A Project Proposal for Partial Fulfilment of The Course Unit IT3162

Group Project for The Degree of Information Technology

TrackNGo Smart Public Transport App

Group VIII

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Declaration

We hereby declare that the project proposal submitted for evaluation of course module IT3162 leading to the award of a Bachelor of Science in Information Technology is entirely our own work, and the contents taken from the work of others have been cited and acknowledged within the text. This proposal has not been submitted for any degree at this University or any other institution.

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Executive Summary

TrackNGo Smart Public Transport App aims to enhance the daily commute for passengers using the public bus transportation system in Sri Lanka. This project aims to tackle the inefficiencies and difficulties experienced by daily commuters, such as the lack of access to real-time bus schedule and route information, as well as the complexity of planning. This proposal explains how technologies like GPS tracking will change how commuters interact with public transport services.

The idea of this application is to increase overall satisfaction by making public transport more predictable, efficient, and easy to use. Integration of GPS tracking systems enables real-time updates of bus locations, greatly enhancing the use of commuting.

The execution of the Smart Public Transport Application will be divided into key stages: system design, technology selection, development, testing, and deployment. The application is to be built using the MERN stack-MongoDB, Express.js, React, Node.js-for maximum performance and scalability.

The Smart Public Transport App aims to modernize the way public transportation is used, helping to reduce commute times, lower traffic congestion, and improve the overall quality of life for commuters across Sri Lanka [1].

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1   Introduction

1.1   Introduction

Public transportation plays a vital role in urban mobility, connecting millions of commuters to work, education, and daily activities. In Sri Lanka, the bus system is one of the most widely used means of transportation, yet it faces significant challenges such as long waiting times, outdated schedules, and inefficient route planning. These issues lead to frustration among commuters, resulting in wasted time and reduced trust in the public transport system.

The "**TrackNGo**" web application aims to address these inefficiencies by leveraging modern technologies such as GPS tracking, real-time route planning, and fare calculation. This app will not only provide accurate, real-time bus locations but will also allow commuters to plan efficient routes, receive personalized notifications, and report lost items.

1.2   Background

Sri Lanka's public bus system lacks the modern technological infrastructure that is becoming standard in public transportation globally. Key issues such as unpredictable bus arrivals, inefficient route suggestions, and manual fare calculations result in longer waiting times and inconvenience for daily commuters. Additionally, there is no centralized system to report lost items, leaving commuters with little recourse if they lose their belongings [2].

With the rise of digital technologies, there is a growing need to modernize Sri Lanka's public transportation system. The TrackNGo app offers a comprehensive solution that brings real-time bus tracking, fare calculation, and news insights to the fingertips of users. By leveraging GPS and other technologies, the app will not only improve commuter experience but also optimize the management of public transportation routes and schedules [3].

1.3   Literature Review & Scope

1.3.1   Literature Review

Public transport mobile applications have the potential to significantly improve the commuting experience in Sri Lanka by addressing key challenges such as unpredictability, inefficiency, and limited information access. With features like real-time tracking, route planning, fare calculation, and personalized notifications, these apps can transform public transport into a more reliable and user-friendly service. The **SLTB Bus Tracker**, already implemented in Sri Lanka, provides an initial example of such technology, though it requires broader adoption and infrastructural support to maximize its effectiveness [4].

Drawing on examples from other countries, such as India's **Chalo app** and the Philippines' **Sakay.ph**, Sri Lanka can learn valuable lessons on how to enhance its public transport system. These countries have successfully integrated live tracking, digital payments, and real-time data to improve commuter satisfaction, demonstrating the potential for similar solutions to succeed in Sri Lanka [5] [6].

Despite the promise, there are significant challenges that need to be addressed, including inconsistent internet connectivity, outdated transport infrastructure, and varying levels of digital literacy across the country. For these smart transport solutions to succeed, Sri Lanka

must invest in technological infrastructure, ensure multilingual and user-friendly app designs, and launch public awareness campaigns to increase adoption.

In conclusion, with a phased and well-supported approach, public transport mobile applications can help modernize the public transport system of Sri Lanka, reducing traffic congestion and promoting sustainable urban mobility, while enhancing the daily commute for citizens.

1.4   Problem Statement

Sri Lanka's public bus system faces several challenges that make commuting inefficient and frustrating. The main issues include:

1. **No Real-time Vehicle Tracking**: Commuters don't know exactly where their buses are, leading to long waits and missed buses.
2. **Poor Route Planning**: Without proper route suggestions, commuters often end up taking longer or less convenient routes.
3. **No User-Friendly Interface for Fare Estimation**: Current system lacks a user-friendly interface for fare estimation, making it difficult to commuters to estimate fare.
4. **No Centralized Lost-and-found System**: Commuters face challenges recovering lost items since there's no easy way to report or track them across different buses or bus stands.
5. **Lack of extra commuter services**: There's no platform offering services like news updates, safety alerts, or last-mile options for getting from the bus stop to your destination.

1.5   Proposed Solution

The proposed Smart Public Transport App for Sri Lanka aims to modernize the way commuters interact with the public bus system.

The app includes the following features:

1. **Real-Time Vehicle Tracking**: Commuters can track buses in real-time, reducing uncertainty around bus arrival times and minimizing waiting periods.
2. **Updated Bus Schedules**: Commuters will have access to the latest bus schedules, ensuring they are always informed of the next available bus.
3. **Notifications and Alerts:** The app will notify users about bus arrivals, delays, or service disruptions, based on their chosen routes and preferences.
4. **Lost and Found Feature**: Users can report lost items or search for items lost on buses, streamlining the process of retrieving lost belongings.
5. **Instant Fare Calculation**: The app will automatically calculate the bus fare based on the distance traveled, and the route allowing commuters to plan their expenses more efficiently.
6. **News Insights**: In addition to transport-related information, the app will offer news and insights, making commuting more engaging and informative.
Through the implementation of these features, the Smart Public Transport App will significantly enhance the convenience, safety, and efficiency of public transport in Sri Lanka.

1.6   Why TrackNGo is Different?

What makes TrackNGo stand out? It's more than just a transport app—it's designed to really make your daily commute easier and more convenient:

1. **Live updates you can count on**: With real-time GPS tracking, you'll always have the latest bus locations and arrival times, so no more guessing when your bus will show up.
2. **Lost and found, made simple**: Losing something on the bus is stressful. TrackNGo's centralized lost-and-found system lets you easily report and recover items.
3. **Built for the future**: TrackNGo isn't just for buses—it's designed to grow. We plan to expand to trains, taxis, and even integrate digital payments and smart crowd management.

1.7   Objectives of the Project

The objectives of the TrackNGo project are as follows:

- **To provide real-time bus tracking** that helps commuters know the exact location of their buses.

- **To estimate the arrival time of the bus** based on factors such as the current location, average speed of the bus, and the live traffic data.

- **To simplify fare calculation** by automating the process based on distance, bus type, and travel preferences, enhancing the transparency of fares.

- **To establish a centralized lost-and-found system** where commuters can report lost items and transport authorities can track and assist in their recovery.

- **To send notifications and alerts** about delays, route changes, and bus arrivals, ensuring commuters stay updated on relevant travel information.

- **To deliver content and news** during commutes to improve the overall commuting experience.

1.8   Feasibility Study

1.8.1 Technical Feasibility

The Smart Public Transport App will be developed using the **MERN stack (MongoDB, Express.js, React.js, and Node.js)**, which ensures scalability and flexibility.

GPS Monitoring: Smart phones of the conductors are used to obtain the Data [7].

1.8.2 Resource Feasibility

The following resources are needed:

- **Frontend developers**: For creating a user-friendly interface using React and TailwindCSS.

- **Backend developers**: For managing server-side logic and data processing using Node and Express.

- **UI/UX designers**: For creating an intuitive and accessible user experience.

- **Smart Phones with GPS Sensors**: To manage GPS tracking System

1.8.3 Risk Feasibility

Risks include:

- **Integration issues**: Real-time GPS data could be difficult to synchronize if systems are not aligned correctly. This can be mitigated by thorough testing and phased integration.

- **User adoption challenges**: Some commuters may resist switching to a digital platform, which can be mitigated through user education and engagement campaigns.

1.9 Scope of Project Implementation

The initial phase of the project will focus on bus services in Sri Lanka's major cities, aiming to provide reliable real-time tracking and route information. As the system scales, it could be expanded to include other transportation services, like trains and taxis. In this phase, the following features will be covered:

1. **Real-Time Bus Tracking**

2. **Route Selection and Fare Calculation**

3. **Lost and Found System**

4. **Notifications and News Insights**

1.10 Methodology

To ensure smooth and adaptable development, the Agile methodology will be adopted [8].

- **Weekly Sprints:** Short, focused development cycles will ensure progress is made regularly, with new deliverables introduced every week.

- **Continuous Integration and Testing:** Every new feature will be integrated and tested in real-time to identify any issues early.

- **User Feedback:** Regular feedback sessions with users will be conducted to gather insights and adapt features based on actual needs.

2 Requirement Analysis

2.1 Introduction

In the context of requirement analysis, the TrackNGo web application is designed to meet the needs of a variety of users—Commuters, Bus Conductors, and Administrators. The primary focus of the requirement analysis is to define the functional and non-functional requirements of the system, ensuring it meets the real-time data needs of users and operates efficiently in diverse transportation scenarios.

User requirements for the app include real-time tracking of buses, fare calculation based on the chosen route, and a centralized lost and found system. Non-functional requirements emphasize performance, security, and scalability, allowing the system to handle high data loads while maintaining responsiveness.

2.2 User Requirements

Passengers (Public Transport Users):

- Ability to view real-time bus locations.
- Access to bus schedules and estimated arrival times.
- Instant fare Estimation for trips.
- Receive notifications about delays or schedule changes.
- Report lost items through the app.
- Provide feedback and rate bus services.

Bus Conductor:

- Ability to update real-time bus location via GPS.
- View bus schedules and planned stops.

Administrators:

- Manage bus routes, schedules, and drivers through an admin dashboard.
- Monitor real-time bus locations and performance metrics.
- Receive passenger feedback and address complaints or issues.
- Resolve lost item reports submitted by passengers.
- Manage the app's backend system, including updating schedules, routes, and user data.
- Monitor app performance, ensuring reliability and service uptime.
- Review system logs and usage data to troubleshoot issues.

2.3 Users

The app serves three key groups:

1. **Commuters**: Primary users who use the app for tracking buses, planning routes, and calculating fares.
2. **Bus Conductor**: The Conductors of the buses.
3. **Admin**: Manages the system's day-to-day operations, monitors usage, handles lost and found reports, and manages user feedback.

2.4   Functional Requirements

Real-Time Bus Tracking:

- The system shall accurately determine the current geographical location of a bus in real-time, processing GPS data transmitted from the conductor's mobile phone.
- A user shall be able to view the real-time location of a bus on a map within the app.
- The system shall update the bus location on the user's map every 10 seconds.
- Bus drivers shall be able to update their bus location via GPS integration.

Route Information:

- The system shall offer information related to the route selected by the user.
- Passengers can input start and end locations to get suggested bus routes.

Bus Schedules and Estimated Times:

- The system shall display up-to-date bus schedules, including real-time estimated arrival and departure times.

Fare Estimation:

- The system shall calculate the fare for each route based on the user's selected starting point and destination.
- The system shall notify users of any changes in fare rates and display the updated fares accordingly.

Notifications and Alerts:

- The app shall send notifications to users regarding delays, route changes, and other disruptions.
- Users shall be able to customize their notification preferences.

Lost Item Reporting:

- Users shall be able to report lost items through the app by providing details such as the bus number, route, and description of the lost item.
- Passengers shall be able to report back for the found items.

Feedback and Ratings:

- The system shall allow users to provide feedback on specific routes or buses after their journey.
- Users shall be able to rate their travel experience and submit suggestions for service improvement.

Admin Dashboard for Conductors:

- The system shall allow authorized personnel to add, update, or remove bus routes from the system.

- Admins shall be able to update bus schedules and fare information through an admin panel.
- Admins shall have access to reports on user activity, lost item claims, and feedback for performance assessment.

Real-Time Notifications for Maintenance and Service Interruptions

- The system shall notify users in advance of any planned maintenance or service interruptions affecting their preferred routes.

2.5   Non-Functional Requirements

1. **Performance**
- The Web app should load within **5 seconds** under normal network conditions (1 Mbps or higher).
- The system must support at least **99.95% uptime** to minimize downtime and ensure consistent service availability.

2. **Security**
- All user data, including personal details and travel history, must be encrypted using the **AES-256 algorithm** for storage, ensuring the privacy and security of sensitive information [9].
- Data transmitted between the app and servers must be protected using the **SSL/TLS protocol** to safeguard against unauthorized access during communication.

3. **Scalability**
- The system must be capable of scaling to handle up to **500,000 concurrent users** and increasing data demands as the app expands to serve more cities and integrate other forms of public transportation.

4. **Usability**
- The average number of errors made by users without any training should be less than **3 errors per hour**.
- The interface must be **user-friendly and intuitive**, designed for users of all technical proficiencies.
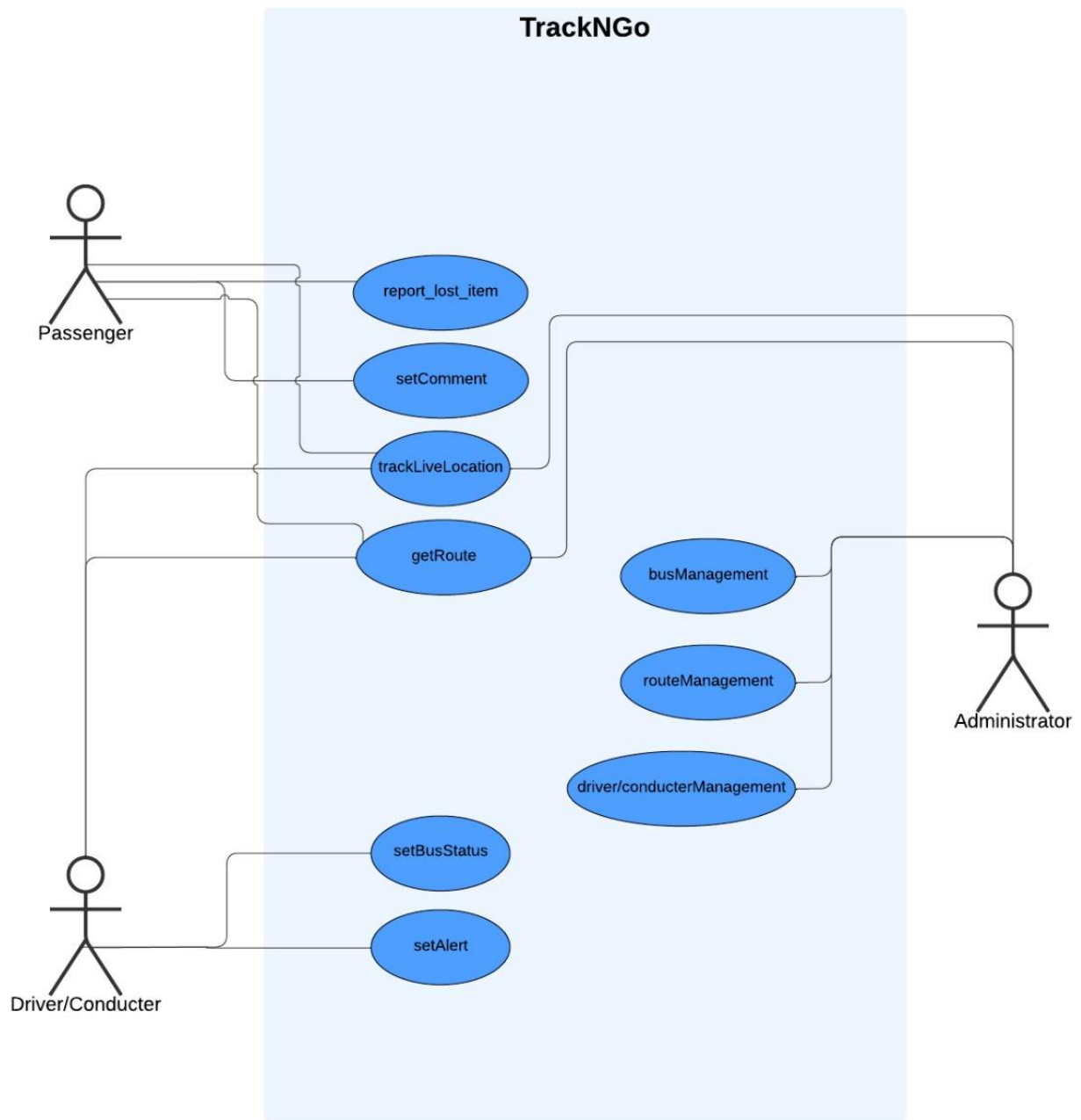
2.6 Use Case Diagram

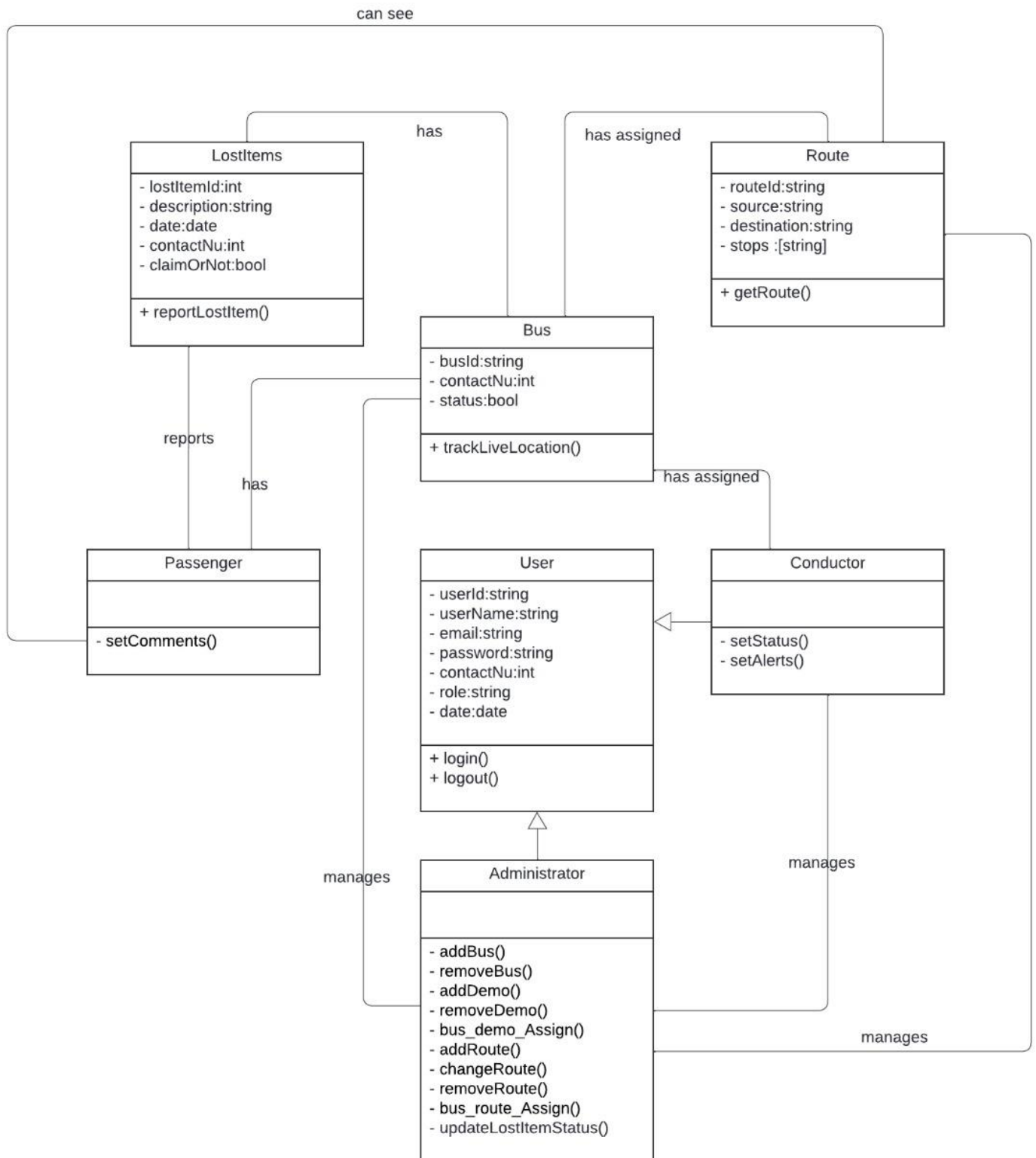*Figure 1 Use Case Diagram*

3 System Design

3.1 Class Diagram

Figure 2 Class Diagram

4   Implementation Plan

4.1   Technical Stack

1. **Frontend**: **React** for creating an interactive and responsive UI.

2. **Backend**: **Node** with **Express** to manage API endpoints.

3. **Database**: **MongoDB** for storing bus routes, user data, and real-time tracking data.

4. **Google Map API**: For GPS Location Tracking System.

5. **Notifications**: HTML Notifications API

4.2   Gantt Chart

	Week 01	Week 02	Week 03	Week 04	Week 05	Week 06	Week 07	Week 08
Project Timeline								
Project Planning and Setup	▓							
Design and Architecture		▓						
Backend Development			▓	▓	▓	▓		
Frontend Development			▓	▓	▓	▓		
GPS Implementation				▓	▓	▓		
Testing and Debugging			▓	▓	▓	▓	▓	
User Testing and Feedback							▓	
Deployment and Launch								▓

1. **Week 1: Project Planning and Setup**

    o   Define user requirements and conduct market research.

    o   Finalize tech stack and begin planning for system architecture and database design.

2. **Weeks 2: Design and Architecture**

    o   Design the system architecture, including the database schema (ERD, class diagrams).

    o   Finalize the user interface designs and interaction flows.

3. **Weeks 3-6: Backend Development**

    o   Set up the Node.js server with Express and MongoDB.

    o   Begin coding API endpoints for user management, bus tracking, fare calculation, and lost item reporting.

4. **Weeks 3-6: Frontend Development**

   o Set up the React frontend framework and implement user interfaces for core functionalities such as real-time bus tracking, fare calculations, and notifications.

   o Integrate frontend with backend APIs.

5. **Weeks 4-6: IoT Integration (GPS Tracking)**

   o Implement GPS tracking systems using API.

6. **Weeks 3-7: Testing and Debugging**

   o Conduct thorough testing of the backend, frontend, and IoT systems.

   o Fix bugs and improve performance based on test results.

7. **Week 7: User Testing and Feedback**

   o Release a beta version of the app for user testing.

   o Gather feedback from users, make necessary changes based on their input.

8. **Week 8: Deployment and Launch**

   o Deploy the final version of the app and officially launch it to the public.

   o Monitor the system for any post-launch issues and respond to them.

5 Conclusion

The Smart Public Transport App marks a significant advancement in modernizing and improving public transportation in Sri Lanka, with a particular emphasis on bus services. As commuters increasingly demand more accessible, efficient, and real-time transport information, the need for such a solution has become clear. By tackling major issues like poor scheduling, the absence of real-time tracking, and inefficient routes, the app provides a strong solution that benefits both transport operators and users [10].

This initiative has established a detailed plan for the creation and launch of the Smart Public Transport App, utilizing a state-of-the-art tech stack, including the MERN (MongoDB, Express, React, Node.js) framework for seamless backend and frontend integration, along with IoT technology for real-time GPS tracking of buses [7].

The app also offers a variety of features—real-time tracking, fare calculation, route planning, push notifications, lost item reporting, safety measures, and more. These functionalities enhance the commuter experience by minimizing waiting times, ensuring safety, and providing extra services like personalized news updates and last-mile connectivity through partnerships with ride-hailing services. The incorporation of smart technologies such as machine learning and predictive analytics means the app will not only enhance current transport operations but will also evolve and optimize over time.

6 References

[1] J. E. a. F. o. E. –. U. o. P. (2023), "Sri Lanka's Transport Systems: Embracing New Technologies for a Better Future," Daily News, [Online]. Available: https://archives1.dailynews.lk/2023/05/23/features/303906/sri-lanka%E2%80%99s-transport-systems-embracing-new-technologies-better-future.

[2] "Sri Lanka Toward an Urban Transport Strategy for Colombo A Technical Note Energy and Infrastructure Department South Asia Region Work in Progress," 2001. [Online]. Available: https://documents1.worldbank.org/curated/pt/476731468101389366/pdf/262970Colombo1UT1Strategy1final.pdf..

[3] L. I. A. a. C. P. dell'Olio, "he quality of service desired by public transport users. Transport Policy, 18(1), pp.217–227," 2011. [Online]. Available: doi:https://doi.org/10.1016/j.tranpol.2010.08.005..

[4] "Eseat.lk," 2024. [Online]. Available: https://tracker.eseat.lk/sltb/bus-tracker/all.

[5] "Chalo App," [Online]. Available: https://chalo.com/app/.

[6] "Sakay.ph — The best commute directions in Metro Manila," [Online]. Available: https://www.sakay.ph/.

[7] Y. Zhuravlova, "IoT App Development: Tools, Platforms, and Tech Stack," 2024. [Online]. Available: https://www.eliftech.com/insights/iot-app-development/.

[8] Altexsoft, "Agile Project Management: Best Practices and Methodologies," 2023. [Online]. Available: https://www.altexsoft.com/whitepapers/agile-project-management-best-practices-and-methodologies/..

[9] " Advanced Encryption Standard (AES)," Geeksforgeeks , 2024. [Online]. Available: https://www.geeksforgeeks.org/advanced-encryption-standard-aes/.

[10] "TOWARDS A DEVELOPED URBAN TRANSPORTATION SYSTEM: LESSONS FOR SRI LANKA INSTITUTE OF POLICY STUDIES OF SRI LANKA," 2022. [Online]. Available: https://www.ips.lk/wp-content/uploads/2022/06/Towards-a-Developed-Urban-Transportation-System-Lessons-for-Sri-Lanka_E_Book.pdf.