NTU Ride Pilot

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BACHELOR OF SCIENCE IN COMPUTER SCIENCE

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Certification

This is to certify that this project titled "**NTU Ride Pilot**" was found to satisfy the requirement for the award of a "**Bachelor of Sciences in Software Engineering**" degree by the Department of Computer Science, National Textile University.

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Declaration

We hereby declared that this document is completely written by us, and it is totally our effort and none of anyone from outside of our group has copied it. This Report is purely written technically in accordance with our project.

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Acknowledgement

First of all, In the Name of Allah, the Most Beneficent, the Most Merciful. All the praises and thanks be to Allah. A lot of love for our beloved Holy Prophet MUHAMMAD (S.A.W), his guidance always helps us to get the right path. After that, the preparation of this Software Requirements Specification (SRS) document was a collaborative effort involving Abubakar, Imran, and Huzaifa. The author would like to acknowledge and express gratitude to all individuals who directly or indirectly contributed to the completion of this document. Special thanks are extended to our Supervisor Zahid Javed and our Co-Supervisor Muhammad Naeem, who provided invaluable guidance and support throughout the SRS preparation process. The author would also like to acknowledge the invaluable support and suggestions provided by Zahid Javed. This SRS document would not have been possible without the support and cooperation of all involved individuals. The author is confident that this document will serve as a comprehensive guide for the development and implementation of the NTU Ride Pilot.

Signed by:

Abubakar Nadeem,

Imran Ali Niaz,

Huzaifa Ahmad,

Date:

00/00/2025

Abstract

Efficient and secure transportation is vital for educational institutions, where thousands of students rely on daily commutes. However, current systems face significant challenges, including inefficiencies, security vulnerabilities, and a lack of real-time tracking and communication. Issues such as overcrowding, unauthorized access, and poor resource utilization arise when students board buses without proper verification. Additionally, the absence of real-time bus monitoring and effective communication channels leads to confusion, delays, and suboptimal transport management.

The *NTU Ride Pilot* addresses these challenges by integrating advanced technologies like RFID-based ID verification, live GPS tracking, and automated communication tools. The system ensures only authorized students access transport services, provides real-time visibility of bus locations for students, parents, and administrators, and enables timely updates regarding delays, route changes, or emergencies. It also tracks driver performance, monitors bus occupancy, and generates insights for optimizing route planning and capacity utilization.

By modernizing transport operations, the *NTU Ride Pilot* enhances safety, boosts operational efficiency, and delivers a reliable and user-friendly commuting experience. This solution is an ideal choice for educational institutions aiming to transform their transportation infrastructure with secure and efficient technology.

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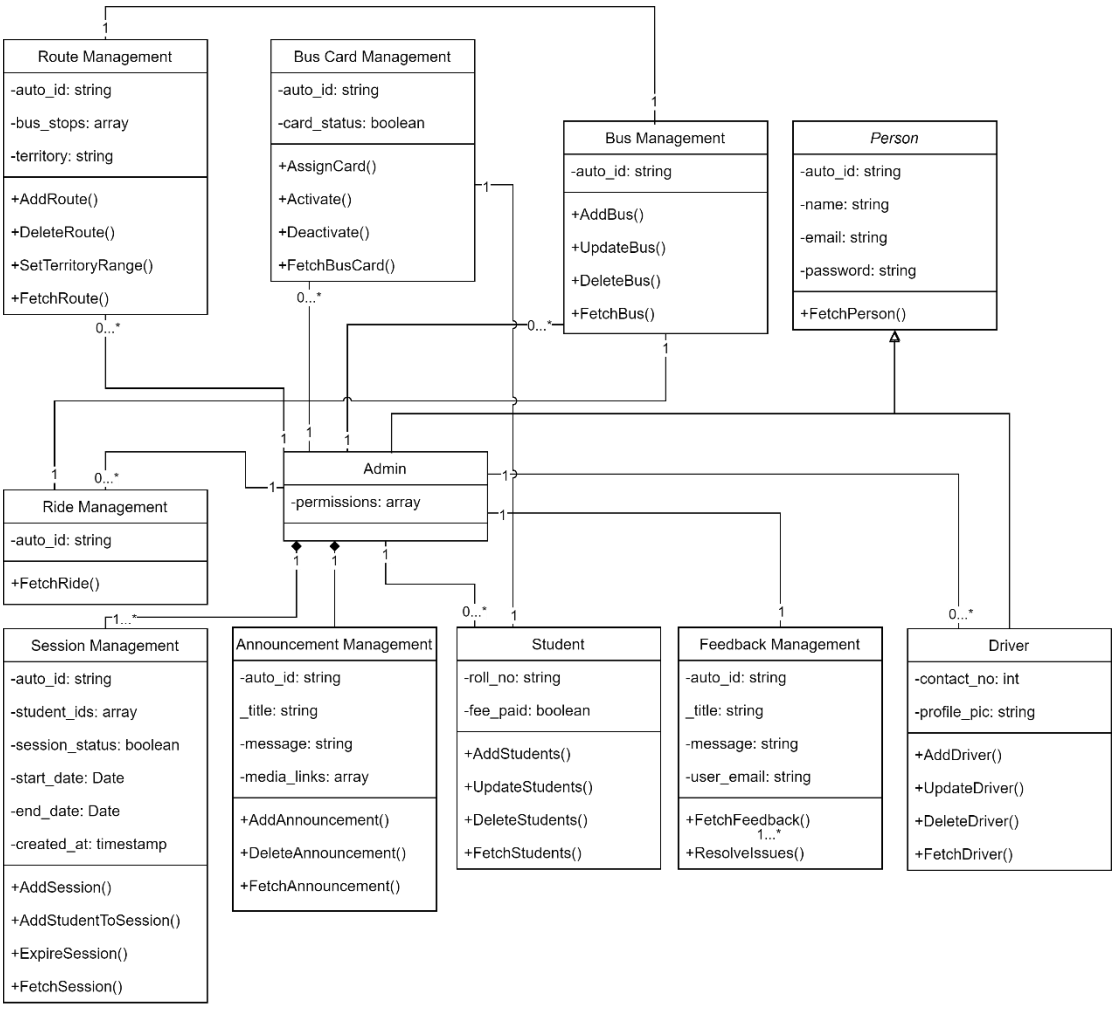
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List of Abbreviations

NTURP	NTU Ride Pilot
RFID	Radio Frequency Identification
NTURP system	Admin Panel, Driver/Student App

CHAPTER 1

1 Introduction

Proper transportation is a requirement in school systems of all types, where many thousands of students face daily transportation needs. But many institutions have problems such as ineffective workflow, potential and noted security threats, no real-time control and messaging systems. Children board buses without identification hence self-aggregation, trespass and misuse of transport means are common as are overcrowding. Further, there is the lack of real time tracking in buses as well as the performance of the drivers, and poor communication channels leads to confusion and poor control and co-ordination of transport operations.

To counter these challenges, we are optimistic about the implementation of the proposed NTURP system in an educational setting. This system incorporates high technologies such as RFID used for the identification process, real-time tracking using GPS, and technology-reliant alerting mechanisms for better transport logistics management. How it helps: It ensures that only approved students gain access to students' transportation services, gives real-time mapping of the bus locations to students, parents, and administrative staff and assists in timely notification on any … delays, route alterations, or emergent situations. Further, it measures driving behaviour, controls the passenger load factor, and provides notifications for route efficiency and capacity management.

This solution does not address objectives present in the current status quo; it revolutionizes transport management turning it into a safe, optimised, and friendly environment for users. With the help of new technologies, the NTURP system increases security, optimizes the work of transport and ensures its safe functioning, which makes it a perfect choice for any school with the desire to create modern transport infrastructure.

1.1 NTU Ride Pilot

NTURP is new approach for improving transportation services and gradually making transport secure and safe for education institutions. It encompasses up-to-date solutions such as RFID for persons' identification, real-time GPS navigation, and an enhanced communication system to build an easy-to-navigate transportation environment. This system enables authorised institutions to finally determine the best routes for bus transport, the best capacity to be provided for each transport at a given period as well as the performance of the transporters in ensuring that students, parents and other members of the institution get secure and efficient means of transport.

1.2 Reason to Develop

The development of the NTURP system is driven by several compelling factors, despite the existence of other transportation solutions:

1.2.1 Addressing Unique Institutional Needs

Schools are bound to face certain problems such as intrusion, traffic congestion and improper signalling. These specific requirements cannot be served efficiently by generic transport management systems, and thus the need to develop a transport management solution for this environment specifically.

1.2.2 Enhancing Safety and Security

This is important to avoid insecurity or that some students who are not using transport facilities benefit as others who deserve it are locked out. RFID approach encompasses accurate and almost instantaneous means of reducing misuse and increasing security for both students and drivers.

1.2.3 Bridging Communication Gaps

Failure to share information with other transport departments, with parents and students results to disorganization. This presented system entails use of instantaneous notification for news such as delay, change of route and often emergencies to promote timely and precise communication.

1.2.4 Optimizing Resource Management

Overcrowding or underutilization of buses is a common issue. By integrating occupancy monitoring and route optimization, this system helps administrators allocate resources more efficiently, reducing costs and enhancing comfort.

1.2.5 Scalability and Adaptability

The system can suit the requirements necessary to smoothly operate with fleet in any type of educational institution regardless of the scale of transportation system present there. It is also scalable where the institutions will be able to increase its benefiting as it responds to the changing transport needs.

This is much more than a technology enhancement project; it is a transformational project across the transport system that takes the future of transport safety and efficiency into consideration in an educational environment.

1.3 Problem Statement

Public and private learning institutions are among the organizations that experience high levels of challenges when it comes to transportation management. Some of the widespread problems are overcrowded or, on the contrary, underfilled buses, theft, poor communication with the bus drivers, and absence of the possibility of tracking a bus's location. Such issues thus complicate movement, organization, and functioning, and pose risk to the learners, their parents, and school management. Currently available solutions do not always have the architecture and flexibility to meet these specific institutional requirements.

1.4 Purpose

The primary objective of the developed NTURP system is to become a one-stop for all the transport management needs of educational establishments. Through secure access verification, GPS tracking while the bus is in operation, and other communication features, the developers of the system intend to enhance the performance, safety, and overall communication into the student, parents, school, and bus company.

1.5 Project Goals

- Implement secure ID verification to prevent unauthorized access.
- Provide live bus location tracking for real-time visibility and improved coordination.
- Enable real-time notifications for updates such as delays, route changes, or emergencies.
- Track key metrics like speed, stop intervals, and adherence to schedules.
- Streamline bus scheduling, capacity management, and route planning.
- Ensure an intuitive interface for administrators, parents, and students.

1.6 Objectives

Objectives of the project are as follows:

- Integrate RFID-based ID verification to ensure only authorized users board the buses.
- Provide GPS-enabled tracking for buses accessible to students, parents, and administrators.
- Enable alerts for overcrowding or underutilization to optimize bus capacity.

- Monitor driver behaviour to ensure adherence to safety and efficiency standards.
- Develop a mobile app for notifications and updates to keep all stakeholders informed.

1.7 Project Scope

Even though this system is created for educational institution it can be expanded at other domains including corporate transport, public streamlined or private bus lines. The architecture of FMGO enables flexibility and expansion depending on the transportation needs and its functionality and organization.

1.8 Proposed Solution

The system provides efficient and well-structured functional solutions for transportation management. The solution offers RFID for ID check during entry, GPS tracking for buses in real time, alert on occupancy, checking of driver performance, and mobile applications. Through this system, there will be highly improved efficiency in the running of institutions, minimized wastage of resources, and improved safety and reliability of transport for all users

1.9 Project Scheduling

Below is the Gantt chart that has been developed for the NTURP project. This chart is intended to illustrate the project's schedule: the time when each activity was planned/started and the time when it was planned/ended. They give a broad plan of how the various tasks in the project are expected to be done, and when thus help in keeping track of the project. The time plan of the project is illustrated in the Gantt chart in Figure 1.1 below.

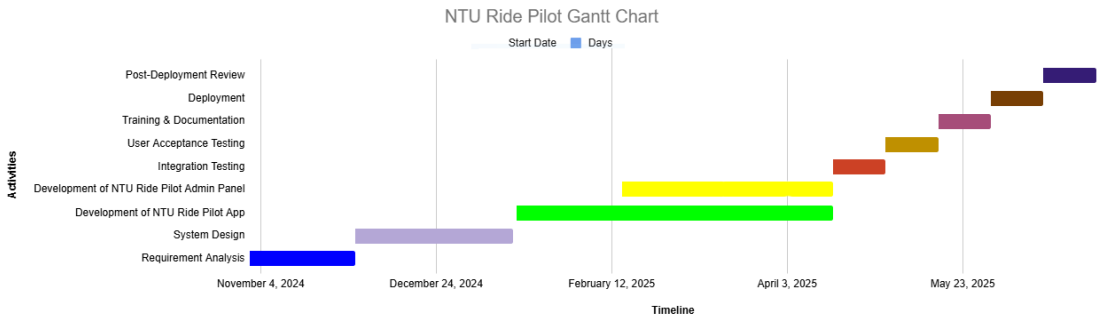

Figure 1.1 Gantt Chart

CHAPTER 2

2 Literature Review

The NTURP aims to enhance transportation services for students and parents by integrating technologies such as RFID scanning, GPS tracking, real-time data analytics, and mapping services. This chapter reviews existing literature and technologies pertinent to the project, including RFID technology in transportation systems, GPS-based bus tracking, load management in public transportation, predictive arrival systems, and the utilization of mapping APIs like Google Maps and Map box. Additionally, it examines existing student transportation management systems to identify current solutions and gaps.

2.1 Related Work

Several transportation management systems cater to student transit needs, offering features like GPS tracking, route optimization, and parent communication. Notable examples include:

2.1.1 Tyler Technologies' Student Transportation Software

Provides integrated solutions for bus routing, fleet maintenance, and parent communication, connecting various aspects of transportation management.
Cons:

- High implementation and licensing costs for smaller institutions.
- Steep learning curve for administrators unfamiliar with the software.
- Limited customization options for unique institutional requirements.

2.1.2 Edulog

Combines school bus routing, GPS fleet tracking, student journeyship management, and parent communication apps into a single platform, aiming to streamline transportation operations.
Cons:

- Complex setup and configuration for multi-campus institutions.
- Frequent updates are causing temporary compatibility issues.
- Limited integration with non-standard hardware or legacy systems.

2.1.3 Loqqat

Provides a smart real-time school bus tracker and management software, enabling route scheduling and live tracking to ensure student safety.
Cons:

- Narrow focus on live tracking, lacking advanced features like fleet maintenance.
- Limited scalability for large institutions with extensive fleets.
- Higher costs for adding additional features beyond basic tracking.

2.2 RFID Technology in Transportation Systems

RFID is widely used in transportation for access control and validation of the user. The usage of an RFID tag within student cards enables easy barcode scanning and validation strengthening the parameter of user credibility. The literature review also focuses on RFID advantages concerning reliability, fast processing, and accuracy in real situations for passenger identification, which would help in determining eligibility of passenger in bus systems.

RFID technology is also used in NTURP to authenticate fee payment and obtain time-based scanning to reduce misapplication of the system. The integration of RFID with time constraints means that the delivery will be partial and will ensure compliance and consequently trust among the stakeholders.

2.3 GPS-Based Bus Tracking

With GPS, social transport has been revolutionized through tracking vehicles in the road networks. In doing so, passengers and bus administrators can track bus positions thus increasing the buses' operational visibility and service delivery. GPS tracking and the provision of estimated arrival time are found to increase the user satisfaction since the device continually and accurately indicates the location.

In NTURP, GPS tracking helps parents and students in planning their travel effectively. When partnered with predictive algorithms, GPS data eliminates the prospects of early or late estimates and keeps drivers on their toes. The same also contains important information about the best route choice and the most suitable time in the context of transportation by bus.

2.4 Load Management in Public Transportation

It is very important to strike a balance between the number of passengers and the carriage capacity in a public transport system because an excess or a shortage of passengers causes problems. Methods like weight sensors and real-time passenger count are found efficient for measuring the bus holding capacity.

In addition to real time load analysis for safety of passengers and bus fleet, NTURP also includes efficient bus operation. Prepare for the load according to the existing pattern and data and use the pattern to estimate the demand for various products or services.

2.5 Predictive Arrival Systems

The estimates of arrival are derived from the GPS, traffic and past records making them reliable for PSA. Research shows that such systems improve user trust and satisfaction. Use of enhanced features and the integration of more advanced machine learning algorithms can of course enhance the accuracy of the predictions.

In NTURP, arrival features that predict help to cut down waiting time and thus the result is convenient to both students and parents. These features, implemented in simple presentations with user-friendly interfaces, are helpful for a user.

2.6 Mapping APIs: Google Maps and Map box

Mapping services are integral to transportation management systems, providing visualization and geolocation functionalities.

2.6.1 Google Maps API

Google Maps API is a full service solution for map integration which allows for real time traffic data, route and time estimations. The versatile Log parser and its reliability is a clear reason why developers choose to work with the company. To work in NTURP, Google Maps API is quite helpful in providing real time location of buses and their estimated time of arrival, thus making the general user interface more effective.

2.6.2 Map box

Map box is an interactive map tool which operating system can be adapted according to the preferences of the developers. It provides dynamic app theme support, working offline maps, and improved integration options. In certain niches of mapping specifically designed solutions, Map box is flexible and fast. For NTURP, Map box gives an opportunity to design compelling, user-friendly front ends for users.
It means that the decision to choose, for example, Google Maps API instead of Map box, will be based on the specifications, the cost, and the expectations from users. Both solutions are fundamental in the establishment of safe transport networks.

CHAPTER 3

3 System Requirements

In this bankruptcy, all of the useful requirements of the NTURP and the overall requirement of the stockholders are documented as it's an important a part of a mission or product that allows to satisfy stakeholder's necessities. Now, we can speak system necessities, practical necessities, software program development, and present and selected methodology with the purpose of technique. These sections describe software program methodologies which are present and decided on for this assignment with the glide of machine and alertness detail depicted.

3.1 Functional Requirements

3.1.1 User Authentication and Authorization:

There should be user roles supported in the system (Super Admin, Admin, Driver, Conductor, Student) and only allow access after a proper authentication. It must have a module for creating the user base, the role they should have, and the permission of the role to open some of the modules that a user should open.

3.1.2 Bus and Route Management

The Admin should also be able to handle bus detail and want to set territories or routes for buses. The Driver should have the facility to record/update the driving routes for individual buses. Also there exists the scenario where the Admin needs to view a list of available buses and their corresponding routes.

3.1.3 Ride Management

The Driver must be able to initiate or end a ride, with the system tracking the live location of buses during active rides. The Driver is responsible for authenticating student cards when they board the bus, and the system must record ride data, including the bus number, route, boarded students, and the driver. Both Admin and Students must have access to the bus's live location, while Admin also be able to view the complete ride history for all buses.

3.1.4 Bus Card Management

The admin must be able to assign bus cards to students, as well as revoke or enable student bus cards as needed. The system must also verify student bus cards during boarding to ensure proper access.

3.1.5 Session and Student Management

The system must allow the Admin to create and end user sessions, as well as set their expiry dates. It should automatically disable student cards when a session expires or is deleted. Additionally, the system must generate app credentials for students upon their addition to the system.

3.1.6 Bus Staff Management

Admin must be able to add and manage Drivers and Conductors within the system. Upon registration, the system must generate app credentials for these staff members to enable secure access and management of their duties.

3.1.7 Complaint Management

Students and Drivers must have the ability to submit complaints through their apps. Admin should have a module to view, address, and resolve these complaints, and the system must maintain a record of all complaints along with their current statuses.

3.1.8 Announcement Management

Admin must be able to create and manage announcements within the system. Announcements must be delivered as notifications to Drivers and Students through their apps to ensure timely updates.

3.1.9 Notification and Alerts

The system must send notifications to Students and Drivers regarding announcements, route updates, and other relevant information. Additionally, the system must alert Admin if a bus deviates from its assigned route or leaves its designated area.

3.1.10 Live Location Tracking

The system must track and display the real-time location of buses during active rides. Both Admin and Students should be able to access this live location data via their apps, and the system must store location data for ride history and analysis purposes.

3.2 Non-Functional Requirements

3.2.1 Security:

Apply strict checks for the users' authorization and authenticity.

3.2.2 Performance

The system should be able to answer user actions on the application quickly.

3.2.3 Availability:

The system should be online all the time.

3.2.4 Scalability:

Also, the system must be capable providing its services to a rising number of users and data.

3.2.5 Usability:

Web based system should be easy to use and navigable with an aim of reaching the users of the product.

3.2.6 Maintainability:

It should be easy for the system to be maintained and upgraded from time without lots of time being consumed.

3.2.7 Efficiency

While functioning, the system should effectively manage the amount and kinds of resources used and reduce response time.

3.3 Use Case Diagram

In respect to showing graphic representations of actor communication with the components of the systems the best method therefore is to identify and draw Use Case diagrams that illustrate which actor is capable of performing or accessing what function or component of the systems under consideration.

3.3.1 Use Case of Sign In

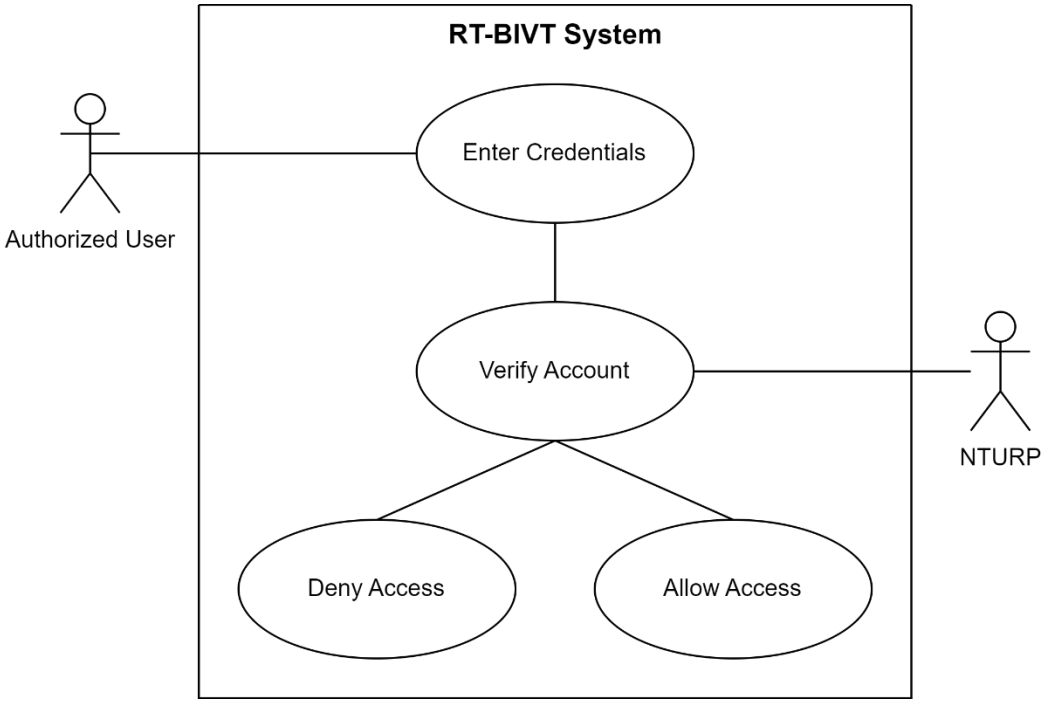

Figure 3.3.1 Use Case of Sign In

3.3.2 Use Case of Sign Up

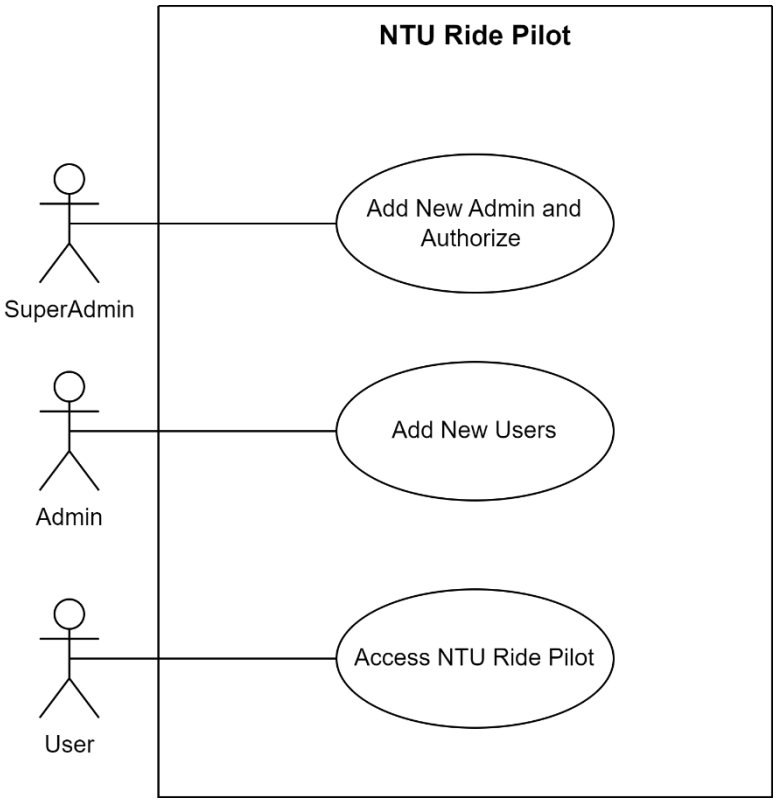

Figure 3.3.2 Use Case of Sign Up

3.3.3 Use Case of Bus and Route Management

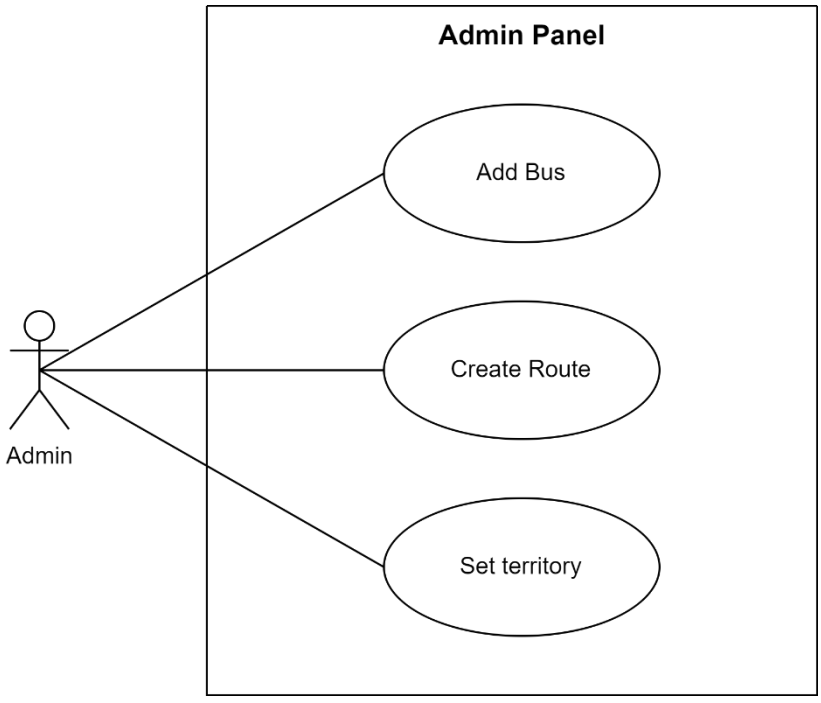

Figure 3.3.3 Use Case of Bus and Route Management

3.3.4 Use Case of Ride Management

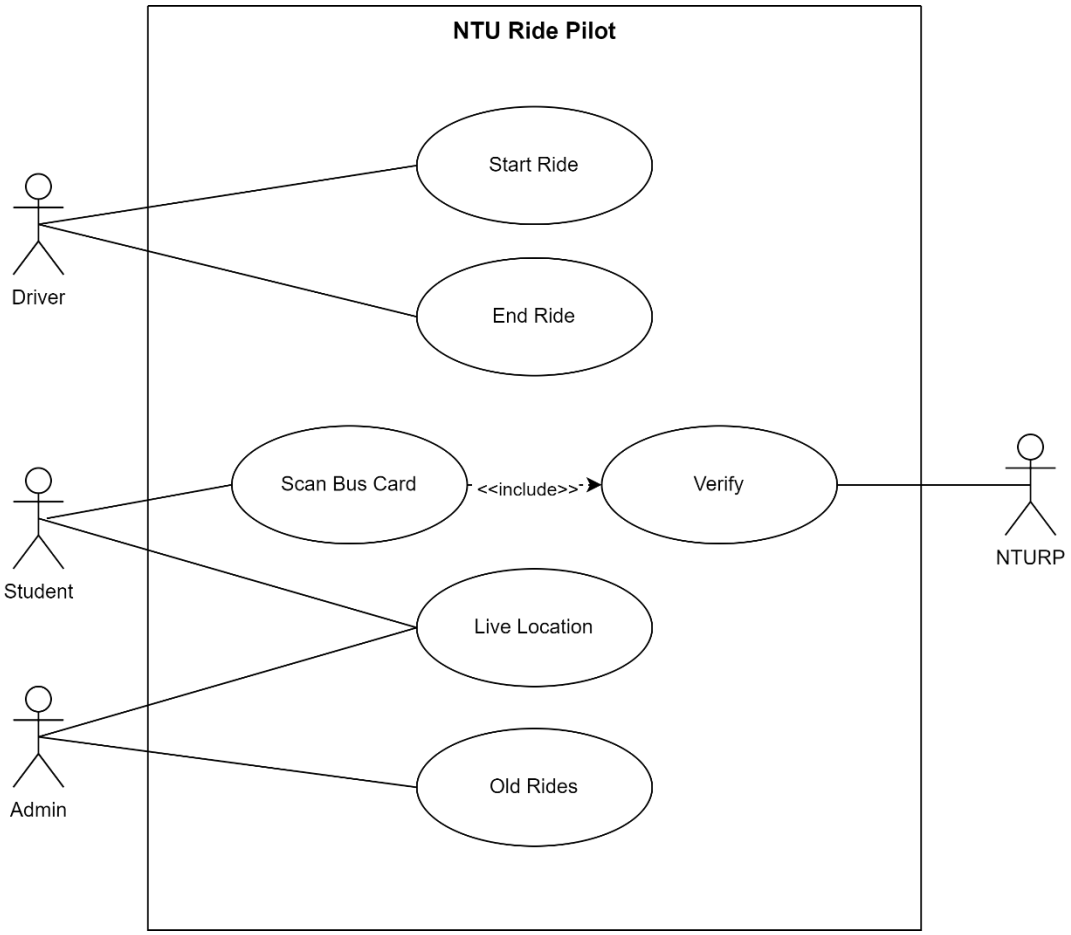

Figure 3.3.4 Use Case of Ride Management

3.3.5 Use Case of Bus card Management

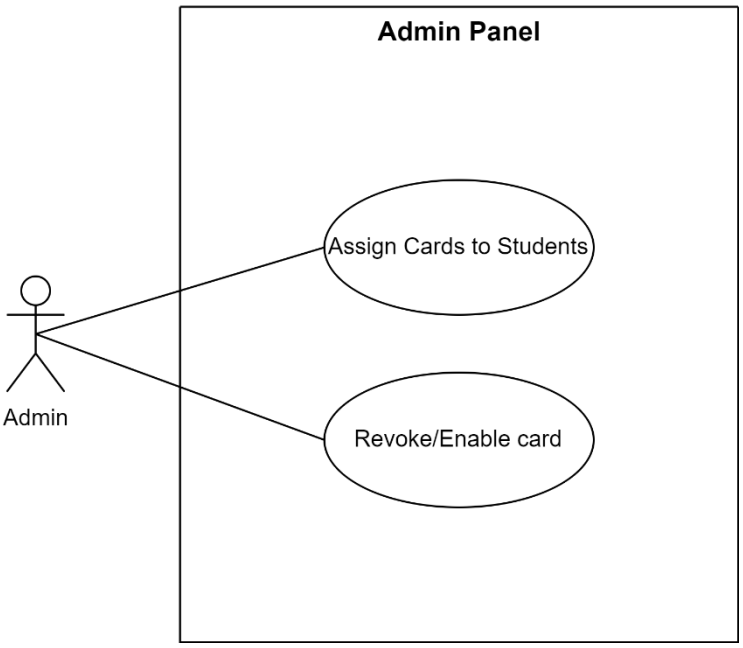

Figure 3.3.5 Use Case of Bus Card Management

3.3.6 Use Case of Student & Session Management

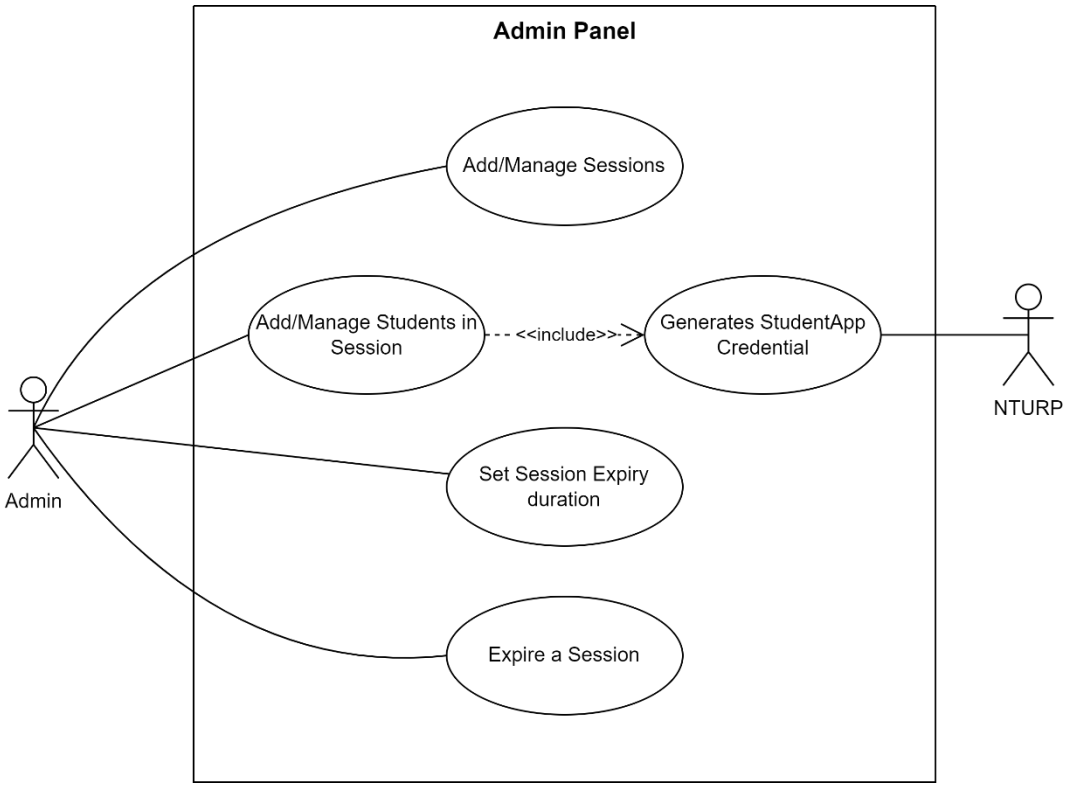

Figure 3.3.6 Use Case of Student & Session Management

3.3.7 Use Case of Bus Staff Management

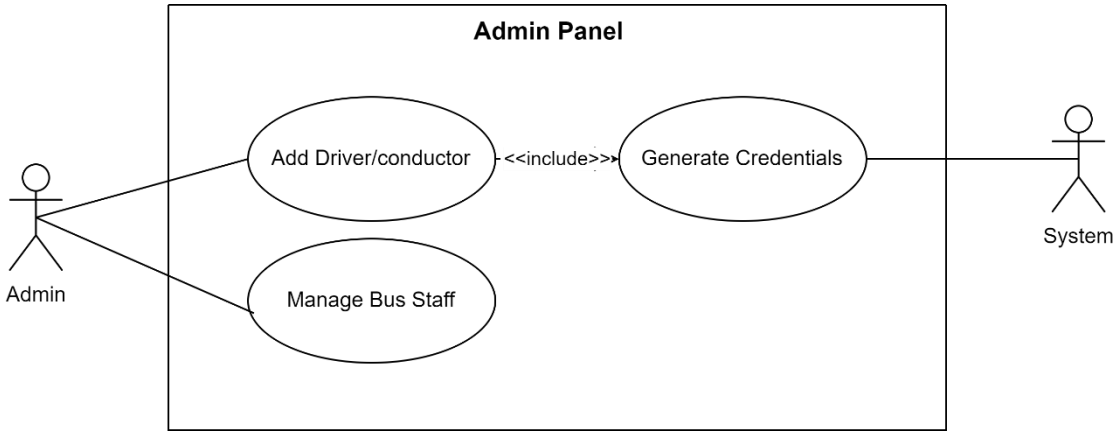

Figure 3.3.7 Use Case of Bus Staff Management

3.3.8 Use Case of Complaint Management

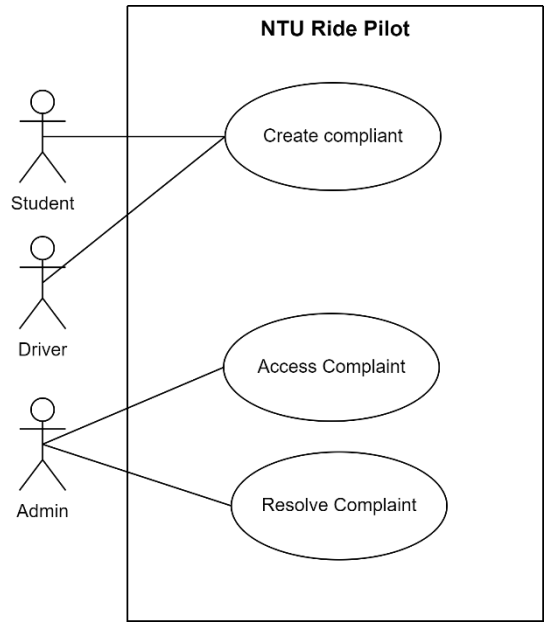

Figure 3.3.8 Use Case of Complaint Management

3.3.9 Use Case of Announcement Management

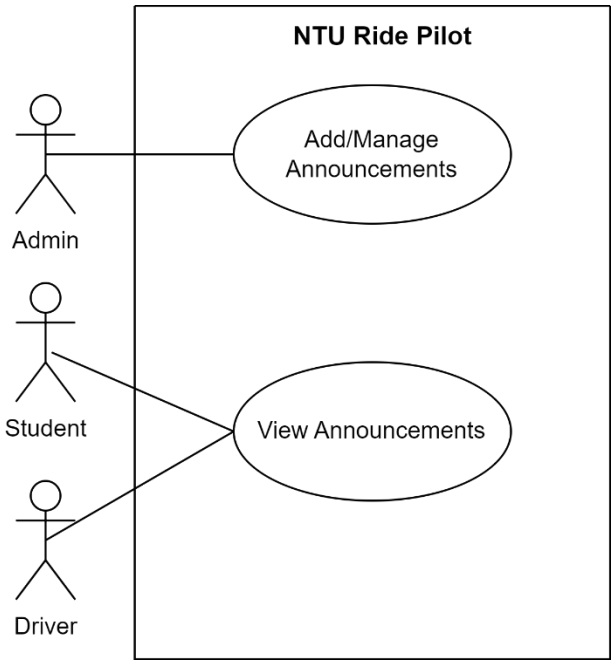

Figure 3.3.9 Use Case of Announcement Management

3.3.10 Use Case of General Functionalities

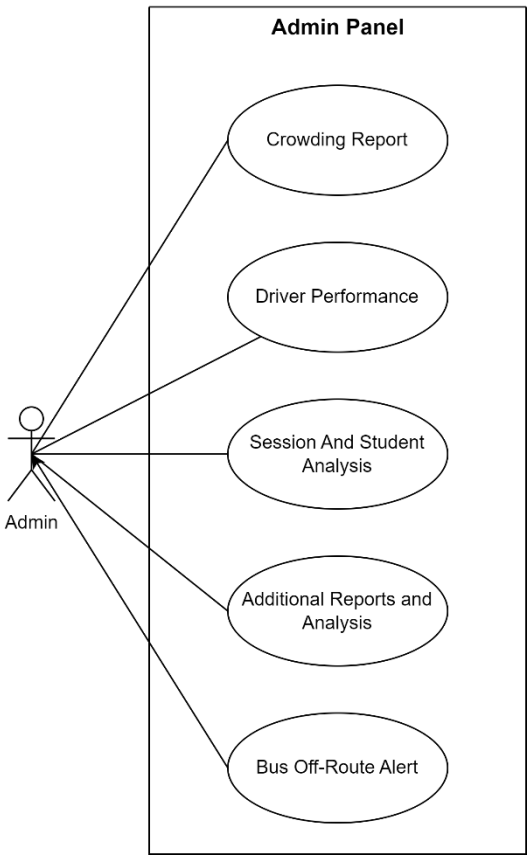

Figure 3.3.10 Use Case of General Functionalities

3.3.11 Use Case of Complete System

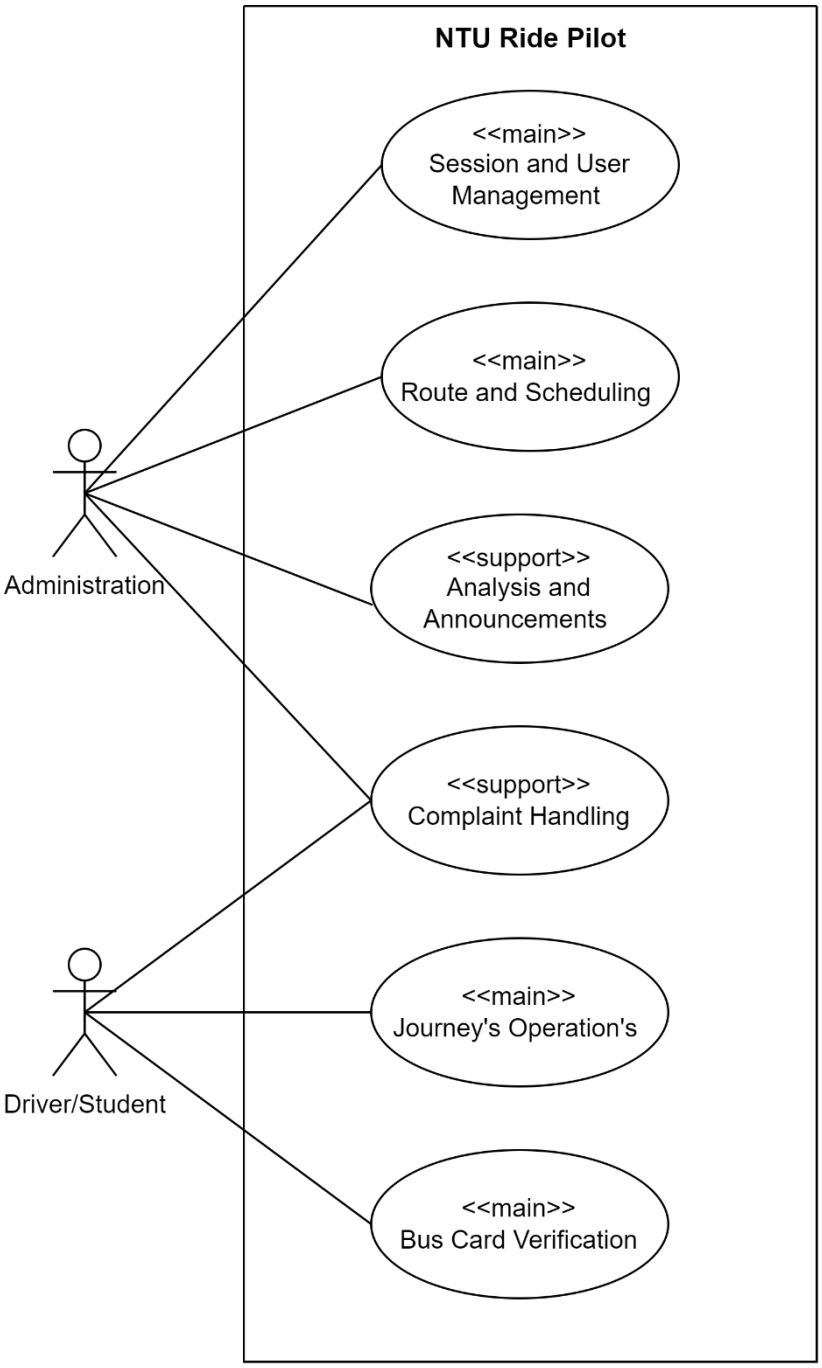

Figure 3.3.11 Use Case of Complete System

3.4 Use Case Description.

Use case description contains every piece of information (use case id, use case name, description, pre- and post-conditions) of each use case.

3.4.1 Description of Sign In:

Table: 3.4.1 Description of Sign In

Field	Details
Use Case Id	01
Use Case Name	Sign In
Actors	Authorized User
Description	Authorized users log in to the NTURP via provided applications. Access is denied if the user does not have an account or proper credentials.
Pre-condition	User must have an account and credentials.
Post-condition	User logs into the NTURP system or is denied access.

3.4.2 Description of Sign Up:

Table: 3.4.2 Description of Sign Up

Field	Details
Use Case Id	02
Use Case Name	Sign Up
Actors	Super Admin, Authorized User
Description	A Super Admin has the ability to create admins and assign specific roles and permissions to each. These admins are tasked with managing the creation of user accounts, including those for bus staff and students.
Pre-condition	User must have an account, enough permissions and credentials to access system.
Post-condition	A new user is created with specific roles and permissions to operate with in NTURP.

3.4.3 Description of Bus and Route Management:

Table: 3.4.3 Description of Bus and Route Management

Field	Details
Use Case Id	03
Use Case Name	Bus and Route Management
Actors	Admin
Description	The admin is responsible for adding buses, defining routes, and assigning territories.
Pre-condition	Admin must be authenticated and have enough permissions to manage buses and routes.
Post-condition	The admin effectively oversees the management of buses, routes, and territories.

3.4.4 Description of Ride Management:

Table: 3.4.4 Description of Ride Management

Field	Details
Use Case Id	04
Use Case Name	Ride Management
Actors	Admin, Driver, Student
Description	The driver starts and ends rides while verifying student bus cards during the trip. The system logs ride-related data and tracks the bus's live location, enabling administration, students, and parents to access ride details and monitor the bus's real-time location.
Pre-condition	The driver must be authenticated and have specified the route and the bus they are assigned to. The student must possess a valid and active bus card.
Post-condition	The driver successfully operates the Rides, while the system tracks and updates the ride details and live bus location. This allows both administrators and students/parents to access the ride

	information and the live location of the bus.

3.4.5 Description of Bus Card Management:

Table: 3.4.5 Description of Bus Card Management

Field	Details
Use Case Id	05
Use Case Name	Bus Card Management
Actors	Admin
Description	The admin is responsible for assigning and managing student bus cards.
Pre-condition	The admin must be authenticated and have necessary permissions to manage bus cards. Students are required to be registered in the system.
Post-condition	The admin can successfully assign bus cards to students, revoke the cards to prevent further use, and re-enable them when needed.

3.4.6 Description of Session and Student Management:

Table: 3.4.6 Description of Session and Student Management

Field	Details
Use Case Id	06
Use Case Name	Session and Student Management
Actors	Admin, System
Description	The admin can create and terminate sessions, set session expiry, and manage students within the system. When a student is added, the system automatically generates app credentials for them. Expiring or deleting a session will deactivate all bus cards associated with that session.
Pre-condition	The admin must be authenticated and have necessary permissions to manage

	bus cards. Student data must be accurate and complete for the generation of credentials.
Post-condition	The admin effectively oversees both sessions and student management.

3.4.7 Description of Bus Staff Management:

Table: 3.4.7 Description of Bus Staff Management

Field	Details
Use Case Id	07
Use Case Name	Bus Staff Management
Actors	Admin, System
Description	The admin oversees drivers and conductors. When a new staff member is added, the system automatically generates app credentials for them.
Pre-condition	The admin must be authenticated and have necessary permissions to manage bus staff.
Post-condition	The admin effectively manages bus staff.

3.4.8 Description of Complaint Management:

Field	Details
Use Case Id	08
Use Case Name	Complaint Management
Actors	Student, Driver, Admin

Description	Students and drivers are allowed to submit complaints about transportation services and related concerns.
Pre-condition	All users are required to be authenticated. Administrators must also be authenticated and possess the necessary permissions to manage complaints.
Post-condition	Complaints submitted by students and drivers get reviewed and resolved by the authorities.

Table: 3.4.8 Description of Complaint Management

3.4.9 Description of Announcement Management:

Table: 3.4.9 Description of Announcement Management

Field	Details
Use Case Id	09
Use Case Name	Announcement Management
Actors	Admin, Driver, Student
Description	The admin shares announcements related to transportation.
Pre-condition	All users are required to be authenticated.
Post-condition	The administrator successfully posts announcements.

3.4.10 Description of General Functionalities:

Table: 3.4.10 Description of General Functionalities

Field	Details
Use Case Id	10
Use Case Name	General Functionalities
Actors	Users
Description	The admin can generate reports and analyse valuable information extracted from the data currently stored.

Pre-condition	The admin must be authenticated and have necessary permissions.
Post-condition	Administration makes better decisions and enhances services through the analysis of current transportation data.

Chapter 4

4.1 Agile Software Development Methodology

Agile methodology is an iterative and incremental approach to software development that emphasizes flexibility, collaboration, and customer feedback. Unlike traditional methodologies like the Waterfall model, Agile allows for adaptive planning, evolutionary development, and continual improvement, enabling rapid and flexible responses to change. It is particularly effective in managing the complexity and unpredictability of software projects.

4.2 Selected Methodology: Agile

A software development methodology is a way to improve development work with the help of dividing the development process into distinct phases to make a system with better productivity. It also helps to structure and control the whole system. It involves different methodologies, also called the Software Development Life Cycle, that are stages for software development with a certain set of rules. Generically, we categorized the methodologies into Rapid application development and planned-driven. Waterfall, spiral is planned driven while agile is Rad based.

4.3 Reasons for Selecting Agile Methodology

1. **Flexibility and Adaptability**: Agile allows the project to adapt to changes in requirements and technology swiftly.
2. **Customer Collaboration**: Regular feedback from users ensures that the development aligns with the user's needs and expectations.
3. **Incremental Delivery**: Agile facilitates the delivery of small, workable segments of the project, ensuring a faster time-to-market and continuous improvement.
4. **Risk Management**: Regular reviews and iterations help in early identification and resolution of issues, reducing the overall risk.

4.4 Agile Project Planning and Execution for NTURP

Agile project planning and execution involve the division of the project into sprints, with each sprint aimed at delivering a potentially shippable product increment. The key phases include:

1. **Product Backlog Creation**: Gather and prioritize necessities for the NTURP undertaking, growing a product backlog.
2. **Sprint Planning**: At the start of every dash, pick a hard and fast of capabilities from the product backlog and plan their delivery.
3. **Daily Stand-ups**: Conduct day by day meetings to speak about development, demanding situations, and plan the day's paintings.

4. **Sprint Execution**: Develop, take a look at, and combine features inside the dash.
5. **Sprint Review**: At the quilt of every sprint, reveal the finished paintings to stakeholders and collect comments.
6. **Sprint Retrospective**: Reflect at the sprint to identify successes and regions for development.
7. **Release Planning**: Plan releases based totally at the undertaking progress, stakeholder comments, and marketplace situations.

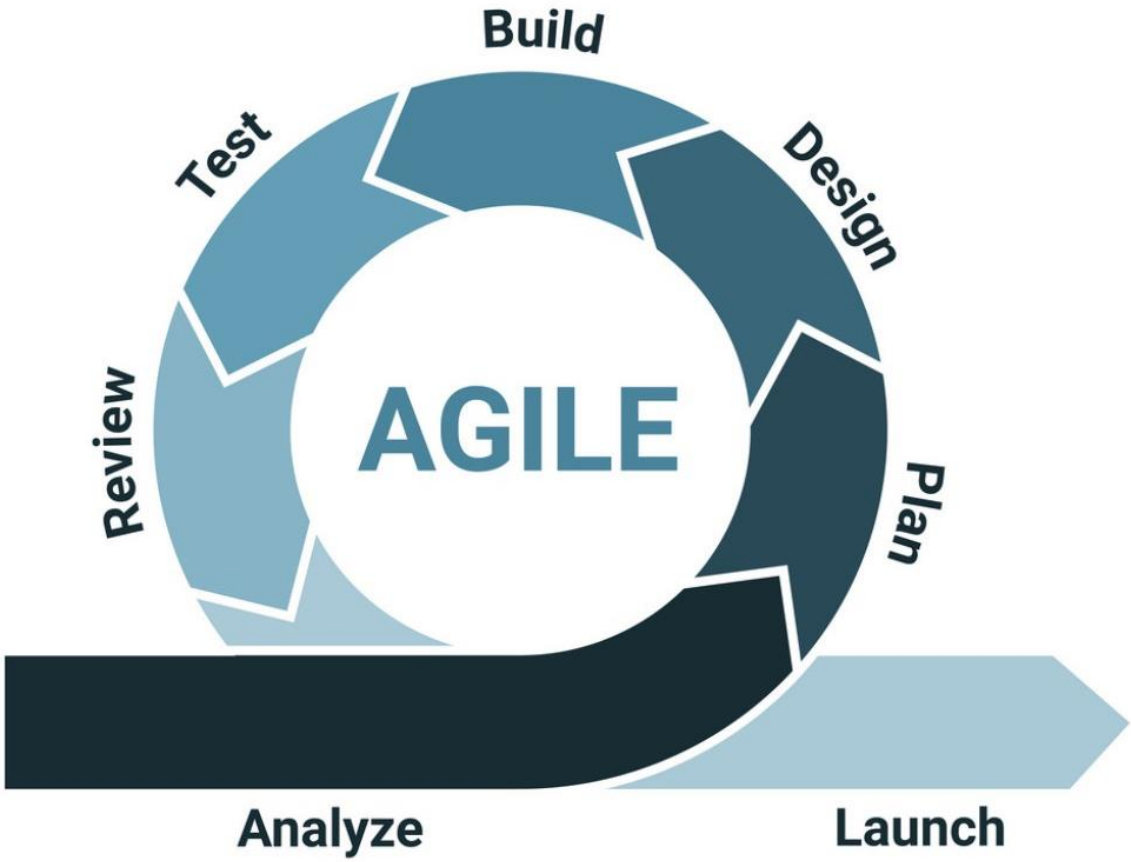

Figure 4.1 Agile Model

Chapter 5

5 System Architecture

5.1 Database Design

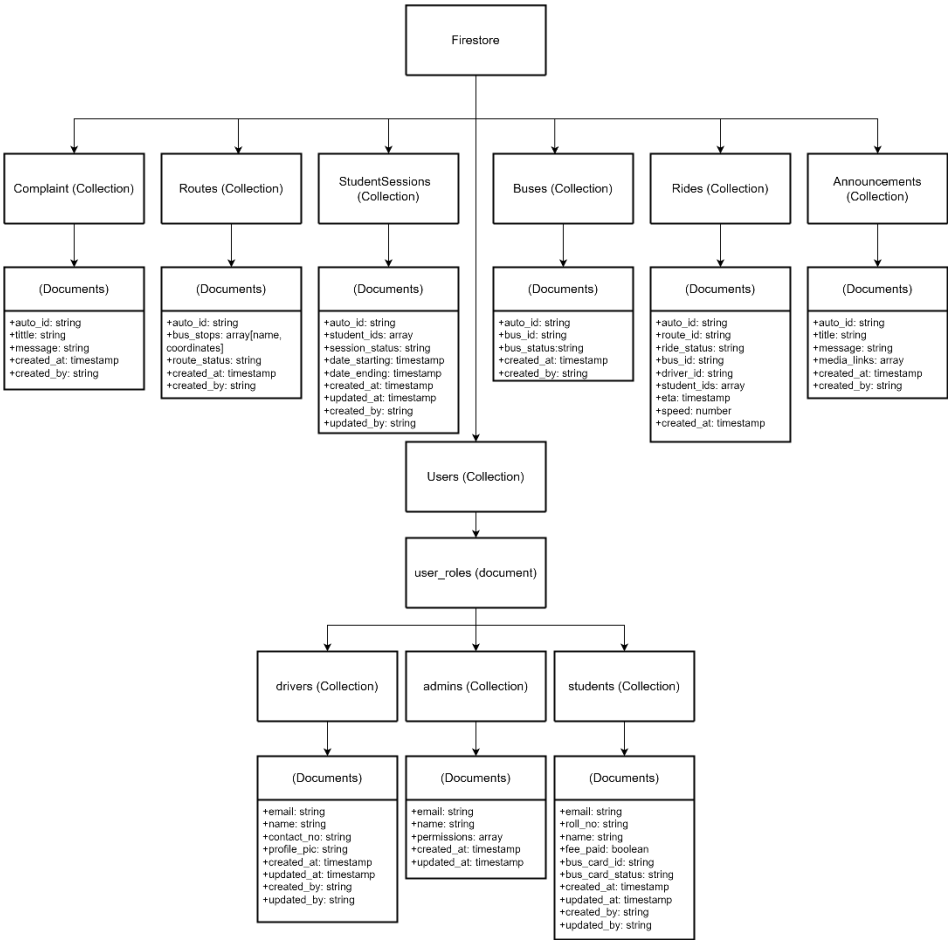

Figure 5.1.1 Database Design

5.2 Sequence Diagram

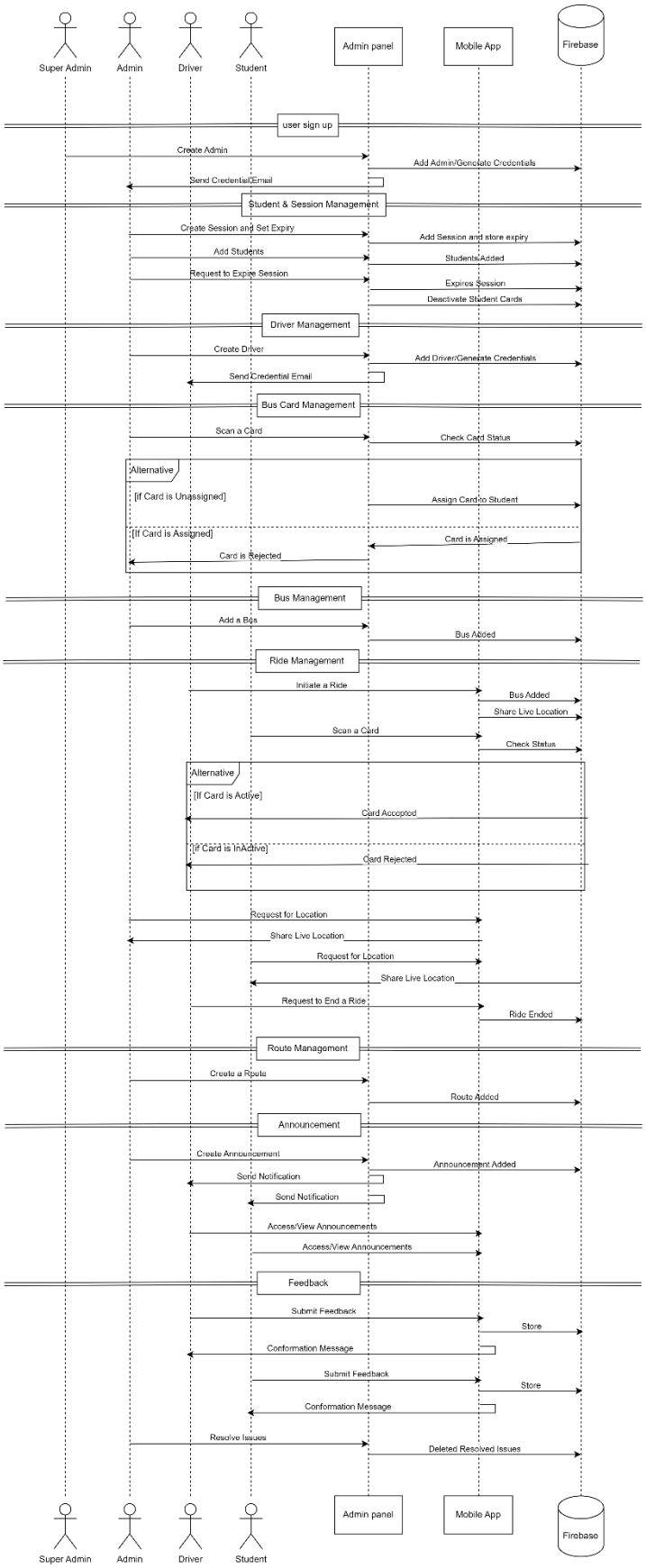

Figure 5.2.1 Sequence diagram of whole system

5.3 Class Diagram

5.3.1 Mobile Application

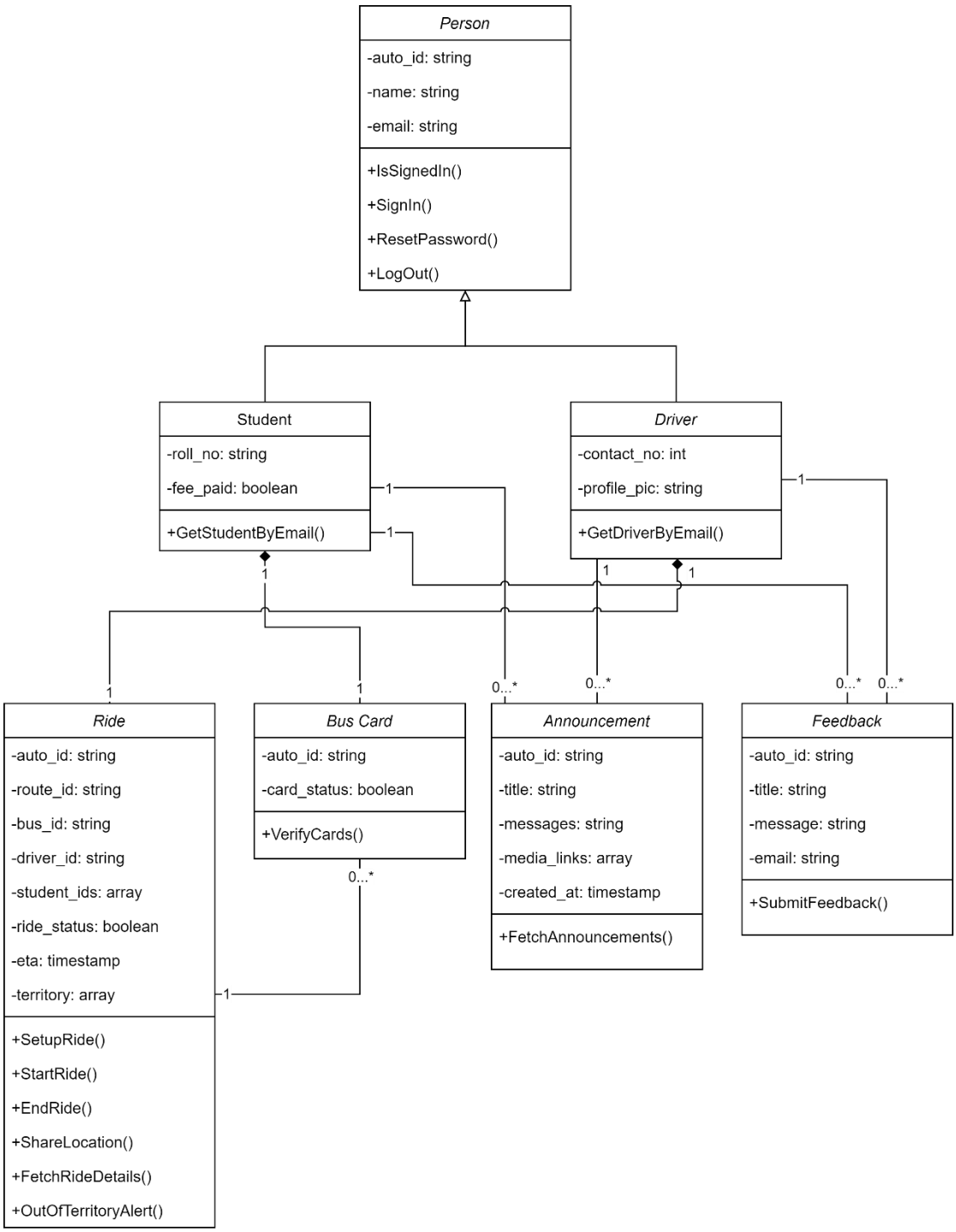

Figure 5.3.1 Class diagram of mobile app

5.3.2 Admin panel

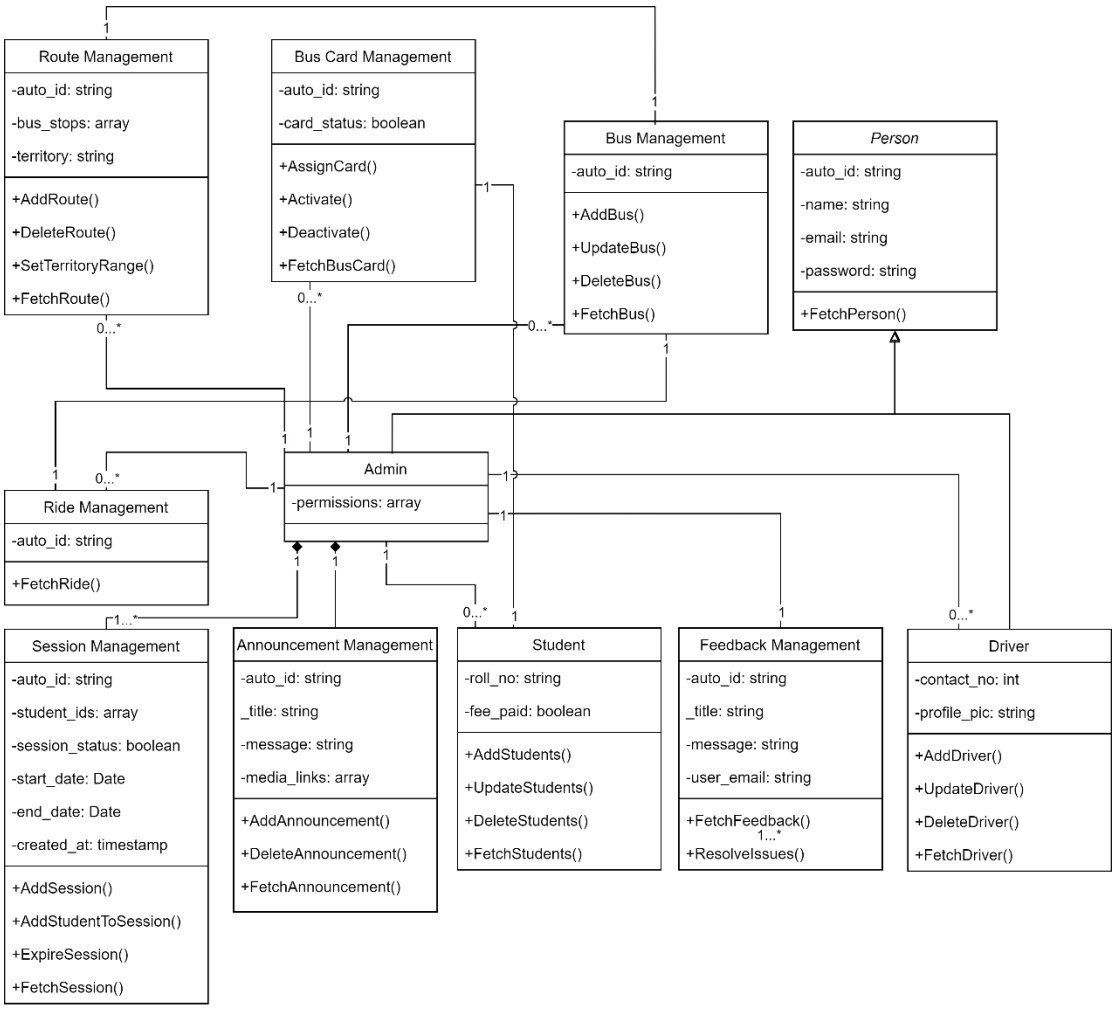

Figure 5.3.2 Class diagram of admin panel