CHAPTER 1. INTRODUCTION

1.1 Background of The Case Study

Transportation plays a vital role in daily life, enabling mobility and connectivity within urban and rural areas. With the increasing complexity of public transportation systems, there is a growing demand for a digital platform that provides real-time information to enhance travel efficiency. "TransConnect" aims to address these needs by offering a comprehensive web-based platform that integrates real-time schedules, route planning, and advanced features to make commuting more convenient and efficient.

1.2 Problem Statement

Public transportation users often face challenges such as:

- Inconsistent and outdated schedule information.
- Difficulty in finding efficient routes.
- Long waiting times and unreliable travel experiences.
- Limited access to advanced features such as online access on the bus and routing.
  To address these issues, a reliable, user-friendly platform is needed to bridge the gap between commuters and transportation services.

1.3 Objectives of The Project

They are general and specific objectives of "TransConnect" which are:

General Objectives

1. To develop an intuitive and easily accessible web platform for public transportation users.
2. To provide a reliable source of real-time transportation data to enhance commuter experience.
3. To promote the use of public transportation by making it more efficient and user-friendly.
4. To reduce travel-related inefficiencies such as delays and unnecessary waiting times.

Specific Objectives

1. To implement real-time public transportation schedules and route updates using external APIs.
2. To develop a route-planning feature that calculates the most efficient path to the user’s destination.
3. To integrate mobile payment options, such as contactless payments via NFC.
4. To provide safety ratings for public transportation systems to enhance user trust and satisfaction.
5. To enable future capabilities such as:
    - Car speed tracking and enforcement based on location.
    - Passenger counting using sensor technology.
    - Advanced analytics for transportation system improvements.

6. To ensure the platform is scalable and adaptable to different regions and modes of transportation.

1.4 Project Rationale

- The rationale behind "TransConnect" lies in its ability to solve critical transportation challenges by leveraging technology. By providing accurate and real-time information, the platform empowers users to make informed decisions and optimize their travel experience. Additionally, the incorporation of innovative features ensures the platform remains relevant and adaptable to future advancements in transportation technology.

1.5 Project Limitations

Despite its potential benefits, "TransConnect" has some limitations:

- Real-time data accuracy depends on external sources, which might occasionally experience delays or inaccuracies.
- NFC payment integration and passenger counting are planned future features and may not be immediately available.
- Initial deployment may be limited to specific geographic regions, restricting global accessibility.
- Users without smartphones or stable internet connectivity may not fully benefit from the platform.

1.6 Implementation Plan

Phase 1: Requirement Analysis and Initial Design

Timeline: September 2024

Key Activities:

1. Perform market research to identify strengths and gaps in existing transportation platforms.
2. Develop a comprehensive System Requirement Specification (SRS) document.
3. Design wireframes and low-fidelity prototypes for a user-friendly and responsive UI.
4. Finalize the technology stack, including frontend, backend, database, and third-party services.
5. Develop a Gantt chart for project milestones and assign responsibilities to team members.

Phase 2: Core Development and Integration
Timeline: September - December 2024
Key Activities:

1. **Frontend Development:**
    - Build a responsive user interface using finalized frameworks (React.js).
    - Implement features for real-time schedule display and route planning.
2. **Backend Development:**
    - Set up the server-side architecture using Django.
    - Develop APIs for handling user data, schedules, and routes.
    - Establish database schema and configure databases for scalability.
3. **API Integration:**
    - Integrate third-party APIs (e.g., Google Maps API, public transportation APIs) for real-time schedule and route data.
    - Implement placeholder features for future NFC payments and passenger counting.
4. **Initial Testing:**
    - Conduct unit testing for individual modules (UI components, APIs, and database queries).
    - Test API responses for accuracy and speed.

Phase 3: Testing and Refinement
Timeline: January - April 2025
Key Activities:

1. **System Testing:**
    - Perform integration testing to ensure seamless communication between frontend, backend, and third-party APIs.
    - Conduct performance testing to assess system scalability and responsiveness.
2. **User Testing:**
    - Launch a beta version of the platform for a limited audience.
    - Gather user feedback on usability, accuracy, and design.
3. **Bug Fixes and Optimizations:**
    - Resolve bugs identified during testing.
    - Optimize backend processes and database queries for faster performance.
4. **Accessibility and Compliance:**
    - Ensure the platform meets accessibility standards (e.g., WCAG).
    - Conduct a security audit to address vulnerabilities.

Phase 4: Deployment and Launch
Timeline: April - December 2025
Key Activities:

1. **Final Deployment:**
    - Set up hosting and deploy the platform to production servers.
    - Configure the system for real-time updates and 24/7 availability.
2. **Training and Documentation:**
    - Provide training sessions for transportation authorities and support teams.
    - Deliver user guides and documentation for system maintenance.
3. **Marketing and Outreach:**
    - Promote the platform through targeted campaigns to raise awareness.
    - Collaborate with public transportation authorities to encourage adoption.
4. **Monitoring and Maintenance:**
    - Monitor system performance and user engagement.
    - Address issues reported by users in real-time.

Phase 5: Future Enhancements and Updates (Post-Launch)
Timeline: January 2026 and beyond
Key Activities:

1. Implement advanced features such as:
    - Car speed tracking and limitation based on location.
    - NFC payment integration for seamless transactions.
    - Passenger counting using sensor technology.
2. Expand the platform to additional regions and transportation networks.
3. Regularly update the platform to align with user needs and technological advancements.

CHAPTER 2: SYSTEM ANALYSIS AND DESIGN

2.1 System Analysis

2.1.1 Introduction to The Analysis and Design

The system analysis and design phase identify the functional and non-functional requirements, system actors, and the structural framework to achieve the objectives of the "TransConnect" platform. The focus is to ensure the system fulfills user needs effectively while maintaining scalability and efficiency. This phase serves as the blueprint for subsequent development and implementation.

2.1.2 System Actors (Internal and External)

Internal Actors:

1. **System Administrator:**
    - Manages system configurations, user accounts, and security settings.
    - Updates transportation schedules and manages APIs for real-time data.
2. **Developers:**
    - Maintain and update the platform, fix bugs, and implement new features.

External Actors:

1. **End Users (Commuters):**
    - Access the platform to view schedules, plan routes, and make mobile payments.
2. **Public Transportation Authorities:**
    - Provide data for schedules, safety ratings, and updates.
3. **Third-Party Services:**
    - APIs for real-time schedule data, route mapping, and mobile payment gateways.

2.1.3 Functional Requirements of Project

1. Provide real-time public transportation schedules and route details.
2. Enable users to plan the most efficient routes to their destinations.
3. Facilitate mobile payments using NFC technology.
4. Display safety ratings for transportation services.
5. Offer advanced features such as car speed tracking, passenger counting, and analytics integration.

2.1.4 Non-functional Requirements of the Project

1. **Performance:**
    - The system must respond to user actions within 3 seconds.
2. **Scalability:**
    - Must handle increased user traffic during peak hours without performance degradation.
3. **Reliability:**
    - The platform must be operational 95% of the time.
4. **Security:**
    - Data encryption for sensitive information like payment details.
    - Role-based access control for administrators and users.
5. **Accessibility:**
    - Must meet Web Content Accessibility Guidelines (WCAG) standards.
6. **Compatibility:**

- The platform must work across major browsers and devices (mobile and desktop).

2.2 System Design

2.2.1 UI Design

The UI design for "TransConnect" emphasizes simplicity, responsiveness, and user-centered functionality.

1. **Homepage:**
   - Quick access to real-time schedules and route planning.
   - Prominent search bar for destination inputs.
2. **Schedule and Route Page:**
   - Interactive map displaying routes and stops.
   - Real-time updates on arrival times.
3. **Payment Interface:**
   - NFC payment options for seamless transactions.
   - Receipt generation and transaction history display.
4. **Admin Dashboard:**
   - Tools for managing schedules, updating routes, and monitoring system performance.

2.2.2 Database Design

The database design is structured to efficiently store and retrieve data for real-time functionality and scalability.

Database Tables:

This database schema supports efficient querying and future expansion for additional features like passenger counting and advanced analytics.

CHAPTER 3: IMPLEMENTATION

3.1 Introduction

The implementation phase outlines the practical steps taken to develop and integrate the "TransConnect" platform. It describes the tools and technologies used to construct the system, along with detailed descriptions of its frontend and backend components. Screenshots of the key functionalities and user interfaces are also provided to highlight the system's design and features.

3.2 Tools and Technology

3.2.1 Frontend Technologies

The frontend was developed using the following tools and libraries:

- **React.js:** For building a dynamic, component-based, and responsive user interface.
- **Bootstrap:** To ensure a consistent and responsive design framework.
- **Axios:** For making API requests to the backend.
- **CSS:** For styling custom elements and adding interactivity.

3.2.2 Backend Technologies

The backend was developed with robust tools to ensure scalability and security:

- **Django:** A high-level Python web framework to handle server-side logic.
- **Django Rest Framework (DRF):** For building RESTful APIs that interact with the frontend.
- **JWT (JSON Web Tokens):** For secure authentication and user management.
- **Celery & Redis:** For handling asynchronous tasks like notifications and logs.

3.2.3 Database Management

The system uses a reliable relational database to store and manage data efficiently:

- **SQLite:** For structured data storage, ensuring high performance and scalability.
- **Django ORM:** For seamless interaction with the database using Python objects.

3.3 Screenshots

3.3.1 Clients/Users

3.3.1.1 Landing Page

The landing page serves as the primary interface for users, featuring an easy-to-navigate layout:

A. Home: Displays a welcome message, an overview of features, and real-time transportation schedules.

B. Services:

- **Transport:** Displays public transportation schedules.
- **Logistics:** Shows cargo and freight options.
- **Routes:** Helps users plan their travel routes.
- **Fleet:** Displays available vehicles and their details.
- **Stations:** Lists station details with maps.

C. Book: Enables users to book tickets and routes.

D. About: Provides information about the platform, its mission, and vision.

E. Contact:

- Allows users to submit inquiries and feedback.
- Includes a notification system for sending responses to users based on their selected category.

F. Sign In & Registration:

- Default user roles (clients) are assigned upon registration.

- Users can only view data they're authorized for, with secure token storage using JWT.

3.3.1.2 Sign-In Process

The platform supports secure sign-in for three roles:

1. **Admin:** Access to all system functionalities.
2. **Driver:** Limited access for vehicle and route management.
3. **Client:** Access to booking, route viewing, and profile management.

3.3.1.3 Functionality

1. **User Management:**
   - Add User
   - View User
   - Edit User
   - Delete User
2. **Routes Management:**
   - Create, Read, Update, and Delete (CRUD) for routes.
3. **Vehicles Management:**
   - CRUD operations for vehicles in the system.
4. **Agencies Management:**
   - Manage transportation agencies.
5. **Trips Management:**
   - CRUD for trip planning and management.
6. **Notification System:**
   - Enables the admin to send category-based notifications to users.
7. **User Logs:**
   - Records user activities and events for auditing.
8. **Profile Management:**
   - Users can update their profiles, change passwords, and manage settings.

CHAPTER 4: CONCLUSION AND RECOMMENDATIONS

4.1 State of Implementation

The "TransConnect" web platform has successfully achieved its primary objectives, offering real-time public transportation schedules, route planning, and enhanced user experiences. The current implementation includes features like route management, vehicle tracking, notifications, and a secure user authentication system.

While the system meets its initial goals, certain future features, such as NFC payment integration, car speed tracking, and passenger counting, are yet to be implemented. These features will require further research and integration with advanced technologies like IoT and machine learning.

4.2 Recommendations

a) Lecturer

- Provide continuous guidance and technical feedback to enhance the project's functionality and design.
- Encourage further exploration of emerging technologies, such as artificial intelligence, to improve system efficiency.
- Share insights on best practices in system development and documentation.

b) School (UR-CST)

- Offer additional resources like workshops, labs, and mentorship to support innovative projects like TransConnect.
- Establish partnerships with public transportation agencies for real-world implementation and testing.
- Recognize and promote student projects that address societal challenges.

c) Students

- Collaborate with peers across disciplines to enrich the development process with diverse expertise.
- Focus on acquiring industry-standard certifications to complement academic knowledge (e.g., Django, React).
- Use TransConnect as a case study for future academic research or entrepreneurial ventures.

d) Business Partners

- Partner with transportation agencies to integrate TransConnect with their systems.
- Invest in the development of advanced features like NFC payment and sensor-based passenger tracking.
- Leverage the platform to improve operational efficiency and customer satisfaction.

e) Customers

- Utilize the platform to plan efficient travel and reduce waiting times.
- Provide feedback on system usability and feature preferences to guide future updates.
- Encourage wider adoption of TransConnect by sharing the benefits with peers and family.