FYP Topic Submission Form

1- Group Information

Project/Group ID	24-FYP-204

2- Main Topic Details

A- Basic Information

Title	*NTU Real-Time Bus ID Verification and Tracking for Enhanced Transport Efficiency and Student Safety*
Type of Project	*Research and Development*
Category of Project	*Web Based/ Mobile App*
Industry Project	*Name: Mr. Shakeel Anwar* *Position: Transport Officer* *Organization: National Textile University Faisalabad* *Contact Number: +92 300 7608464*
Problem Statement	*The current NTU bus system suffers from inefficiencies and financial issues, allowing students to board without proper verification, leading to overcrowding and unauthorized access. There is no real-time mechanism for verifying student IDs, tracking bus locations, or monitoring driver performance. Additionally, the lack of effective communication channels prevents timely transport-related announcements, resulting in confusion, delays, and poor management of bus capacity.*
Objectives	*To implement a real-time ID verification system to significantly reduce unauthorized boarding's and ensure only fare-paying students access the buses.* *To improve bus utilization rates by leveraging live tracking and occupancy monitoring for effective resource management and generating alerts for overcrowding or underutilization.* *To enhance communication efficiency by providing timely transport-related announcements to students and parents via a dedicated mobile*

	app, while offering a transparent platform to track bus locations and receive real-time updates on delays or changes.
Introduction and background of the problem	*The significance of the NTU bus system stems from current inefficiencies and security concerns, where unauthorized students can board, leading to overcrowding and unfair usage. This lack of real-time ID verification and bus tracking compromises safety and operational efficiency. Previous efforts to address these issues have been limited, with manual checks proving inadequate. The proposed automated Bus ID Card Scanner System aims to leverage QR code technology for immediate ID verification, along with GPS tracking to enhance resource management and communication. This innovation will ultimately improve transportation safety, streamline operations, and provide real-time updates to students and parents.*
Proposed Solution	*The proposed solution to enhance the NTU bus system involves developing an integrated platform that leverages real-time technologies to address key inefficiencies and improve overall transportation management.* *Methodology:* *Real-Time ID Verification: Utilize QR code scanning to instantly verify student IDs at boarding points. This ensures that only authorized and fare-paying students can access the buses, with immediate flagging of unauthorized or fake cards to prevent misuse.* *Live GPS Tracking: Implement a real-time bus location tracking system that is accessible to admins, parents, and students. This feature will facilitate better route management, enhance safety monitoring, and provide transparency regarding bus locations and schedules.* *Overcrowding and Underutilization Alerts: Monitor the number of students boarding each bus, generating alerts for administrators and drivers when buses are overcrowded or underutilized. This will enable proactive resource management and facilitate necessary route adjustments.*

	Driver Efficiency Monitoring: Track driver speed, stop intervals, and overall journey times, comparing this data against scheduled routes. This will ensure compliance with timetables and speed limits, optimizing bus schedules and improving overall route efficiency. *Parental and Student App: Develop a dedicated mobile app that provides real-time bus tracking, route details, and important transport updates. Parents will be able to track their child's bus, download fee slips, and receive notifications about delays or changes, while students can provide feedback on driver performance.* *Real-Time Transport Announcements: Enable the transportation department to communicate important updates instantly, such as route changes, delays, and emergency notifications. This will ensure that timely information reaches students and parents, enhancing overall communication within the transportation system.*
Proposed Tools and 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 to effectively manage route details, student details, bus schedules, and important announcements.* *Flutter: For driver interface for scanning student IDs and streaming GPS locations, along with a parental app for tracking bus status and receiving updates.* *GPS and Camera: For real-time GPS tracking of 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.* *GitHub: For code version management, backup, and collaboration to ensure the project's integrity and history.*

B- Detail of FYP Idea

Related Technologies / Literature Review

Two existing technologies are particularly relevant to enhancing the NTU bus management system:

QR Code Technology:
Overview: QR codes are two-dimensional barcodes scanned by smartphones or dedicated readers, commonly used in ticketing, payments, and identity verification.

Relevance: In the bus management system, QR codes will enable real-time ID verification for students, confirming their authorization to board and reducing unauthorized access. Research indicates that QR codes can streamline boarding processes and enhance operational efficiency.

GPS Tracking Systems:
Overview: GPS technology provides real-time vehicle tracking using satellite signals, widely applied in logistics, fleet management, and public transport.

Relevance: Integrating GPS tracking in the bus system will offer real-time visibility of bus locations, improving route management and safety while keeping parents and students informed about arrivals and departures. Studies show that GPS significantly enhances resource allocation and operational efficiency in public transportation.

Literature Review
Research indicates that real-time tracking systems in public transport increase ridership and user satisfaction by providing accurate arrival times. Additionally, automated ID verification, particularly using QR codes, effectively reduces fraud and ensures only authorized users access services, enhancing safety and efficiency.

Proposed Methodology

Agile Software Development
Iterative Development:
The project will be developed in iterative cycles (sprints), allowing for continuous feedback and improvements. Each sprint will focus on specific features, such as QR code scanning, GPS tracking, and the mobile app interface.

User-Centered Design:
Engaging with end-users (students, parents, and transport department staff) throughout the development process will ensure that the system meets their needs. Regular feedback sessions will be conducted to gather insights and make necessary adjustments.

Continuous Integration and Testing:

The development process will include automated testing to ensure that each feature works as intended and integrates smoothly with the overall system. Continuous integration practices will be adopted to facilitate seamless updates and deployments.

Documentation:
Comprehensive documentation will be maintained throughout the development process, including system requirements, design specifications, and user manuals. This will support both development and future maintenance efforts.

Research Methodology

Literature Review:
A thorough literature review will be conducted to identify existing technologies and methodologies related to bus management systems, QR code technology, and GPS tracking. This will inform the design and functionality of the proposed system.

Technology Evaluation:
An evaluation of different technologies (e.g., various QR code libraries, GPS service providers) will be performed to select the most suitable tools for implementation. This evaluation will include cost analysis, performance metrics, and compatibility with existing infrastructure.

Prototype Development:
Prototyping will be utilized to develop initial versions of key components (e.g., mobile app, admin panel) for testing and validation. These prototypes will be assessed through user testing to gather feedback and refine functionalities.

Data Collection and Analysis:
Data will be collected during the testing phases to analyze user interactions, system performance, and overall effectiveness. This data will guide further iterations and improvements to the system.

Evaluation and Validation:
The final system will undergo rigorous evaluation to ensure it meets the defined requirements and achieves the project objectives. Validation will include user acceptance testing and performance assessments against key metrics (e.g., reduction in unauthorized boarding's, improvements in bus utilization).

Schedule of activities and Gantt chart

Activity	Tentative Date
Technology Evaluation	**1 week**
System Design	**2 weeks**
Prototype Development	**2 weeks**

User Testing and Feedback	**1 week**
Development of Core Features	**2 weeks**
Integration of Systems	**2 weeks**
Quality Assurance Testing	**2 weeks**
Deployment	**1 week**
User Training	**2 weeks**
Project Evaluation	**2 weeks**

3- FPY Topic (Option 2)

Basic Information

Title	*Augmented Reality for Infrastructure Mapping*
Type of Project	*Research and Development*
Category of Project	*Web Based/ Mobile App*
Industry Project	

Problem Statement	*The current method of managing and visualizing building infrastructure, such as electrical wiring, plumbing, or gas piping, on construction sites or during maintenance, is inefficient and prone to errors. These systems are often hidden behind walls or floors, making it difficult for engineers and technicians to locate them without destructive exploration. Moreover, paper blueprints or 2D digital plans do not provide an accurate spatial understanding of how these systems exist in a real environment, leading to costly errors, delays, and rework.* *There is also no easy mechanism to overlay 3D models of these systems on real-world environments for efficient visualization. Technicians need to rely on manual measurements and guesswork, which can be inaccurate and time-consuming.*

Proposed Solution	The proposed solution aims to build an AR application that allows users to scan QR codes placed at key points in a building. These QR codes will anchor 3D models of piping, wiring, or other systems (exported from SketchUp) over the real-world environment. The user will be able to walk around the site and see accurate, scaled models of infrastructure systems, aligned precisely with their real-life counterparts. **Methodology:** 1. **Real-Time 3D Visualization with ARCore**: Use Google ARCore to overlay 3D models (created in SketchUp) onto the real-world environment. QR codes will be used to trigger and position these models in exact locations, ensuring accurate alignment with the building's physical structure. 2. **QR Code Anchoring**: QR codes will be strategically placed in the environment. When scanned, these codes will provide real-time data that allows the AR app to anchor the 3D model in the correct location. This will ensure that the visualized models of infrastructure components like pipes or wires align perfectly with the physical world. 3. **3D Model Creation in SketchUp**: Use SketchUp to create accurate, scaled models of building infrastructure (such as plumbing, electrical wiring, or gas pipes). These models will be exported in formats like FBX or OBJ and imported into the ARCore environment using Unity or another 3D engine. 4. **System Optimization**: Simplify the models to ensure they are optimized for AR visualization, maintaining performance on mobile devices without sacrificing the detail needed for technical accuracy. 5. **User Interaction and Interface**: The app will feature a user-friendly interface that allows engineers or technicians to scan QR codes, view infrastructure systems in AR, and interact with the 3D models (e.g., rotating or zooming in on parts of the system).
Proposed Tools and Technologies	To develop the AR system for visualizing 3D models of wiring, plumbing, or gas pipes, the following tools and technologies will be used: 1. **SketchUp**: o **Purpose**: SketchUp will be used to create the 3D models of the infrastructure components (e.g., wiring, plumbing, piping) based on available 2D blueprints.

	- **Reason**: SketchUp is an intuitive tool with easy learning curves, especially for users without prior 3D modeling experience. It supports exporting models in formats (such as FBX and OBJ) that are compatible with ARCore. 2. **ARCore (Google's AR SDK)**: - **Purpose**: ARCore will handle augmented reality capabilities such as motion tracking, plane detection, and depth sensing. It will be used to align the 3D models to the real-world environment. - **Reason**: ARCore is ideal for creating mobile-based AR applications with high accuracy in terms of model positioning and environmental tracking. 3. **QR Code Scanning Library (ZXing or Google Vision)**: - **Purpose**: A QR code scanning library will be used to scan QR codes in the environment. These codes will act as anchors to accurately position the 3D models within the real-world environment. - **Reason**: QR codes are a low-cost, easy-to-use solution for accurately placing virtual objects in specific real-world locations using AR. 4. **Flutter/React/Next.js**: - **Purpose**: These technologies will be used for building the front-end user interface of the mobile app that will interact with the AR functionality, providing users with a smooth interface for managing 3D visualizations, scanning QR codes, and receiving real-time updates. - **Reason**: Flutter and React/Next.js are widely used for developing mobile and web applications. They allow for fast, cross-platform development and can integrate seamlessly with ARCore.

Supervisor Signature **Co-Supervisor Signature**