Raspberry Pi based Embedded System for Vehicle Automation over Internet

Nagalaskhmi T S[1], Nirmala L[2], Akash Soragaon[3]

Assistant Professor, Electronics and Instrumentation Engineering, GSSSIETW, Mysore, India[1]

Senior Assistant Professor, School of ECE, Reva University, Bengaluru, India[2]

M. Tech, Advanced Embedded System, Reva University, Bengaluru, India[3]

Abstract: With the emerging technological innovations, users are looking for automotive system than the manually operated system. As the number of vehicle users increased, the number of accidents and thefts are increasing. Due to a convergence of multiple technologies usage of Internet evolved in the field of networking, which helps objects to be sensed and controlled remotely. Pi based Embedded System for Vehicle Monitoring, tracking and controlling over internet uses mobile or computer device to monitor, track, and control the vehicle. This project is also aimed to monitor the driver activity through the internet from anywhere around the world by the owner of the vehicle. The owner can monitor the different sensors in the vehicle and can also keep track of the vehicle using GPS in the system and can store these datas in the cloud. In case anything goes wrong in the system the owner can get the update and will be able to stop the vehicle by sending a command. This command turns of the motor. Until an authentication command is sent by the owner the vehicle cannot restart. The entire activities of the sensors are controlled by the Raspberry Pi which acts as a master controller and Arduino acts as a slave controller.

Keywords: Vehicle Controlling, Monitoring and Tracking, Gmail as Cloud storage.

I. INTRODUCTION

Vehicle tracking and monitoring systems were first implemented for the shipping industry because people wanted to know where each vehicle was at any given time [1]. This has been extended in almost all automobiles especially to track the vehicles in real time. In order to monitor and interact with one or more entities and make the connection to the Internet, technical communication devices are required. The devices can be attached to or embedded in the entities themselves – thus creating smart things. There are physical objects in the vehicle one wants to track, to monitor and to interact with. The main purpose of this project is to develop such kind of a system which can trace, monitor the activity of the driver and different sensors in the vehicle and also to control the vehicle with the help of wireless technology.

Due to increase in a number of Internet users in and around the world, vehicle tracking, controlling and monitoring over the internet has advantages over other technology to establish a communication between clients and end user. The system developed can be fixed into almost all automobiles for example School bus, Rented Cars or cabs, buses, autos etc in order to avoid theft, to track the particular vehicle remotely and to monitor the driver activity to reduce accidents.

II. LITERATURE REVIEW

2.1 Vehicle Tracking System
Global Positioning System (GPS) is most widely used for the tracking system. The most common ways to track

vehicle is the Global Positioning System (GPS) and Global system for mobile communication or General Packet Radio Service (GSM/GPRS) technology [1].The real time vehicle tracking system, used for many applications including vehicle security and fleet management [6]. School bus tracking and monitoring system in which GPS is used to track the school bus which provides an accurate arrival time of the vehicle to a particular location or stop. Hence, the student can spend time for other activities rather than waiting for a school bus [3]. The use of GSM and GPS technology together to allow the system to track the vehicles which provide most up-to-date information on the ongoing trips. The locations are reported by SMS message which takes an advantage of wireless technology in providing powerful transportation management engine [4]. An algorithm for bus arrival system for individual stops along service route with GPS technology was developed. The algorithm is implemented in an intelligent system that can automatically detect the running route and direction of a bus and predict its arrival times at the downstream stops under any operating conditions [5]. A system is developed which integrates GSM and Google map. The GSM modem at the control center receives an SMS of the coordinates. This will update the main database and the position of the vehicle is displayed through Google map [6]. Tracking of vehicle has been made simpler with the advent of GPS technology. Real time tracking of many vehicles on cloud platform was developed and it makes easy to track many vehicles at a time using the GPS and GSM. [7]. GPS

positioning technology plays an important role in positioning, monitoring, and navigation [8]. The combination of GPS and GSM technology enables the user to track/locate the vehicle in ease and convenient manner [9].

2.2 Vehicle Monitoring System

Vehicle theft becomes a social real time problem now a day's [3, 11]. Hence, it's become necessary to monitor the vehicle and also driver activity in a certain situation to overcome the problems. The Combined technology of GSM and GPS helps to monitor the car speed without assigning policemen and wasting man force. GPS helps to find the location of the car and GSM helps to send the message to the nearest police station [10]. To monitor dangerous goods GPS with Radio Frequency Identification (RFID) technology is put forward for real time data acquisition, tracking and monitoring. The captured data is sent to the database center via CDMA [11]. The combination of GPS and GSM technology is used to monitor and track the school bus at real time and displayed on the web page and also monitors different sensors and update to the server over GSM [3]. GPS is used to get geographical coordinates at real time and GSM/GPRS is used to transmit the vehicle location to the database. A Smartphone application is developed to monitor the location of a vehicle and thus, user can predict the estimated time and distance of arrival [1]. Android Smartphone is used to monitor the vehicle. Here GPS/GNSS is used to get the vehicle position and send the datas over the cellular network. The designed system is feasible for the vehicle owner to monitor the vehicle [12].

2.3 Vehicle Controlling System

Theft is increasing and thus vehicle safety place an essential role for public vehicles. Vehicle tracking and locking (controlling) place an important role when the vehicle theft occurs. GPS is used to find the location of vehicle and GSM is used to send SMS to send the control signal to lock the vehicle engine. The vehicle can able to restart and open the door of 1the vehicle only from the signal that is received by the controller from the authorized person [13]. Dual tone multi-frequency [DTMF] based decoder and GSM network is used to control the vehicle movement i.e. moving forward, backward, Left and Right [14]. In the case of burglary and drunk and driving cases where the owner needs to monitor the vehicle and to controlling like locking and opening the door remotely GSM is used [7]. Automatic turning off the ignition by the controller when the alcohol detection in the vehicle is sensed by the sensor and send the distress message with the location to the police or family member over GSM [15].

2.4 Review Analysis

After studying the methods for vehicle tracking, controlling, monitoring and alerting the GPS, GSM/GPRS system place a wider role for real time tracking, monitoring and controlling of vehicles like car, buses, trucks and cargo. The GPS is used to locate the vehicle. GSM/GPRS is used to send the location of a vehicle and also controlling the vehicle remotely.

Looking into tracking of multiple vehicles or a single vehicle database is used to store the location of the vehicle. Cloud is also used to store the data like the location of vehicle [7], sensors data. Also for monitoring the temperature, Smoke/Gas leakage [3], alcohol [7, 15] etc different controllers are used. A Smartphone app is also developed for tracking the vehicle, monitoring and controlling the vehicle. The concept of IoT in home automation [16] and car parking system [17] uses Gmail and Cloud Foundry as cloud storage respectively. Microsoft Azure is used in cloud based multiple vehicle tracking systems [7].

There are many controllers that are available in the market. Based on the requirement and application controllers are choose. As of the study Arduino, ARM Controllers and Raspberry pi are most widely used in vehicle automation nowadays [18].

III. IMPLEMENTATION

Vehicle monitoring, tracking and controlling helps to track the vehicle remotely and monitors the driver activity (alcoholic detection) and also the speed of the vehicle over internet. The entire system consists of two controllers. The master controller is the Raspberry pi and slave is the Arduino. The command to turn ON/ OFF command is sent over internet by the owner of the car using smart phones or laptop or tablets to the raspberry pi. Based on the command sent to the pi required action is carried out. If the command is ON, pi send the message to the Arduino over USB (Universal Serial Bus) and turn on the motors, the speed of the vehicle is controlled based on the distance sensor values, and the GPS connected to the pi helps to continuously track the vehicle and update the same to the cloud where Gmail acts as a cloud in this project. If any accident occurs, it updates to the owner and also the cloud. The alcoholic sensor connected to the Arduino helps to sense the alcoholic content of the driver, if it detects it immediately turn off the motor and update the same to the owner of the vehicle and also to the cloud. When any theft occur the owner can able to turn off the system by sending OFF command over internet. The controlling action is done within the local area network.

The block diagram of the overall project can be seen in Fig 1. This embedded system mainly consists of two controllers- Pi and Arduino, distance sensor, motors, alcoholic sensor, vibration sensor, GPS module, GSM module and Wifi dongle. Distance sensor used to control the speed of the motor, alcoholic sensor to detect the alcoholic content if the driver of the vehicle is drunk, vibration sensor is used to send detect any accident occurs, GPS module is to track vehicle position and GSM is used to send the message to the owner of the vehicle. The vehicle position, the speed of the vehicle and if any alcohol or accident occurs all these datas will be updated

into Google spreadsheet. Wifi dongle is used for internet connection with the nearest network.
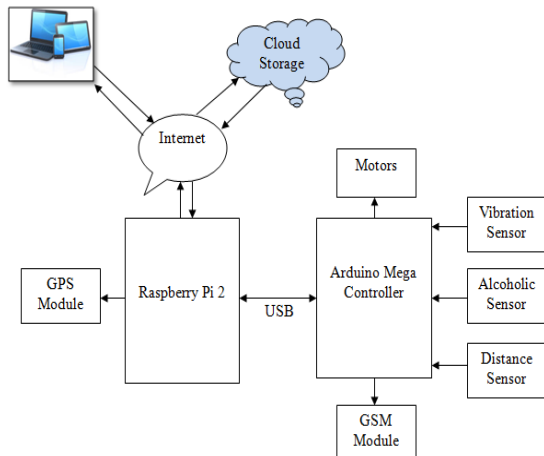

Fig -1: Block Diagram of the Project

The system is turned on. The command is sent to the Pi over the internet. Once the command is read the required action is carried out in the Arduino. The distance sensor is continuously measuring the surrounding object distance based on that value the speed of the motor is controlled.

If Front end Sensor is F_DS and rear end sensor is B_DS then the vehicle speed is

> If F_DS || E_DS<=40 ----------- Vehicle stops.
> IF F_DS >=50 && <=100 ----------- Normal Speed
> IF F_DS >=100 && <=400 ---------- High Speed

These datas are continuously sending to the raspberry pi through serial communication. This speed data and the GPS connected to Pi are updating to the cloud (Gmail). If an accident occurs, motor stops running and then this data along with location are updated to the spreadsheet and the message is sent to the authorized person. Once the alcoholic content is detected then the Arduino sends the message to stop running the motor. Immediately it updates the cloud over the internet and also to the owner of the vehicle over GSM.

IV. METHODOLOGY

The entire flow diagram of the project is shown in Fig 2. Configure all the ports and turn ON the system. Send an ON/OFF command over internet. Based on the command sent required action is performed and update the datas to Google spread sheet. The Steps involved is

Step 1: Starting up the Server-This is the first step from where the program execution starts. The program written using Python on Pi is made to run. This contains the configuration of TCP_IP Port and the usage of LAMP server. Arduino must be connected to Pi else it shows the error message. Once it is connected the TCP_IP port mentioned in the code should matches with the internet connection port, if not the server (Apache) won't start.
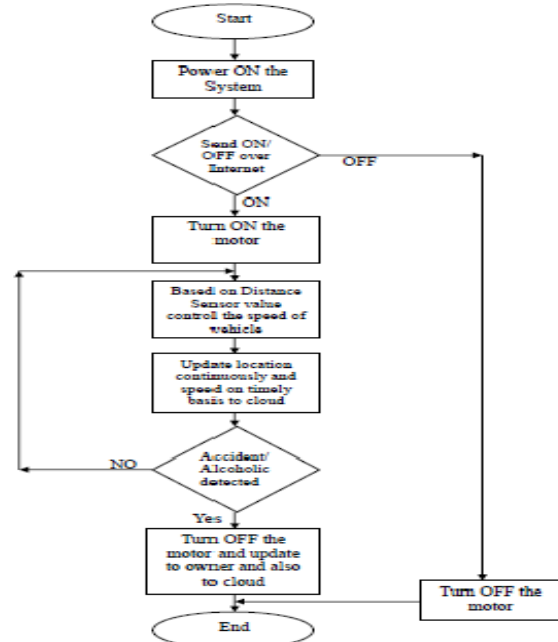

Fig-2: Flow Chart of the Project

Step 2: Web Page to give Command- A web page is created using PHP (Personal Home Page) which is a scripting language for server side designed for web development. It contains a basic HTML (Hyper Text Markup Language) code. Fig 3 shows the web page designed to send a command/action over internet. The required action (ON/OFF) is typed in the space given after Enter command.
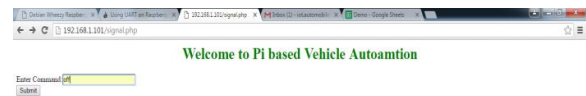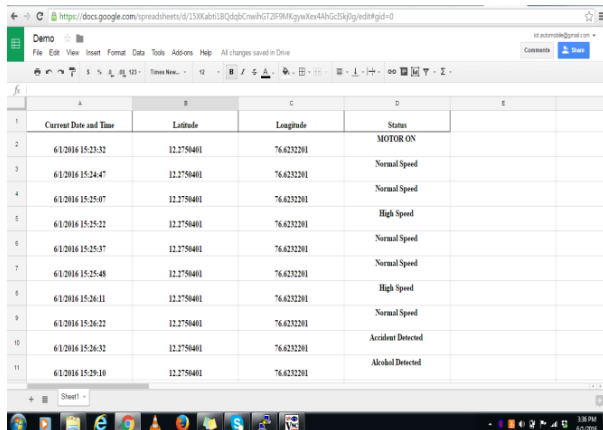

Fig-3: Web page designed to send required action

Step 3: Updating Datas into Google Spreadsheet
To store datas, Google Spreadsheet is used which acts as a cloud storage. The datas like speed, vehicle position and status of the vehicle and driver are stored in the spreadsheet. This helps to track the vehicle and monitor datas remotely. Certain database can be accessed only from a particular system. This is overcome by the usage of Google spreadsheet provided by Google App Engine. The updated details to Google spreadsheet which consists of the date and time, Latitude and Longitude of the vehicle and the status columns (speed and if an accident or Alcoholic content detected).

Fig-4: Updated datas on Google Spreadsheet

V. RESULTS

Pi based Vehicle monitoring, tracking and controlling uses internet to track the vehicle position, monitor certain datas and controlling action like ON/OFF the motor. The hardware module of this embedded system is shown in fig 5.
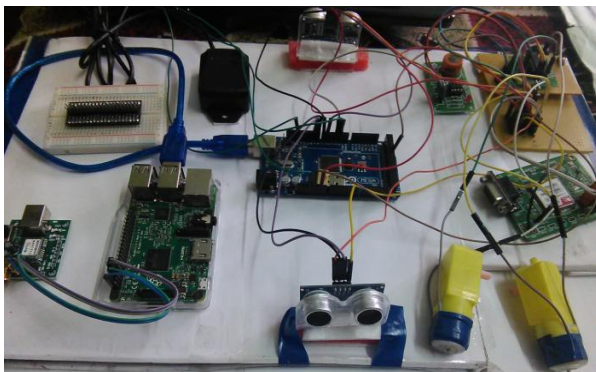

Fig-5: Hardware module of the Project

This project is designed to establish communication between the owner of the vehicle and the user over wireless technology. The required command is sent to the system to turn on or off the motor for which a separate web page is created. The message sent is read by the pi and it, in turn sends the command to Arduino over USB. The Arduino read the command and required action is performed. For every time interval, the datas like vehicle position, date and time and the status (speed, alcohol and accident) are updating to Google spreadsheet.

VI. CONCLUSION AND FUTURE WORK

6.1 Conclusion

The role of embedded system for accurate and reliable transmission of data using wireless technology in the real world vehicle automation is important. This concept of embedded system in wireless technology is applied in the proposed work for vehicle automation by using Internet, GSM and GPS, along with Pi and Arduino Controllers. The proposed system has a broad application foreground

in the real application field to remotely track and monitor the driver activity along with certain important sensor datas of the vehicle. The stored data on spreadsheet helps the vehicle round trip and can have the exact information of the vehicle condition and driver activity.

6.2 Future Enhancement

In the proposed system sending the command over the internet is done only within the local network, which can be enhanced for sending data over the global network. The intimation message in the proposed system is sent to the authorized person over GSM, which can also be done over E-mail. Finally, this proposed system can be used for multiple vehicle automation rather than a single vehicle. We can install a panic button into the system especially for rented cabs and school/college buses thus helps in alerting someone in the emergency situation.

REFERENCES

[1]   SeokJu Lee, Girma Tewolde, Jaerock Kwon, "Design and Implementation of Vehicle Tracking System Using GPS/GSM/GPRS Technology and Smartphone Application", IEEE World Forum on Internet of Things (WF-IoT), Seoul , March 2014.
[2]   Stephan Haller, " The Things in the Internet of Things" , Internet of Things Conference Tokyo, Japan. 2010.
[3]   Prashant A Shinde, Prof. Y.B Mane, "Advanced Vehicle Monitoring and Tracking System based on Raspberry Pi", IEEE Sponsored 9th International Conference on Intelligent Systems and Control (ISCO), 2015.
[4]   Abhid Khan, Ravi Mishra, "GPS-GSM based Tracking System", International Journal of Engineering Trends and Technology, Volume 3 ,Issue-2, ISSN: 2231-5381, 2012
[5]   Dihua Sun, Hong Luo, Liping Fu, Weining Liu, Xiaoyong Liao, and Min Zhao, "Predicting Bus Arrival Time on the Basis of Global Positioning System Data", Transportation Research Record: Journal of the Transportation Research Board, No. 2034, Transportation Research Board of the National Academies, Washington, D.C., 2007, pp. 62–72.
[6]   Muhammad Ridhwan , Ahmad Fuad and Micheal Drieberg, "Remote Vehicle Tracking System using GSM Modem and Google Map", IEEE Conference on Sustainable Utilization and Development in Engineering and Technology, 2013.
[7]   Nalini V, Sandesh A S, Royal Denzil Sequiera , Dr. P Jayarekha , "Cloud Based Multiple Vehicle Tracking and Locking System", IEEE International Advance Computing Conference (IACC), 2015.
[8]   Hui Tan ," Design and Implementation of Vehicle Monitoring System Based on GSM/GIS/GPS", Second International Conference on Information Technology and Computer Science, 2010.
[9]   Pham Hoang Oat, Micheal Drieberg and Nguyen Chi Cuong, "Development of Vehicle tracking System using GPS and GSM Modem", IEEE Conference on Open Systems (ICOS), Sarawak, Malaysia, December 2 - 4, 2013.
[10] Abdul-Wahid A. Saif, Haytham Sammak, Diya Matar and Omar AI-Midani , "Automatic Monitoring and Speed Violation Ticket System" , IEEE International Conference on Systems Man and Cybernatics (SMC), Istanbul, October 2010.
[11] Miao Yu, Ting Deng and Jie Fu, "Application of RFID and GPS Technology in Transportation Vehicles Monitoring System for Dangerous Goods", Second International Conference on Remote Sensing, Environment and Transportation Engineering (RSETE), Nanjing, June 2012.
[12] Ha Duyen Trung, Pham Tien Hung, Nguyen Duy Khanh, and Hoang Van Dung, "Design and Implementation of Mobile Vehicle Monitoring System based on Android Smartphone", Third World Congress on Information and Communication Technologies (WICT), Hanoi, December 2013.

[13] R.Ramani, S.Valarmathy, S.Selvaraju, M.Thiruppathi, R.Thangam, and Dr. N. Suthanthira Vanitha, " Vehicle Tracking and Locking System Based on GSM and GPS", I.J. Intelligent Systems and Applications , 09, 86-93, Published in MECS online, August 2013.

[14] Bishwajit Banik Pathik, A.S.M. Ashraf Ahmed, Labina Alamgir and Abu Nayeem, "Development of a Cell Phone Based Vehicle Remote Control System", International Conference on Intelligent Green Building and Smart Grid (IGBSG), Taipei, 2014.

[15] Pratiksha Bhuta, Karan Desai, Archita Keni and Vijayalakshmi Badre, "Alcohol Detection and Vehicle Controlling", International Journal of Engineering Trends and Applications (IJETA) – Volume 2 Issue 2, Mar-Apr 2015.

[16] Vaibhav Hans, Parminder Singh Sethi and Jatin Kinra, "An Approch to IoT based Car Parking and Reservation System on Cloud", International Conference on Green Computing and Internet of Things(ICGIoT), Noida, October 2015.

[17] Vinay sagar K N and Kusuma S M, "Home Automation Using Internet of Things", International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056, Volume: 02 Issue: 03, June 2015.

[18] Nagalakshmi T S and Nirmala L, "Automation of Automobile using IOT: A Survey", International Journal of Advance Engineering and Research Development(IJAERD) e-ISS(O)-2348-4470, Volume 3 , Issue 4,April-2016.

BIOGRAPHY

Nagalakshmi T S received degree in Instrumentation Technology from GSSSIETW, Mysore affiliated to VTU, Belgaum in 2013 and M.Tech in Advanced Embedded System from Reva University, Bengaluru in 2016. Presently working as a Assistant Professor in Electronics and Instrumentation Engineering department, GSSSIETW, Mysore.

Nirmala L received the B.E. dergree in Electronics and Communication Engineering from Gulbarga University, India in 2001 and M.Tech in VLSI Design and Embedded Systems from Visvesvaraya Technological University(VTU), India in 2008. She is presently working as Senior Assistant Professor in School of Electronics and Communication Engineering, Reva University, Bangalore, India and also pursuing Ph.D in VTU Belgaum. Her research interests include modeling, and control of axial systems.

Akash Soragaon completed his M.Tech from Reva University, Bengaluru in Advanced Embedded System. He perceived his B.E in Electrical and Electronics from Don Bosco Institute of Technology, Bengaluru affiliated to VTU, Belgaum.