A Project Work - Phase I on

BUSLAG : TRACKING APPLICATION

Submitted in partial fulfillment of the requirements for the award of the

Bachelor of Technology

in

Department of Computer Science and Engineering
(Artificial Intelligence and Machine Learning)

by

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CERTIFICATE

This is to certify that the Project Work - Phase I entitled **"BuslaG Tracking Application"** is submitted by **Parige Sai Dinesh(20241A6642), Vallepu Hemchandra(21245A6606) and Nagendra Sri Krishna(20241A6617)** in partial fulfillment of the award of degree in BACHELOR OF TECHNOLOGY in Computer Science and Engineering (Artificial Intelligence and Machine Learning) during Academic year 2023-2024.

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ACKNOWLEDGEMENT

There are many people who helped us directly and indirectly to complete our Project Work - Phase I successfully. We would like to take this opportunity to thank one and all. First, we would like to express our deep gratitude towards our internal guide **Mr. K Arun, Assistant Professor,** Department of Computer Science and Engineering (Artificial Intelligence and Machine Learning), for his support in the completion of our dissertation. We wish to express our sincere thanks to **Dr. G. Karuna,** Head of the Department**,** and to our principal **Dr. J. PRAVEEN,** for providing the facilities to complete the dissertation. We would like to thank Project Coordinator, Dr. R. P. Ram Kumar, our faculty members and friends for their help and constructive criticism during the period. Finally, we are very much indebted to our parents for their moral support and encouragement to achieve goals.

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DECLARATION

We hereby declare that the Project Work - Phase I titled **"**BuslaG Tracking Application**"** is the work done during the period from **18th July 2023 to 22nd November 2023** and is submitted in the partial fulfillment of the requirements for the award of degree of Bachelor of Technology in Computer Science and Engineering (Artificial Intelligence and Machine Learning) from Gokaraju Rangaraju Institute of Engineering and Technology (Autonomous under Jawaharlal Nehru Technology University, Hyderabad). The results embodied in this Project Work - Phase I have not been submitted to any other University or Institution for the award of any degree or diploma.

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ABSTRACT

A smooth and effective College Bus Transportation System is essential at a time with changing educational environments. “BuslaG,” a cutting-edge initiative, aims to improve GRIET college's Campus Bus Transportation “BuslaG,” at the intersection of "Bus, Location, Access, for GRIET campus," revolutionizes college bus transportation. The proposed application (BuslaG) helps the students with real- time tracking using Global Positioning System (GPS) technology, supplemented by Geographic Information Systems (GIS), which improve accessibility by mapping bus routes and concern stops with the passengers (students). “BuslaG,” forecasts exact bus arrival time with the help of machine learning, allowing students to plan well. “BuslaG,” also helps with a real-time alert system that can actively notify the students about their bus location and also notifies the driver about the students approaching the bus with the help of real-time onboarding system, which can improve overall bus transit time.

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LIST OF ACRONYMS

GRIET	Gokaraju Rangaraju Institute of Engineering and Technology
GPS	Global Positioning System
GSM	Global System for Mobile Communication
ETA	Estimated Time of Arrival
IoT	Internet of Things
UML	Unified Modeling Language
HTTPS	Hypertext Transfer Protocol Secure

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CHAPTER 1

INTRODUCTION

The following section provides insight into the inspiration behind BuslaG's development, exposing the need for a radical College Bus Transportation System. It covers the exciting impacts of BuslaG on campus transportation, offering an overview of its key elements, including real-time tracking, arrival prediction, onboarding, and alerts.

1.1. Introduction

With advancements in education, transportation, and communication, we, as developers, are constantly working on applications that aim to reduce the time and effort required by individuals. In this regard, the BuslaG team has embarked on a revolutionary project that benefits both students and bus staff. In this era of changing educational environments, one crucial aspect often overlooked is the efficiency and seamlessness of College Bus Transportation Systems. For many students, faculty, and staff, reliable transportation to and from campus is a vital component of their daily lives. It directly impacts their educational experience, overall well-being, and even the sustainability of the institution itself. Recognizing this, we introduce "BuslaG," a groundbreaking initiative meticulously designed to revolutionize and enhance the College Bus Transportation System at GRIET (Gokaraju Rangaraju Institute of Engineering and Technology). BuslaG will provide a convenient, reliable, and affordable transportation option for students, faculty, and staff. It will also provide a sustainable mode of transportation, reducing emissions and saving the college money. BuslaG will also provide a safe way to travel, with features such as GPS tracking, estimate the arrival time, alerts system and onboarding position system. Additionally, BuslaG will provide additional opportunities for student engagement and socialization. BuslaG will help reduce traffic congestion on campus, making it more efficient for drivers, students and faculty. Recognizing the pivotal role that transportation plays in the lives of our university community, we are thrilled to introduce "BuslaG." This initiative has been meticulously crafted to revolutionize and elevate the College Bus Transportation System at GRIET (Gokaraju Rangaraju Institute of Engineering and Technology). BuslaG is set to provide a seamless, dependable, and cost-effective transportation option for our students, faculty, and staff. Moreover, it serves as a sustainable means of transportation, reducing emissions and contributing to significant cost savings for the college. Furthermore, BuslaG presents additional

opportunities for student engagement and socialization, fostering a sense of community and connection. By reducing on- campus traffic congestion, it will enhance the efficiency of transportation for both drivers. In the upcoming chapters, we will delve even deeper into the driving force behind BuslaG's development, explore its core features, and elucidate the extensive benefits it brings to the GRIET community. We invite you to embark on this transformative journey with us as we pave the way for a more efficient, sustainable, and engaging College Bus Transportation System, powered by the innovation of Kodular. Join us as we reveal the future of our campus transportation system.

The Birth of BuslaG

The creation of "BuslaG" is a story of innovation and clever thinking. The name itself combines "Bus," "Location," and "Access," designed specifically for the GRIET campus. But BuslaG is more than just a transportation service; it's a dynamic solution that will change how college bus transportation works. BuslaG was developed with one goal in mind: to improve the way college bus transportation is seen and experienced. The idea came from realizing that transportation is not just a logistical need, but an important part of the college experience. BuslaG is committed to meeting the challenges of modern education and student life. It aims to make transportation easier for students and staff, while also supporting the institution's vision of providing a supportive educational environment.

Significance of an Efficient College Bus Transportation System

The significance of an efficient College Bus Transportation System cannot be overstated. In the context of GRIET, as with any institution of higher learning, the accessibility and reliability of bus transportation exert a profound influence on the daily lives of both students and faculty. It is crucial to emphasize that a well-planned and robust transportation system is more than a mere convenience; it constitutes a fundamental pillar of an inclusive, sustainable, and flourishing educational ecosystem.

In essence, the quality of the transportation system directly impacts the accessibility and effectiveness of education. An institution's commitment to providing accessible transportation services reflects its dedication to ensuring that every member of its academic community, regardless of their individual circumstances, can actively engage in the learning process. An efficient transportation system is a means of inclusivity, eliminating barriers and making education available to a broader spectrum of individuals.

Moreover, such a system embodies sustainability. By optimizing routes, reducing emissions, and improving resource utilization, it contributes to the broader goal of reducing the institution's ecological standards.A robust College Bus Transportation System is also vital for the institution's overall well-being. It ensures that students and faculty can attend classes and participate in academic and extracurricular activities without disruption.

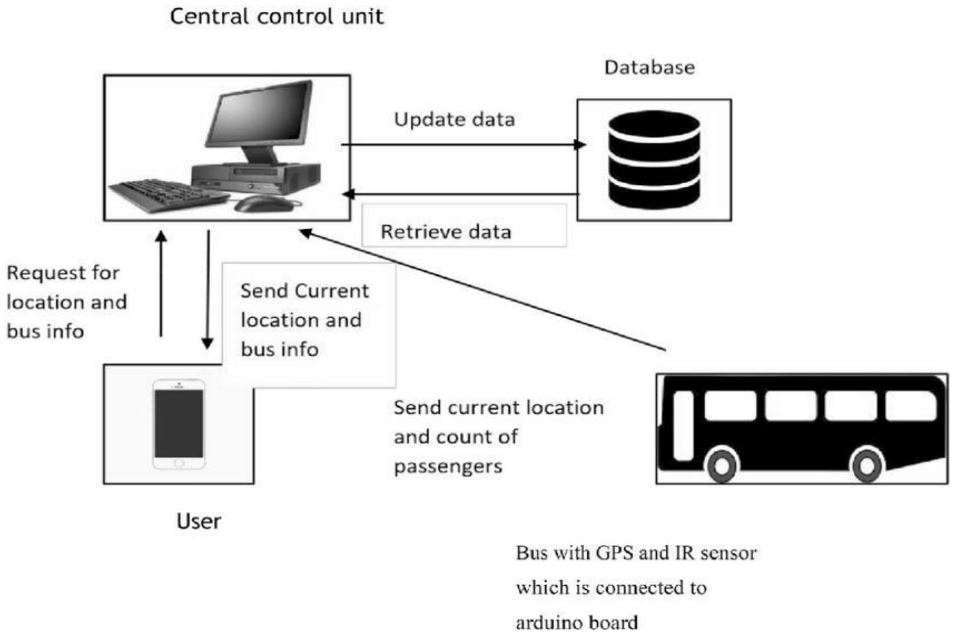

Figure 1.1Public bus tracking system using android application (Courtesy: Source [1])

At the heart of the BuslaG initiative beats a visionary approach, one deeply rooted in the recognition of the multifaceted challenges posed by the existing College Bus Transportation System as shown in the figure 1.1. This transformation transcends the conventional provision of buses:it is an integrated, technologically advanced, and student-centric strategy.

1.2. Objectives of the Project

- To create a reliable live bus tracking system for GRIET campus buses and utilize data to estimate the arrival time of the bus.
- To create a real-time alert system that can actively notify the students about their bus location.
- To create a real-time boarding position system.

1.3. Methodology Adopted to Satisfy the Objective

In this section the following information is presented:

1.3.1 Briefly introduce the BuslaG project and its significance.

1.3.2 Core Components of BuslaG.

1.3.3 Data Collection (GPS Module).

1.3.4 Data Processing (Gateway).

1.3.5 Application Development (BuslaG).

1.3.6 Performance Evaluation.

Finally, Conclude by summarizing how the information presented above guides the procedure to enhance campus transportation through BuslaG.

1.3.1 Briefly introduce the BuslaG project and its significance

An essential component of student life in an ever changing educational environment is reliable campus transportation. In this regard, the BuslaG project stands out as a ground-breaking effort and of great significance. BuslaG is a revolutionary solution that has been carefully built to completely restructure the College Bus Transportation System at GRIET campus. It is not just an application. The goal of this project is to make life easier for teachers, staff, and students by recognizing that dependable transportation is a necessary part of a vibrant, inclusive, and sustainable educational ecology.

Four key components make up BuslaG: an alerting system, an onboarding positions system, predicted arrival time, and live location tracking. These components, which were created using the intuitive Kodular platform, guarantee that campus accessibility is smooth, effective, and customized to meet the ever-changing needs of the contemporary academic community.

In addition to making everyday travel easier, BuslaG is well-positioned to support the institution's environmental goals by reducing emissions and limiting interruptions caused by transportation. It imagines a time where academic experiences are enhanced by mobility rather than being hampered by it. This initiative has the potential to completely change our perception of and interaction with campus transportation thanks to its creative approach and user-friendly design.

1.3.2 Core Components of BuslaG

At the heart of the BuslaG project lies four key components that collectively redefine the campus transportation experience. These core elements have been meticulously designed to offer a seamless, efficient, and user-centric approach to college bus transportation. They encompass real-time tracking, predictive arrival times, a alerting system, and an onboarding positions system. Each of these components serves a specific purpose, empowering students and staff to navigate their daily journeys with ease and confidence. As we explore each of these core elements in detail,

it becomes clear that BuslaG is more than just an application; it is a visionary solution set to revolutionize how we perceive and experience campus transportation.

- **Live Location Tracking**

Live Location Tracking is a dynamic system that allows users to monitor the real-time positions of college buses on a map within the BuslaG application. It relies on GPS data from the buses to provide up-to-the-minute information about their exact locations as they navigate their routes.

- **Significance**
  - **Efficient Commutes:** Users can plan their schedules effectively, minimizing wait times and optimizing their time spent at the bus stop.
  - **Safety:** Knowing the live locations of buses ensures that passengers are aware of their whereabouts, contributing to a safer transportation experience.
  - **Data Utilization:** Data collected through tracking can be used to analyze routes, identify traffic patterns, and make informed decisions for route optimization
- **Predicted Arrival Time**

Predicted Arrival Time is an innovative feature that uses historical data and algorithms to estimate when a bus is likely to arrive at a specific bus stop. It offers users insights into when they can expect the bus to arrive.

- **Significance**
  - **Improved Planning:** Passengers can plan their schedules with confidence, arriving at the bus stop just in time for boarding, reducing unnecessary waiting.
  - **Enhanced Convenience:** Predicted Arrival Time reduces uncertainty and helps passengers make more efficient use of their time.
  - **Data-Driven Decisions:** Historical data collected can be used for refining the accuracy of predicted arrival times and optimizing routes.
- **Alerting System**:The Alerting System within BuslaG is a vital component dedicated to ensuring that users are continuously informed about essential updates and changes in the transportation system. It goes beyond merely notifying users of delays or route diversions; it actively keeps passengers engaged with real-time alerts has shown in figure 1.2. These alerts are triggered at key moments in the journey, including when buses reach stops and when they approach them.

- **Significance**
    - **In-Transit Updates:** The Alerting System provides real-time notifications to users, making them aware of their bus's progress as it approaches and reaches designated stops.
    - **Minimized Waiting Time:** Passengers receive alerts when the bus is near, allowing them to be at the stop precisely when it arrives, reducing unnecessary waiting.
    - **Enhanced User Engagement:** By keeping users actively informed throughout their journey, the system ensures that passengers remain engaged and connected with their transportation experience.

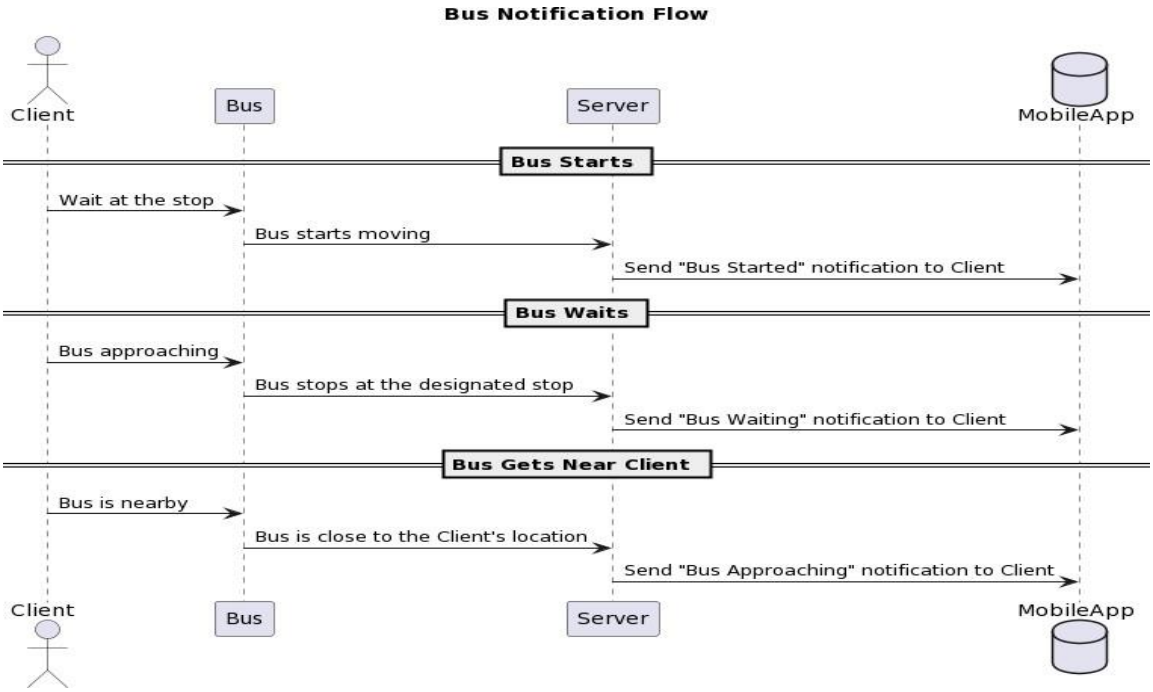

Figure 1.2 Alerting System flow of work

- **Onboarding Positions System**

The Onboarding Positions System is a comprehensive feature within BuslaG designed to provide real-time information, not just to users but also to the drivers. It serves as a guidance system that informs drivers about the number of passengers waiting at each bus stop and whether they should stop at that particular stop has shown in figure 1.3. This two-way communication streamlines the boarding process and optimizes the use of time and resources.

- **Significance**
    - **Real-Time Passenger Data:** The system constantly monitors and updates the number of passengers waiting at various bus stops, ensuring drivers have access to information.
    - **Efficient Boarding:** By providing drivers with insights into passenger counts, they can make informed decisions about stopping at each designated bus stop, reducing time wasted at empty stops.
    - **Time Optimization:** This streamlined process benefits both passengers and drivers by making the bus route more efficient and reducing unnecessary stops.

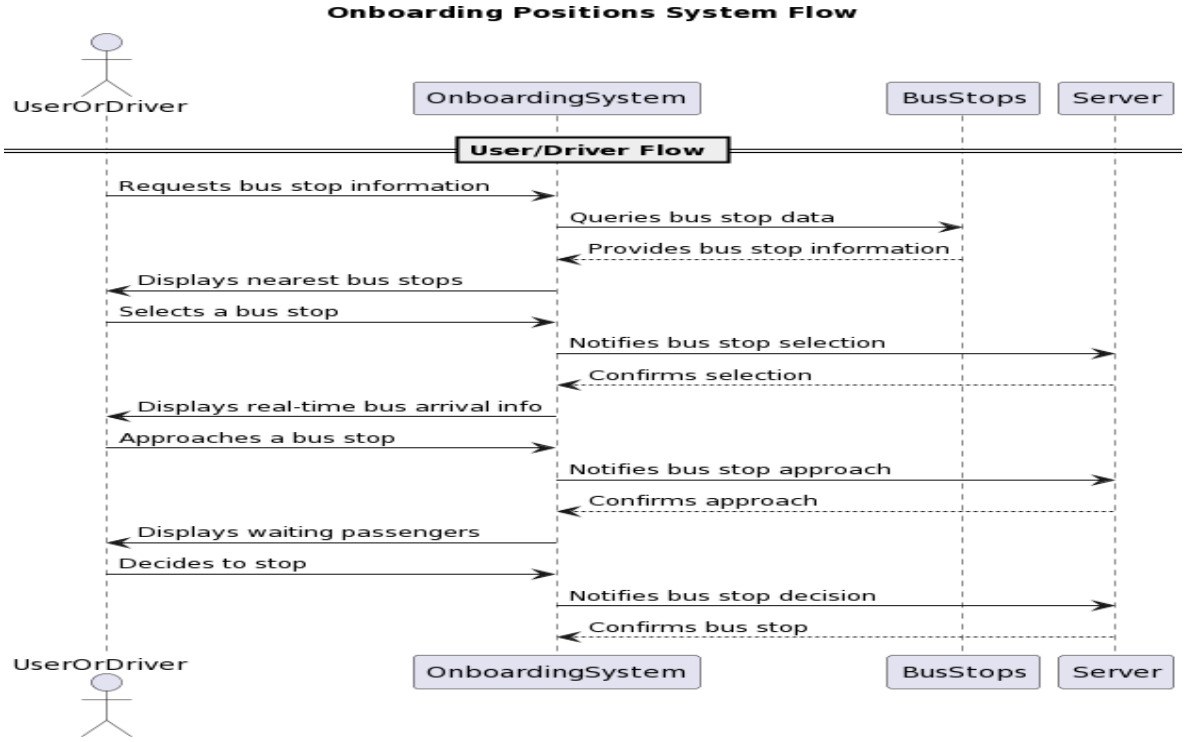

Figure 1.3 Onboarding Positions System flow of work

1.3.3 Data Collection (GPS Module)

The Data Collection component involves gathering real-time location data from buses by utilizing mobile GPS technology available on the drivers' smartphones. This data serves as the foundation for tracking and monitoring the buses. This data is fundamental for enabling the tracking and monitoring of college buses, ensuring students' convenience and punctuality. GPS modules are not physically installed in the buses; instead, the data collection relies on the drivers

installing a dedicated application on their smartphones and enabling location services. These applications continuously collect critical information about the bus's current location, speed, and direction throughout the journey. The data collected includes latitude and longitude coordinates, timestamps, and vehicle speed.

- **Key Features**
  - **Real-time Tracking:** The GPS data is collected at frequent intervals, often in real-time, providing precise and up-to-the-minute location information for each bus in the fleet. This feature offers students the ability to monitor the exact position of their buses, reducing uncertainties and waiting times.
  - **Accuracy:** Modern mobile GPS technology offers exceptional accuracy in determining the bus's geographic position. This high level of precision is vital for maintaining accurate and reliable tracking, ensuring that students receive dependable information about bus locations.
  - **Data Transmission:** The collected GPS data is promptly transmitted to a central server or the Gateway for further processing. This transmission mechanism enables data to be efficiently and securely transferred from the driver's smartphone to the central system.

1.3.4 Data Processing (Gateway)

The Data Processing component, known as the Gateway, serves as an intermediary system responsible for receiving, processing, and transforming the raw GPS data collected from the drivers' smartphones. Its main purpose is to convert this data into meaningful and actionable information for real-time bus tracking and alerting. The Gateway is the central hub that receives GPS data from the drivers' smartphones, which continuously transmit information about the buses' locations, speeds, and directions.upon receiving the raw GPS data, the Gateway initiates a series of processing tasks, including data filtering and cleaning. This step helps remove errors and outliers, ensuring the accuracy and reliability of the information.

Estimation of Bus Arrival Times: One of the critical operations of the Gateway is the calculation of estimated bus arrival times. It achieves this by applying machine learning algorithms that take into account historical data, real-time conditions, and the current location of buses. The result is precise predictions of when buses will arrive at their destinations or specific bus stops.

Communication: The Gateway actively communicates with the Application Development component (BuslaG) to provide the processed data required for real-time tracking, alerts, and notifications. It acts as a bridge, ensuring that the application has access to accurate and up-to-date information.

1.3.5 Application Development (BuslaG): The Application Development component, known as "BuslaG," is the user-facing application that provides a comprehensive set of features and functionalities for real-time bus tracking, alerting, and notifications. Its primary purpose is to deliver a user-friendly and efficient interface for students, drivers, and administrators to interact with the bus tracking system.

Real-Time Tracking: "BuslaG" offers a real-time tracking feature that allows students and drivers to monitor the precise locations and movements of college buses on a map. This feature provides up-to-the-minute information about the buses' positions and routes.

Alerting System: The application is equipped with an alerting system that actively notifies students and drivers about bus locations. Students receive notifications when the bus is nearby, enhancing punctuality and convenience. Drivers are also informed about the proximity of students waiting at bus stops.

Onboarding Position System: "BuslaG" includes a real-time boarding position system, which simplifies the process of boarding buses. It provides information to students and drivers about the availability of students at various bus stops, enabling more efficient and time-saving bus transit.

Administrator Dashboard: Administrators have access to a dedicated dashboard within "BuslaG." This dashboard allows administrators to monitor the system's performance, configure parameters, set alerts, and manage various aspects of the bus tracking system.

1.3.6 Performance Evaluation: The Performance Evaluation component is responsible for assessing and analyzing the effectiveness and efficiency of the entire "BuslaG" college bus transportation system. Its primary purpose is to measure the system's performance, identify areas for improvement, and ensure that it consistently meets the needs and expectations of its users.

1.4 Architecture Diagram

The Architecture diagram represented in Figure 1.4 outlines the overall design of a BuslaG Application Pipeline. The above Architecture diagram is a visual representation or tool for understanding and interpreting the process workflow that is being followed to develop a BuslaG application.

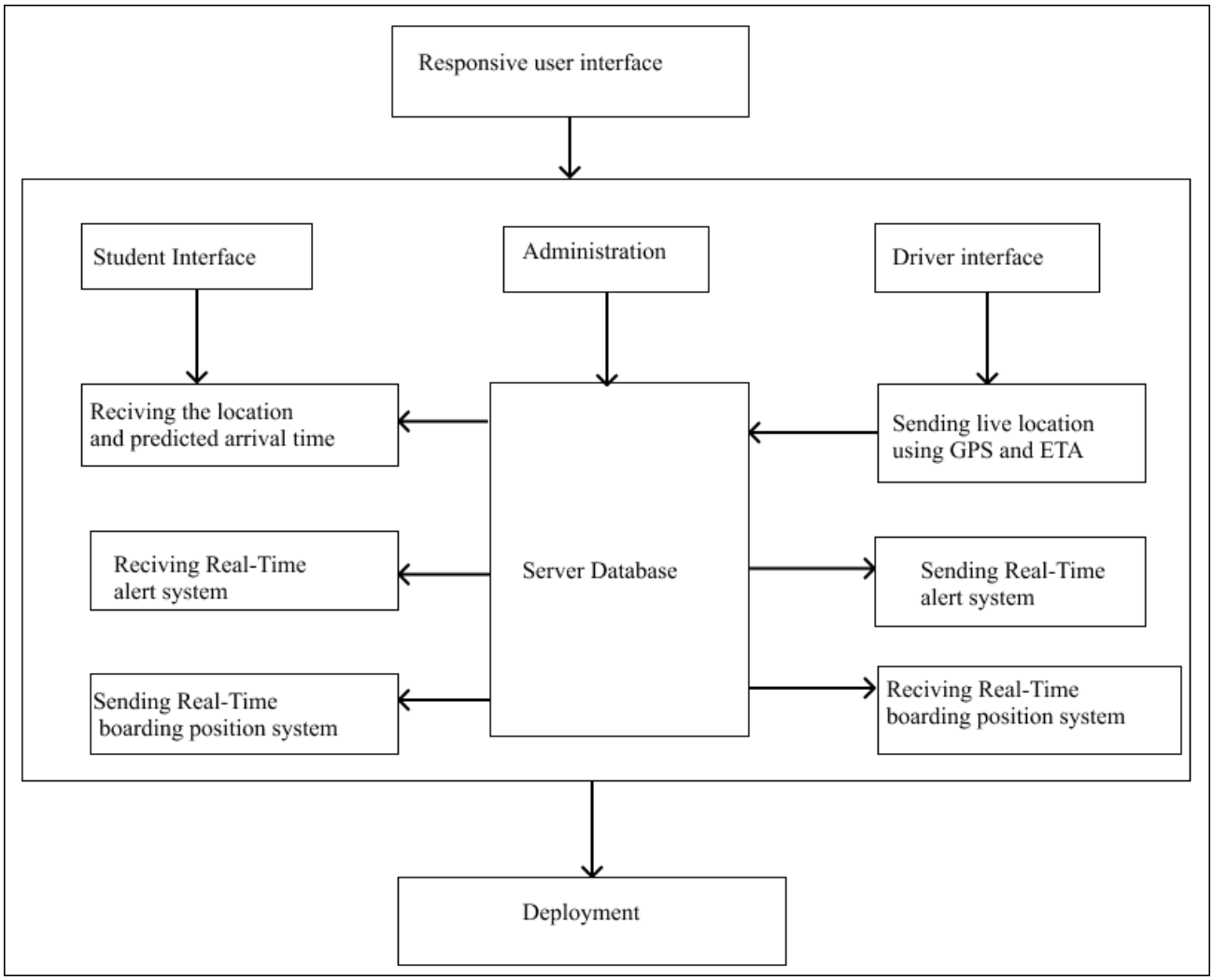

Figure 1.4 Architecture Diagram

- **Responsive User Interface:** Crafted with precision, the interface dynamically adjusts to device screen size and orientation. This commitment to adaptability ensures an optimal user experience across various devices, acknowledging the diverse technological landscape students may use.
- **Student Interface:** The student interface, a web-based application, enables students to access course materials and engage with peers. Its responsive design ensures a seamless experience across devices.

- **Administration**: Instructors manage courses, and student enrollment, and track progress using a robust administrative component with reporting tools.
- **Driver Interface**: A mobile app empowers bus drivers to track bus locations, estimate arrival times, and send real-time alerts to students and parents.
- **Location and Arrival Time:** The system receives real-time bus location and arrival estimates from the driver interface, updating the student interface.
- **Live Location and ETA**: The system transmits live bus location and estimated arrival times to the student interface, displayed on a map for student tracking.
- **Real-Time Alerts**: Real-time alerts about route changes or delays are received from the driver interface and promptly sent to students and parents.
- **Boarding Position System**: The system broadcasts real-time bus boarding positions to students, displayed visually on a map.
- **Firebase Integration:** The system utilizes Firebase, a cloud-based platform, for seamless real-time data synchronization between components. This ensures quick updates and accurate information flow.
- **Deployment:** The system is deployed on Firebase's cloud infrastructure, providing global accessibility, scalability, and robust data storage for student records, course materials, and assignment grades. Firebase contributes to the system's flexibility and efficiency in education delivery.

1.5 Organization of the Report

The structure of this report is designed to ensure a logical flow of information, presenting each section coherently and concisely to facilitate the reader's understanding of the BuslaG project.

- **Introduction**

This section provides an introductory overview of the BuslaG project, outlining the motivation behind its development. The objectives of the project are clearly defined, along with the methodology used to achieve them. An architectural diagram offers a visual representation of the BuslaG system's design.

- **Literature Survey**

The Literature Survey presents a comprehensive review of existing resources related to campus transportation systems. Relevant research articles, conference papers, and journals are

analyzed to identify common themes, trends, and insights. A summary of existing works, including their advantages, results, and drawbacks, is provided to give context to the BuslaG project.

- **Proposed Method**

In this section, the proposed method is introduced, including the problem statement and project objectives. The architecture diagram is explained in detail, offering an in-depth understanding of the BuslaG system's structure. Software and hardware requirements are specified to guide the implementation.

- **Results and Discussions**

Following the implementation of the proposed method, this section presents the results and their analysis. A discussion ensues, delving into the implications of the results and their alignment with the project's goals.

- **Conclusion and Future Enhancements**

This section offers a conclusion based on the results and analyses, summarizing the project's outcomes. It also explores potential future enhancements that could further improve the BuslaG system.

- **Appendices**

In the appendices, the source code of the BuslaG project, including the primary model architecture, is attached.

CHAPTER 2

LITERATURE SURVEY

This chapter includes the description and summary of current strategies, their advantages, results and their shortcomings.

2.1 Summary of Existing Approaches

Ang Li, William H.K. Lam and team [2] proposed a method to estimate real-time multi class path travel times using multi source traffic data. The objective was to estimate the path travel times of different vehicles over different traffic conditions. This paper proposed a novel modeling framework that considers variance–covariance relationships between vehicle classes for real-time estimation of multi-class path travel times with use of multi-source traffic data collected from AVI sensors and GPS data. The proposed methodology was examined with a case study of a selected urban expressway in Hong Kong with data obtained from multiple sources. The path travel time estimates by vehicle class are validated and the results demonstrate the merits and performance of the proposed framework.

Kerem S. Tuncel, Haris N. Koutsopoulos, Zhenliang Ma [3] proposed a data-driven real-time denied boarding prediction in urban railway systems. The objective was to estimate denied crowd boarding on platforms. This paper proposed a data-driven method for real-time denied boarding prediction in urban railway systems using automated fare collection (AFC) and automated vehicle location (AVL) data. The results highlight the model's accurate and robust performance in predicting denied boarding on platforms using purely AFC and AVL data (e.g., an average of 6%–7% error) under both recurrent and non-recurrent situations, in which transfer demand-related factors contribute most to the prediction.

Mrs. Vijayalakshmi, N. Dhikshitha, and team [4] proposed the manuscript on a real-time college bus tracking system. The objective was to design a system that will automate the college transport fare collection process using GPS contactless smartcard technologies as well as provide industrial IoT facilities to know the present location of the college vehicle and the arrival time at the particular bus stop. This paper proposed real-time vehicle tracking using GPS and GSM and also used RFID to allot unique identification for each student, so that the information of the student

boarded the bus is monitored accordingly. The results of this paper concluded that the model created can be used as a prototype for tracking the buses in real-time.

Changlin Li, Shuai Lin, and team [5] proposed a sequence and network embedding method for bus arrival time prediction using GPS trajectory data. The objective was to estimate the time of arrival of buses based on the GPS trajectory data alone for small cities. This paper proposed a novel deep-learning model based on sequence and network(i.e., graph) embedding (SGE-net) which adopts only GPS trajectories as input and achieves accurate bus arrival time prediction without external data. The results showed that the SGE-net outperforms the baseline models, and validated the effectiveness and robustness of the SGE-net.

Yuecheng Rong, Jun Liu, and team [6] proposed a real time bus waiting estimation of vehicles without GPS. The objective was to estimate the time of arrival of the buses without installation of any sensors. This paper proposed a novel end-to-end multi-task framework named BusWTE, which estimates bus waiting time for those bus routes without GPS sensors deployed. BusWTE utilizes a variety of urban datasets, including historical bus trip data reported by a limited number of GPS equipped buses, road network data, traffic condition data, and mobility data. The proposed model used biLSTM architecture to encode the sequence of features and a temporal attention mechanism to capture the dynamic correlation between the route features. The final model is deployed in many cities of China.

Rajesh Y, Sravan Kumar U, Venkatesh G [7] proposed the paper on real-time bus tracking system. The objective of the proposed paper is to develop an application to keep track of the bus. This paper proposed a real time machine shadowing system for the scholars using android Smartphone's which can be used for shadowing and positioning of the motorcars by using Global Positioning System(GPS). An android based smartphone application is developed using Java and Android studio and with the help of GPS, so that the application is used by the users to keep track of the location of the buses.

Md. Irfan Ahmed, g. Madhusudhan, and team [8] proposed a web-based application for tracking buses and its management. The objective of the paper was to help people save time without waiting for the bus. This paper proposed a web application which contains the information

of the arrival and departure times of the buses it provides priority for selecting a bus based on passengers' rush, and other important information like ticket prices, and bus schedules. The application keeps track of the bus by accessing the location of the bus driver using Google Maps API. This web-based application allows customers to schedule their journey and save valuable time.

N.Malligeswari, Jothilakshmi, P.Arunadevi, K.Sindhumathi [9] proposed an IoT based college bus tracking system. The objective of the proposed paper was to help students in boarding the college buses without any delay. The paper proposed a college bus tracking system using GPS and GSM to keep track of the bus and give information about the location of the bus , traffic delay, broken vehicles etc. The final system was able to decrease the workload for the bus management team and supply an instant platform to update the latest and perfect bus traffic information to bus users.

Abinash M 1, Mohanram S 2 and team [10] proposes a system for tracking the location of college buses in real time and notifying passengers of upcoming stops using LoRaWAN technology. The system consists of a network of LoRaWAN sensors deployed on college buses and a cloud server that processes the data collected by the sensors and provides real-time updates to passengers through a mobile app. The system was evaluated on a fleet of 10 buses at a college campus. The results showed that the system was able to track the location of buses with an accuracy of 99%. The system was also able to notify passengers of upcoming stops with an average lead time of 1 minute.

Meenakshi Ashokan, N Niranjan, and team [11] proposed a campus connect college bus tracking system. The objective was to provide students with information about the college buses to ensure smooth traveling and save time for the students. The paper proposed was based on the most recent GPS technology using the Internet of Things, allowing college students to monitor the movement of the college buses, keep a timetable, and provide real-time bus positions for users. The application was designed in such a way that it displays the exact position of the buses to each student's individual bus on Google Maps. The proposed method provided information of the fee

to be paid for the buses and made payment digital with added features such as Net banking or credit card payment.

Table 1.1 Summary of Existing Papers

Ref No.	Methodologies	Disadvantages
[2]	Bayesian network modeling with real-time multi-source traffic data to predict multi-class path travel times.	Requires large amounts of training data, can be computationally expensive.
[3]	Machine learning model to predict denied boarding in real time, trained on data including passenger demand.	data quality requirements, potential bias, and computational complexity.
[4]	GPS devices installed in buses to track location in real time, with mobile app for students and parents.	Requires investment in GPS devices, may be vulnerable to cyberattacks, and may not be accurate in all cases.
[5]	Embeds bus GPS data into a low-dimensional space using a sequence embedding model, then trains a graph neural network (GNN) to predict bus arrival time using the embedded data.	Requires a large amount of historical bus GPS data and bus arrival time data to train the GNN. May also be sensitive to noise in the bus GPS data.
[6]	Uses BiLSTM architecture, fully-connected layers ,temporal attention mechanism, and multi-task learning to estimate bus waiting time.	Requires bus location data from another system and real-time data processing.

[7]	Uses Android smartphones and GPS devices to collect and track the location of buses in real time, and displays this information to passengers on a mobile app.	Requires Android smartphones and GPS devices to be installed on buses, and may be vulnerable to cyberattacks.
[8]	GPS devices track bus location in real time, central server displays to users.	Costly to install GPS devices, privacy concerns.
[9]	GPS devices on buses send location data to a central server, which is accessed by a mobile app to provide real-time tracking and estimated arrival times.	Costly to install GPS devices, privacy concerns for students and parents.
[10]	LoRa WAN devices on buses transmit location data to a gateway, which forwards it to a central server that updates a database and sends notifications to a mobile app.	Signal penetration challenges, battery life management, and data security concerns.
[11]	Campus Connect uses RFID, touch screens, and electronic bus-stop boards to track buses and provide real-time updates to a mobile app.	Campus Connect may be expensive to implement and may not be accurate in all areas.

2.2. Summary: Drawbacks of Existing Approaches

All the Existing approaches face challenges: data-intensive, computationally expensive, and vulnerable to biases. Dependence on extensive historical data, noise sensitivity in GNNs, and real-time processing complexities are common issues. GPS reliance introduces installation costs and cybersecurity threats, raising privacy concerns in public transport and school buses. Accuracy problems emerge in areas with signal penetration challenges, impacting system reliability. Campus Connect encounters high implementation costs and potential accuracy limitations. Overall, data quality, privacy, accuracy, and operational efficiency pose significant hurdles, demanding comprehensive solutions for successful deployment in diverse domains.

CHAPTER 3

PROPOSED METHOD

This chapter deals with an in-depth explanation of the problem statement, the objective of the study, architecture diagram, module explanation and UML design diagrams

3.1. Problem Statement and Objective of the Project

Problem Statement: Current college bus transportation lacks a streamlined mechanism for live location sharing, leading to inconvenience and uncertainty for students. The absence of real-time tracking hampers effective transit management. To address this issue, "BuslaG" aims to implement a live location sharing system that leverages GPS technology, providing students with accurate and real-time information about the bus location. This enhancement seeks to improve the overall efficiency, reliability, and convenience of GRIET's college bus transportation system.

This work is centered on live location sharing using GPS through an Android application. The project's primary objective is to develop an Android bus tracking app using Kodular, a visual programming environment. This app enables users to monitor buses in real time, displaying their current locations on a map. Additionally, the app offers various features to enhance user interaction and facilitate effective bus navigation. The app's login page ensures secure access to the tracking features from the outset. Users can quickly examine the live location of the buses they are interested in once they have logged in. Users can utilize this function to efficiently plan their travel since they can monitor the bus's movement and predict when it will arrive at their destination.

The app's ability to show multiple routes is one of its primary features. Users have a variety of predefined routes to choose from, each with a distinct set of stops. The app allows users to choose their favorite boarding or disembarking spots by giving them comprehensive information about the stations along the route they have chosen. This function allows freedom in selecting the most practical route and caters to the various needs of travelers. The programme has dynamic tracking, which updates the bus's latitude and longitude readings in real-time on a continual basis. For users, this guarantees precise and trustworthy location information. The app interacts with a server-side backend system that makes use of Firebase's real-time database to provide seamless data synchronization. This integration ensures quick data changes and retrieval, keeping the app accurate and responsive.

The app prioritizes user usability in terms of design. Users may easily navigate and retrieve

the needed information thanks to its user-friendly and aesthetically pleasing design. Users may easily follow their desired bus thanks to the interactive map display, which makes the whereabouts of the buses visible and easy to understand. Overall, the Kodular-based bus tracking software provides an all-inclusive solution for tracking and monitoring buses in real time as we shown in figure 1.1 can be considered as an example. It is a useful tool for travellers, improving their travel experience and assuring efficient transportation thanks to its user-friendly layout, numerous route possibilities, and dynamic tracking features.

3.2 Explanation of the Architecture Diagram

As mentioned in Figure 1.4 here is a detailed explanation of the architecture diagram

- **Responsive User Interface**

The interface is meticulously crafted to be responsive, adapting dynamically to the screen size and orientation of the device. This design philosophy guarantees an optimal user experience, irrespective of the device employed by students. It reflects a commitment to accessibility, acknowledging the diverse technological landscape students may navigate.

- **Student Interface**

The student interface serves as the cornerstone of the system, offering students seamless access to a myriad of educational resources. Beyond merely viewing course materials and assignments, students can actively engage with instructors and peers. This web-based application ensures accessibility across various devices, providing students with a consistent and user-friendly experience.

- **Administration**

At the heart of the system's administrative capabilities lies a robust component. Instructors wield the power to create, manage, and fine-tune courses effortlessly. This administrative facet facilitates student enrollment processes, allowing for the seamless addition and removal of students. Moreover, it empowers instructors with tools for comprehensive progress tracking, report generation, and analytical insights.

- **Driver Interface**

The driver interface, embodied in a mobile application, empowers bus drivers with real-time control and monitoring capabilities. By tracking the bus's location and estimating arrival times at each stop, drivers enhance communication with students and parents. The interface serves as

a conduit for drivers to dispatch real-time alerts, ensuring timely communication of delays or alterations in the bus route.

- **Receiving Location and Predicted Arrival Time**

A critical interaction point is the system's reception of the bus's location and predicted arrival time from the driver interface. This information undergoes seamless integration into the student interface, offering students real-time insights into the location of their bus.

- **Sending Live Location Using GPS and ETA**

Conversely, the system actively transmits the live location and estimated arrival time of the bus to the student interface. This information manifests visually on a map, empowering students to track the bus's movement and anticipate its arrival at their designated stop.

- **Receiving Real-Time Alert System**

Real-time alerts emanating from the driver interface are received by the system, detailing any alterations or delays in the bus route. These alerts are swiftly disseminated to students and parents through the student interface and push notifications, ensuring timely awareness.

- **Sending Real-Time Alert System**

Complementing the reception of alerts, the system proactively sends real-time notifications to students and parents regarding changes or delays in the bus route. This bidirectional communication mechanism fosters transparency and responsiveness.

- **Sending Real-Time Boarding Position System**

A vital feature entails the system broadcasting the real-time boarding position of the bus to the student interface. Displayed on a map, this information equips students with a visual representation of the bus's current location and upcoming boarding positions.

- **Receiving Real-Time Boarding Position System**

Conversely, the system integrates the real-time boarding position data received from the driver interface. This integration ensures that the student interface remains up-to-date, providing students with accurate and real-time information about the bus's location and boarding positions.

- **Deployment**

To ensure widespread accessibility, the system is deployed on Firebase, a robust cloud-based platform. This strategic deployment choice empowers students and instructors with the flexibility to access the system from any geographical location globally.

- **Server Database**

The system's central repository resides in Firebase's real-time database, housing a comprehensive dataset. This dataset encompasses student records, course materials, and assignment grades. Firebase's architecture is designed for efficiency, ensuring quick data retrieval and updates.

3.3 Modules Connectivity Diagram

As shown in Figure 3.1, raw data i.e foundational Driver GPS Module serves as the source of raw GPS data, providing critical information about the bus's location. The Gateway acts as a crucial link, transferring data to the BuslaG Application, the system's core software. This application processes raw data, offering real-time insights into tracked assets' locations. Live Location Tracking provides dynamic, accurate updates on asset movements. Predicted Arrival Time estimates when assets will reach destinations, aiding user planning. The Alerting System sends timely notifications about disruptions. The Onboarding Positions System enhances efficiency by providing boarding information. Performance Evaluation assesses the system efficiently.

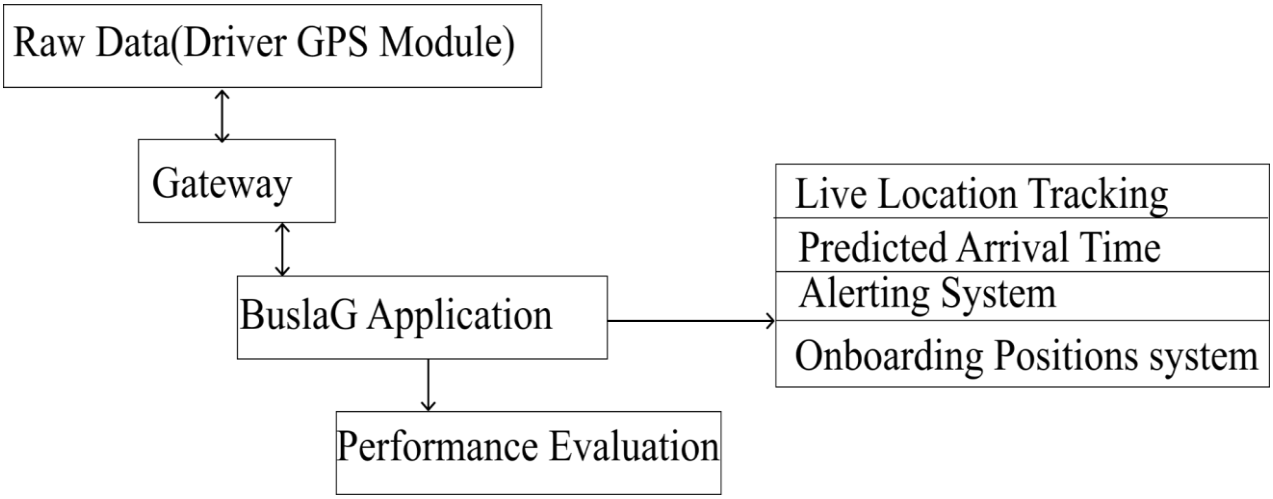

Figure 3.1 Module-connectivity Diagram

3.4 Software and Hardware

Requirements Software Requirements

- Kodular >=1.5.2

  Kodular is a user-friendly platform that lets you create mobile applications without needing to know complex coding languages. It uses a simple drag-and-drop interface, meaning you can build your app by moving pre-made blocks around rather than typing out lots of code. It offers a wide range of components and features you can add to your app, like buttons, text boxes, and even more advanced things like GPS functionality or connecting to databases. With Kodular, you don't have to start from scratch; you can use their library of pre-built features and customize them to suit your app's needs. Plus, you can extend your app's capabilities by adding in extra features through third-party extensions or even creating your own. The platform is great for beginners since it uses a visual, blocks-based system for programming. It's pretty intuitive; you just connect the blocks to create the actions you want your app to perform. Plus, there's a supportive community and helpful resources available if you get stuck or need guidance.

  Ultimately, Kodular makes app development accessible to people who might not have a coding background, allowing them to create their own customized mobile applications for Android devices.

- Firebase>=v7.1.0

  Firebase is a suite of tools provided by Google to help developers build and manage apps more easily. It offers various services like a database to store app data, authentication to manage user logins, cloud functions for running code, hosting for app deployment, analytics for tracking user behavior, cloud messaging for notifications, and more. Developers can pick and choose which Firebase services they need for their app, making it simpler to handle complex tasks like storing data, managing users, analyzing app performance, and adding machine learning features. It's like a toolbox that provides ready-to-use solutions for common app development needs, saving time and effort in creating and managing these functionalities from scratch.

Hardware Requirements

- Smartphones with GPS >= Android version 6.0

- stable internet connectivity for drivers and server
- user devices (smartphones) for students and administrators>= Android version 5.0

3.5 Modules and their Description: This section provides the detailed description of the modules which are the building blocks of this project. The function of these modules together completes this whole project.

3.5.1 Raw Data (Driver GPS Module)

The initial component, the Driver GPS Module, serves as the foundational element by providing raw GPS data directly from the GPS receiver. This raw data includes critical information about the bus's current location, offering the starting point for the entire tracking system.

3.5.2 Gateway

The Gateway acts as the intermediary between the GPS tracking system and the internet. It functions as a pivotal connection point, facilitating the transfer of GPS data from the Driver GPS Module to the central BuslaG Application. This device plays a crucial role in ensuring seamless communication and data flow within the system.

3.5.3 BuslaG Application

At the core of the system, the BuslaG Application is the software that stores and manages the GPS data received from the Driver GPS Module. This application serves as the brain of the operation, processing and organizing the raw data to provide meaningful insights into the real-time location of tracked assets.

- **Live Location Tracking:** Live Location Tracking is a critical component that utilizes the processed GPS data from the BuslaG Application. It provides users with real-time updates on the location of the tracked assets, offering a dynamic and accurate representation of their movements on a map.
- **Predicted Arrival Time**
- **Alerting System**
- **Onboarding Positions System**
- **Performance Evaluation**

3.6 Requirements Engineering

Key functionalities for bus tracking: real-time tracking, route planning, user management, navigation guidance, feedback system, issue reporting for improved experience.

3.6.1 Functional Requirements

When developing a bus tracking application using Kodular, you can incorporate various functionalities and features to enhance the user experience. Here are specific functionalities and features that can be expected from a bus tracking application built with Kodular

Real-Time Bus Tracking

GPS Integration: Utilize the device's GPS capabilities to track the real-time location of buses.

Map Display: Show the buses' locations on a map in real time, allowing users to visually track their positions.

Bus Markers: Display markers or icons representing buses on the map to indicate their locations.

Bus Route Planning

Bus Routes and Stops: Provide information about bus routes, stops, and schedules within the application.

Route Search: Enable users to search for specific routes or stops, allowing them to plan their journeys effectively.

User Account Management: User Registration and Login: Provide user registration and login functionality to personalize the user experience and store user preferences.

User Profiles: Allow users to manage their profiles, update personal information, and save favorite routes or stops.

Navigation and Directions

- **Turn-by-Turn Directions:** Provide navigation instructions to guide users from their current location to the nearest bus stop or a specific destination.
- **Nearby Bus Stops:** Show nearby bus stops based on the user's current location, assisting users in finding the closest stop.

- **Feedback and Ratings:** User Feedback: Incorporate a feedback feature where users can provide ratings, comments, or suggestions regarding the bus service or application functionality.
- **Reporting Issues:** Allow users to report any issues or incidents encountered during their bus journeys.

3.6.2 Non-Functional Requirements

Non-functional requirements, also known as quality attributes, specify the characteristics and constraints of a bus tracking application that are not directly related to its specific functionalities. These requirements define the overall performance, reliability, security, usability, and maintainability of the application. Here are some non-functional requirements that are important for a bus tracking application.

Performance

Responsiveness: The application should provide real-time updates and quick response times to user interactions, such as map zooming, searching for routes, or tracking bus locations.

Scalability: The application should be able to handle increasing numbers of users and bus tracking data without significant performance degradation.

Efficient Resource Usage: Optimize resource usage, such as CPU, memory, and network bandwidth, to ensure the application operates smoothly and efficiently.

Reliability and Availability

System Reliability: The application should be stable and reliable, minimizing crashes, errors, and unexpected behavior.

Redundancy: Implement backup systems or redundant servers to ensure continuous availability of the application even in the event of a failure or maintenance activity.

Security

User Authentication and Authorization: Implement secure user authentication mechanisms to protect user accounts and ensure that only authorized users can access sensitive features or data.

Data Encryption: Encrypt sensitive user data, such as passwords or personal information, to ensure confidentiality and prevent unauthorized access.

Secure Communication: Use secure protocols (e.g., HTTPS) to transmit data between the application and external systems, ensuring the privacy and integrity of the exchanged information.

Usability and User Experience

Intuitive Interface: Design a user-friendly and intuitive interface that is easy to navigate and understand.

Accessibility: Ensure the application is accessible to users with disabilities, complying with accessibility standards and guidelines.

Consistency: Maintain consistency in the visual design, interaction patterns, and terminology used throughout the application.

3.7 Analysis and Design through UML

The Unified Modeling Language (UML) can be used to model and document software systems. It includes a set of diagrams and concepts which are used for representing the different aspects of software systems, including their structure, behavior as well as interactions with external systems. Different types of diagrams such as Class diagrams, Activity diagrams and Sequence diagrams,

which represent distinct aspects of a software system can be created using UML. Any software developed through Object-oriented cannot be successful without the UML. Since all software systems are developed with thousands of lines of code, UML makes it easy to trace relationships, understand relationships, and track workflows. It provides the facility to understand the architecture of the system and maintain communication between the diagrams. It helps you understand roles, assign people, and maintain communication between them during the workflow. In software development, UML is widely used to communicate and document the design and structure of the software system. It would be helpful to allow for clarification and exchange of

complex ideas and concepts, identifying the possible problems or difficulties in designing a system before its implementation.

Class Diagrams

The Class Diagrams are the building blocks of UML. It gives an overall illustration of the system. It is also used to understand the business perspective of the model. Based on the information given the Class Diagrams are designed no matter how complex or simple the information is. This is used to represent the structure of a software system by including class, attributes, methods, and their relationship.The class diagram portrays the relationships and functionalities among various classes within the BuslaG application as shown in the Figure 3.2, facilitating the interaction between bus drivers and students while enabling location tracking and communication.

Interaction and Functionality

The BuslaG Application class utilizes the Location class to manage and store the current location data of both bus drivers and students. Real-time tracking is facilitated by invoking the updateLocation methods within the BusDriver and Student classes to update their respective locations. The application uses the FirebaseDatabase class for persistent storage of location data, enabling continuous tracking and communication between bus drivers and students even in offline scenarios. Any change in the student's location triggers a notification from the BuslaG Application class to the respective bus driver, enhancing communication and coordination.

In summary, this comprehensive class diagram outlines the connections and functionalities of the BuslaG application, ensuring efficient communication, location tracking, and interaction between bus drivers and students.

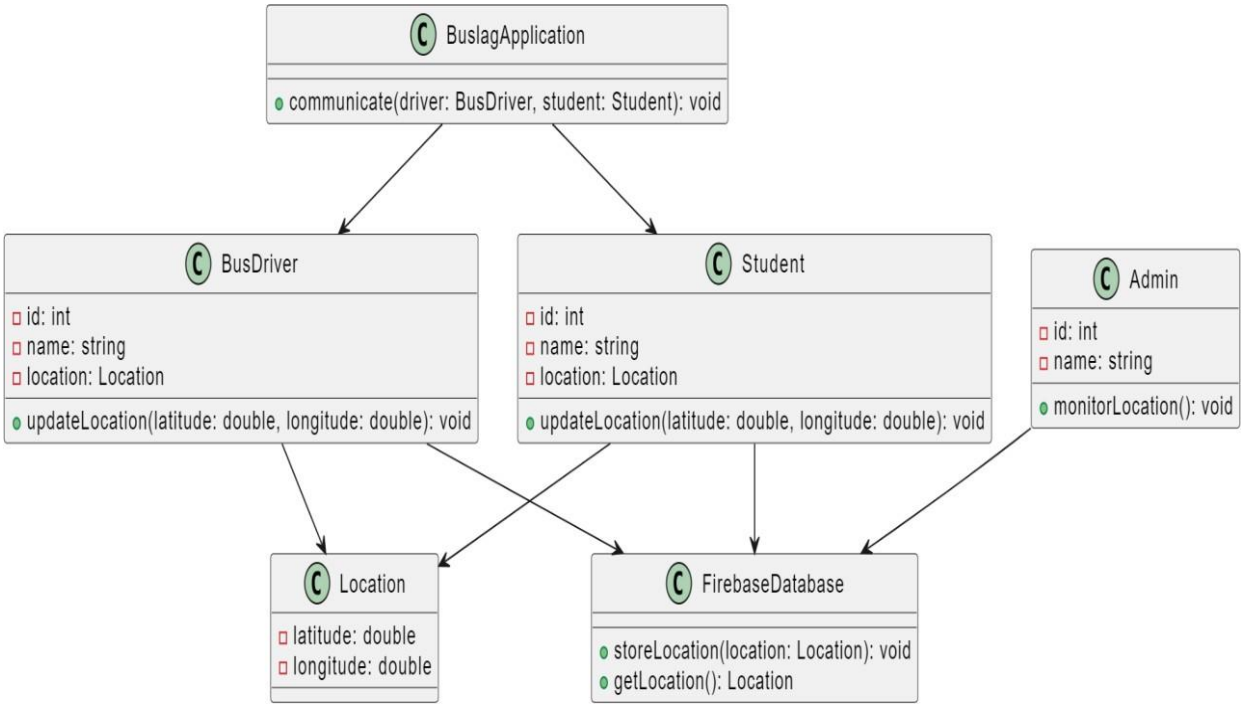

Figure 3.2 Class Diagram

Sequence Diagram

Sequence diagrams are a common tool for modeling the behavior of It is used to represent model's interactions between components and objects over time, such as the order of sending and receiving messages in a software system or complex systems in general. The sequence Diagram consists of Lifeline, actor, activation, and message. A lifeline is used to represent the individual participant. An actor is an object which interacts with the system. Activation is represented in a rectangle which depicts the amount of time required for operating by an element. The message is used to interact between instances. The sequence diagram shows the steps of a buslaG application. The first step is to communicate with the bus driver student as shown in figure 3.3. The bus driver student uses the BuslaG application to communicate with the bus driver student. The second step is to get a location. The bus driver student uses the BuslaG application to get their current location. The third step is to store the location in the FirebaseDatabase. The fourth step is to retrieve the location of the bus driver student from the FirebaseDatabase. The fifth step is to update the location of the bus driver student in the BuslaG application. The sixth step is to monitor the location of the bus driver student. The seventh step is to send a notification to the bus driver when the location of the bus driver student changes.

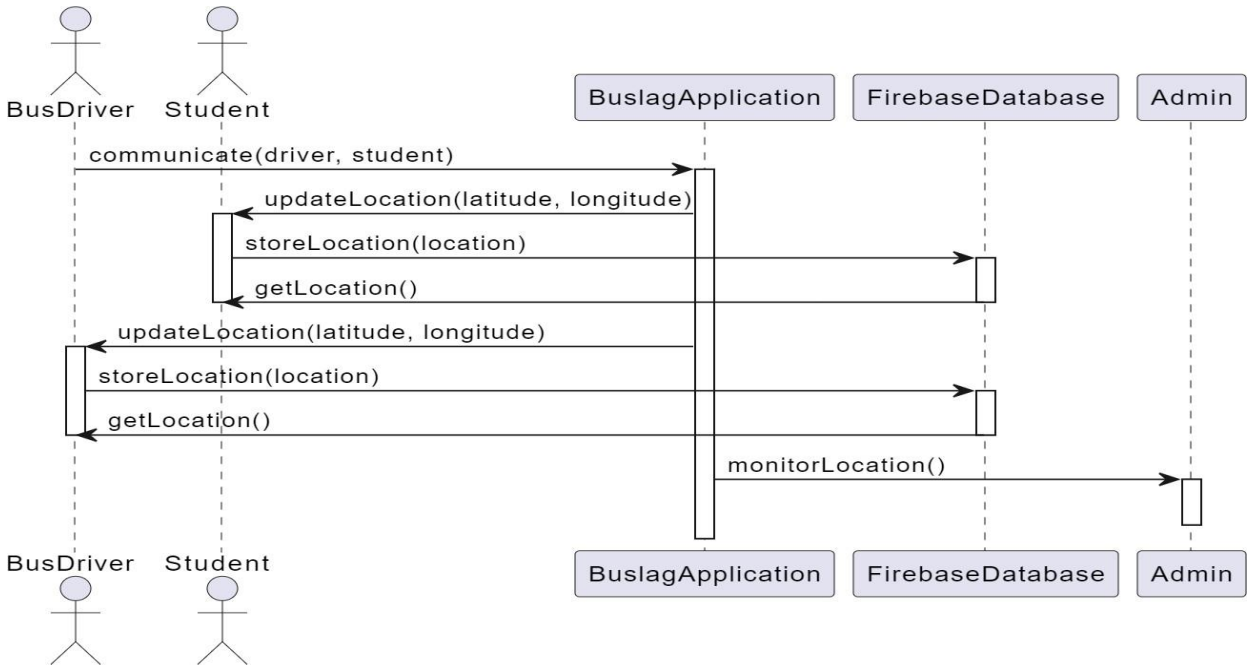

Figure 3.3 Sequence Diagram

Summary

The sequence diagram delineates the step-by-step flow of interactions within the BuslaG application. It starts with enabling communication channels between bus driver students and bus drivers, followed by location-related actions such as obtaining, storing, retrieving, and updating location data. Continuous monitoring ensures real-time tracking, and notifications serve as alerts to inform the bus driver about changes in the bus driver student's location. Overall, the sequence diagram portrays how the BuslaG application facilitates communication and location tracking between bus driver students and bus drivers in a coherent and systematic manner.

Usecase diagram

The use case diagram for Buslag shows the following actors: Bus Driver, Student, and Admin. The use cases are: Update Location, Communicate, and Monitor Location which are mentioned in the figure 3.4 .

The Bus Driver actor can use the Update Location use case to update their current location. The

Student actor can use the Communicate use case to communicate with the Bus Driver actor. The Admin actor can use the Monitor Location use case to monitor the location of the Bus Driver actor and the Student actor. The use case diagram shows that the Buslag application allows bus drivers, students, and admins to communicate with each other and track each other's location.

Here is a more detailed explanation of each use case

Update Location

The Update Location use case allows the Bus Driver actor to update their current location. This is done by sending a message to the Buslag application with the Bus Driver actor's current latitude and longitude. The Buslag application then stores the Bus Driver actor's current location in the FirebaseDatabase.

Communicate

The Communicate use case allows the Student actor to communicate with the Bus Driver actor. This can be done through a variety of means, such as text chat, voice chat, or video chat. The Buslag application uses the FirebaseDatabase to facilitate communication between the Student actor and the Bus Driver actor.

Monitor Location

The Monitor Location use case allows the Admin actor to monitor the location of the Bus Driver actor and the Student actor. This is done by retrieving the Bus Driver actor's current location and the Student actor's current location from the FirebaseDatabase. The Admin actor can then view the Bus Driver actor's current location and the Student actor's current location on a map.

The use case diagram for Buslag shows that the application provides a variety of features that are useful for bus drivers, students, and admins. The Update Location use case allows bus drivers to keep their current location up-to-date, which is important for safety and security reasons. The Communicate use case allows students to communicate with bus drivers, which can be helpful for questions or concerns. The Monitor Location use case allows admins to monitor the location of bus drivers and students, which can help track and dispatch buses.

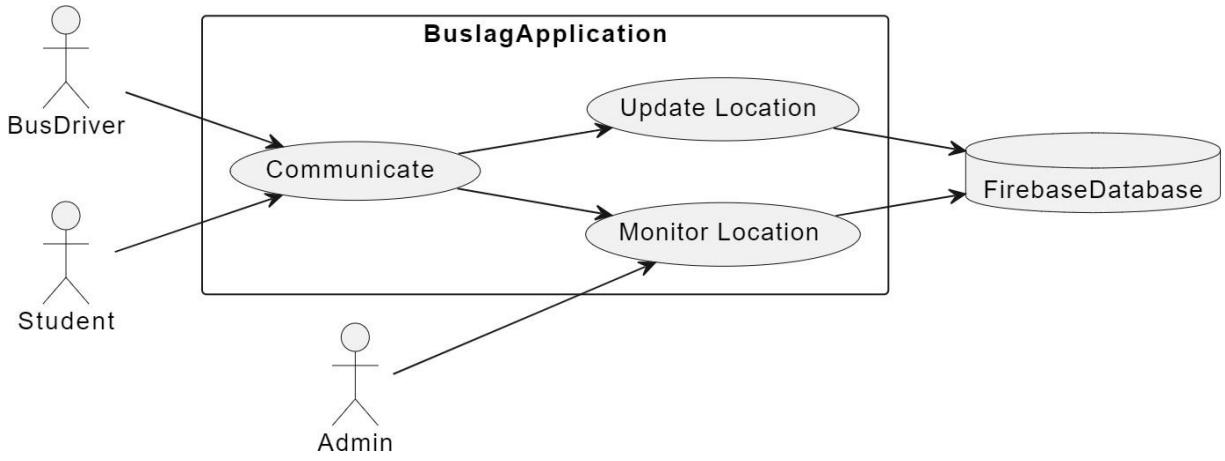

Figure 3.4 Usecase Diagram

Activity Diagram

Activity diagrams are a type of behavioral diagram in the Unified Modeling Language (UML) that visually represent the flow of activities and control flow logic within a system. They are commonly used for modeling business processes, workflows, and software algorithms.

Key Elements of Activity Diagrams

- **Activity Nodes:** Represent actions or operations performed within the system.
- **Arrows:** Indicate the flow of control between activities.
- **Decisions:** Represent branching points where the flow of control is determined based on conditions.
- **Merge Points:** Indicate where multiple flow paths converge back into a single flow.
- **Start and End Nodes:** Represent the beginning and end points of the process.

Activity diagrams are a powerful tool for understanding and modeling the behavior of systems, particularly in complex processes with multiple decision points. Their visual nature and clarity make them valuable for communication, documentation, and error detection.

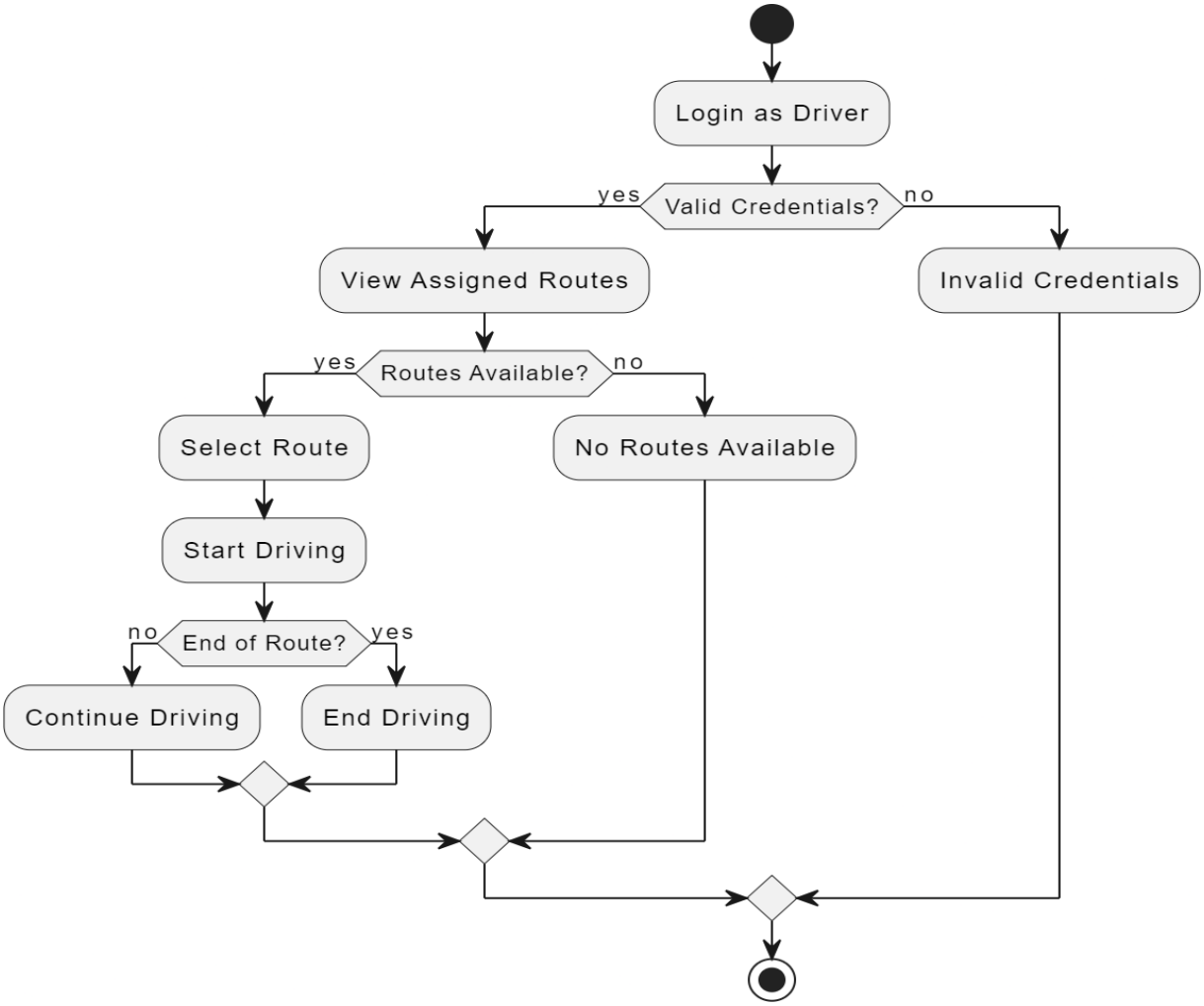

Figure 3.5 Activity Diagram

CHAPTER 4

RESULT AND DISCUSSIONS

4.1 Description of the Data

The data collected from the college transport department for the Buslag application provides a rich foundation for creating various features to enhance the overall user experience.

- **Overview of Data**
- Route: Names of bus routes.
- Time: Departure times from each stop.
- Fee: Ticket fares for each route.
- Stops: List of stops on the route.

Features Development

Real-time Tracking: Utilizing GPS data, the application tracks buses on a map, providing live updates to both students and administrators about the bus's current location.

Route Planning: By analyzing route data, students can efficiently plan their bus journey, identifying the most optimal route to their destination through the application.

Fare Estimation: Leveraging fee data, the application estimates fares for specific routes, enabling students to purchase tickets online based on accurate fare estimates.

Real-time Tracking Example

Data Retrieval: The Buslag app fetches the bus's real-time location from GPS.

Location Comparison: It compares this location to scheduled stops, determining proximity.

Map Updates: The app dynamically updates the map, displaying the bus's position and estimated arrival times at each stop.

User Experience: Students and admins access the map, allowing them to track the bus's progress in real-time.

2023-24

ROUTE No 1 L B Nagar

ROUTE	TIME	FEE
Chintal Kunta	7:30 AM	50000
L B Nagar	7:35	50000
Nagole	7.40	50000
Uppal Ring Road	7.50	50000
Habsiguda	7.55	50000
Tarnaka	8.00	50000
Rail Nilayam	8.05	45000
Himalaya	8.10	45000
Paradise	8.15	45000
Begumpet	8.20	40000
Lalbunglow	8.25	40000
Balkampet	8.27	40000
Fathenagar	8.29	40000
Sanat Nagar	8.30	36000
Kukatpally	8.50	30000
K P H B	9.00	23000
JNTU	9.03	23000

JAYENDER
9959060641

ROUTE No 2 ECIL

ROUTE	TIME	FEE
ECIL	7.30AM	50000
A S Rao Nagar	7.35	50000
Sainikpuri	7.40	50000
Neredmet	7.45	50000
Vinayak Nagar	7.47	50000
Safil Guda	7.50	50000
Lalbazar	8.00	46000
Lothukunta	8.05	46000
Alwal	8.07	46000
Suchitra	8.20	43000
Kompally	8.30	41000
Bahadurpally	9.10	32000
Bachupally	9.30	15000

NARSIMHA CHARY
9618948324

ROUTE No 3 Mehdipatnam

ROUTE	TIME	FEE
Mehdipatnam	7.50AM	50000
Tolichowki	8.00	50000
Shaikpet	8.05	50000
Darga (Manikonda)	8.10	50000
Rayadurgam P S	8.15	47000
Gachibowli	8.20	47000
Kothaguda x road	8.30	43000
Cyber Towers	8.35	40000
Madhapur PS	8.40	40000
Ayyappa Society	8.50	37000
YSR Statue	8.55	37000
Hitech city station	9.00	27000
Malasian Town Ship	9.05	24000
Isthara	9.10	24000
JNTU	9.15	23000
Nizampet X Road	9.25	15000

JAHANGIR
9542235621

ROUTE NO 4 Jeedimetla

ROUTE	TIME	FEE
Suchitra	7.50AM	43000
Dairy Farm	8.00	42000
Bowenpally PS	8.05	42000
Feroz Guda	8.10	42000
Bala Nagar	8.15	35000
IDPL	8.20	35000
Chintal	8.22	35000
Shapur	8.30	35000
Jeedimetla Depo	8.40	35000
Suraram	8.45	35000
Gandimaisamma	8.50	32000
Pragathi Nagar Road	9.00	23000
Bachupally	9.15	15000

VENKATESHWAR RAO
9949251546
(Gajula Ramaram)
NAGESHWARA REDDY
9963837352

ROUTE NO 5 S R Nagar

ROUTE	TIME	FEE
Yusufguda	8.30AM	45000
K K Towers	8.35	42000
Kalyan Nagar	8.55	42000
Mothi Nagar	9.00	42000
Mytrivanam	8.40	39000
S R Nagar	8.45	39000
Vengala Rao Nagar	8.50	39000
Erragadda	9.05	35000
Kukatpally	9.15	30000
K P H B	9.20	23000
JNTU PS	9.30	23000

GOPAL
9963833781

ROUTE NO 6 Lingampally

ROUTE	TIME	FEE
Patancheru	8.30AM	42000
R C Puram	8.35	40000
Berum guda	8.40	38000
Ashok Nagar	8.45	38000
Lingampally X Road	8.50	32000
Chanda Nagar	8.55	32000
Madhinaguda	9.00	32000
Alwyn Chowrasta	9.10	26000
Miyapur	9.20	15000
B K Enclave	9.25	15000

BALA RAJU
7981663609

Figure 4.1 Raw data of bus route

Summary:

The collected data from the college transport department as shown in figure 4.1 serves as the backbone for Buslag's functionalities. It enables real-time tracking, route planning, fare estimation, and arrival alerts. For instance, the real-time tracking feature utilizes GPS data to display live bus locations, aiding both students and administrators in monitoring bus progress. This comprehensive utilization of data enhances the app's usability and convenience, ultimately improving the overall transportation experience for users.

4.2 Detailed Explanation of the Experimental Results

The live location updation feature has been a resounding success as shown in Figures 4.2 and 4.3 of the gateway updation of location, with students and admins reporting a significant improvement in their overall transportation experience. Students have been able to use the feature to track the bus location in real-time, avoid being late for class, and reduce anxiety. Admins have been able to use the feature to monitor the movement of buses, ensure that they are running on schedule, and improve the safety of students and staff.

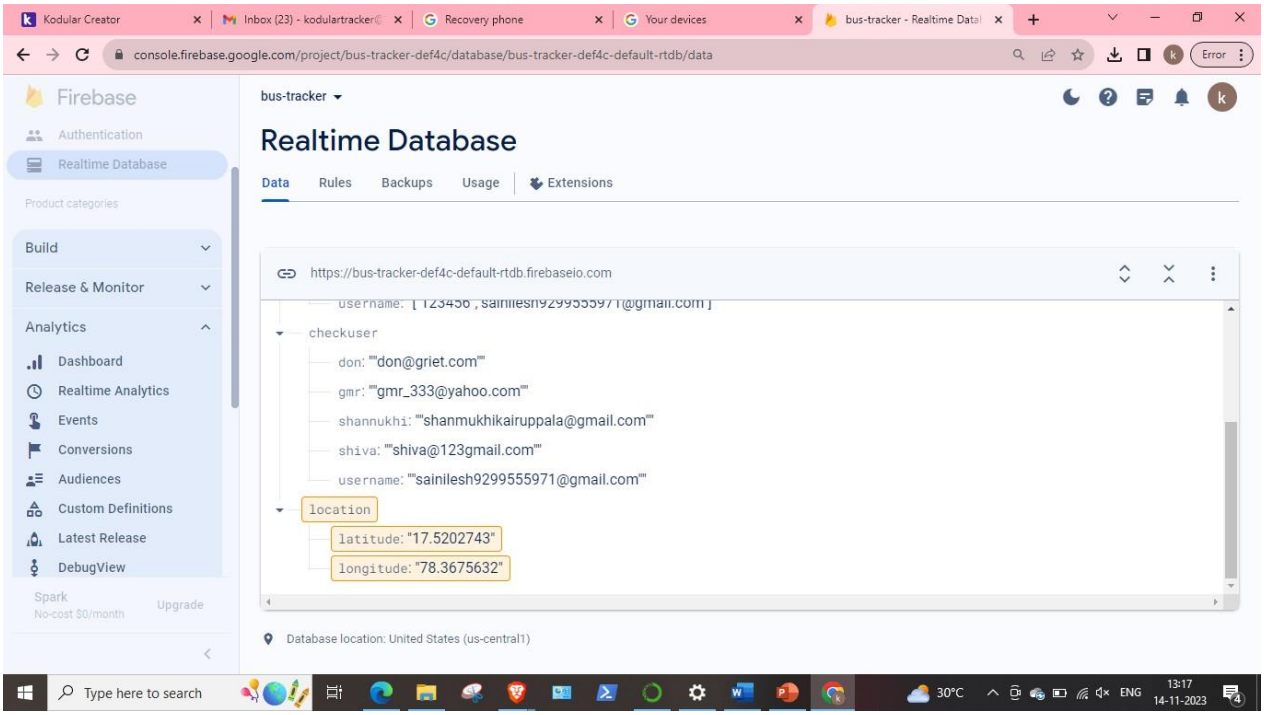

Figure 4.2 Gateway location updation-1

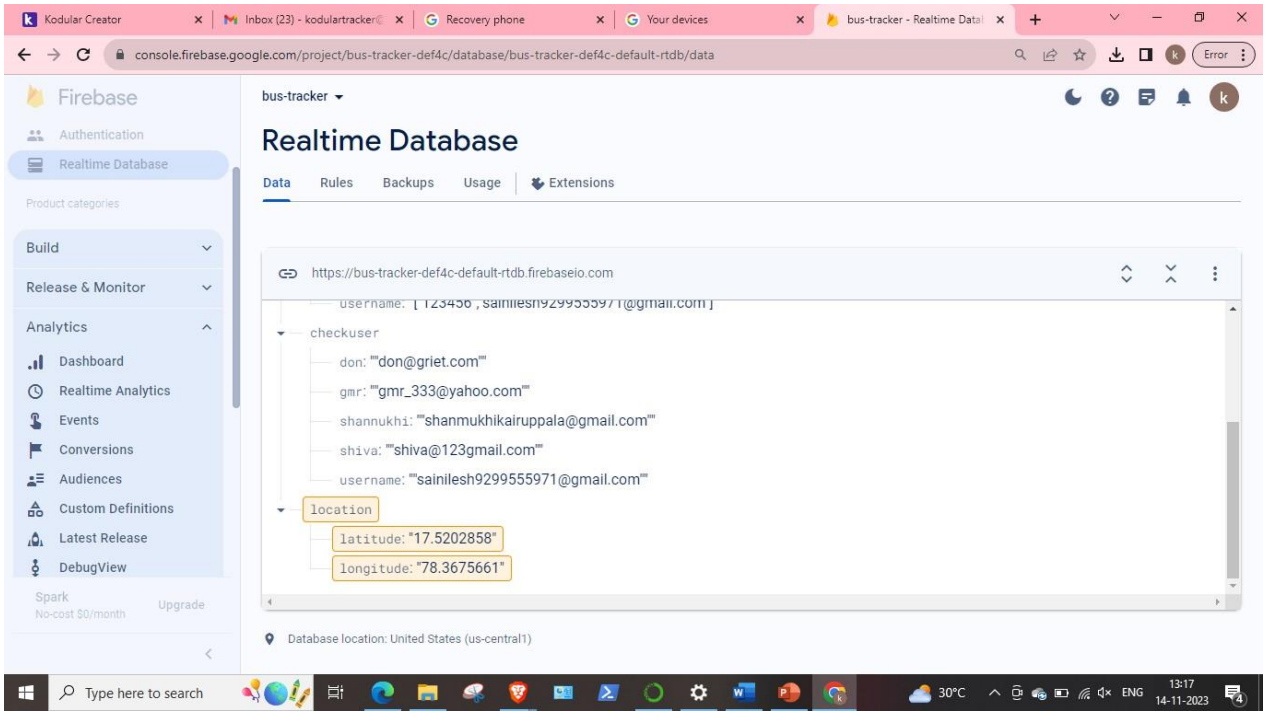

Figure 4.3 Gateway location updation-2

Based on these results, it is clear that the live location updation feature has been a valuable addition to the Buslag application and has significantly improved the transportation experience for college students in Hyderabad.

BuslaG Application

- **Opening the App**

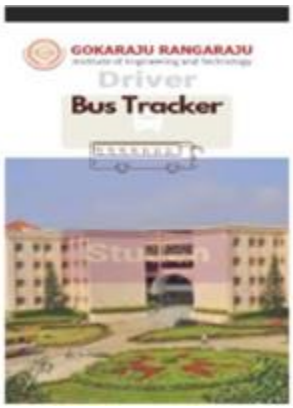

Figure 4.4 Home screen of the application

Users access the Select app on their mobile phones or tablets.

Upon opening, the login screen greets the user as shown in Figure 4.4.

- **Logging In**

Users input their provided username and password.

These credentials are granted by the respective school or organization linked to the app.

- **Selecting a Role:**

Figure 4.5 Role Section Page

Once logged in, a screen prompts the user to choose their role—typically "driver" or "student" as shown in Figure 4.5.

Users select the role that corresponds to their position or purpose for using the app.

Driver

Login and Updating Location

Figure 4.6 Driver Login Page

Drivers log in using their provided credentials, gaining access to the app's dashboard as

shown in figure 4.6.

Upon login, drivers can update their current location using the app's GPS functionality.

Students

Figure 4.7 Various routes

Students log in to the app by accessing the app's user interface.

The app presents a selection of various routes for transportation, detailing stops, schedules, and route specifics as shown in Figure 4.7.

Choosing and Tracking Routes

Students select their desired route from the available options within the app as shown in figure 4.8.

Once a route is selected, the app provides a real-time map displaying the location of the bus or driver assigned to the chosen route.

- **Tracking Bus Location**

Using the real-time tracking feature, students can view the current location of the bus on the map. This enables students to track the bus's progress as shown in Figure 4.8 and anticipate its arrival at their location or designated stop. The app displays the current location of the driver or student on a map interface.

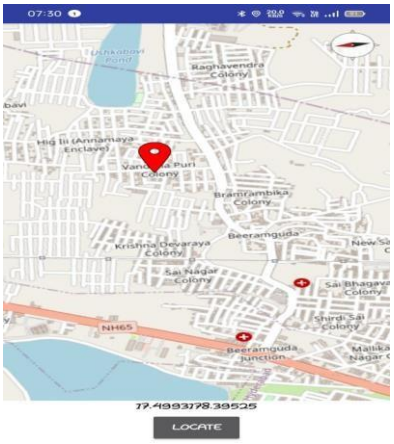

Figure 4.8 Tracking result

CHAPTER 5

CONCLUSION AND FUTURE ENHANCEMENTS

The BuslaG system stands as an innovative solution, revolutionizing bus tracking by offering real-time updates and improving user navigation experiences. Its successful implementation and demonstrated efficiency in facilitating communication between drivers and passengers reflect its immediate impact. Looking ahead, BuslaG's future enhancements revolve around refining existing features and introducing new functionalities. Improving predictive arrival times is a key area for enhancement. By fine-tuning algorithms and leveraging historical data, the system aims to provide more accurate estimations, enabling users to better plan their journeys.

Enhancing the alert system represents another crucial facet. Customizing alerts for diverse scenarios, such as route changes, delays, or emergencies, will significantly benefit users. These tailored notifications will ensure timely communication, keeping passengers informed and enhancing overall user satisfaction. Expanding the user interface to cater to a wider audience is also a priority. Making the application more accessible across various devices and user demographics will increase its usability and reach. Introducing features like multi-language support and accessibility options will further augment BuslaG's user-friendliness. Moreover, integrating additional functionalities, such as in-app support for direct communication between drivers and students, holds promise. Enabling chat or voice features within the app can enhance real-time interaction and foster a more connected community.

Future iterations will prioritize scalability and adaptability. Ensuring the system can handle increased user volume without compromising performance is vital. This involves optimizing backend infrastructure and data processing mechanisms to sustain smooth operation during peak usage times.Additionally, exploring potential partnerships or integrations with external services, such as local transport authorities or ride-sharing platforms, could extend BuslaG's utility. Collaborations could enhance route planning, offer interconnectivity with other transportation modes, and widen its scope of service.

In conclusion, BuslaG's future enhancements aim to elevate the system's functionality, usability, and reliability. By focusing on refining existing features and introducing new capabilities, BuslaG aspires to continue shaping a more efficient and user-centric bus

transportation ecosystem.

CHAPTER 6

APPENDICES

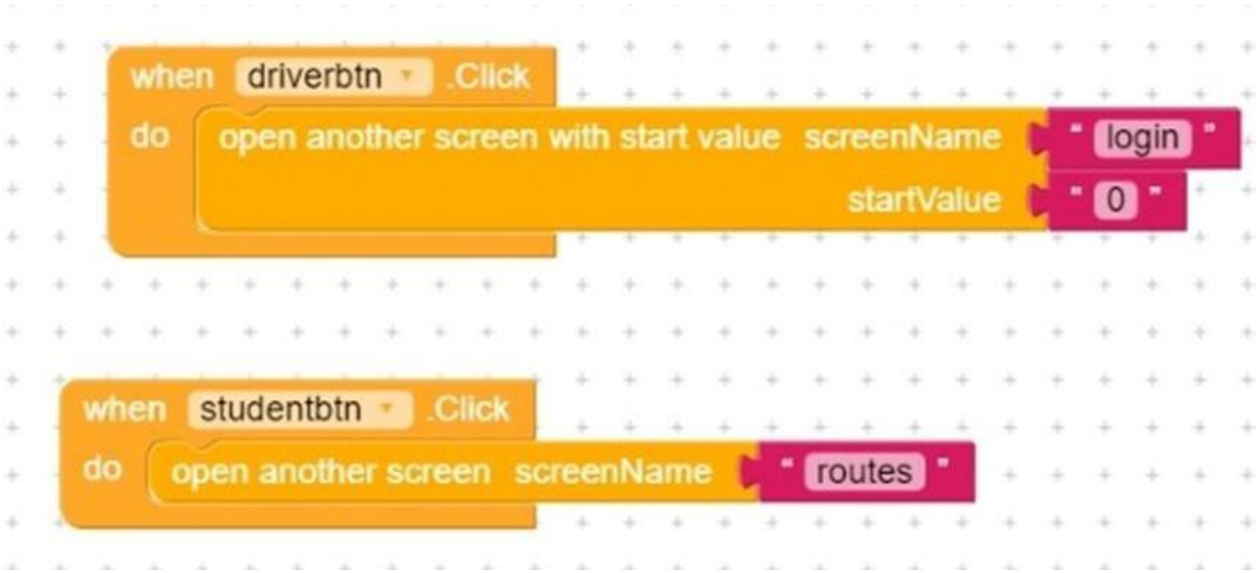

Figure 6.1 Code snippets of Role Section Page

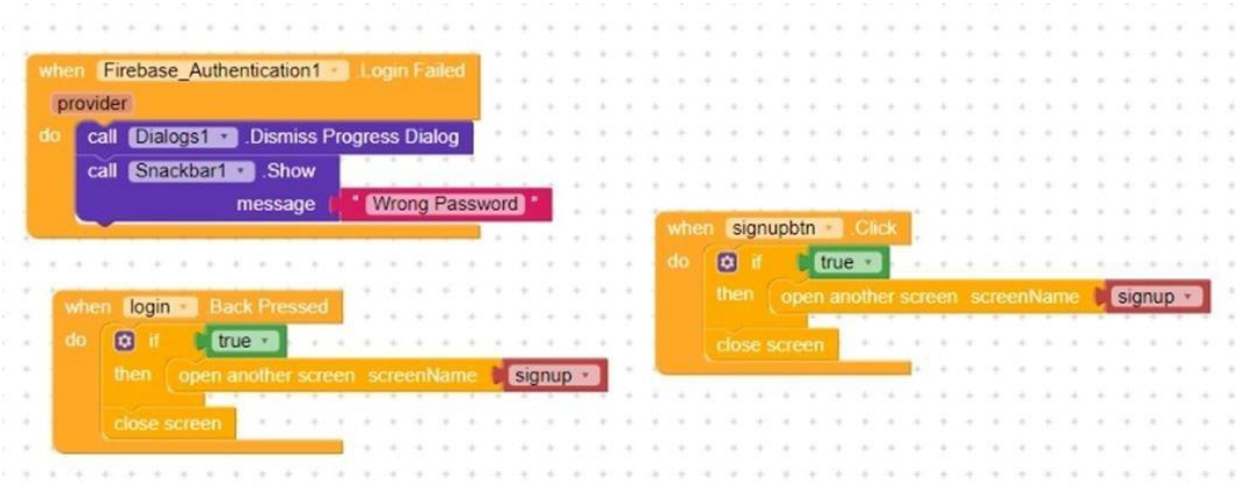

Figure 6.2 Code snippets of Driver Login Page

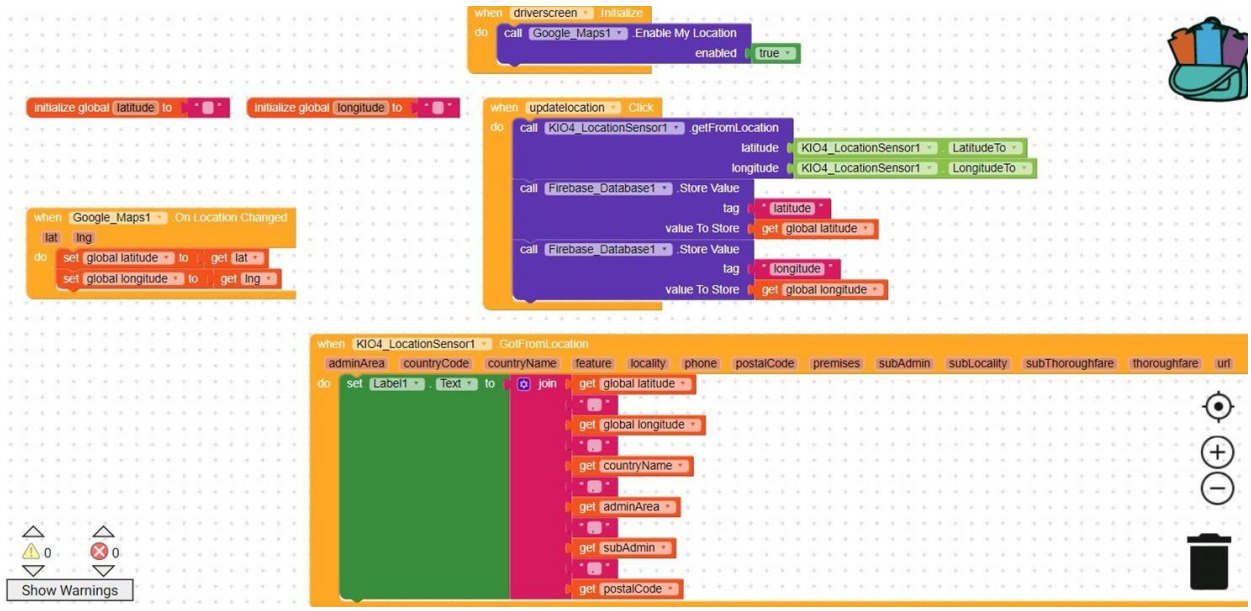

Figure 6.3 Code snippets of Updation of Location

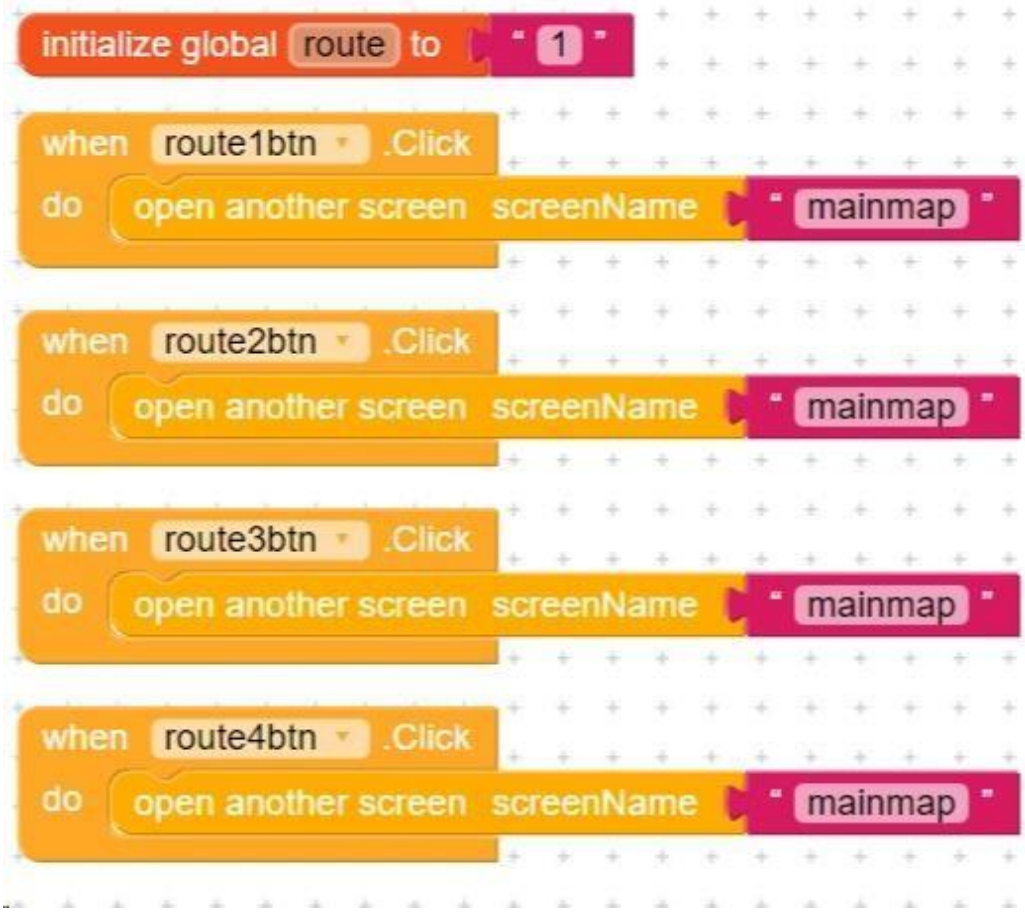

Figure 6.4 Code snippets of Route Selection

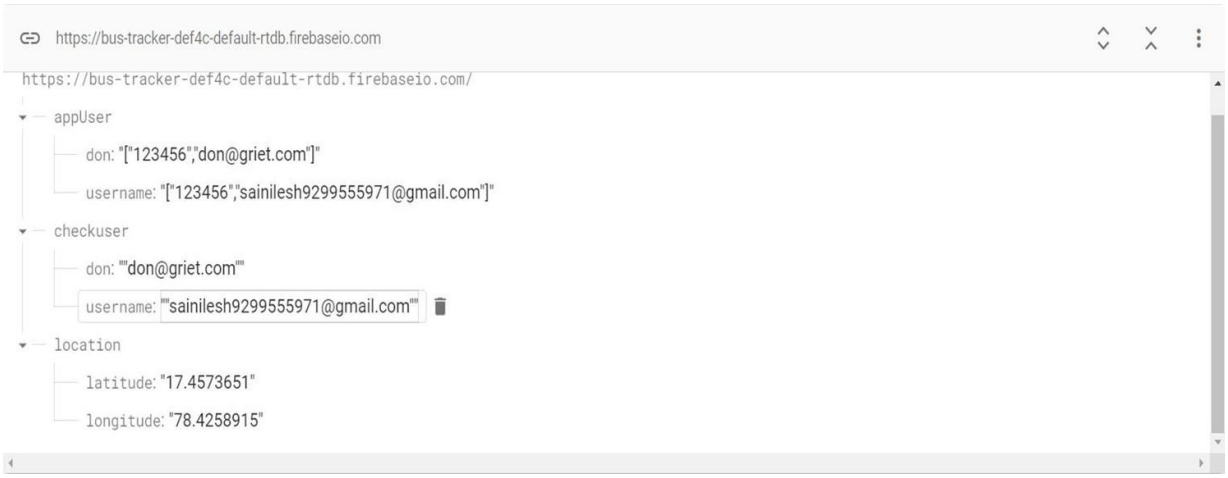

Figure 6.5 Code snippets of Firebase Database

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