Software Engineering FYP-24-SE-A-04 Proposal: Bus ID Card Scanner for Improved Student Management and Security

Problem Statement:

Many universities, including ours, use bus cards for student transportation management. However, the current system for verifying and managing these bus cards is inefficient and prone to misuse. Students can board buses without proper verification, and there is no effective mechanism to detect fake or unauthorized cards. This creates security risks and hinders proper attendance tracking, leaving gaps in the university's ability to monitor the system efficiently.

Moreover, not all students at the university pay the semester transportation fare, causing an unjust situation for those who do. This leads to overcrowding and misuse of the bus system by students who have not contributed to the transportation fund. As a result, the transportation department experiences inefficiencies and financial strain.

A major security concern is that, while the university enforces strict monitoring at its entrances, requiring every individual to show a student card or ID card to enter, the buses remain an unchecked entry point. Buses pick up students without proper verification and enter the university without further checks, posing a potential security threat. This gap in security undermines the university's efforts to ensure only authorized individuals access the campus.

Key Observations and Gaps:

1. **Manual ID Checking**:

   o **Current Process**: The university bus system relies on drivers or staff manually checking student IDs as they board the bus. This process is slow and often leads to errors.

   o **Gap**: There is no automated system in place to detect fake cards or verify student identity in real-time, allowing unauthorized students to misuse the system.

2. **Lack of Real-Time Data**:

   o **Current Process**: There is no centralized database to track student boarding in real time, making it difficult for the university to know how many students are on the bus or whether certain students missed the bus.

   o **Gap**: The absence of real-time data leads to poor route optimization and limited capacity management, which affects the overall efficiency of the bus system.

3. **No Automatic Attendance Tracking**:

   o **Current Process**: Bus drivers are not equipped with tools to automatically track which students boarded or exited at specific stops.

o **Gap**: Without automatic attendance tracking, the university cannot accurately monitor bus ridership or ensure student safety, particularly for long routes.

4. **Unfair Use of Transportation**:

o **Current Process**: Many students who have not paid the semester transportation fare are still able to board the buses, creating an unjust situation for those who have paid.

o **Gap**: There is no system in place to ensure that only fare-paying students are using the transportation service, leading to overcrowded buses and increased operational costs.

The Challenge We Aim to Address:

We propose developing an automated **Bus ID Card Scanner System** that addresses the shortcomings of the current bus management system by introducing real-time student verification, automated attendance tracking, and real-time data reporting for university administrators. The system will also ensure that only students who have paid the semester transportation fare can use the service, reducing overcrowding and misuse.

In addition, by analysing real-time route data, the transportation department will be able to reduce fuel consumption and optimize routes based on student density. This will allow for better resource management and open opportunities for future optimizations, such as predicting student demand and reallocating buses accordingly.

Proposed Solution:

We propose developing a **Bus ID Card Scanner System** that will use NFC, QR, or RFID technology to scan student bus cards when they board or exit the bus. The system will instantly verify the authenticity of the card, track attendance in real time, and ensure that only students who have paid the transportation fare can use the service. A mobile app will allow students to manage their bus cards, while an admin panel will offer university staff full control over the system, including route and capacity management based on real-time data.

Key Features:

1. **Card Validation:**

o The system shall validate bus ID cards by scanning to determine their authenticity (real or fake), ensuring that only authorized students who have paid the transportation fees are allowed to board.

2. **Bus Driver/Conductor Application:**

- o The application shall perform real-time card validation, promptly scanning the student's card, querying the server, and notifying the driver or conductor of the card's validity (authorized or unauthorized).

- o The application shall display the total number of students on board, along with a list of names of students who have boarded the bus.

- o The system shall track the number of students boarding each bus in real time and display the total to the bus driver.

- o The system shall prevent multiple drivers from logging into the same bus application simultaneously. Once a driver is logged into the bus app, no other drivers shall be able to log in for that bus until the current session is terminated.

3. **Admin Panel Features:**

- o The admin panel shall allow the entry of initial data through forms, including bus routes and a list of students who have paid the transportation fees.

- o The system shall enable admins to track the real-time location of all buses via the admin panel.

- o The admin panel shall provide real-time analytics on the duration of bus journeys.

- o The system shall send notifications to admins for bus departures and arrivals.

- o The admin panel shall offer analytics detailing the time taken between each bus stop on a route.

- o Any deviations from the assigned bus route shall trigger a real-time notification to the admin.

- o The system shall send real-time reports to the admin, highlighting buses that are overcrowded or under-populated.

4. **Parental Application:**

- o The parental application shall allow parents to view the live location and bus number of the vehicle their child has boarded.

- o The parental application shall include user authentication and password reset functionality to ensure secure access.

- o The parental application shall display the estimated time of arrival (ETA) for parents tracking the bus their child has boarded

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Technologies to Be Used:

1. **Firebase**:

   o **Backend Services**: Firebase will be used for real-time data management, user authentication, cloud-based storage, and hosting. It will ensure seamless syncing of boarding records, bus schedules, and real-time data.

2. **React.js and Next.js**:

   o **Admin Panel and Web Interface**: React.js will be used to develop the dynamic user interface for the admin panel, while Next.js will enable server-side rendering for better performance and scalability. This combination will create an efficient and responsive platform for managing student cards, routes, and system reports.

3. **Flutter**:

   o **Mobile App Development**: Flutter will be used to create a cross-platform mobile app for students, bus drivers, and administrators. The app will allow students to check bus schedules, track buses in real-time, and manage their bus ID cards.

4. **Android Mobile Devices**:

   o **Cost-Effective Approach**: Bus drivers will use their own Android mobile phones, or the university will provide them with affordable Android sets. These devices come equipped with all necessary components, including GPS, internet connectivity, and camera, reducing the need for additional hardware.

5. **GPS and Internet Connectivity**:

   o **Real-Time Bus Tracking and Data Sync**: The Android phone's built-in GPS will provide real-time location tracking for buses, while the internet connectivity will ensure data syncs to Firebase in real-time, including ID scans, student attendance, and bus location updates.

6. **Camera (for ID Scanning)**:

   o **ID Card Authentication**: The mobile app will use the Android phone's camera to scan student ID cards (QR, NFC, or barcode) and query the database to validate and authenticate the cards. The system will notify the driver if the ID is valid or fake immediately.

Expected Outcome:

By the end of this project, we will have developed a fully functional **Bus ID Card Scanner System** that addresses the key gaps in the current system, including fake card detection, real-time student tracking, and automated attendance monitoring. The mobile app will enhance the

student experience, and the admin panel will provide university staff with the tools they need to efficiently manage transportation.

Furthermore, the system will help reduce fuel consumption by ensuring that only those who truly need transportation are paying for and using it. The transportation department will also gain valuable insights into route optimization and student density, leading to more efficient resource management. Additionally, the security threat posed by unchecked bus entries will be neutralized, ensuring that only verified individuals can enter the university through buses, further strengthening campus security.

Conclusion:

This project will revolutionize the university's transportation system by automating card verification, enhancing security, and providing real-time data to both students and administrators. By ensuring that only students who have paid for transportation can use the service, we can reduce misuse and improve the overall efficiency of the system.

Additionally, the project opens doors to further optimizations, such as route analysis, student density tracking, and reduced fuel consumption, making it a valuable asset for the future of university transportation management. Importantly, the system will also neutralize the security threat posed by unchecked bus entries, reinforcing the university's security measures and ensuring that only authorized students are granted access to the campus through buses.