

An Android Application for School Bus Tracking and Student Monitoring System

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Abstract— The BUS TRACKING AND STUDENT MONITORING SYSTEM is a mobile application that ensure security to the students. The main objective of this application is to build a vehicle monitoring system for school children. Nowadays, parents are perturbed about children going to school because of the increasing number of cases of missing students. On certain occasions, students need to wait a much longer time for arrival of their school bus; our proposed system provides a technical solution for the above scenario. The system consists of an Internet enabled android application which will interact with a server. Authentication, attendance monitoring, vehicle tracking are the other features provided by the system. Driver, Faculty/Teachers, Parents, and Administrators are the end users of the application. The application uses wireless technologies like GPS and GPRS/GSM. With this android application parents can watch all the movements of the bus and monitor their child's presence.

Keywords—Global Positioning System (GPS); General Packet Radio Service (GPRS); Global System for Mobile Communication (GSM); Student Monitoring; Android; Bus Tracking; Firebase; Cloud Server; Google Maps API.

I. INTRODUCTION

Today, parents are worried about the safety of their children. There are a lot of issues like kidnapping children on their way home, or from home when they are sleeping or during a party. Recent studies show that India is in 4th place in the number of child missing cases after United States of America, United Kingdom and Germany having 96000 child missing cases per year [1]. Nowadays, even the bus getting delayed due to a small reason makes the parents bothered about it. But today's technology can provide a much better solution to ensure the children's safety. To track and monitor their children, the proposed system provides an Android based bus tracking system. All the registered users can view/collect and exchange data inside the android application. Inside the vehicle there would be a teacher/faculty who would be in charge of the vehicle and he/she would also be in charge of taking the student's attendance. As soon as it is taken, parents would be notified if their child has boarded the bus or not. The GPS in the driver's mobile is used to track the vehicle. Once

the vehicle starts to move the parents can view the live feed in their application with the help of Google Maps. This helps keep them updated about all the issues on the way and plan their work accordingly. Each and every updates are notified to the parents as soon as possible. This work focuses on the design and implementation of a School bus tracking android application.

The paper is organized as: Section II explains all the works related to the proposed system. In Section III, we explain the working and all the modules in this application. Section IV explains the algorithms in this system and in Section V all the results are explained. In Section VI, all the future enhancements that could be brought in system are mentioned.

II. RELATED WORK

The literature [2] implements a RFID method to monitor student attendance, using GPS tracking mechanism to track the vehicle position and finally predicting the arrival time using Kalman filtering method. Here we are replacing the hardware parts using an android application. The literature [3] proposes and implements a low cost object tracking system using GPS and GPRS. The system allows a user to view the present and the past positions recorded of a target object on Google Map through the internet. Basically we are using an android application to develop a bus tracking system which is cost effective. The literature [4] monitor bus traffic inside spacious bus stations, and can inform administrators whether the bus is arriving on time, early or late based on RFID technology. This information is then displayed on the different wireless displays inside and outside the bus station. Paper [5] deals with Expectation Maximization algorithm to resolve traffic anomalies and it uses Hadoop map reduce method. [6]Proposes an application which uses GPS and GPRS technologies to predict the real – time location of the bus and the arrival time of bus. The Literature [7, 8, 9, 10] talks about vehicle tracking and various arrival time prediction methods. The proposed system can also be extended to get this information in a cost effective manner.

III. PROPOSED WORK

The proposed system is an Android application which helps parents keep track of their ward(s). This application is handled by four categories of users: Parents, Faculty/Teacher, Driver, and Admin. Admin handles all the users and all emergency situations [about main events that are happening or that would happen in a particular day]. Faculty is in charge of all children in a vehicle and makes sure that they have boarded the bus or not. Driver is in charge of notifying the start and end of journey. Only after his/her confirmation shall the bus's location starts transmitting to parents. Parents can watch the live location of the bus and ensure that their child have boarded or not by just reviewing. Each child is identified by his/her own unique ID.

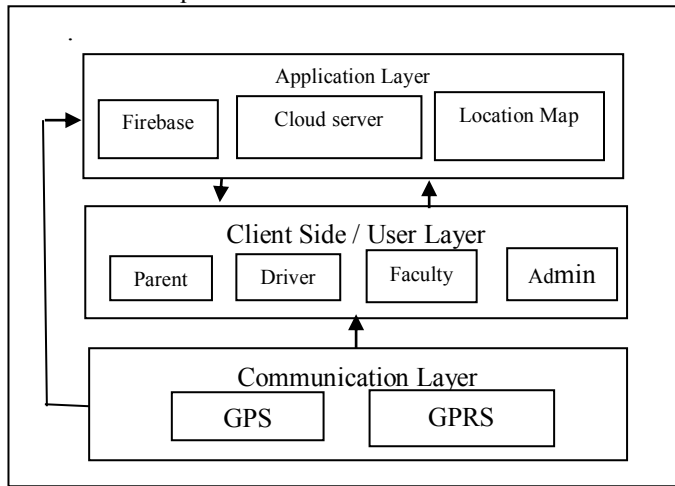


Fig 1. Architecture Diagram

A. Communication Layer

This Layer is used to establish a connection between the User layer and the Application layer. Various technologies like GPS and GPRS is used in this layer.

- **GPS:** Global Positioning System is used to locate the device. Tracking is possible even without the GPS, we could use the distance of the device from nearest tower and some other features. But it won't be accurate, the obstacles in the way makes it hard. If we are using GPS, then we would be able to pinpoint the device even through some obstacles, but if there are a lot of obstructions or if the device is indoor it might be tough to get the location.
- **GPRS:** General Packet Radio Service is a wireless communication service based on packets and enables continuous connection to Internet to the mobile device. It is using this connection; we are sending data from device to cloud server and Firebase and taking data from them. A stable GPRS connection is needed for the live tracking of the bus.

B. Client / User Layer

This layer mainly consists of all the users of this application. They interact with the system to collect and give information. The various functions of all the users are as stated below.

- **Faculty:** He/she is the one who is in charge of the whole children in the vehicle and their safety. They are given the authority to mark the attendance of the children in the to and fro journey and make sure that the children board the bus in time safely. Once the attendance is taken, it is sent to the cloud server and will be stored there. As soon as the attendance is updated, parents would be notified and they could just check it.
- **Driver:** He would notify the vehicle is starting to move from the school. Once he notifies, the location starts transmitting from his device. It is sent to Firebase and stored there for later use. For every update in location, the parent can view each and every movement of the bus.
- **Parent:** He/she can constantly watch over his child on his/her way to school and back home. They can watch all the small moves that the bus makes and can check if their child has boarded the bus or has gone missing or did he/she bunked the bus. Parents would be notified if there is a holiday, atleast a night prior to it and even special events or some issue on the way.
- **Administrator:** He/she is the responsible for the management of all users, vehicles and routes in the system. Admin is also given the authority to inform parents about all events even if it is a small one.

C. Application Layer

This layer contains all the important technologies that are working mainly in the back end. It consists of the following components and its functions are explained along with it.

- **Firebase:** It is platform for the development of web and mobile applications provided by Google which is free for a small number of users using the same access point. In Firebase, GPS location is saved in Real time database which will be ready for updating in the other end. It only takes a few milliseconds to save and make the same changes where it is being called upon. It is the best platform that could be used for tracking using GPS
- **Cloud Server:** A server is used to store the details of the users and all the information about the buses, routes and attendance of the children. Historical data are also saved in the server. It is where all the users interact and collect all the information that they need.
- **Location Map:** It is shown in parent's device using Google Maps API. Once a change in location data is found in the Firebase, the same will be updated in the Map.

IV. ALGORITHM

This section contains the various algorithms in different user's device/ server. Here we are identifying vehicles position using Google Map API. The code will capture vehicles position and send it to Firebase cloud database. The driver is responsible to enable this module using his login credentials. The screenshot of the module has given in Fig 4 and in Fig 5.

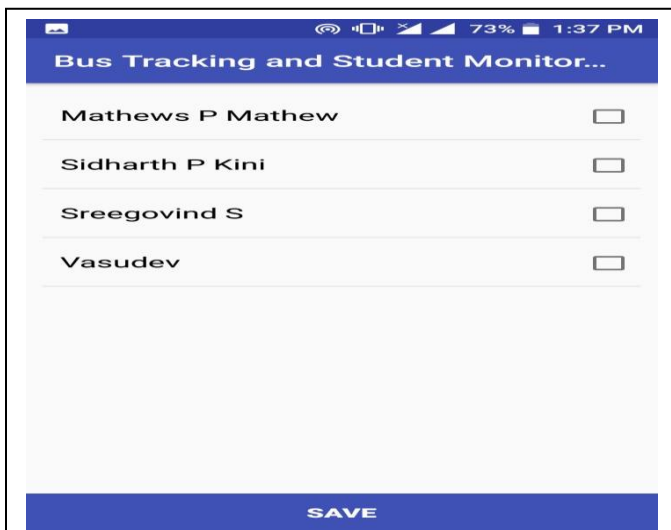
A. Starting Journey in the Driver Module

Input: Login Credentials of the Driver.

Output: Live GPS location of the vehicle

1. Login to Driver Portal
2. Click on "Start Journey" once it is time to leave the school.
3. Read Latitude and Longitude of the device from GPS.
4. Google Map loads showing the vehicle's location.
5. Start sending the location data to Firebase until the destination is reached.

The attendance module will capture the attendance of the students in the bus with time and send to the cloud server for further processing. Faculty present in the bus is responsible for this. An android interface is used to do the attendance entry. The screenshot is shown in the following figure (Fig 2).



Taking Attendance in the Faculty Module

Input: Login Credentials of the Faculty.

Output: Attendance list of the children in the vehicle.

1. Login to Faculty Portal.
2. Click on "Take Attendance" once the vehicle leaves the school.
3. Mark the set of students that are present in the bus.
4. The final data is sent to the cloud server.

The following set of pseudo code is used to track the bus by parents. Whenever a route change or delay in reaching the intermediate stops has been recorded and stored in the firebase cloud server and plot the data in Google Map.

Tracking Bus in the Parent Module

Input: Login Credentials of the Parent.

Output: Live location of the vehicle.

1. Login to Parent Portal.
2. Click on "Track bus" to see the current location of the bus.
3. Fetch data from Firebase for every changes that occurs.
4. Plot the data in Google Map.

The screenshot for the vehicle tracking module has been captured in the following figure (Fig 3). Sometimes bus route may change because of traffic, religious celebrations or protests etc. and thereby delay comes in travelling. Based on the delay in the travelling, the parents can know the position of the vehicle is the one of the important attractions of this module. We can enhance the features just by predicting the arrival time of the vehicle in each intermediate stops [2].

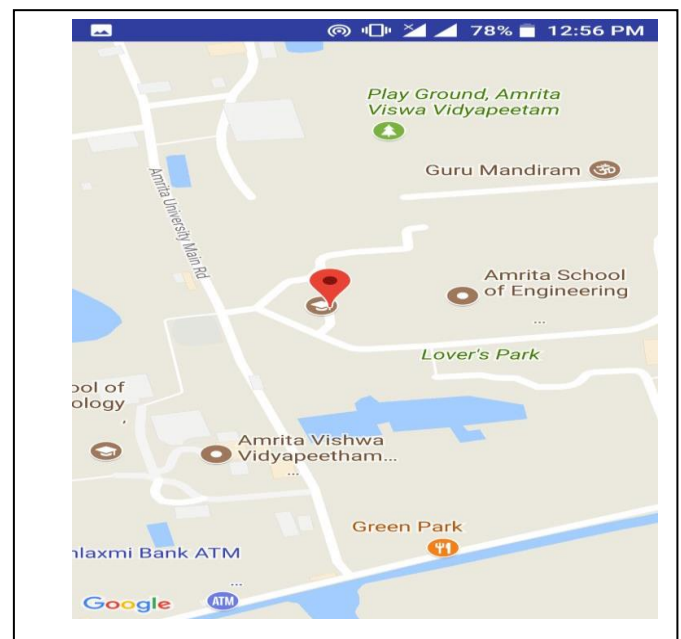


Fig 3.Track Bus

Viewing Attendance in the Parent Module

Input: Login Credentials of the Parent.

Output: Status of their child.

1. Login to Parent Portal.
2. Click on "View Attendance" to see if the child has boarded the bus.
3. Fetch data from server.
4. View/Show the attendance status.

The above pseudo code will allow the parents to view the attendance of their ward and hence they can ensure the security. The data will be retrieved from the firebase cloud server and populate the data to the android application.

V. RESULTS

The system was developed using android studio, the webserver is xampp. The database used is phpmyadmin and firebase. The application is basically installed in android tabs and phones. The different GUI s in the application and their use has shown below. It contains different modules for administrator, faculty, parents and drivers. Screenshot of parents view has been shown below (fig 4). Application contains attendance monitoring and vehicle tracking and monitoring features (Fig 2 and Fig 3).

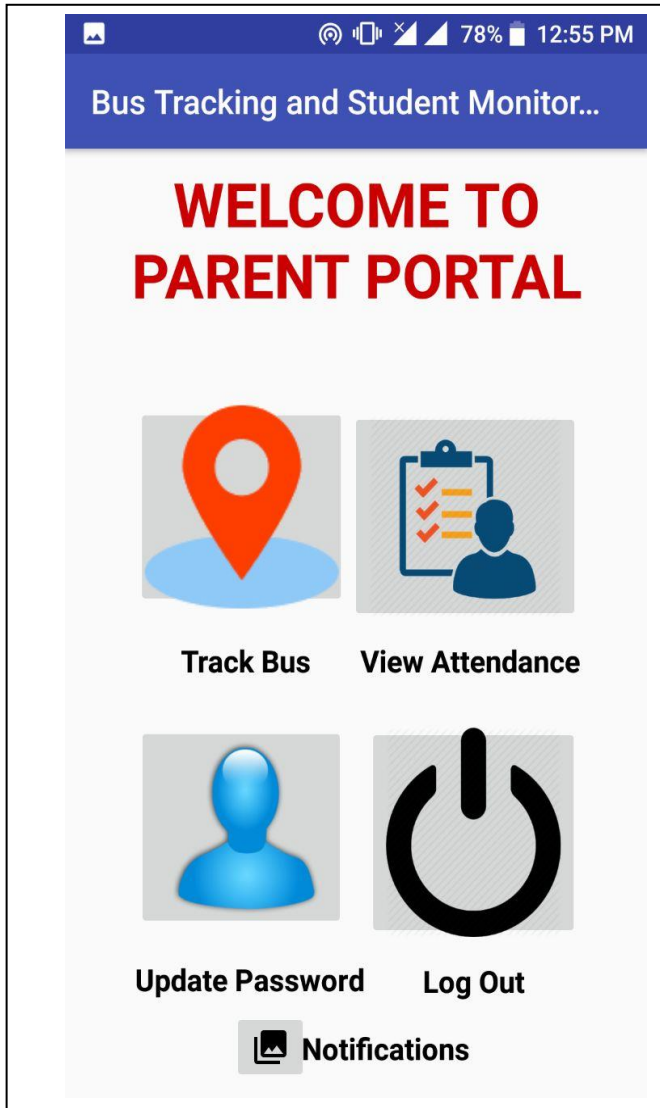


Fig 4: Screenshot of parents view

Attendance Monitoring Module: The teacher is responsible for the safety of children in that vehicle. Faculty takes attendance in the morning and evening and update the information for the parents. An android application interface is using to record the attendance by the faculty in charge. The recorded attendance has been pulled up to android application from firebase server

and which can be viewed by the parents , screenshot of same is placed here (Fig 4).

Vehicle Tracking and Monitoring: The driver notifies the start of the vehicle and from that moment, the vehicle's location could be seen by the parents. Retrieving the position of the vehicle using Google map API. Parents could keep of their children using this application. As soon as the vehicle starts moving, parent would be notified about that and they could just watch each and every movement of the vehicle. Just as the vehicle is leaving the school, the child's presence would also be notified.

VI. Conclusion

We developed an Android application for school bus tracking and to monitor children. It was with the use of wireless technologies like GPS and GPRS and some good platforms like Firebase. With the help of this application parents need not worry about their child. Its implementation is done in a very cost effective way as it only needs mobile's GPS and Internet connection. This might not be 100% efficient as it depends on the speed of the mobile and the connectivity of the GPS. This would be a great relief for the parents who are really worried about their child's safety. Some of the future enhancements that could be brought in this system are Fingerprint Scanner, RFID Tags [2], ETA (Estimated time of Arrival) [2], Chat box for parents to interact with faculties etc.,

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