

School Bus Monitoring System Using Raspberry Pi

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Abstract - An advanced and novel system for monitoring and tracking the school van to ensure the safety of children, the proposed system works in case of emergencies such as accidents, break down, fire accidents by immediately sharing the location and images of the inside environment of the bus to the school authorities. Images are captured using Pi camera and location by GPS module. Radio Frequency Identifier (RFID) tags are used to track the number of students travelling. A panic switch and two keys are provided. Keys are used if vehicle gets stuck in traffic and in the case of vehicle breakdown. An email alert will be sent to the parents. Panic switch is used in case of emergency. In each case email is attached with the images of the inside environment of the bus. The system possess the hall effect sensor to sense the speed of the vehicle, In case of rash driving the sensor intimates the Raspberry Pi and an alert is sent to the school authority through email.

Keywords: Raspberry Pi, Radio Frequency Identifier, Hall effect sensor, Pi camera

I. INTRODUCTION

In recent years, we have been seeing or reading about the school buses involved in mishaps, negligence by the drivers, children missing cases and other hazards. The proposed system focuses on the monitoring and tracking of the school bus and thereby minimizing the hazards that may occur.

In the proposed system, a low-cost Radio Frequency Identification (RFID) has been implemented. RFID is a technology which is used as an alternative for manual scanning in order to detect human beings plugged with RFID tag.[1] The tag need not be within the line of sight of the reader, RFID is one method for implementing AIDC (Automatic Identification and Data Capture), RFID cards are also used in order to identify the entity.[2]

The proposed system provides automated tracking and monitoring of the vehicle which is helpful for school bus, their owners and children's safety [3]. It also provides a panic switch and two keys. Panic switch is used in case of emergency and keys are used if the vehicle gets stuck in traffic and also in case if vehicle break downs. On pressing the mentioned buttons, an image of the inside environment of the school bus along with the co-ordinates of the location will be mailed and also a message will be sent to the school authorities and parents [4] Hall Effect sensor is used, it

works by sensing the magnetic field, once the speed limit exceeds the specified limit then the Raspberry Pi sends the mail to the school authorities.

For tracking the vehicle using GPS and maintain its database, MySQL database system is used along with advanced feature of Raspberry-Pi. In the database base monitoring and updating mechanism. Date, Speed, Time at which the vehicle was tracked and store into the database of Raspberry Pi. The proposed Pi system will provide students safety mechanism. For tracking the vehicle using GPS and the advanced feature of Raspberry-Pi. This technology based on Raspberry Pi provides few more advanced features to use in our project. The idea of tracking the vehicle can be enhanced with the current location of the vehicle.

In tracking applications, it is desirable to know the accurate location of a tag in the reader area. A new method is proposed for accurate positioning of RFID into some unit cells of triangular shape [5]. Each unit cell is covered in order to extract the position of the tags. By adding this capability to conventional chip less RFID systems, they can be used in crucial applications in a wide range, such as health care monitoring. By using GPS we can track the location of the school bus [6]. This method invokes an idea for detecting the school bus in the case of emergencies.

II. DESIGN

System Objectives:

- Intimating the parents about the pickup and drop off activities of the children through an E-mail and SMS alert.
- Informing students' parents in case of emergencies with the corresponding messages in SMS and an E-mail along with the attachments of location and a picture of inside environment in the bus will be sent to the parents..
- Intimating school authority in case of rash driving carried out by the driver at a particular point of time.

To use RFID technology in the field of intelligent monitoring of buses not only solving the high-cost problems in the GPS/GPRS technology and changing the traditional way of human experience-based scheduling, but also monitoring buses running on the road in real time. What's better, it can improve the quality of service and bring

convenience to public. RFID is a kind of automatic identification technology. It achieves non-contact data communication by sending radio frequency signal. RFID system consists of two parts, the electronic tag and reader. Its basic principle: after entering the field, the tag receives RF signal emitted by the reader (installing each station) and

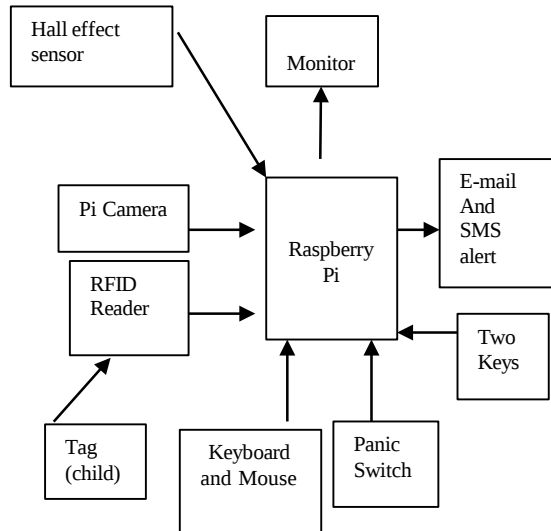


Fig.1 System Design

It sends out the product information stored in the chip by using the energy gained from the induced current, then sent to the application program on data processing. Intelligent transportation system based on RFID solutions does not rely on satellite signals, with no complex GIS system. Fig.1, shows the design of the proposed system. Using of RFID technology will not be the problems, there by safeguarding the long-term stable and reliable system operation. The concept of RFID reader here, invokes an innovative idea to find a communication way between the identification and the Raspberry Pi.

A. System Specification

1. Embedded Linux Board

Fig 2, show the Raspberry Pi board used in the proposed system which having following features:



Fig..2 The Raspberry Pi B+ Board

1. Ethernet port for internet connectivity. Connector
2. VGA connector and HDMI connector.
3. 3.5mm stereo jack for audio out to amplifier.

2. Sensors

Hall effect Sensor

Specifications:

1. Magnet is used and it is placed in the wheel of the vehicle.
2. Sensor has unique pins to connect it to the Raspberry Pi.
3. Requires no External components.
4. Fig.3 shows the Hall Effect sensor used in the system

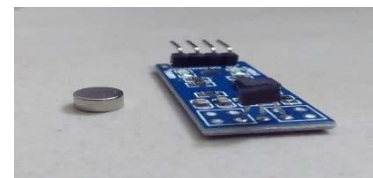


Fig.3 Hall Effect sensor

3. RFID tags and reader

Specifications:

1. RFID reader uses electromagnetic field with a frequency of 13.56 MHz to automatically identify the tags as shown in Fig.4.
2. Operating voltage is 2.7V to 5.5Vdc.

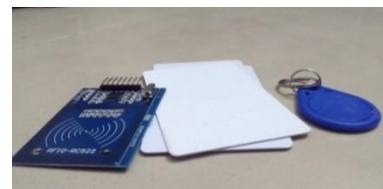


Fig.4 RFID tags and reader

4. Pi camera

Specifications:

1. Lens 1/4 5M
2. Aperture 2.9
3. Fig.5, shows camera capable of capturing 1080p still images.



Fig.5 Pi camera

5. GPS

Specifications:

1. GPRS multi-slot class 10 standard
2. GPRS mobile station class B standard.
3. Meet the GSM phase 2/2 Standard.
4. Fig.6, shows the GPS module used in the system.



Fig.6. GPS module

B. System Design

1. Vehicle real time tracking using GPS module

GPS Module gets the location position interfaces along with the Raspberry pi gives the real time tracking information of the vehicle such as Longitude and Latitude points. That information related to the school bus are taken from USB interface and got stored into the database of raspberry pi and further will sent to the school authority and parents using GPS. The Raspberry pi's file system stores longitudes and latitudes of the vehicle. In case of emergencies, that is when the bus met with an accident or when it is struck in the traffic, the current location of the vehicle is detected and will be attached along with the E-mail sent to the parents. Hence the longitudes and latitudes which are stored inside the raspberry pi's file system have been taken from Expert GPS Software. Using the Expert GPS Software the location of the school bus is traced with accurate longitude and latitude positions of the school bus, hence that traced path gives longitudes and latitudes of that particular path which can be stored in particular file format inside raspberry pi's file system. Fig.7 shows the attachment of the school bus location in an E-mail.

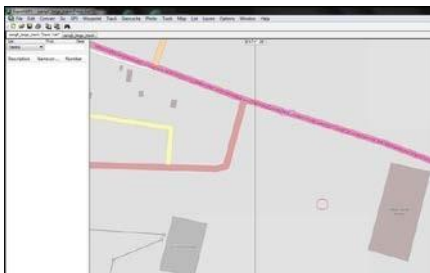


Fig.7 Location of the school bus.

2. Database of Students

The information of the students and their parents are collected and maintained in a database. Information like phone number and email ids are collected in order to send alert messages through SMS and E-mail in case of emergencies and delay of the bus.

3. Hall Effect sensor.

Hall Effect sensor will sense the magnetic field of the magnet placed in the wheel of the vehicle, Every time the tire rotates, the speed of the vehicle is calculated and if it exceeds the specified value then an email alert will be sent to the school authority.

4. RFID Reader& Tags

Electromagnetic fields are used in Radio Frequency Identification (RFID) to automatically identify and track the objects with tags. The tags will have the information which is previously being stored in the form of electronic pulses. Passive tags collect energy from a nearby RFID reader's interrogating radio waves. Working tags have an available power source such as a batteries and can operate as far as hundreds of meters from the RFID reader located in the bus.

Unlike the functioning of a barcode, necessarily the RFID tag need not be within the direct sight of the RFID reader, so it can be embedded in the tracked object such as a card. RFID is one among several methods for Automatic Identification and Data Capture (AIDC). Here we store the databases of the children in the RFID tags.

5. Pi Camera

Pi Camera connects to Raspberry Pi through a short ribbon type cable. The sensor itself has a native resolution of up to 5 mega pixels, and it has a fixed focus lens on-board of the Pi board. In terms of still images, the camera is capable of capturing 2592 x 1944 images, and also high resolution videos.

6. Panic switch and two keys

Panic switch is used in case of emergency and the other two keys which are provided are used when vehicle gets stuck in traffic and if vehicle breaks down.

III. RESULTS

A. Working of RFID Reader and RFID Tags

Fig.8, shows the working of RFID Reader. The RFID is connected to the Raspberry Pi board and RFID Tag is scanned with the reader.



Fig.8 Working of RFID

When a child boards the school bus, his RFID tag is scanned, the tag contains a unique identification code. The scanned code is sent to the Raspberry Pi, and it matches the identification code stored in the database of the corresponding child. A message will be sent from the Raspberry Pi to the child's parents that their child has boarded the bus at this particular time and date. The same procedure is followed when the child is dropped at the dropping point from the school. A message will be sent to the child's parents that their ward has been dropped at the dropping point in the particular time with date.

B. Working of Pi camera

The working of Pi camera is shown in the Fig.9. Pi Camera captures the images of the environment inside the school bus. In case of emergencies a button is pressed such that the Pi Camera captures the picture, and the picture is sent as an attachment along with the location in the E-mail. The captured images are first sent to the Raspberry Pi, then the Pi attaches the image long with the location in the E-mail to send it to the parents.



Fig.9 Working of Pi Camera

C. Working of GPS

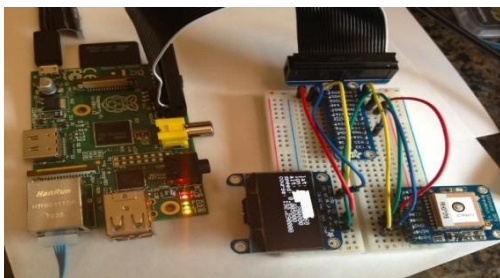


Fig.10 Working of GPS

The GPS module is connected to the Raspberry Pi as shown in Fig.10. When the emergency button is pressed the

system sends an attachment in the E-mail about the location of the school bus and the image captured using pi camera. The test worked successfully as expected.

IV. CONCLUSION

The project is intended to be designed using structured modelling to provide the desired results. Different technologies have different methodologies to implement the monitoring of school bus, more precisely safety of children in school bus. The proposed system is intended to play an important role in real time monitoring and also intended to provide safety and secure solution to the students and parents. An SMS alert is sent to the parents whenever their child boards the school bus and also when the child is dropped from school at the dropping point. Whenever there is school bus accident, the system provides the condition of students by an E-mail and SMS alert. The E-mail alert is provided along with the images of the internal environment in the school bus, and the location of emergency. An alert message is sent to the school authority if the school bus driver carries out rash driving at any point of time.

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