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Rev VI

Bachelor of Science in Computer Science

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Certificate

We accept the work contained in the report titled "Rev VI", written by Mr. Ahmed Bakali AND Mr. Ahmad Ali Qureshi as a confirmation to the required standard for the partial fulfillment of the degree of Bachelor of Science in Computer Science.

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Abstract

Learning online has become more and more popular in past few years and continues to grow till today, there is and will be great need of utensils to enhance the learning environment for children. An efficient real vehicle tracking and monitoring system is developed and implemented. The proposed system made uses technology that combines Web and Android application with an OBD2 device with inbuilt GPS and GPRS module. The vehicle tracking system uses the GPS module to get coordinates at regular time intervals. The GSM/GPRS module is used to transmit and update the vehicle location to a database. A Web and Android application is developed for continuously monitoring the usage and tracking of the vehicle location. The Google Maps API is used to display the vehicle on the map. In order to show the feasibility and effectiveness of the system, this paper presents experimental results of the vehicle tracking system and some experiences on practical implementations.

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Acronyms and Abbreviations

ECU	Engine Control Unit
GNSS	Global Navigation Satellite System
OBD	On Board Diagnostics
PHP	Hypertext Pre-processor/Personal home page
RPM	Revolutions per Minute
SQL	Structured Query Language
Yii	Framework for PHP

Chapter 1

Introduction

1.1 Introduction

The modern world has little time to spare for things that were otherwise time consuming. In this urban life transportation is very common. A lot of mishappenings occur on the road every day, therefore the need of security and maintenance monitoring of one's car is developed. This hassle has been dealt by modern technology. Though OBD ports exist in most modern cars, yet the full fledge capabilities of the port are yet to be put to good use in Pakistan. The OBD port mostly found around the gear area or the steering wheel is a port put in by car manufacturers that records readings of the car, yet if taken in an analogy it would be more like a mouse without an actual PC, rendering it useless.

1.1.1 Objective

To design a Smart phone and Web application allowing user to monitor real time performance and position of their vehicle.

1.1.2 Problem Description

Vehicles used by drivers for private or commercial purposes are not taken care of by the drivers. The owner always stays concerned about how is his vehicle being used. This system will help him monitor and look after all his concerns.

1.1.3 Project Scope

We have been observing nowadays that a lot of cars are driven by personal and/or private drivers who sometimes use their owner's cars on their own will. It is very likely for the driver to use the owner's car for his personal purposes even if not allowed. The drivers in our society often tend to cheat on their owners by driving the car extra miles, consuming more fuel, and adjusting it with the owner's miles. This way the owner has to refuel frequently bearing a decent amount of financial loss. In order to monitor how the car is being used, no steps have been taken. This application is aimed to cater all the car owners who are unhappy with their car performance. It will enable the owner to get to know if the driver if the driver is following his instructions or not. This will be fruitful in getting to know the speed limits which would ultimately lead on to Fuel cost saving. The app will update the owner if the car has stayed in the designated area or not. This real time monitoring will ensure efficiency by cutting down on fuel cost and maintenance expenditures as the car will then be driven very carefully. By these means, the cars will be taken care of proving to be very prolific towards the financial assistance of the owner of the car.

Chapter 2

Literature Review

2.1 Literature Review

Despite the benefits of the OBD devices and its widespread use international. The limitation of Pakistan's motor industry is such that locally assembled cars that represent the majority on the road do not have the required ECU- Engine Control Unit that is used for the OBD devices. Though OBD ports have been in cars manufactured since 1996 [2] but the global trend never managed to reach Pakistan. And those that did have OBD ports had OBD1 ports, the modern devices that are made for modern ECU's do not support OBD1 ports and need OBD2 which is a modern version of the port.
Another issue is that internationally OBD port's protocols of communications differ from one manufacturer to the other. However luckily for Pakistan most cars used and bought are Japanese such as Toyota, Honda and Suzuki which all use somewhat the same protocol. [3]
The rigidness of the consumer market in accepting new trends added to the monopoly of current mechanics that refuse to deal with newer technologies have been some of the prime reasons for the devices to not have been sold or used on a larger scale in Pakistan.
The proposed layout for this project was to initially find a device that could support the existing OBD ports that are used mostly in Pakistan which were OBD2. We have to familiarize ourselves with the device and its protocol of communication. The integration of the device with the web and mobile app was paramount as there were a lot of different API's that had to be integrated and readings of which had to be interpreted to make useful data of the raw dump.
Despite other big companies that had jumped into the OBD device race and us contacting them, we got to know that they had given up on the project due to the variations in OBD ports, protocol and the ECU's in car [4]. However we thought it to be useful to introduce a working model such that manufacturers and assemblers of cars are pushed towards including the latest ports in their cars and given the added functionality to the customers.
We believe this struggle was the same one that initial tracking devices faced in Pakistan

and they have finally managed to enter the market in a greater way. Our technology with time will find its way as well.

2.1.1 OBD2

OBD2 is a device which monitors emissions, mileage, speed, and other useful data receiving all the data from the ECU. Few of the reading it gives are;

Mileage
Mileage sensor
Relative odometer
Digital
Engine ignition sensor
Alarm trigger
Private mode
Custom digital sensor
Temperature coefficient
Engine
Engine revs sensor
Engine efficiency sensor
Absolute engine hours
Fuel
Impulse fuel consumption sensor
Absolute fuel consumption sensor
Instant fuel consumption sensor
Fuel level sensor
Fuel level impulse sensor

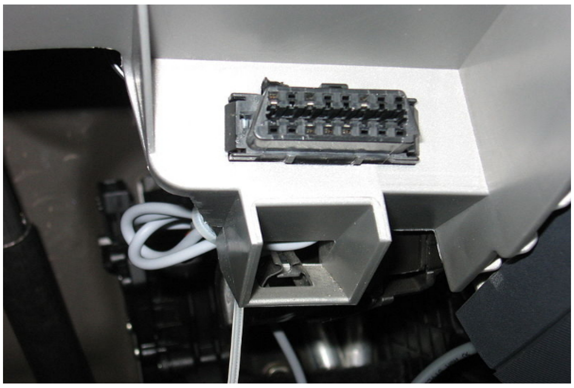

Figure 2.1: OBD port is usually found under the Steering area of a vehicle.[1]

2.1.2 GPS

A GPS tracking system uses the GNSS network. This GPS devices give information on location, and direction. A GPS can potentially give both real-time and historic navigation data on any kind of journey. The longitude, latitude and altitude coordinates are sent to the map to pin point the location.

2.2 Related Work

2.2.1 Automatic

As mentioned above, there are multiple useful apps and devices for OBD. One of which is Automatic, the device is one that is connected to the OBD2 port and is used to connect with multiple apps offered to help monitor the health and usage of the car. The device comes with multiple apps varying according to usage from Teenager use to family use and company use.
Automatic states that the smartness of cars are underestimated and a deeper look and smarter use can unlock the brains of your vehicle. [5] The web app shows different spans of data analysis according to the user's requirements. Different trips are saved separately to monitor the initial location and destination of every trip as well as the average speed, rpm and time taken. A graph shows different patterns of fuel consumption according to different periods, while a map shows grids of all the trips taken in the mentioned period.

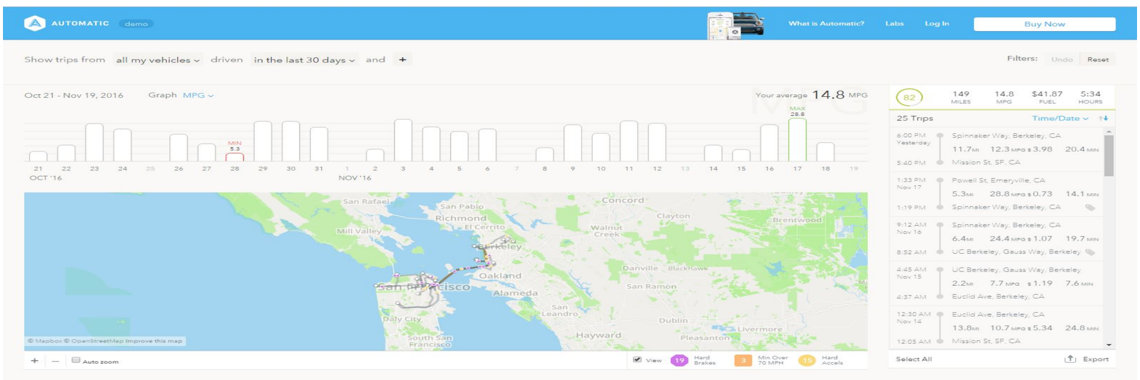

Figure 2.2: Automatic Demo Dashboard

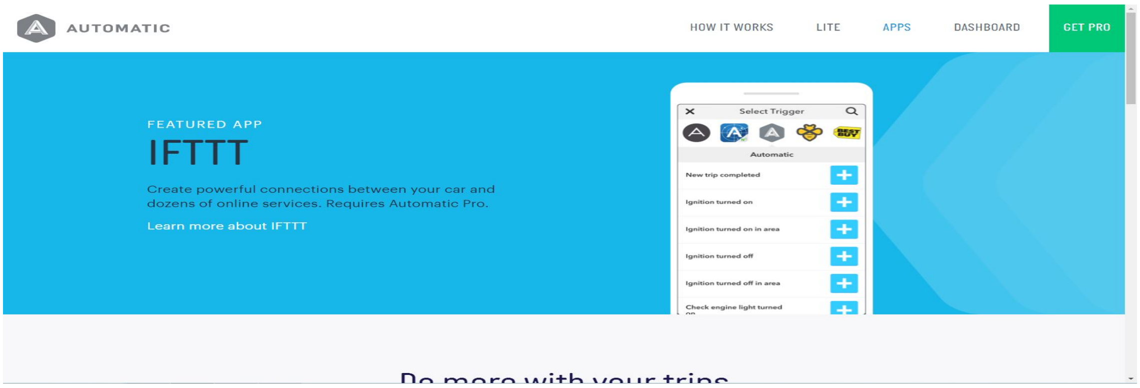

Figure 2.3: Automatic Smartphone App

2.2.2 TrackingWorld

However despite the mentioned existing system, it is important to note that no such systems exist in Pakistan so our system is the first of its kind in Pakistan. Despite brands and devices such as Tracking World existing in Pakistan, the device simply helps track the car to prevent theft. However as mentioned above, our device goes far beyond just that and helps achieve far greater things than just track a car's location. [6]

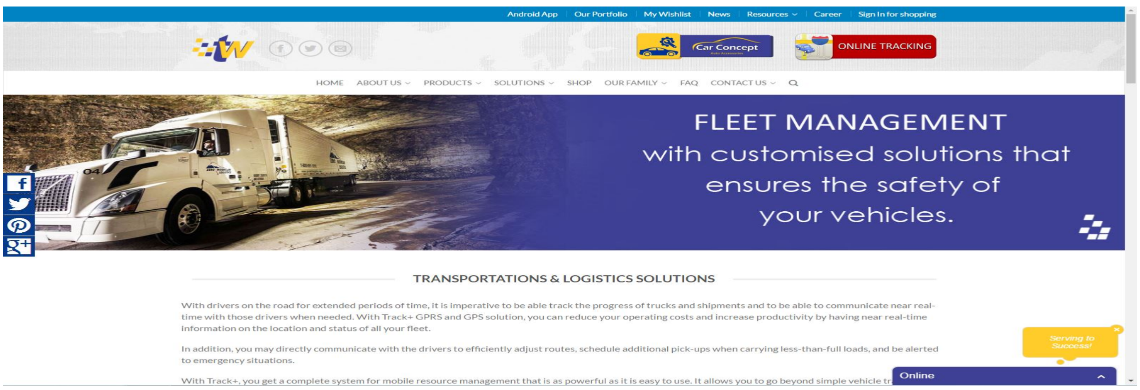

Figure 2.4: TrackingWorld Fleet Management

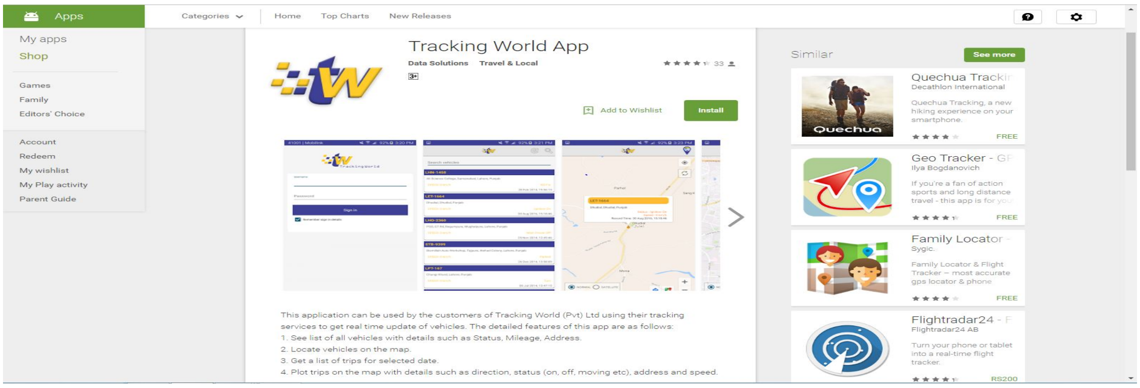

Figure 2.5: TrackingWorld Smartphone App

Chapter 3

Requirement Specifications

3.1 Proposed System

We will be working on OBD2 devices that records all readings taken from the car and sends it to a linked device. The readings taken are as follows:

- Speed
- RPM
- Fuel consumption
- GPS Coordinates

As the measurements suggest, the device helps in a lot of different ways mainly being:

- Monitoring the engine's health with regards to consumption.
- Consumption analysis with regards to RPM and speed.
- Helping locate the car in cases of theft or general patterns of use when given to a driver.

The above mentioned benefits are just a few amongst many others that the device helps realise [7]. The OBD device communicates with the users devices on multiple fronts, mainly being:

- Handheld mobile devices.
- Internet browsers on personal computers.
- Tablets.

This multiple front access gives the user the capability of remotely monitoring the vehicles statistics. The statistics are shown in two different formats them being:

- Web application that can be accessed through any web browser.
- Android app that is linked to the OBD device.

3.2 Requirement Specifications

3.2.1 Hardware Requirement

NYI-TECH OBD2 NT-183G [8]

Interface:	OBD interface: Support A/B Type Configration interface: Micro USB Button interface: MMCX
Support Diagnostic Protocol	Passenger ISO15031 and Dedicate (TOYOTA, NISSAN, MAZDA, HONDA, MITSUBISHI, SUBARU, SUZUKI, DAIHATSU)
GPS Performance:	Receiver Channels: 56 reacquisition Sensitivity-160dBm position accuracy2.5m CEP Cold Start30s Hot Start1s
Actual Measurement 3D Positioning time	Cold Start30s 120s Hot Start3s 15s
GSM/GPRS	Working frequency GSM.GPRS 850/900/1800/1900MHz
Storage:	8MB FLASH

Table 3.1: OBD datasheet

Functional Requirement

- Data transmission from ECU to OBD device
- GPS fetching coordinates of the location
- OBD data and GPS data transmitted to Web Server
- Display of received manipulated data

3.2.2 Non Functional Requirement

Usability

- Rev VI should be easy to navigate by using clear words, menus and tabs.

Reliability

- Rev VI should be available 24 hours a day for application users.

Performance

- Rev VI should not take longer than 05 seconds to respond to a page request for members; when using an internet connection that is 1mb or higher.

Interface

- Rev VI should be through a web browser such as Chrome or Internet Explorer.

- Rev VI should be able to run on an android device with android version 4.1 and above.

Security

- Rev VI should be vulnerable to any attacks and should not allow any unauthorized authentication.

3.3 Use case

3.3.1 Use Case Diagram

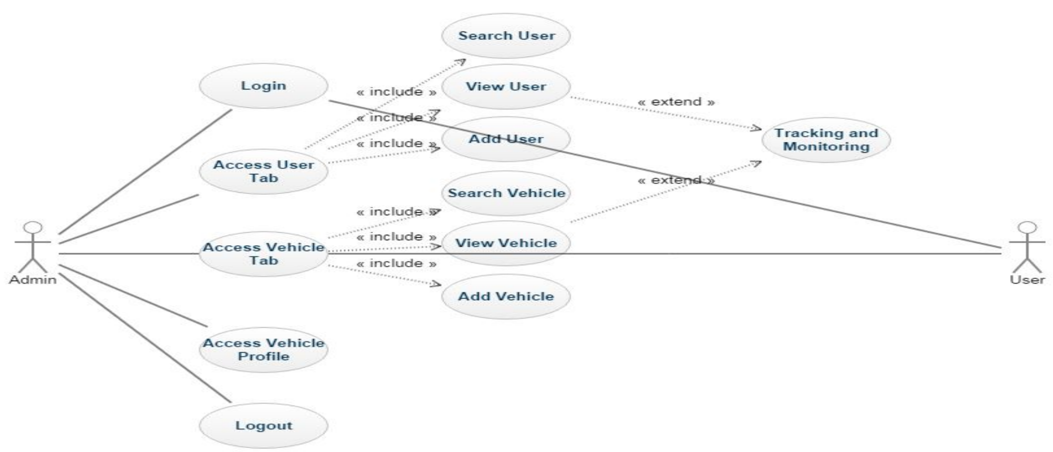

Figure 3.1: Use Case Diagram

3.3.2 Use Case Description

Figure 3.2: Use Case Diagram

Name	Login
Actors	Admin, User
Identifier	UC-1
Description	This use case describes how user logs in the application
Pre-Conditions	Starting application
Basic Course of Action	Application requests the actor to enter the username and password Actor enters username and password System validates the actor's input
Failure	Actor enters an invalid username or password

Table 3.2: Login to Application Use Case

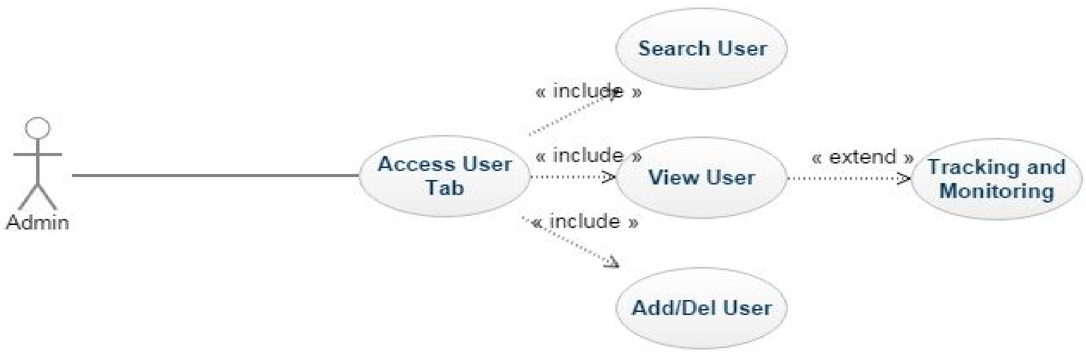

Figure 3.3: Use Case Diagram

Name	Access User Tab
Actors	Admin
Identifier	UC-2
Description	This use case describes the possibilities of action the actor can perform
Pre-Conditions	Successful Login
Post-Conditions	Tracking and Monitoring
Basic Course of Action	Actor can search for a registered user Actor can view the user details Actor can add a new user
Failure	User not found User is offline

Table 3.3: Access User tab Use Case

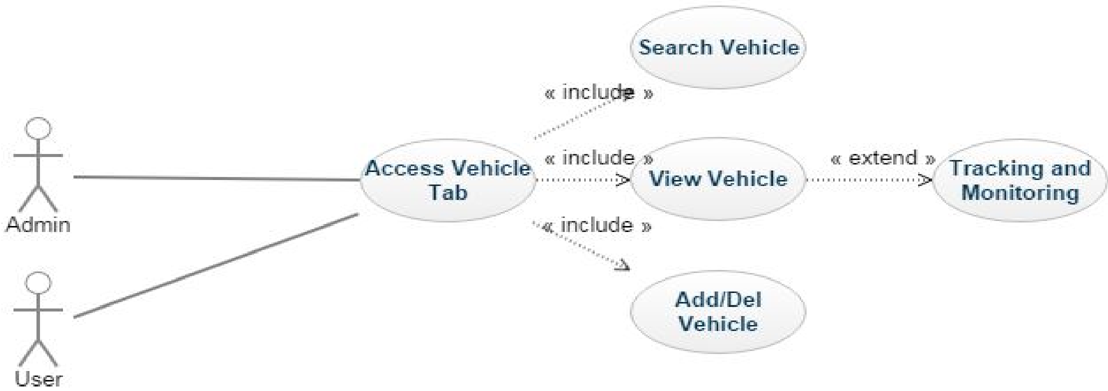

Figure 3.4: Use Case Diagram

Name	Access Vehicle Tab
Actors	Admin, User
Identifier	UC-3
Description	This use case describes the possibilities of action the actor can perform
Pre-Conditions	Successful Login
Post-Conditions	Tracking and Monitoring
Basic Course of Action	Actor can search for a registered vehicle Actor can view the vehicle details Actor can add a new vehicle
Failure	Vehicle not found Vehicle is offline

Table 3.4: Access Vehicle tab Use Case

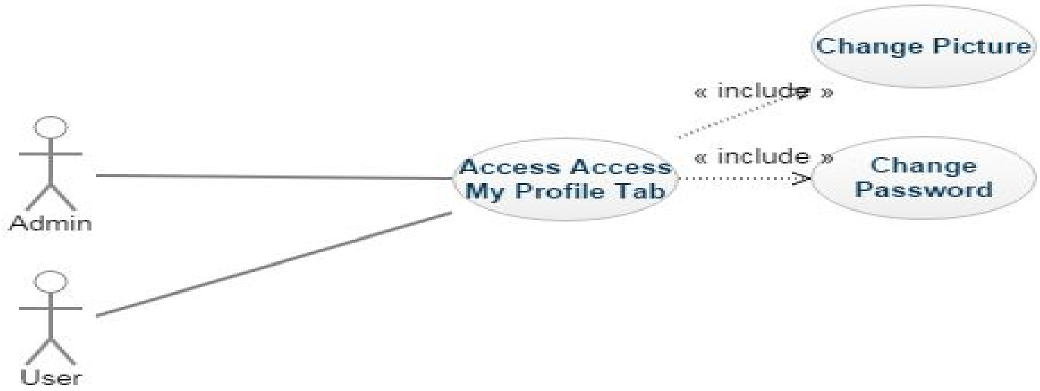

Figure 3.5: Use Case Diagram

Name	Access My Profile
Actors	Admin, User
Identifier	UC-4
Description	This use case describes the possibilities of action the actor can perform
Pre-Conditions	Successful Login
Post-Conditions	Desired changes made
Basic Course of Action	User can change his Password User can change his Picture
Failure	Password not changes Error in uploading the Picture

Table 3.5: Access My Profile Use Case

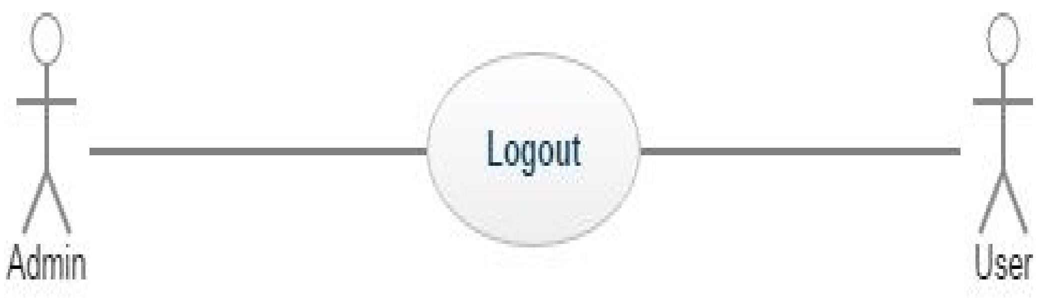

Figure 3.6: Use Case Diagram

Name	Logout
Actors	Admin, User
Identifier	UC-5
Description	This use case describes that Actor wants to logout
Pre-Conditions	Logged into the application
Post-Conditions	Exit Application
Basic Course of Action	Click on Logout option
Failure	None

Table 3.6: Logout Use Case

Chapter 4

System Design

4.1 System Architecture

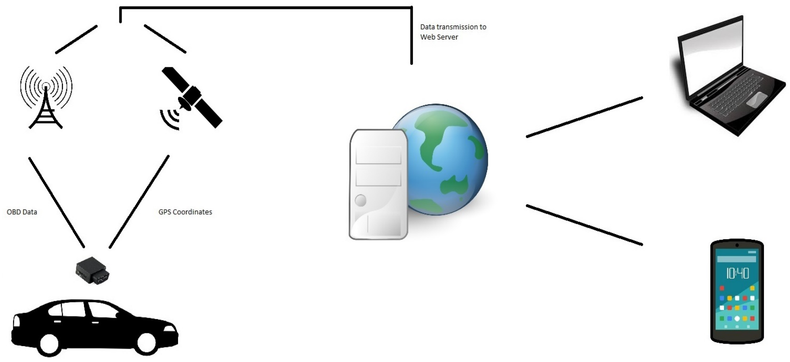

Figure 4.1: System Architecture

As per the diagram and the data provided above, our proposed system will work in the following steps:

1. The OBD device connected to the OBD2 port will get the required data from the vehicle and the GPS coordinates from its inbuilt GPS system.

2. The raw data will then be transferred through data bundles using wireless internet, mostly SIM card based internet.

3. The data will be sent through the web to the web server that collects latest and stores historical data according to users.

4. The data after being made meaningful with be shown on the web portals as well as the android app available for the system.

4.2 Design Constraints

The major constraints of the system are as following:

- Device should always be connected
- Strong network coverage in order to transmit data through 3G.

4.3 Design Methodology

Our system as a front-end will have three main parts:

- Dashboard: That would show the map with grids as to where the vehicles have gone or are going for tracking purposes with details about every trip.
- Users: Different data presented according to different users of the app and portal
- Vehicles: A sorting of data according to the vehicle used for those trips and general monitoring of their stats.

4.4 High Level Design

4.4.1 Sequence Diagram

The following is the sequence diagram of our application. The major tasks a user can do is Login to the application and then have an access to the Dashboard. When on the Dashboard he can perform multiple tasks, the major of it being Tracking and Monitoring by either User or Vehicle.

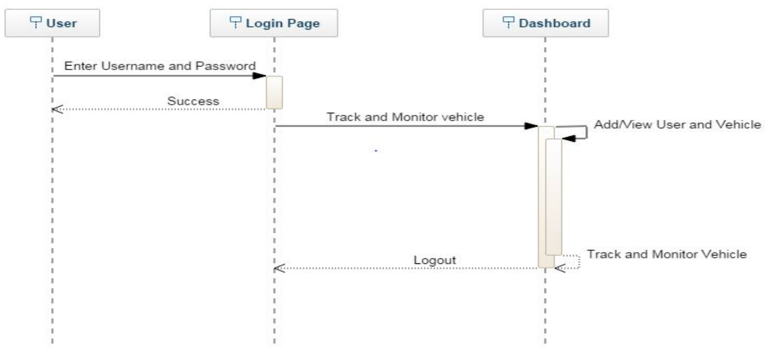

Figure 4.2: Sequence Diagram

4.4.2 Database Design

Database is made using MySQL DB. There are three main Tables; User, Vehicle, Logs. There are two types of Users with different privileges. When a successful user is created, the user can then register a car for himself. When a device is available, a car can be registered, it is then assigned to a owner who is already registered.

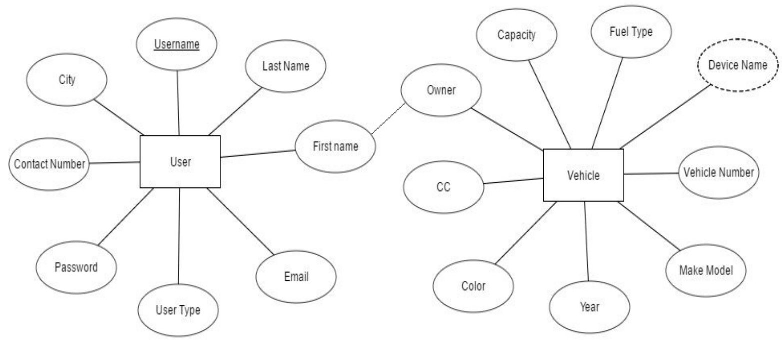

Figure 4.3: Entity Relationship Diagram

Chapter 5

System Implementation

5.1 System Architecture

The system has been divided into three tiers

- Model Layer.
- View Layer.
- Controller Layer.

View layer deals with content presentation and user interaction. The Controller layer incorporates all the functionality of the system and to the Model layer and the loading of modules. The Controller layer acts as a bridge between the View Layer and the Model Layer. Model layer consists of data fetching and storing from and to the database server.

5.2 Tools and Technology

- **Xampp Server** Environment for installing Apache, and MySQL and PHP.
- **Apache** For making Web Server.
- **Notepad++** For PHP coding.
- **Android Studio, Mean Stack, Angular** For developing Android Application
- **Google Maps** API used for location of vehicle
- **MySQL DB** Used to create Database
- **Nyitech PC Tool** To optimize settings of OBD2 device

5.3 Languages Used

- PHP
- Java
- JScript
- SQL
- Jquery

Web Applications are normally isolated into server side, client side and a Database Administration. For developing Client Side PHP (Yii framework) and JavaScript/J-Query are being utilized, PHP is also used on the server side and for DBMS we are using MySQL.

5.4 Interface of our Apps

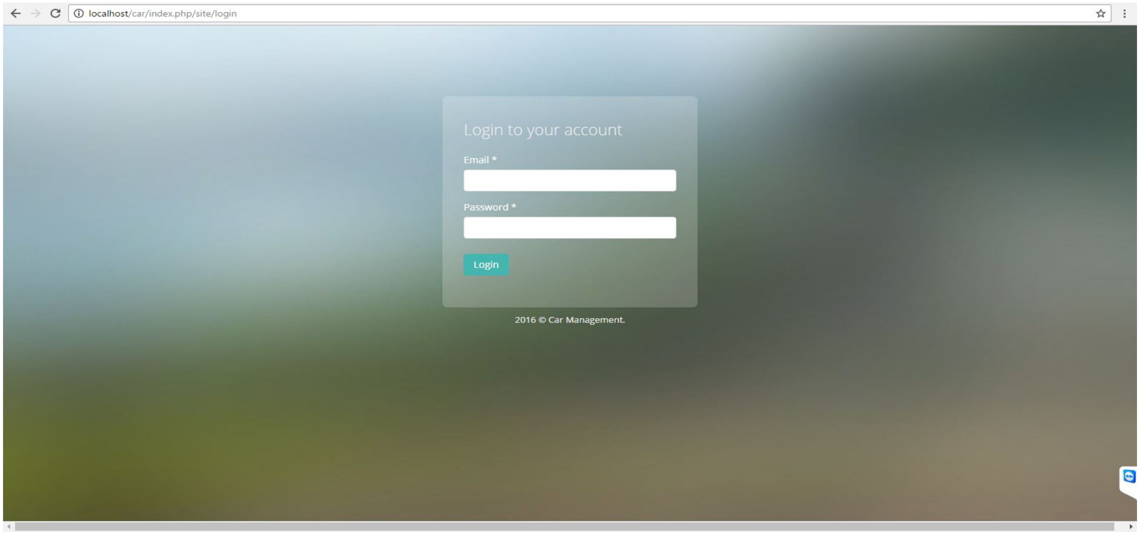

Figure 5.1: Login page on Web App

The user enters their credentials here to Login, in case of failure, the user stays on this page.

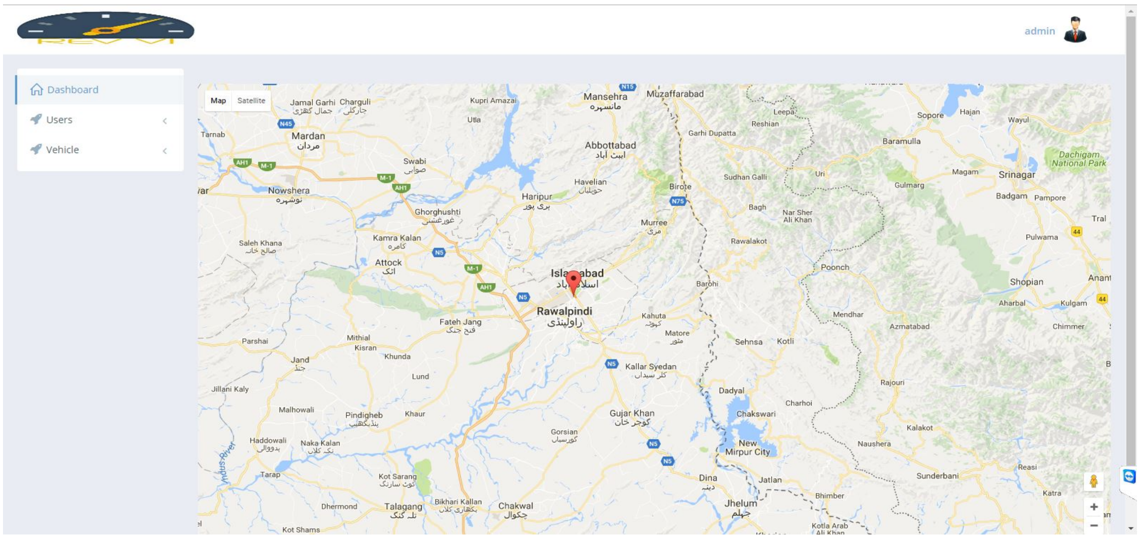

Figure 5.2: Web App Dashboard

Once the user has successfully logged in to the app, the main dashboard allows the user to navigate through the app. The map pin points all of the available vehicles to track and monitor.

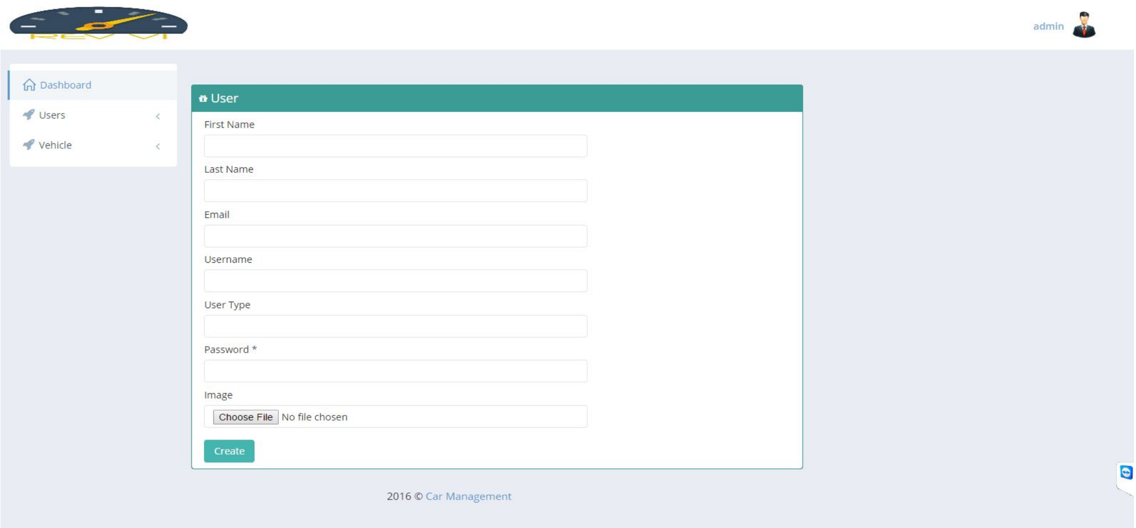

Figure 5.3: Adding a User

This page allows the Admin to Add a new user.

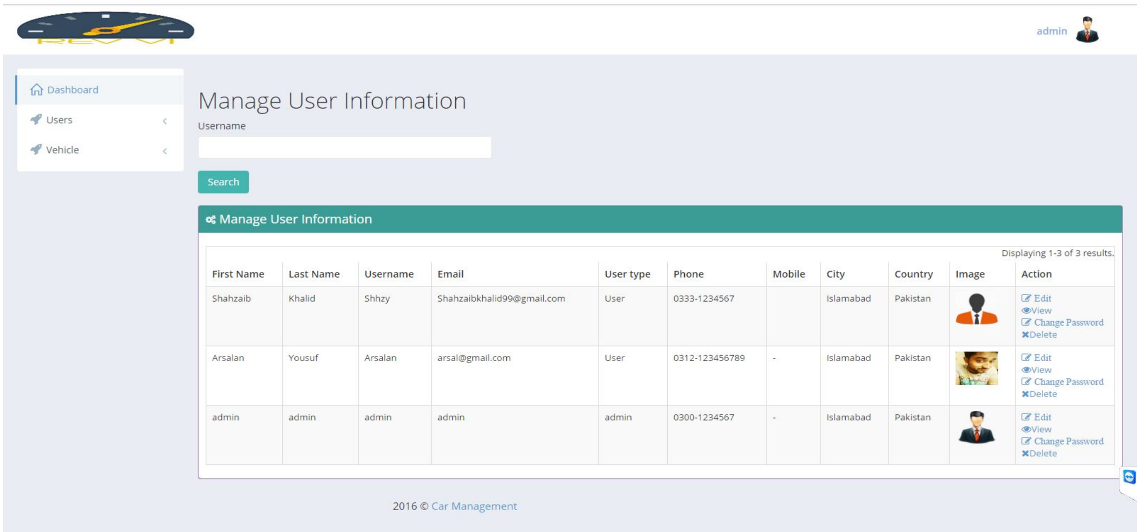

Figure 5.4: Viewing Users

This page allows the Admin to edit, view and search an existing user.

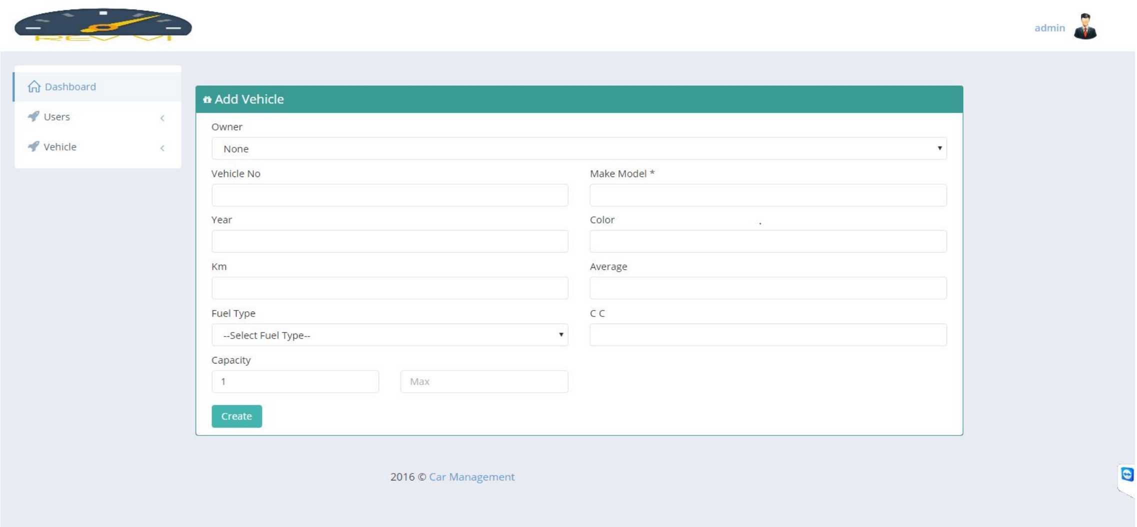

Figure 5.5: Adding Vehicle

This page allows the Admin to Add a new Vehicle.

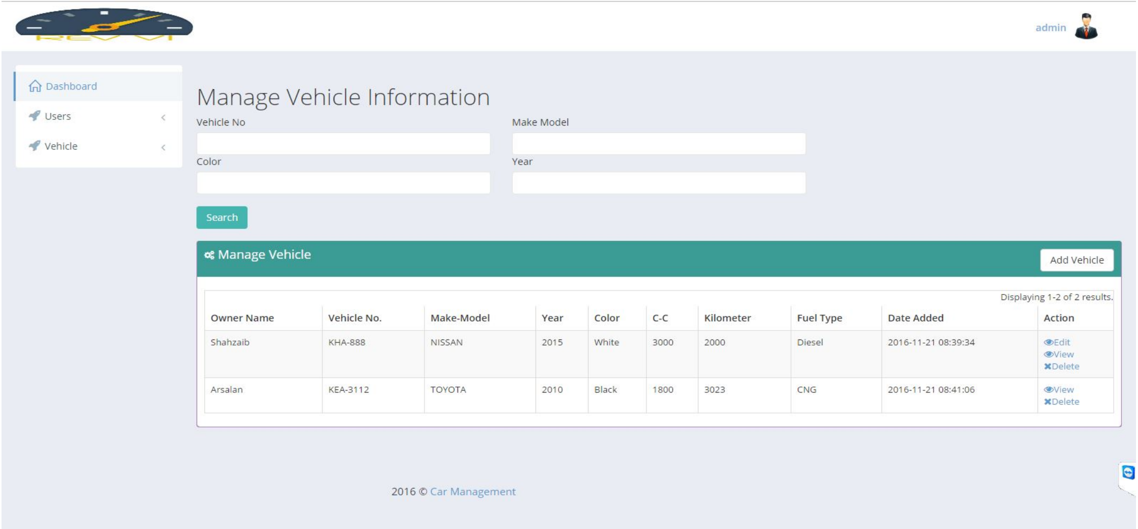

Figure 5.6: Managing Vehicles

This page allows the Admin to edit, view and search an existing Vehicle.

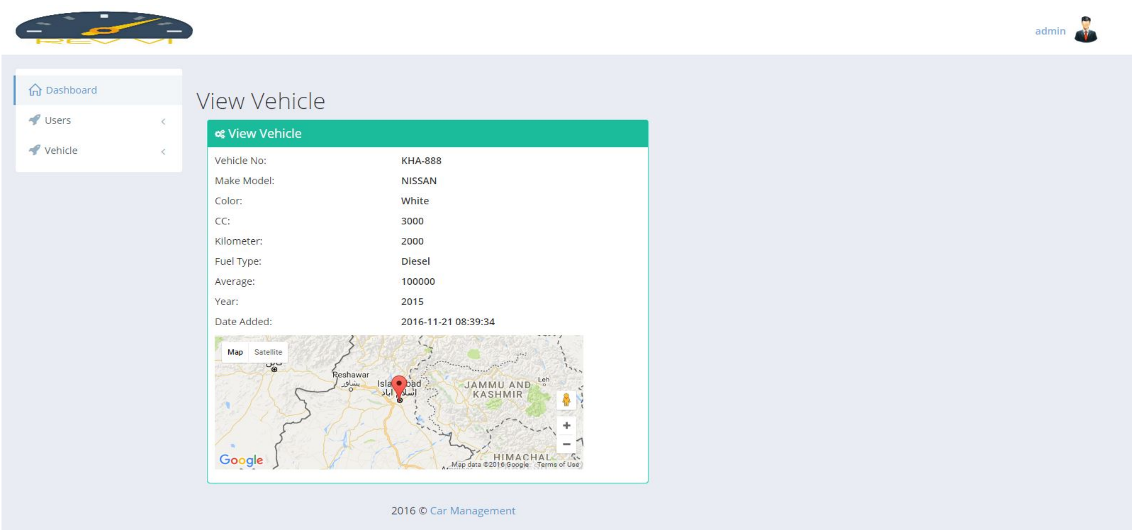

Figure 5.7: Tracking and Monitoring Selected Vehicle

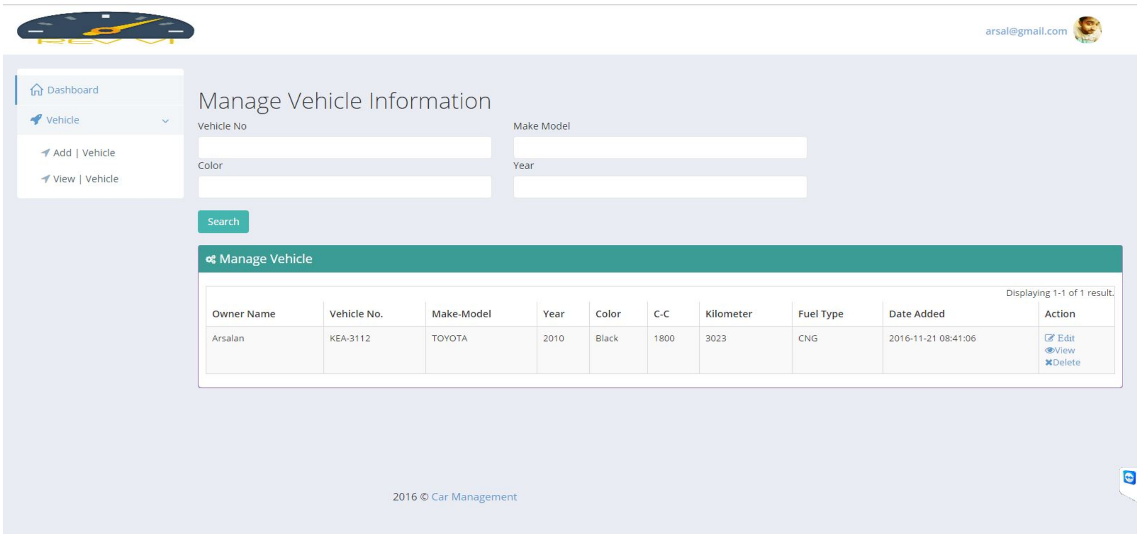

Figure 5.8: User Logged in to View or Add his vehicle

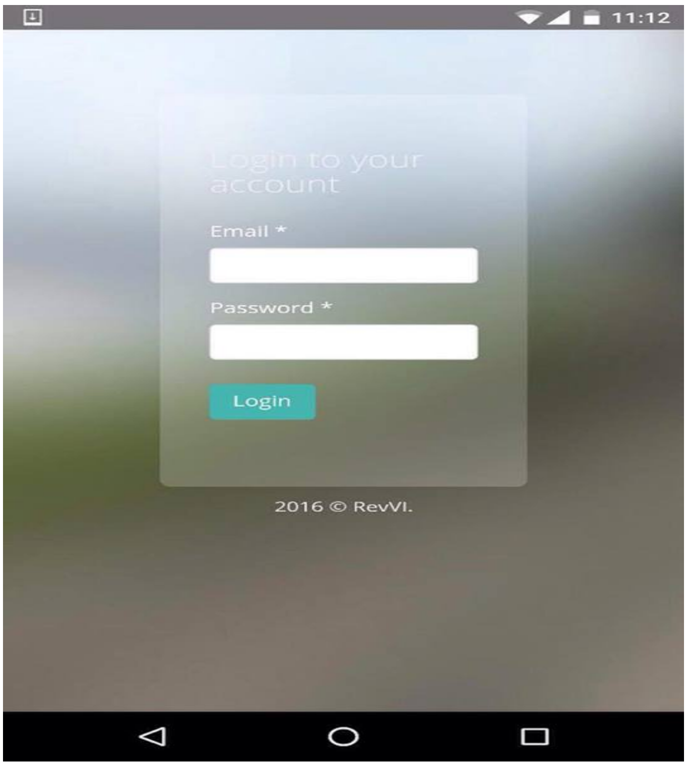

Figure 5.9: Login page on Android App

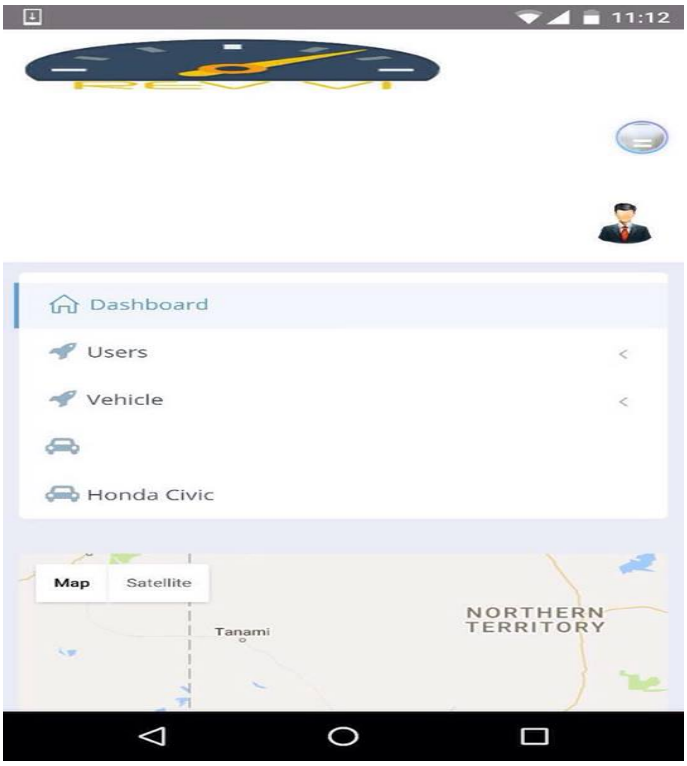

Figure 5.10: Android App Dashboard

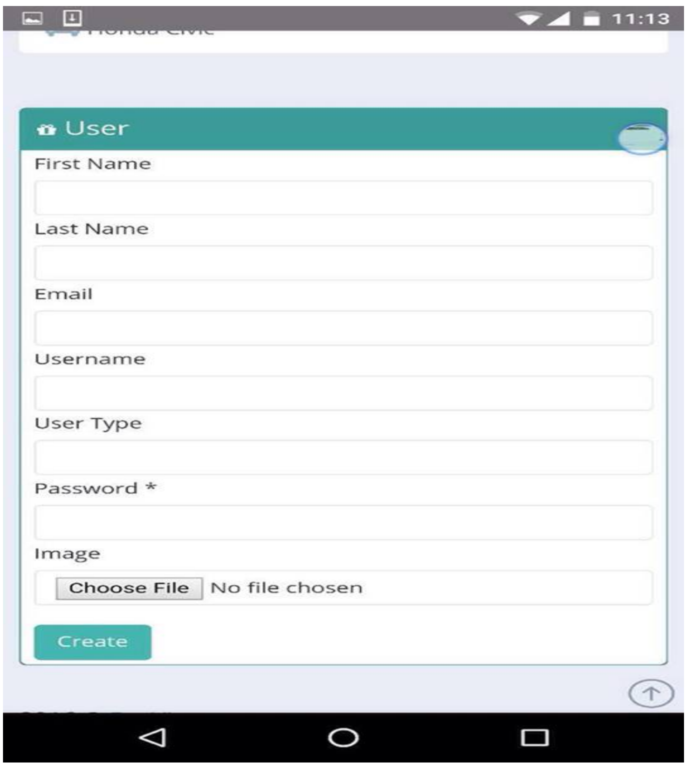

Figure 5.11: Android App Adding User

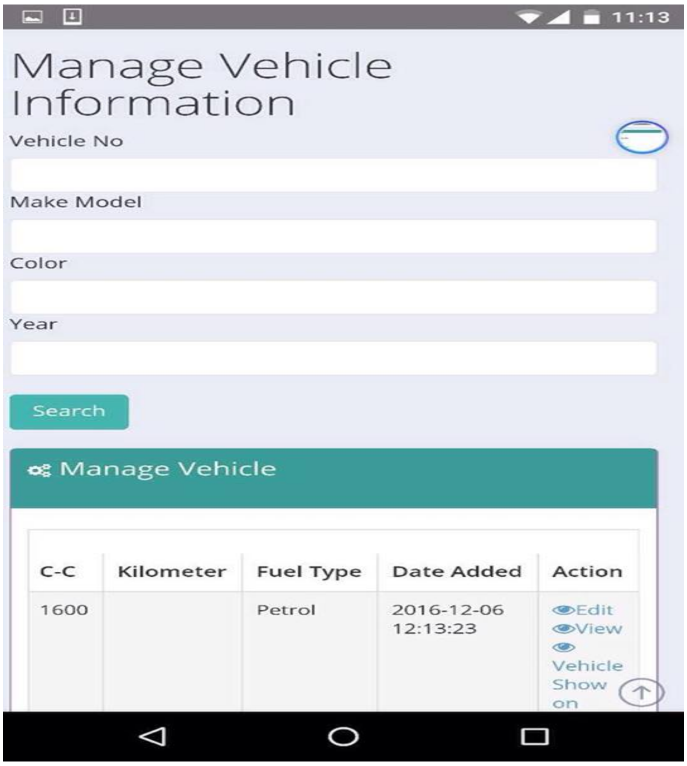

Figure 5.12: Android App Managing Vehicle

Chapter 6

System Testing

6.1 Test Approach

The test approach consists of different types of tests for Rev VI in order to discover its limitations and measure its entire capabilities. The test approach has various types of testing techniques and types to satisfy the complete system testing aspects. Outdoor testing was performed by both of the partners and they used their own cars for testing purposes. The scenario represents a possible real event. Each test case scenario was designed to test the application overall.

6.1.1 Integration Testing

This integration test validates the app working together with the OBD.

6.1.2 User Interface Testing

Usability testing was conducted by users with little prior knowledge of tracking and monitoring applications. Some principles of HCI were practiced during the usability testing. This usability testing was typically focused on the presentation and user interaction of the application, such as graphical user GUI.

6.1.3 System Testing

System testing was done to check whether the system fulfills the stated requirements and objectives by running entire system in real environment scenarios.

6.1.4 Integrity Testing

Integration testing is testing the modules as a group, so all the modules are integrated and tested individually as well as combined.

6.1.5 Compatibility Testing

The integrity testing mainly focused on data and the database integrity. GPS data which is stored in the database was tested to consistent and reliable locating on the Google map.

6.1.6 Test Cases and Results

Login			
S.No	**Test Case Description**	**Expected Result**	**Actual Result**
1	Existing user login	Enter dashboard	Correct
2	Non registered user login	Reject	Reject
3	Incorrect password entered	Reject	Reject
4	Incorrect username entered	Reject	Reject

Table 6.1: Login Test Cases and Results

Different tests were conducted regarding the Login of the app. Multiple forms of input types for usernames and password were tested and results were noted.

Common Functions			
S.No	**Test Case Description**	**Expected Result**	**Actual Result**
5	Verify all buttons working properly	Direct to clicked option	Correct
6	Verify privileges	Direct to clicked option	Correct
7	Logout	Exit dashboard	Correct

Table 6.2: General Test Cases and Results

The general functions of the apps were tested by clicking the available buttons and checking if they are linked properly to the expected results. Admin and User were logged in and tested of the privileges they were granted.

Users			
S.No	**Test Case Description**	**Expected Result**	**Actual Result**
8	Add User	Successfully add user details in database	Correct
9	Delete user	Successfully delete user from database	Correct
10	View User	Track and Monitor user related activities	Correct
11	Search user	Find the searched user	Correct

Table 6.3: Users Test Cases and Results

The user tab were tested by adding, viewing and editing the User. The database was tested, resulting in successful addition, deletion and editing of users. In the User view tab, the readings for monitoring were tested, along with the GPS location on the map.

Vehicles			
S.No	**Test Case Description**	**Expected Result**	**Actual Result**
12	Add Vehicle	Successfully add vehicle details in database	Correct
13	Delete vehicle	Successfully delete user from database	Correct
14	View vehicle	Track and Monitor vehicle related activities	Correct
15	Search user	Find the searched user	Correct

Table 6.4: Vehicles Test Cases and Results

The Vehicle tab were tested by adding, viewing and editing the Vehicle. The database was tested, resulting in successful addition, deletion and editing of Vehicle. In the Vehicle view tab, the readings for monitoring were tested, along with the GPS location on the map.

GPS			
S.No	**Test Case Description**	**Expected Result**	**Actual Result**
16	Drive car	Show correct location on Map	Correct

Table 6.5: Gps Test Cases and Results

The GPS was tested by driving the car in real time and verifying the location.

OBD			
S.No	**Test Case Description**	**Expected Result**	**Actual Result**
17	Drive car	Show correct Speed, RPM and Fuel readings	Correct

Table 6.6: OBD Test Cases and Results

The OBD was tested by driving the car in real time and verifying by comparing the readings shown on the app and with the ones in shown in the vehicle's Speed Meter.

Chapter 7

Conclusions

The project, even though a fully functional project with hardware and software working properly, is yet to be taken to a more professional scale. The ECU's installed in the car do give readings and few exceptions according to the errors that are presented by the car. In the future, the project will have the ability to decode all those errors, record them for future analysis and display all the readings it gives. This can be done and achieved once the project is funded and deployed on a larger scale accordingly. The User Interface of the apps will be improved with new and updated panels with graphical representations of all the required reading. The major difficulty faced in development of this application was to fetch and manipulate the data from the hardware. We had to configure the hardware with our web server in order to bridge a communication between the hardware and the software. As Computer Science students, we have little knowledge about the hardware integration which led to spending major time on that part. Difficulties faced while using Google maps API were overcome with the help of our supportive supervisors. This project had been a helpful resource for us to conduct research on technologies being used around the world. We came across and learned new languages and platforms in order to obtain maximum possible and optimum results. We wish to further work on this project and develop it to its full potential so we can make this project into product.

References

[1] What is the obd-ii port and what is it used for? Picture used. `Cited on pp. vii and 4.`

[2] Does my car have obd-ii? `Cited on p. 3.`

[3] Sohail Ajmal. Toobd-ii selling cars in pakistan. `Cited on p. 3.`

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[5] Automatic. `Cited on p. 5.`

[6] Transportation and logistics solution. `Cited on p. 6.`

[7] Obd modes and pids. `Cited on p. 9.`

[8] NT-183G. `Cited on p. 10.`