

Real-Time Bus Tracking and Attendance Monitoring System with ML

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ABSTRACT

This study introduces an intelligent system aimed at improving the safety of school transportation and simplifying attendance tracking through the use of QR codes and Machine Learning techniques. Each student is provided with a unique QR code printed on their identification card, which is scanned when entering and leaving the school bus. This process enables automatic recording of attendance without manual intervention.

The system immediately informs parents about their child's boarding notifications. It also prepares periodic attendance summaries that help school administrators analyze student travel patterns. In addition, GPS-based tracking allows real-time monitoring of bus location, while a Machine Learning model is used to estimate arrival times more accurately.

Key Words: QRcode, Attendance, Monitoring, Notification, Tracking, Automation, Bus arrival time prediction.

1. INTRODUCTION

Student safety and efficient transportation management are critical concerns for schools and parents. Traditional attendance methods such as roll calls are time-consuming and prone to errors. To overcome these limitations, this paper proposes a Smart School Bus Attendance and Monitoring System using QR Code. Each student is assigned a unique QR code which is scanned while boarding and exiting the bus. The system records attendance automatically along with time details. Parents receive real-time email notifications regarding their child's status. Additionally, the system generates attendance reports and ensures transparency. The proposed system improves safety, reduces manual effort, and enhances communication between parents and school authorities.

2. LITERATURE REVIEW

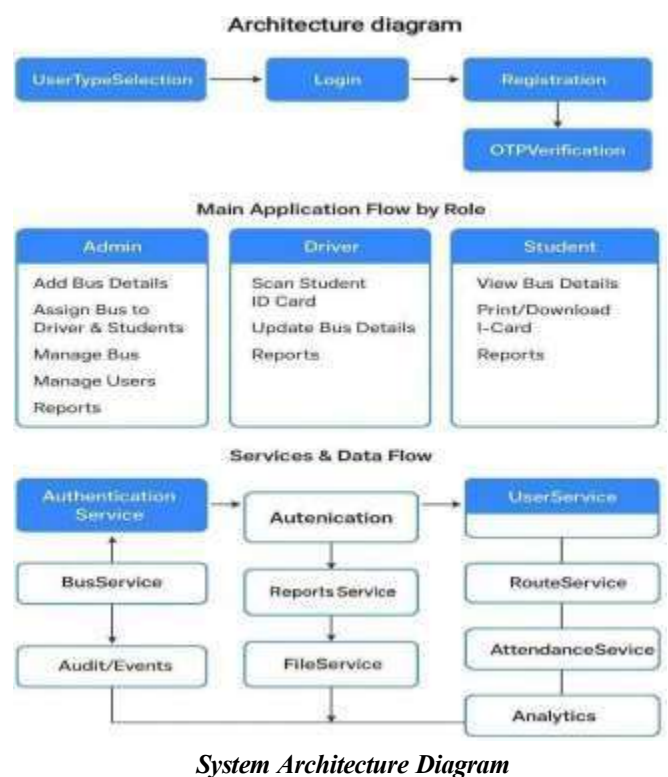
2.1 Existing Systems

Existing systems use GPS and mobile applications for tracking and attendance monitoring. These systems improve tracking accuracy but often lack integration and simplicity.

2.2 Research Gap

Most existing solutions focus only on tracking or attendance separately. There is a lack of systems providing a unified platform for both tracking and automated attendance with real-time communication.

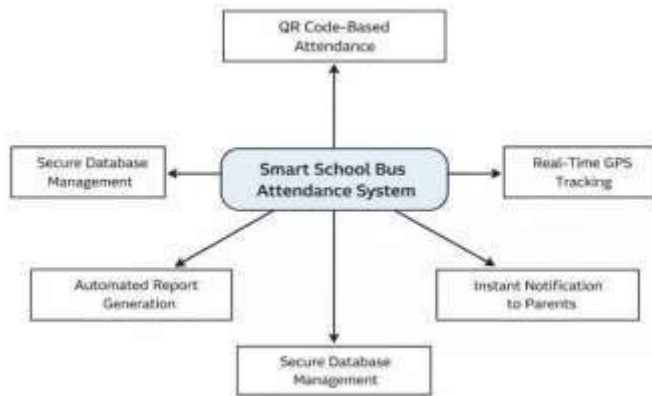
3. PROPOSED SYSTEM ARCHITECTURE



3.1 System Components

1. **QR Scanner:** Captures student data
2. **Backend Server:** Processes data.
3. **Database:** Stores attendance records
4. **Notification System:** Sends alerts to parents.
5. **Machine Learning Module:** real-time prediction output

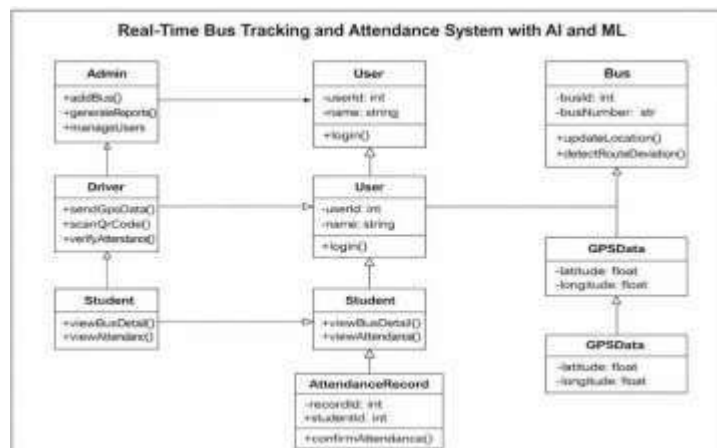
3.2 System Features



System Feature Diagram

1. Real-time attendance tracking
2. Email notification alerts
3. Automated report generation

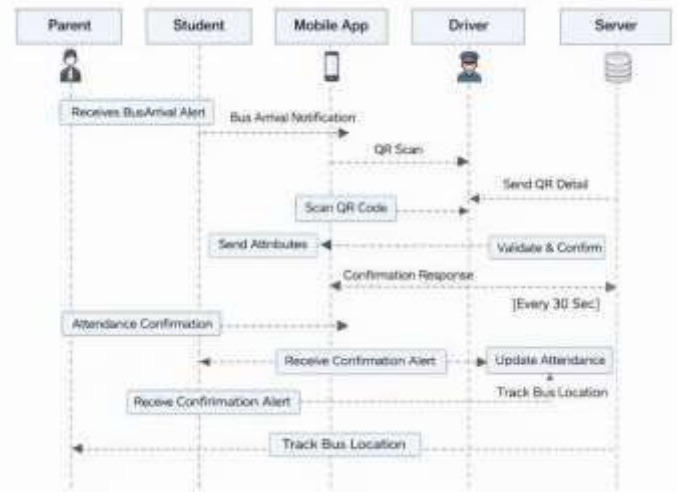
4. METHODOLOGY



UML Class Diagram

1. **Data Collection:** Student QR codes are scanned.
2. **Processing:** Data is stored in the database.
3. **Notification:** Alerts sent to parents.
4. **Reporting:** Weekly reports generated.
5. **Prediction:** Random Forest Regression is used as the prediction component to estimate bus arrival time based on input features like day of the week, stop order and base travel time.

Sequence Diagram for Student QR Code Attendance System



UML Sequence

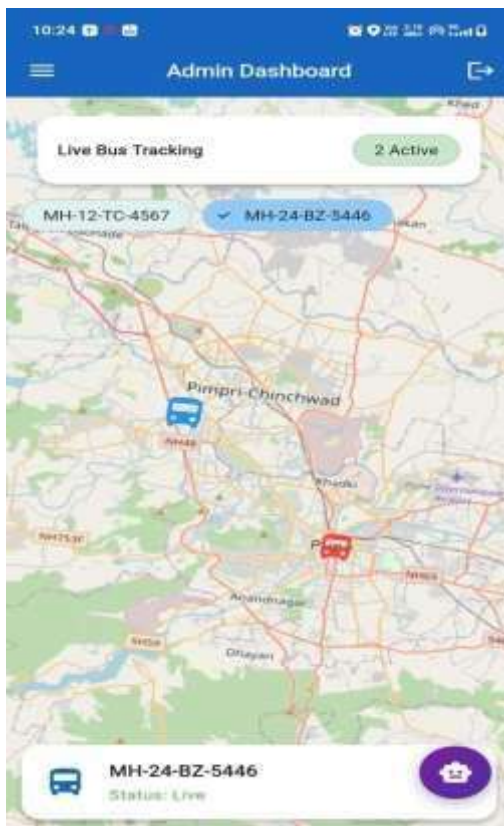
5. TECHNOLOGY STACK

Layer	Technology / Tool
Frontend	Flutter
Backend	Python
Database	SQLite

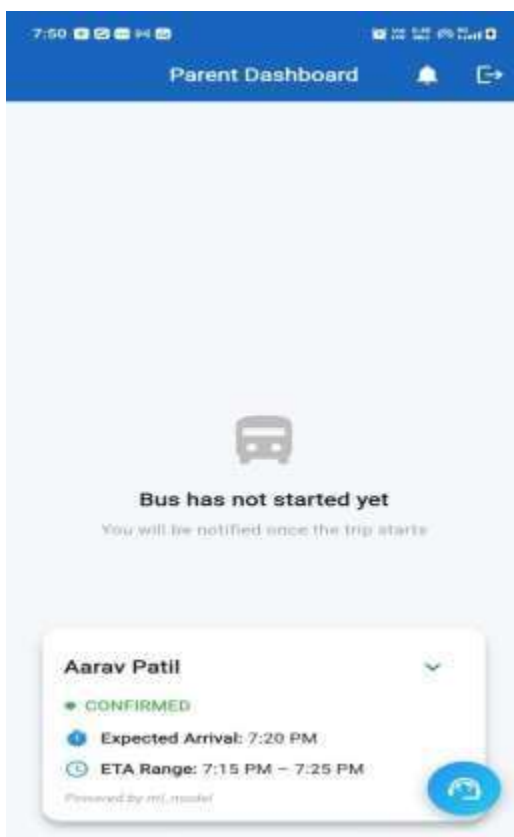
6. OUTCOMES

Key Features:

- Login for multiple users (Admin, Driver, Parent)
- Live bus tracking using GPS
- Driver management system
- Child tracking & attendance monitoring
- Real-time status updates
- Bus arrival time prediction



1. Live Bus Tracking



2. Bus arrival time prediction

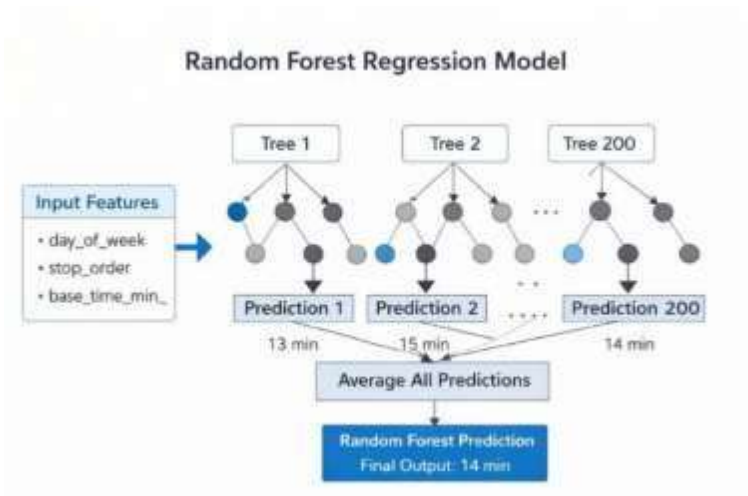
School Bus Attendance Report

Generated on: 2026-03-30 16:03:36.732790

Student	Class	Std	Bus	Status	Date & Time
Aarav Patil	5A	5	MH-12-SN-1922	DROPPED	22/1/2026 05:44
Aarav Patil	5A	5	MH-12-SN-1922	PICKED	20/1/2026 09:35

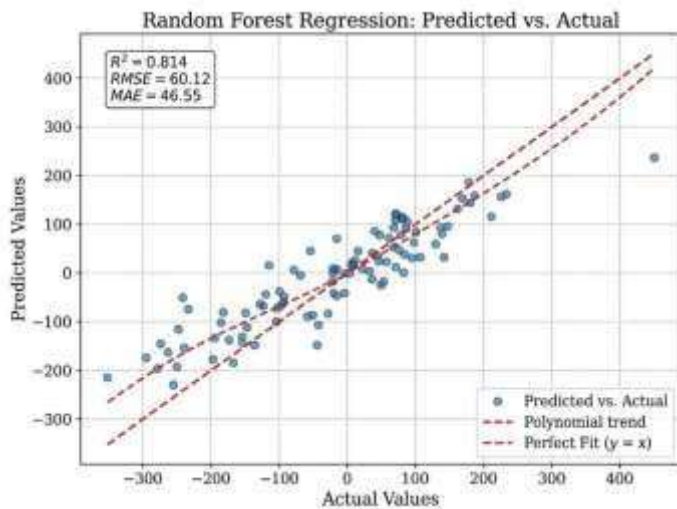
3. Downloadable Report

School Bus Attendance Report highlights several constraints inherent in the system's design. Each entry is bound by fixed fields such as Student, Class, Std, Bus, Status, and Date & Time, which ensure uniformity but also limit flexibility. For instance, the Status column only allows discrete values like PICKED or DROPPED, constraining how attendance events are recorded.



Random Forest Regression Model for predicting bus travel time. Input features such as day_of_week, stop_order, and base_time_min are processed by multiple decision trees, each generating its own prediction.

These outputs are then averaged to produce a single, more reliable estimate. ensemble learning reduces variance and improves accuracy compared to relying on a single decision tree.



“Random Forest Regression: Predicted vs. Actual” provides a visual evaluation of the model’s performance. Each blue dot represents a comparison between predicted and actual values, showing how closely the regression model aligns with observed outcomes. The red dashed line labeled Perfect Fit ($y = x$) indicates the ideal scenario where predictions exactly match actual values, while the polynomial trend line illustrates the overall distribution pattern of the data points.

7. CONCLUSION

The proposed Real-Time College Bus Tracking and Student Attendance System provides an efficient approach to improving transportation management in educational institutions. It simplifies the process of monitoring student movement by automatically recording boarding and drop-off details, eliminating the need for manual attendance methods.

The system enhances safety by enabling continuous tracking of the bus and ensuring that accurate information is available to both parents and administrators. By integrating multiple functionalities into a single platform, it increases transparency and reduces operational complexity.

In summary, this solution offers a practical and modern alternative to traditional systems, supporting better management and improved student security. Future improvements can focus on incorporating advanced identification techniques such as facial recognition, applying data-driven methods for route planning, and ensuring consistent performance in areas with limited network connectivity.

Future Enhancements

1. Integration of facial recognition for enhanced security and authentication
2. Implementation of AI-based analytics to predict attendance trends and anomalies

3. Development of an admin web dashboard for advanced monitoring and control
4. Integration with school ERP systems for centralized data management
5. Addition of emergency alert features (panic button) for students and drivers.

7. ACKNOWLEDGMENT

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8. REFERNCES

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