



IMPLEMENTING QR TECHNOLOGY IN SCHOOL BUS TRACKING

P.Anupama¹,G.Aravind²,J.Anudeep³,G.sandhya⁴,P.Anjaneyullu⁵
Assisatnt Professor, Department of Computer Science and Engineering¹
Student, Department of Computer Science and Engineering^{2,3,4,5}
Sree Dattha Institute of Engineering and Science, Sheriguda, Telangana. ^{1,2,3,4,5}

ABSTRACT

In the present day, it is common for parents and guardians to worry about the well-being and safety of their children. While some schools implement extensive and costly measures to ensure student security, such technologies often remain inaccessible to less wealthy institutions. This paper proposes an efficient and reliable school bus tracking and safety solution in the form of an Android application paired with a website. The system includes location tracking, a simple yet foolproof authentication and notification mechanism, and anomaly detection techniques to raise alerts in case of unusual activity. This system allows parents to be aware of their child's location in both unexpected and regular circumstances. School authorities can also monitor the status of their buses via a website. Additionally, this paper introduces features like route optimization and traffic-based delay prediction to improve travel efficiency.

Index Terms: school bus tracking, student safety, Android application, location tracking, route optimization, delay prediction, anomaly detection, notification system.

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I.INTRODUCTION

In today's world, ensuring safety and security is a major concern and top priority. There have been numerous reports of mishaps involving children during travel. Child safety is always a primary concern for parents and school authorities, especially when children are away from their caregivers. Parents are always eager to ensure that all necessary precautions are being taken, such as monitoring their child's timely return from school. The presence of conductors and caretakers on buses helps ensure that children are safely boarding and leaving the bus. However, not all schools have enough personnel, and working parents often need live updates on their child's whereabouts. Another common problem faced by people in India is relying on ever-busy streets for daily

commutes. Traffic particularly affects heavy vehicles like buses, leading to delays. Schools using buses as a mode of transport need to know how early the buses should depart to pick up students. Delays can disrupt the entire school schedule.

Observations from a survey with local school authorities and parents of school-going children revealed a lack of such a system. There was a general agreement that such a system would be beneficial, particularly for those traveling long distances or through congested routes. A review of existing literature on the topic reveals numerous tracking technologies that monitor students' activities and bus routes, some with additional security measures. However, these often require complex hardware and are one-dimensional with potential loopholes.



Therefore, a solution is needed that can:

- Provide reliable information about a child's whereabouts from pick-up to drop-off.
- Be as automated as possible to reduce the workload of bus staff.
- Provide additional information such as estimated arrival times.
- Issue alerts in case of deviations from the norm.
- Be easy to use without requiring complicated or expensive hardware.

This paper proposes an Android-based solution using QR code scanning to authenticate each child and log their entry or exit from the bus. The solution uses this logged information, along with location and route data from Google APIs, to monitor the live status of the bus and the children. The system communicates via REST APIs with a Django backend server and dispatches notifications to parents. It also includes features to alert the conductor and school authorities in case of mistakes in boarding, leaving, or routing.

The application is reliable, easy to use, and inexpensive. To address traffic-induced delays, this study presents an additional feature to predict bus delays due to road anomalies, suggesting to school authorities the optimal departure times for school buses in the morning.

II. LITERATURE SURVEY

- G. Jemilda, R. Bala Krishnan, and B. Johnson propose an Android mobile phone application that provides information about buses, bus numbers, and bus routes both online and offline. The reason for choosing the Android platform is that Android allows for open-source development, which is probably the most feasible and user-friendly approach. This paper also deals with Location-Based Services, which are used to track the current location of the bus and give an estimated remaining time for the tracked bus to reach its destination using client-server technology.

Additionally, it displays the required maps with the help of GPS.

- Mayur Bhor, Nikhil Kadam, and Dinesh Shinde propose an embedded system focusing on children's safety, school bus tracking, and the exact location of school buses using GPS longitude and latitude positioning, with information sent via SMS. Despite strict measures taken for children's safety by authorities, crimes against children are increasing significantly. To restrict these crimes, enhancing security for children is crucial. Mishaps and missing children cause parents to worry, and school authorities may face heavy penalties for these incidents. School bus monitoring is an effective measure to prevent such mishaps. Each student possesses an RFID tag on their smart card for identification. Two IR sensors are used to check whether a student is arriving or leaving the bus. A speedometer checks the bus's speed. Hence, the proposed "LPC 2148" based embedded system provides a complete solution for children's safety and school bus tracking.
- Suresh Babu Potladurty proposes that schools are the second best place for children to receive education and ethical values after home. Providing safety for students during transportation to and from school is vital. This project helps parents and school administration manage and monitor factors such as the number of students on board, details of each student, pickup and drop-off times, location, and attendance. Parents can monitor the school bus's location and the student's pickup and drop-off times through an Android application. The project uses a GPS unit and a fingerprint sensor connected to the Node MCU over Wi-Fi through an Arduino Uno. The geographic coordinates of the school bus, provided by the SKG13 GPS, are updated in the database. The fingerprint scanner detects the student's identification when boarding the bus. The bus unit uses



Node MCU to push data into the school unit database, which can be managed and accessed only by admins. These steps ensure the child's safety during transportation.

- Shraddha Shah and Bharti Singh propose a solution to assist parents in tracking their children's location in real time due to the increase in kidnapping and road accident cases. This paper recommends an SMS-based solution using a GPS module for location tracking and an RFID card for child identification. When a child boards a bus, the RFID tag in their identity card is detected by the reader in the bus, and the system sends a text message to the parents with the current location and time. This allows parents to keep track of their children's whereabouts. The paper also proposes a security system, including drunk and drive prevention and speed control mechanisms.
- Tun Mohamad Aqil Mohamad Fadzir, Hasmah Mansor, and Zuriati Janin propose a solution to address parents' concerns about their children's safety during school bus transportation. This paper proposes an SMS-based solution to assist parents in tracking their children's movement in and out of the school bus. SMS notifications are sent to parents when their children board and disembark from the bus. The project aims to develop a school bus security system using RFID and GSM technologies. RFID identifies the student's identity and the parent's contact number, while GSM notifies parents of their children's movements via SMS. Tests conducted on the developed prototype show it can provide a real-time messaging system to parents about their children's whereabouts, with an additional student attendance checker feature. This developed prototype system aims to give parents peace of mind when entrusting their children to school bus transportation.

III. EXISTING SYSTEM

The existing system for school bus tracking often relies on expensive and extensive technologies, making it inaccessible for schools with budget constraints. Parents and guardians are understandably concerned about the safety of their children during school bus transportation. While some schools can afford advanced security measures, others lack access to such resources. This project aims to address this disparity by proposing an efficient and affordable school bus tracking cum safety solution. The system consists of an Android application paired with a website, incorporating location tracking, a QR-based authentication mechanism, and notification features. Additionally, anomaly detection techniques are employed to raise alerts in case of unusual activities, ensuring an extra layer of security. The proposed system not only keeps parents informed in both known and unforeseen circumstances but also allows school authorities to monitor bus status through a dedicated website. To enhance the overall travel experience, the system implements route optimization and traffic-based delay prediction as additional features. This comprehensive approach seeks to make school bus tracking and safety measures accessible to a broader range of educational institutions, promoting the well-being of students without imposing a financial burden.

IV. PROPOSED SYSTEM

A. Architecture Model and Flow Description

The core of this research is to implement an intelligent system for tracking school buses. It should ease the work of the school authorities by making the system automated. The overall flow is explained.

A mobile application is used for giving parents/guardians a real-time update on the status of their children. This application is implemented in Android. The application facilitates the tracking the live location of the bus, taking the attendance of the children entering and leaving the bus, sending alerts to

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authorities and parents in case of emergencies and giving an estimated time of arrival. Real-time location is tracked using Google Maps API on smartphones.

For the bus conductor and/or staff, the application is used to take the attendance of the children present on the bus with the help of QR code. This information is dispatched to the school server. Similarly, the drop status is also recorded using the code scan. The bus conductors have an emergency button on the application, which can be used during extreme emergencies to alert the authorities via the web portal and the parents via the mobile application.

A web application is maintained for the school authorities to view the status of the bus and maintain the database of the students, parents and bus drivers information. MySQL database is maintained to store this information. The updates are sent from the conductor's phone to the Django server via REST APIs and stored in the database. By the web portal, school bus authorities can simply keep a check on the status of the bus and be alert in case of emergencies. The forecast for bus delays due to traffic is viewed on the website by the authorities to schedule the departure of buses to avoid tardiness.

The mobile application can be accessed as a parent or a bus conductor as shown in Figure. 1. The credentials are exclusively provided to them by the school. A parent can log in as a parent to check his child/children's status when boarding or departing the bus. A profile will be maintained for the user to edit any information of the children which will be reflected in the database. The live location is available is visible to parents at all times and estimated time is shown on the application based on traffic congestion, etc. These details are also fetched via REST APIs from the Django server after they have been transmitted to the server from the conductor's phone.

The technical requirements that should be considered while using the system are:

- Smartphone must allow access to GPS sensors and Camera
- Data collection from QR Code should happen in real-time
- Alerts to conductors, school authorities and guardians require internet connectivity

V.SYSTEM ARCHITECTURE

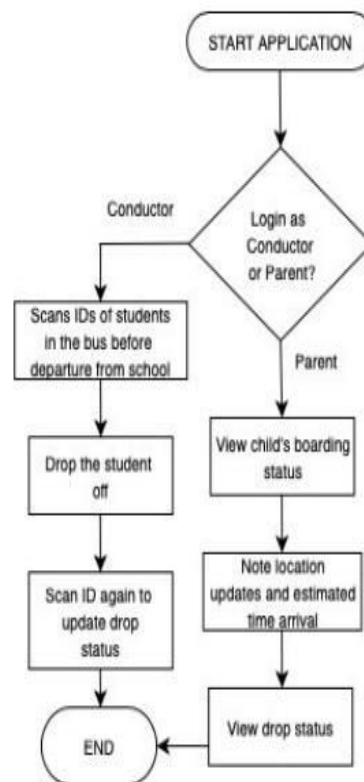


Figure 1. System Architecture

VI.IMPLEMANATION MODULES

Authentication Module: The Authentication module is responsible for implementing the QR code scanning mechanism to verify the identity of students and school staff boarding the buses. This module ensures a secure and fool-proof authentication process, reducing the risk of unauthorized access and enhancing overall safety.

Location Tracking Module: The Location Tracking module utilizes GPS technology to continuously monitor and track the real-time location of school buses. This information is crucial for parents, school authorities, and the system



itself to ensure that buses are on the correct route, provide accurate arrival times, and enhance the overall visibility of the bus fleet.

Anomaly Detection Module: The Anomaly Detection module employs advanced techniques to identify unusual activities or emergencies during bus journeys. This module plays a crucial role in raising alerts in real-time, allowing for prompt responses to potential safety concerns. By monitoring deviations from normal patterns, the system enhances overall security measures.

User Interface Module (Android Application and Website): The User Interface module provides an intuitive and user-friendly interface for both parents and school authorities. It includes an Android application for parents to track their child's bus and receive notifications, as well as a website for school staff to monitor the overall status of the buses. This module ensures accessibility and ease of use for all stakeholders.

Optimization and Prediction Module: The Optimization and Prediction module focuses on enhancing the efficiency of the school bus transportation system. It includes features such as route optimization to minimize travel time and fuel consumption, and traffic-based delay prediction to anticipate and address potential delays. This module contributes to cost savings and ensures a more reliable and punctual transportation service.

VII.RESULTS



Figure 2; Main screen



Figure 3

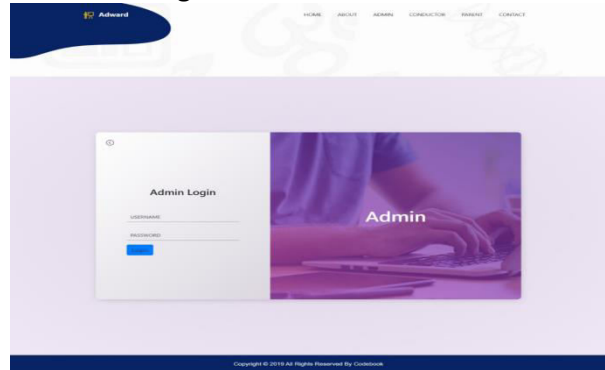


Figure 4

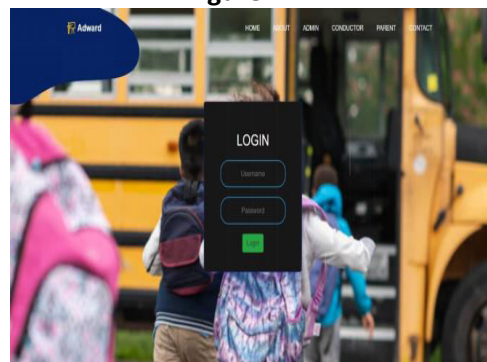


Figure 5

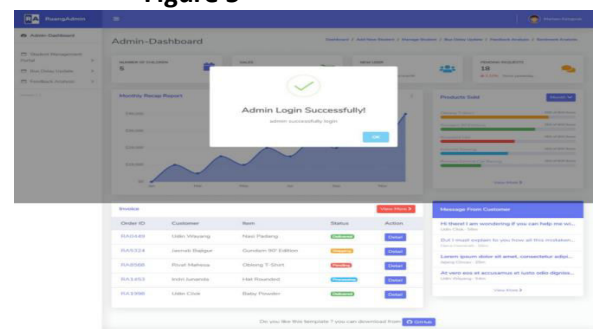


Figure 6



Child Profile	Child ID Number	Children Name	Class	M Name	F Name	Email	Contact	Address
	1001	nija	1st class	radhika	ryan	ryan@gmail.com	9949220084	hyd
	1002	radhika	8th class	radhika	rakhi	rakhi@gmail.com	9949220084	hyd
	1001	max	3rd class	mar	mar	mar@gmail.com	9949220084	hyd
	1004	niv	4th class	navud	navud	navud@gmail.com	9949220084	hyd
	1005	soma	8th class	soma	soma	soma@gmail.com	9949220084	hyd

Figure 7



Figure 8



Figure 9

Child Rollnum	Child Name	Child Class	Child Contact	Child E-mail	Child Address	Boarding Status	From	To
1001	nija	1st class	9949220084	ryan@gmail.com	hyd	Boarded	School	Home
1002	radhika	8th class	9949220084	rakhi@gmail.com	hyd	Boarded	School	Home
1001	max	3rd class	9949220084	mar@gmail.com	hyd	Boarded	Home	School
1004	niv	4th class	9949220084	navud@gmail.com	hyd	Boarded	School	Home

Figure 10

Child Rollnum	Child Name	Child Class	Child Contact	Child E-mail	Child Address	Boarding Status	From	To
1001	nija	1st class	9949220084	ryan@gmail.com	hyd	Dropped	Home	School

Figure 11

Figure 12

Figure 13

Child Rollnum	Child Name	Child Class	Child Contact	Child E-mail	Child Address	Boarding Status	From	To
1002	radhika	8th class	9949220084	rakhi@gmail.com	hyd	Boarded	School	Home

Figure 14





Figure 15

VIII.CONCLUSION

The proposed solution aims to design a children's safety system that tracks school buses and provides relevant information to parents via a mobile application and authorities via a web portal. Student attendance is recorded using QR scanning, and the data is collected and viewed by school authorities. Guardians receive alerts about their children's status on the bus based on attendance information. Additional features include route optimization, providing conductors with the fastest and most secure paths. The system also implements delay prediction using different classification models, with a comparison showing that Random Forest achieved the best performance with an error rate of 11.6%. Moreover, the system provides detailed information to guardians about anomalies, as well as the arrival and departure times of children. Overall, the system is user-friendly for both bus staff and parents, with added security features that enhance its effectiveness compared to previous systems. It facilitates efficient interaction between schools and guardians, thereby ensuring greater security and peace of mind.

IX.FUTURE ENHANCEMENTS

The future enhancements of the proposed solution include integration with other transportation systems, advanced security features like real-time video surveillance and facial recognition, and improved AI for better delay predictions and route optimization. Additionally, expanding communication channels and ensuring scalability and multi-language support will enhance functionality and user experience. Finally, integrating with school

management systems and adding features to parent and student apps will streamline operations and improve overall user satisfaction.

X.REFERENCES

- [1]G. Jemilda, R. Balakrishnan, B. Johnson, G. Linga Sangeeth "Mobile Application for College Bus Tracking" March 2015 .
- [2] Snehal P. Umratkar, Prof. Ram Kumar SecureChild - Children Tracking Android Application March 2015
- [3] Bhor, Mayur & Shinde, Dinesh & Mane, Pranoti. (2017). Children Safety and School Bus Tracking Solution. International Journal of Electrical, Electronics and Computer Systems (IJECS). 5. 19-22.
- [4] Amit Bhojar, Jagdish Pimple "GPS based real time vehicle tracking system for kids safety using RFID and GSM" 2018
- [5] Shah, Shraddha & Singh, Bharti. (2016). RFID based school bus tracking and security system. 1481-1485. 10.1109/ICCSP.2016.7754404.
- [6] Lim, T.S. & Sim, S.C. & Mansor, M.M.. (2009). RFID based attendance system. 778 - 782. 10.1109/ISIEA.2009.5356360.
- [7] Fadzir, Tun & Mansor, Hasmah & Gunawan, Teddy & Janin, Zuriati. (2018). Development of School Bus Security System Based on RFID and GSM Technonologies for Klang Valley Area. 1-5. 10.1109/IC SIMA.2018.8688783.
- [8]S.Dukare, Sumit & Patil, Dattatray & Rane, Kantilal. (2015). Vehicle Tracking, Monitoring and Alerting System: A Review. International Journal of Computer Applications. 119. 39-44. 10.5120/21107-3835.
- [9]Ruturaj Shelake, Reshma Chavan, Raju Rai, Prof.Mangesh Manake "Intelligent Transport System for Real Time School Bus Tracking For Safety and Security of Child Using GPS" April 2018
- [10]S.Sangeetha, S.Krishnapriya, Ms. S Janani "SCHOOL BUS TRACKING AND SECURITY SYSTEM" March 2018
- [11]M. R. Desai, Mr.Prajwal Kumar Takkalaki, Mr.Manjunath Bhapri, Mr.Amalkiran Marshanalli, Mr.Gourish Malage "STUDENTS



TRACKING SYSTEM FOR SCHOOL BUS" June 2017

[12]Eken, Sleyman & Sayar, Ahmet. (2014). A Smart Bus Tracking System Based on Location-Aware Services and QR Codes. INISTA 2014 - IEEE International Symposium on Innovations in Intelligent Systems and Applications, Proceedings. 10.1109/INISTA.2014.6873634.

[13]P.Ambedkar, P.Suresh Babu "Smart School Bus for Children Transportation Safety Enhancement with IOT" July 2017

[14]Supriya Sinha, Pooja Sahu, Monika Zade, Roshni Jambhulkar, Prof. Shrikant V. Sonekar "Real Time College Bus Tracking Application for Android Smartphone" Feb 2017

[15]R C, Jisha & Mathews, Mathews & Kini, Sidharth & Kumar, Vineeth & Harisankar, U & Shilpa, M. (2018). An Android Application for School Bus Tracking and Student Monitoring System. 1-4. 10.1109/ICCIC.2018.8782320.

[16]Abhilash R, Mahima R, Monisha S, Nagashri R "Smart Tracking System for School Buses" April 2017

[17]I. Korkmaz, A. Camci, C. Cengiz, D. Dirik, E. Cekci and F. M. Akbaba, "A Smart School Bus Tracking System," 2019 International Symposium on Networks, Computers and Communications (ISNCC), Istanbul, Turkey, 2019, pp. 1-6, doi: 10.1109/ISNCC.2019.8909188.

