BACK TRACKING OF VEHICLES USING GPS AND WEB APPLICATION

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Abstract : In the present era, traffic increases enormously which causes an increase in vehicle theft, mishandling and forgery. This system aims at tracking and monitoring of vehicles in real time as well as in back date such that history of any particular vehicle can be tracked whenever required. This system uses GPS and GSM/GPRS for tracking the location of vehicles and sending its data for monitoring. The system has two units namely, vehicle unit and server unit. At vehicle unit or vehicle end GPS, GSM/GPRS is placed and interfaced with Arduino. At the server end, vehicles location is continuously being recorded and stored in the database. Further the system uses web page application form for accessing vehicles information on Google map. The databases are connected to web pages as well as to Google map such that when data is entered by authorized user, the location will be directly plotted on Google map. So the system helps the vehicle owner to keep a record of the vehicle and can mark its location on across the globe anytime anywhere.

IndexTerms **- : GPS; GSM/GPRS; Arduino; Server; Google maps; Database; Web Application.**

I. INTRODUCTION

Today, population is increasing day by day across the world and with the increase in population, traffic on the road is also increasing with the same rate. So number of vehicles are also increased correspondingly and with this theft, misuse, mishandling of vehicles take place. So there is a need of vehicle tracking and monitoring in real time, so as to avoid such misuse of vehicles. So the proposed work aims at implementation of a system for tracking and monitoring of vehicles in real time as well as in back time such that if anybody wants to track previous record of vehicles through date and vehicle number, they can do so by entering certain details in web page and locations will be shown on Google map.

This system can be used by transporters who owns a large number of vehicles and even by personnel for their own vehicles safety. As transporters run a large number of vehicles for transporting goods and materials and they don't know about the vehicles location so there is always a fear of theft and misuse of vehicles by the driver or anyone else. This system helps to track them their vehicles continuously from anywhere and everywhere, even without the knowledge of the driver. The system can be installed anywhere inside the vehicle in a hidden place so that no one will come to know that they are being tracked. Even the individual vehicle holder can also install this system in their vehicle for safety or better security.

The hardware at the vehicle end consists of GPS, GSM/GPRS and Arduino. This all is interfaced and installed inside the vehicle where it will not be accessible by anyone either from inside or outside of the vehicle. It continuously sends location of vehicle to server unit. At server unit, location of the vehicle is continuously recorded in database and shown on Google map. So if the vehicle is stolen, it can be tracked easily from Google map and for further processing the same can be conveyed to the police department and this helps them too to find the location easily.

1.1 Getting location of Vehicles

The very first step of system is to get the latitudinal and longitudinal position of vehicle from the satellite. This is achieved by using GPS at vehicle end. Global Positioning System (GPS) is a real-time satellite navigation system for determination of three dimensional positions [1]. It provides geolocation and time information anywhere on or near the earth. GPS works in all types of weather conditions, automated system, easily operable and simple in data processing, so it is widely used by people. It was developed by several U.S government organizations, including the Department of Defense (DOD), the National Aeronautic and Space Administration (NASA), and the Department of Transportation (DOT) [2].

GPS has three segments: Satellite constellation, Ground control/monitoring network, and User receiving equipment. The baseline satellite constellation consists of 24 satellites positioned in six earth-centered orbital planes with four operational satellites and a spare satellite slot in each orbital plane [1]. These satellites provide the ranging signals and navigation data to the user equipment. The control segment oversees and maintains the space segment. At the heart of the Ground Control Network is the Master Control Station (MCS) located at the Schriever (formerly named Falcon) air force base near Colorado Springs, Colorado. The MCS operates the system and provides command and control functions for the satellite constellation. The user segment, or the user receiver equipment (GPS receivers), receives the signal from the space segment and computes the navigation, timing and other information.

In this system, GPS is programmed for sending data to server in few milliseconds, this duration can be increased or decreased according to need of user.

1.2 Sending data to Server end

After getting Vehicle's location through GPS, the system uses GSM/GPRS module which sends the GPS data to server end. Global System for Mobile communication (GSM) is standard for second-generation (2G) cellular mobile network. GSM is a digital mobile telephony system widely used in world for communication. It is developed by the European Telecommunications Standards Institute (ETSI) [3] to describe protocols for second generation (2G) digital cellular networks used by mobile phones. It is widely used in the world for communication purpose. GPRS is a service within GSM network, which is used to transmit information in the form of packets.

This GPS and GSM/GPRS modules are interfaced with Arduino UNO which is basically a microcontroller used for controlling single and transmitting and receiving data and information. Arduino is open source software which is started by students of Interaction Design Institute Ivrea in Ivrea, Italy, in 2003 as a program for providing an easy way to interact with devices. The Arduino project provides an integrated development environment (IDE) based on the Processing language project. Arduino uses a simplified version of C++ and also the program can be erased and reprogrammed easily [4].
All these components are interfaced and placed inside vehicle from where it cannot be accessed by anyone. For assuring that none of the data is being lost due to server error or internet error, the system uses EEPROM of Arduino of storing information such that whenever the data is not sent to server accurately it is being stored in Arduino at vehicle end and as soon as server starts working properly, the stored data is sent to server end.

1.3 User Interface at Server end

The proposed system uses, a web application which shows dynamic readings at any instant and with the help of web application one can find the vehicles location just by entering the vehicle number and date. The system also gives a record of previous days as it was already stored in the database. So if anybody wants to know where their vehicle moves in particular date, then just by entering date and Vehicle number, location (containing latitude and longitude) will be directly shown on a Google map. A user interface is created such that when the user wants to track vehicle, he/she can get the location of a particular vehicle for certain interval, then by entering vehicle number and that particular date from and date to, all the locations between that interval will be shown on a Google map.

So this system is very useful in present world where a large number of vehicles goes missing, stolen and mishandled. This system tracks vehicles in real time and gives the user its information regularly whenever they want to know and can be accessed from anywhere. This system is simple in processing and compact in handling.

1.4 Contributions

In this paper, Real time and back date vehicle tracking system using GPS, GSM/GPRS technology is implemented in web application and mainly emphasized on areas of embedded system, wireless communication and web application. Results are obtained from applying algorithms are such that one can view a vehicle's location on the Google map just by entering Vehicle number at any instant of time though User Interface. This system contributes tracking of vehicle in back date such that if anyone wants to previous days record of vehicle then it can be tracked using vehicle number and that interval in which locations are required.

II. LITERATURE SURVEY

A valuable amount of research has been carried out on Vehicle tracking and locating it on Google maps. Various technologies used in the related work have been also explored. Some of them are discussed here briefly:

1. Pham Hoang Oat et al. [2], gives vehicle tracking system using GPS and GSM modem. In order to locate vehicles conveniently and easily, this proposed system uses GPS and GSM modem and therefore developed a vehicle tracking system. The system provides user to track vehicles from a remote location. This paper gives hardware prototype for the tracking system.

2. The work presented by Safa Abd elmonem Yosif et al. [5], provides design of bus tracking and fuel monitoring system. The paper developed a bus tracking and monitoring system along with fuel and speed monitoring and facilitate administrator to manage. The proposed system uses Arduino, GPS, GMS and map suit ASP.MVC for bus tracking and monitoring along with showing graphically its exact location on Google map.

3. Harpreet Kaur and J. S. Sahambi [6], used fractional feedback Kalman filter for tracking vehicles in video. This system uses a fractional feedback loop across the Kalman filter to modify the steady state gain of Kalman filter. The cost of modified Kalman filter is estimated to be minimized as compared to proposed Kalman filter. The results of this system significantly shows the accuracy and robustness of Kalman filter.

4. Md. Marufi Rahman et al. [7], presented real time vehicle tracking system based on Arduino and GPSGSM. In this system, Global Positioning System (GPS) and Global System for Mobile Communication (GSM) is interfaced with Arduino to track vehicles in real time and locating it on a Google map.

5. Fatin Balkis et al. [8], provides the design of Vehicle Tracking Device (VTD) and its process. VTD is a device for tracking vehicles which uses Short Message Service (SMS) to focus. VTD gives location coordinates of vehicle to cell phone when there will be request of it through SMS. The system uses integrated GPS and GSM for tracking vehicles using some application, namely Waze or Google Maps. VTD is a tracking device that integrates both hardware and software.

6. The work presented by Ashok V. et al. [9], provides a secure freight tracking system in rails using GPS technology. This system is designed for security of freights. The system uses GPS and GSM technologies for tracking and avoiding an undesirable situation. This paper also incorporates the use of the One Time Password (OTP) and fingerprint for adding security to the system.

7. Nilesh Ananthanarayanan [10], presented intelligent vehicle monitoring system using wireless communication. This paper aims at developing a system that can find people who uses mobile phones while driving and break the traffic rules made by the government. To develop this intelligent vehicle monitoring system, hardware tools required are GPS, GSM and a microcontroller in a whole. This system is developed for preventing the use of cell phones during driving.

8. The work presented by Mohammed Baqer M. Kamel [11], gives real-time tracking system for vehicles based on GPS/GPRS. The proposed system uses GPS and GPRS for tracking of vehicles. The exact vehicles location is obtained by using embedded GPS sensors. The GPRS technology is used to send vehicles location data directly to a server. Web interface enables the authorized user/ owner to track vehicles.

9. P. Jyothi and G. Harish [12], presented the design and implementation of real-time vehicle monitoring, tracking and controlling system. This system uses GPS/GSM SIM900A module for tracking vehicles. The GPS module gives the present location of vehicles and GSM module is used to send vehicle location to the owners cell phone is form of SMS. The system also checks for speed, gas leakage and temperature.

10. Neeraj K. Kanhere and Stanley T. Birchfield [13], presented tracking and incremental segmentation of vehicles in real time using stable features at low camera angles. This paper uses camera which is relatively low to ground for tracking and segmenting of vehicles. This system uses a 3-D mapping from scene to picture for distinguishing features of 3-D coordinates accurately using plumb line projection. These features are then taken into account and linked to produce the number and locations of the vehicles, and standard feature tracking is used to maintain the locations of the vehicles over time.

11. Kichun Jo et al. [14], presented tracking and behavior reasoning of moving vehicles based on roadway geometry constraints. This paper gives vehicle tracking system which uses behavior reasoning algorithm to judge vehicles dynamic state and also objectives of driver. This system is used for estimating the dynamic state of neighbouring vehicles and to classify the vehicle behavior which is obtained from the multiple model filter.

12. Prashant A. Shinde et al. [15], gives real time vehicle tracking and monitoring system based on Linux board and android application. This system is designed and implemented for tracking school vehicles from one location to another in actual time. This system uses embedded Linux board called Raspberry pi and smartphone android application for tracking. The proposed system uses GPS/GPRS and GSM SIM900A.

All the above works implements vehicle tracking system in real time but the proposed system mainly focuses on tracking of vehicles in back date incorporation with real time tracking. Let us consider a example that any registered vehicle, say, MP04GS7890 travelled to certain location on 07/03/18 and any registered user wants to track the same vehicle on 17/03/18 then just by entering vehicle number (MP04GS7890) and date (07/03/18), then its location will be shown on Google map with marker. Also, if user tracks vehicle for certain interval then all the locations that falls under that particular interval will be shown on Google map.

III. SYSTEM ARCHITECTURE

This section describes the design of system in detail, functioning of each unit and process involved in whole system. The whole system is divided into two units:

1. Vehicle Unit
2. Server Unit

3.1 Block Diagram

Block diagram of vehicle unit and server unit system is shown in figure 1 and figure 2 respectively.

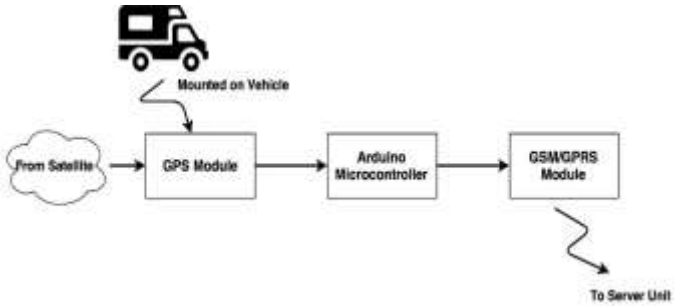

Figure 1 Block Diagram of Vehicle Unit

The vehicle unit contains one GPS Module, one GSM/GPRS Module, and an Arduino microcontroller. All the modules are powered using vehicle battery. GPS receiver starts giving out the location information (latitude, longitude and altitude) as soon as it gets a satellite fix. Output of GPS is in the form of standard NMEA (National Marine Electronics Association) sentences. This location data are read and decoded using an Arduino microcontroller. This data is sent to the server unit using the GSM/GPRS module. Arduino communicates with GSM/GPRS module using AT commands. Data is sent to server end through GPRS communication.

Server unit will receive data coming from the vehicle unit. Data from the vehicle end will be continuously received at a server and data is stored in a database and finally corresponding data will be shown on a Google map. Whenever a transporter or vehicle owner wants to get information about their vehicle, they can get it from the database. Further user interface is also created at server end such that by entering the vehicle number and date time, one can find that vehicles location for a particular time period on a Google map.

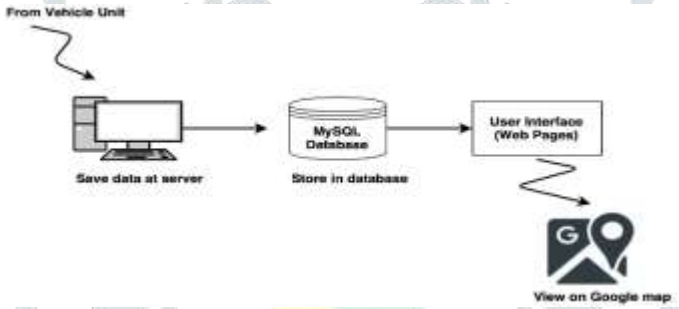

Figure 2 Block Diagram of Server Unit

3.2 Flowchart

The flowchart of Vehicle unit and Server unit are shown in figure 3 (a) and (b) respectively. Flowchart of both the units can be explained as follows:

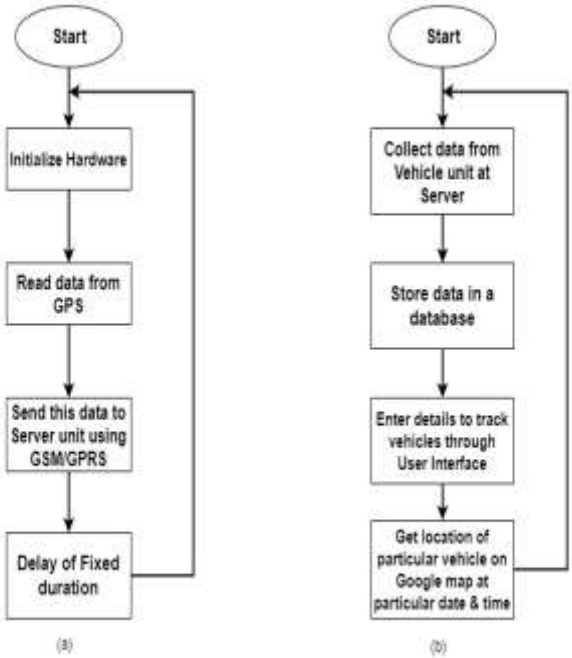

Figure 3 (a) Flowchart of Vehicle Unit & (b) Flowchart of Server Unit

1. First of all, hardware is initialized for getting vehicle's location through GPS.
2. GPS read the latitudinal and longitudinal location of the vehicle moving across.
3. These data from vehicle is recorded and send to Server unit using GSM/GPRS after delay of fixed time.
4. At the Server end, location of the vehicle is directly received at server and stored in the database.
5. A user interface is also created at server end such that the user can view all the location of vehicle on the Google map just by entering Vehicle's number for a particular date and time.

IV. PROPOSED METHODOLOGY

The system is categorized under Vehicle unit and Server unit basically. So the methodology used for implementing this "real time vehicle tracking and monitoring system using web application and Google maps" with required tools, software and their interfacing is explained here.

4.1 Vehicle Unit

4.1.1 Arduino UNO

Arduino UNO is a microcontroller board works on basis of ATmega328P. It has 14 input/output digital pins (out of this PWM outputs can use 6 pins), 6 input analog pins, a 16 MHz quartz crystal, a USB connector, a power jack, an ICSP header on board and a reset button. So, GPS and GSM/GPRS are interfaced with Arduino and these all tools are placed inside vehicle which can't be accessed by anyone.

4.1.2 GPS and its interfacing

Global Positioning System (GPS) is one of the most important tool required to develop this system as it gives the accurate geographical location of vehicle by locking satellites. In this system, a module used is NEO-6M GPS receiver manufactured by U-Blox. The output is given in the form of National Marine Electronics Association (NMEA) sentences.

The module has four pins Vcc, GND, TX and RX, where Vcc and GND are used for supplying power. GPS module gets power from Arudino by connecting Vcc to 3.3V or 5V and GND to GND. TX and RX are for transmitting and receiving serial data respectively from Arduino. The interfacing of GPS with Arduino is shown in figure 4.

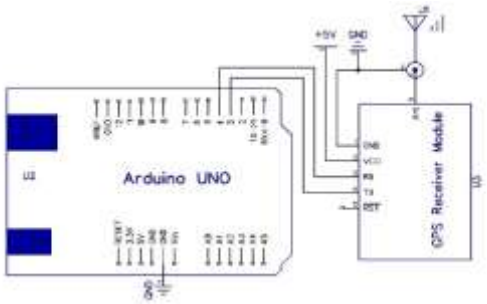

Figure 4 Interfacing of GPS with Arduino

4.1.3 GSM/GPRS and its interfacing

The GSM / GPRS module is required to establish a communication link between the vehicle unit and server unit. Here in this system GSM/GPRS modules is used for sending vehicles data from GPS to server end. The work uses SIM900A GSM/GPRS module. A GSM / GPRS module is a chip or circuit used to establish communication between mobile and computing machine, so here it is used to communicate between GSM/GPRS at vehicle to system at server end. GPRS is a service with GSM, which is used to transfer data in packet form. General Packet Radio Service (GPRS) is a packet oriented mobile data service on cellular communication.

The module has RX, TX and GND pins which can be used for serial communication with Arduino microcontroller. The module is powered using a 12V / 1A DC adapter. GND pin of GSM is connected to Arduino ground pin and RX and TX are connected to the TX and RX respectively. The circuit diagram for interfacing of GSM/GPRS module with Arduino is shown in figure 5.

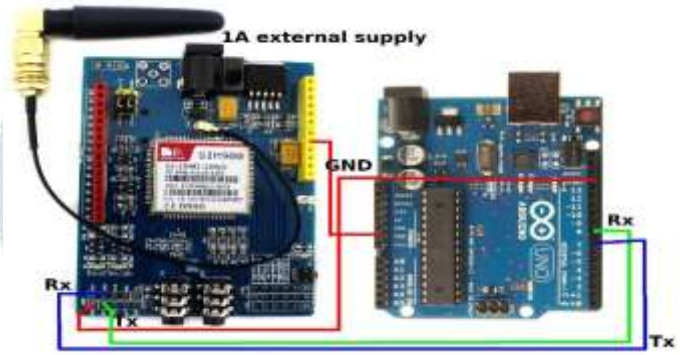

Figure 5 Interfacing GSM/GPRS with Arduino

The complete flowchart of vehicle unit describing algorithm used in this system is shown in figure 6.

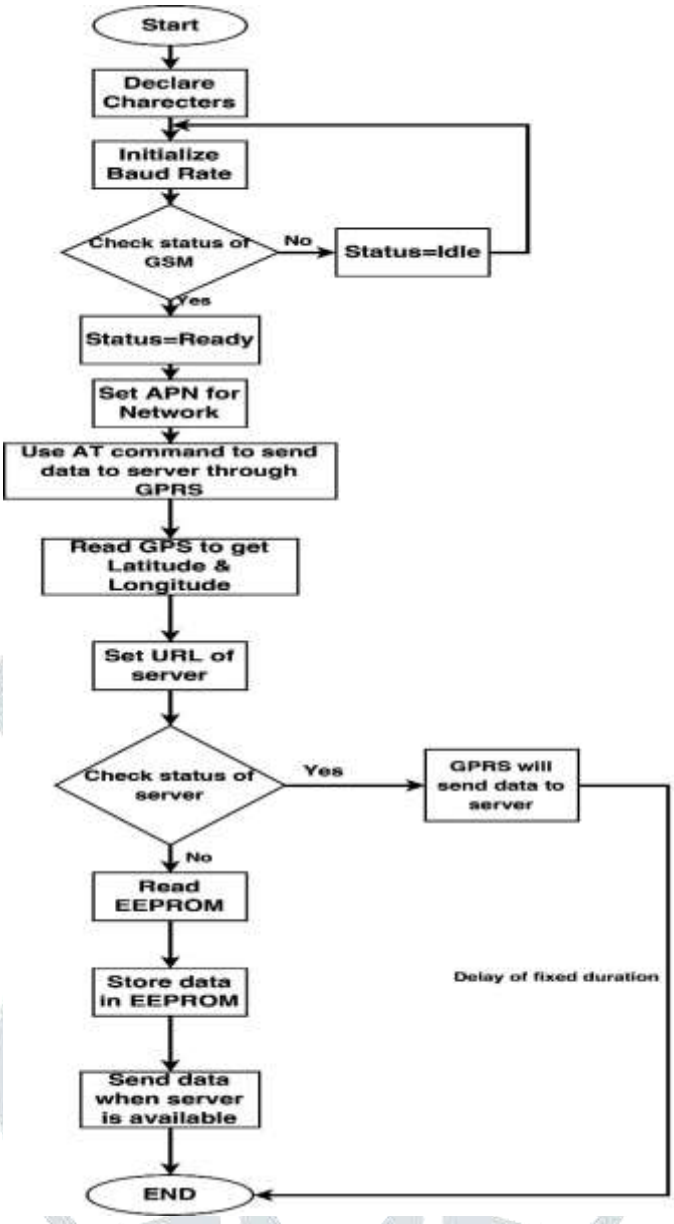

Figure 6 Complete Flowchart of Vehicle unit

4.2 Server Unit

At the server end, data from vehicle unit is received through GPRS technology and also stored in the database. Further, User Interface is created such that if an owner / user wants to see vehicle location between particular interval of date, then that locations can be viewed directly on Google maps. The work at the server end is divided in creation of database, storing information in database, the User Interface is created and accessed for viewing location.

4.2.1 Creation of database

In this system, MySQL database is used for storing data in a database. The database is created at the server itself in PhpMyAdmin. MySQL database is open source and easy to handle and manage, it is popular too and it supports PHP programming language which is the most appropriate language for Web application.

4.2.2 Web page Creation

Web pages are created at the server end such that user can view the locations of vehicle on Google maps. Web pages created are:

1. Sign up page is created such that the User/Owner can make account on the server and this data of users is stored in the database.

2. Login page is created such that only registered and authorized user whose data is already present in the database can access the vehicle tracking.
3. Vehicle Registration page is created to register vehicles previously before tracking.
4. Vehicle tracking page is created for tracking current and past records of vehicle by entering registered vehicle number.

4.2.3 Server

Server is an environment for development of web. It allows to create web applications with PHP, Apache and MySQL database. Along with this, PhpMyAdmin allows to create, manage and process databases easily. Server comes with the package of these applications and serves as a tray of icons. It works comfortably with PHP programming which is most appreciated language for web development. Also, it enables PhpMyAdmin to create MySQL database which can easily create, store and manage data and information. In this project, server is used for creating MySQL database and for viewing the location of vehicles on a Google map. A PHP code is written for connecting database to server to get a location on the map directly.

V. RESULTS AND DISCUSSION

Initially, all the hardware tools are initialized and interfaced with Arduino and installed in vehicle unit which is shown in Figure 7.

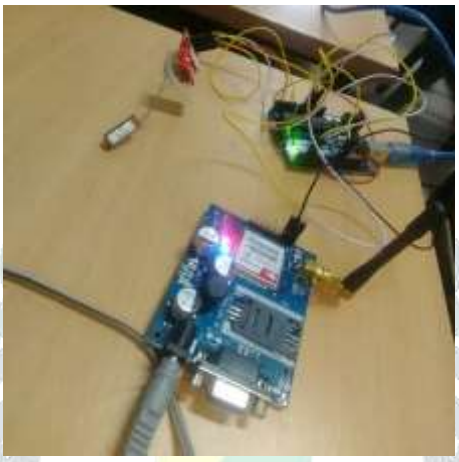

Figure 7 Experimental Setup at Vehicle Unit

Further, server unit is also started and location of vehicles is continuously being stored and monitored. At the server end, the User Interface is created for login, signing up, registering vehicle and tracking vehicle. Snapshot of few web pages like login and vehicle tracking are shown in figure 8, 9. Also, other web pages are created in similar manner.

Also, the database is created for storing data of vehicles and some more details. A database is created on the server itself and this data is retrieved at user interface when one wants to track the vehicle. Vehicle registration can also be done through web pages and stored in the database. This system is mainly for user/client who wants to track or want to know the location of vehicle at present or for past days. So for this purpose web page to track vehicle is created at a server where only a vehicle number is required and user will be able to view all the locations of vehicle on Google map between particular interval of time whatever given by the user.

Figure 8 Web page for Login

Figure 9 Web page for Vehicle tracking system

The above scenario can be explained with the help of following cases:

Case 1: Suppose the user wants to search vehicle for a certain period of time, say a week, 10 days or 20 days, all the locations between that period will be displayed on the map. A snapshot of this case is shown in figure 10.

As shown above, database have 4 locations for vehicle number ”MP09GS1234” and that same locations are displayed on Google maps when searched for between a certain date, say 05/07/2017 to 25/07/2017, so all the locations lies between that interval hence map shows all the locations. Also markers on the map shows Owner name, vehicle number and date.

Figure 10 Result of Vehicle Tracking (Case 1)

Case 2: Suppose the user wants to search vehicle on particular date, i.e. on one single date, then all the locations on that date will be shown on map. Snapshot of this case is shown in figure 11.

As shown database has 3 locations for vehicle number ”MP09GS3456” but user searched only for 18/07/2017, and that date has only 2 locations. So map will shown only data that fall under that date with a marker and its information accordingly.

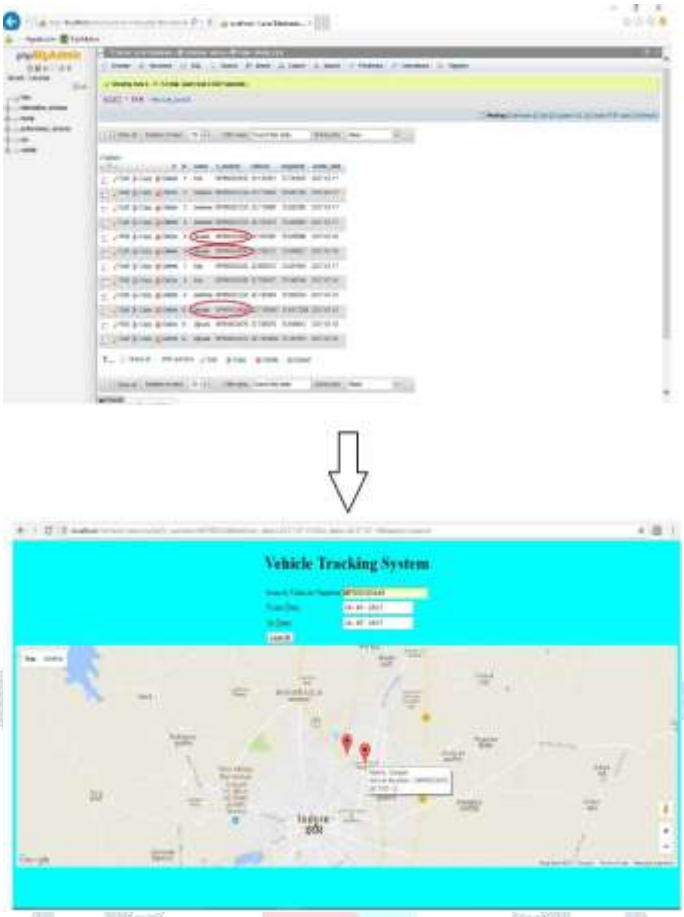

Figure 11 Result of Vehicle Tracking (Case 2)

Case 3: Suppose a user searched vehicle for certain date which is not present in the database means that the vehicle doesn't have any location for that particular date given by a user, then the page displays no records found. As database has 2 locations for vehicle number "MP04SG5176" for date 15/07/2017 and 16/07/2017. But user searched that vehicle in between 1/07/2017 to 10/07/2017. As the vehicle doesn't have any location in between that interval, so page gives message "No records found!" as shown in Figure 12.

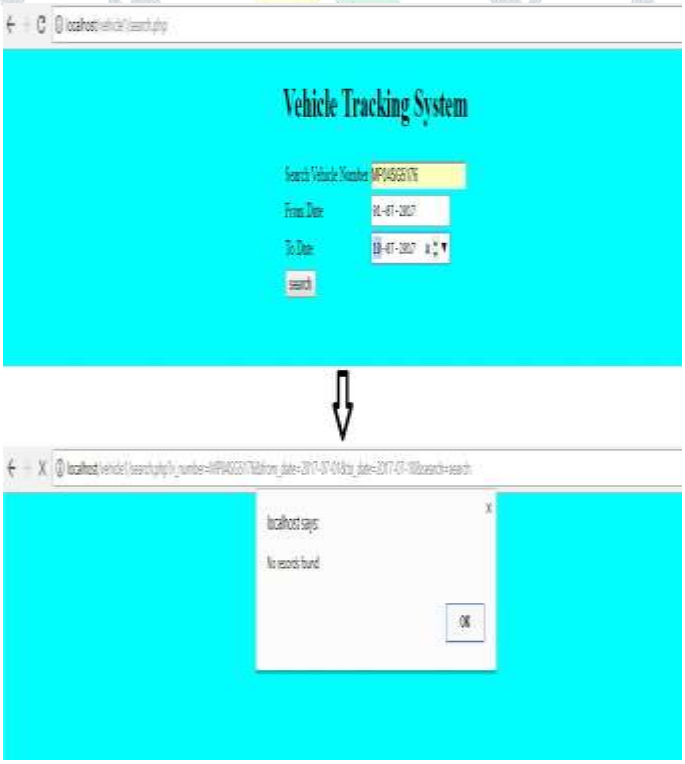

Figure 12 Result of Vehicle Tracking (Case 3)

Case 4: Suppose a user searched for a vehicle is not present in the database means vehicle was not registered earlier then the page will show a message that vehicle is not registered. As database doesn't contain any vehicle number "MP09AB1234" and user searched in web page for any date, say 04/07/2017 to 08/07/2017. But the vehicle is not registered and thus not present in the database, so page will give message "Vehicle Not Registered!" as shown in Figure 13.

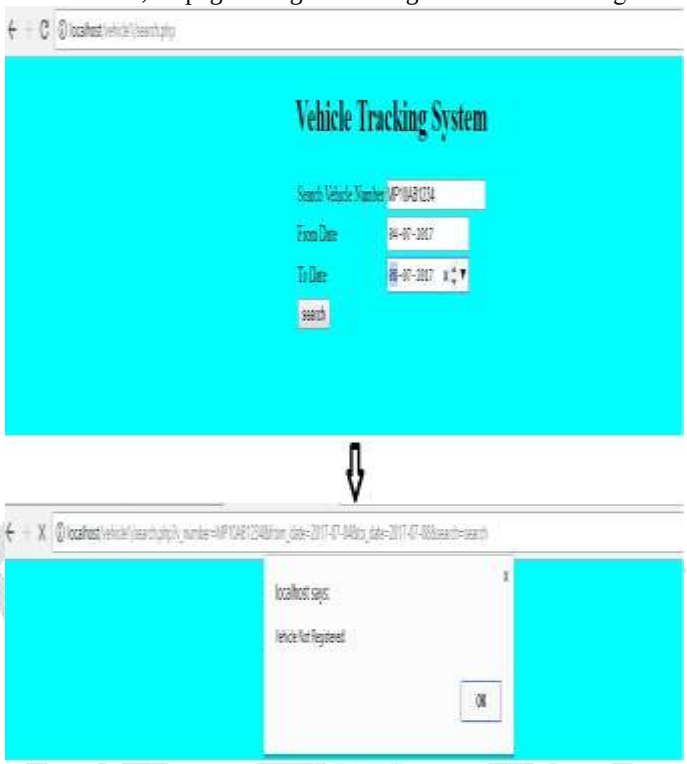

Figure 13 Result of Vehicle Tracking (Case 4)

VI. CONCLUSION AND FUTURE SCOPE

In this paper, Real time vehicle tracking and monitoring system is implemented using GPS, GSM/GPRS and Arduino with web application at server such that clients can track the vehicle through vehicle number for a certain period of time and locations can be viewed directly on Google maps.

In future, this system can be implemented for large transporters who run a large number of vehicles. So they can easily track and monitor their vehicle from anywhere without contacting driver. Further, path can also be shown between locations and some features like for how much time vehicle stopped and where, for how long it had been running etc. can also be incorporated.

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