IoT Based Smart Bus System using wireless sensor networks

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Abstract: Millions of kids want to travel from their houses to their institution daily. The safety in the transport of the kid’s plays an important role and it is said that, kids were kept locked in the bus during their boarding till they reach the destination. Another challenge is that they may miss the bus and board the wrong bus in certain cases. This paper provides the solution to overcome these issues and to develop a system that monitors the entry and exit of students in their buses with an excellent IoT based technology. The proposed system will record the data of student’s entry and exit in the bus using RFID (Radio Frequency Identification) and GSM technologies when the travel is successful from their house to their institutions, the system itself generates the SMS to all the parents concerned. Meanwhile it detects the children who are entering the wrong bus and absence and it detects whether the driver is drunken also. If any stuck in the traffic the driver can give the information to the management without any delay.

Keywords: Alcohol, RFID, Arduino UNO and wireless sensor networks

1. Introduction:

This paper proposes a smart bus system which is designed to monitor the entry and exit of children to their buses. This system is applicable for various tasks which includes in identifying the name of each student by sensing the RFID tag. LCD Display is used for displaying the names of the students. Then the driver will come to know that the numbers of students were present inside the bus during departure and it will show the current count in the LCD Display.

A literature review stated that there were many researches which uses Radio Frequency identification (RFID) as a key feature in transmitting the student’s identity by Kumar [1]. This identity is later converted into various serial numbers that distinguishes each student from others. This system has an RFID reader and an RFID tag. A microchip which is present in RFID which is connected to an antenna; this chip has the capacity of 2 KB which includes data and product's information. Further, this paper states that, the performance of the reader field reduces with the increase in the distance. By using VHF 860-930 MHZ, the maximum area of reading is limited to 4-5 meter.
In [2], the author proposes a model that monitors whether the students inside the bus is safe. It combines various techniques i.e., RFID, GPS (Global Positioning System), and GPRS (General Packet Radio Service) technologies [3]. Each student will be provided a unique RFID card which is placed in their bag. While the corresponding student entering the bus, the circuit will record the date, time, and location and the same will be stored in a database. In Dubai, a new technology is being incorporated for upgrading the transport services for increasing the safety in the transport and family members can able to track their children at any moment [4].

In [5], the author presented a system where the student is having RFID Card individually and has to swipe while entering the bus. Then the RFID reader transmits all the data to the mobile number associated with the database. In this paper they have used Central Management Server (CMS) for 2G/3G/WIFI network [6]. The CMS server is responsible for sending SMS to the concern parents mobile. While the bus is in transit, Digital Video Recorder will record both audio and video in various spots in the school bus that will be updated in the CMS Server through 2G/3G/WIFI network [7]. Another feature is monitoring the bus location in the website details provided. The Management allows all the parents to access the centralized website for real-time monitoring of their children.

In [8] the author proposes bus monitoring using RFID technology where it reads all the data while the students crossing and it provides immediate accurate response. In [9] the author proposes and developed a bus tracking system using IoT. RFID technology is being used for tracking and for displaying the location Thingspeak web system is used to reduce the wait system and over-crowd in the bus stop. In [10] the author proposes a cloud-based bus tracking system which uses IoT and cloud base platform for reducing human intervention, passenger waiting time and energy. The main objective is to overcome the passenger’s waiting time and avoiding the queue in the bus stops.

2. Proposed System

Figure 1 shows the block diagram of proposed methodology where all the sensors are interfaced The Controller used in this paper is Audino uno ATmega328 microcontroller integrated circuit.
Block Diagram Description:

The controller used in this project is the Arduino uno which uses ATmega328 microcontroller integrated circuit. The components used are alcohol sensor, GPS module, GSM module, and RFID module. If the switch is in the morning mode it will be displayed on the LCD screen. Before starting the bus, the alcohol sensor will check for the alcohol content, if there is presence of the alcohol the relay will be cut indicating the bus will not be allowed to start. And also, a warning message will be sent to the authority. And bus can only be started by another driver after passing the alcohol test.

When the bus starts moving, the message will be sent to the corresponding parent through GSM indicating that the bus is reaching their station and also it will be displayed on the LCD. Simultaneously throughout the way the system will check for block, and alcohol. GSM is used for the tracking of the bus path and GSM module is used for the messaging purposes. And the message will be also displayed on the LCD. When the stop reached a message will be displayed on the LCD screen to swipe the RFID card and the RFID module will waits for the swiping of the RFID card and if the RFID code matches the door will be opened and student will be allowed to enter the bus. And while moving to the next station message will be sent to the next parent that their station is reaching. And the process continues. If the switch is at evening position that is at evening section first the alcohol check is done as before.

2.1. Arduino UNO:

Figure 2 shows the pictorial representation of Audino uno ATmega328 microcontroller integrated circuit which contains 28 pins which includes 6 analog inputs and 12 digital inputs which can be represented as PC to PCs and PD1 to PD11 respectively.
2.2. RFID Card reader:

Figure 3 shows the RFID card reader which uses the electromagnetic fields to identify and track the objects. The information is stored electronically. There is no necessity that the tag should be placed in front of reader, it may be fixed in the object itself. The tag which is present in the RFID has two major components: an IC and antenna. The IC is meant for processing the data, storing and retrieving the output from the sensor and other specialized functions.

An antenna is meant for signal transmission and receiving. A volatile memory is used for storing the information about the RFID tag.

2.3. Alcohol Sensor:

Figure 4 shows the schematic diagram of alcohol sensor which works on the basis of electrochemical sensing phenomenon and sensitive to all the gases related to it and can be used in ambient temperature.
It consists of a heater and MQ135 having lower conductivity for the pure air.

2.4. GSM Modem:

Fig 5 shows the SIM900 GSM modem which is used for sending SMS to the school management through internet. This uses the mobile operator. This modem is a type of modem works based on the mobile operator subscription. MMS through radio waves.

To establish the connection between a system and GSM/GPRS module is established.

For enabling higher data rate, the modified version of GSM i.e., GPRS can be used. It consists of an input supply unit and interfacing unit. Mostly used. RS-232 and USB are the suitable interfaces for these purposes. for computer. MODEM plays a vital role in communication systems.
2.5. GPS Device:

Fig.6 shows the global navigation satellite system which is available in United States Air force. This system provides the exact location along with geographical data and time. The GPS receiver receives the signal in all over the world which is monitored and controlled by the satellite. These technologies can improve the information about the location and it has the capability to enhance the Global Positioning system.

![GPS](image)

2.6. LCD Display:

The most commonly used LCD display in various devices is 16x2 LCD module. This LCD module has more advantages than the multi segment LEDs. The common advantages are that they can be programmed easily and there is no restriction for displaying special characters even animations also can be done.

There will be 2 lines having 16 characters each. Here, each character will be displayed in 5x7 pixel matrix. Command and Data are the two registers present in this LCD module. A Command is defined as the instructions which are given to LCD and the Command register will store all the instructions. The instructions help the processor to initialize the controller, screen clearing and the control of cursor position in the display etc. The data to be displayed on the LCD is done by the data register.
3. Software Implementation:

The major software used for writing the functions and simulations are as follows.

![Simulation Diagram]

Fig 7: Simulation Diagram

3.1 Proteus:

All the components for designing and the simulation work was carried out by using the ISIS 7 Professional (Proteus) software. Proteus has a certain limitation where RFID Card reader and GSM modem cannot be simulated. For achieving that, Actually GSM modem and RFID reader is connected to the system by using serial port. Both will be connected to the system by using the serial communication before implementation. The Schematic diagram of the simulation is shown in Figure 7

4. Simulation Results:

The following figure 8 and 9 are the simulation results of two cases namely when the driver is drunken and the other is the bus met with an accident which results in the parts of the bus is broken.
5. Conclusion:

Nowadays integrating both GSM and RFID is essential in child safety during their journey in school buses. Most of the cases lead to theft of the child. In this paper, a Safety system for school children is developed. RFID detection is kept inside the bus and it detects the tags which is wearable by the children. The signal is sent via GSM Modem and the data is kept in a server. The System has a technology implemented where it identifies the child who were not board or leave the bus and send a message for alerting their parents. Apart from that, the attendance of the children are also being checked and it is updated in the database. It has another feature is that, if any traffic block occurs, the driver can press a switch, the information will be sent to the management. In case the driver is drunk, it will also be indicated and alerted in advance.

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