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School bus tracking application

Project Report of Software Modelling and Analysis

CS 284

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Abstract

This project aims to create an application for tracking school buses. Application name (**BusBuddy**). The aim of this application is to ensure the safety of children during school transportation and to facilitate communication between parents and drivers. The idea of the application is for parents and school authorities to track the live location of school buses and inform them of the expected arrival time or inform them of any changes or delays that may occur. The application provides many features for users, including manage profile and sending feedback about the application to improve it, etc. And other features depending on the role of the user. To achieve accurate location tracking, GPS technology has been used. This technology provides accurate and up-to-date information about the location of the school bus. RFID technology has also been used to record the attendance of students on the bus. This feature ensures that all students are accounted for and present during transfer. And other technologies used. Regarding future scalability, the application has the ability to develop and expand by adding new features it works to improve the efficiency of school transportation and provide an effective and safe experience for users.

Keywords GPS; RFID

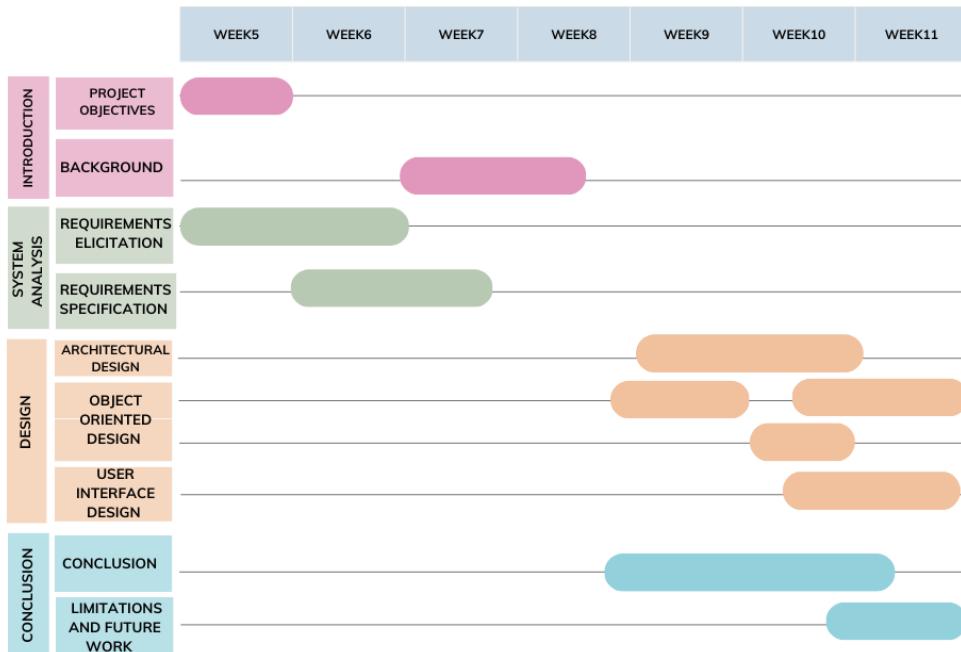
Chapter 1: Introduction

1.1 Project Objectives

- Ensuring the safety and security of students during transportation to and from school.
- Improving communication between parents, school administrators, and bus drivers.
- Streamlining bus route planning and scheduling to optimize efficiency and reduce costs.
- Providing real-time tracking of buses to parents and school officials.
- Enhancing student attendance tracking and reporting for schools.

1.2 Project Timeline

**PROJECT TIMELINE
SCHOOL BUS TRACKING APPLICATION**



1.3 Background Related work

1.3.1 Background

Ensuring student safety during school transportation is a top priority for parents and school authorities. While parents seek to provide safe transportation for their children, some may have to rely on school buses which may cause concern to parents due to poor communication between parents and the driver and other reasons. But what if we try to ease parents' anxiety by developing a school bus tracking app that offers services that help ensure student safety?

That's why our app has been developed to improve the school transport process by allowing parents to track the location and status of the school bus and ensure that the student arrives safely by carefully selected certified drivers. One of the goals we seek to achieve through our app is to address common issues that can occur during school transport, such as poor communication between the driver and the parent. etc...

In the process of developing our application, we will need sufficient knowledge of certain technologies such as:

GPS Technology: stands for Global Positioning System, which is a satellite-based navigation system that allows users to accurately determine their location and track their movements. It is used in a wide range of applications such as transportation, and mapping.

Google Maps API : is a set of programming tools and services provided by Google that enables developers to integrate maps and access location-based data such as geocoding and provide other location-related features in their apps such as route optimization by using the Directions API and the Distance Matrix API from Google Maps ,the app can calculate the best routes for school buses based on factors such as traffic.

RFID Technology (radio frequency identification): It is a wireless communication method that uses radio waves to transmit data between the reader and the RFID tag. The tag contains a small chip, an antenna, and may be placed inside a card. When it is in range of the reader, the reader sends out a radio signal that powers the RFID tag and allows information stored on the chip to be sent to its associated databases.

Also, we need to understand mobile application development in both operating systems (iOS and Android) and knowing the Java programming language because that's what we'll be using, as well as knowing how to design the user interface well with tools like figma.

1.3.2 Related work

This is some applications similar to our work and the similarity of the general idea of our system. They are all the same idea and the general goal, which is to improve the school transport service by providing services that ensure the safety of students. But they are all different in implementation and in the services provided, each system has its own advantages and fingerprint.

SafeStop:

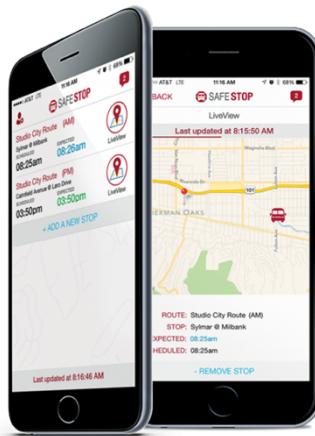


Figure 1: SafeStop app

It is a popular school bus tracking app that provides real-time tracking and communication between school officials, parents, and bus drivers, ensuring the safety of students.

Advantages:

- It provides its users with the ability to track the live location of school buses
- Alerts parents when the bus is close to home.
- Allows parents to see the estimated time of arrival on the bus and receive notifications about any changes in the trip.
- The application interface is easy to use

Disadvantages:

- It does not inform you of the actual arrival time of the school bus, unlike what was mentioned in the services of this application.
- Notifications that parent receive about any changes or delays are inaccurate and are received very late

Stopfinder:

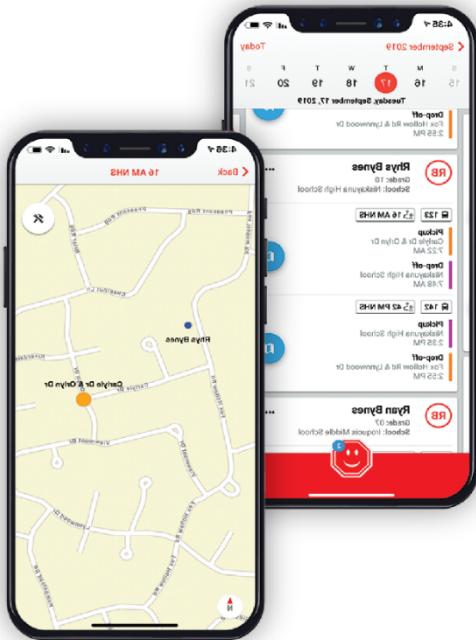


Figure 2:Safefinder app

It provides information on the location and arrival time of school buses, using this app parents can easily track the bus.

Advantages:

- Allows parents to view student bus schedules.
- Parents receive notifications of when the bus will arrive at
- Parents can follow more than one school bus at the same time.

Disadvantages:

- The application does not send alerts sometimes ,contrary to what is mentioned in the services it provides.
- Sometimes the bus location is not accurately displayed.

This is some studies that have proven their effectiveness related to our work:

"Effects of a school bus tracking app on parents' perceptions of student safety" (Cohen et al., 2021): The study found that using a school bus tracking app alleviated parental anxiety.

"Using GPS Technology to Improve School Bus Operations and Communications" (Boriboon., 2011). The study found its efficiency in improving communication between parents, students, and school officials. Parents were able to receive notifications about delays or changes, which allowed them to adjust their plans based on this.

Chapter 2: System Analysis

2.1 Requirements Elicitation

"System requirements are classified as functional requirements that focus on services the system should provide and how the system should react to particular inputs non-functional requirements that focus on constraints on the services or functions offered by the system." ([Sommerville, 2009](#)). In the following paragraph we will define our system requirements

2.1.1 Functional Requirements

1. The system allows users to manage their personal accounts.
2. The system must allow its users to create an account with their personal data.
3. The system should allow users to log in to access their dashboard based on their role and permissions.
4. The system must allow users to communicate with each other through chat or call.
5. The system should allow parents to view school bus schedules and request changes if necessary.
6. The system should enable parents to pay school bus fees through the app.
7. The system should allow parents and school authorities to track the live location of the school bus.
8. The system must allow parents and school authorities to view driver information.
9. The system must allow drivers to record student attendance.
10. The system should allow parents and school authorities to view students' attendance history for the bus.
11. The system should allow drivers to report any accident during the trip.
12. The system must send automatic notifications to the school authorities of the report.
13. The system must allow the school authorities to view the report of the incident.
14. The system should allow the school authorities to change the status of the incident whether it is resolved or not.
15. The system should automatically notify the parents of the change in the accident status.
16. The system should allow parents and school authorities to view student's attendance history for the bus.

17. The system should send automated notifications to parents and school authorities regarding the arrival and departure of the school bus.
18. The system allows users to send feedback about their use of the application.
19. The system should send an email notification with user feedback to administrators.
20. The system should allow application administrators to manage user accounts and fix technical problems.

2.1.2 Non-Functional Requirements

- **Performance:**
The response time must be within a few seconds for the operations requested by the user in the system.
- **Usability:**
The user interface should be user-friendly and require no more than 30 minutes of training for the new user.
- **Reliability:**
The system must be reliable ,and it must have a backup and recovery plan in case of any failure.
- **Maintainability:**
The system should be easy to update and maintain when there is any emergency problem.
- **Availability:**
The system should be available at any time (24 hours).
- **Speed:**
The system should process at least 1000 transactions per minute.
- **Size:**
The application should not take up more than 100 MB of storage space on a user's device.
- **Robustness:**
The system should be able to handle unexpected input or errors without crashing or losing data.
- **Security:**
The system shall be safe from breaches of user data.

2.1.3 User Requirements

1. Parents, drivers, and school authorities should be able to register themselves.
2. Users should be able to log in to use the application.
3. Parents, drivers, and school authorities should be able to communicate with each other.
4. Parents should be able to view school bus schedules.
5. Parents should be able to request to change the school bus route.
6. Parents should be able to pay school bus fees through the app.
7. Parents and school authorities can track the live location of the school bus.
8. Parents and school authorities can view the attendance record of students on the bus.
9. Parents and school authorities should be able to view driver information.
10. The driver should be able to report any accident during the trip.
11. The driver should be able to record the attendance of the students.
12. The driver and school authorities can view the delivery route.
13. The school authorities should be able to manage the bus trip of her school.
14. The school authorities can assign drivers for the trip.
15. School authorities should be able to assign students to the excursion.
16. School authorities should be able to view report incident.
17. Admin should be able to manage user accounts.
18. Admin should be able to fix technical problems.

2.2 Requirements Specification

The use case model shows the interactions between the actors (they may be humans or other systems) and the system in a simple and understandable way and may benefit the stakeholders to understand the system better.

2.2.1 Actors of the system:

We have four main actors in our system:

- **Parents:** who use the application to ensure the safety of their children so that they can track the location of the bus, etc.
- **School authorities:** who use the application to manage the bus trip, such as managing routes, schedules, etc.
- **Bus Driver:** who use the application to access route information and report any incidents that occur during the trip, etc.
- **Admin:** is a person or group responsible for managing and supervising the operation of the application, such as managing user accounts or troubleshooting technical issues.

2.2.2 Use Case Diagram:

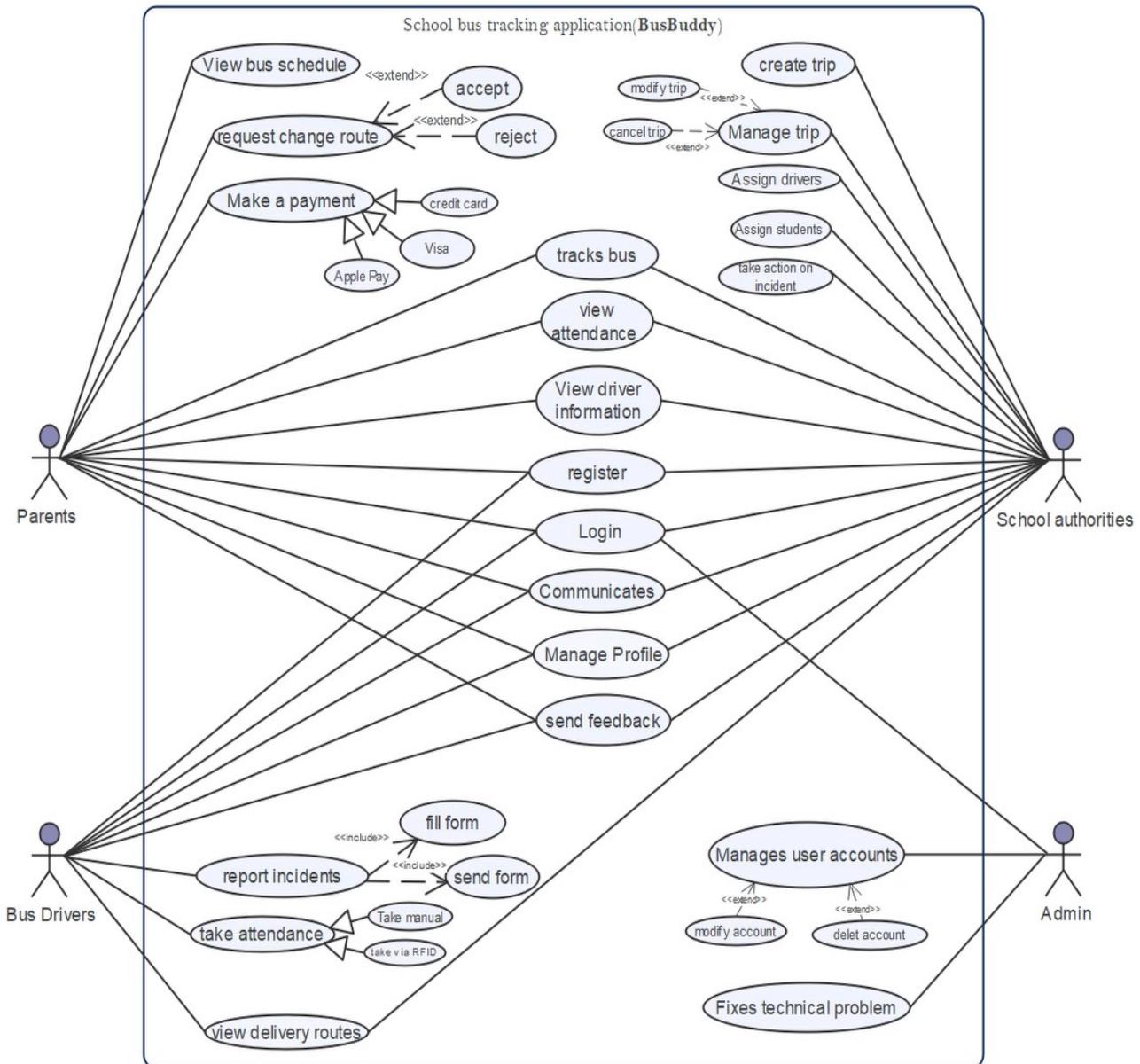


Figure 3: Use case diagram

2.2.3 Use Case Descriptions:

System	School bus tracking application (BusBuddy)
Use case	Login.
Actors	Parents - Drivers - School authorities- Admin.
Description	Users (Parents - Drivers - School authorities- Admin) can login to the application.
Pre-Condition	User must have an account.
Post-Condition	Successful login and user connect to their account.
Flow of event	<ul style="list-style-type: none"> • The user opens the application from his device. • The application displays the login screen with the roles of the users (Parents - Drivers - School Authorities - Administration). • The user selects the appropriate option based on their role by clicking on it. • The user enters username or email and password. • The application verifies the user's access to the account and verifies their role. • If the verification is successful, the application logs into the appropriate dashboard based on the user's role and permissions.

Table 1: Description of login

System	School bus tracking application (BusBuddy)
Use case	Register.
Actors	Parents - Drivers - School authorities.
Description	New users can register in application.
Pre-Condition	Internet presence - download the app.
Post-Condition	Successfully registered and have an account.
Flow of event	<ul style="list-style-type: none"> • The user opens our app on their device . • The user selects the option to register for a new account. • The user selects their role from the available options (Parents, driver, school authorities). • The user enters their personal information, name, e-mail, phone number, etc • The application sends a verification message(email or SMS) to the user to confirm their account . • The user enters the verification code. • The verification code is correct, the application will be sent to the user if it has been successfully registered.

Table 2:Description of register

System	School bus tracking application (BusBuddy)
Use case	Tracks bus.
Actors	Parents - School authorities.
Description	Enables parents and school authorities to track the live location of school buses.
Pre-Condition	Download the app - the presence of the Internet - have an account - to be authorized.
Post-Condition	Parents and school authorities are able to track school buses in real time.
Flow of event	<ul style="list-style-type: none"> • The user opens the application. • The user chooses the school bus tracking option. • The app displays all available school buses. • The user selects the bus wants to track. • The application displays the live location of the selected bus on the map. • The user able to tracks the bus. • The user can view the estimated time of arrival of the bus at a particular destination, etc

Table 3:Description of tracks bus

System	School bus tracking application (BusBuddy)
Use case	View attendance.
Actors	Parents - School authorities.
Description	Enables Parents and School authorities to view attendance records of students on the school bus.
Pre-Condition	The student's attendance data is already recorded in the system.
Post-Condition	Authorized users can view attendance records of students on the school bus.
Flow of event	<ul style="list-style-type: none"> • The user opens the application. • The user chooses the attendance list of students on the school bus. • The user selects the student whose attendance history they want to view. • The app displays the attendance history of the selected student, showing the dates and times they got on and off the bus. • The user can view attendance records based on the selected date range or date.

Table 4:Description of view attendance

System	School bus tracking application (BusBuddy)
Use case	Request change route.
Actors	Parents.
Description	Enables parents to request a change bus route.
Pre-Condition	To be authorized to request a bus change.
Post-Condition	The change request is successfully sent to the school authorities, and they review it and respond with acceptance or rejection.
Flow of event	<ul style="list-style-type: none"> • User opens the app. • The app displays the "Request Bus route" option. • User chooses option. • The application prompts the user to provide details of the proposed change such as the location of the new pick-up/delivery, and the reason for the change by filling out the form. • The user sends the request. • The app sends a notification to school authorities regarding the required change. • School authorities review the request and can approve or reject the proposed change. • If approved, School authorities change the bus route information in the app and the change is saved in app. • The app automatically notifies parents and drivers of changes. • In case of refusal, School authorities provide a reason for the decision and inform the parent via the application.

Table 5:Description of request change route

System	School bus tracking application (BusBuddy)
Use case	View driver information.
Actors	Parents - School authorities.
Description	Enables parents and school authorities to view driver information.
Pre-Condition	Users must have permission to view the information.
Post-Condition	Driver information is displayed to the user.
Flow of event	<ul style="list-style-type: none"> • The user opens the application. • The user selects the option to display drivers' information. • The app displays a list of all bus drivers associated with the school. • The user selects a driver from the list to view their information. • The app displays the driver's information, such as name, contact details, license number, and a record-breaking certificate.

Table 6:Description of view driver information

System	School bus tracking application (BusBuddy)
Use case	Communicates.
Actors	Parents - Drivers - School authorities.
Description	Enables drivers, parents, and school authorities to communicate with each other and facilitates the process. Communication may be through messages or a call .
Pre-Condition	Install the app - an active account - the presence of the Internet.
Post-Condition	The ability to communicate easily and effectively.
Flow of event	<ul style="list-style-type: none"> • The user opens the application. • The user chooses to communicate the person to communicate with shall be determined by the school authorities, the driver, or the guardian. • Determines the way of communication through messages or a call. • If it is through messages, the user writes the message and sends it, waiting for a response and if by contact, he contacts the concerned party. • The application keeps a record of all communications and messages.

Table 7:Description of communicates

System	School bus tracking application (BusBuddy)
Use case	View buses schedules.
Actors	Parents.
Description	Parents can view their children's school bus schedule.
Pre-Condition	Availability of bus schedules in the system and updated regularly.
Post-Condition	View school bus schedules and affiliate information.
Flow of event	<ul style="list-style-type: none"> • The application displays a list of school buses dedicated to the names of its schools. • The user chooses the buses of a specific school, and the system shows him all the buses belonging to this school. • The system shows the parent a star sign next to the bus in which his child is located. • The system displays the schedule for each bus and the route taken by the bus, including the locations of receipt and delivery. • Parents can view the bus schedule for a specific day, week, or month. • Once the changes are made, the system updates the bus schedules for all parents.

Table 8:Description of view buses schedules

System	School bus tracking application (BusBuddy)
Use case	Manage Profile.
Actors	Parents - Drivers - School authorities.
Description	Allowing Parents - Drivers - School authorities to manage their accounts so that they display their existing personal information and can update it, or they can delete their account.
Pre-Condition	The user must have an account . The user has the appropriate permissions to manage their profile.
Post-Condition	The user's profile information is updated or deleted from the system depending on the action they have taken.
Flow of event	<ul style="list-style-type: none"> • The user opens the application. • The user clicks on the "Profile" option in the application. • The system displays the user's current profile information, such as name, contact details, etc • The user can update the profile. • The user saves his changes by pressing the "Save" button. • The system updates the user profile information. • The user can also delete the profile by clicking on the "Delete" option, and the application displays a confirmation message on the process with a mention of the consequences, such as you will not be allowed to access the account and you will lose all registered data. • The user confirms the action. • The system will delete the profile.

Table 9: Description of manage profile

System	School bus tracking application (BusBuddy)
Use case	Send feedback.
Actors	Parents - Drivers - School authorities.
Description	The application allows Parents - Drivers - School authorities to send feedback, suggestions, or complaints about the application to the administrator.
Pre-Condition	The user has an account in the app. The user has encountered a problem, has a suggestion, or wants to give general feedback about the system.
Post-Condition	<ul style="list-style-type: none"> • It is handled according to application policies. • The user may receive a response or follow-up from the administrators.
Flow of event	<ul style="list-style-type: none"> • The user clicks on the "Send feedback" option in the application. • The system displays a feedback form that allows the user to enter his name, e-mail address, message, and any attachments that may support the topic. • The user fills out the feedback form and submits it by clicking the "Submit" button • The system sends an email notification to the administrators. • Administrators receive and review feedback, and take appropriate action as necessary, such as resolving the issue, or responding to the suggestion.

Table 9: Description of send feedback

System	School bus tracking application (BusBuddy)
Use case	Make a payment.
Actors	Parents.
Description	The app enables parents to "make a payment" by paying the school bus transportation fee for their children.
Pre-Condition	<p>The user must have an account.</p> <p>The user has children go on school buses to make payments to school officials.</p> <p>The user has enough money in his bank account to pay.</p>
Post-Condition	<p>The success of the operation by issuing a payment receipt.</p> <p>Automatically send payment receipt to school authorities.</p>
Flow of event	<ul style="list-style-type: none"> • The parent selects the "Make Payment" option from the payment section of the app. • The application displays all the remaining amounts for the payment and the expiry period for the payment. • The system displays a payment interface that allows parents to select a payment method such as a credit card, Visa, or Apple Pay. • The system asks the user to enter payment details. • The parent enters the payment details and confirms the payment. • The system sends the payment details securely to the payment gateway that processes the transaction. • If the payment is successful, the payment gateway provider sends a confirmation message to the system, which updates the payment status and records the details of the payment transaction, including the payment amount, payment date, and payment method. • The system generates a payment receipt, which is shown to the parent and can be saved, and automatically sent to the school authorities email.

Table 10:Description of make a payment

System	School bus tracking application (BusBuddy)
Use case	View delivery routes.
Actors	Drivers - School authorities.
Description	It helps drivers to view the routes to which students will be taken to and also helps the school authorities follow the routes set by them.
Pre-Condition	<p>The user is authorized to view the delivery path.</p> <p>The presence of delivery path information to the system.</p>
Post-Condition	The user saw the route of delivery successfully - the driver can deliver based on the locations of the routes specified for him.
Flow of event	<ul style="list-style-type: none"> • The user, whether it is the driver or the school authorities, chooses the option "View delivery route" from the main menu. • A map with the delivery routes assigned to him by the school is shown to the driver, sorted by nearest and then farthest. • If the delivery process is completed for a certain route, the driver clicks on "Delivered" and so on until he finishes dropping off all the students who ride with him on the bus. • Also, school authorities can see the delivery routes of their school and the driver assigned to each bus. • The driver and school authorities can zoom in or out of the map view. • School authorities can also see the status of the delivery for a specific route if it is done or not.

Table 11:Description of view delivery routes

System	School bus tracking application (BusBuddy)
Use case	Take attendance.
Actors	Drivers.
Description	It enables the driver to record attendance for students on the bus, and it can be manual or automatic via RFID technology.
Pre-Condition	Driver login to the app. The "Take Attendance" box is available for drivers in the app. The presence of a list of students assigned to the bus driver in the app.
Post-Condition	Attendance data is recorded and saved in the app.
Flow of event	<ul style="list-style-type: none"> • The driver selects the "Take Attendance" option from the menu in the app. The application displays the list of students assigned to the driver's bus. • The driver selects each student on the bus by selecting a checkmark next to their name (manual), or by scanning their RFID tag (automatic). • The application records attendance data and classifies each student as present or absent. • The system saves attendance data and sends it to the school authorities for record keeping.

Table 13: Description of take attendance

System	School bus tracking application (BusBuddy)
Use case	Report incidents.
Actors	Driver.
Description	The driver can report any incidents that occur during the bus trip, such as the bus malfunction or any incidents that may affect the safety of the students.
Pre-Condition	Driver login to the app. An accident occurs during the bus trip.
Post-Condition	The accident report is saved and handled by the school authorities.
Flow of event	<ul style="list-style-type: none"> • The user selects " report incidents " • The application displays a form for entering the details of the accident, including the date, time, location, level of the accident (very serious or moderate severity), and a description of the accident. • The driver fills out the form and submits it. • The system saves the accident report and notifies the school authorities of the accident to follow the appropriate procedure. • School authorities can view the accident report and take appropriate action, such as calling 999, arranging for bus replacement, or notifying parents.

Table 12:Description of report incidents

System	School bus tracking application (BusBuddy)
Use case	Manages the trip.
Actors	School authorities.
Description	The application enables school authorities to manage bus trips, extending modifying, or cancelling trips.
Pre-Condition	School authorities login to app. The school registered their buses and drivers. have a trip to manage it
Post-Condition	Bus trip information is updated in the app.
Flow of event	<ul style="list-style-type: none"> The school authorities select the " Manage trip " option from the menu in the app. The app displays a list of the school's existing trips, with options to modify trip, or cancel a trip. If they choose to modify trip, the school authorities select the trip from the list and make changes, such as adjusting the start and finish time or changing the bus route or assign a driver for it. If they choose to cancel a trip, the school authorities select the trip from the list and confirm the cancellation. The system updates trip information and sends notifications to drivers and parents of any change or cancellation. School authorities can view status(If it is done or not) of each trip in the app.

Table 13:Description of manages the trip

System	School bus tracking application (BusBuddy)
Use case	Assign drivers.
Actors	School authorities.
Description	School authorities can assign drivers for school bus trips in the app.
Pre-Condition	School authorities have created at least one school bus trip in the app.
Post-Condition	The chosen driver is assigned to the specified school bus trip.
Flow of event	<ul style="list-style-type: none"> The school authorities open the application. The school authorities select the " Manage trip " option from the menu. The application displays a list of the school's existing trips. The school authorities choose the trip for which they want to assign a driver. The app displays trip details. The school authorities choose the option to "assign a driver" on the selected trip page. The application displays a list of available drivers. The school authorities choose the driver they want to Assigned for the trip. The app prompts the school authorities to confirm the driver's assignment. The school authorities confirm the appointment of the driver. The app updates the trip information with the newly appointed driver.

Table 14:Description of assign drivers

System	School bus tracking application (BusBuddy)
Use case	Assign students.
Actors	School authorities.
Description	School authorities can assign students to a particular school bus trip in the app.
Pre-Condition	School authorities have created at least one school bus trip in the app.
Post-Condition	Students are successfully assigned to the chosen bus trip.
Flow of event	<ul style="list-style-type: none"> • School authorities choose the " Manage trip " option from the menu in the app. • The application displays a list of the school's existing trips. • School authorities determine the specific trip you want to assign students to. The app displays a list of students who are eligible for the selected trip. • The school authorities select which students you want to assign for the trip. School authorities confirm process. • The system updates trip information to reflect the newly assigned students. The system sends notifications to the parents of the designated students telling them about the trip details.

Table 15:Description of assign students

System	School bus tracking application (BusBuddy)
Use case	Take action on incident.
Actors	School authorities.
Description	School authorities can take action on reported incidents related to a school bus trip in the app.
Pre-Condition	At least one incident has been reported.
Post-Condition	The school authorities took appropriate action regarding the reported incident.
Flow of event	<ul style="list-style-type: none"> • School authorities enter the "Incidents" section of the app. • The application displays a list of all reported incidents related to the school's school bus trips. • The school authorities choose the incident they want to take action on. • The app displays details of the selected incident, including the time, date, location, and description of the incident. • The school authorities review the details of the accident and assess the severity of the accident. • Depending on the severity of the accident, the school authorities will take appropriate action, which may include contacting the emergency services or not. • When the incident is resolved, the school authorities change the status of the incident by selecting the “Resolved” mark with the action taken in the notes field. • The system automatically notifies parents and drivers of the accident status.

Table 16:Description of take action on incident

System	School bus tracking application (BusBuddy)
Use case	Manages user accounts.
Actors	Admin.
Description	Enable the administrator to manage user accounts in the application
Pre-Condition	The system has existing user accounts that need to be managed.
Post-Condition	User accounts have been successfully managed by the administrator the system saves the changes to the user accounts.
Flow of event	<ul style="list-style-type: none"> • The admin goes to the "Manage Users" section of the application. • The application displays a list of existing user accounts. • The admin selects the user account that he wants to manage. • The application displays the account details of the selected user. • The admin can perform various actions, such as modify an existing account or deleting an account. • If the admin chooses to modify an existing account, they can modify the user's details or change their role. • If the admin chooses to delete an account, the system prompts the admin to confirm the operation. • Once the admin completes the actions, the system saves the changes to the user accounts.

Table 17:Description of manages user accounts

System	School bus tracking application (BusBuddy)
Use case	Fixes technical problem.
Actors	Admin.
Description	The admin fixed technical issues arising in the application.
Pre-Condition	A technical problem has been reported or identified in the system.
Post-Condition	The technical issue has been resolved successfully.
Flow of event	<ul style="list-style-type: none"> • The admin receives a report of a technical problem in the system. • The admin logs into the system • The admin determines the cause of the technical problem. • The admin plans to solve the problem by devising different solutions that may work • The admin chooses the appropriate solution and implements it • The admin tests the system to ensure that the problem is resolved • The admin documents the problem, its cause, implemented solution, and test results.

Table 18:Description of fixes technical problem

System	School bus tracking application (BusBuddy)
Use case	create trip
Actors	School authorities.
Description	Creation of a new trip within the app by the school authorities
Pre-Condition	School authorities must be authenticated. have the information required for the trip
Post-Condition	A new trip is successfully created
Flow of event	<ul style="list-style-type: none"> • School authorities choose to "create a trip" in the app. • The app provides a form, request of them to enter the necessary trip details. • The school authorities fill in the required information. • The authorities submit the new trip. • The authorities receive a confirmation message indicating that the trip creation was successful. • The system assigns a unique trip number. • The system updates the trip schedule and notifies the stakeholders, such as bus drivers and parents

Chapter 3: System Design

3.1 Architectural design

A pattern will be used the Model-View-Controller (MVC) because it allowed to multiple ways to view and interact with data and allows the data to change independently of its representation. So, it provides a clear separation of concerns between data, user interface, and business logic, making the system more scalable, maintainable. So, it is suitable for our system and facilitates the process of communicating with the users and the application.

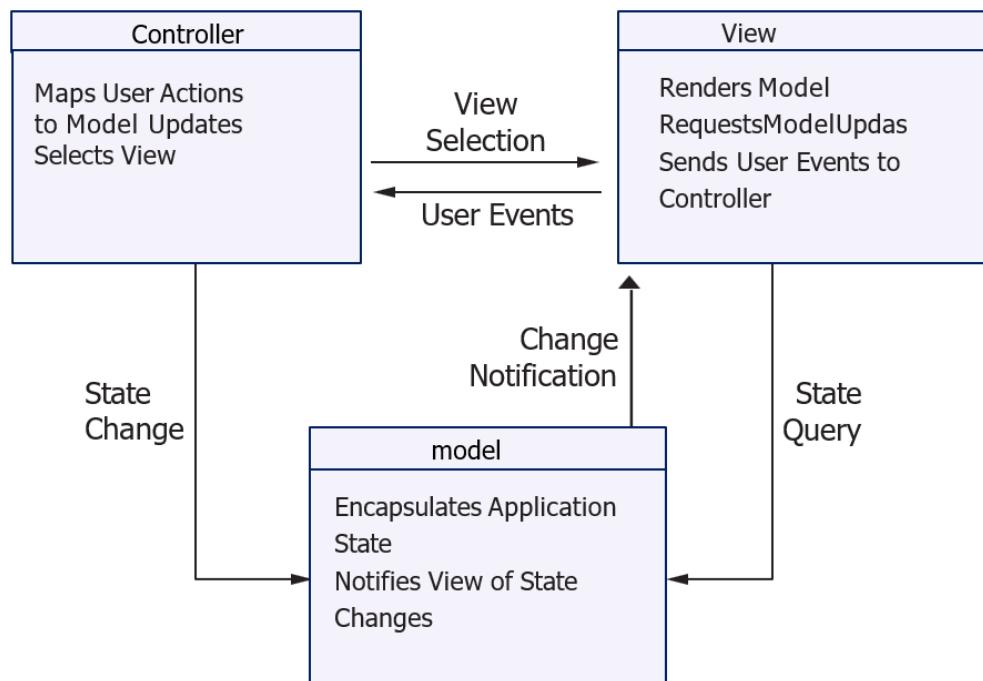


Figure 4: General Model-View-Controller

The overall look of the MVC has been reconfigured to suit our system in the figure below.

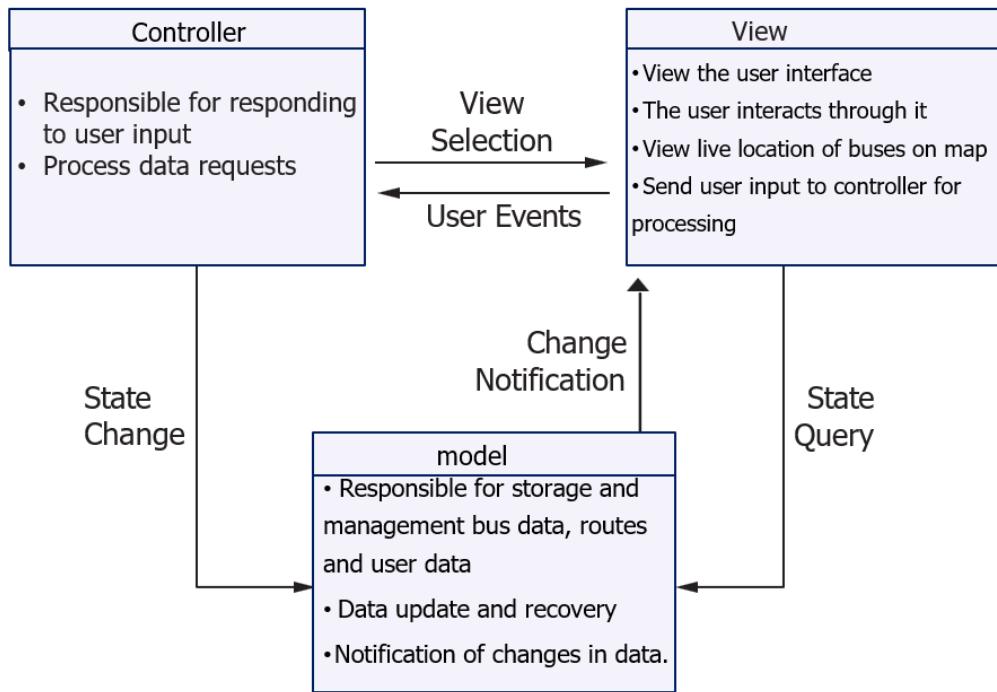


Figure 5: Model-View-Controller for our app

3.2 Object Oriented Design

3.2.1 Structural Static Models

- class diagram

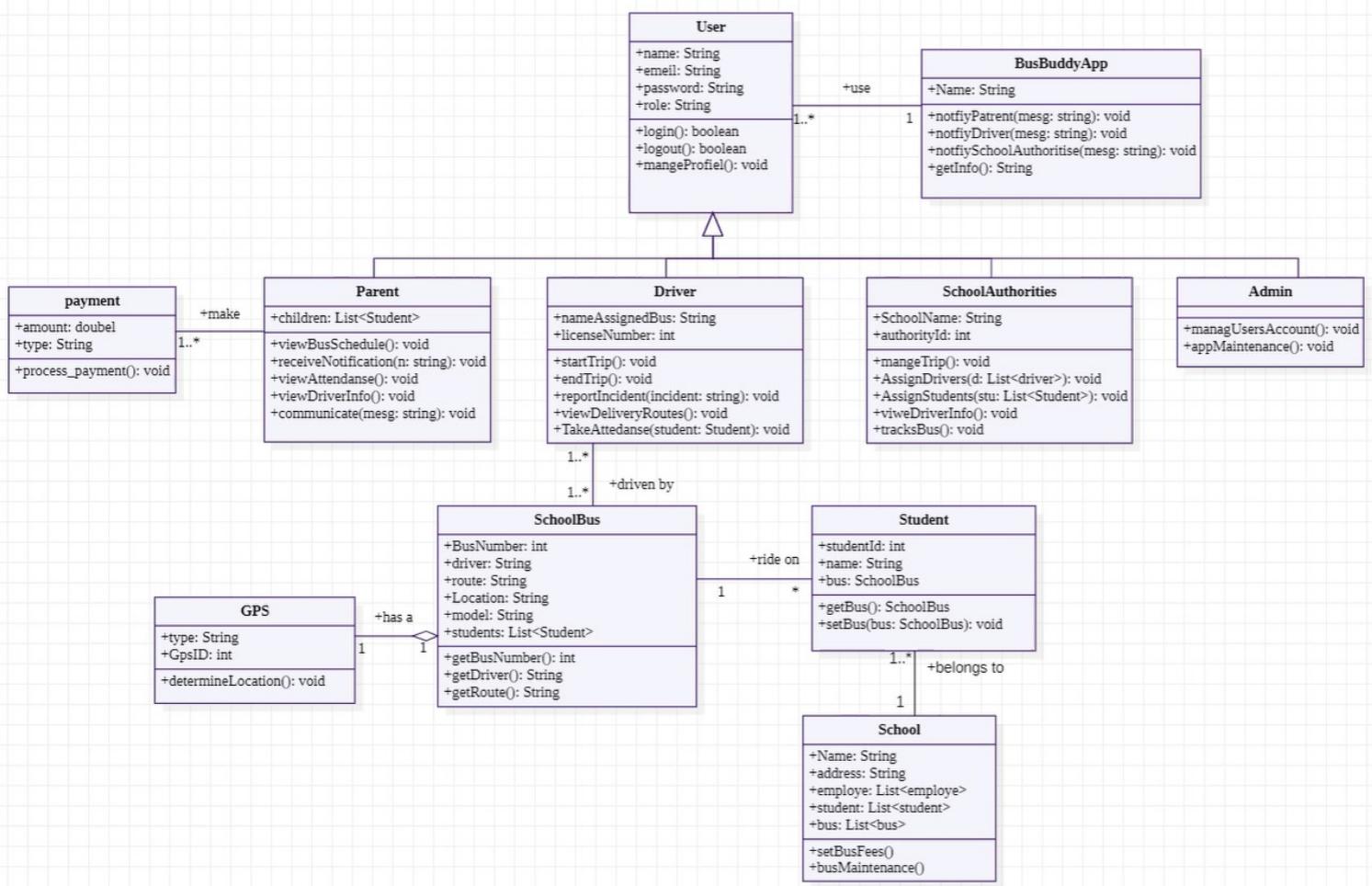


Figure 6: Class diagram

3.2.2 Dynamic Models

- Activity Diagram

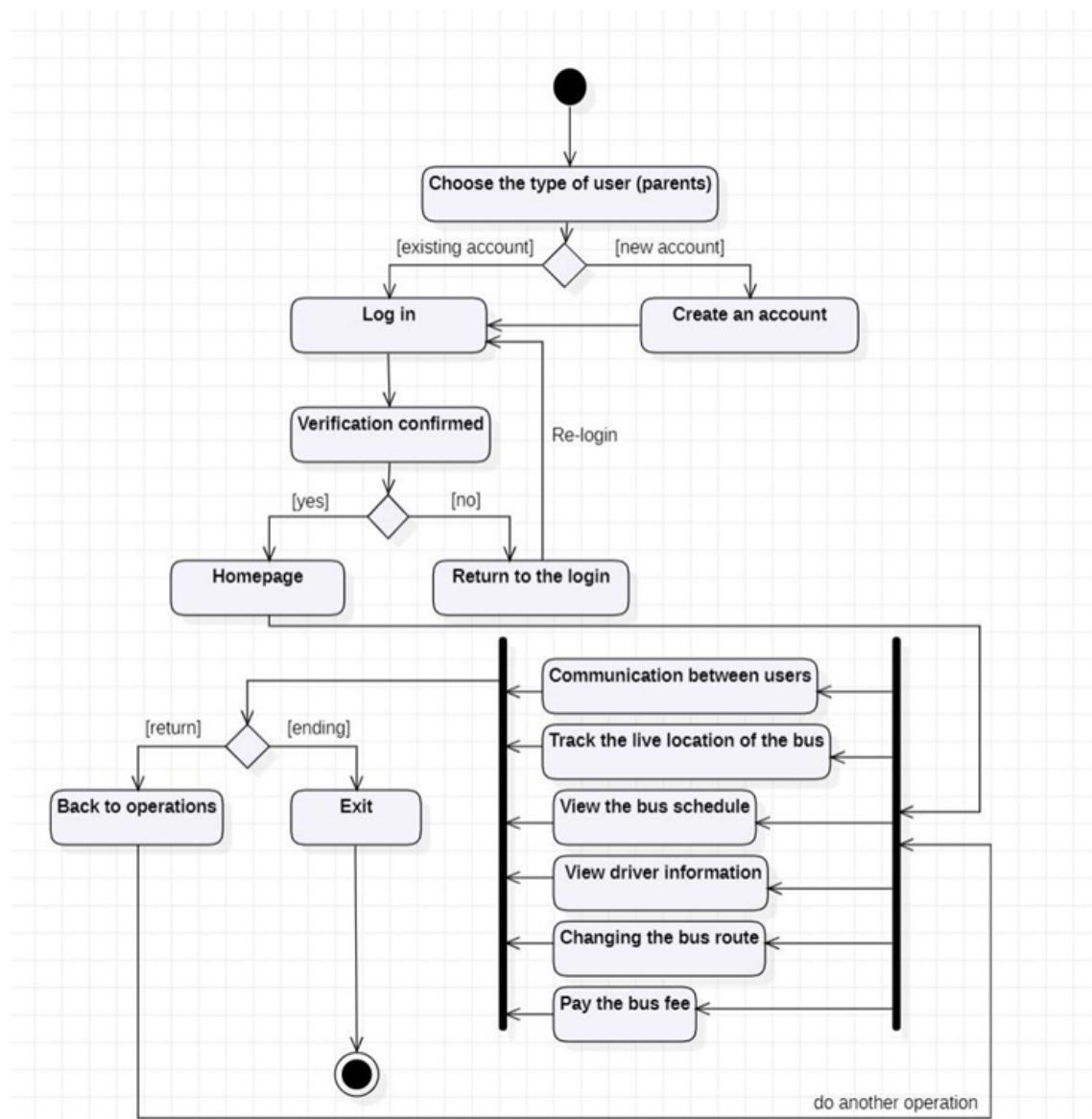


Figure 7: Activity Diagram

- Sequence Diagrams

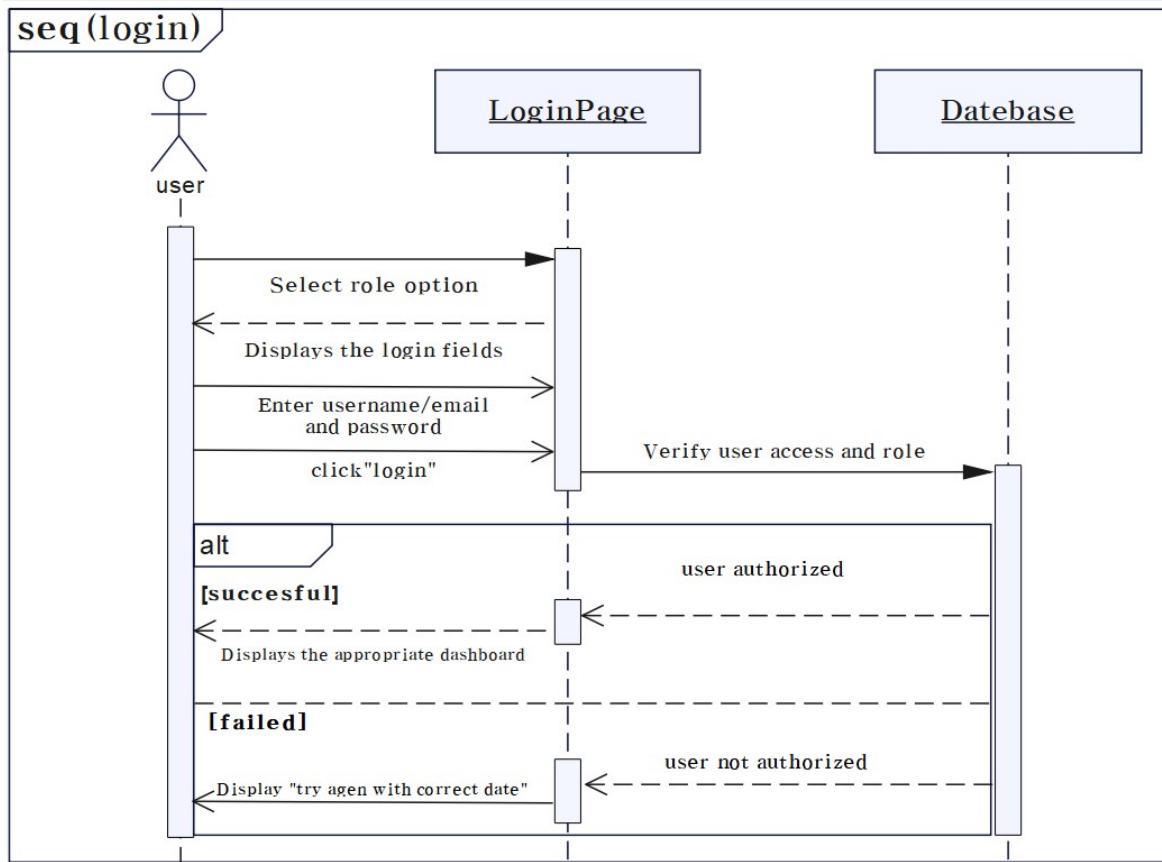


Figure 8:seq(login)

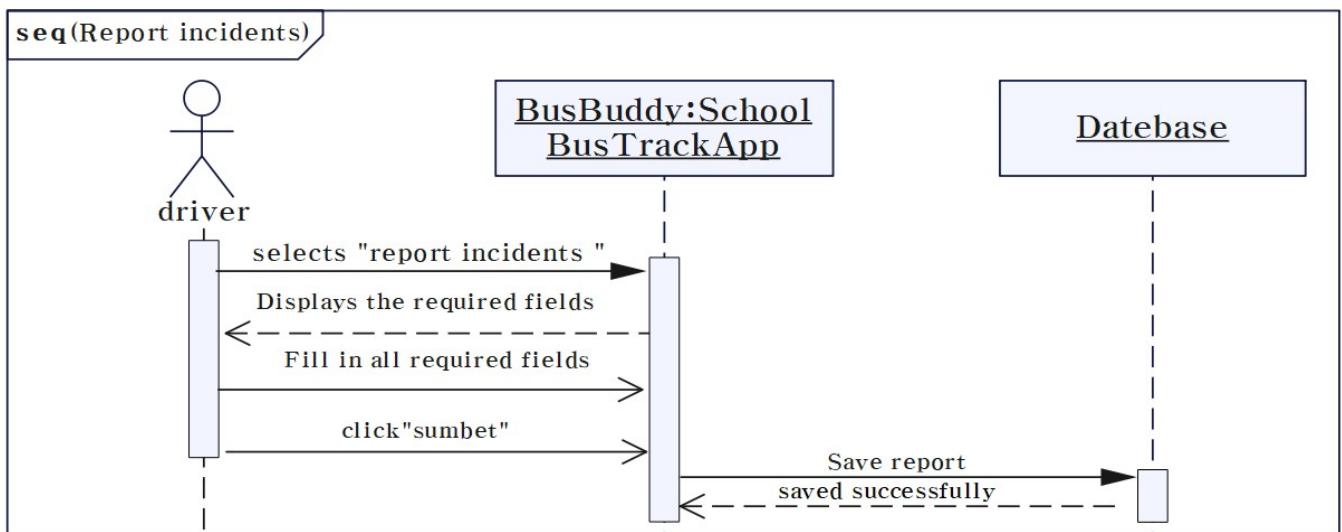


Figure 9:seq(Report incidents)

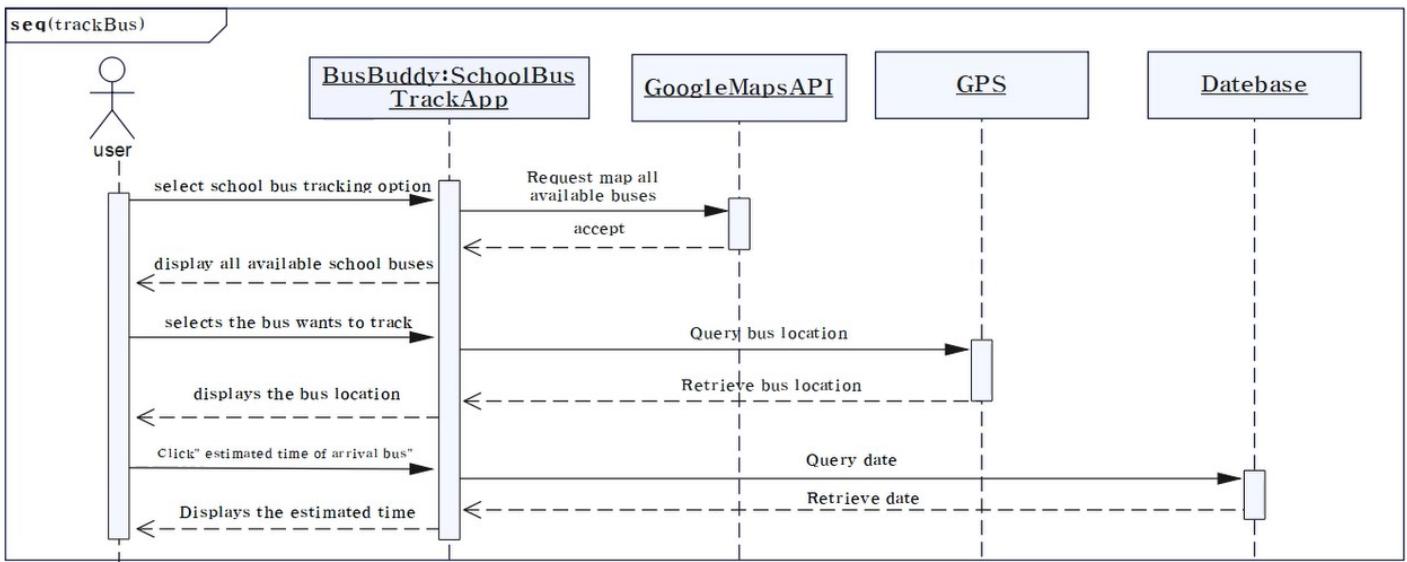


Figure 10: seq(trackBus)

3.3 User Interface Design



Figure 11:User type interface

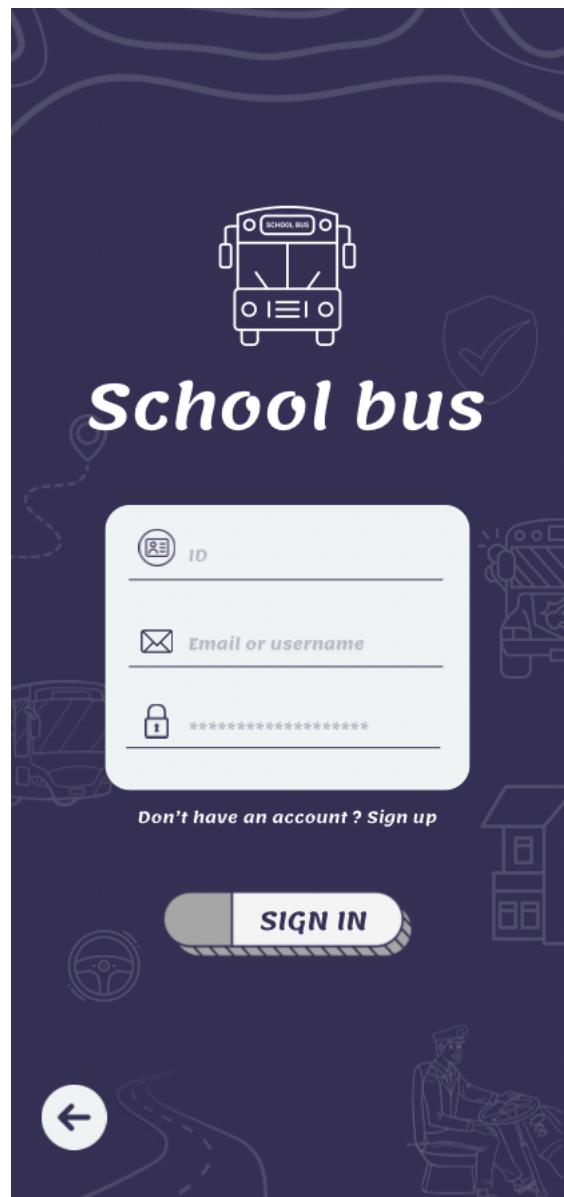


Figure 12:Sign in interface

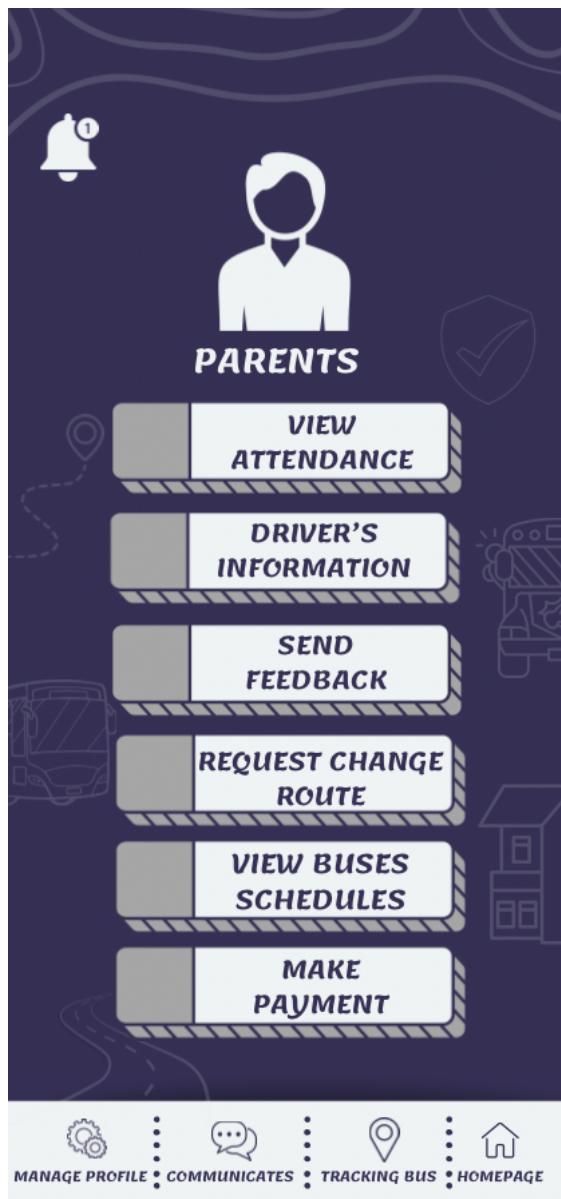


Figure 13:Homepage



Figure 14:Tracking bus interface



Figure 15:Communicate interface

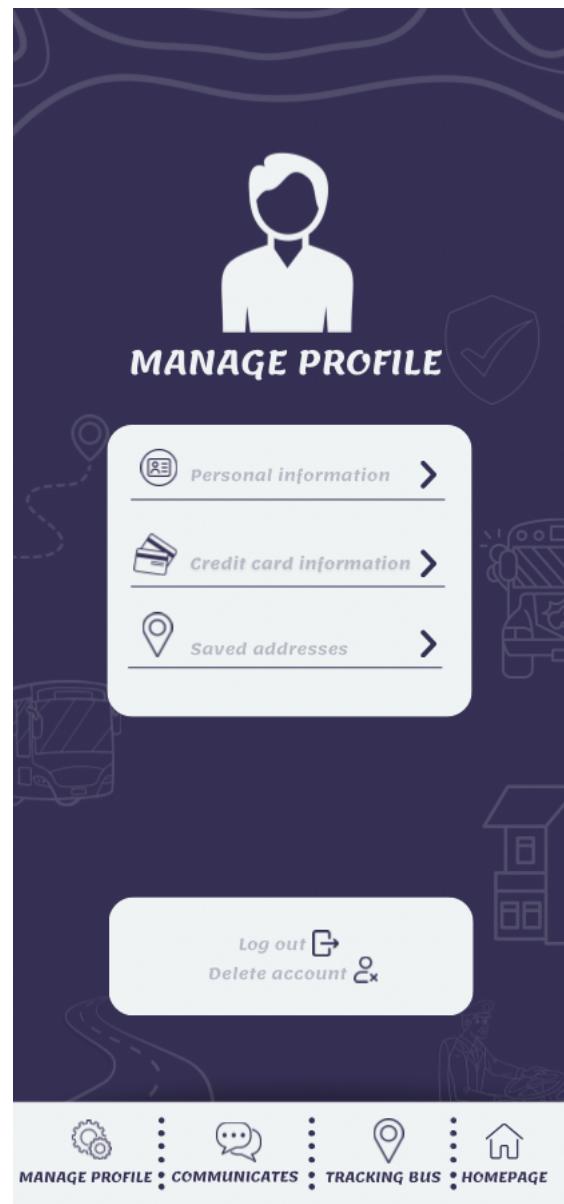


Figure 16:Manage profile interface

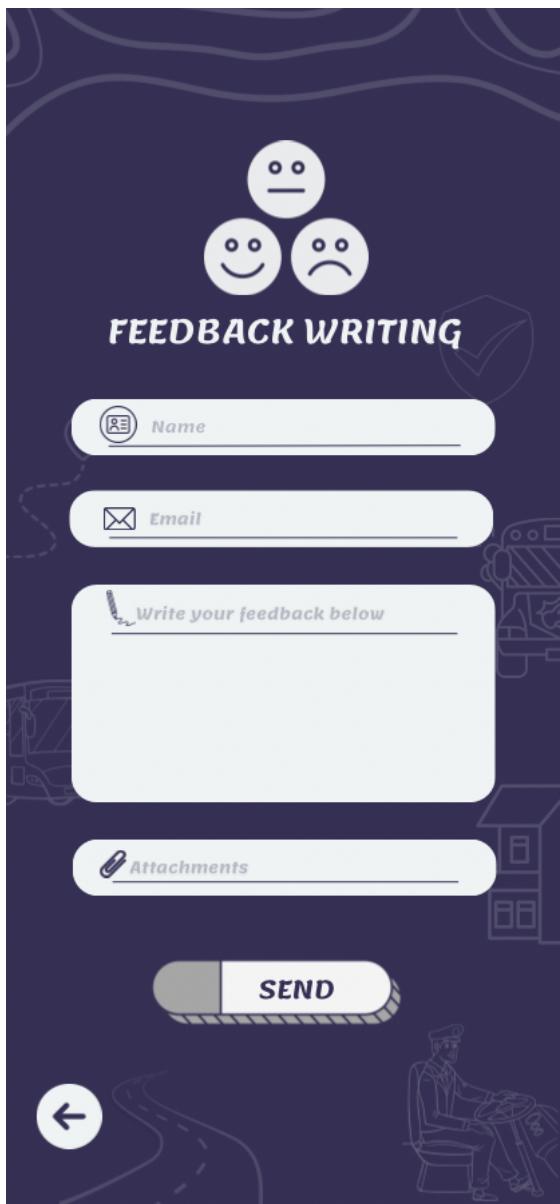


Figure 17:Feedback writing interface

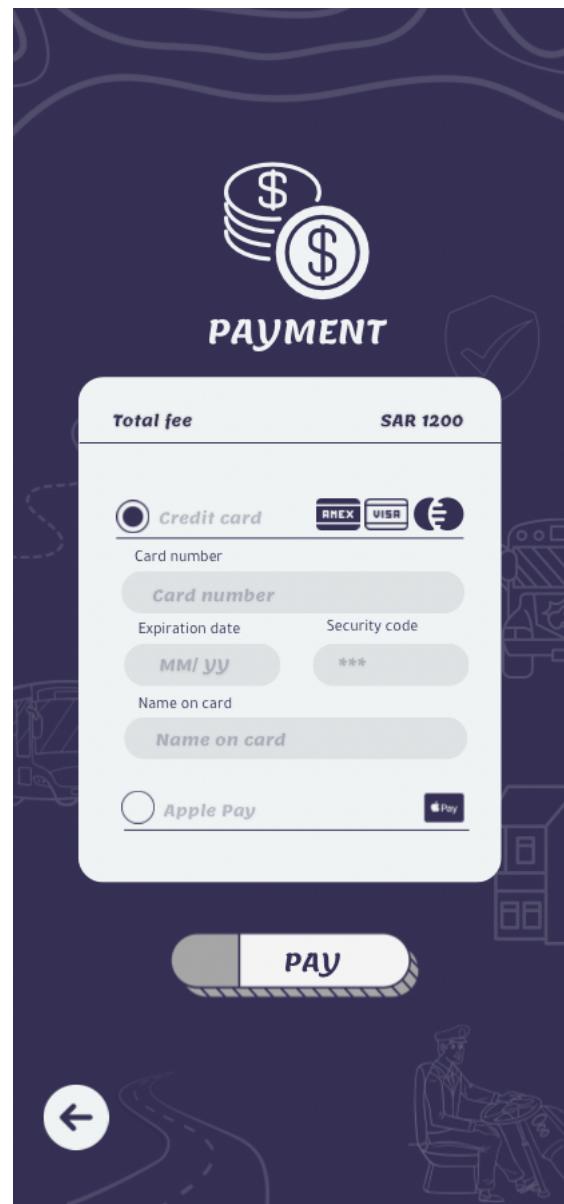


Figure 18:Payment interface

Chapter 4: Conclusion and Future Work

4.1 Conclusion

In conclusion, our application offers good features to ensure the safety of students during school transportation. By facilitating effective communication between parents, school authorities and bus drivers. One of the main features of our app is providing information about live bus locations, routes, and schedules. The app also features easy to use interfaces. we have taken care to develop our application based on high requirements such as good performance and reliability.

4.2 Limitations and Future Work

4.2.1 Limitations and challenges:

- We have given complete freedom in choosing the project idea and using any drawing programs. However, the only limitation we faced that is the good and flexible drawing diagram programs require a subscription with a fee.
- It's difficult to make the document for everyone so that any modification or change from the members of the group everyone can show the last copy.
- One of the most difficulties that we faced as a project team was the incompatibility of times between the members of the group to hold a meeting.
- We found it difficult to search for technologies that might benefit us in creating the application, as most of the sources were not allowed to be accessed.

4.2.2 Future Work:

In the future, we want to expand more and have enough knowledge to complete the system implementation phase and the system testing and optimization stage to get it out in the best possible way, which makes the system also available on the web and not only an application in mobile, in the future we want to add many services that may benefit the user, for example we may offer features with a Premium subscription, We will work on improving the interface design to make it more flexible and easy And we can expand the application to make it track even private drivers for children who are not affiliated with a particular school and regarding the scope of the program, we want to expand it so that we make it also available outside Saudi Arabia.

References

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- [3] S. Sarmady, F. Haron, and A. Z. H. Talib, "Modelling groups of pedestrians in least effort crowd movements using cellular automata," in *Proc. 2009 2nd Asia International Conference on Modelling & Simulation*, Bali, Indonesia, 2009, pp. 520-525.