Software Engineering FYP-24-SE-A-04 Proposal: NTU Real-Time Bus ID Verification and Tracking for Enhanced Transport Efficiency and Student Safety

Problem Statement:

The current university bus system is causing significant inefficiencies and security concerns. Students are boarding buses without proper verification, leading to overcrowding, unauthorized access, and unfair usage by those who have not paid transportation fees. There is no real-time system to verify student ID cards, track bus locations, or monitor driver performance.

Additionally, the lack of a mechanism to **effectively communicate transport-related updates** or announcements to students and parents is further complicating the system's operation. This results in confusion, delays, and poor management of bus capacity, as well as safety concerns due to miscommunication. Without a proper communication channel, transport department updates, such as route changes, delays, or emergency notifications, are not reaching the people who need them in real-time.

Key Issues:

1. **No Automated ID Verification:** Manual checks are inefficient and allow unauthorized students to board.
2. **No Live Bus Tracking:** There is no real-time visibility into the location of buses for admins, parents, or students.
3. **Overcrowding/Underutilized:** Buses are frequently overcrowded or underutilized, leading to inefficiency and discomfort.
4. **Driver Performance:** There is no tracking of driver speed, stop intervals, or overall journey times, leading to inefficiencies in scheduling and route optimization.
5. **No Effective Transport Communication:** The system lacks a mechanism to relay important transport-related announcements to students and parents in real-time.
6. **Poor Communication with Parents and Students:** There is no way for parents or students to receive timely notifications about bus schedules, delays, or changes, affecting their ability to plan efficiently.

Solution:

We propose an automated **Bus ID Card Scanner System** that uses **QR code technology** to verify student identity in real time, ensuring that only authorized students can board the bus. The system will provide **live GPS tracking** for buses, monitor **bus occupancy**, track **driver performance**, and enable the transport department to **effectively communicate announcements** and updates to students and parents via a mobile app.

This system will allow university administrators to **optimize bus routes**, manage bus capacity based on real-time data, and **monitor driver efficiency** to improve overall transportation operations. Students and parents will have **access to real-time bus locations**, receive important notifications, and stay informed about any changes or delays in the transportation system.

Key Features:

1. **Real-Time ID Verification:**
   The system shall use QR code scanning to instantly verify student IDs, ensuring that only authorized and fare-paying students can board. Unauthorized or fake cards will be flagged immediately, preventing misuse.
2. **Live GPS Tracking:**
   The system shall provide real-time bus location tracking, which will be accessible by admins, parents, and students. This will enable better route management, safety monitoring, and transparency for users.
3. **Overcrowding and Underutilization Alerts:**
   The system shall monitor the number of students boarding each bus, generating alerts for administrators and drivers when buses are either overcrowded or underutilized. This will enable better resource management and route adjustments.
4. **Driver Efficiency Monitoring:**
   The system shall track driver speed, stop intervals, and overall journey times, comparing them with the scheduled routes to ensure drivers are adhering to timetables and speed limits. This data will help optimize bus schedules and improve route efficiency.
5. **Parental and Student App:**
   The mobile app shall provide real-time bus tracking, route details, and important transport updates. Parents will be able to track the location of their child's bus, download fee slips, and receive notifications about delays or changes. The app will also allow students to provide feedback on driver performance.
6. **Real-Time Transport Announcements:**
   The system shall enable the transportation department to instantly communicate important updates, such as route changes, delays, cancellations, or emergency notifications. These announcements will be pushed to both students and parents, ensuring everyone stays informed.

Technologies:

- **Firebase:** For real-time data synchronization, user authentication, cloud storage, and notifications.
- **React.js and Next.js:** To build a dynamic and scalable admin panel for managing routes, bus occupancy, and driver efficiency.

- **Flutter:** For mobile app development, ensuring compatibility across Android platforms.
- **GPS and Camera:** Real-time GPS tracking for buses and QR code scanning for student ID verification.
- **Google Maps and Map box:** To provide accurate live mapping and route tracking for bus locations.

Expected Outcome:

By the end of this project, the university will have a fully functional **Bus ID Card Scanner System** that addresses all the existing gaps in transportation management. This system will improve security by preventing unauthorized students from boarding, reduce overcrowding through real-time monitoring, and optimize driver performance by tracking their journey efficiency. Additionally, it will provide a much-needed communication platform for transport announcements and notifications, ensuring that parents and students are always informed of important updates.

Conclusion:

The proposed system will revolutionize the university's transportation management by introducing **real-time verification**, **live tracking**, and **effective communication** between the transport department, students, and parents. By automating ID verification and providing transparent tracking and alerts, the system will enhance safety, fairness, and overall operational efficiency.

This comprehensive solution will reduce overcrowding, improve bus capacity management, and ensure that transportation resources are used efficiently, ultimately making the university's bus system more secure and responsive to the needs of both administrators and users.