Integration of School Bus Monitoring and Enhanced Safety using IOT

Mr Ganorkar Abhijit[1], Mr Deshpande Sarvesh[2], Ms. Gadekar Rutuja[3], Mr Kakad Mayur[4],

Prof. Chikane Y. R.[5]

Student, Department of Information Technology, AVCOE, Sangamner, India[1234]

Teacher, Department of Information Technology, AVCOE, Sangamner, India[5]

Abstract: The use of private vehicles intensifies the existing unbearable traffic jam and majority of the parents consider school buses to be largely unsafe for their kids. However, safe and user friendly school buses can reduce the use of private vehicles and will eventually cut back the traffic jam in cities especially in school hours. All buses can be tracked by the guardians using the proposed intelligent and secured tracking system for school buses. This proposed system includes an Android application that can be employed to send notifications during entry and exit of the students using Fingerprint scanner, ensuring arrival confirmation of the student by dual authentication. The system will also notify parents when the bus is a 15-min distance away from the home. The focus of the research is to display the feasibility of a safe and intelligent school bus using secured tracking system based on authentication procedures. It is expected that the offshoot of this research initiative will regain the confidence and reliability of parents in school bus and reduce the use of individual transport.   A smart school bus will keep the student safe, easing the tension for parents and the city will have a smooth traffic system.

Keywords: School Bus; Safety System; GPS; Fingerprint; Iota.

I. INTRODUCTION

In the context of daily affairs, one of the common problem is traffic jam where the personal cars carrying students during school hour directly compounds the negative impacts on traffic jam. This happens because parents having private transport don't want to take the risk of using public transport or traditional school bus for school-going children. While parents who don't own a private transport and use the public ones to carry the children to school, often stay around the school for the whole of the school-hour duration. These parents often have to take number of different routes en route to school and back home. Another probable scenario is that the parents send their children to school alone but they stay tensed as they don't have any regular status updates of their loving ones. There can also be issues such as the students may not go to school or just simply passing time outside the institution, while their parents having no way to locate the whereabouts of these students. Metro cities see worsening of the traffic situation, particularly in school hours. All the sides agree that a sustainable solution providing proper safety in school buses would be beneficial to parents as well as to the students themselves. It will also reduce traffic jam in school-hours. The Internet of Things (IoT) is a concept in which surrounding objects are connected through wired and wireless networks without user intervention. In the field of IoT, the objects communicate and exchange information to provide advanced intelligent services for users. Owing to the functionalities of IoT, this paper proposes an IoT based smart school bus tracking system which can aid parents and responsible persons in real-time tracking of the buses having GPS facility. Parents will get notification of arrival of the bus, and at the time of getting on and off the bus by the students.

II. RELATED WORK

A number of school bus tracking systems have been reported in literature, and they address parts of the concern of school bus tracking and monitoring [8, 9, 10, 11, 12]. Generally, they have used a combination of different technologies. They have used the Global Positioning System (GPS) to record the bus location and the Radio Frequency Identification (RFID) to record the student's data and then transfer this information to a server via Global System for Mobile Communication (GSM) network, to be stored in a database. The FRID detect the entering and exiting activity on the bus. The RFID reader queries the RFID tag by sending a signal to the tag and then the tag returns the previously stored data in the tag [17, 18]. The GPS provides the position and time information. The GPS system is based on a number of satellites regularly transmit their location in orbit as well as the time. The GPS use this information from at least three satellites and uses this information to calculate its own location (longitude, latitude, altitude) [19]. In this application, the GPS is used to detect the bus location, the pickup the drop-off location of students and time. The General Packet Radio Service (GPRS) shield provides away of using GSM network to receive and send data to and from a remote location [20]. The data base is used

to keep records of the location of the school bus and the boarding and disembarking records of the students. K. Shaaban, and others [8] proposed a system which monitors the loading and unloading activities and sends an SMS message if a student is absent or is bus. None of the proposed system capabilities were implemented, only the reading from RFID module was separately tested in the Lab environment. V. Asundkar and S. P. Godse [9] proposed a system, which partially address the concern of the school bus tracking, and monitoring issues, the proposed system was not actually implemented, but only proposed as future work. In [10] proposed a system that partially address the concern of the school bus issues, the system track the bus location, the boarding and the exiting from the school bus, the next bus stop alert and SMS notification.

P. A. Shinde and Y. B. Mane [11] proposed a system that partially address the school bus issues, the system track the bus location and sent a notification if the bus take a wrong route. If the bus speeds up beyond the limit, the system sends a warning message. S. C. Savitha, S. Natya, and J. Parinitha [12] proposed a system that partially address the school bus tracking and monitoring issues by providing location of the bus, the next stop notification and an alert message in case of accidents. S. Sangeetha, S. Krishnapriya, Ms. S Janani [13] proposed a system, which partially address the concern of the school bus tracking, and monitoring issues, the proposed system is an SMS based application, where the students information's are stored in a database and embedded as a QR in children's identity card. When the children board/disembark the bus, the QR code is scanned by a mobile application, the children boarding/disembarking time and the bus stop details are sent to the parents as an SMS notification in real time. M. S. Minu, Deepak Adithya K. N [14] proposed a system that tracks the bus and estimate the time of arrival and then send notification to the student before arrival of the bus. K. Sridevi, A. Jeevitha, K. Kavitha, K. Narmadha, K. Sathya [15] proposed a system that tracks the location of the bus and update the location in a server. Students can estimate the arrival of the bus by the position of bus on a map. L.Sindhuja, M.Naresh, Dr.M.Narsing Yadav [16] proposed a system that tracks the bus location, monitor pickup/drop-off of students from and to school and issues notifications when student did not board or leave the bus. A vibration sensor was used to detect the occurrence of bus accident.

III. PROPOSED METHODOLOGY

In the system architecture School administration will usually operate the website, under Admin Domain. The user with admin credential has to log in first by a specific username and password. The admin is offered the option of adding and editing students', buses and driver's information. Besides, user authentication and authorization options are also included in this module. Alongside recently taken actions are shown in the status bar. In this system, fingerprint scanning and verification mechanism are attached in the door for authentication purpose. There is a display system in the bus to show the matching result. GPS is also implemented in the bus for real-time navigation. All these devices are connected with a microcontroller which uses esp8266 WIFI module to send the data in the database. The overall architecture has been shown below.

A. *System Architecture*
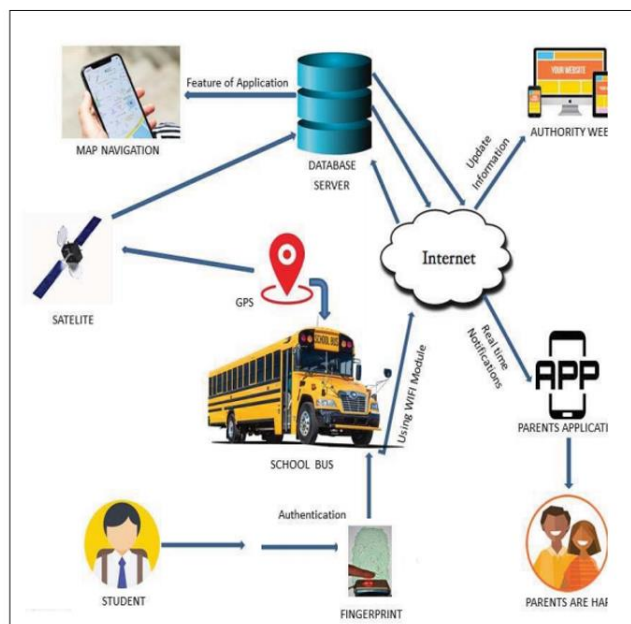
B. *Proposed Work*

- Step 1: At first student's Fingerprint will be checked for the first level verification.
- Step 2: If the fingerprint doesn't match, then it will be considered as invalid attempt.
- Step 3: Verification is done
- Step 4: If a positive match occurs, data will be sent to database and parents will be notified about the student's arrival.
- Step 5: When the student is about to be dropped off to his or her destination point, Fingerprint is checked again. Then notification will be sent to parents; so that student can't get out of bus anywhere else or can't be late to get out of the bus when they reach at school.

C. Modules

1. Admin Module:
    In this module, the website can be used to add and update the student and bus information to the database, the updated information will be reflected in the website itself. This domain is directly connected to database where other domains are also connected. So any real-time change can be executed by the admin and the whole system can be tracked.
2. Service Module :
    In this module the IoT technologies are included which is implemented in the school buses. The service is provided by Fingerprint and GPS to ensure the safety of the students. Fingerprint scanner is used for authentication, and GPS is for tracking the bus to get the real-time navigation and send the alert even before the arrival of the bus.
3. User Module :
    In the User Module, an android application will aid the parents to get notifications of their children's current status. The application can also be used to obtain navigation status of the bus in real-time through a map, as well as to get certain information such as driver's contact number.

D. *Algorithm*
KNN:
K-nearest neighbours (KNN) algorithm is a type of supervised ML algorithm which can be used for both classification as well as regression predictive problems. However, it is mainly used for classification predictive problems in industry.
   • Ease to interpret output: It can be easy and simple to guess output using KNN compared to other algorithms.
   • Calculation time: The time required for KNN is very less as training phase is omitted data available in dataset can be used directly for testing phase.
   • Predictive Power: KNN is most suitable for the prediction. There is good solution given by using KNN algorithm for prediction.

- Step-1: Select the number K of the neighbors
- Step-2: Calculate the Euclidean distance of K number of neighbors
- Step-3: Take the K nearest neighbors as per the calculated Euclidean distance.
- Step-4: Among these k neighbors, count the number of the Data points in each category.
- Step-5: Assign the new data points to that category for which the number of the neighbor is maximum.
- Step-6: Our model is ready.
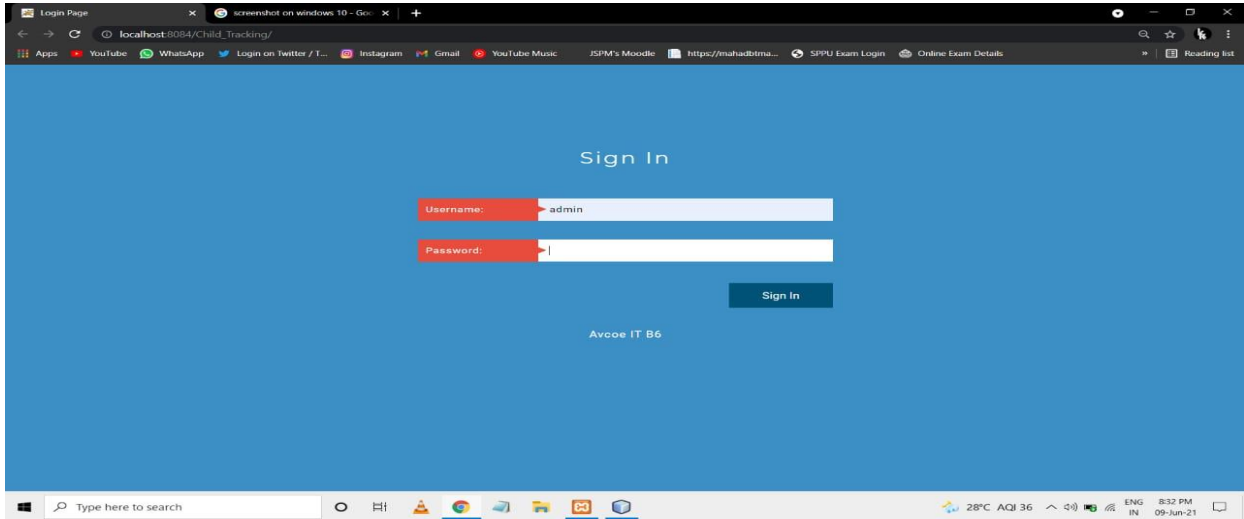
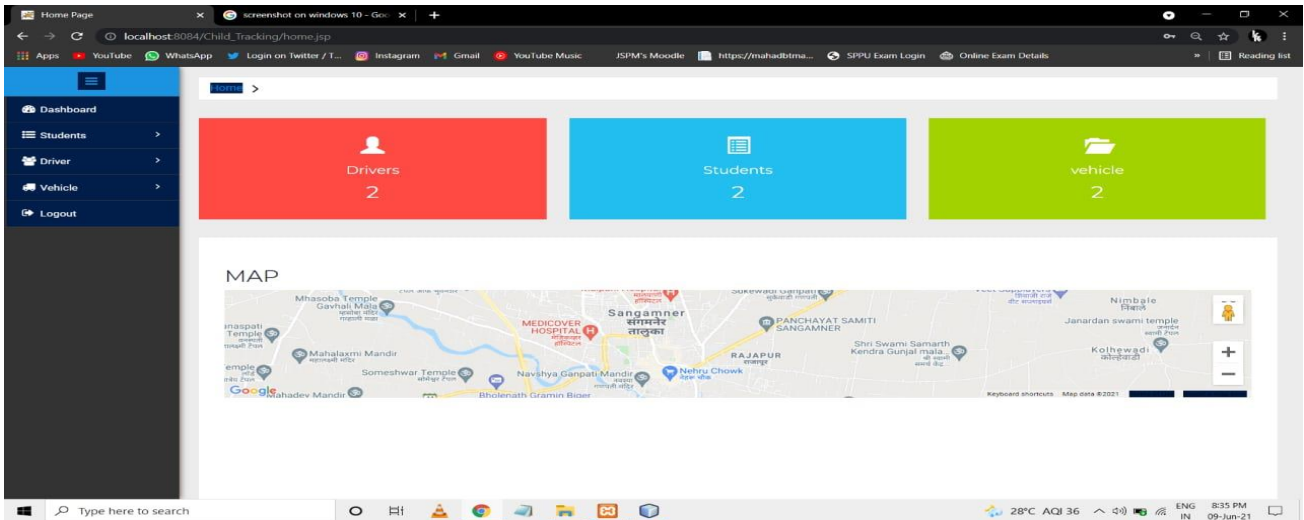## IV. RESULTS & DISCUSSIONS

A) Login Screen

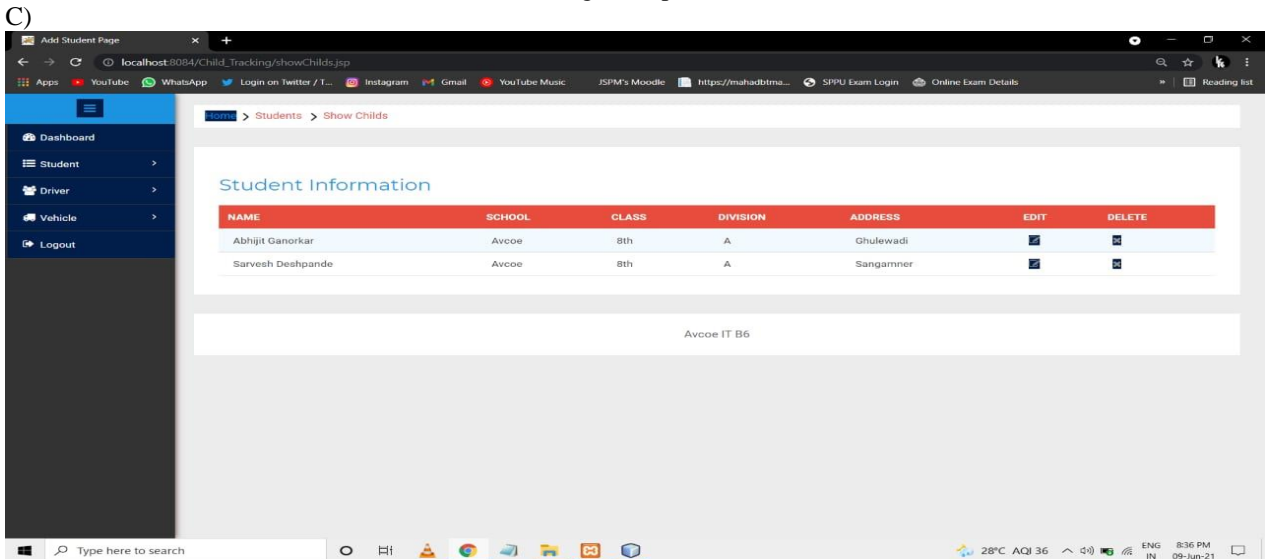Fig. 1 Login Screen

Fig. 3 Map

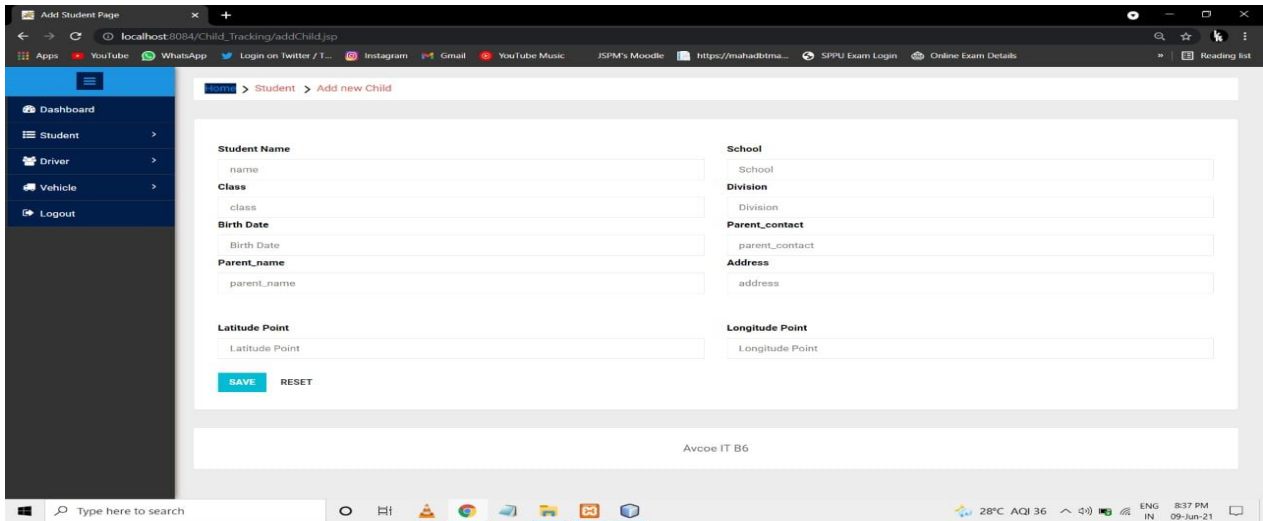C)

Fig. 4 Student Information
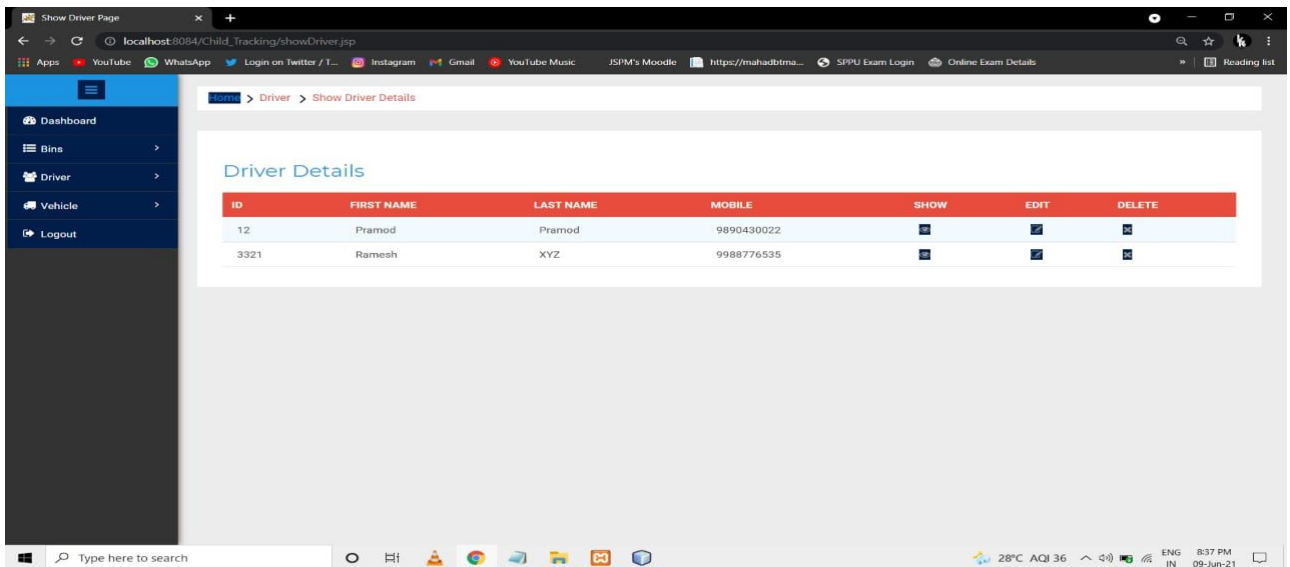
Fig. 5 Student Registration
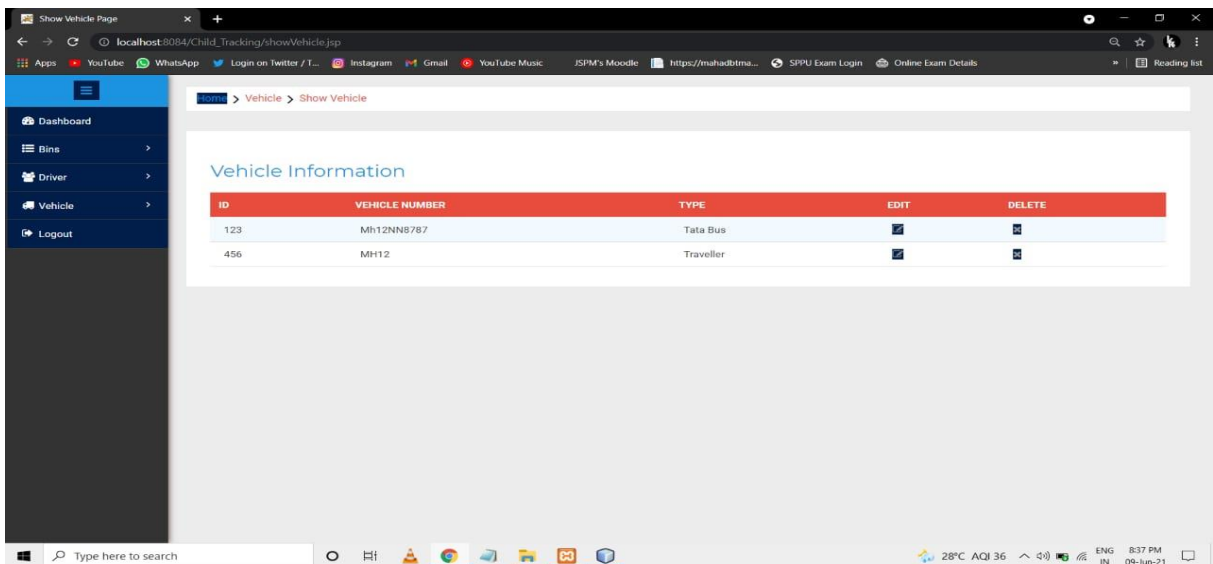

Fig. 6 Driver Details
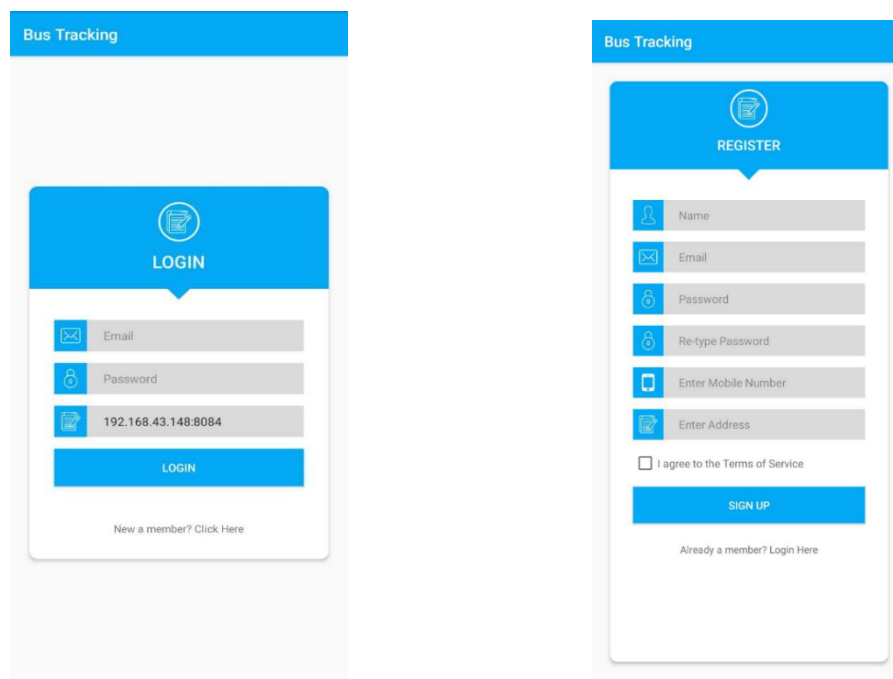

Fig. 3 Vehicle Information

Fig. App Interface

V. CONCLUSION

In this study, a secure school bus system has been proposed for city. This system will ensure safety; ease tension and anxiety of parents, and will without doubt, improve road conditions. It will also provide an easy pick1up system by providing notifications. Guardians will get notifications through an Android application; this app can be used to see the current status of the bus in a map, thus it will be easy for the parents to track the movement of the bus and get notified at the appropriate times. Hence, they will have a highly reliable, secure and intelligent system to depend upon.

In future system include plan to install for IP cameras which will produce live images from inside the bus, it will also add speed alert, road change alert, route change notification, smoke sensor, addition of stoppage ID in the entry and exit notification etc. An efficient encryption method will be developed to strengthen security.

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