Smart Transit: Real Time Bus Tracking and Monitoring System Using Embedded Technologies

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Abstract: In recent days children's safety is a very big problem for parents and society too! Our child is not feeling safe while traveling. Many incidences occurred where school drivers or other peoples in buses abused children. So, to monitor child's boarding on bus and drop off from bus we have proposed here real time school bus transport monitoring system. This system uses RFID, Face recognition, GSM and GPS modules embedded with microcontroller. While bus is moving, real time streaming of video is made available to parents from the bus. The model proposed here is very useful in safety concerns of students as well as women's if used in school buses and company cabs.

Key words: Embedded, Microcontroller, RFID, GSM, Wireless Transmission.

I. Introduction

Many researchers tried to find solutions to make school bus traveling safe for children but due to complex structures and cost, still school buses are not using it. RFID is the best and we known device that can collect the attendances of students. The use of RFID Tag in system is much easier than the biometric recognition. GSM and GPS modules are widely used in wireless transmissions in real time systems. Due to this location data can be made available on internet in real time. The model proposed here is a way to provide simple, better and economical solution for Childs safety while travelling to school. The proposed model works on RFID, GSM and GPS with a face recognition system interfaced with an arduino nano microcontroller. For attendance of student in school bus RFID and cameras are used whereas, GPS module is used to track the school bus.

II. Literature Review

Many researchers have worked on the attendance system for school buses and schools. The following graph in Figure 1 shows the related works done in the past few years.
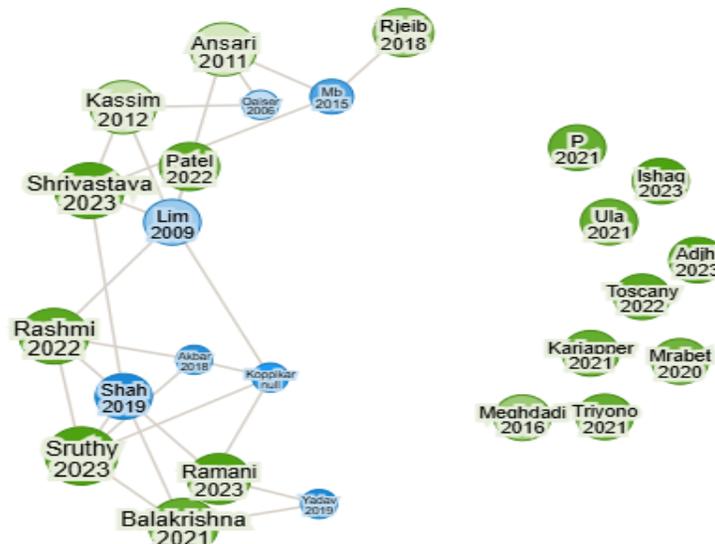

Figure 1: Literature Maps

Anurag Shrivastava et al in 2023 has worked on RFID based attendance system. In their system RFID tag and readers are used to collect the attendance. They used RFID with an arduino microcontroller and ESP8266 to build the system. Their research is more useful for college and school teachers to maintain record of student's attendances. [1]

S. R. S. Kavitha et al in 2023 have developed an Attendance monitoring system using RFID technology. They used wireless technology to collect and monitor attendance taken by RFID readers. An attendance management software was developed for maintaining and tracking the attendance records of students. [2]

R. A. S. Brindha et al in 2022 worked on a smart attendance system which uses RFID tags in students' ID cards with individual UID numbers assigned to every RFID tag. The RFID readers are installed in the classroom for attendance records. The system detects the UID of the tag and records it. To avoid false attendance, face recognition was also used in the system. The whole system was controlled using a microcontroller. [3]

Ramani. G et al 2023 have developed an attendance tracking system which tracks the student's presence in the classroom. This system also uses RFID tag and reader with face recognition to record the attendance. The whole attendance record was made available on the internet using IoT which is making tracking easier than other systems. [4]

K. Balakrishna et al in 2021 worked on students' attendance monitoring systems. Here, they used RFID tags and readers with the GSM module. API, a software programming Interface was developed to connect parents' mobiles with the recorded data. Their system worked effectively providing access to the recorded attendance data. [5]

Agus Triyono and Farindika Metandi in 2021 had used Raspberry Pi microcontroller with RFID for attendance monitoring system. Software was developed using Python and PHP languages and the database is created with the help of the Marina DB database engine. The attendance of students as well as teachers is recorded in the classroom. [6]

III. Model Design and Materials

Hardware Model Design

The proposed model is built around Arduino nano microcontrollers. An RFID tag and Reader is used for attendance records of the students. RFID reader and face recognition devices are connected to Microcontroller Arduino nano. The data available from the camera and RFID reader is sent to the server for storage and other use. The model block diagram and work flow is shown in figure 2. The arduino nano requires a very low power supply which can be made available by the use of batteries also. The whole unit is placed near the door of the school bus. Another camera module is placed inside the bus covering all the areas of the bus where children are sitting. The view from the bus can be seen by the parents through a mobile app. The whole system works on rechargeable battery.
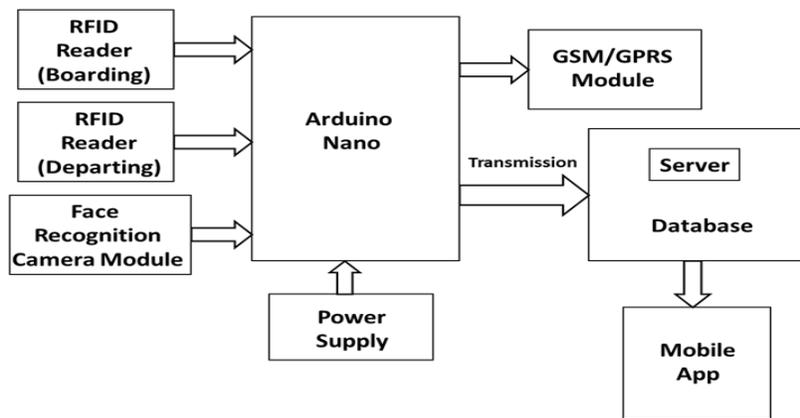

Figure 2: Hardware System Design

Key Components Used in System Hardware

RFID: the RFID contains RFID Tag, Tag Reader and the host computer for the confirmation process and database storage [7].
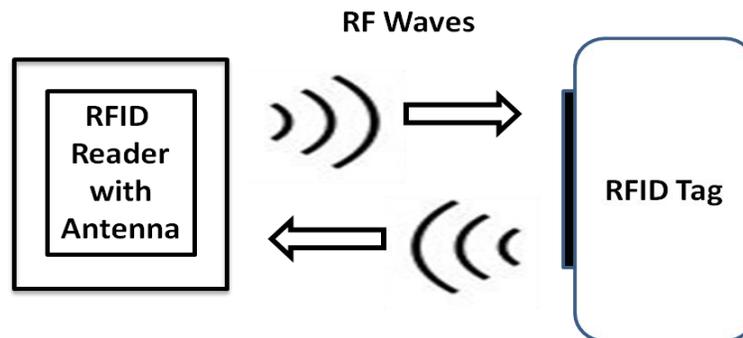

Figure 3: RFID Tag and Reader Working

The RFID tag has its unique UID which is already stored in the host system software program. When the tag is scanned on an RFID reader, the system software matches the UID with the reference one and if it matches it provides information or output according to the system requirements.

GSM and GPS Module: SIM800L GSM/GPRS Module is used here for this system. It is a tiny GSM Module which will provide mobile connectivity with Arduino.

Figure 4: SIM 800L GSM/GPRS Module

It can send text messages or calls to mobile and also provides internet connectivity through GPRS for the tracking purpose. It operates on a 3.4 to 4.4 V power supply or lithium battery. The module is connected to a microcontroller through UART and supports baud rate of 1200 to 115200 bps. It will connect to the global GSM network using any 2G SIM card. One slot is provided on the other side of the module to insert the SIM card. NEO-6M GPS module is used to interfaced with Aruno nano.

System Flowchart

As soon as the student or child is boarded inside the bus, he will scan his RFID tag on the system and the attendance is stored inside the system. At the same time his face is also recognized by the system and if both the information matches with the reference data then SMS will be sent to his parent as their child is boarded on the bus. At the same time data is transmitted to server for storage and bus tracking is made available on Mobile App. On the drop off of child or student again he will scan the RFID tag on drop off RFID reader module. The same face recognition system will recognize the face and if both matches system will send drop off massage on respective parents' mobile number.
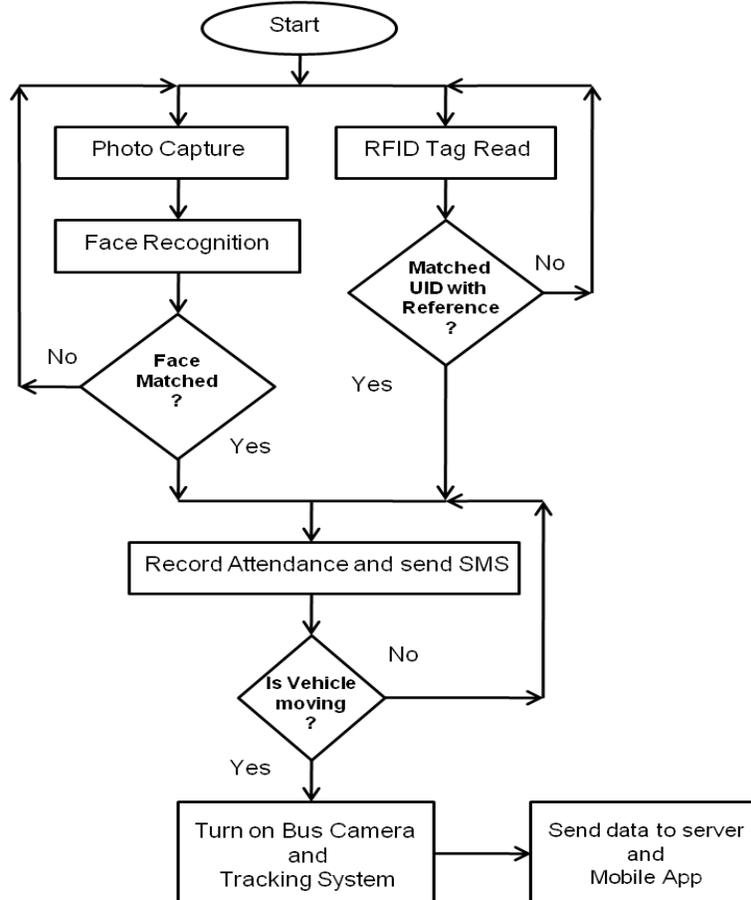

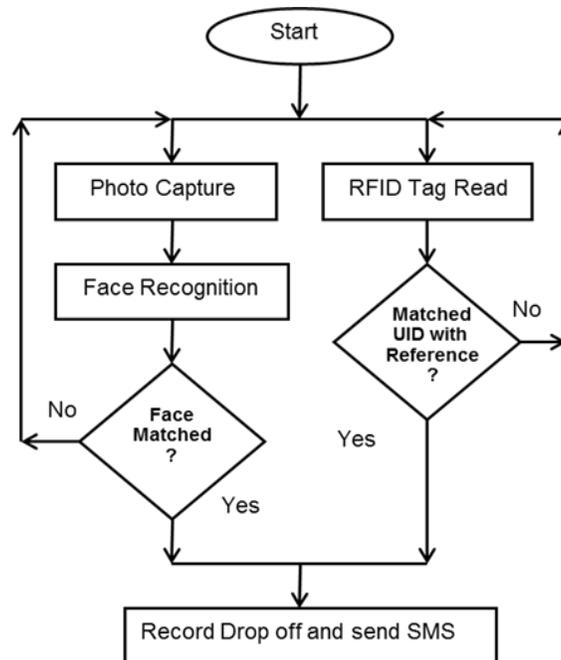Figure 5: Flowchart of Child Boarding Attendance System

Figure 6: Flowchart of Child Drop Off Attendance System

To customize and make data available and manage on the internet, developed a web-based application using MySQL and PHP which provide tracking of bus and attendance data to parents.

IV. Conclusion

The system proposed here provides real time data of child and bus location to parents directly on their mobile. The system effectively uses RFID, GSM, GPS and face recognition modules. This system is designed considering low power consumption and small space requirement in bus as it is going to be placed on door side of the bus. This advanced real time monitoring system can be used to improve school bus transport and child safety. In future, the whole system can be powered using solar energy gathered from the solar panel placed on rooftop of the bus.

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