proper manner. It is hard to track the current location of a vehicle. (ongoing/ parking)

9. Running charts (Log report of the journey) are maintained by the drivers manually and most of the time transparency of running charts are vague. Since overtime calculation and other allowances are calculated manually based on the running charts, the government has to spend unnecessary costs on driver allowances.

10. Since all the details are recorded manually the data redundancy and inconsistency is high.

11. There is no proper report generation in the existing system.

1.4 Aims and objectives

The main aim of the proposed system is to develop a web based Fleet Management System to increase efficiency and productivity of the government institutions' vehicle management activities in a smooth manner.

The proposed system will optimize the use of vehicles in accordance with the institution's operating needs and solve the problem of tracking and accountability of vehicles that enhance the quality of the service and develop efficiencies to make the service more effectively.

Furthermore this system will provide the facilities such as identification information of the vehicle, details of the vehicle location, allocation to officers and drivers, vehicle booking, revenue licenses and insurance date notification etc. In addition to the above functionalities, the system will generate summary of refueling by vehicle and average fuel consumption, summary mileage of each vehicle, generate information in connection with the decision making activities such as determine whether fuel consumption is economical or not, to provide the recommendation whether vehicle is further maintenance or dispose and required information for the next year budget estimation.

The proposed system provides a dashboard for better and easy understanding of their vehicle positions and related statistics. The vehicle tracking system is implemented for monitoring vehicles from any location at any time with the help of Global Positioning System (GPS) and Orange Board. We worked on getting geo coordinates (latitude and longitudes) using the GPS module to capture location and time of data received.

Duty assignment of a requested job is done through an automated process, once the secretaries approve the job. And an SMS is sent to the staff officer and the driver informing that a vehicle is assigned.

1.5 Scope with clear boundaries

The project will cover the vehicle Requesting, Vehicle Assigning, Location tracking, vehicle Maintenance and Management Information Generation. It will make available the business activities presently carried out by the Officers, Drivers, Technical Officer, Transport Manager, additional secretary and the automated system. However, the system will not support the financial involvement of maintenance, repairs and replacement of the vehicles within the scope.

2. LITERATURE REVIEW

2.1 Introduction to literature review

Fleet management refers to the overall actions that take place to keep a fleet running efficiently, on time, and within budget. Therefore, fleet management consists of several different functions for vehicles and operations running well. The technology and software solutions of Fleet Management systems reduce the costs and risks. The productivity is increased & the driver safety is enforced. It also helps to keep proper maintenance sched-

ules. Furthermore, it facilitates live tracking of vehicles

2.2 Similar Systems

2.2.1 MYGEOTAB

Geotab's fleet management software provides powerful tools for businesses at their proposal for generating new opportunities for growth and savings. Geotab's fleet management software, MyGeotab, removes the complexity of collecting data and transforms it into useful information that businesses can work on.

Fleet managers can get started quickly by selecting or customizing rules, in measuring events surrounding five core arrears: productivity, safety, fleet optimization, compliance and expandability.

Geotab rating vessels reports can compare the performance of one team to another to look at idle styles and other factors. Contribute to safe driving behavior with driver's response and training tools. Drivers sharing cars are still identified by MyGeotab's Driver ID NFC Technology.

MyGeoTab	Proposed Fleet Management System
No vehicle booking system	Vehicle booking system
No automated job assignment	Automated job assignment
No automated running chart	Automated running chart
Active GPS tracking	Active GPS tracking
Rich reporting functionality	Moderate reporting functionality
Web-based software reporting platform	Web-based software reporting platform
Supporting unlimited number of vehicles and users	Supporting limited number of vehicles and users
Custom mapping	No custom mapping
Driver behavior management	No driver behavior management

Table 2.1 MyGeoTab vs. Proposed Fleet Management System

2.2.2 FLEETIO

The Fleetio series of cloud-based and mobile-based vehicle handling solutions enables automated shipping operations and management of truck drivers. Fleets can track, score and rank drivers, manage maintenance, fuel, vehicle testing, parts, dealers and more. Data regarding property usage, maintenance costs, fuel savings, components and operations can all be tracked within Fleetio.

Fleetio features include interaction, navigation, and automation, as well as asset management, maintenance management, fuel management, communication management, component inventory management, and GPS

tracking. Vehicles can be managed and recorded, from status description, licensing (including renewals), and photos, to inspections and notes on all aspects of vehicle control, including accidents, injuries and repairs and improvements. Problems, service and repairs can be tracked, as well as invoices, receipts, purchase orders, and component inventory management. Maintenance service schedules can be predicted based on actual vehicle use.

Features:	
FLEETIO	**Proposed Fleet Management System**
No vehicle booking system	Vehicle booking system
No automated job assignment	Automated job assignment
No automated running chart	Automated running chart
Driver-Centric measurement	No driver centric measurement
Maintain work orders	Moderate maintain work orders
Use Decoding system for Retrieve vehicle specs and maintenance schedules	No such decoding system
GPS & telematics integration	GPS & telematics integration
Reduce vehicle downtime	Moderate vehicle downtime

Table 2.2 FLEETIO vs. Proposed Fleet Management System

2.2.3 Dialog Enterprises extends smart fleet management solution to Perera & Sons

Dialog's Smart Fleet solution enables the monitoring of key environmental conditions and also vehicle telematics ensuring the safety of goods, the fleet and the staff. Equipped with temperature sensors, real-time data is made available for monitoring and decision-making. The solution is a Global Positioning System (GPS) driven, cost-effective IOT solution providing end-to-end visibility to the entire transportation process by gathering diagnostics and operating information from commercial vehicles.

Smart Fleet helps to plan and monitor the entire order delivery process, with the opportunity to assign future tasks / orders based on real-time car availability. Its geofencing feature ensures that the vessel stays within certain limits, with alerts enabled to notify if vehicles exit the assigned boundaries and reach high-risk or closed areas during an epidemic, while real-time system alerts are triggered by the event. in emergencies or if the vehicle deviates from its assigned function.

Dialog's Smart Fleet Management System	Fleet Management System
No vehicle booking system	Vehicle booking system
No automated job assignment	Automated job assignment

No automated running chart	Automated running chart
Active GPS tracking	Active GPS tracking
High productivity and efficiency	High productivity and efficiency
Enable geofencing technique with notifications	Geofencing technique with color indication
GPS & telematics integration	GPS & telematics integration
Enable real-time system alert	Enable real-time system alert
No notifications for vehicle maintenance	Enable notifications for vehicle maintenance

Table 2.3 Dialog's Smart Fleet Management System vs. Proposed Fleet Management System

2.2.4 Vinity Soft Business Solutions

Vinity Soft Business Solutions is a Canadian company. It provides a solution for vehicle management systems. Vehicle and driver maintenance records, fuel maintenance, accident detail maintenance, inventory management, maintenance scheduling, Parts Management, track vehicle expenses, track vehicle expenses and depreciation, are provided by this fleet management solution. In this system there are several reports generated under three modules such as vehicle, personal and vendors.

Followings are some of the key features:

- Service reminders – Create new reminders or updating existing ones.
- Service history – log all maintenance as performed.
- Fuel log – fuel history details.
- Parts inventory – keep track of spare parts inventory and get reminded when parts need to be re-ordered.
- Notes & issue tracking – operators and mechanics can quickly report issues on vehicles and equipment during inspections.
- Documents – store and view important documents related to particular vehicle, driver, service or work order such as insurance records or scanned invoices.

2.2.5 DIMO Fleet Genie

DIMO Fleet Genie is a product of DIMO PLC, Sri Lanka. The system provides the following facilities to manage the vehicles.

- Improve fleet safety
- Improve fleet efficiency and productivity.

- Ensure fleet compliances

- Endure driver and staff performances.

- Ensure the quality of the delivery assets.

DIMO Fleet Genie helps tracking, monitoring and managing of the company vehicles fleet easily. It is a GPS based IOT fleet management system. So, the entire fleet performance can be viewed in a single dashboard. The following services are given by this system.

- Tracking & monitoring - locate your vehicle and provide the shortest distance and lowest traffic conditions

- Vehicle fuel level monitoring - monitor fuel levels and fuel efficiency of your fleet

- Asset Tracking - track the vehicle door opening & closing times when moving your valuable goods and ensure the safety of the goods

- Asset Monitoring - monitor the temperature of the load body when transporting temperature-sensitive goods. Deliver your goods at the right temperature

- DVR (Digital Video Recording) - remotely monitor the vehicles. Cabin, load body with live & backup footages

3. SYSTEM ANALYSIS AND DESIGN

3.1 Analysis of the system
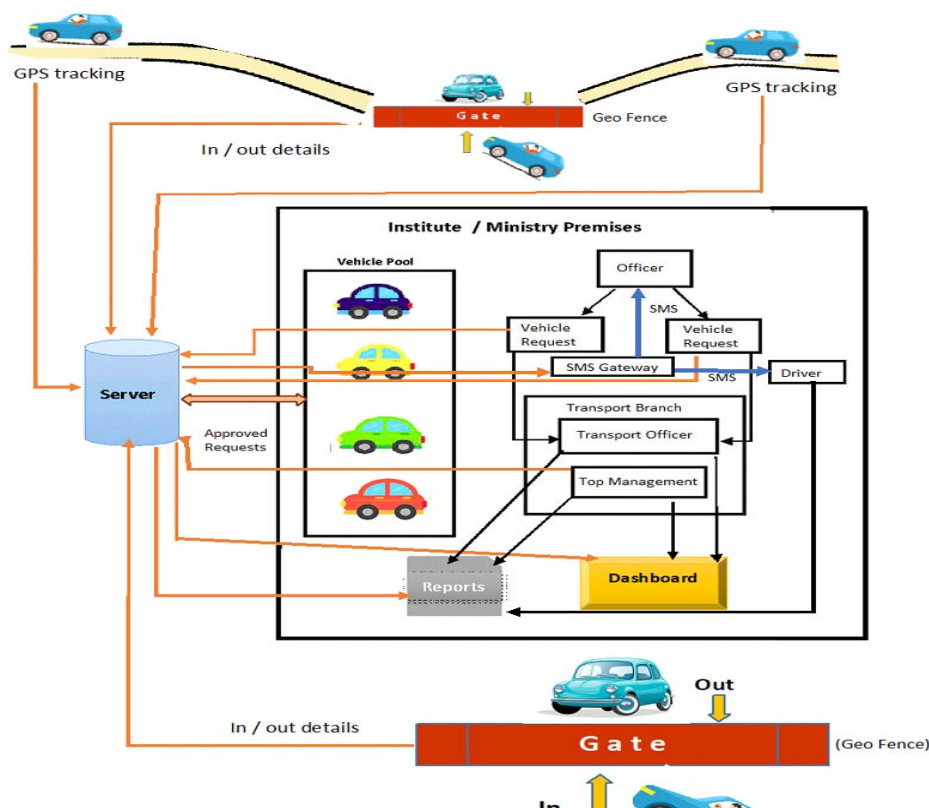
3.1.1 Overview of the system

Figure 3.1 – Overview of the system

The above diagram depicts an overview of the fleet management system. The main objective of the proposed system is to utilize the vehicles in the vehicle pool and to minimize the transport cost.

The details of the vehicles are stored in a database. The following data are stored in the database.

- Vehicle ID (Vehicle No, Vehicle Engine number, Vehicle Make, Vehicle Model, Fuel Type, Seating capacity, Distance per liter, Driver details)
- Staff details (ID, Name, Address, DOB, Mobile No, Email, Designation, Branch,)
- Job details (Job ID, Job start date, Job send date, Task, No of passengers, Distance, Fuel quantity)
- Running chart (ID, Start Date, End Date, Start time, End time, Fuel Quantity)
- GPS History (
- Maintenance details (Maintenance ID, Maintenance Type, Maintenance Date, Description)

To allocate a vehicle, the following procedure is followed.

- Officers can request vehicles for their duties through the system. The requested jobs are considered as pending jobs.
- Branch wise pending jobs are approved by the additional secretaries.
- Once the job is approved, a vehicle and a driver are assigned by the system to a job.
- The vehicles are selected in an optimal manner.
- Then the staff officer will be received a system generated SMS informing that a vehicle is allocated for his duty and the driver also will be received a system generated SMS informing the job.

Recording In – Out time/date and tracking the vehicle

- In and out of the vehicle is tracked by Geo Fence.
- The vehicle is monitored using GPS throughout the journey.

3.1.2 Fact gathering techniques used

- Requirements were gathered by using face to face interviews, reviewing documents, site inspections, and inspecting the functionalities of the existing manual process of vehicle management.
- Similar systems were studied to get an idea about the functions of a fleet management system.

- Site inspections were used to get the details of user difficulties and their suggestions on improvements. Most valuable factors such as problems of the manual system and suggestions to the new system were found by interviewing the officers, transport staff as well as drivers.

- Studying the current manual documentations, a wide-range of information such as what details should be recorded, to whom the documents are transferred have been identified.

- The features which should be improved are identified by inspecting the functionalities of the existing fleet management systems.

3.7 Methodology Used

An iterative incremental model is used to develop this system.

In an Iterative Incremental model, initially, a partial implementation of a total system is constructed so that it will be in a deliverable state. Increased functionality is added. The process is repeated until the entire product development is completed. The repetitions of these processes are called iterations. At the end of every iteration, a product increment is delivered.

Because of the following reasons we decided to follow the iterative incremental model to develop the fleet management system.

- The requirements were not very much clear and requirements were not identified at once.
- The project has lengthy development schedules.
- The project has new technology.
- The domain is new to the team.
- Since we chose the Iterative Incremental Model, We could develop prioritized requirements first.
- And we could provide the important functionalities first to the clients within a short time period.
- Customer can provide feedback to each product increment, thus avoiding surprises at the end of development also the requirements changes can be easily accommodated with the customer feedback.

3.8 System Design

3.8.1 Hardware Design

The hardware design of the proposed system has two main parts.

The first part is the component that attached to the vehicle that consists of orange pi zero (an open-source single board computer) , NEO 6M GPS Module which will send the coordinate and information to the second part which is the remote server. This integrated, cost effective hardware system that defends on GPS/GPRS technology to track the vehicle. The concept of Geofencing is used for identify vehicle In/Out state. The relevant

officers can retrieve the record of movement of vehicles anytime and anywhere. This embedded system will attached to the vehicle and will send coordinates every 10 seconds to the remote server and then display the location on a Google map in dashboard.

Figure 3.2 – Overview of the system

4. SYSTEM IMPLEMENTATION AND TESTING

4.1 System Implementation

During the implementation phase the processes of the design phase are transformed into a form that is executable. Transforming the algorithms into a programming language (coding), Translating the logical data model into an executable format, Compiling and Testing the syntactical correctness of the modules, and correcting erroneous system components are the main activities carried out during this phase.

4.2.1 System Development Environment

The scripting languages and tools that were used in developing the system are mentioned within the following Table.

Server-side scripting language	PHP 5

Web Server	Apache
Database Technology	MySQL 5
Web server package	WAMP Server
Web Browser	Google Chrome, Microsoft Edge
SMS Gateway	Notify.lk SMS Gateway
User Interface Designing	HTML,CSS, Adobe Photoshop

Table 4.1 System development Environment

4.2.2 Reasons for selecting the above technologies

- **Web Development technology**

The selected development technology, PHP, is a widely used, general-purpose, open source scripting language that was originally designed for web development, to produce dynamic web pages with better loading speed. PHP has excellent flexibility and combinability and has a great synergy with HTML. WAMP which is a free and open source cross-platform web server package, consisting mainly of the Apache HTTP Server, MySQL database and PHP was used to develop the system as it is very easy to use. All these components are free, and the WAMP Stack is well-tested, which implies the reduction of required time. So, the PHP based website hosting is inexpensive compared to other technology-based websites. Hence it is selected as the development technology for this project. For Designing interfaces Adobe Photoshop and Cascading Style Sheets were used.

- **Database Management System**

The Database Management system used in this system is MySQL as it is an open source, full-featured database management system and as it is the most compatible DBMS with PHP and Apache. It facilitates easy query analysis and database management. With its superior speed, reliability, and ease of use, MySQL has become the preferred choice for the web.

- **SMS Gateway**

Notify.lk is used for sending SMS, as it is a cost effective SMS Gateway. It is a suite of programs for communicating with mobile phones. This software acts as a gateway and it helps to Send and Receive SMS Messages from a PC.

4.2.3 Deployment Environment

During the development both the server and the client machines were the same and the system was tested in the same machine. The following will be the needed requirements during deployment.

Web Server

| Processor | I7 processor |

Memory	64GB
Hard Disk	2TB
Operating System	Windows
Database	MySQL
Connectivity	100mbps internet Connection

Table 4.2 PC configuration of Server in deployment Environment

Client

Processor	2.1 Ghz ,I3 or above
Memory	4GB
Hard Disk	500TB
Operating System	Windows
Browser	Google Chrome or any
Connectivity	Ethernet/Wifi

Table 4.3 PC configuration of Client in Implementation Environment

4.2.4 Module structure description

The following modules contained within the proposed system.

Login Module

This module contains the code for the Login process. The usernames and passwords are taken as the user inputs and once the form is submitted the username and the password is validated against the database. If the entry is correct the user is directed to the relevant page or else meaningful error messages are displayed to the user by the system.

Registration Module

This module contains the code for the Registration process. Here all the user inputs are validated properly through the code. For invalid and blank entries appropriate error messages are displayed. If all entries are correct the user will be registered with the system.

User Settings Module

This module contains codes for changing profiles and passwords. Profile change code allows the users to change the retrieved personal data in case of a phone number or address change. Change password code allows the users to change their password while confirming the username and the old password

Vehicle Module

This module contains codes for Vehicle entering, viewing and editing process. The Vehicle entering process al-

lows the Transport manager to enter the new vehicles to the system and the Vehicle Editing process allows to view and edit vehicle details.

Job Module

This module contains codes for the job entering process, job viewing process and job approval Process. The Jobs which are stored on the database, can be retrieved with four criteria within the module. Ex: Pending, Assigned, Cancel and Finished. The Job entering Process allows the Officers to enter the jobs into the system. Job viewing process and Job approval Process allows the Additional Secretaries to view and approve the jobs.

Process Automation Module

This module contains codes for automation of job approval and SMS sending. Once the job is approved a vehicle is automatically assigned for a specific job by evaluating the criteria properly and a SMS is sent to the officer and the driver. The Running Chart also updated automatically.

Reporting Module

This module contains codes for report generation. Within the code, different kinds of report options can be selected with the buttons. Ex: Vehicles Report, Pending Jobs Report, Drivers Report etc. Filtering data is facilitated through date ranges and also given criteria such as Pending, Approved or Finished for Jobs. The generated reports can be taken in pdf format for printing.

4.2.5 Algorithm and the PHP Coding for the Automated System

Algorithm

1. Select Pending Jobs Relevant to the branch from the job table. (Records are filtered According to the Additional Secretary's branchId)

2. Display Pending Jobs Relevant to the branch from the job table.

3. Select and View details of a specific Job

4. Approve Job/Cancel Job

- If Approve option selected

1.Select the records which is equals to these criteria jobStartDate, jobStartTime, jobStartDistrict, jobStartCity

2. Calculate the Sum(NoOfPassengers) of above records

3. If Sum(NoOfPassengers) + noOfPassengers<= No of seats of the vehicle assigned for the previous jobs

4. Update Vehicleid and DriverId fields in the job table with the vehicle Id of the vehicle assigned for the previous jobs (Assign the vehicle of the previous jobs for this job also)

 5 Otherwise Update Vehicleid and DriverId fields in the job table with a new vehicle (Assign a new vehicle)(the vehicle no of seats should>= noOfPassengers of the current job

And The vehicle which has the highest fuel efficiency)

4. Update the 'Pending' status of the particular job to 'Approved'.

5. Send SMS to the Staff Officer indicating the Vehicle Assigned for the Job with DriverId, Name and Vehicleld(Veh.No).

6. Send SMS to the Driver indicating the Job Assigned with JobId and StaffId,Name,PhoneNo.

7. Insert jobId, jobStartDate, JobEndDate to the running chart table.

4.2.6 Job Assignment PHP Code

Job Approval and Assignment process Automation Code

```php
<?php session_start();
//Open Connection
require_once("includes/opencon.php");
$_SESSION["roleId"];
$_SESSION["userId"];


//Get JobId
$jId=$_REQUEST['jobId'];


//Get job Details of a given jobId
$sql_job="SELECT * FROM job,staffofficer where job.staffId=staffofficer.staffId and jobId='$jId'";
$res_job=mysqli_query($conn,$sql_job);
$row_job=mysqli_fetch_array($res_job);


//Approve Job
if ($_SERVER["REQUEST_METHOD"]=="POST"){
        $jobId=$_POST['jobId'];
        $jobEndDistrictId=$_POST['jobEndDistrictId'];
        $jobEndCityId=$_POST['jobEndCityId'];
        $jobEndDate=$_POST['jobEndDate'];
        $jobEndTime=$_POST['jobEndTime'];
        $noPassanger=$_POST['noPassanger'];
```

```
//select vid and the total number of passengers

$sql1="SELECT distinct vid,sum(noPassanger) FROM job WHERE jobEndDate='$jobEndDate' and
jobEndTime='$jobEndTime' and jobEndDistrictId='$jobEndDistrictId' and jobEndCityId='$jobEndCityId' and
status='Approved' group by vid";

$res1=mysqli_query($conn,$sql1);

$row1=mysqli_fetch_row($res1);

$vid=$row1[0];//Vid

$totp=$row1[1];//sum(noPassanger)


//select No of Seats and driverId for a given vehicleId

$sql2="select vNoSeat,driverId from vehicle where vid='$vid'";

$res2=mysqli_query($conn,$sql2);

$row2=mysqli_fetch_row($res2);


$vNoSeat=$row2[0];//No of Seats

$driverId=$row2[1];//driverId

$totpas=$row1[1]+$noPassanger;//Get the total no of Passengers


//If the no of seats still greater than total no of passengers in the previously assinged vehicle,
//update the new job with same vehicle no

if ($totpas<=$vNoSeat){

$sqlapp="update job set status='Approved',vId='$vid',driverId='$driverId' where jobId='$jobId'";

        $resapp=mysqli_query($conn,$sqlapp);

        if($resapp!=""){

                $msg="Job  Approved  <br><br>  <a  href='viewjobs.php'>Approve  More
Jobs</a>";

                header('Location:message.php?m='.$msg);

        }

        else

        {

                $msg="Job  Approved  <br><br>  <a  href='viewjobs.php'>Approve  More
Jobs</a>";
```

```php
                                header('Location:message.php?m='.$msg);

                        }

                }
        else
        {
```

//select the vehicle which has the highest distance Per Litre where the no of seats are greater than no of passengers

```php
                        $sql3="select vId,driverId,distancePerLitre from vehicle where vNoSeat>='$noPassanger' order by distancePerLitre desc";

                        $res3=mysqli_query($conn,$sql3);

                        $row3=mysqli_fetch_array($res3);

                        $vId=$row3['vId'];

                        $driverId=$row3['driverId'];
```

//Update job table with a new vehicle id and a driverId for the particular job

```php
        $sqlapp="update job set status='Approved',vId='$vId',driverId='$driverId' where jobId='$jobId'";

                        echo $sqlapp;

                        $resapp=mysqli_query($conn,$sqlapp);

                        if($resapp!=""){


                        $msg="Job Approved <br><br> <a href='viewjobs.php'>Approve More Jobs</a>";

                                header('Location:message.php?m='.$msg);

                        }
                        else
                        {
                        $msg="Job is Not Approved <br><br> <a href='viewjobs.php'>Approve More Jobs</a>";

                                header('Location:message.php?m='.$msg);

                        }

                }

}


?>
```

```
<html>
 <head>
  <title>Approve Job Page</title>
</head>
 <body>
  <main class='top'>
      <div>
      <table border=1 class='center'>

<form method='POST' action='<?php echo $_SERVER['PHP_SELF'];?>'>
<tr><th colspan=4>Job Details</th></tr>
<tr><th colspan=2>Job Id</th><td colspan=2><input type='text' name='jobId' value='<?php echo $row_job['jobId']; ?>'></td></tr>
<tr><th colspan=2>Job Request Date</th><td colspan=2><input type='text' name='jobReqDate' value='<?php echo $row_job['jobReqDate']; ?>'></td></tr>
<tr><th colspan=2>Job Start Date</th><td colspan=2><input type='text' name='jobStartDate' value='<?php echo $row_job['jobStartDate']; ?>'></td></tr>
<tr><th colspan=2>Job Start Time</th><td colspan=2><input type='text' name='jobStartTime' value='<?php echo $row_job['jobStartTime']; ?>'></td></tr>
<tr><th colspan=2>Job End Date</th><td colspan=2><input type='text' name='jobEndDate' value='<?php echo $row_job['jobEndDate']; ?>'></td></tr>
<tr><th colspan=2>Job End Time</th><td colspan=2><input type='text' name='jobEndTime' value='<?php echo $row_job['jobEndTime']; ?>'></td></tr>
<tr><th colspan=2>jobTask</th><td colspan=2><input type='text' name='jobTask' value='<?php echo $row_job['jobTask']; ?>'></td></tr>
<tr><th colspan=2>No of Passengers</th><td colspan=2><input type='text' name='noPassanger' value='<?php echo $row_job['noPassanger']; ?>'></td></tr>
<tr><th colspan=2>Estimated Distance</th><td colspan=2><input type='text' name='estimateDistance' value='<?php echo $row_job['estimateDistance']; ?>'></td></tr>
<tr><th colspan=2>Estimated Fuel Quantity</th><td colspan=2><input type='text' name='estimatedFuelQty' value='<?php echo $row_job['estimatedFuelQty']; ?>'></td></tr>
<tr><th colspan=2>Officer Name</th><td colspan=2><input type='text' name='staffLname' value='<?php echo
```

$row_job['staffFname']," ",$row_job['staffLname']; ?>'></td></tr>

<tr><th colspan=2>Job End District</th><td colspan=2><input type='text' name='jobEndDistrictId' value='<?php echo $row_job['jobEndDistrictId']; ?>'></td></tr>

<tr><th colspan=2>Job End City</th><td colspan=2><input type='text' name='jobEndCityId' value='<?php echo $row_job['jobEndCityId']; ?>'></td></tr>

<tr><th colspan=2>Job Status</th><td colspan=2><?php echo $row_job['status']; ?></td></tr>

<?php

echo "<td colspan=4 align='center'><input type='submit' value='Approve Order'><input type='button' value='Cancel'></td>";

echo "</form>";

echo "</table>";

echo "</body>

         </html>";

// Close Connection

mysqli_close($conn);

?>

4.2.7 Hardware Components used for IOT development

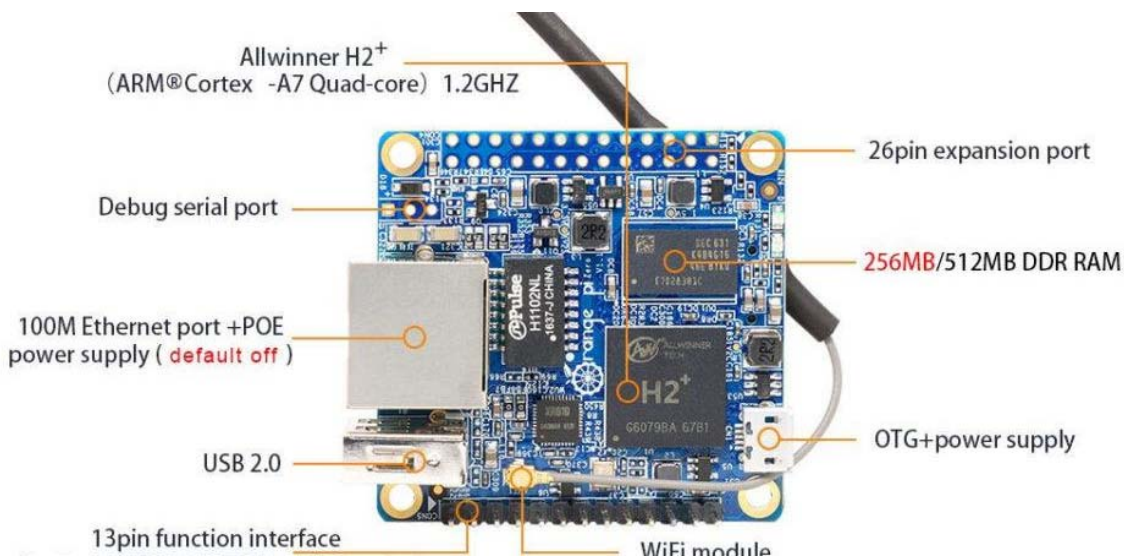## 1. Orange pi Zero Development Board/ Orange Pi Zero Mini PC

Figure 4.1 Orange pi Zero Development Board

It's an open-source single-board computer . Orange Pi helps to run different applications and uses different operating systems. It can run Android, Ubuntu, Debian etc. The Orange Pi Zero has a quad-core ARM-based Cortex A53 processor with a 1.5 GHz clock speed. This has a 64-bit architecture, which allows for faster computational performance. When you couple this with 512 MB or 1 GB RAM, you get a speedy combination that can handle most basic tasks with ease.

In Our Develop system, we used an Armbian Operating system with Orange pi zero development board. Armbian is a base operating system platform for single board computers. Armbian is a lightweight operating system compared with Debian or Ubuntu based Linux operating systems. Armbian build tools support each system and are compiled, assembled and optimized easily. It has powerful build and software development tools to make custom builds.

Why chosen Orange pi zero

There are numerous different microcontroller platforms accessible for physical computing. In this Orange Pizero platform **WiFi** module is present and will allow you to connect the Orange Pi in wireless mode. It is a great advantage for our development system. In addition to this feature, a mini USB port dedicated to power and additional USB 2.0 port are included here. Orange Pi Zero has two GPIO combinations, one for 13 pins and one for 26 pins. The 13-pin combination is used to connect the Interface board and expansion board with additional USB ports, analog AV output, microphone, and IR port. The 26-pin combination is available for user peripherals. Moreover, it offers some advantages for this kind of development.

1. Inexpensive

  Orange pi boards are moderately cheap compared with other single board computers like Raspberry pi.

2. Cross-platform

 The Orange pi runs multiple operating system windows, Macintosh OS, Linux working frameworks.

3. Low power consumption

Need only 5 V Power supply.

4. Sufficient number of practical applications

2. GPS Module -NEO6MV2 NEO-6M

Global positioning System (GPS) used to detect the Latitude and Longitude of any location on the Earth with extract Universal Time Coordinate time. This device receives the coordinates from the satellite for each and

every second with time and date. GPS offers great accuracy and also provides other data besides position coordinates. The module connects to the Orange pi zero board 9600 bps baud rate through URT interface. Only four wires are needed to read the module's GPS data. This module is compatible with 3.3 V- 5 V interface. It also has an Electrically Erasable Programmable Read-Only Memory and a Flash which is useful to save configuration data.
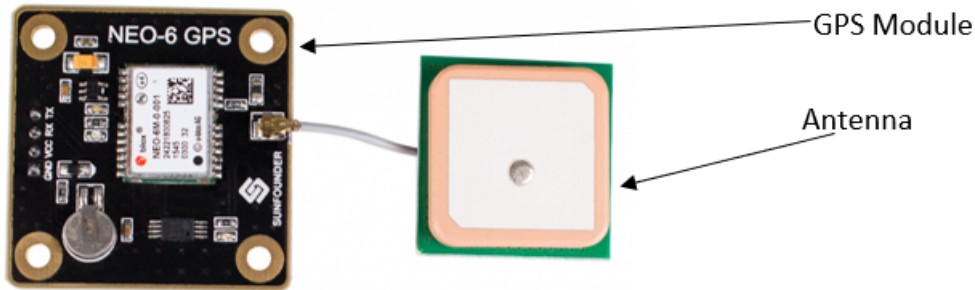

Figure 4.2 NEO-6M GPS Module

Features of GPS Module

1) A complete GPS module with an active antenna integrated, and a built-in EEPROM to save configuration parameter data.

2) Built-in 25 x 25 x 4mm ceramic active antenna provides strong satellite search capability.

3) Equipped with power and signal indicator lights and data backup battery.

4) Power supply: 3-5V; Default baud rate: 9600bps.

5) Interface: RS232 TTL

Advantages of GPS

Following are the advantages of GPS:

- The GPS signal is available worldwide. Therefore, users will not be deprived of it anywhere

- GPS can be used anywhere in the world, it is powered by world satellites, so it can be accessed anywhere, a solid tracking system and a GPS receiver are all you need.

- The GPS system gets calibrated on its own and hence it is easy to be used by anyone.

- It provides users with information based on location in real time. This is helpful in different applications such as mapping (used in cars), location (geocaching), analysis of performance (used in sports), etc. Example: Application for Google Earth.

Dongle is used for sending and receiving GPRS data through TCP/IP protocol.

3. USB to TTL converter.

The AN-USB-TTL module is a cost-effective way to convert TTL signals to a USB interface. When connected to a PC USB port the AN-USB-TTL module is automatically detected and is installed as a native COM port

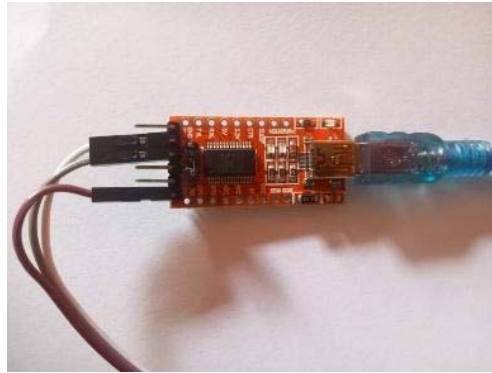which is compatible with any existing serial communication application.

Figure 4.3 USB-TTL Converter

4. USB dongle or WiFi Connectivity

5. Connecting Wires (jumper wires)

4.2.8 Software and Technology Specification in the Hardware Implementation

- **Software Specification in the Hardware Implementation**

Software Hardware Integration language	Python 3.8
Orange Board OS	Armbian O/S
connect a keyboard and mouse at the same time	Putty 0.77 version
Database Connectivity	MySQL (WAMP Server)

Table 4.4 Software Specification in the Hardware Implementation

- **Technologies used in the Hardware Implementation**

1. Geofencing.

Geo-fencing is a technique that allows users to create virtual boundaries in a real-world setting. On the ma p, the user can define a specific radius area. If somebody enters or exits that region, they will be notified in real-time. This protects the asset's safety and security, as well as a monitoring system to prevent any unauthorized activity.

Why we used this technology for our development?

- Establishing a geofencing and linking it to GPS Tracker allows knowing when a Vehicle has entered or exited the defined geofenced location.
- Geofencing is cost-effective as we can use the same GPS tracker to get the in and out of the vehicle without using an extra device.

Figure 4.4 Geofence

2. Google Maps API

Google Maps API is a set of application programming interfaces that lets us talk to its services. It will allow us to build simple apps to very sophisticated location-based apps for Web, iOS, and Android.

Google Maps API key is used to access Google Maps API. Some applications or plugins using the capabilities of Google Maps require getting and adding an individual token. If you have one of these plugins, you should register on the Google API Console and get your own key.

A Google Maps API key is a personal code provided by Google to access Google Maps.

This is also cost effective and easy to develop.

3. TCP/IP protocol

4.2.8 Flow of Hardware Implementation with software integration

- Gathering the Hardware through needed
- Drawing the circuit diagram
- Assemble those Hardware according to circuit diagram
- Boot orange pi zero board using putty interface
- Configure IP setting
- Upload the python code through Com port (Serial communication)
- Set up Geofence coordinates.
- GPS module connect to vehicle through Orange pi zero board.
- Provide GPRS connectivity to Orange pi zero board through Dongle or WiFi connectivity.
- Set up Google Map API using Google Map Key.
- Read data through fleet Management software.

4.2.9 Working principle

In this Hardware Development, Orange Pi board will use for controlling whole process with a GPS Receiver. GPS Receiver is used for detecting coordinates of the embedded system .WiFi connection or internet dongle used for push data to web server . Server uploads this data using python program to Databases in the fleet management system.

GPS
Mod
ule

Figure 4.4 Working Principal