Design and Implementation of Vehicle Navigation System in Urban Environments using Internet of Things (IoT)

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Abstract: Advanced vehicle monitoring and tracking system based on embedded Linux board and android application is designed and implemented for monitoring the school vehicle from any location A to location B at real time. The present system would make good use of new technology that based on embedded Linux namely Raspberry Pi and Smartphone android application. This system works on GPS/GPRS/GSM SIM900A. GPS finds the current location of the vehicle, GPRS sends the tracking information to the server and the GSM is used for sending alert message to vehicle’s owner mobile. This system is placed inside the vehicle whose position is to be determined on the web page and monitored at real time. There is a comparison between the current vehicle path already specified paths into the file system. Inside the raspberry pi’s file system taken from vehicle owners through android phone using android application. Means the selection of path from location A to B takes place from vehicle owner’s android application which gives more safety and secures traveling to the traveler. Hence the driver drives the vehicle only on the vehicle owner’s specified path. The driver drives the vehicle only on the vehicle owner’s specified path but if the driver drives in wrong path the message alert will be sent from this system to the vehicle owners mobile and also sent speakers alert to driver through audio jack. If the vehicles speed goes beyond the specified value of the speed, then warning message will be sent to owner mobile. This system also takes care of the traveler’s safety by using Gas leakage and Temperature sensors.

Keywords: Raspberry Pi, Gas sensor, Temperature sensor, GPS, GSM, GPRS, Android Mobile

1. INTRODUCTION

In the early days, we observe the drivers exhaust driving and vehicle theft activity which causes real time problems such as accidents causing many hazards. In day to day life we see or read such type of activities which are raising the question of our safety and security in both public and private sectors. Due to these hazards there is a need for real time monitoring and tracking [1] the vehicle and also storing and updating its database of certain situations. In the urban areas, human help is somewhat difficult in providing the database of tracked vehicle [2]. In the proposed system, the system provides a fully automated tracking and monitoring of the vehicle which helpful for school bus, their owners, children’s safety and also it provides the accurate arrival time of the vehicle at particular location or stop. And hence using accuracy in time, children can spend more time in studying, sleeping, or relaxing rather than wait for a delayed bus. Spending less time waiting for a bus improves comfortable and effective time management of the student as well. In order to reduce man power and saving of money, here the system provides easy tracking solution using Embedded Linux Board [11].
This system gets tracking information of the vehicle such as vehicle number i.e. Unique ID, location, speed, date, time and store the information into the data base of Raspberry Pi[10], the existing system provides safety mechanism by using sensors, due to these sensors temperature raising inside the vehicle or gas leakage alert messages or sent to driver and owner.

By using GPS [2] [15] we can track location and maintain its data base. With the help of MySQL database system which is advance feature of Raspberry Pi [10] this data base information is updated to vehicle database server and the user can access this information using smart phone [3]. So that we can easily identify and continuously monitor the vehicle moment and determine the estimated distance and also time of arrival for the given destination.

2. PROPOSED SYSTEM

The Proposed system continuously monitors and tracks [1] the school vehicle at real time environment using web page in smart phone. If the driver chooses the wrong path the system gives alert message to the owner smart phone as well as on raspberry Pi audio system. So that the provision of more safety and secure travelling facility is improved using Android application of smart phone [6] [13]. This system also provides the children safety environment by using sensors and updating the alerts such as speed, time, location and date to vehicle owner with help of data base. This data base is also useful in case of vehicle theft detection. The proposed system would get controlled with the help of Raspberry pi which is placed inside the vehicle shown below in figure.1.

![System Design](image)

**Figure.1. System Design**

To communicate GPS/GPRS/GSM [15] modules we use USB interface with Raspberry Pi [11]. The current received path longitudes and latitudes are compared with stored longitudes and latitudes present in data base file format inside Raspberry Pi, if there is any mismatch found with the help of GPS [5], the wrong path detection alert message is sent to vehicle owner mobile and also sent to server with the help of GPRS. So that the owner, students and their parents can easily track the vehicle location by using smart phone with help of login facility on web page.
The proposed system provides student’s safety with help of Temperature and Gas leakage sensor which are interfaced with raspberry Pi, if the temperature sensor crosses the specific value or if found any gas leakage in vehicle the message alert is sent to the vehicle owner. So that safety mechanism is provided by the system.

3. SYSTEM DESIGN FLOWCHAR

![Flowchart of proposed system](image1)

**Figure 2.** Flowchart 1 of proposed system

![Flowchart of proposed system](image2)

**Figure 2.1.** Flowchart 2 of proposed system

a. System specification

1) Embedded Linux Board

![Raspberry Pi B+ Board](image3)

**Figure 3.** The Raspberry Pi B+ Board

![GSM /GPRS with GPS](image4)

**Figure 3.1.** GSM /GPRS with GPS
4. Design and implementation

4.1 Real time vehicle tracking on the web page using GPS/GPRS/GSM module and Raspberry pi [10].

These module gets interfaced with Raspberry Pi gives the information of longitude, latitude, speed, time of the vehicle by using real time tracking and stores the information in database server for further updating. Registered user tracks the information through login webpage as follows:

Super Login: In this provision, the vehicle’s owner can track the vehicle in his Smartphone using Super Login on the web page. Hence only owner can access this login. Primary Login: In this provision, the registered students can track the school vehicle in their Smartphone using Primary Login on web page. Hence only those students who get registered into the system can access this login.

Secondary Login: In this provision, the student’s parents can track the school vehicle in their Smartphone using Secondary Login on the web page. Hence only registered student’s parents can access this login.

4.2 Using smart phone vehicle’s right and wrong path tracking algorithm:

This system provides safety and secure solution for wrong path alert using smart phone android application for the selection of particular path from A to B through which the vehicle supposed to travel. Hence the driver drives the vehicle according to the first vehicle owner decided path from A to B with help of latitude and longitude traced by the owner and stores the information in database using Bluetooth or USB port. By using Raspberry system file programming, the longitudes and latitudes received from GPS current location are compared with data base stored longitude and latitude received from android application.

![Figure 4](image-url) The longitudes and latitudes which are stored in the file format inside raspberry pi have been taken from android application using Bluetooth.

Hence if this comparison gives less tolerance then the driver is in right path i.e. from A to B, if not the driver has choosen wrong path and the message alert is sent to vehicle owner mobile that the vehicle is on wrong path using GSM/GPS module [15]
The raspberry Pi provides 3.5mm audio jack facility, so that if the driver drives the vehicle on wrong path the audio alert is specified by the “omxplayer alert.mp3” to solve this problem

3) Vehicle tracking information database monitoring system using LAMP (Linux, Apache, MySQL, and PHP):

Using Linux Apache, MySQL and PHP i.e. Lamp system the vehicle is tracked and the information such as Longitudes, latitudes, speed, date and time are stored in database of Raspberry pi. The browser monitors and tracks the updates stored in vehicle with the help of server information provided by the GPRS (SIM 900 A).

4) Safety mechanism for the students using Sensors:

The proposed system takes care of the children’s safety by using LPG Gas leakage sensor and temperature sensor. The temperature sensor DS18B20 which works on the 1 wire protocol gives a digital output hence can be get directly interface with the Raspberry Pi. The threshold value of the temperature set in the program. If that threshold temperature value gets cross by output value of the temperature sensor due to some reason then alert message will be sent to the vehicle owner’s Smartphone. Also the LPG Gas leakage sensor get interface with Op-amp LM358N which gives a digital output. That output voltage can be controlled by using current limiting resistors which helps the Raspberry pi’s GPIO from damage. Likewise both sensors output driven through Raspberry pi would get compare with threshold values and if limit crosses then the alert message will be given to vehicle owners mobile using GSM of SIM900A module. In following results, the threshold value set at 30 Degree Celsius.

5. Testing and result

5.1. Testing of DS18B20 Temperature sensor using Raspberry pi

The sensor testing and their results are taken as follows:

As temperature sensor DS18B20 works upon 1 wire protocol, the sensor gives digital output data whenever receives input voltage from raspberry pi and it get stored in file system of raspberry pi. Using file system programming, the sensor data get easily access and processed further for giving alert message. Here while performing sensors testing, major issues need to be considered namely:

a) Raspberry pi’s GPIO are compatible at 3.3V logic level so sensors output needs to be limited at this 3.3V logic level.

b) Devices required in the proposed system needs to be selected as per Raspberry pi’s GPIO and other interfaces logic level compatibility. The input voltage and input current driven through power supply to the Raspberry pi needs to be selected as per specified logic level.
5.2 Testing of Gas Sensor MQ6 using Raspberry pi

The Gas sensor MQ6 gives output as it receives 5V input. So whenever the sensor sense LPG gas it gives analog output which then given to LM358N Op-amp gives digital output. Then the digital output has driven through limiting resistor and further given to raspberry pi. The calibration of results of the output voltage has been taken using potentiometer. Hence by checking the raspberry pi’s GPIO pin status, the sensor output data used for giving alert message of leakage gas to the vehicle owner Smartphone.

The sensor testing and their results are taken as follows:

The input voltage and input current driven through power supply to the Raspberry pi needs to be selected as per specified logic level. Which then given to LM358N Op-amp gives digital output. Then the digital output has driven through limiting resistor and further given to raspberry pi. The calibration of results of the output voltage has been taken using potentiometer.

Figure. 6. Testing results of MQ6 gas sensor
5.3 Testing results of GPS module using Raspberry pi

The GPS Module testing gives the following results of all output sequence GPS data.

![Testing results of GPS Module using Raspberry pi.](image)

The following table shows meaning of each data in the GNRMC data format received from GPS and GLONASS satellite. Hence the required GNRMC data format received from GPS and GLONASS satellite get separated as shown in the figure below.

![Required GNRMC data format get separated using algorithm.](image)

Now in the further development, we take the tolerance between this separated current vehicle information like longitude, latitude, speed, date, time from GPS receiver and the information received from android application of owner’s Smartphone so as to provide wrong path alert to the vehicle owner.

5.4 Tracking position on web page developed using HTML, PHP; CSS is shown in the figure below

![Web page developed for vehicle database monitoring purpose.](image)
CONCLUSION
This system has made good use of Smartphone technology by providing safety and secure traveling to the traveler using wrong path alert mechanism. The system plays an important role in real time tracking and monitoring of vehicle by updating vehicle real time information on the server side after certain interval of time in order to monitored vehicle continuously. Drives vehicle on the wrong path or in case of vehicle’s accident situation occurs, the system provides the vehicle’s current location, speed to the vehicle owner’s mobile. Hence this benefits to track the vehicle as early as possible. Student’s safety mechanism also gets provided using temperature and LPG gas leakage sensors. In this certain situations, as per student’s safety concern, also gives alert massage on student parents mobile so that parents also know about their children’s safety.

In future this system can be interfaced with vehicle airbag system that prevents vehicle occupants from striking interior objects such as the steering wheel or window. This can be developed by interconnecting a camera to the controller module that takes the photograph of the accident spot that make the tracking easier.

ACKNOWLEDGMENT
I have taken offers in this project. The authors would like to thanks however, it would not have been possible without the kind support and help of many individuals and organizations. I would like to extend my sincere thanks to all of them.

REFERENCES
[1] Seokju Lee, Tewolde, G Jaerock Kwon,” Design and implementation of vehicle tracking system using GPS/GSM/GPRS technology ad smart phone application”, Internet of things (IoT), 2014. IEEE world forum on, Vol. No., pp.353 358, 6-8 March 2014.
[2] R Ramani, S Valarmathy, N Suthanthira Vanitha, S Selvaraju and M Thiruppathi, “Vehicle tracking and locking system based on GSM and GPS”, IJ Intelligent systems and Applications, 2013, 09, 86-93
[3] A 1 Rashed, M A Omar, O A Singh,” A real time GSM/GPS based tracking system based on GSM mobile phone,” Future generation communication Technology(FGCT), 2013 second International Conference on, Vol. No., PP. 65,68,12-14 Nov 2013
[4] Tarapiah, S Atalla, S Alsayid,”Smart on board transportation management system Geo- Casting featured”, Computer Application and information system (WCCAIS), 2014 World Congress on, Vol. No,.pp. 1,6, 17-19 Jan 2014
[5] R Kumar, H Kumar, “Availability and handling of data received through GPS device in tracking vehicle”, Advance Computing Conference(IACC),2014 IEEE International, Vol., No.,pp.245, 249, 21-22 Feb. 2014
[6] Pengfei Zhou, Yuanqing Zheng, Mo Li,”Predicting bus arrival time width mobile phone based participatory sensing,” Mobile computing IEEE Transaction on, Vol.13, No.6,pp.1228.1241 june 2014.
[7] Liu, Anqi Zhng, Shaojun Li,”Vehicle anti theft tracking system on internet of things,” Vehicular Electronics and safety (ICVES), 2013 IEEE International conference on, Vol., No.,pp.48,52,28-30 July 2013

[8] Hoang Dat Pham, M Chi Cuong Nguyen, “Development of vehicle tracking system using GPS and GSM modem,” open systems (ICOS), 2013 IEEE, Vol., no., pp.89, 94, 2-4 Dec. 2013

[9] Zhigang Shang, Wenli; He, Chao; Zhou, Xiaofeng; Han, Zhonghua; Peng, Hui; Shi, Haibo, "Advanced vehicle monitoring system based on arcgissilverlight," Modelling, Identification & Control (ICMIC), 2012Proceedings of International Conference on , vol., no., pp.832,836, 24-26 June 2014.

[10] Upton, Eben, and Gareth Halfacree. Meet the Raspberry Pi. Wiley. Com, 2012

[11] Membrey, Peter, and David Hows. Learn Raspberry Pi with Linux. Apress, First Edition, 2012

[12] Iman M. Almomani, Nour Y. Alkhalil, Enas M. Ahmad, Rani a M. Jodeh “Ubiquitous GPS Vehicle Tracking and Management System”, IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT) 2011

[13] Bhavana Godavarthi, Paparao Nalajala,” Wireless Sensors Based Data Acquisition System using Smart Mobile Application,” Internet of things, “International Journal of Advanced Trends in Computer Science and Engineering” Vol. 5 No.1, pp. 25-29 Jan 2016

[14] Raspberry Pi Ocial website. [Online] Available: http://www.raspberrypi.org

[15] Paparao N, G Bhavana, ”RTOS Based Image Recognition & Location Finder Using GPS, GSM and Open CV” International Advanced Research Journal in Science, Engineering and Technology, Vol.2, No. 12, pp. 85-88, Dec 2015

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