



## American International University-Bangladesh (AIUB)

### Department of Computer Science

### Faculty of Science & Technology (FST)

## SmartTransit – A public transport assistant platform

A Software Requirement Engineering Project Submitted  
By

Semester: Spring_24_25		Section: B	Group Number: 03	
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The project will be Evaluated for the following Course Outcomes

EVALUATION CRITERIA	Total Marks (50)	
	40	
Introduction [Section 1.1-1.4], Format, Submission, Defense	[10 Marks]	
System Overall Description & Functional Requirements	[10 Marks]	
System Quality Attributes and Project Requirements	[10 Marks]	
UML and E-R Diagram with Data Dictionary	[10 Marks]	
UI/UX Prototyping	[10 Marks]	

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# **Software Requirements Specification**

**for**

## **SmartTransit – A public transport assistant platform**

**Version 7.0 approved**

**Prepared by**

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## Table of Contents

Revision History .....	4
1. Introduction.....	4
1.1 Purpose.....	4
1.2 Document Conventions.....	5
1.3 Intended Audience and Reading Suggestions .....	5
1.4 References.....	5
2. Overall Description.....	6
2.1 Product Perspective.....	6
2.2 Product Functions .....	7
2.3 User Classes and Characteristics.....	9
2.4 Hardware and Operating Environment .....	10
2.5 Design and Implementation Constraints .....	10
2.6 User Documentation .....	11
3. System Requirements.....	12
3.1 System Features .....	12
3.2 Non-Functional/Quality Requirements.....	18
3.3 Project Requirements .....	19
4. Design and Interface Requirements .....	20
4.1 UML Diagrams .....	20
4.1.1 Class Diagram .....	20
4.1.2 Use-case Diagram.....	21
4.1.3 Activity Diagram .....	22
4.1.4 E-R Diagram:.....	23
4.2 Data Dictionary .....	24
4.3 UI/UX Design Specification .....	28

## Revision History

Name	Date	Reasons for changes	Version
Sohag	10.04.2025	Initial draft created with background and purpose sections	1.0
Sazid	15.04.2025	Added product perspective and clarified business objectives	2.0
Sadman, Anannya	25.04.2025	Drafted functional and non-functional requirements	3.0
Sohag, Sadman, Anannya	01.05.2025	Added UI/UX prototype for user, bus authority and ticket verifiers.	4.0
Sadman, Shohag	15.05.2025	Updated ER- Diagram	5.0
Anannya	25.05.2025	Added project requirements with updated COCOMO estimations	6.0
Full Team	15.06.2025	Final review, corrections, and version approval	7.0

## 1. Introduction

### 1.1 Purpose

This document specifies the software requirements for **SmartTransit – A Public Transport Assistance Platform** (Version 7.0). It covers the full system, including the mobile app for passengers, an admin dashboard for transport authorities, and the backend services handling real-time tracking, seat availability, plan routes with estimated arrival times, digital ticketing, set up bus services. The purpose of SmartTransit is to improve the public transport experience in densely populated cities of Bangladesh by solving key issues like long wait times, poor route visibility, and inefficient ticketing. It will also support transport authorities in managing and analyzing system operations. The concept and feature design are inspired in part by the existing "[EasyWay Public Transport](#)" app, which demonstrates the practical benefits of real-time transit information systems. This product aligns with goals of smart city development and sustainable urban transport by encouraging public transport usage and reducing traffic congestion.

## 1.2 Document Conventions

This document follows standard formatting and typographical conventions:

- The document follows a **consistent numbering** system for all **sections** and **subsections**.
- **Bold Text**: Used for section **headings**, **subsection titles**, and **key terms** to enhance readability.
- **Italic Text**: Used for emphasizing specific terms, defining new terminology, or elaborating on features and properties in detail.
- **Requirement Categorization**: Requirements are classified into two main categories:
  - **Functional Requirements (FR)**: Represent core functionalities of the product, identified using the format **FR-[ID]** (e.g., **FR-01**).
  - **Non-Functional Requirements (QAN)**: Specify performance, usability, reliability, and other quality attributes, identified using the format **QA[N]** (e.g., **QA1**).
- Priority levels are indicated using **red color texts** such as **High**, **Medium**, and **Low**.
- Certain text highlighted in blue also contains embedded hyperlinks for quick access to additional resources or references.
- Unordered lists are used throughout this document to present related items or key points in a non-sequential manner. The following conventions are used for unordered lists:
  - **Bullet Style**: Standard bullet points are used to denote items of equal importance.
  - **Indentation**: Nested bullet points indicate sub-items or details related to the primary item.
- Superscripts are used in this document to indicate exponents, derivatives, or other notations that require a raised symbol in mathematical formulas (E.g. Calculating COCOMO).

## 1.3 Intended Audience and Reading Suggestions

This document is for anyone involved in the development, design, testing, or use of the SmartTransit app.

- **Developers and testers** should focus on the system requirements and technical sections.
- **Project managers** may find the overall description and feature list most useful.
- **Designers** should check the UI/UX section for layout and interaction guidance.
- **End users or stakeholders** can read the introduction and user scenarios to understand what the app will do and how it helps them.

Everyone is encouraged to start with the Introduction to get a full picture of the problem and the solution being proposed.

## 1.4 References

[1] **Smart City Bus Tracking for Improved Urban Mobility**

Author: [S. Vaishnavi](#); [G. Renish](#); [T. Surendra](#); [J. Ram Kumar](#); [V. Srinivasan](#)

Date Accessed: 20 May 2024

URL: <https://ieeexplore.ieee.org/document/10346218>.

**[2] Transportr - Public Transit - Apps on Google Play**

*Source:* Play Store

*Date Accessed:* 22 December 2024

*URL:* <https://play.google.com/store/apps/details?id=de.grobox.liberario&hl=en>

**[3] EasyWay public transport**

*Source:* Play Store

*Date Accessed:* 22 December 2024

*URL:* <https://play.google.com/store/apps/details?id=com.eway&hl=en>

## **2. Overall Description**

### **2.1 Product Perspective**

Public transportation in densely populated cities of Bangladesh faces major challenges such as unreliable schedules, lack of real-time information, inefficient ticketing, and poor route planning. These issues lead to long wait times, overcrowded buses, and low passenger satisfaction, which in turn increase the use of private vehicles and contribute to traffic congestion.

The product described in this Software Requirements Specification (SRS) is a new, self-contained software solution designed to address these issues through a smart, data-driven approach. The system includes a mobile application for passengers and an administrative web dashboard for transport authorities. It offers features such as real-time tracking of vehicles, route planning with estimated arrival times, live seat availability, digital ticket booking, and set up bus services. It is not a direct upgrade or replacement of any existing solution, but rather a fresh and innovative product created specifically to support modern public transportation needs.

The primary business objective of this public transport assistance platform is to provide a smart and innovative solution that improves the quality and efficiency of public transportation, especially in cities facing overcrowding, poor service, and limited digital systems. The business goals are:

- To enhance public transport reliability and convenience through real-time tracking, route planning, and digital ticketing.
- To reduce the use of private vehicles by making public transport more user-friendly and accessible.
- To provide transport authorities with useful data and tools for better route management and service planning.
- To improve the overall travel experience for passengers and increase their trust in public transit systems.
- To offer a scalable and affordable solution that can be easily adopted by other cities with similar challenges.

- To support environmentally sustainable urban mobility and contribute to smart city development by introducing digital solutions into public transport.

This solution aims to bridge the digital gap in public transport and help reshape the commuting experience for millions in a more efficient, organized, and environmentally friendly way.

## 2.2 Product Functions

The **SmartTransit** platform is a complete solution consisting of a mobile app for passengers, an admin dashboard for transport authorities, and a backend system that powers all functionalities. The system focuses on these core functions:

### Real-Time Tracking

Passengers can view live locations of buses on a map through the mobile app. This feature helps users manage their time better and avoid long waits. It includes:

- Displaying bus locations updated in real time
- Tracking buses using GPS integration
- Showing the direction and current status of buses (e.g. arriving, delayed)

### Seat Availability

The app displays available seats on each bus before it arrives. This helps users make travel decisions more comfortably. Key features include:

- Showing real-time seat occupancy for each bus
- Updating seat status based on boarding and exiting data
- Helping users avoid overcrowded buses

### Route Planning with Estimated Arrival Times

Users can search for the best route to their destination with estimated times based on current conditions. This function offers:

- Route suggestions with multiple options
- Estimated arrival and departure times based on live traffic
- Map view with route details and bus stop information

### Digital Ticketing

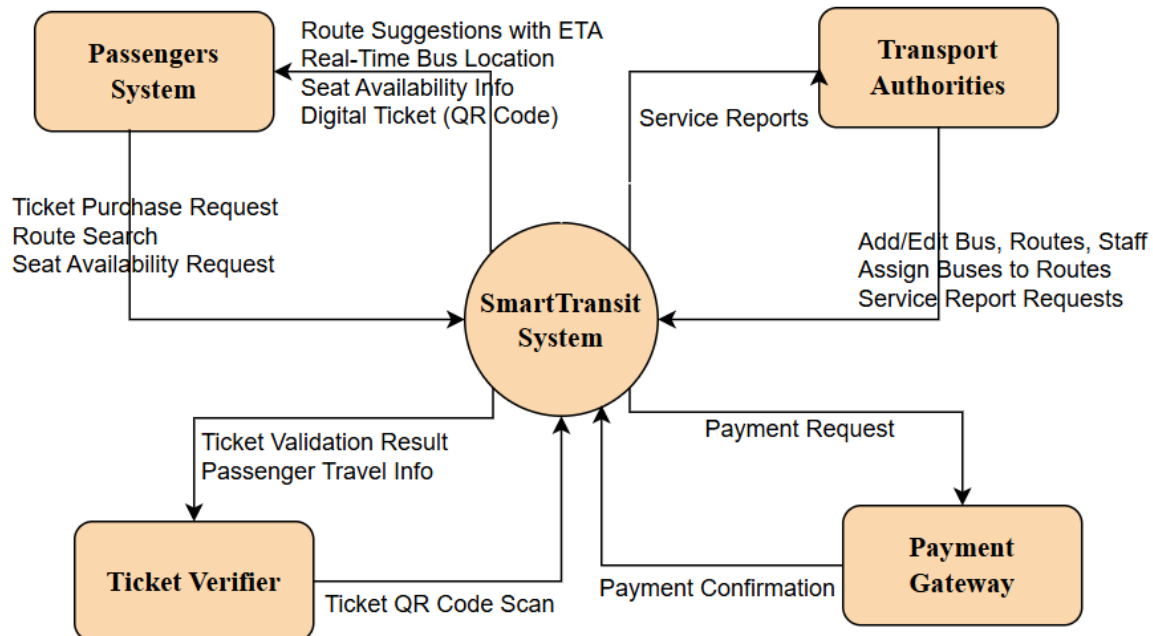
Passengers can buy and use tickets digitally through the app, making travel easier and cash-free. This includes:

- Online ticket purchase using mobile payment methods (eg. bKash)
- Digital ticket with QR codes.
- Easy ticket verification for transport staff.

### Set Up Bus Services (Admin Functionality)

Transport authorities can manage the overall transport system using a web dashboard. They can:

- Add, remove, or edit bus, bus routes, bus Staffs
- Assign buses to specific routes
- Monitor service performance and make changes in real time





## 2.3 User Classes and Characteristics

User Class	Usage Frequency	Technical Expertise	Access Level	Subset of Product Functions used	Experience
<b>Passengers System</b>	Frequent (daily) (High)	Basic mobile app usage	Limited (user-level)	Real-time tracking, route planning, seat availability, ticket booking	General users; no special training
<b>Transport Authorities</b>	Regular (daily) (High)	Intermediate to advanced	Full access to admin dashboard	Service setup, performance monitoring, financial & route management	Professional staff
<b>Ticket Verifiers</b>	Regular (shift-based) (Medium)	Basic to moderate	Ticket scanning, Passenger travel information.	Ticket verification, Passenger travel information and route details	Field staff; brief training needed

### Characteristics of Each User Class:

#### Passengers:

Passengers will use the mobile app to view real-time bus locations, plan routes, check seat availability, and purchase digital tickets. They require a simple, user-friendly interface with easy navigation and quick access to transport information. Most users will have basic smartphone skills and expect a smooth, reliable experience for daily commuting.

#### Transport Authorities:

Transport authority will use the web-based dashboard to manage routes, schedules, vehicle assignments, and monitor real-time operations. They will need access to analytical tools and reporting features for data-driven decision-making. This user group is expected to have intermediate technical skills and operational knowledge of public transport systems.

#### Ticket Verifiers:

Ticket verifiers will use a dedicated interface or tool (likely within the mobile app) to scan and validate passengers' digital tickets via QR codes. Their access will be limited to verification functions, passenger travel information and route details. They will require minimal training to operate the tool efficiently during active service hours.

## 2.4 Hardware and Operating Environment

The **SmartTransit** platform will operate in both mobile and web-based environments, requiring compatibility with common hardware and software setups used by passengers, transport staff, and system administrators.

### 1. Passenger Mobile App

- **Device Requirements:** Android smartphones (version 8.0 and above), iPhones (iOS 12 and above)
- **Operating System:** Android OS, iOS

### 2. Admin Dashboard (Web Application)

- **Device Requirements:** Desktop or Laptop
- **Operating System:** Windows 10+, macOS 10.14+, Linux-based systems
- **Web Browser Compatibility:** Google Chrome, Mozilla Firefox, Microsoft Edge, Safari (latest two versions)
- **Software Requirements:**
  - Web browser
  - Internet access for real-time data communication
  - Optional spreadsheet or PDF viewer for exporting reports

This software will operate smoothly in environments with moderate internet speed and should be optimized for both high-end and budget mobile devices to ensure accessibility for a wide range of users.

## 2.5 Design and Implementation Constraints

The development and deployment of the **SmartTransit** platform will be subject to several design and implementation constraints that may limit certain technical or operational choices. These constraints include:

- **Device Compatibility:** The mobile app must support a wide range of devices, including low-end Android smartphones commonly used in Bangladesh. This limits the use of resource-intensive features and requires optimization for performance and memory usage.
- **Network Dependency:** The app needs an internet connection (Wi-Fi or mobile data) to work properly, especially for showing live bus locations, seat updates, and ticket booking. In areas where the internet is slow or unstable, some features might not work as expected. The app should be designed to handle these situations smoothly, like showing saved data when live updates aren't available.
- **GPS Accuracy:** Real-time tracking depends on GPS accuracy, which may vary by device and location. The system must include error handling and location smoothing to improve reliability.

- **Data Privacy and Security:** All user data, including location and payment details, must be handled according to Bangladesh Govt. data protection regulations. Secure authentication, encrypted communication, and role-based access control must be implemented to ensure data privacy and prevent unauthorized access.
- **Payment Gateway Integration:** The app must integrate with secure and trusted mobile payment services available in Bangladesh (e.g. bKash, Nagad, Rocket) which may have their own API and policy constraints.
- **Technology Stack Restrictions:** The backend system will use specific technologies such as Node.js or Django, with a relational database like PostgreSQL or MySQL. This requires the development team to work within the capabilities and limitations of these technologies.
- **Cross-Platform UI Design:** Since the app will be used on both Android and iPhone devices, the design needs to look and work well on both types of phones. Each platform has its own style and rules (like button shapes or navigation styles), so the app must follow those to give users a familiar and smooth experience.
- **Scalability Requirements:** The system must be designed to handle high user loads, especially during peak hours. This requires proper planning for server scalability, load balancing, and efficient database queries.
- **Maintenance Ownership:** Post-deployment, the system may be maintained by a local IT team, which requires clean, well-documented code, standard programming conventions for ease of support and updates.

## 2.6 User Documentation

To help users understand and operate the **SmartTransit** system smoothly, several documentation resources will be provided.

### **For Passengers (Mobile App Users):**

Passengers will receive a simple user manual in PDF format that explains how to use key features such as real-time tracking, route planning, seat availability, and ticket booking. In-app help tips and a FAQ section will be available to assist with common tasks or issues. Additionally, short video tutorials will demonstrate how to use the app effectively for new users.

### **For Transport Authorities (Admin Dashboard Users):**

Transport staff will be provided with a detailed admin guide that explains how to manage bus routes, schedules, monitor system performance, and handle ticket-related tasks. Training materials and video walkthroughs will be available to help new administrators become familiar with the dashboard functions.

### **Formats and Standards:**

All documentation will be provided in user-friendly PDF format and made accessible through the app or website. Video tutorials will be available in MP4 format and embedded directly in the

application. The content will use simple, clear language and follow clean formatting standards. Where possible, support for both English and Bangla will be included to improve accessibility.

## 3. System Requirements

### 3.1 System Features

Feature	Benefit (×2)	Penalty (×1)	Total	Value %	Relative Cost	Cost %	Relative Risk	Risk %	Priority
FR-3.1.1 User Login	8	6	22	7.28%	3	4.69%	2	4.44%	0.80
FR-3.1.2 User Registration	7	5	19	6.29%	3	4.69%	2	4.44%	0.69
FR-3.1.3 Route Search	9	5	23	7.62%	4	6.25%	3	6.67%	0.59
FR-3.1.4 Live Tracking	9	6	24	7.95%	7	10.94%	4	8.89%	0.55
FR-3.1.5 Ticket Purchase	8	5	21	6.95%	5	7.81%	3	6.67%	0.48
FR-3.1.6 Save Payment	5	3	13	4.30%	3	4.69%	2	4.44%	0.47
FR-3.1.7 Ticket History	6	4	16	5.29%	3	4.69%	2	4.44%	0.58
FR-3.1.8 Notifications	5	3	13	4.30%	2	3.13%	2	4.44%	0.55
FR-3.1.9 Profile Management	5	2	12	3.97%	2	3.13%	2	4.44%	0.52
FR-3.1.10 Accessibility & Lang.	6	3	15	4.96%	4	6.25%	3	6.67%	0.42
FR-3.1.11 Bus Owner Reg. & Prof.	8	5	21	6.95%	4	6.25%	3	6.67%	0.56

FR-3.1.12 Bus & Route Setup	6	4	16	5.29%	5	7.81%	2	4.44%	0.58
FR-3.1.13 Employee Management	5	4	14	4.63%	2	3.13%	2	4.44%	0.59
FR-3.1.14 Ticket Verification	7	5	19	6.29%	4	6.25%	3	6.67%	0.57
FR-3.1.15 Check-in and Check-out	6	5	17	5.62%	3	4.69%	3	6.67%	0.50
FR-3.1.16 Live Seat Availability	9	6	24	7.95%	7	10.94%	4	8.89%	0.47
FR-3.1.17 Financial Reporting	5	3	13	4.30%	3	4.69%	3	6.67%	0.47
<b>Total</b>	114	74	302	100%	64	100%	45	100%	-----

• **Weighted Total** = (Relative Benefit × 2) + (Relative Penalty × 1)

• **Value %** = (Weighted Total ÷ 302) × 100

• **Priority** = (Value %) ÷ ((Cost %) + (Risk %))

### 3.1.1 User Login

#### Functional Requirements (FRs)

- 1.1. The system shall allow users to login with their given username and password.
- 1.2. The credentials will be matched against the system database.
- 1.3. If the credentials match the database, the login will be successful, and users will be taken to the home screen.
- 1.4. If the credentials do not match, then users will be notified about the wrong credentials and will be given 3 chances for the login attempt.
- 1.5. If a user attempts more than 3 times with wrong credentials the account will be locked for 10 minutes. A countdown timer will be shown to the user for next tries.

**Priority Level:** High

**Precondition:** The device must be registered with the system and users shall have valid credentials.

**Cross-references:** N/A

### **3.1.2 User Registration**

#### **Functional Requirements (FRs)**

- 2.1. The system shall allow users to create a new account with name, email, phone number and password.
- 2.2. The system shall validate the uniqueness of the email address.
- 2.3. The system shall send a confirmation link to the user's email for account verification.
- 2.4. The system shall send an OTP code will be sent to the user's email address or phone number.
- 2.5. An OTP code will be send, upon register the system will ask for the OTP code for successful register.

**Priority Level:** High

**Precondition:** None

**Cross-references:** N/A

### **3.1.3 Route Search**

#### **Functional Requirements (FRs)**

- 3.1. The app shall allow users to search for bus routes using "From" and "To" inputs.
- 3.2. The app shall show available routes, stops.
- 3.3. The app shall allow users to filter routes by travel time and seat availability.

**Priority Level:** High

**Precondition:** User is logged in

**Cross-references:** N/A

### **3.1.4 Live Bus Tracking**

#### **Functional Requirements (FRs)**

- 4.1. The app shall show the real-time location of buses on a map.
- 4.2. The app shall show estimated arrival times (ETAs) at each stop.
- 4.3. ETAs shall update based on current traffic conditions.

**Priority Level:** High

**Precondition:** User has selected a route

**Cross-references:** N/A

### 3.1.5 Ticket Purchase

#### Functional Requirements (FRs)

5.1. The app shall allow users to buy tickets using mobile payment methods.

5.2. Upon successful payment, a QR code ticket shall be generated.

5.3. The system shall email the ticket and show it in the app.

**Priority Level:** High

**Precondition:** User is logged in and has selected a route

**Cross-references:** N/A

### 3.1.6 Save Payment Option

#### Functional Requirements (FRs)

6.1. The app shall allow users to save their payment information if they choose.

6.2. Saved payment details shall enable one-tap checkout.

**Priority Level:** Medium

**Precondition:** User has made at least one payment

**Cross-references:** N/A

### 3.1.7 Ticket Info and History

#### Functional Requirements (FRs)

7.1. The system shall display ticket details after purchase.

7.2. Users shall be able to download tickets in PDF format.

7.3. Users shall be able to view previous ticket purchases in their profile.

**Priority Level:** High

**Precondition:** User has purchased a ticket

**Cross-references:** N/A

### 3.1.8 Notifications

#### Functional Requirements (FRs)

8.1. The app shall send real-time notifications for bus arrival, delays, and route changes.

8.2. Users shall be able to enable/disable notifications from settings.

**Priority Level:** Medium

**Precondition:** User has opted in for notifications

**Cross-references:** N/A

### 3.1.9 Profile Management

#### Functional Requirements (FRs)

9.1. The app shall allow users to view and edit profile information.

9.2. Users shall be able to change password and contact details.

**Priority Level:** Medium

**Precondition:** User is logged in

**Cross-references:** N/A

### **3.1.10 Accessibility & Language**

#### **Functional Requirements (FRs)**

10.1. The app shall provide voice and visual accessibility features.

10.2. The app shall support multiple languages.

10.3. Users shall choose language at registration or from settings.

**Priority Level:** High

**Precondition:** None

**Cross-references:** N/A

### **3.1.11 Bus Owner Registration & Profile**

#### **Functional Requirements (FRs)**

11.1. The system shall allow bus owners to register using their NID and business details.

11.2. The system shall verify bus owners via BRTC and NID databases.

11.3. Bus owners shall manage bus details, contact info, and business profile.

**Priority Level:** High

**Precondition:** None

**Cross-references:** N/A

### **3.1.12 Bus and Route Setup**

#### **Functional Requirements (FRs)**

12.1. Bus owners shall add and manage bus, bus routes and schedules.

12.2. The system shall allow editing or removing route information.

**Priority Level:** High

**Precondition:** Bus owner is logged in

**Cross-references:** N/A

### **3.1.13 Employee Management**

#### **Functional Requirements (FRs)**

13.1. Bus owners shall add drivers and conductors using employee details.

13.2. Owners can update or delete employee accounts.

13.3. Only the bus owner shall have the right to reset employee passwords.

**Priority Level:** High

**Precondition:** Bus owner is logged in

**Cross-references:** N/A

### **3.1.14 Ticket Verification by Employees**

#### **Functional Requirements (FRs)**

14.1. Employees shall log in using credentials given by the bus owner.

14.2. Employees shall scan QR codes to validate passenger tickets.



14.3. Employees shall see passenger details and ticket status.

**Priority Level:** High

**Precondition:** Employee is logged in

**Cross-references:** N/A

### **3.1.15 Check-in and Check-out**

#### **Functional Requirements (FRs)**

15.1. Employees must scan tickets when passengers board.

15.2. Tickets must be scanned again when passengers exit.

15.3. If no checkout is recorded, the system shall apply an extra charge.

**Priority Level:** High

**Precondition:** Valid ticket was scanned on check-in

**Cross-references:** N/A

### **3.1.16 Live Seat Availability and route details**

#### **Functional Requirements (FRs)**

16.1. The system shall update seat availability based on check-in/out.

16.2. Seat status shall be visible to users, owners, and employees in real-time.

16.3. A full-capacity notification shall be triggered when needed.

16.4. Ticket verifiers can see the route details including route map, bus stops, estimated time to next stop, and current location of the bus. Include current occupancy (e.g., 22/40 seats filled), alerts (e.g., full capacity)

**Priority Level:** High

**Precondition:** Bus is operating

**Cross-references:** N/A

### **3.1.17 Financial Reporting**

#### **Functional Requirements (FRs)**

17.1. Bus owners shall view financial reports (ticket sales, earnings).

17.2. Reports shall show missed checkouts and penalties.

17.3. Reports shall be exportable (PDF, Excel).

**Priority Level:** Medium

**Precondition:** Bus owner is logged in

**Cross-references:** N/A

### 3.2 Non-Functional/Quality Requirements

**QA1: Usability:** The system shall provide a user-friendly interface, allowing new users to plan a route and purchase a ticket within an average of three and a maximum of five minutes.

**Priority Level:** Medium

**Precondition:** N/A

**Cross-references:** QA6 (Accessibility)

**QA2: Performance:** The app shall display live bus tracking updates within 5 seconds of receiving location data.

**Priority Level:** High

**Precondition:** GPS data is being received

**Cross-references:** QA3(Availability), QA4(Scalability)

**QA3: Availability:** The system shall maintain 99.5% uptime, excluding scheduled maintenance periods.

**Priority Level:** High

**Precondition:** Server is deployed in production environment

**Cross-references:** QA2(Performance)

**QA4: Scalability:** The system shall support at least 10,000 concurrent users without degradation in performance.

**Priority Level:** High

**Precondition:** Cloud infrastructure is provisioned

**Cross-references:** QA2(Performance), QA7(Maintainability)

**QA5: Security:** All personal data and payment information shall be encrypted during transmission and storage using industry-standard protocols.

**Priority Level:** High

**Precondition:** SSL and database encryption enabled

**Cross-references:** N/A

**QA6: Accessibility:** The system should be easy to use for people with disabilities, such as those who have trouble hearing, or moving.

**Priority Level:** Medium

**Precondition:** None

**Cross-references:** QA1(Usability)

**QA7: Maintainability:** The codebase shall follow clean code practices and be documented to allow future developers to resolve bugs or add features within an average of 2 working days.

**Priority Level:** Medium

**Precondition:** Source code is version-controlled

**Cross-references:** QA4(Scalability)

### 3.3 Project Requirements

Let's assume the Source Line of Code is **8000**

So, Effort needs to be,

$$PM = 2.4 \times (8000/1000)^{1.05} = 21.30$$

Development time,

$$DM = 2.50 \times (PM)^{0.38} = 7.993 \approx 8$$

Required number of people,

$$ST = PM/DM = 21.30/7.993 = 2.66 \approx 3$$

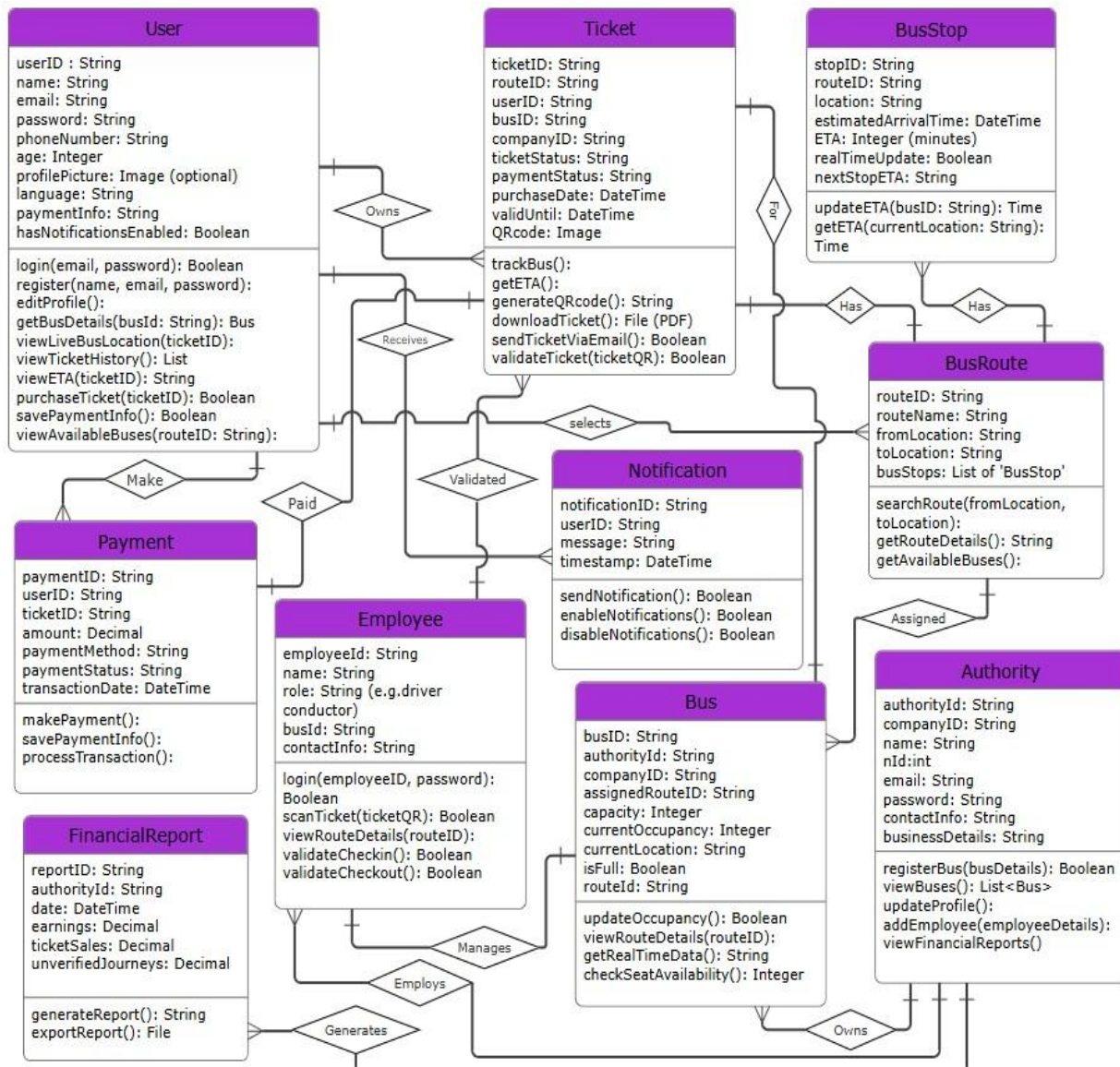
Therefore, the work needs to be done for  $(4 \times 8) = 32$  weeks

The COCOMO (Constructive Cost Model) is used to estimate the effort, development time, and team size required for this project. Given an assumption of Source Lines of Code (SLOC) of **8000**, the effort is calculated as **21.30** person-months using the basic COCOMO formula. The development time is estimated to be **8** months, and the required team size is approximately **3** people. This project is classified under the Organic Mode, which suits small to medium-sized projects with well-understood requirements.

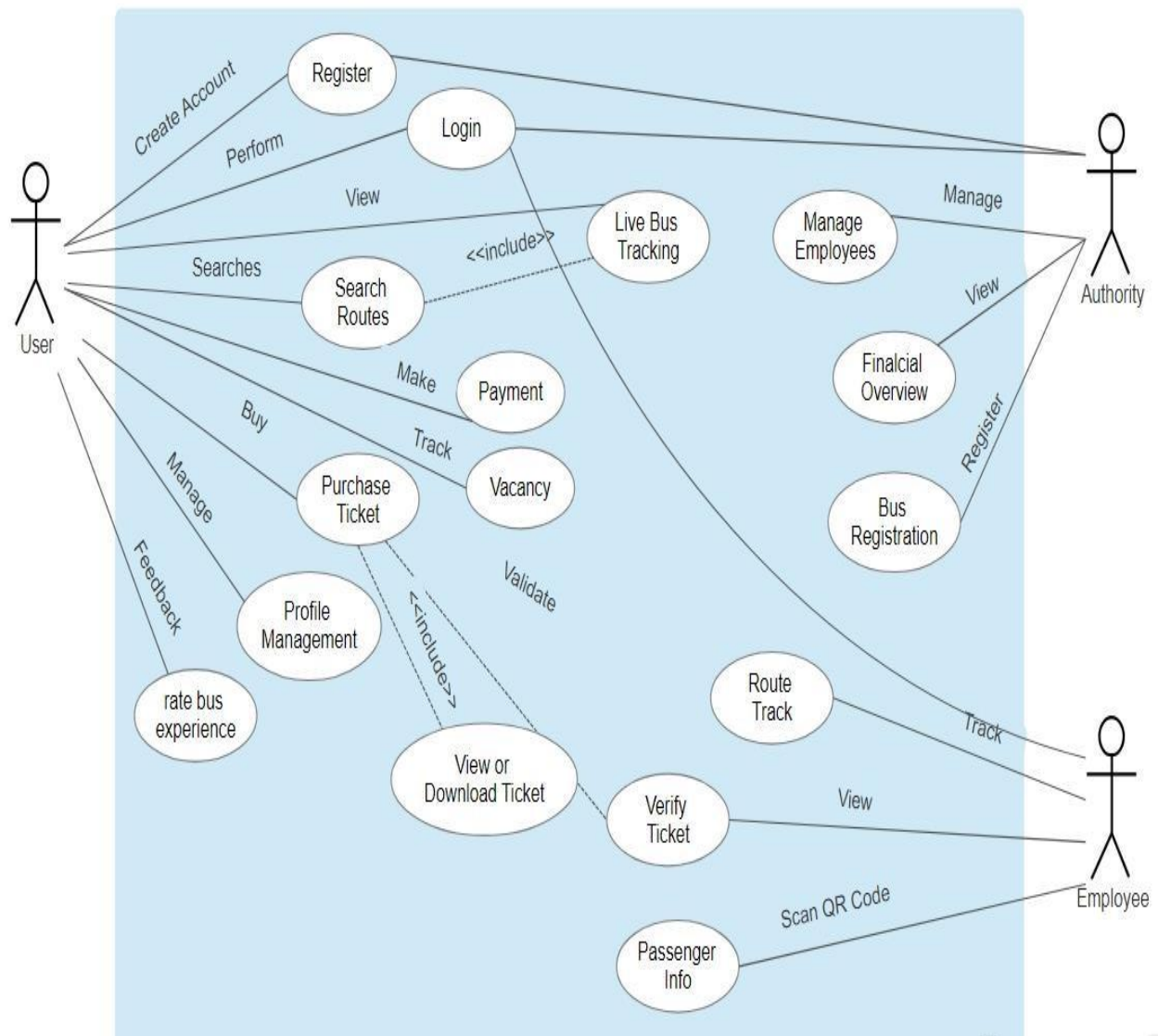
## 4. Design and Interface Requirements

## 4.1 UML Diagrams

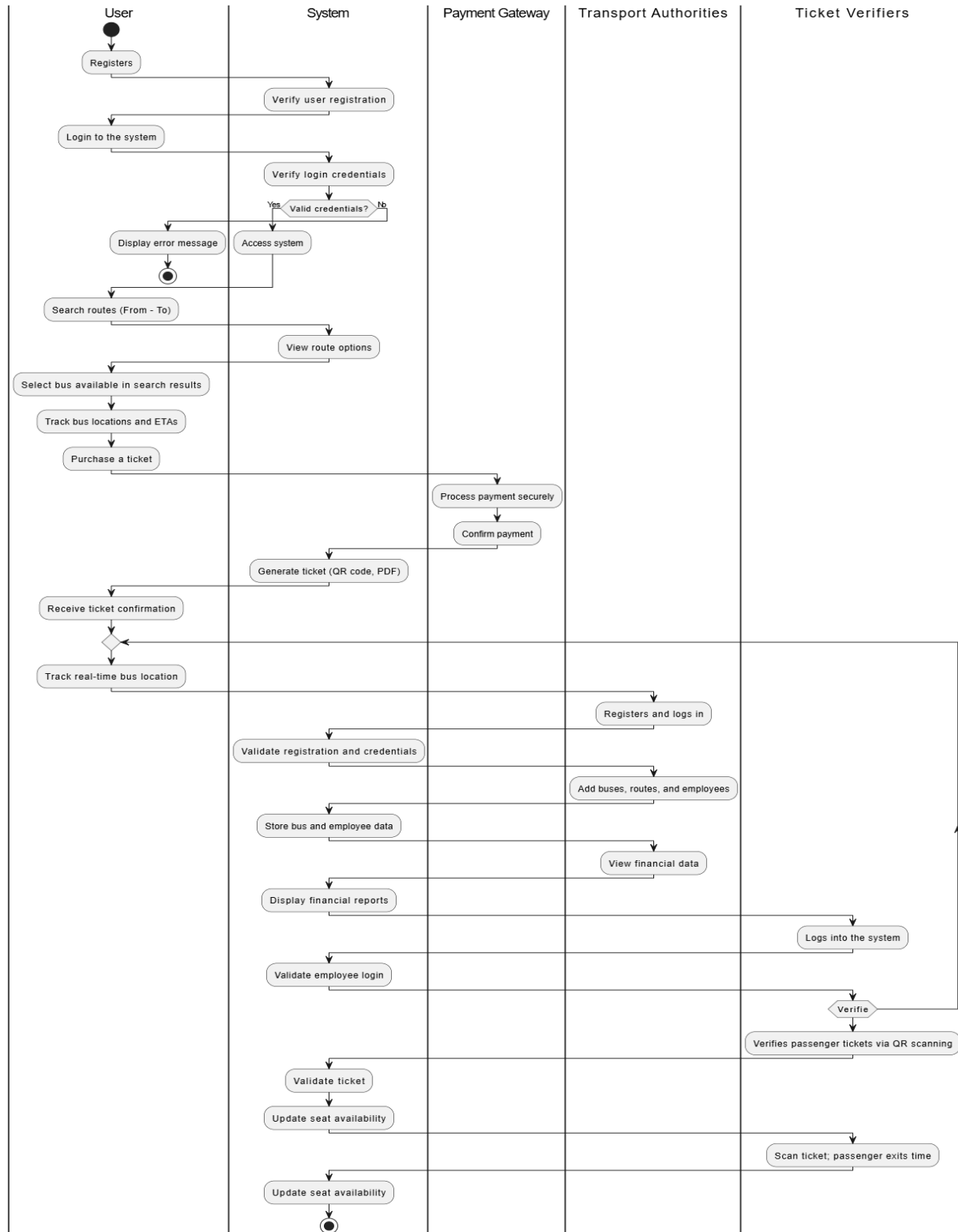
### 4.1.1 Class Diagram



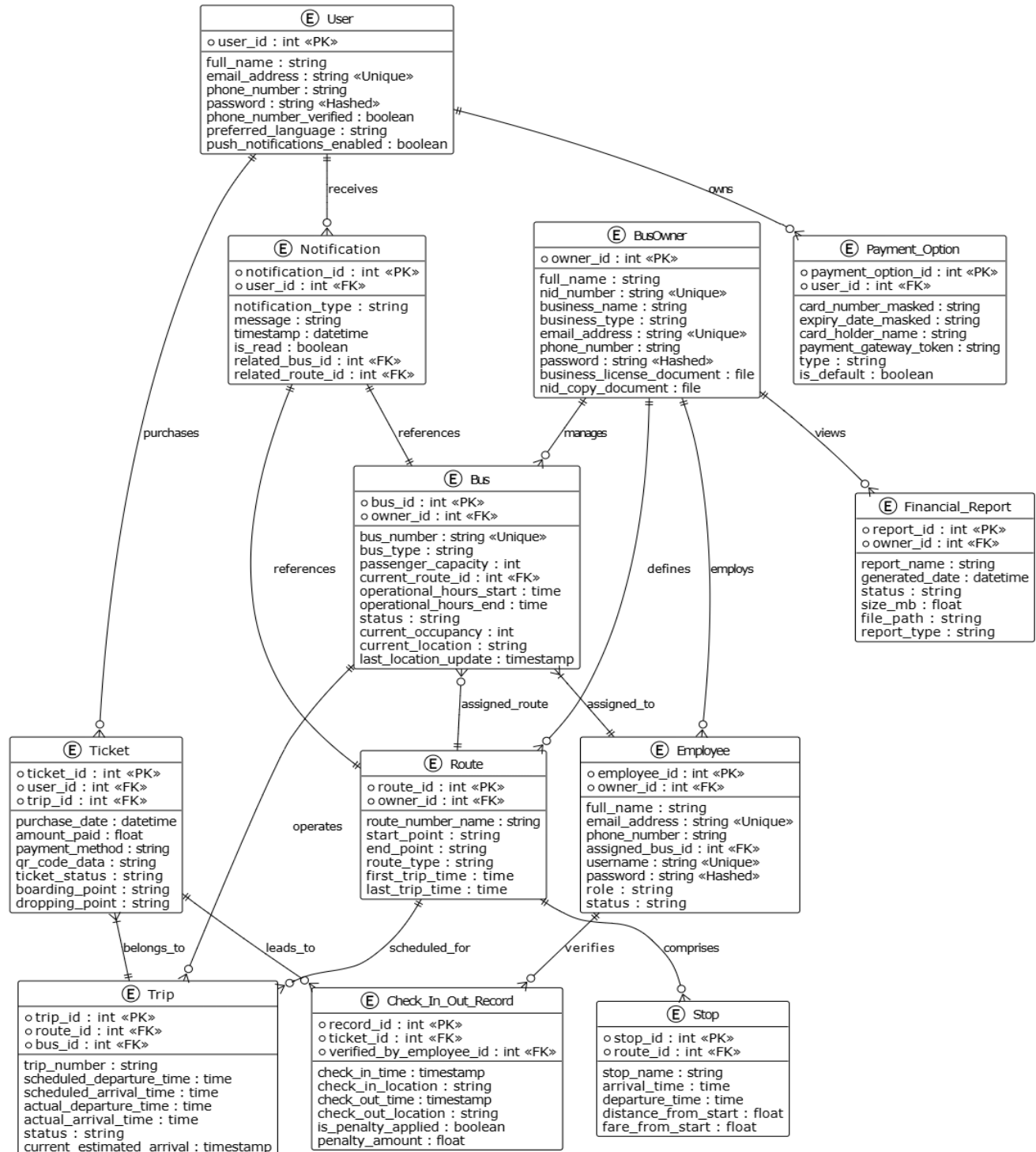
### 4.1.2 Use-case Diagram



### 4.1.3 Activity Diagram



## 4.1.4 E-R Diagram:



## 4.2 Data Dictionary

Entity	Attribute	Type/Size	Validation	Key
<b>User</b>	user_id	Number (10)	Required	Primary
	full_name	Text (50)	Required	
	email_address	Text (100)	Valid Email, Required	Unique
	phone_number	Text (15)	Valid Phone Number	
	password	Text (128)	Hashed/Encrypted	
	phone_number_verified	Boolean	True/False	
	preferred_language	Text (20)	Optional	
	push_notifications_enabled	Boolean	True/False	
<b>BusAuthority</b>	owner_id	Number (10)	Required	Primary
	full_name	Text (50)	Required	
	nid_number	Text (17)	Unique, Required	Unique
	business_name	Text (100)	Required	
	business_type	Text (50)	Required	
	email_address	Text (100)	Valid Email	Unique
	phone_number	Text (15)	Valid Phone Number	
	password	Text (128)	Hashed/Encrypted	
	business_license_document	File Path	Optional	
	nid_copy_document	File Path	Optional	
<b>Employee</b>	employee_id	Number (10)	Required	Primary
	owner_id	Number (10)	FK to BusOwner	FK
	full_name	Text (50)	Required	
	email_address	Text (100)	Valid Email	Unique
	phone_number	Text (15)	Valid Phone Number	
	assigned_bus_id	Number (10)	FK to Bus	FK
	username	Text (30)	Unique, Required	Unique
	password	Text (128)	Hashed/Encrypted	
	role	Text (30)	Required	
	status	Text (15)	Active/Inactive	
<b>Bus</b>	bus_id	Number (10)	Required	Primary
	owner_id	Number (10)	FK to BusOwner	FK
	bus_number	Text (20)	Unique, Required	Unique
	bus_type	Text (20)	Required	



	passenger_capacity	Number (3)	Min 10	
	current_route_id	Number (10)	FK to Route	FK
	operational_hours_start	Time	HH:MM format	
	operational_hours_end	Time	HH:MM format	
	status	Text (15)	Running/Stopped	
	current_occupancy	Number (3)	>= 0	
	current_location	GPS Coordinates	Valid Lat/Long	
	last_location_update	Timestamp	Valid DateTime	
<b>Route</b>	route_id	Number (10)	Required	Primary
	owner_id	Number (10)	FK to BusOwner	FK
	route_number_name	Text (50)	Required	
	start_point	Text (50)	Required	
	end_point	Text (50)	Required	
	route_type	Text (20)	Local/Express	
	first_trip_time	Time	HH:MM format	
	last_trip_time	Time	HH:MM format	
<b>Stop</b>	stop_id	Number (10)	Required	Primary
	route_id	Number (10)	FK to Route	FK
	stop_name	Text (50)	Required	
	arrival_time	Time	HH:MM format	
	departure_time	Time	HH:MM format	
	distance_from_start	Decimal (5,2)	>= 0.0	
	fare_from_start	Decimal (5,2)	>= 0.0	
<b>Trip</b>	trip_id	Number (10)	Required	Primary
	route_id	Number (10)	FK to Route	FK
	bus_id	Number (10)	FK to Bus	FK
	trip_number	Text (20)	Required	
	scheduled_departure_time	DateTime	Required	
	scheduled_arrival_time	DateTime	Required	
	actual_departure_time	DateTime	Optional	
	actual_arrival_time	DateTime	Optional	
	status	Text (20)	On-Time/Delayed	
	current_estimated_arrival	DateTime	Optional	
<b>Ticket</b>	ticket_id	Number (10)	Required	Primary
	user_id	Number (10)	FK to User	FK
	trip_id	Number (10)	FK to Trip	FK

	purchase_date	DateTime	Required	
	amount_paid	Decimal (6,2)	>= 0.0	
	payment_method	Text (20)	Required	
	qr_code_data	Text (255)	Encoded QR String	
	ticket_status	Text (20)	Valid/Cancelled/Expired	
	boarding_point	Text (50)	Required	
	dropping_point	Text (50)	Required	
<b>Check_In_Out_Record</b>	record_id	Number (10)	Required	Primary
	ticket_id	Number (10)	FK to Ticket	FK
	check_in_time	Timestamp	Valid DateTime	
	check_in_location	GPS Coordinates	Valid Lat/Long	
	check_out_time	Timestamp	Valid DateTime	
	check_out_location	GPS Coordinates	Valid Lat/Long	
	is_penalty_applied	Boolean	True/False	
	penalty_amount	Decimal (6,2)	>= 0.0	
<b>Payment_Option</b>	verified_by_employee_id	Number (10)	FK to Employee	FK
	payment_option_id	Number (10)	Required	Primary
	user_id	Number (10)	FK to User	FK
	card_number	Text (20)	Masked Format	
	expiry_date_masked	Text (10)	MM/YY	
	card_holder_name	Text (50)	Required	
	payment_gateway_token	Text (128)	Secure Token	
	type	Text (20)	Visa/Mobile Banking/etc.	
<b>Notification</b>	is_default	Boolean	True/False	
	notification_id	Number (10)	Required	Primary
	user_id	Number (10)	FK to User	FK
	notification_type	Text (30)	Required	

	message	Text (255)	Required	
	time	DateTime	Required	
	is_read	Boolean	True/False	
	related_bus_id	Number (10)	Optional	FK
	related_route_id	Number (10)	Optional	FK
<b>Financial_Report</b>	report_id	Number (10)	Required	Primary
	owner_id	Number (10)	FK to BusOwner	FK
	report_name	Text (50)	Required	
	generated_date	DateTime	Required	
	status	Text (20)	Draft/Final	
	size_mb	Decimal (4,2)	>= 0.0	
	file_path	Text (255)	File Path	
	report_type	Text (30)	Earnings/Activity	

## 4.3 UI/UX Design Specification

**4.3.1** This section provides an overview of the user interface (UI) design of the system for end users (**passenger**).

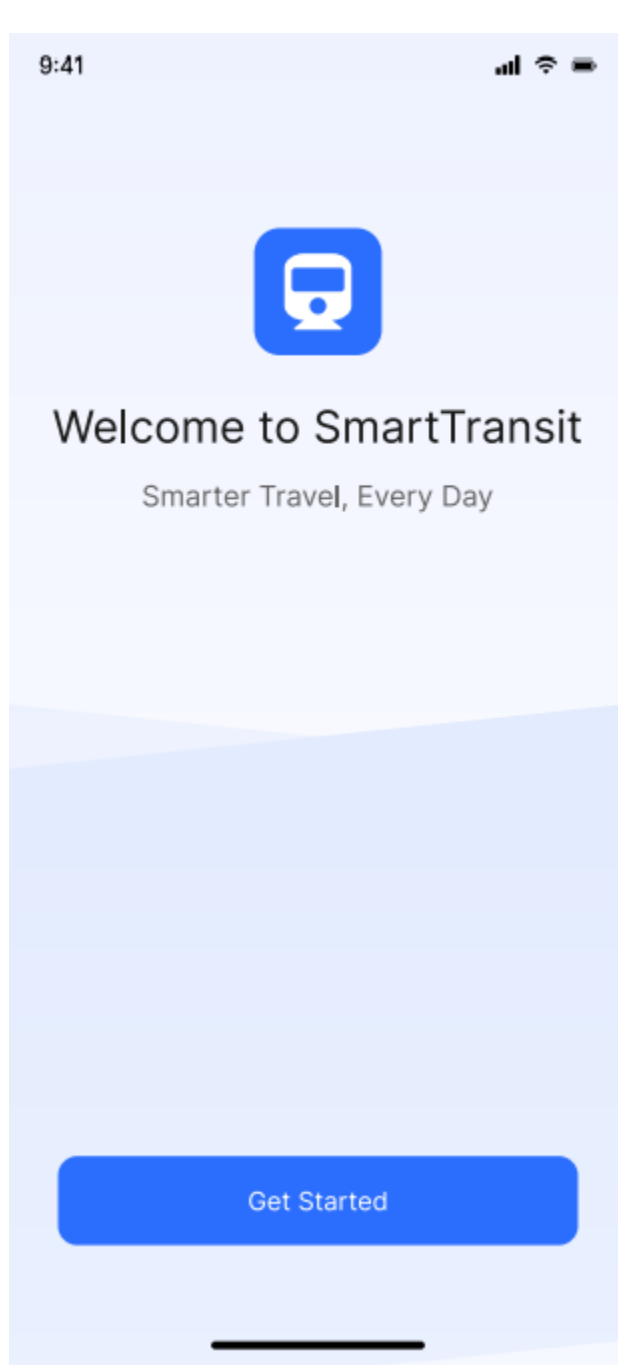


Fig: Splash Screen

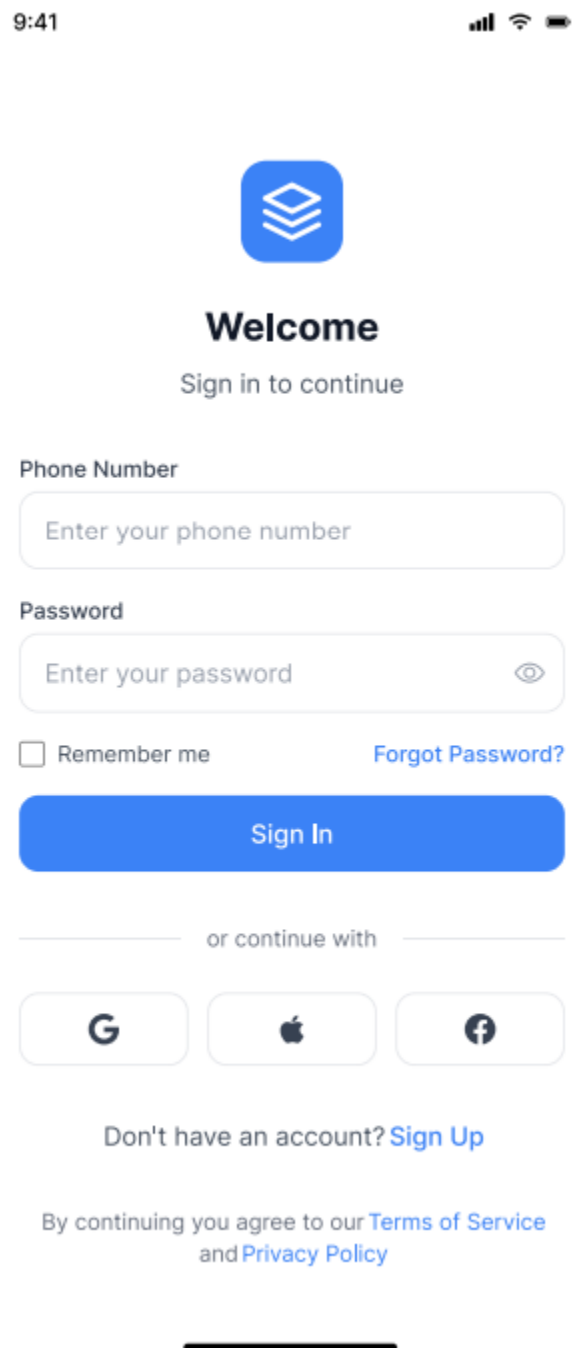


Fig: Login Screen

9:41



## Create Account

Join SmartTransit for easier commuting

Full Name

Email Address

Phone Number

Password

Confirm Password

☐ I agree to the Terms of Service and Privacy Policy

☐ Set English as my preferred language

Sign Up

Already have an account? [Log in](#)

### OTP Verification

Code sent to your email

[Resend Code](#)

Verify

Fig: OTP verify  
Screen

Fig: Registration Screen

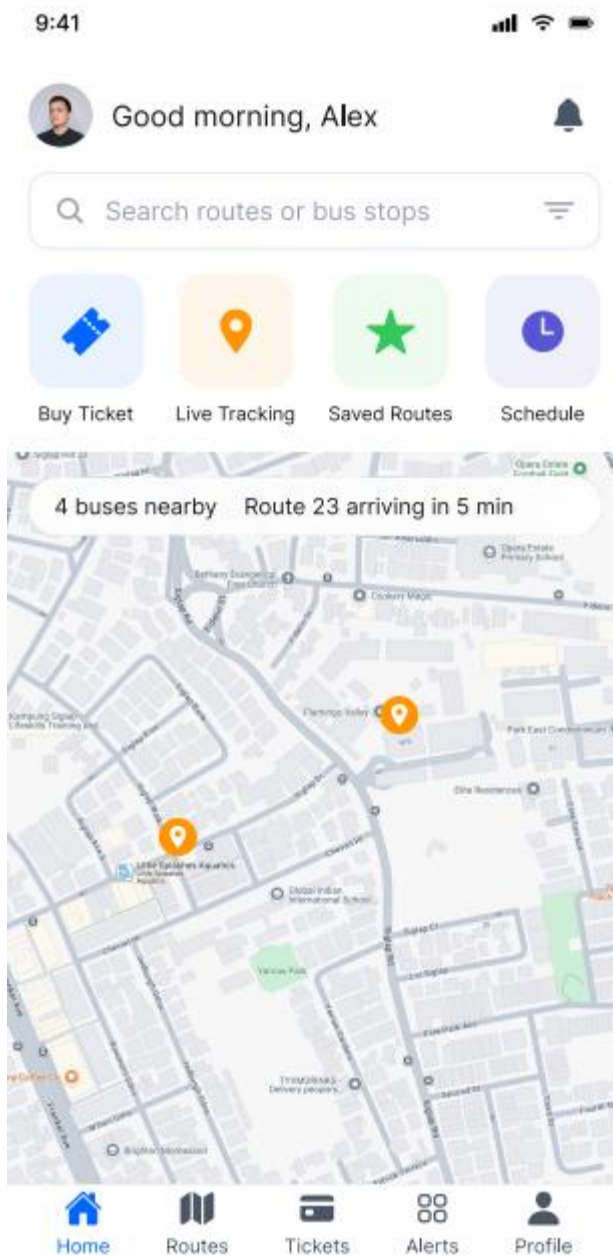
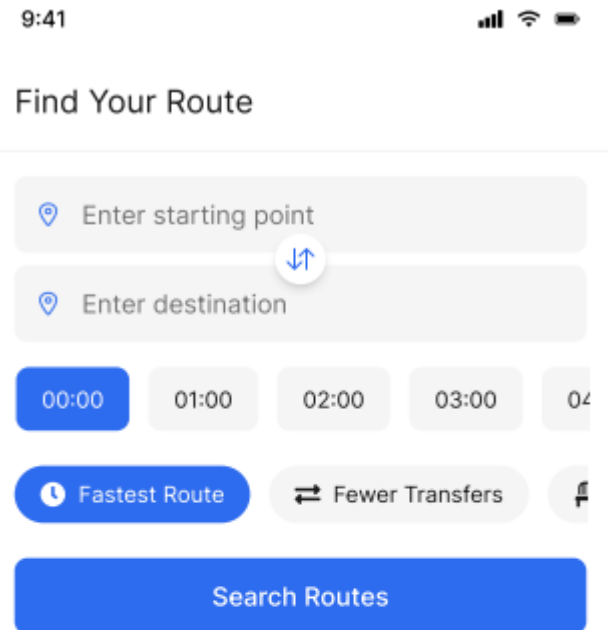


Fig: Home Screen

Fig: Route search  
Screen

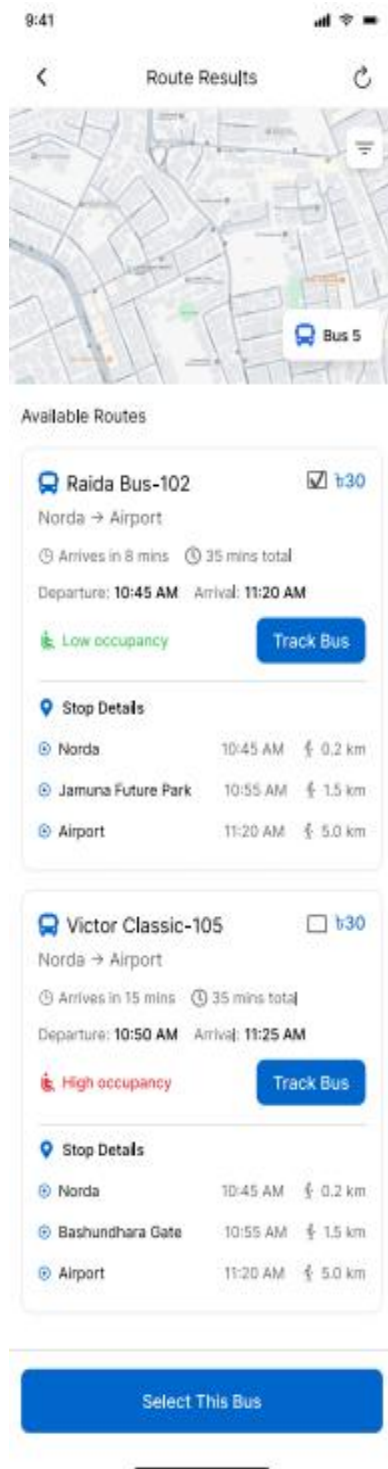


Fig: Route Search  
Result Screen

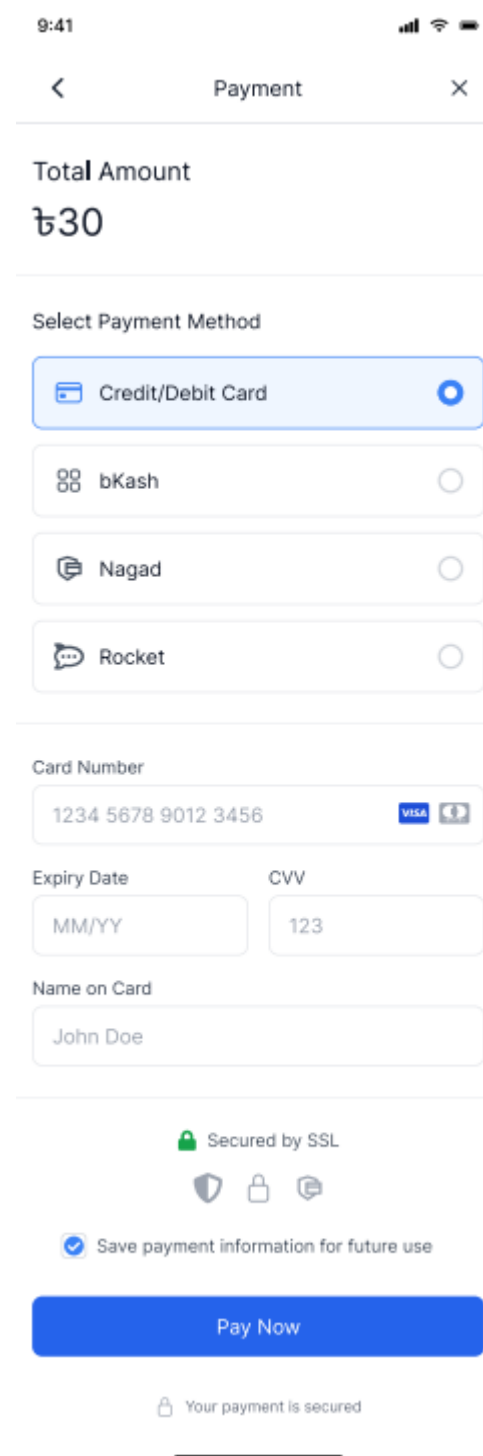
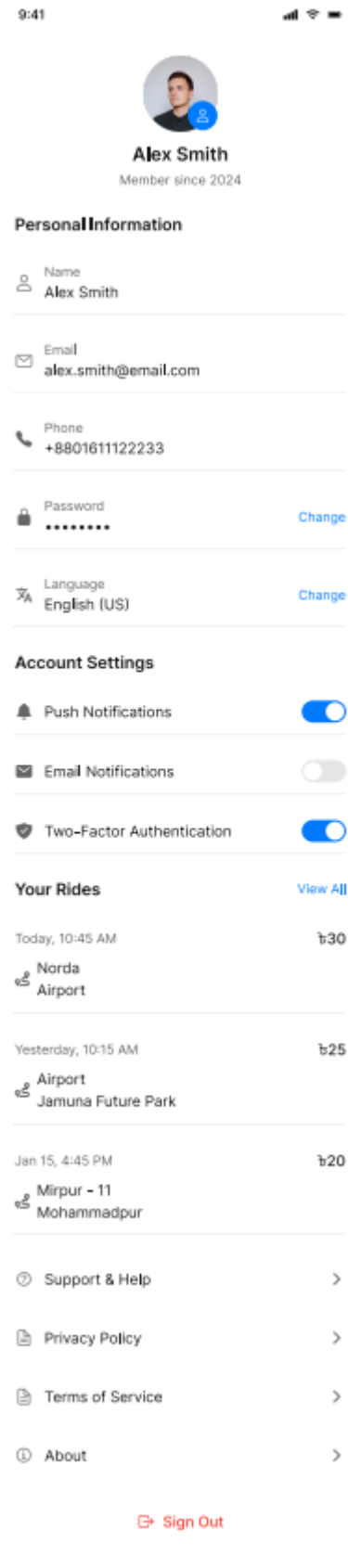


Fig: Payment Screen



Fig: Ticket Screen

Fig: Profile  
Management Screen



#### 4.3.2 This section provides an overview of the user interface (UI) design of the system for **Ticket Verifiers**.

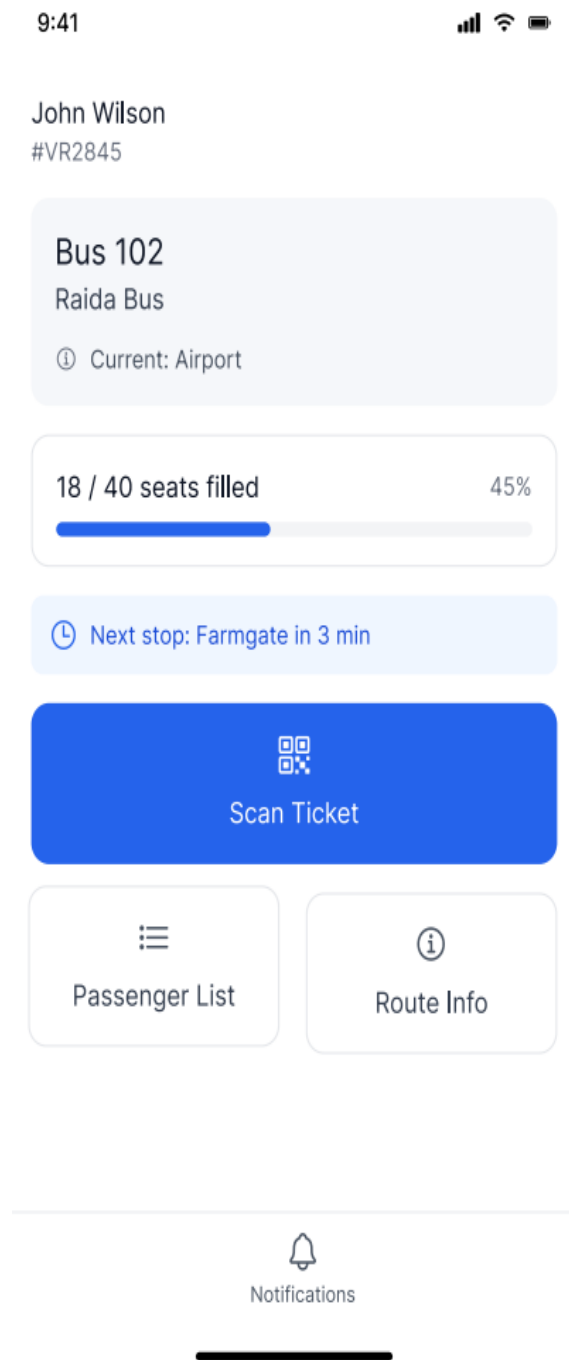


Fig: Ticket Verifiers  
Home screen

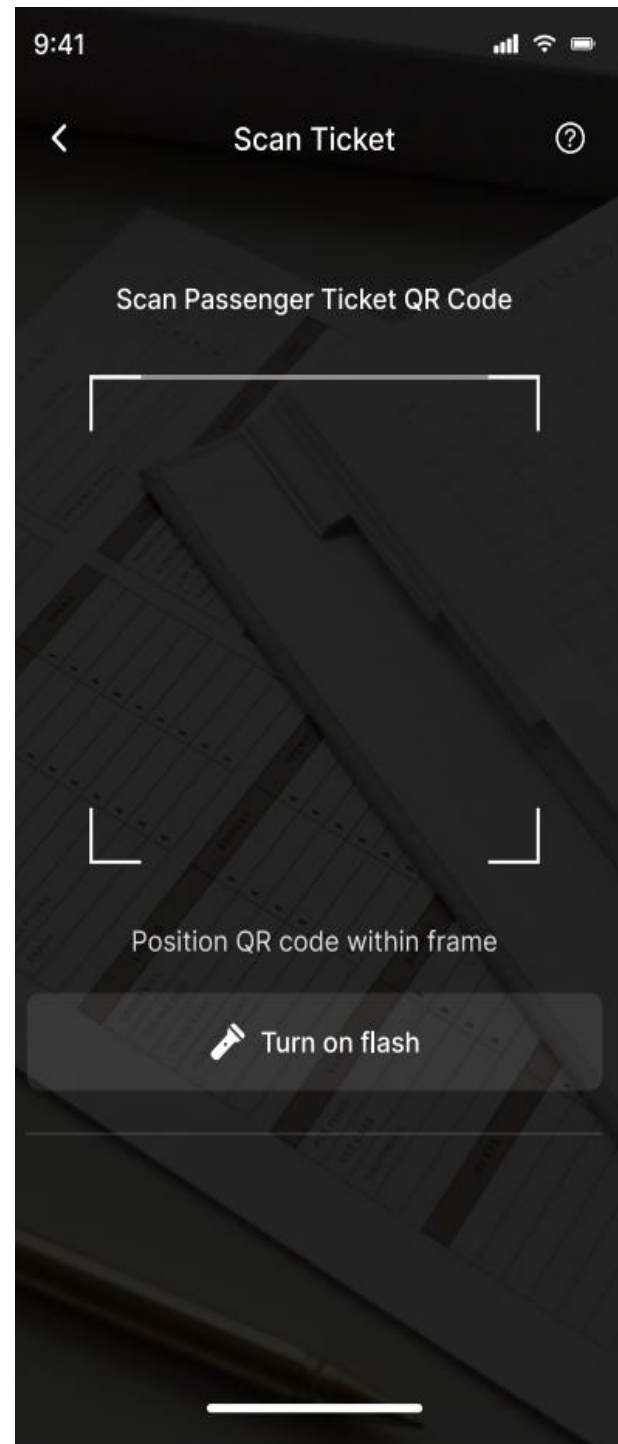


Fig: Ticket Scan screen

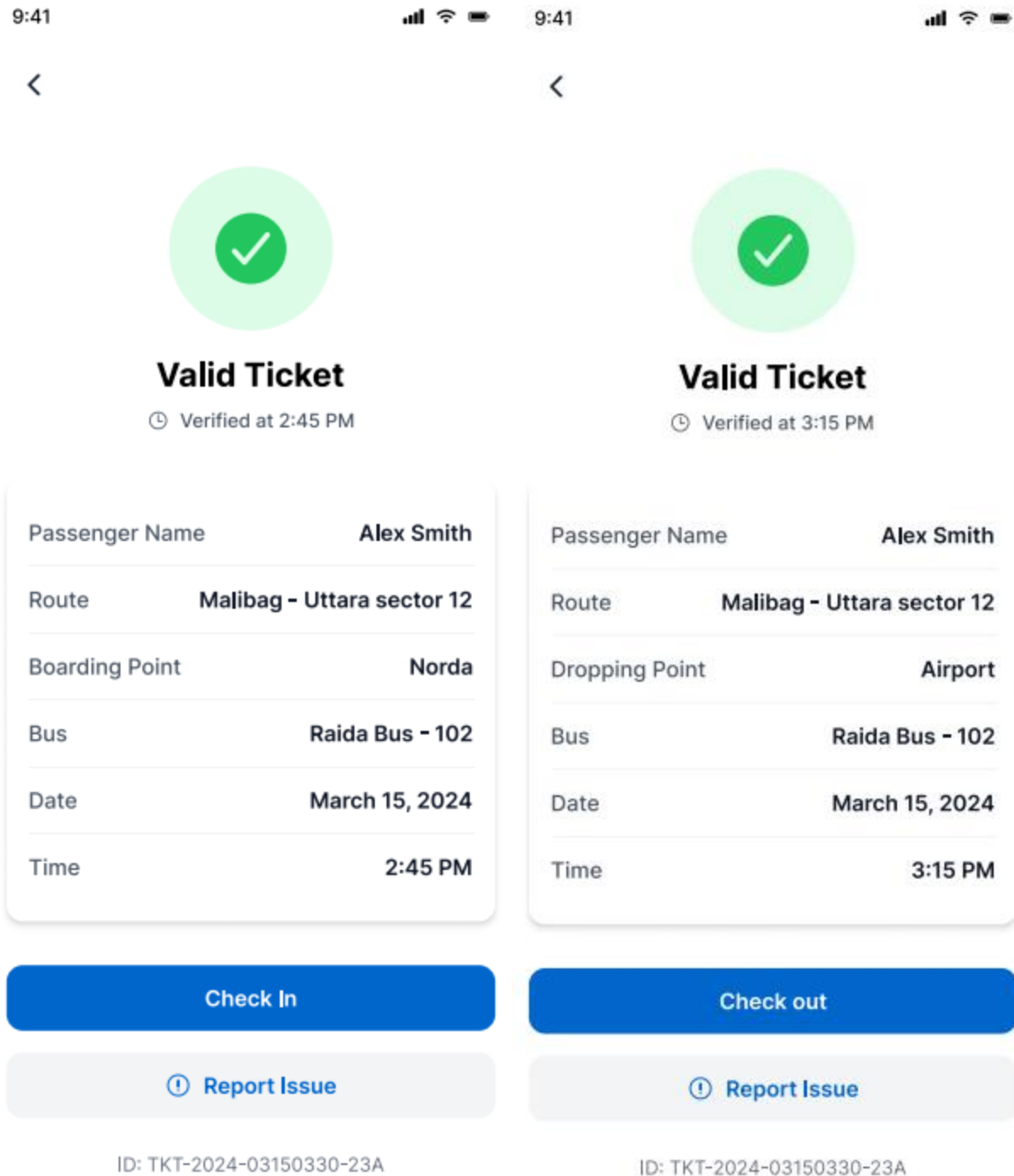


Fig: Ticket check-in  
screen

Fig: Ticket check-out  
screen

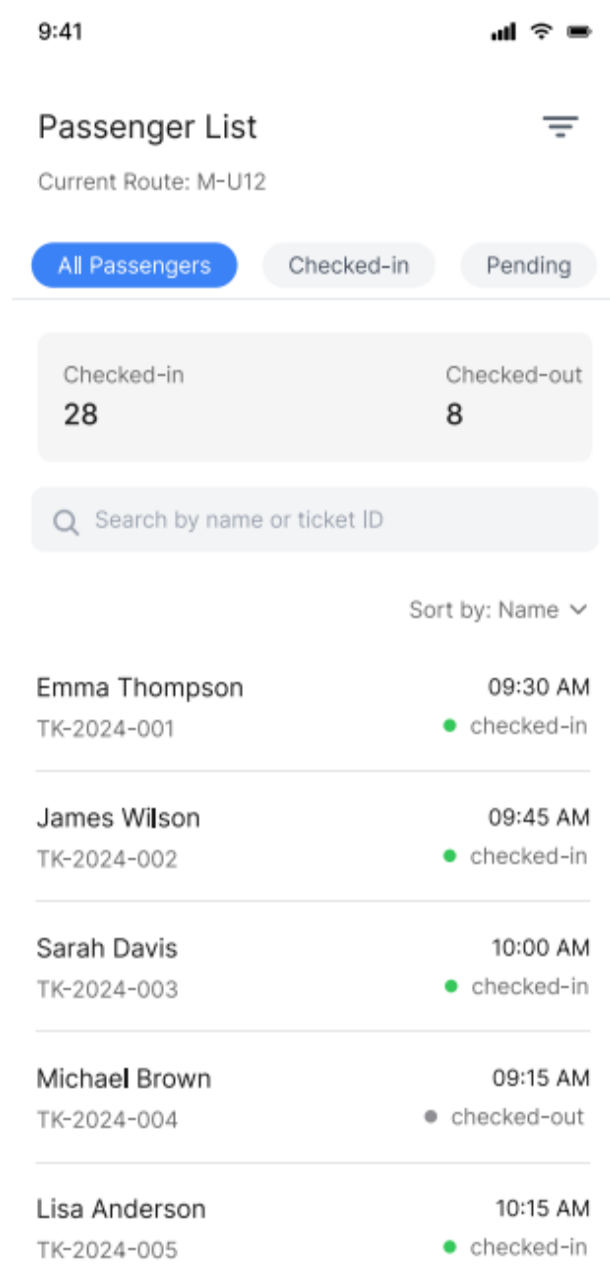


Fig: Passenger List  
screen

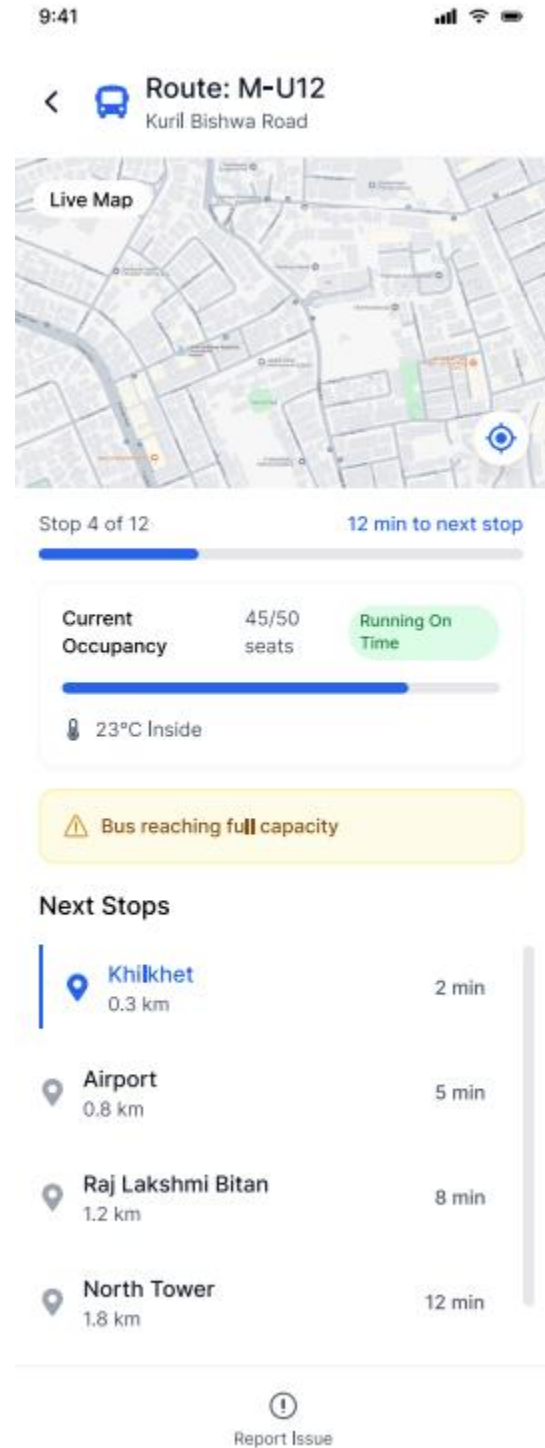
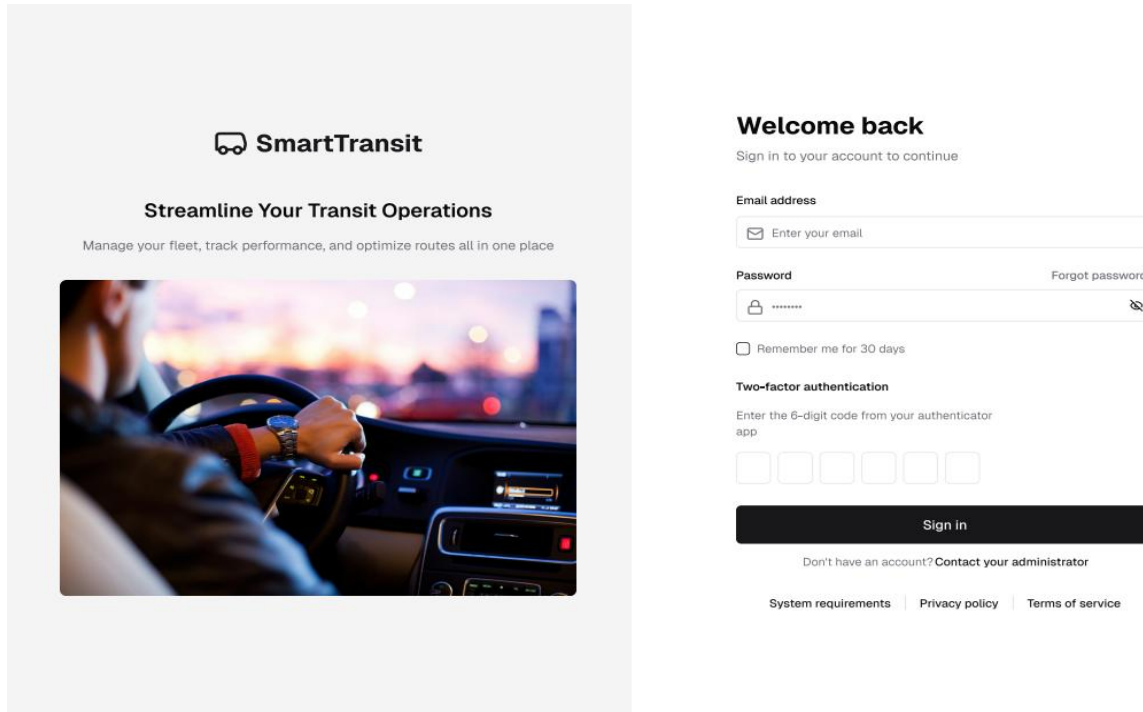


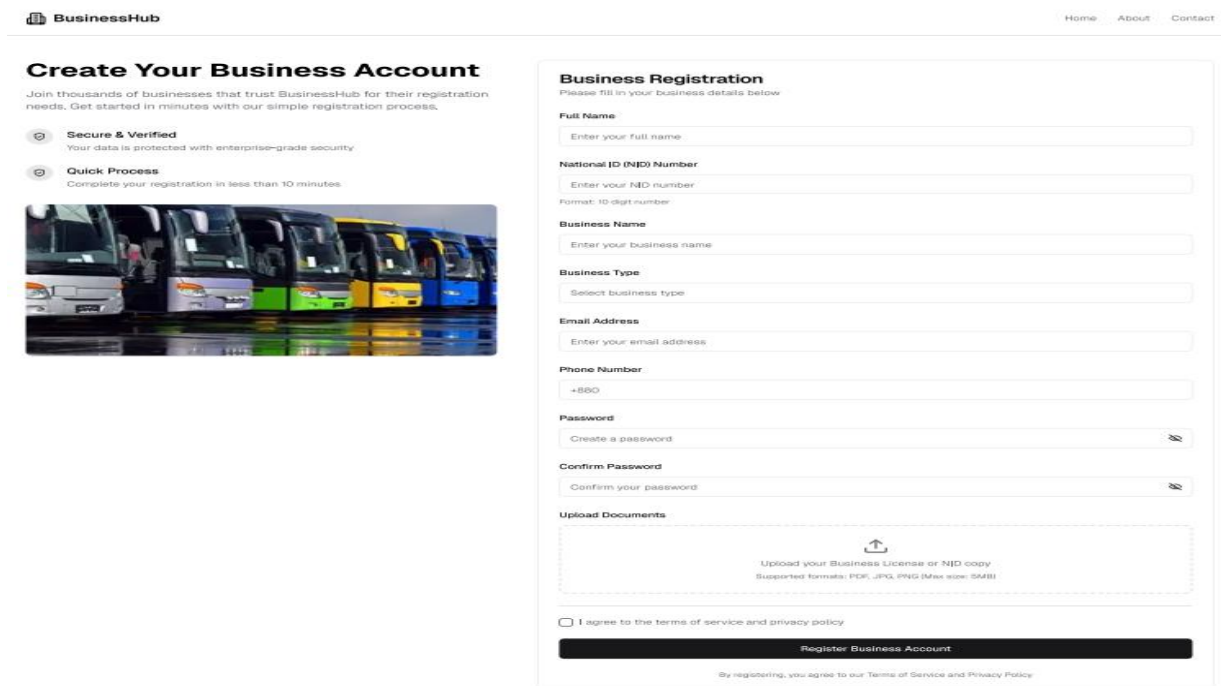
Fig: Route information  
screen

### 4.3.3 This section provides an overview of the user interface (UI) design of the system for Admin.



The image shows the Admin Login screen for SmartTransit. On the left, there is a header with the SmartTransit logo and the text "Streamline Your Transit Operations" followed by "Manage your fleet, track performance, and optimize routes all in one place". Below this is a photograph of a person driving a bus. On the right, the "Welcome back" section prompts the user to "Sign in to your account to continue". It includes input fields for "Email address" and "Password", a "Forgot password?" link, a "Remember me for 30 days" checkbox, and a "Two-factor authentication" section with a 6-digit code input. A "Sign in" button is at the bottom, along with a link to "Contact your administrator" and links for "System requirements", "Privacy policy", and "Terms of service".

Fig: Admin Login screen



The image shows the Business Registration screen for BusinessHub. The header includes the BusinessHub logo and navigation links for "Home", "About", and "Contact". The main heading is "Create Your Business Account" with a subtext: "Join thousands of businesses that trust BusinessHub for their registration needs. Get started in minutes with our simple registration process." Below this are two bullet points: "Secure & Verified" (Your data is protected with enterprise-grade security) and "Quick Process" (Complete your registration in less than 10 minutes). A photograph of several buses is shown. The "Business Registration" form on the right includes fields for "Full Name", "National ID (NID) Number", "Business Name", "Business Type", "Email Address", "Phone Number", "Password", and "Confirm Password". It also has an "Upload Documents" section with a file upload icon and text: "Upload your Business License or NID copy. Supported formats: PDF, JPG, PNG (Max size: 5MB)". At the bottom, there is a checkbox for "I agree to the terms of service and privacy policy" and a "Register Business Account" button. A footer note states: "By registering, you agree to our Terms of Service and Privacy Policy".

Fig: Admin Registration screen

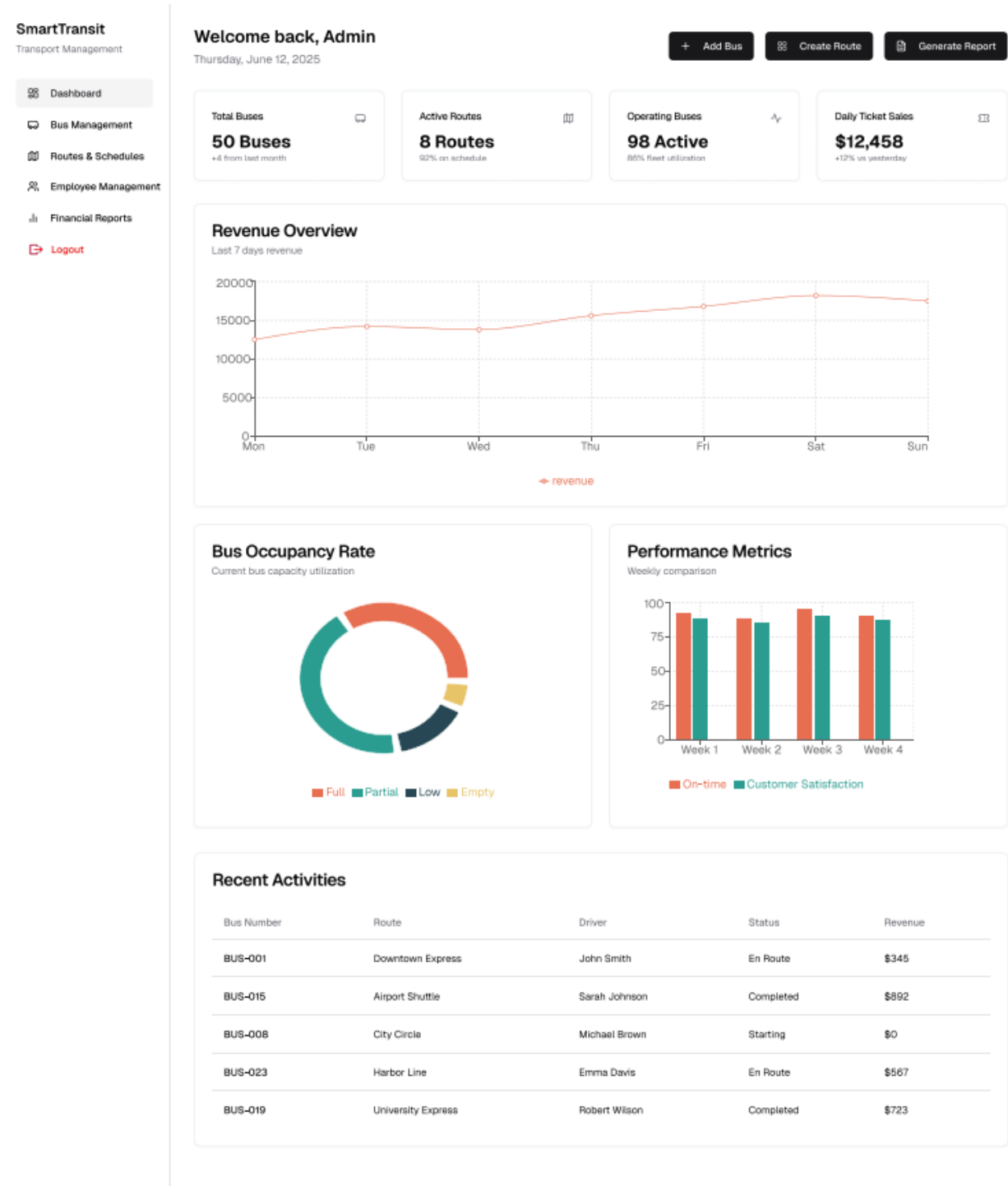


Fig: Admin Dashboard

Admin

Total Buses

24

Active Routes

18

Buses in Service

20

Maintenance Due

4

### Register New Bus

Bus Number

Bus Type

Select bus type

Passenger Capacity

Route Assignment

Select route

Operational Hours

Registration Date

Cancel

Submit

### Registered Buses

Add New Bus

Bus Number	Type	Capacity	Current Route	Status	Operational Hours	Actions
BUS-2023-001	AC	40	Route 101	Active	06:00 - 22:00	
BUS-2023-002	Non AC	45	Route 205	Maintenance	07:00 - 21:00	
BUS-2023-003	AC	40	Route 303	Active	05:30 - 23:00	
BUS-2023-004	Non AC	45	Route 102	Inactive	06:00 - 22:00	

Fig: Add new bus screen

Route Management System
Dashboard
Routes
Schedules
Reports
Admin

### Route Setup & Schedule Management

#### Route Details

Route Number/Name

Route Type

Start Point

End Point

First Trip

Last Trip

#### Route Map

#### Intermediate Stops

Stop Name	Arrival Time	Departure Time	Distance (km)	Fare	Action
Central Station	06:00	06:05	0	0	
Market Street	06:15	06:17	3.2	20	
University Campus	06:30	06:32	5.8	40	

+ Add Stop

#### Schedule Management

Trip Number	Departure	Arrival	Vehicle	Status
101-1	06:00 AM	06:45 AM	BUS-001	Active
101-2	06:30 AM	07:15 AM	BUS-002	Active
101-3	07:00 AM	07:45 AM	BUS-003	Active

Cancel
Preview Schedule
Save Route

Fig: Add new route screen

## Employee Management

Manage your drivers and conductors

+ Add Employee

### Add New Employee

Full Name

Enter full name

Employee ID

Enter employee ID

Email Address

Enter email

Assigned Bus

Select bus

Phone Number

Enter phone number

Username

Enter username

Role

Select role

Password
















Enter password

Cancel

Save Employee

Q Search employees..

Filter by role

Employee ID	Full Name	Role	Contact Info	Assigned Bus	Status	Actions
EMP001	John Smith	Driver	john.smith@example.com +1 (555) 123-4567	BUS-101	Active	  
EMP002	Sarah Johnson	Conductor	sarah.j@example.com +1 (555) 234-5678	BUS-102	Active	  
EMP003	Michael Brown	Driver	m.brown@example.com +1 (555) 345-6789	BUS-103	Inactive	  
EMP004	Emily Davis	Conductor	emily.d@example.com +1 (555) 456-7890	BUS-104	Active	  
EMP005	James Wilson	Driver	j.wilson@example.com +1 (555) 567-8901	BUS-105	Active	  

Showing 1 to 5 of 5 entries

< 1 >

Fig: Add new employee screen



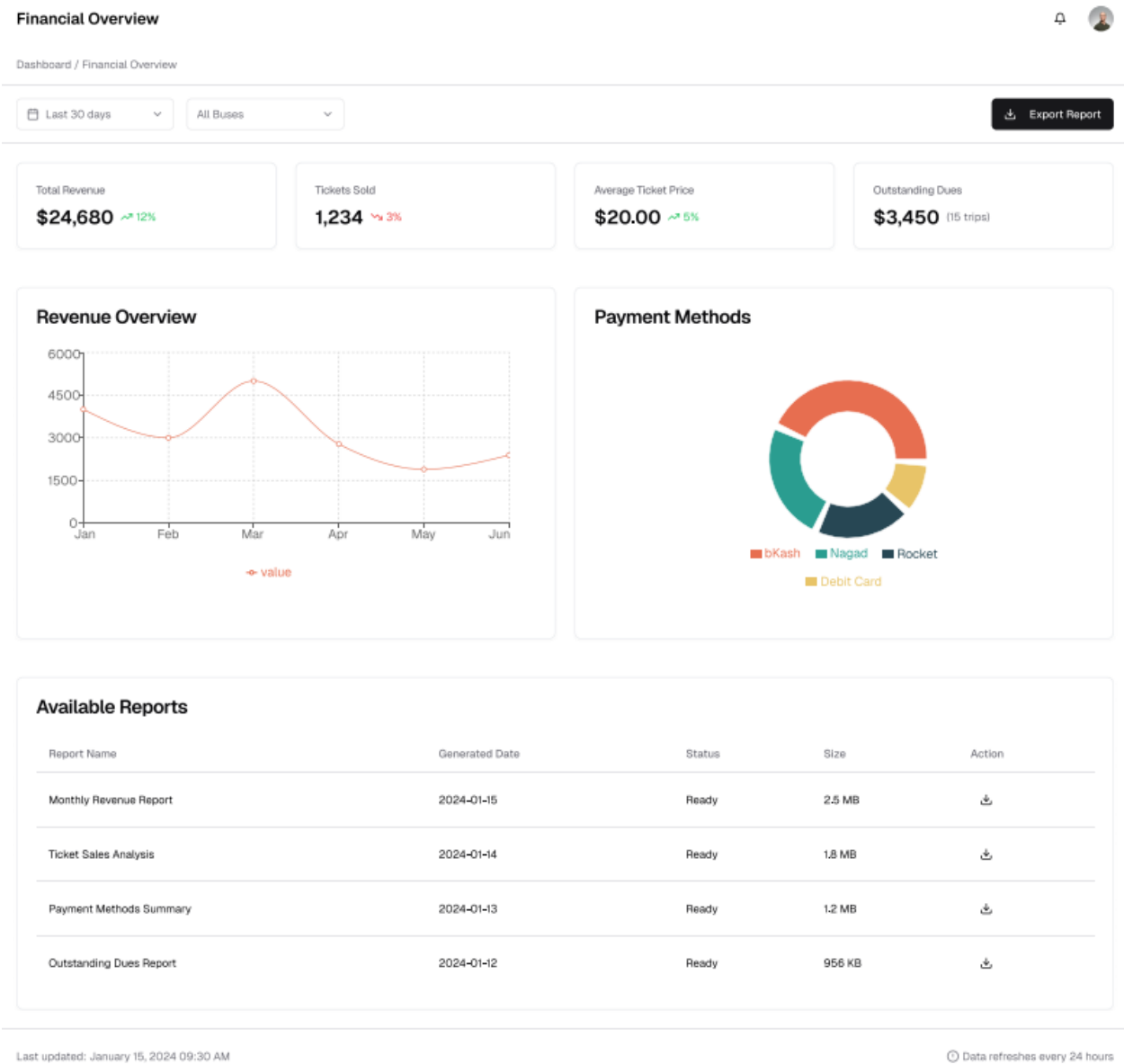


Fig: Financial overview screen