AL-QALAM UNIVERSITY KATSINA

DESIGN AND IMPLEMENTATION OF TRANSPORT MANAGEMENT SYSTEM

USMAN ISHAQ KAROFI

NAS/STE/19/1051

UNDER THE SUPERVISION OF DR. USMAN HAMZA

A PROJECT SUBMITTED TO THE DEPARTMENT OF SOFTWARE ENGINEERING AND CYBERSECURITY, COLLEGE OF COMPUTING AND INFORMATION SCIENCES, AL-QALAM UNIVERSITY, KATSINA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE DEGREE IN SOFTWARE ENGINEERING

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DECLARATION

I hereby declare that this project work titled “Design and Implementation of Transport Management System” is my original work, undertaken under the supervision of Dr. Usman Hamza, and the work has not been submitted to any higher institution for any academic award. All sources used have been duly acknowledged.

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Usman Ishaq Karofi Date

NAS/STE/19/1051

CERTIFICATION

This is to certify that the project work titled “Design and Implementation of Transport Management System” by Usman Ishaq Karofi; NAS/STE/19/1051 was carried out under my supervision.

_____ _____

Dr. Usman Hamza Date

Project Supervisor

APPROVAL

This project work titled “Design and Implementation of Transport Management System” has been read and approved as meeting the partial requirement for the award of Bachelor of Science degree in Software Engineering of Al-Qalam University, Katsina.

_____	_____
Malam Hayat Suleiman Tuge Project Examiner	Date
_____	_____
Dr. Usman Hamza Project Supervisor	Date
_____	_____
Malam Yusuf Abubakar Sadiq Project Coordinator	Date
_____	_____
Dr. Armaya’u Zango Umar Head of Department	Date

DEDICATION

I dedicate this project to Almighty Allah.

ACKNOWLEDGEMENT

My sincere appreciation and gratitude goes to the Almighty (ALLAH) for his grace, support and his mercy grant upon me.

I greatly express my gratitude to our beloved lecturers in the department of Software Engineering and Cybersecurity like my Head of Department, Dr. Armaya'u Zango Umar, My project supervisor, Dr. Usman Hamza, Project Coordinator, Malam Yusuf Abubakar Sadiq and Examination Officer, Mr. Hayat Suleiman Tuge for their kindness and advises.

A special, distinctive thanks to my parent for their support both academically and financially, I prayed that Almighty ALLAH bless them and their entire family, Amin.

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ABSTRACT

This research project focuses on developing a Web-Based Road Transport Management System to address challenges in the transit sector. The system aims to automate transportation operations, enhance efficiency, and provide accurate ticketing and data analysis capabilities. Integration of technology promises improved decision-making and customer experiences in road transport.

Keywords: Transportation, Web-Based System, Road Transport, Efficiency, Ticketing, Data Analysis, Decision-Making, Technology Integration.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Transportation plays a vital role in moving people and goods across various modes such as land, water, and air. Different transportation modes possess distinct characteristics and contribute to the overall movement of goods and individuals. Modes of transportation can be categorized as land (road, rail, and pipeline), water (shipping), and air (aviation). This research work focuses on transit, which utilizes road transport for the movement of people and goods using cars, buses, and Lorries.

In addition to transportation modes, the concept of a Management Information System (MIS) is crucial. MIS is a computer-based system that uses data from Transaction Processing Systems (TPS) to generate routine reports for assisting middle managers in decision-making processes.

The aim of this research work is to develop a Web-Based Road Transport Management System to support managers in their decision-making processes within the transit sector.

1.2 Problem Statement

The existing manual booking system used by travel agents in the transport company faces challenges due to high passenger volumes, resulting in long queues and extended waiting times. Overbooking and limited seat availability is persistent issues. The current system lacks quick access to relevant information for decision-making. With an increasing number of staff and agents, retrieving employee information such as grade level, employment year, and salary becomes slow and challenging. This can lead to errors in promotions and salary payments. To overcome these challenges, a web-based information system is being developed to streamline operations and improve efficiency within the conventional transport system.

1.3 Aim and Objectives

The aim of this project is to develop a Transport Management System (TMS) that automates and optimizes transportation operations for organizations. The objectives include:

1.3.1 Develop a Transport Management System that displays accurate departure and arrival times for passengers.

1.3.2 Create a ticket generation system that produce PDF tickets containing journey details, passenger information, and securely embedded barcodes.

1.3.3 Provide administrators with tools to generate reports based on specific date rages, enhancing data analysis capabilities.

1.4 Research Question

1.4.1 How to develop a Transport Management System that displays accurate departure and arrival times for passengers.

1.4.2 How to create a ticket generation system that produce PDF tickets containing journey details, passenger information, and securely embedded barcodes.

1.5 Scope of the Study

This project focuses on conducting a survey of the information recording and retrieval system employed by the UMTRA Company. The areas of interest include ticketing, seat reservation, and the management of staff information. The aim is to assess the effectiveness and efficiency of the current system in these areas and identify potential areas for improvement.

1.6 Significance of the Project

This design and implementation project focuses on evaluating the impact of integrating computer technology into the information generation and management system of the UMTRA Company. The primary goal is to showcase the benefits that computerization can bring to the overall functioning of the UMTRA System. Through this research, the UMTRA Management will acquire a deep understanding of the advantages associated with implementing computer technology. Armed with this knowledge, they will be able to make informed decisions regarding the seamless integration of computers into their existing information system, leading to enhanced efficiency and effectiveness in their transport operations. The project will encompass the design and implementation of the computer-based system, ensuring its successful integration and optimization within the UMTRA Company.

1.7 Summary

The chapter covers the entire concept of the project, which manual booking system used by the transport company faces challenges such as long queues, overbooking, and limited seat availability. The objectives of the project include developing a web application for scheduling journeys and generating tickets, designing user-friendly software, and creating a suitable use-case diagram for implementation.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter provides a comprehensive overview of the transportation industry, addressing the movement of both goods and people. It highlights the categorization of road transportation into two primary groups: the transportation of goods and the transportation of people, emphasizing the significance of regulatory measures in differentiating these services. The key factors affecting the efficiency of goods transportation are discussed, including infrastructure, distance, shipment attributes, and vehicle choices. The chapter also introduces diverse modes of people transportation, from personal vehicles to mass transit systems, offering insights into the industry's multifaceted nature.

2.1 Overview of Transportation

Transportation, as defined by Thomas, (2021), involves the movement of people and goods from one location to another. Road transportation can be categorized into two main groups: the transportation of goods and the transportation of people. Licensing requirements and safety regulations in many countries ensure a clear distinction between these two services.

The efficiency and nature of road transportation for goods depend on factors such as local infrastructure development, the distance traveled, the weight and volume of the shipment, and the type of goods being transported. For short distances and small shipments, vans or pickup trucks are commonly used, while larger shipments, even if they don't fill an entire truck (less than truckload), are more suitable for transportation by trucks.

When it comes to transporting people, individuals typically use cars or automobiles, while mass transit options such as buses or coaches are also available.

A transportation system refers to the equipment and logistics involved in moving passengers and goods (Shodmonov, 2022). It encompasses all forms of transport, including cars, buses, boats, aircraft, and even space travel. Transportation systems play a vital role in troop movement logistics, planning, as well as the operation of local school bus services.

Importance’s of Transportation

Transportation is vital for economic growth, employment, access to services, global connectivity, emergency response, urban development, environmental impact, innovation, national security,

cultural exchange, education, and research. It plays a pivotal role in our daily lives and society as a whole.

2.2 Types of Transportation System

The following are known categories of transportation systems.

2.2.1 Aviation Transport: The invention of the airplane in 1903 revolutionized transportation, enabling the rapid movement of people and goods across cities and countries within a matter of minutes or hours (Joseph-Michel, 2021). The Wright brothers, Orville and Wilbur, made significant advancements in aviation with the development of the A11 aircraft. Through their experiments with gliders and the incorporation of a gasoline engine and propeller, Orville successfully piloted the plane's first flight in 1903, fulfilling humanity's age-old dream of flying.

Aviation transport, also known as air transportation or air travel, refers to the movement of people, goods, and cargo by aircraft (McAdam, 2022). It is a mode of transportation that relies on airplanes and helicopters to carry out various activities, including passenger travel, freight shipping, and aerial services. Aviation transport is a crucial component of the global transportation network and plays a significant role in connecting people and goods across different regions and countries.

Aviation as the Movement of People and Goods: According to the Federal Aviation Administration (FAA), aviation transportation refers to "the movement of people and goods by aircraft." This broad definition highlights the fundamental role of aircraft in facilitating mobility and trade (FAA, 2020).

A Mode of Transportation from a transportation perspective, aviation is considered a mode of travel alongside land, sea, and rail. It is characterized by the use of aircraft to transport passengers and cargo (Oster et al., 2013).

Aviation transportation serves as a global connector, reducing the barriers of time and distance. It enables international travel and trade, making the world more interconnected (Graham & Guyer, 2016).

2.2.1.1 Specialized Aspects of Aviation Transportation

2.2.1.1.1 Cargo Aviation: Cargo aviation involves the transport of goods, ranging from consumer products to medical supplies and high-value cargo. It plays a vital role in global supply chains (Wang & Oum, 2014).

2.2.1.1.2 General Aviation: General aviation encompasses private and non-commercial activities, including private aircraft, business jets, and recreational flying (Kaplan, 2017). It serves a diverse range of purposes, from personal travel to aerial photography.

2.2.1.1.3 Military Aviation: Military aviation involves the use of aircraft for national defense, including combat operations, troop transport, and reconnaissance (Peyser & Watts, 2020). It is a cornerstone of modern military strategy.

2.2.1.2 Aviation's Evolution and Impact

2.2.1.2.1 Historical Evolution: The invention of the airplane by the Wright brothers in 1903 marked a pivotal moment in transportation history (Joseph-Michel, 2021). The subsequent development of commercial aviation transformed the way people and goods are transported, revolutionizing industries and societies worldwide (Gudmundsson, 2017).

2.2.1.2.2 Economic Impact: The economic significance of aviation transportation cannot be overstated. It contributes to job creation, stimulates tourism, and fuels economic growth by facilitating trade and investment (Button, 2019).

2.2.1.2.3 Environmental Challenges: Despite its undeniable advantages, aviation faces environmental challenges, particularly regarding carbon emissions and noise pollution (Bailey & Rieger, 2014). Researchers emphasize the need for sustainable practices and alternative fuels to mitigate these impacts (Smithson et al., 2022).

2.2.1.3 Purpose of Aviation Transport

The purpose of aviation transport is to revolutionize and expedite the movement of people and goods across cities and countries. This mode of transportation fulfills humanity's age-old dream of flying and enables rapid mobility, reducing travel times to mere minutes or hours (Joseph-Michel, 2021).

2.2.1.4 Method of Aviation Transport

Aviation transport relies on the use of aircraft, including airplanes and helicopters, to accomplish various transportation tasks. It encompasses passenger travel, freight shipping, and aerial services, connecting people and goods across different regions and countries (McAdam, 2022).

2.2.1.5 Benefits of Aviation Transport

2.2.1.5.1 Global Connectivity: Aviation serves as a global connector, bridging geographical distances and promoting international travel and trade (Graham & Guyer, 2016).

2.2.1.5.2 Speed and Efficiency: It provides one of the fastest modes of transportation, enabling rapid travel over long distances (Joseph-Michel, 2021).

2.2.1.5.3 Economic Impact: Aviation contributes significantly to economic growth by creating jobs, stimulating tourism, and facilitating trade and investment (Button, 2019).

2.2.1.5.4 Specialized Aspects: Aviation encompasses specialized areas such as cargo aviation, which plays a critical role in global supply chains (Wang & Oum, 2014), as well as general aviation, serving diverse purposes from personal travel to aerial photography (Kaplan, 2017), and military aviation, a cornerstone of national defense (Peyser & Watts, 2020).

2.2.1.6 Challenges of Aviation Transport

2.2.1.6.1 Environmental Impact: Aviation contributes to carbon emissions and noise pollution, posing environmental sustainability challenges (Bailey & Rieger, 2014). Sustainable practices and alternative fuels are essential to mitigate these impacts (Smithson et al., 2022).

2.2.1.6.2 Security: Ensuring the security of air travel against potential threats like terrorism remains a significant challenge (Joseph-Michel, 2021).

2.2.2 Marine Transport: Marine transport utilizes rivers or seas as a means of transportation for people and goods between towns or countries (Schnurr & Walker, 2019). This mode of transportation involves the use of canoes, ships, and submarines, utilizing the sea surface or underwater pathways. In the early days, pioneers relied on rafts for water transportation, taking advantage of the ease of travel on water compared to land. Large floating boats were capable of carrying multiple families along with their livestock and possessions.

Marine Transportation as Waterborne Movement, Marine transportation, at its core, refers to the movement of goods, people, and resources on waterways using various vessels, such as ships, boats, and barges (Ha, 2016).

From an economic perspective, marine transportation is often defined as a critical enabler of global trade, facilitating the movement of raw materials, finished products, and energy resources across international borders (Notteboom & Rodrigue, 2019).

Marine transportation is recognized as a distinct mode of transportation alongside road, rail, and air. It provides unique advantages for long-distance travel and bulk cargo transport (Baird & Wang, 2018).

2.2.2.1 Marine Transportation's Historical and Contemporary Role

2.2.2.1.1 Historical Significance: The historical significance of marine transportation dates back centuries, as seafaring vessels have been essential for exploration, colonization, and trade (Tzannatos, 2015). Maritime routes have shaped the course of history by connecting civilizations.

2.2.2.1.2 Economic Impact: The economic impact of marine transportation is profound, contributing significantly to global GDP and employment (Nguyen & Notteboom, 2019). Ports and shipping activities are critical drivers of regional and national economies.

2.2.2.1.3 Environmental Challenges: While marine transportation is environmentally efficient in terms of emissions per ton-kilometer, it faces challenges related to emissions, ballast water management, and the impact of shipping on marine ecosystems (Cullinane & Wang, 2021). Sustainable practices and regulations are essential to mitigate these challenges.

2.2.2.2 Specialized Aspects of Marine Transportation

2.2.2.2.1 Container Shipping: Container shipping is a dominant subsector of marine transportation, involving the transport of standardized containers filled with various goods. This system has revolutionized global trade (Panayides & Song, 2017).

2.2.2.2.2 Bulk Shipping: Bulk shipping involves the transportation of commodities in large quantities, such as coal, iron ore, and grain. Bulk carriers play a critical role in this sector (Wang & Brooks, 2019).

2.2.2.2.3 Cruise Tourism: Marine transportation encompasses the cruise tourism industry, providing leisure travel experiences to millions of passengers each year (Dehoorne et al., 2018). Cruise ships are floating resorts, offering a wide range of amenities and destinations.

2.2.2.3 Purpose of Marine Transport

Marine transport serves as a means of transportation for people and goods between towns or countries, utilizing rivers, seas, and oceans as pathways (Schnurr & Walker, 2019). It encompasses the use of various vessels, such as ships, boats, and submarines, for the movement of goods, people, and resources on waterways (Ha, 2016).

2.2.2.4 Method of Marine Transport

Marine transport involves the utilization of a diverse fleet of waterborne vessels, including ships, boats, and barges, to transport cargo, passengers, and resources across waterways (Ha, 2016). It plays a critical role in enabling global trade, facilitating the movement of raw materials, finished products, and energy resources across international borders (Notteboom & Rodrigue, 2019).

2.2.2.5 Benefits of Marine Transport

2.2.2.5.1 Historical Significance: Throughout history, marine transportation has played a pivotal role in exploration, colonization, and trade, connecting civilizations and shaping the course of history (Tzannatos, 2015).

2.2.2.5.2 Economic Impact: Marine transportation significantly contributes to global GDP and employment, serving as a critical driver of regional and national economies (Nguyen & Notteboom, 2019).

2.2.2.5.3 Environmental Efficiency: Marine transport boasts environmental efficiency in terms of emissions per ton-kilometer. However, it faces challenges related to emissions, ballast water management, and environmental impacts on marine ecosystems (Cullinane & Wang, 2021).

2.2.2.6 Challenges of Marine Transport

2.2.2.6.1 Environmental Challenges: Despite its environmental efficiency, marine transport grapples with issues such as emissions and the impact of shipping on marine ecosystems (Cullinane & Wang, 2021). Sustainable practices and regulations are crucial to address these challenges.

2.2.2.6.2 Specialized Aspects: Different aspects of marine transport, including container shipping, bulk shipping, and cruise tourism, require specialized considerations and operational practices (Panayides & Song, 2017; Wang & Brooks, 2019; Dehoorne et al., 2018).

2.2.3 Rail Transport: Rail transport is highly advantageous, particularly in regions like Europe or Japan (Shodmonov, 2022). Trains serve as an excellent mode of transportation in various parts of the world, offering efficient travel options for both domestic and international journeys.

At its core, railway transportation refers to the movement of goods and passengers on tracks using locomotives and railcars (Ceder, 2019).

A Mode of Land Transportation, From a transportation perspective, railway transportation is considered a distinct mode of land-based travel alongside road transportation. It is recognized for its efficiency and capacity to transport large quantities of goods (Button & Haynes, 2018).

Railway transportation has historically been recognized as a significant driver of industrialization and economic development. It connects regions, enables trade, and supports urbanization (Levinson, 2007).

2.2.3.1 Historical and Contemporary Role of Railway Transportation

2.2.3.1.1 Historical Significance: The historical significance of railway transportation is evident in its role in revolutionizing land-based travel during the 19th century. Railways played a vital role in the expansion of nations, trade, and mobility (Wolmar, 2014).

2.2.3.1.2 Economic and Environmental Impact: Railway transportation contributes to economic growth, job creation, and reduced road congestion (Berechman & Paaswell, 2013). Additionally, it is often considered an environmentally friendly mode of transportation, given its lower carbon emissions per ton-kilometer compared to road transport (Blanco et al., 2016).

2.2.3.2 Specialized Aspects of Railway Transportation

2.2.3.2.1 Passenger Rail: Passenger rail transportation focuses on moving people efficiently and safely, offering various services from commuter trains to high-speed rail networks (Nash, 2019).

2.2.3.2.2 Freight Rail: Freight rail transportation centers on the movement of goods, commodities, and raw materials, contributing significantly to supply chain logistics and trade (Farris et al., 2019).

2.2.3.2.3 Urban Transit: Urban transit systems, such as subways and light rail, serve as integral components of public transportation networks in cities worldwide (Vuchic, 2013).

2.2.3.3 Purpose of Rail Transport

Rail transport is highly advantageous, particularly in regions like Europe or Japan (Shodmonov, 2022). It serves as an efficient mode of transportation for both domestic and international journeys, moving goods and passengers on dedicated tracks using locomotives and railcars (Ceder, 2019).

2.2.3.4 Method of Rail Transport

Rail transport is a distinct mode of land-based travel, known for its efficiency and capacity to transport large quantities of goods alongside road transportation (Button & Haynes, 2018). It has

historically played a significant role in industrialization, economic development, and urbanization (Levinson, 2007).

2.2.3.5 Benefits of Rail Transport

2.2.3.5.1 Historical Significance: Railways have revolutionized land-based travel since the 19th century, expanding nations, trade, and mobility (Wolmar, 2014).

2.2.3.5.2 Economic Impact: Rail transport contributes to economic growth, job creation, and reduced road congestion (Berechman & Paaswell, 2013). It is often considered environmentally friendly, with lower carbon emissions per ton-kilometer compared to road transport (Blanco et al., 2016).

2.2.3.6 Challenges of Rail Transport

2.2.3.6.1 Specialization: Rail transport has specialized aspects, including passenger rail, freight rail, and urban transit, each with unique operational considerations (Nash, 2019; Farris et al., 2019; Vuchic, 2013).

2.2.4 Transit Road Transport: Transit road transport refers to the use of roads for the transportation of people or goods between different places or towns (McAdam, 2022). This mode of transportation relies on vehicles such as cars, buses, and lorries. It is a common and cost-effective means of transportation, making it the central focus of the research work.

Transit road transportation, at its core, refers to the provision of organized, scheduled, and often public transportation services using vehicles that run on roads within urban and suburban areas (Vuchic, 2005).

A Mode of Urban Transportation, From a transportation perspective, transit road transportation is a mode that offers an alternative to private car travel in densely populated areas. It serves as a means for people to access employment, education, healthcare, and recreational activities (Cervero, 2013).

Transit road transportation encompasses public transportation services that are operated and regulated by governmental authorities or public agencies. It aims to provide accessible, efficient, and sustainable transportation options to the public (Hensher & Beck, 2019).

2.2.4.1 Historical and Contemporary Role of Transit Road Transportation

2.2.4.1.1 Historical Evolution: The history of transit road transportation can be traced back to the early horse-drawn omnibuses and streetcars. The development of electric trams and the expansion of bus services in the 20th century marked significant milestones in urban mobility (Cudahy, 2002).

2.2.4.1.2 Urban Mobility and Sustainability: Transit road transportation plays a crucial role in addressing urban congestion, reducing carbon emissions, and promoting sustainable urban development (Litman, 2019). It is recognized as a vital component of the urban transportation system.

2.2.4.2 Specialized Aspects of Transit Road Transportation

2.2.4.2.1 Bus Transit: Bus transit is a common form of transit road transportation that serves both urban and suburban areas. It offers flexible route options and is often considered a cost-effective means of public transportation (Hensher & Wallis, 2019).

2.2.4.2.2 Light Rail and Tram Systems: Light rail and tram systems provide higher capacity and speed compared to buses. They are typically used in larger cities to move passengers efficiently (Topp & Hanley, 2016).

2.2.4.2.3 BRT (Bus Rapid Transit): BRT systems offer a middle ground between bus and light rail transit, providing dedicated lanes, efficient boarding procedures, and modern amenities (Levinson & Ma, 2007).

These diverse transportation modes have transformed the way we travel and transport goods, with aviation offering unparalleled speed, marine transport utilizing waterways, rail transport providing advantages in specific regions, and transit road transport being a widespread and affordable option.

2.2.4.3 Purpose of Transit Road Transport

Transit road transport involves the use of roads for the transportation of people and goods between different places or towns (McAdam, 2022). It relies on vehicles such as cars, buses, and lorries and is a common and cost-effective means of transportation.

2.2.4.4 Method of Transit Road Transport

Transit road transportation provides organized, scheduled, and often public transportation services using vehicles that run on roads within urban and suburban areas (Vuchic, 2005). It serves as an

alternative to private car travel, offering access to employment, education, healthcare, and recreational activities in densely populated areas (Cervero, 2013).

2.2.4.5 Benefits of Transit Road Transport

2.2.4.5.1 Historical Evolution: The history of transit road transportation traces back to horse-drawn omnibuses and streetcars, evolving into electric trams and expanded bus services in the 20th century (Cudahy, 2002). It has played a pivotal role in urban mobility.

2.2.4.5.2 Urban Mobility and Sustainability: Transit road transportation addresses urban congestion, reduces carbon emissions, and promotes sustainable urban development (Litman, 2019). It is a vital component of the urban transportation system.

2.2.4.6 Challenges of Transit Road Transport

2.2.4.6.1 Specialization: Transit road transport includes various modes such as bus transit, light rail, tram systems, and Bus Rapid Transit (BRT), each with specific features and considerations (Hensher & Wallis, 2019; Topp & Hanley, 2016; Levinson & Ma, 2007).

2.3 Information System

This is the process of combining people, hardware, software, communication devices, network and data resources to process (which can be storing, retrieving or transforming information) data and information for a specified purpose. (Ekanem, 2019). And according to Wikipedia.org, (IS) is a complimentary network of hardware and software that people and organizations use to collect, filter, process, create and distribute data.

2.3.1 Types of Information System

2.3.1.1 Transaction Processing System (TPS): The Transaction Processing System plays a crucial role in Company by recording and managing day-to-day transactions such as passenger ticketing, customer orders, billing, inventory levels, and production output. It serves as the foundation for other information systems, allowing the transportation company to monitor operations and maintain a comprehensive database of transactional data.

2.3.1.2 Management Information System (MIS): The Management Information System is a computer-based system that utilizes data recorded by the TPS to generate routine reports. These reports assist middle managers in making tactical decisions for the company (Ekanem, 2019). The MIS provides valuable insights into various aspects of the transportation company's operations, enabling informed decision-making.

2.3.1.3 Executive Support System (ESS): The Executive Support System is a user-friendly system that presents highly summarized information to top-level managers in the transport company. It plays a crucial role in overseeing operations and developing strategic plans. The ESS integrates internal data from TPS, MIS, and Decision Support Systems (DSS) with external data, providing a holistic view of the organization's performance (Ekanem, 2019).

2.4 Review of Related works

2.4.1 Purpose of Transport Management Software

The primary purpose of transport management software is to streamline and optimize various aspects of transportation and logistics operations. This includes planning, scheduling, tracking, and managing the movement of goods and people efficiently. It aims to enhance overall operational efficiency, reduce costs, improve customer service, and ensure compliance with regulations (Smith et al., 2020).

Booking and ticketing of transportation services, such as flights, trains, buses, and other modes of transport. It aims to simplify the process for travelers, optimize seat or ticket allocation, and provide real-time access to booking and ticketing services (Li & Zhang, 2021).

2.4.2 Method of Transport Management Software

Transport management software achieves its goals through a combination of technologies and tools. It typically includes features like route optimization, real-time tracking, inventory management, and reporting capabilities. These functionalities are often delivered through web-based or mobile platforms, allowing users to access critical information and make informed decisions (Jones & Wang, 2018).

Transport booking and ticketing software typically operates through web-based platforms or mobile applications. It integrates various features, including user-friendly interfaces for travelers to browse and book tickets, payment processing, seat allocation algorithms, and real-time updates on schedules and availability (Zhang et al., 2019).

2.4.3 Benefits of Transport Management Software

2.4.3.1 Efficiency: It enables automated route planning and optimization, reducing fuel consumption, and minimizing delivery times (Huang & Bell, 2017).

2.4.3.2 Cost Reduction: By optimizing routes, managing resources more efficiently, and reducing errors, transport management software can lead to significant cost savings (Lee & Lei, 2019).

2.4.3.3 Improved Customer Service: Real-time tracking and communication capabilities enhance customer service by providing accurate delivery times and immediate responses to inquiries (Tang et al., 2021).

2.4.3.4 Data-driven Insights: Transport management software generates valuable data and analytics that can be used for strategic decision-making, helping companies adapt to changing market conditions (Gupta & Jain, 2018).

2.4.3.5 Convenience: Travelers can book tickets, select seats, and manage their reservations from the comfort of their devices, reducing the need for physical ticketing offices (Gössling et al., 2018).

2.4.3.6 Real-time Updates: Travelers receive instant updates on schedules, delays, and cancellations, enhancing their travel experience (Xu & Jiang, 2020).

2.4.3.7 Revenue Generation: Transport providers can maximize their revenue through dynamic pricing strategies, upselling options, and analytics-driven decision-making (Zhao et al., 2018).

2.4.4 Challenges of Transport Management Software

2.4.4.1 Integration Complexity: Integrating the software with existing systems, such as ERP and CRM, can be complex and time-consuming (Sun & Yao, 2016).

2.4.4.2 Data Security: Protecting sensitive transportation and logistics data from cyber threats is crucial, and software security is a constant concern (Liu et al., 2020).

2.4.4.3 User Adoption: Ensuring that employees and stakeholders embrace the software and adapt to new processes can be a challenge (Wang & Wu, 2019).

2.4.4.4 Regulatory Compliance: Keeping up with evolving transportation regulations and ensuring compliance can be demanding (Zhang et al., 2020).

2.4.4.5 Scalability: As the user base grows, the software must scale to handle increasing demand, maintain performance, and ensure uninterrupted service (Li & Zhang, 2021).

2.4.4.6 User Experience: Ensuring a seamless and user-friendly experience is essential to encourage travelers to use the software and keep them engaged (Ribeiro et al., 2019).

2.4.4.7 Market Competition: The transport booking and ticketing software market is competitive, and staying ahead often requires innovation and differentiation (Gössling et al., 2018).

2.4.5 TransWay:

TransWay is an expert in fare collection solutions for public transportation. TransWay was established in 1997 and has been providing public transportation companies with tailored solutions that optimize ticketing, fare collection and reporting ever since its inception. TransWay provides an end-to-end solution that includes everything from ticket issue stations, validators, portable sales and validator devices, to a back office system that ties everything together with data and reports.

2.4.5.1 Purpose of TransWay Fare Collection Solutions

TransWay aims to provide expert fare collection solutions for public transportation companies. Their purpose is to optimize the ticketing, fare collection, and reporting processes for these companies. Established in 1997, TransWay has been dedicated to tailoring solutions that enhance the efficiency and accuracy of fare collection in public transportation.

2.4.5.2 Method of TransWay Fare Collection Solutions

2.4.5.2.1 Ticket Issue Stations: These stations likely serve as points where passengers can purchase tickets or add credit to their transportation cards.

2.4.5.2.2 Validators: Validators are likely used to check and validate tickets or cards when passengers board transportation.

2.4.5.2.3 Portable Sales and Validator Devices: These devices may provide mobile options for ticket sales and validation, offering flexibility for passengers and operators.

2.4.5.2.4 Back Office System: TransWay's back office system serves as the central hub that connects all components, managing data and generating reports to provide insights into the transportation system's performance.

2.4.5.3 Benefits of TransWay Fare Collection Solutions

2.4.5.3.1 Efficiency: The solution likely streamlines fare collection processes, reducing waiting times for passengers and optimizing operations for transportation companies.

2.4.5.3.2 Accuracy: With ticket validation and reporting, the system likely ensures accurate fare collection and helps prevent fare evasion.

2.4.5.3.3 Comprehensive Data: The back office system likely gathers comprehensive data, which can be used for decision-making, route optimization, and improving services.

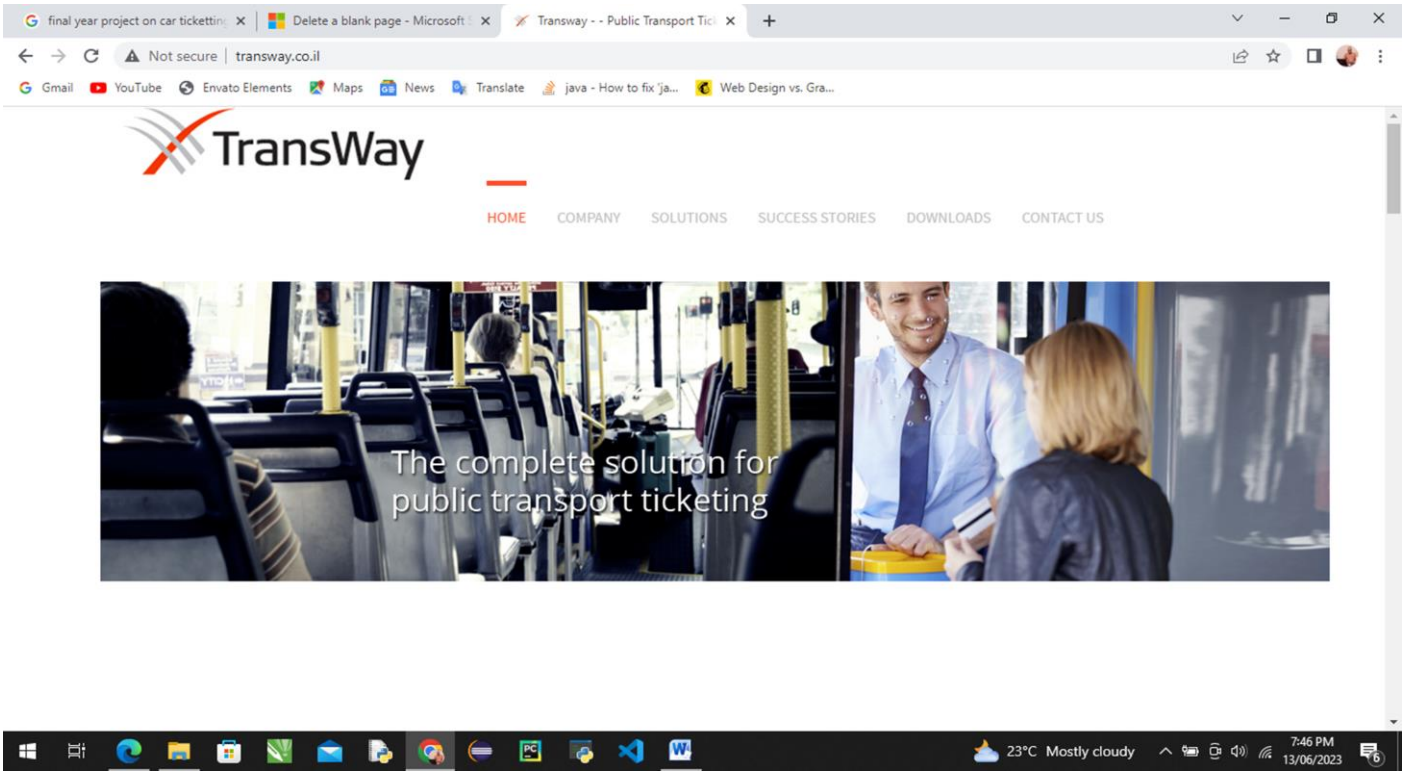
2.4.5.4 Challenges of TransWay Fare Collection Solutions

2.4.5.4.1 Location Indication: One limitation is the lack of location indication, which can be crucial for passengers to know the location of ticket issue stations and validators.

2.4.5.4.2 Departure and Arrival Time: The absence of departure and arrival time information can hinder passengers in planning their journeys effectively.

2.4.5.4.3 Mobile Technology Integration: TransWay does not seem to utilize mobile technology that interacts with web application servers, which could enhance the accessibility and user experience of the system.

2.4.5.4.4 Seat Selection: The system does not enable passengers to select seats of their choice, which may affect passenger comfort and satisfaction.



2.4.6 TraWex:

Trawex is a travel technology company that specializes in providing travel software solutions for the travel industry. They offer a wide range of products and services to travel agencies, tour operators, hotels, airlines, and other travel businesses. Trawex's primary focus is on developing

and delivering innovative travel technology solutions to help companies streamline their operations, enhance their online presence, and improve their overall business performance.

2.4.6.1 Purpose of TraWex Travel Technology Solutions

TraWex specializes in providing travel technology solutions to various businesses in the travel industry, including travel agencies, tour operators, hotels, airlines, and more. Their primary purpose is to offer innovative travel technology solutions that help these companies streamline their operations, enhance their online presence, and improve overall business performance (TraWex, 2023).

2.4.6.2 Method of TraWex Travel Technology Solutions

2.4.6.2.1 Software Solutions: TraWex likely provides software solutions that cater to different aspects of the travel business, such as reservation systems, booking engines, and management platforms.

2.4.6.2.2 Customization: While TraWex offers customizable solutions, it may involve tailoring the software to meet specific business requirements, which can include configuration and integration with existing systems (TraWex, 2023).

2.4.6.2.3 Technical Support: TraWex is likely to offer technical support services to assist businesses in implementing and managing their travel technology solutions.

2.4.6.3 Benefits of TraWex Travel Technology Solutions

2.4.6.3.1 Operational Efficiency: The solutions likely help businesses streamline their processes, reduce manual work, and operate more efficiently (TraWex, 2023).

2.4.6.3.2 Online Presence: Enhancing the online presence through TraWex's solutions can attract more customers and improve visibility in the competitive travel industry.

2.4.6.3.3 Business Performance: TraWex's solutions can potentially lead to improved business performance by increasing revenue, reducing costs, and optimizing operations (TraWex, 2023).

2.4.6.4 Challenges of TraWex Travel Technology Solutions

2.4.6.4.1 Complexity: Implementing and utilizing travel technology solutions can be complex and may require businesses to invest in training or hire specialized personnel (TraWex, 2023).

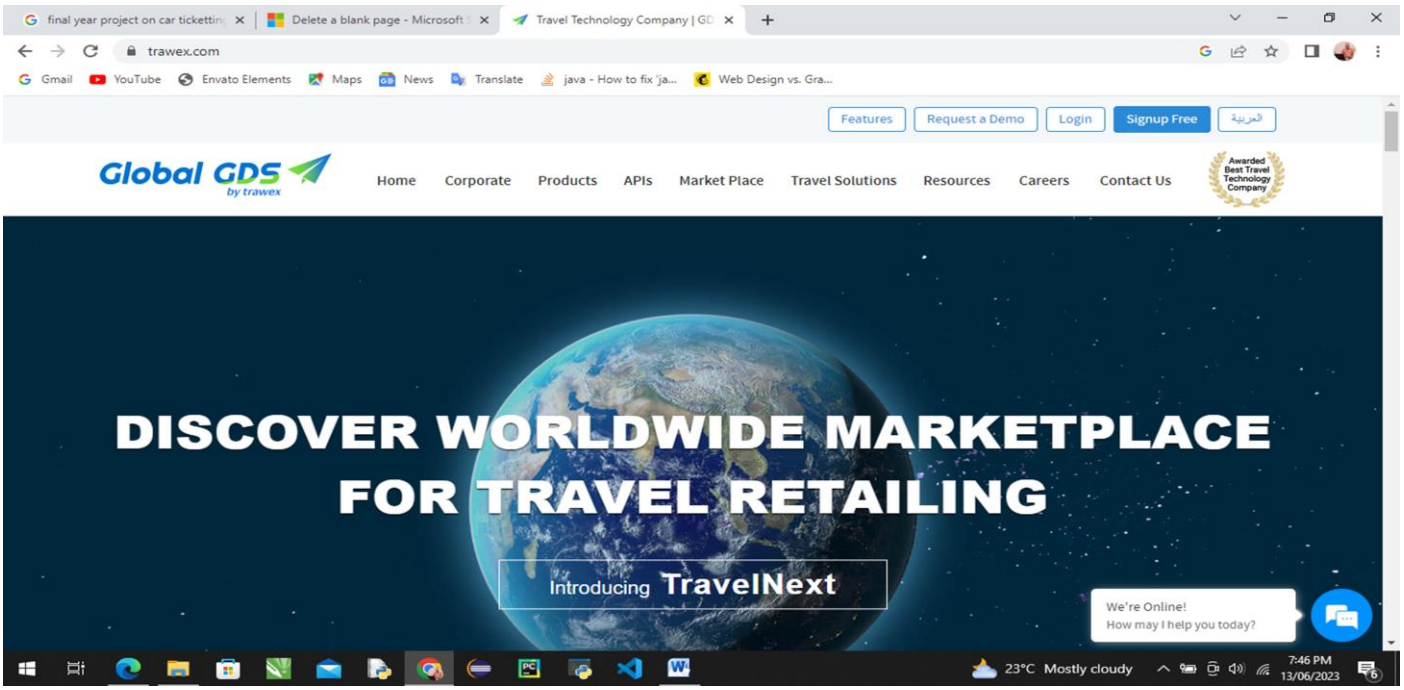
2.4.6.4.2 Customization: While TraWex offers customization, there may be limitations in tailoring the software to meet specific business requirements, potentially incurring extra costs (TraWex, 2023).

2.4.6.4.3 Integration Challenges: Integrating TraWex's solutions with existing systems or third-party applications can pose challenges, including compatibility and data mapping (TraWex, 2023).

2.4.6.4.4 Technical Support: The level and availability of technical support from TraWex may vary depending on service agreements (TraWex, 2023).

2.4.6.4.5 Dependency on Internet Connectivity: Many of TraWex's solutions are web-based, relying on stable internet connectivity, which may be a limitation in areas with limited or unreliable internet access (TraWex, 2023).

2.4.6.4.6 Evolving Technology: The travel industry evolves continuously, and TraWex's solutions need to adapt to industry changes to remain competitive (TraWex, 2023).



2.5 Gaps and Limitations

The potential gaps and limitations of Trawex and TransWay, a travel technology company, include challenges with integration, customization, learning curve, technical support, evolving technology, data security, privacy, and scalability.

2.6 Summary

This Chapter explores transportation industry, highlighting its importance, distinguishing between goods and passenger transportation, and discuss regulatory aspects. It also covers factors affecting goods transportation efficiency, introduces various transportation modes, emphasizes the role of information systems, and introduces TransWay while setting the stage for further research in transportation systems. Therefore, this design and implementation will focused on transport ticketing system.

CHAPTER 3

SYSTEM ANALYSIS AND DESIGN

3.0 Introduction

This chapter provides an analysis of data collected and delivers a conclusion based on the information collected. Based on the conclusion, the chapter discusses the architecture of the system. It discusses the stakeholders involved and their expectations, and describes the functional and non-functional requirements of the system based on the requirements gathered during data analysis. The system shall be referred to as UMTRA Application.

3.1 System Development Methodology

A System Development Methodology is a structured and systematic approach for planning, designing, implementing, testing, and maintaining information systems or software applications. It provides a framework to guide the development process, ensuring that projects are completed efficiently, on time, and within budget.

3.1.1 Agile Software Development Methodology

Agile is an iterative, team-based approach to development. This approach is for creating new software based on customer collaboration iterative development and response to change (Rico, Sayami & Sone, 2019). According to (Highsmith & Cockburn, 2017), agile development purposes to create and respond to provide return on investment in business environment. It combines collaboration with focus on maneuverability and effectiveness. It promotes use of people to transfer ideas faster and cheaply to developers, as opposed to traditional document driven processes.

Six stages in agile methodology of the Software Development Life Cycle (SDLC) based on the concepts of concept, inception, iteration, testing, production, and review:

1. Concept: This stage involves the initial concept and ideation phase. The project team identifies the high-level objectives, scope, and potential features of the software product. The concept stage aims to establish a shared understanding of the project's vision and goals.

2. Inception: In the inception stage, the project team conducts a more detailed analysis of requirements and creates a product backlog. The team collaborates with stakeholders to prioritize features and define the minimum viable product (MVP) or initial release. This stage helps set the direction for the project and establishes a foundation for subsequent iterations

3. Iteration: The iteration stage represents the core of agile development. It involves a series of short, time-boxed iterations or sprints, typically lasting a few weeks. Each iteration focuses on delivering a working product increment that adds value to the overall product. The development team selects user stories or backlog items from the product backlog, implements them, and conducts testing.

4. Testing: Testing is an integral part of agile development and is performed throughout the SDLC. The testing stage involves various activities, such as unit testing, integration testing, system testing, and user acceptance testing. Testing ensures that the software meets quality standards, functional requirements, and user expectations.

5. Production: In the production stage, the developed software increment is deployed to the live environment or made available to end-users. This stage involves configuring the necessary infrastructure, performing final system checks, and ensuring a smooth transition from development to production. The software is made accessible to users, and any necessary data migration or system setup is performed.

6. Review: The review stage marks the end of each iteration or sprint. The development team and stakeholders gather to review the completed work, provide feedback, and evaluate the increment's alignment with the defined requirements and expectations. The review stage helps identify areas for improvement, gather insights for backlog refinement, and make any necessary adjustments for subsequent iterations.

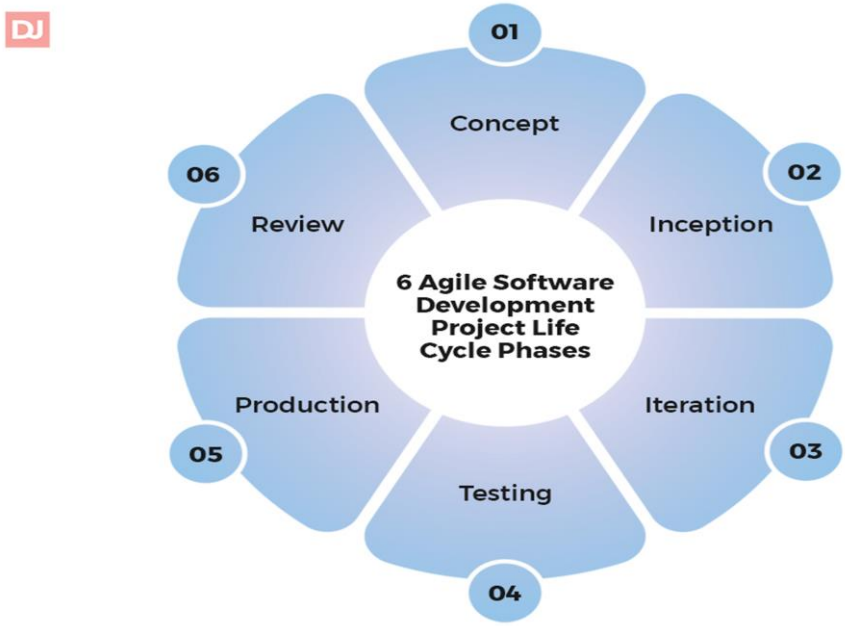


Fig. 3.1: Agile Software Development Project Life Cycle

According to (Rico, Sayami & Sone, 2009), agile methods deliver high quality, inventive software to the market fast and cost-effectively. It provides a solution to incorporation of innovation, management of product development and quality assurance. They identify 4 common values of agile methods as: customer collaboration, teamwork, adaptability and iterative development. Mary Lotz (2019) also identifies several advantages of agile techniques which include: agile approach provides a unique opportunity for clients to be involved throughout the project, by breaking the project into manageable units; the project team can focus on high-quality development, testing and collaboration.

Due to the highlighted advantages, the agile approach was chosen as a suitable methodology for development of the proposed system.

3.2 Requirement Engineering:

Requirement Engineering (RE) is a systematic and disciplined approach to gathering, documenting, analyzing, and managing requirements for a software system or product. It is a critical phase in the software development process as it lays the foundation for designing and building a system that meets the needs and expectations of its users.

3.2.1 Hardware Requirements:

Hardware requirements refer to the specific physical components and specifications that a computer or device must have to run a particular software application or system effectively. These requirements typically include details about the processor, memory (RAM), storage capacity, graphics card, and other hardware components necessary for the software to function optimally.

a) **Servers:** Sufficient server capacity to handle ticket booking requests, transactions, and data storage.
b) **Workstations:** Computers or terminals for ticketing agents to manage bookings and sales.
c) **Networking:** Reliable network infrastructure to facilitate communication between different system components.

3.2.1 Software Requirements:

Software requirements pertain to the necessary software components and configurations needed for a particular application or system to operate correctly. This includes specifying the compatible

operating system, required software dependencies, such as libraries or frameworks, and any other software-related conditions that must be met. Ensuring software requirements are met is essential to ensure the software functions as intended and is compatible with the underlying software environment.

a) **Operating System:** A stable and secure operating system, such as Windows or Linux, to run the ticketing system.
b) **Database Management System:** A database system to store and manage ticketing information, customer data, and transaction records.
c) **Web Server:** since there is web interface for online bookings, a web server (e.g., Apache, Nginx) will be required.
d) **Development Framework:** Django framework is required as it's the framework for the backend.
e) **Payment Gateway Integration:** Integration with a secure payment gateway to process online payments.

3.2.2 Functional Requirements:

Functional requirements define the specific functions that the system performs, along with the data operated on by the functions. The functional requirements are presented in scenarios that depict an operational system from the perspective of its end users. Included are one or more examples of all system features and an enumeration of all the specific requirements associated with these features.

a) The system shall incorporate mechanism to authenticate its users
b) The system shall verify and validate all user input and should notify in case of error detection and should help the user in error correction
c) The system shall allow sharing of files in the system
d) The system shall allow quick messages to be exchanged without face to face interaction
e) Ticket Booking and Reservation: Users should be able to search for bus routes, select seats, and book or reserve tickets.
f) Ticket Cancellation and Refunds: Users should have the ability to cancel their tickets and request refunds if needed.
g) Seat Selection: The system should allow passengers to choose their seats from an available seating layout.

h) Real-time Availability: The system should display real-time availability of seats, showing the number of seats left on a particular bus.
i) User Management: User registration, login, and profile management for both customers and ticketing agents.
j) Reporting and Analytics: Generate reports on sales, revenue, popular routes, and other relevant metrics to track performance.

3.2.3 Non-Functional Requirement

Non-functional requirements address aspects of the system other than the specific functions it performs. These aspects include system performance, costs, and such general system characteristics as reliability, security, and portability. The non-functional requirements also address aspects of the system development process and operational personnel. It includes the following:

3.2.3.1 Performance:

a) Response Time: The system should provide fast response times for ticket bookings, seat selections, and other operations.
b) Scalability: The system should be able to handle increasing user loads and transaction volumes without significant performance degradation.
c) Throughput: The system should support a high number of concurrent users and transactions.
d) Availability: The system should be available and accessible to users for most of the time, with minimal downtime.

3.2.3.2 Reliability:

a) Fault Tolerance: The system should be resilient to failures, and if any component fails, it should have backup mechanisms to ensure uninterrupted service.
b) Disaster Recovery: The system should have a plan and mechanisms in place to recover quickly from catastrophic events or system failures.
c) Data Integrity: The system should maintain the accuracy and consistency of data, ensuring that no data is lost or corrupted during transactions or system failures.

3.2.3.3 Security:

a) Authentication and Authorization: The system should employ secure user authentication and authorization mechanisms to ensure that only authorized users can access the system and perform specific actions.
b) Data Protection: Personal and payment data should be encrypted and stored securely to protect users' privacy and prevent unauthorized access.
c) Audit Trail: The system should log and track user activities and transactions for auditing and security purposes.
d) Compliance: The system should adhere to relevant security standards and regulations, such as the Payment Card Industry Data Security Standard (PCI DSS).

3.2.3.4 Usability:

a) User-Friendly Interface: The system should have an intuitive and easy-to-use interface for customers and ticketing agents.
b) Accessibility: The system should be accessible to users with disabilities, following relevant accessibility guidelines.
c) Multilingual Support: The system should support multiple languages to cater to a diverse user base.

3.2.3.5 Maintainability:

a) Modularity: The system should be designed with a modular architecture that allows for easy maintenance, updates, and enhancements.
b) Code Maintainability: The system's code should be well-structured, commented, and follow coding best practices to facilitate future maintenance and modifications.
c) Documentation: The system should have comprehensive documentation, including system architecture, APIs, and user guides, to assist administrators, developers, and end-users.

3.3 System Design

This process supports existing infrastructure requirements and provides specific recommendations for hardware and network solutions based on existing and projected user needs. Application requirements, data resources, and people within an organization are all important in determining the

optimum hardware solution. It is represented using a three tier architecture that comprises of user interface, process management and Database Management System (DBMS). It shows the components of the system, the services they provide and the way they communicate to bring about the system functionality.

3.3.1 Implementation Design

1. **Project Name (Transport Management System):** This is the title or name of the research project, indicating the specific area or topic investigating, which, in this case, is a system, related to transport management.

2. Research Problem: This section outlines the specific issue or problem intend to address through your research. In the context of a Transport Management System, the research problem could be related to improving the efficiency of transportation logistics, enhancing route planning, reducing costs, or any other relevant challenge in the field.

3. Literature Review: This part of the research design involves a comprehensive review of existing literature and research related to your research problem. It helps gain a better understanding of the current state of knowledge in the field, identify gaps in the literature, and inform your research approach.

4. Methodology: Methodology refers to the overall approach and methods you will use to conduct your research. In this case, it includes:

- **Requirement Engineering:** This is a specific phase within your research methodology. Requirement engineering involves gathering, documenting, and analyzing the requirements for your Transport Management System. It's about understanding what the system needs to accomplish and what stakeholders expect from it.

- **System Design:** After requirement engineering, you move on to system design. Here, you will design the architecture, components, and structure of your Transport Management System based on the gathered requirements.

5. Analysis & Implementation: This stage involves both analyzing the system design to ensure it aligns with the requirements and implementing the Transport Management System based on the design. It may include coding, configuration, and testing.

6. Recommendation and Conclusion: In this section, you provide recommendations based on the findings and outcomes of your research. You might suggest improvements, best practices, or

strategies for addressing the research problem. The conclusion summarizes the key findings of your research.

7. Contribution Drawn to Research Problem: In the final stage, you discuss how your research contributes to addressing the research problem identified earlier. This is where you highlight the practical implications of your work and its potential impact on the field of transport management or related areas.

In summary, In below figure 3.2 research design outlines the systematic approach you will follow to investigate and address a specific research problem related to a Transport Management System. It encompasses various phases, from understanding requirements to designing the system, implementing it, and ultimately drawing conclusions and making recommendations that contribute to solving the identified problem.

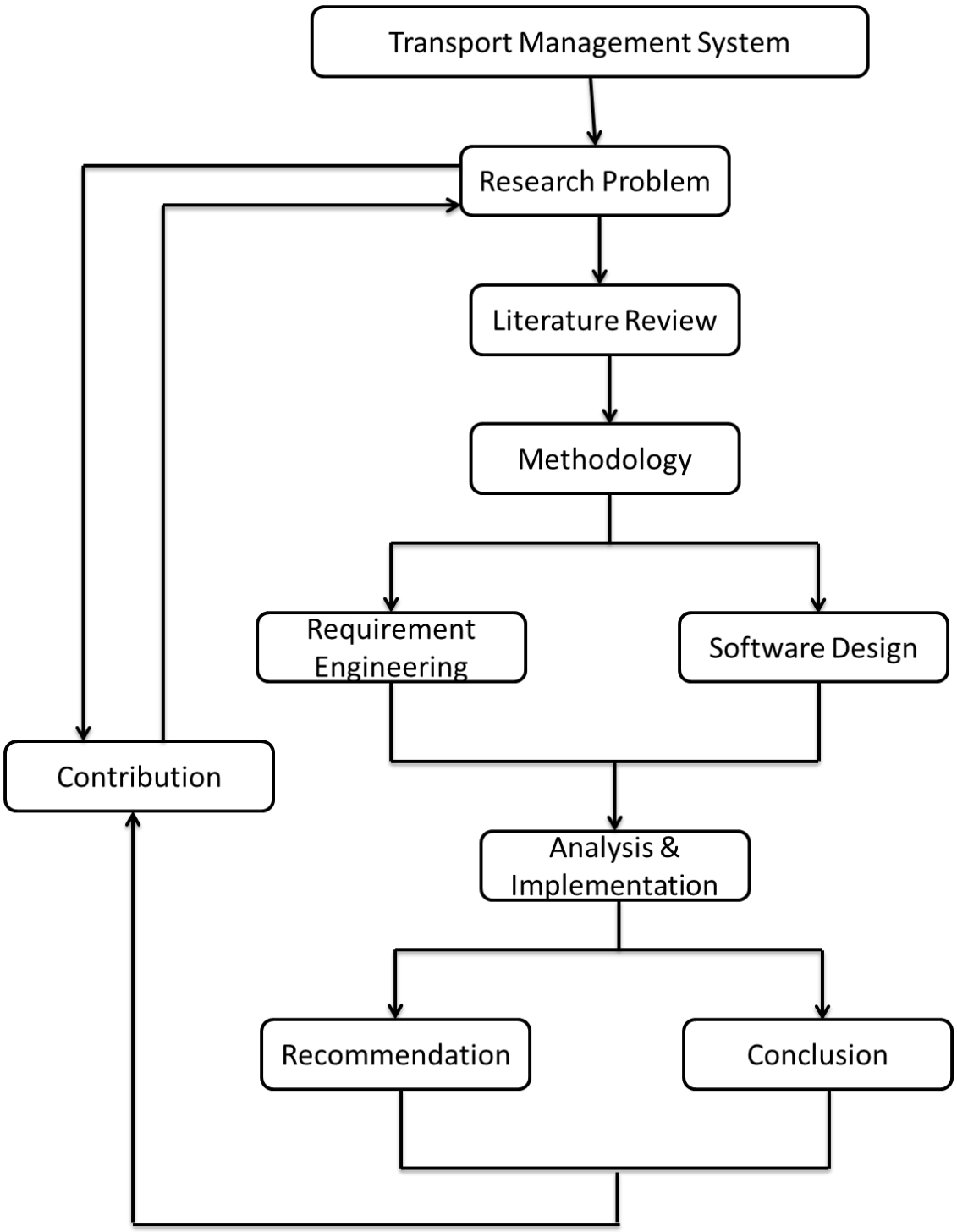


Fig. 3.2: Research/Implementation Design

3.3.1 Use Case Diagram

A use case is a description of the behavior of a program as it responds to a request from outside that program (user). In Figure 3.4, you are shown the case of use of functions in the bus transport system. In other words the use case refers to “who” can do “what” with the system in question. The

use case procedure is used to capture the ethical requirements of a program by defining the threads driven by the situation by operational requirements.

- **Use Cases**: These tasks or activities that the system can do, such as "Login". Each of these tasks is represented as a bubble or shape on the diagram.
- **Actors**: These are the people that interact with the system. Actors are shown as icons outside the diagram.
- **System Boundary**: This is the border around the diagram, showing what's inside (the system) and what's outside (the users or other systems).
- **Lines**: Lines connect the actors to the use cases to show who uses what. It's drawing lines from people to the tasks they can do with the computer system.
- **Extend Relationships**: Shows relationship that represents a conditional or optional behavior that can extend the basic behavior of a use case

1.3.1.1 User Activities

The most common activities carried out by user are illustrated bellow

- The user can search for the seat
- The user can sign up/do registration with the system
- The registered user can login to the system
- The user can check for the available seat
- The user can also do payment for the seat on the system
- The user can print receipt on the system as evidence of payment

1.3.1.2 Administrator Activities

- The administrator will verify all the registered user, and allow them to login to the system
- The administrator give acknowledge to any payment user made on the system
- The administrator can add vehicle, driver and generate report as well

1.3.1.3 Use Case Description

The description section provides an overview of what the use case is all about. It gives readers a high-level understanding of the purpose and context of the use case.

- **Use Case Name:** This is the title or name of the specific use case you are documenting. It should provide a clear and concise description of the action or functionality being described.

- **Actor:** In this section, you identify the actor or actors involved in the use case. Actors are typically the users or external entities interacting with the system to achieve a specific goal. Actors can be individuals, other systems, or hardware devices.

- **Preconditions:** Preconditions are the conditions or requirements that must be satisfied or true before the use case can begin or be executed. They set the stage for the use case and describe the starting conditions.

- **Flow of Events:** The flow of events is the core of the use case description. It provides a step-by-step narrative of what happens during the execution of the use case. It outlines the main actions, interactions, and decision points that occur as the use case progresses.

- **Post-conditions:** Post-conditions describe the state or conditions that exist after the use case has successfully completed. They specify what changes or results occur as a direct outcome of the use case.

- **Exception:** The exception section, also known as the "Alternate Flows" or "Extensions," addresses scenarios that deviate from the main flow of events. It describes exceptional conditions, error handling, or alternative paths that can occur during the execution of the use case.

i. Use Case: Sign Up

Sign Up: Refers to the process by which a user creates a new account or registers for the system. The relationship of the actor and the sign up is shown above in figure 3.2

Use Case Name	**Sign Up**
Brief Description	The "Sign Up" use case describes the process by which a user creates a new account in the car booking system. This use case enables users to access the system's functionalities, make bookings, and manage their account information.

Actor	Customer
Flow of Event	➢ The user navigates to the registration page or interface of the System. ➢ The system presents a registration form with fields to input the required information, such as name, email, password, and contact details. ➢ The user enters the necessary details, ensuring all mandatory fields are filled correctly.
Pre-Condition	➢ The system is accessible and operational. ➢ The user is on the registration page or interface.
Post-Condition`	➢ The user has successfully registered and activated their account in the car booking system. ➢ The user can now log in to the system using their registered email and password. ➢ The system stores the user's account information for future reference and access.
Exception Condition	If the email address is already associated with an existing account: ➢ The system displays an error message indicating that the email address is already registered. The user is prompted

	to use a different email address or recover their existing account if necessary.

Table 3.1: Sign Up Use Case Description

ii. Use Case: Login

Login: This use case represents the process by which a user and admin gains access to their account within the system. The relationship of the actor and the Login is shown above in figure 3.2

Use Case Name	**Login**
Brief Description	The "Login" use case describes the process by which a user accesses the car booking system by providing their registered email and password. This use case allows users to authenticate themselves and gain access to the system's functionalities.
Actor	Customer, Admin
Flow of Event	➢ The user navigates to the login page or interface of the system. ➢ The system presents a login form with fields to input the user's registered email and password. ➢ The user enters their email and password in the respective fields. ➢ The user submits the login form. ➢ The system verifies the provided email and password combination against the stored user account information. ➢ If the email and password combination is valid, the system authenticates the user and grants access to the system's

	functionalities. ➢ The system directs the user to the system's main dashboard or the previously accessed page.
Pre-Condition	➢ The system is accessible and operational. ➢ The user is registered and has a valid account in the system.
Post-Condition`	➢ The user has successfully logged into the car booking system. ➢ The user gains access to the system's functionalities based on their assigned roles and permissions. ➢ The system establishes the user's session and maintains their authenticated state throughout their interaction with the system.
Exception Condition	If the email and password combination is invalid: ➢ The system displays an error message indicating that the provided credentials are incorrect. The user is prompted to enter the correct email and password combination or initiate the password recovery process.

Table 3.2: Login Use Case Description

iii. Use Case: Reserve Seat

User Case: This use case represents the process by which a user reserve seat within the system. The relationship of the actor and the Reserve Seat is shown above in figure 3.2

Use Case Name	**Reserve Seat**
Brief Description	The "Reserve Seat" use case describes the process by which a user reserves a seat in the system after selecting it. This use case enables users to secure a specific seat for their desired trip and proceed with the booking process.
Actor	Customer
Flow of Event	➢ The user has already performed the "Search Seat" use case and selected a seat from the available options. ➢ The user proceeds to the reservation step in the car booking system. ➢ The system displays a reservation summary, including details of the selected seat, trip information, price, and any additional relevant information. ➢ The user reviews the reservation details and ensures they are accurate and aligned with their requirements. ➢ The user confirms the seat reservation by clicking a "Reserve" or similar button. ➢ The system validates the reservation request, checking for seat availability and ensuring that the selected seat has not been reserved by another user in the meantime. ➢ If the seat is still available, the system marks the seat as reserved and

	associates it with the user's booking. ➢ The system generates a reservation confirmation, including a unique reservation identifier, and provides it to the user for reference. ➢ The system updates the user's booking or reservation record with the relevant information, including the reserved seat and associated trip details.
Pre-Condition	➢ The user is logged into the system. ➢ The user has searched and selected a seat that is available for reservation.
Post-Condition`	➢ The user has successfully reserved the selected seat in the car booking system. ➢ The seat is marked as reserved and associated with the user's booking record. ➢ The system updates the seat inventory and booking records to reflect the reservation status.
Exception Condition	If the selected seat is no longer available for reservation: ➢ The system displays an appropriate error message indicating that the seat has been reserved by another user or is no longer available. The user can choose to select a different seat or modify their

	search criteria.

Table 3.3: Reserve Seat Use Case Description

v. Use Case: Payment of Seat

Payment of Seat: This use case represents the process by which a user makes payment of seat within the system. The relationship of the actor and the Payment of Seat is shown above in figure 3.2

Use Case Name	**Payment of Seat**
Brief Description	The "Payment of Seat" use case describes the process by which a user makes a payment for the reserved seat in the system. This use case enables users to complete the financial transaction and secure their reservation. Two scenarios are covered: e-payment (online payment) and manual payment.
Actor	Customer, Payment Gateway
Flow of Event	➢ The user selects the "Payment" or similar option to initiate the payment process for the reserved seat. ➢ The system displays the payment options and prompts the user to select the e-payment method. ➢ The user chooses the desired e-payment option (e.g., credit card, debit card, online wallet). ➢ The system redirects the user to the selected payment gateway for secure transaction processing. ➢ The user provides the necessary payment details (e.g., card number, CVV, expiration date) and any additional

	authentication required by the payment gateway. ➢ The payment gateway validates the payment information and processes the transaction. ➢ The payment gateway sends a payment confirmation message to the car booking system, indicating the success or failure of the transaction. ➢ If the payment is successful, the system updates the user's booking record to indicate the completed payment and confirms the seat reservation. ➢ The system generates a payment receipt or confirmation, providing it to the user as proof of payment and reservation.
Pre-Condition	➢ The user has successfully reserved a seat in the car booking system. ➢ The user is logged into the car booking system.
Post-Condition`	➢ The user has successfully made the payment for the reserved seat in the car booking system. ➢ The payment information is securely processed and recorded. ➢ The user's booking record is updated to reflect the completed payment and

	confirmed reservation. ➢ The system generates a payment receipt or confirmation, providing it to the user.
Exception Condition	➢ The user selects the "Payment" or similar option to initiate the payment process for the reserved seat. ➢ The system displays the payment options and prompts the user to select the manual payment method (e.g., cash, bank transfer). ➢ The user chooses the manual payment option. ➢ The system provides instructions to the user regarding the manual payment process, such as bank account details or payment location. ➢ The user performs the manual payment using the chosen method. ➢ The user informs the system about the completed manual payment by entering the payment details or notifying the system through a designated channel. ➢ The system verifies the manual payment details provided by the user. ➢ If the payment verification is successful, the system updates the user's booking record to indicate the completed

	payment and confirms the seat reservation. ➢ The system generates a payment receipt or confirmation, providing it to the user as proof of payment and reservation.

Table 3.4: Payment of Seat Use Case Description

v. Use Case: Add Vehicle

Add Vehicle: This use case represents the process by which admin add vehicle in the system. The relationship of the actor and the Add Vehicle is shown above in figure 3.2

Use Case Name	**Add Vehicle**
Brief Description	The "Add Vehicle" use case describes the process by which an administrator or authorized user adds a new vehicle to the system. This use case enables the system to expand its inventory of available vehicles, allowing users to select and book from a wider range of options.
Actor	Admin
Flow of Event	➢ The administrator or authorized user accesses the "Add Vehicle" functionality within the car booking system. ➢ The system presents a form or interface to capture the details of the new vehicle. ➢ The administrator or authorized user enters the necessary information about the vehicle, such as make, model, year, seating capacity, features, and any additional relevant details. ➢ The user submits the form or confirms the addition of the new vehicle.

	➢ The system validates the entered information, checking for any errors or missing required fields. ➢ If there are validation errors, the system displays appropriate error messages indicating the necessary corrections. ➢ Once the information is valid and complete, the system adds the new vehicle to the car booking system's inventory. ➢ The system assigns a unique identifier to the vehicle, allowing it to be uniquely identified and tracked within the system. ➢ The vehicle becomes available for users to search, select, and book.
Pre-Condition	➢ The user is logged into the car booking system with administrative or authorized access. ➢ The system is accessible and operational.
Post-Condition`	The new vehicle is successfully added to the car booking system's inventory. ➢ The vehicle is assigned a unique identifier and becomes available for users to search, select, and book.
Exception Condition	If the entered vehicle information conflicts with an existing vehicle:

	➢ The system displays an error message indicating that a vehicle with similar details already exists. The administrator or authorized user is prompted to review and modify the entered information to ensure its uniqueness.

Table 3.5: Add Vehicle Use Case Description

vi. Use Case: Add Driver

Add Driver: This use case represents the process by which admin add driver to the system. The relationship of the actor and the Add Driver is shown above in figure 3.2

Use Case Name	**Add Driver**
Brief Description	The "Add Driver" use case describes the process by which an administrator or authorized user adds a new driver to the system. This use case enables the system to manage and track drivers associated with the vehicles in the system's fleet.
Actor	Admin
Flow of Event	➢ The administrator or authorized user accesses the "Add Driver" functionality within the car booking system. ➢ The system presents a form or interface to capture the details of the new driver. ➢ The administrator or authorized user enters the necessary information about the driver, such as name, contact details, license information, and any additional relevant details. ➢ The user submits the form or confirms the addition of the new driver.

	➢ The system validates the entered information, checking for any errors or missing required fields. ➢ If there are validation errors, the system displays appropriate error messages indicating the necessary corrections. ➢ Once the information is valid and complete, the system adds the new driver to the car booking system's driver database. ➢ The system assigns a unique identifier to the driver, allowing them to be uniquely identified and associated with the appropriate vehicles. ➢ The driver becomes available for assignment to specific vehicles within the system's fleet.
Pre-Condition	➢ The user is logged into the car booking system with administrative or authorized access. ➢ The car booking system is accessible and operational.
Post-Condition`	➢ The new driver is successfully added to the car booking system's driver database. ➢ The driver is assigned a unique identifier and becomes available for assignment to

	vehicles within the system's fleet.
Exception Condition	If the entered driver information conflicts with an existing driver: ➢ The system displays an error message indicating that a driver with similar details already exists. The administrator or authorized user is prompted to review and modify the entered information to ensure its uniqueness.

Table 3.6: Add Vehicle Use Case Description

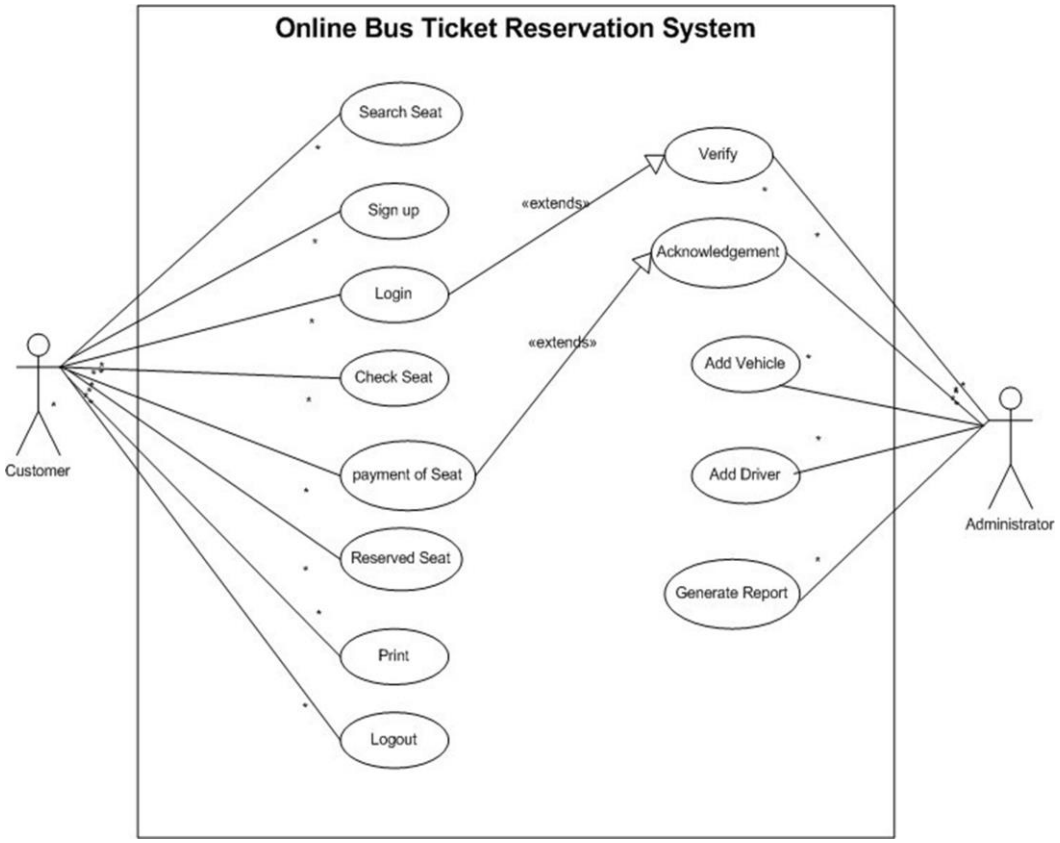


Figure 3.3 Use Case

1.3.2 Data Flow Diagram

The data flow diagram (DFD) is represented by a graphic "flow" of data through the information system, modeling its process processes. DFD indicates what type of information will be entered and exited from the system, where the data will go in and out, and where the data will be stored. Deal

development of DFD'S is done at several levels. Each process in low-level drawings may be reduced to a detailed DFD to the next level. Highquality painting is often referred to as contextual drawing. It contains a single process, which plays a key role in studying the current system. The process in graphic content level exploded into another process at the first level of DFD. Figures 3.2 to 3.4 show a diagram of the flow of data about the system

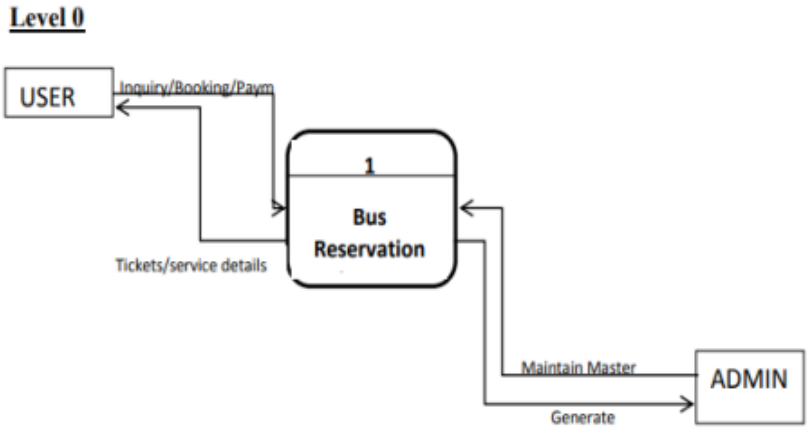


Figure 3.4 Context View of the System

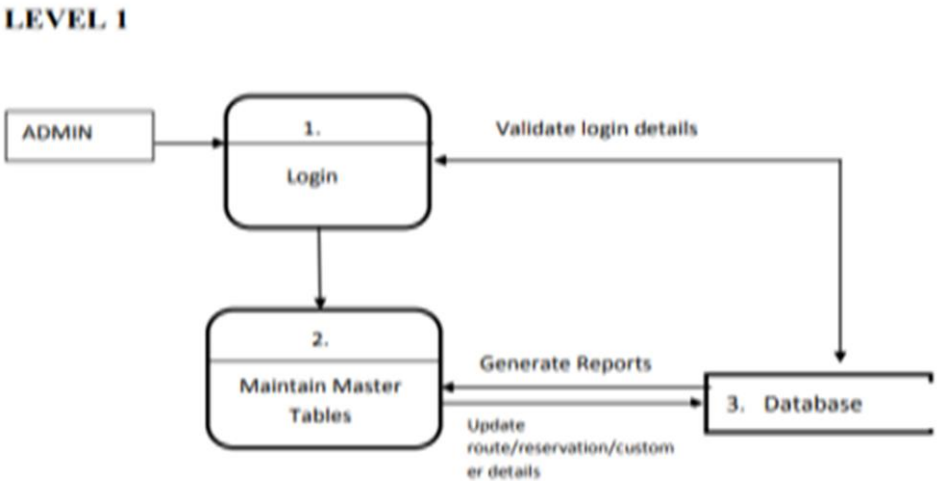


Figure 3.5 Context View of the System

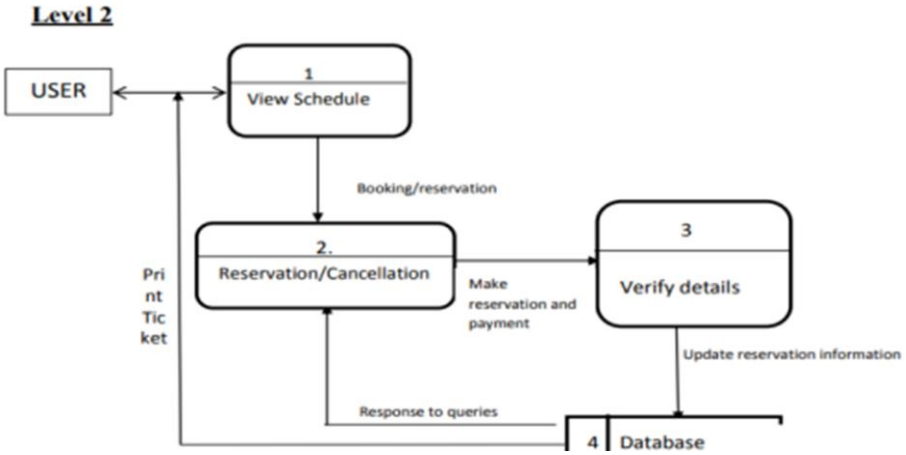


Figure 3.6 Context View of the System

3.4 Database Schema

i. Users Table

User Table: Refers to a table field of User in Database Scheme, the table is shown below in Table 3.7

S/N	Field Name	Data Type
1.	Users_id(Primary key)	Int
2.	Name	Text
3.	Email	Text
4.	Phone Number	Int
5.	Password	Text
6.	Address	Text

Table 3.7: Users Table

ii. Vehicle Table

Vehicle Table: Refers to a table field of Vehicle in Database Scheme, the table is shown below in Table 3.8

S/N	Field Name	Data Type
1.	Vehicle_id(Primary key)	Int
2.	Name	Text
3.	Model	Text
4.	Year	Int
5.	Seating capacity	Int
6.	Vehicle type	Text
7.	Availability Status	Enum: "Available", "Booked", "Unavailable"

Table 3.8: Vehicle Table

ii. Booking Table

Booking Table: Refers to a table field of Booking in Database Scheme, the table is shown below in Table 3.8

S/N	Field Name	Data Type
1.	Booking_id(Primary key)	Int
2.	User_id(Foreign key referencing Users) table	Int
3.	Vehicle_id (Foreign Key referencing Vehicles)	Int
4.	Pickoff location	Text
5.	Drop-off Location	Text
6.	Pickoff Datetime	Datetime

7.	Drop-off Datetime	Datetime
8.	Fee	Float
9.	Booking_status	Enum: "Pending", "Confirmed", "Cancelled"

Table 3.8: Booking Table

iii. Drivers Table

Driver Table: Refers to a table field of Drivers in Database Scheme, the table is shown below in Table 3.9

S/N	Field Name	Data Type
1.	Driver_id(Primary key)	Int
2.	Name	Text
3.	Phone Number	Int
4.	Driving licenses	Text

Table 3.9: Drivers Table

3.4.1 Relationships:

a) Each User can have multiple Bookings (One-to-Many relationship: Users to Bookings).

b) Each Vehicle can have multiple Bookings (One-to-Many relationship: Vehicles to Bookings).

c) Each Booking is associated with one User (Many-to-One relationship: Bookings to Users).

d) Each Booking is associated with one Vehicle (Many-to-One relationship: Bookings to Vehicles).

3.5 Summary

This chapter covered requirement engineering, agile methodology in SDLC, and specific use case descriptions for the system. It emphasized the importance of gathering and validating user requirements, following an iterative and flexible development approach, and provided use case descriptions for key functionalities.

CHAPTER 4

SYSTEM IMPLEMENTATION

4.0 Introduction

This chapter entail in system implementation process, the technologies use and the testing of the software UMTRA.

4.1 Technical Tools Used

System implementation describes the system development and testing process of the system.

Front-End Technologies: HTML, CSS, and JavaScript

- **HTML (Hypertext Markup Language):** HTML is used for structuring the content of your web pages, defining headings, paragraphs, lists, forms, and other elements.
- **CSS (Cascading Style Sheets):** CSS is used for styling your web pages, controlling layout, fonts, colors, and other visual aspects.
- **JavaScript:** JavaScript is a programming language that adds interactivity and dynamic behavior to your web pages. It's used for tasks like form validation, animations, and fetching data from the server.

Back-End Framework: Php

- PHP (Hypertext Preprocessor) is a widely-used, open-source scripting language primarily designed for web development

Database: MySQL

- MySQL is a popular open-source relational database management system (RDBMS) that is commonly used in web development.

Integrated Development Environment (IDE): Visual Studio Code (VSCode)

- VSCode: Visual Studio Code is a popular code editor with extensive support for various programming languages, including HTML, CSS, JavaScript, and Python. It offers features like syntax highlighting, code completion, debugging, and integration with version control systems.

4.1.1 Home Page

This is the first page that appears to users on contact with the application. It allows users to navigate the application. The image is shown in (Appendix A 1).

4.1.2 Login Page

This page requires the user's user name and password to enable them access their dashboard.

It also consists of the register button. The image is shown in (Appendix A 1I).

4.1.3 Register Page

This enables new users to register by inputting their required information. The image is shown in (Appendix A 1II).

4.1.4 User Dashboard

This page shows available car and their destination, book ticket etc. The image is shown in (Appendix A 1V).

4.1.5 Admin Dashboard

This page shows where admin can manage users, add car and destination etc. The image is shown in (Appendix A 1V).

4.2 System Testing

In this phase the functionalities of the system are tested in order to judge if the system doing what it is meant to do on clicking relevant buttons. The activities to be carried out are listed in the table 4.9 below;

TEST ID	FUNCTION	DESCRIPTION	EXPECTED RESULT	ACTUAL RESULT	STATUS
1	User Signup	Test user registration functionality.	New user is registered.	New user registered.	Passed
2	User Login	Test user login with valid credentials.	User successfully logged in.	User logged in.	Passed
3	User Login	Test user login with invalid credentials.	Error message displayed.	Error message displayed.	Passed

4	Bus Search	Test searching for available buses.	List of buses displayed.	List of buses displayed.	Passed
5	Seat Select	Test selecting available seats for booking.	Seats are marked as booked.	Seats booked successfully.	Passed
6	Payment	Test successful payment process.	Payment confirmation shown.	Payment successful.	Passed
7	Seat Select	Test selecting already booked seats.	Error message displayed.	Error message displayed.	Passed
8	Booking	Test booking confirmation after payment.	Booking confirmed.	Booking confirmed.	Passed
9	Ticket	Ticket Generating	Ticket Generated	Ticket Generated	Passed
10	User Logout	Test user logout functionality.	User is logged out.	User logged out.	Passed
11	Route Search	Test searching for a specific bus route.	Route details displayed.	Route details displayed.	Passed
12	Admin Login	Test admin login with valid credentials.	Admin successfully logged in.	Admin logged in.	Passed
13	Admin Add Bus	Test adding a new bus by the admin.	New bus added.	New bus added.	Passed
14	Admin Edit Bus	Test editing bus details by the admin.	Bus details updated.	Bus details updated.	Passed
15	Admin Delete Bus	Test deleting a bus by the admin.	Bus is removed from the list.	Bus is removed.	Passed

Table 3.10: Testing Table

4.3 Software Requirements:

Operating System:

- The system should be compatible with various operating systems, such as Windows,

macOS, and Linux.

Web Browsers:

- The system should work seamlessly on popular web browsers like Google Chrome, Mozilla Firefox, Safari, and Microsoft Edge.

Backend Framework:

- The system utilizes the Php to handle backend functionalities.

Database Management System:

- The system is integrated with SQLite as the backend database management system.

Development Tools:

- The system developers use tools like Python for backend programming, HTML/CSS/JavaScript for front-end development, and Visual Studio Code as the integrated development environment (IDE).

Version Control:

- The development team uses Git for version control to manage code changes effectively.

Security Tools:

- The system should integrate security tools for encryption, data protection, and vulnerability assessment.

4.3.1 Hardware Requirements:

Server:

- A robust server is needed to host the web application, manage user requests, and execute business logic.
- Adequate RAM, CPU, and storage resources are essential to handle concurrent user requests efficiently.

Client Devices:

- The system should be accessible from various client devices, including desktops, laptops, tablets, and smartphones.

Network Infrastructure:

- A stable and fast internet connection is required for smooth user interactions and data exchange.
- Network security measures should be in place to protect user data during transmission.

Storage Solutions:

- Sufficient storage space is needed to accommodate the application code, database, and any media files associated with the application.

Backup and Recovery Systems

- Backup solutions are essential to prevent data loss, and recovery systems should be in place to restore the system in case of failures.

Security Measures:

- Hardware firewalls, intrusion detection systems, and antivirus solutions should be implemented to protect the server from unauthorized access and cyber threats.

4.4 System Evaluation:

The Transport Management System has successfully brought together diverse stakeholders within the automotive booking ecosystem. This integration has led to the creation of a unified platform for streamlined car reservation processes. Key participants within this ecosystem include Customers and Transport Agencies. A personalized approach was taken to gather their insights and feedback, ensuring a comprehensive evaluation.

4.4.1 Customers:

User feedback revealed that the system's interface is user-friendly and facilitates seamless interactions. This significantly simplifies the car booking process, enhancing the overall experience for customers.

4.4.2 Transport Agencies:

Echoing the sentiment of the customers, Transport Agencies also expressed their satisfaction with the system's user-friendly design. This consensus highlights the success of the application's interface.

4.4.3 Feedback Collection Methodology:

A personalized feedback collection methodology was adopted to engage directly with Customers and Transport Agencies. These direct interactions provided valuable insights into their experiences, preferences, and recommendations for enhancements.

4.4.4 Performance and Efficiency:

Comprehensive performance tests were conducted to ensure that the application performs efficiently under various scenarios. Key metrics, such as response times, data processing speed, and resource allocation, were rigorously evaluated to guarantee optimal performance.

4.4.5 Security and Data Integrity:

The system underwent rigorous security assessments to ensure the safeguarding of sensitive user data. Robust security measures, including data encryption and access controls, were implemented to ensure the confidentiality and integrity of user information.

4.4.6 Usability Testing:

Representative users participated in usability testing sessions, assessing the application's interface, navigation flow, and overall user experience. Insights gained from these tests were instrumental in refining the user journey.

4.4.7 Compatibility and Scalability:

The application's compatibility across devices, browsers, and platforms was thoroughly evaluated. Additionally, its scalability was tested to ensure it can accommodate a growing user base while maintaining optimal performance.

4.4.8 Future Enhancement Recommendations:

The system evaluation process highlighted potential avenues for improvement. These include exploring additional features to enhance user experiences and consistently monitoring and updating the system to ensure sustained performance and relevance.

4.4.9 Stakeholder Engagement:

Stakeholder involvement, including project advisors, mentors, and potential users, played a pivotal role in the evaluation process. Their valuable insights and feedback contributed to the system's refinement.

4.4.10 Evaluation Report:

A comprehensive evaluation report was compiled, encompassing all findings, feedback, and recommendations. This report serves as a testament to the application's achievements and provides a roadmap for its ongoing development and growth.

4.5 Chapter Summary:

Chapter 4 covers the Car Booking System's implementation using various tools, successful testing, and adherence to software and hardware requirements. It also evaluates the system's performance, security, and user-friendliness, while providing recommendations for future enhancements.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATION

5.0 Introduction

Chapter Five of this project provides a comprehensive overview of the journey undertaken, highlighting the key aspects discussed throughout the previous chapters. This chapter encapsulates the core findings, conclusions, and recommendations drawn from the project's implementation and evaluation phases. It aims to offer readers a holistic understanding of the project's significance and potential avenues for future exploration.

5.1 Summary

Throughout the preceding chapters, we embarked on a journey to develop and implement the Unified Car Booking System (UMTRA). The project began by identifying the need for an efficient and user-friendly platform to streamline car reservation processes. In Chapter Two, a detailed analysis of existing systems provided valuable insights into their limitations, laying the foundation for UMTRA's development.

Chapter Three delved into the project's design phase, outlining the system's architecture, user interface, and database schema. This stage emphasized the importance of creating an intuitive user experience and an efficient backend framework. Building upon this foundation, Chapter Four presented the intricate process of system implementation. It detailed the technical tools employed, ranging from HTML, CSS, and JavaScript for frontend development to Django for backend management, while also outlining the rigorous testing conducted to ensure seamless functionality.

5.2 Conclusion

In conclusion, the Unified Car Booking System (UMTRA) represents a significant advancement in the realm of car reservation platforms. By combining a user-centric interface with robust backend infrastructure, UMTRA has successfully addressed the challenges posed by existing systems. The evaluation process underscored the system's efficiency, security, and user-friendliness, validated by positive feedback from both customers and transport agencies.

5.3 Recommendations and Future Enhancements

As we move forward, several recommendations can guide the further evolution of the Unified Car Booking System (UMTRA). Firstly, continued engagement with stakeholders, including users and transport agencies, will foster ongoing improvement. Additionally, exploring advanced security

measures, data analytics capabilities, and integration with emerging technologies could enhance the system's functionality and appeal.

In terms of future enhancements, the implementation of real-time tracking features, personalized user profiles, and integration of e-payment using card and internet banking, development of Mobile Application of the system and integration with navigation services could elevate UMTRA's utility. Moreover, expanding the system's reach to include multi-modal transportation options and international services could broaden its impact.

In closing, this project serves as a testament to the potential of innovative technology in transforming traditional processes. The Unified Car Booking System (UMTRA) not only meets current needs but also paves the way for a dynamic and responsive future in the realm of transportation services.

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APPENDICES

APPENDIX A: Pictures

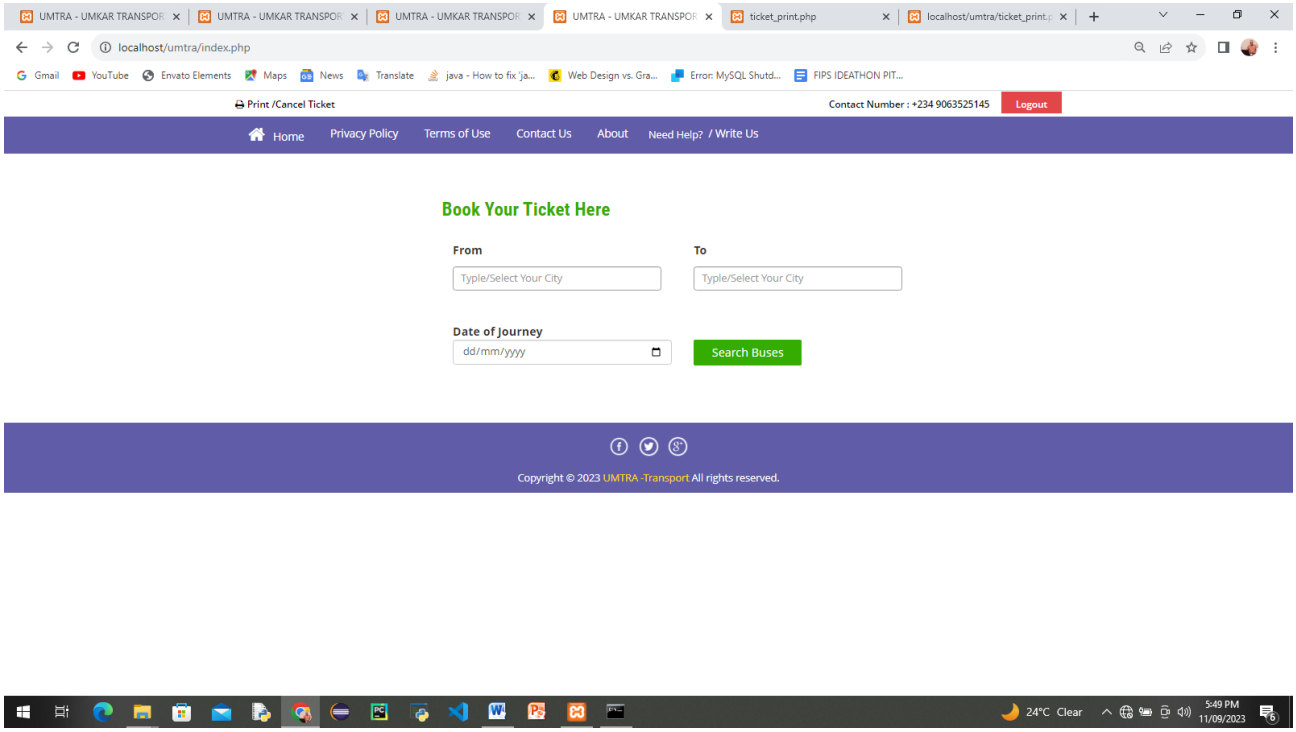

Figure A.i Home Page

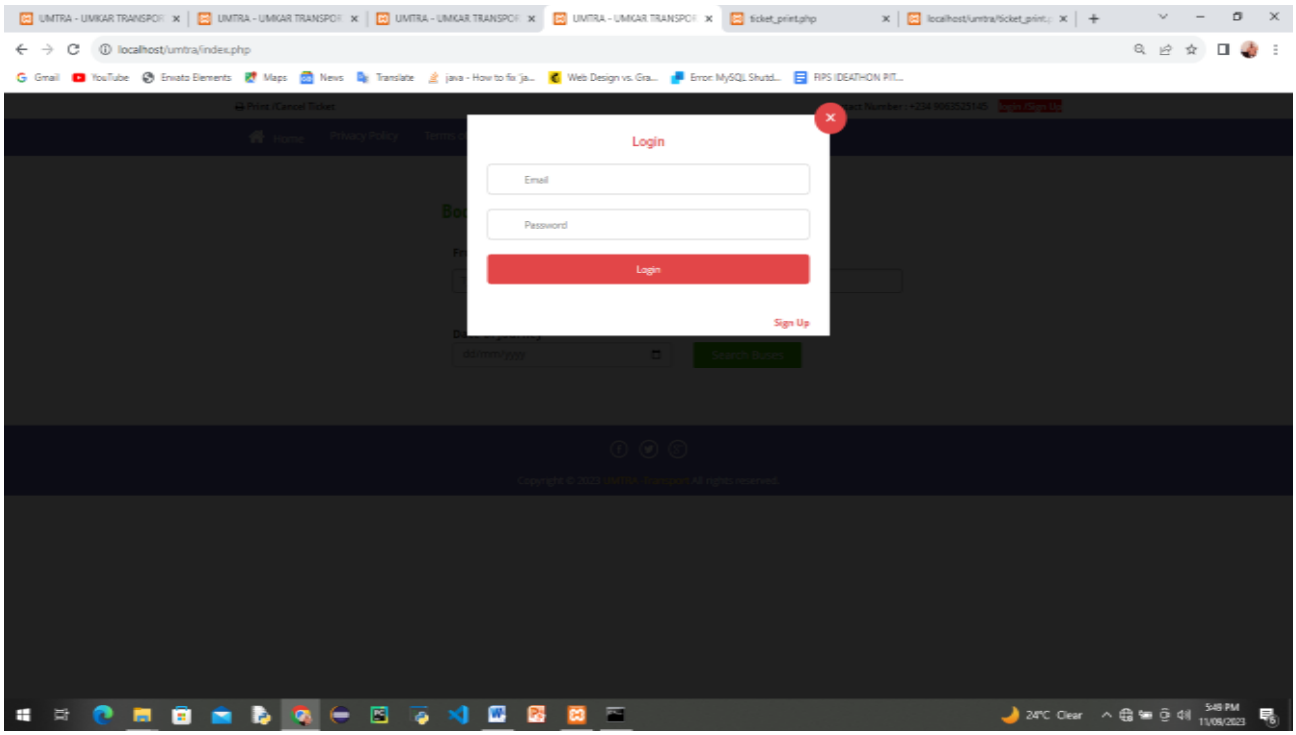

Figure A.ii Login Page

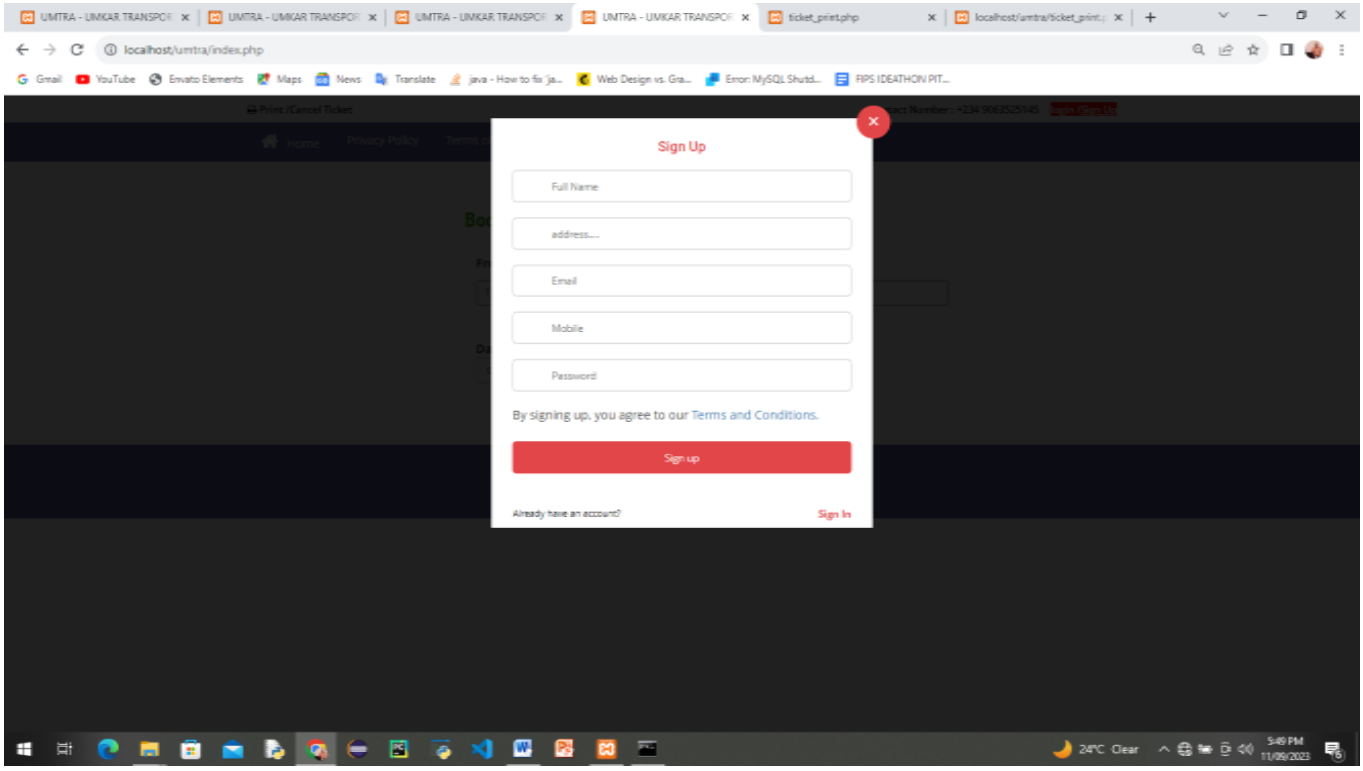

Figure A.iii Register Page

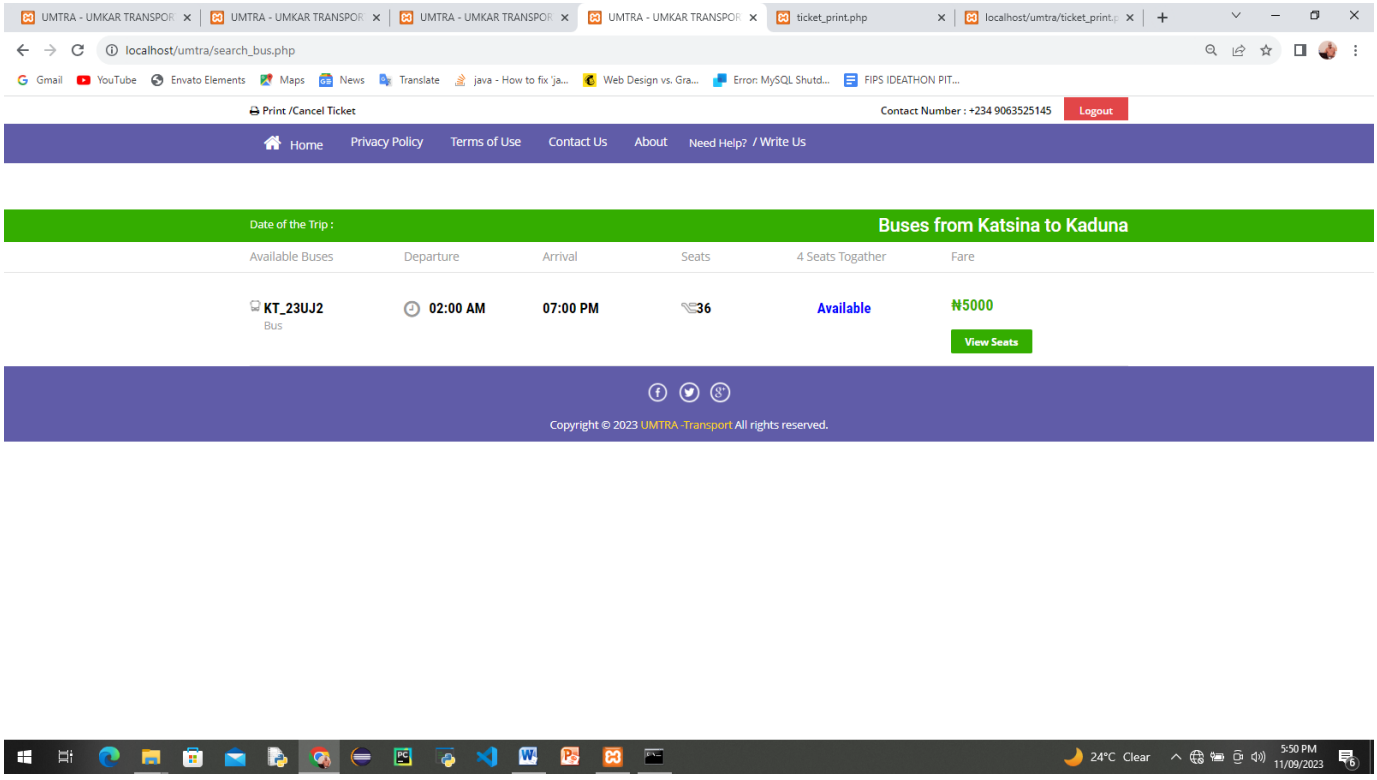

Figure A.iv User Dashboard

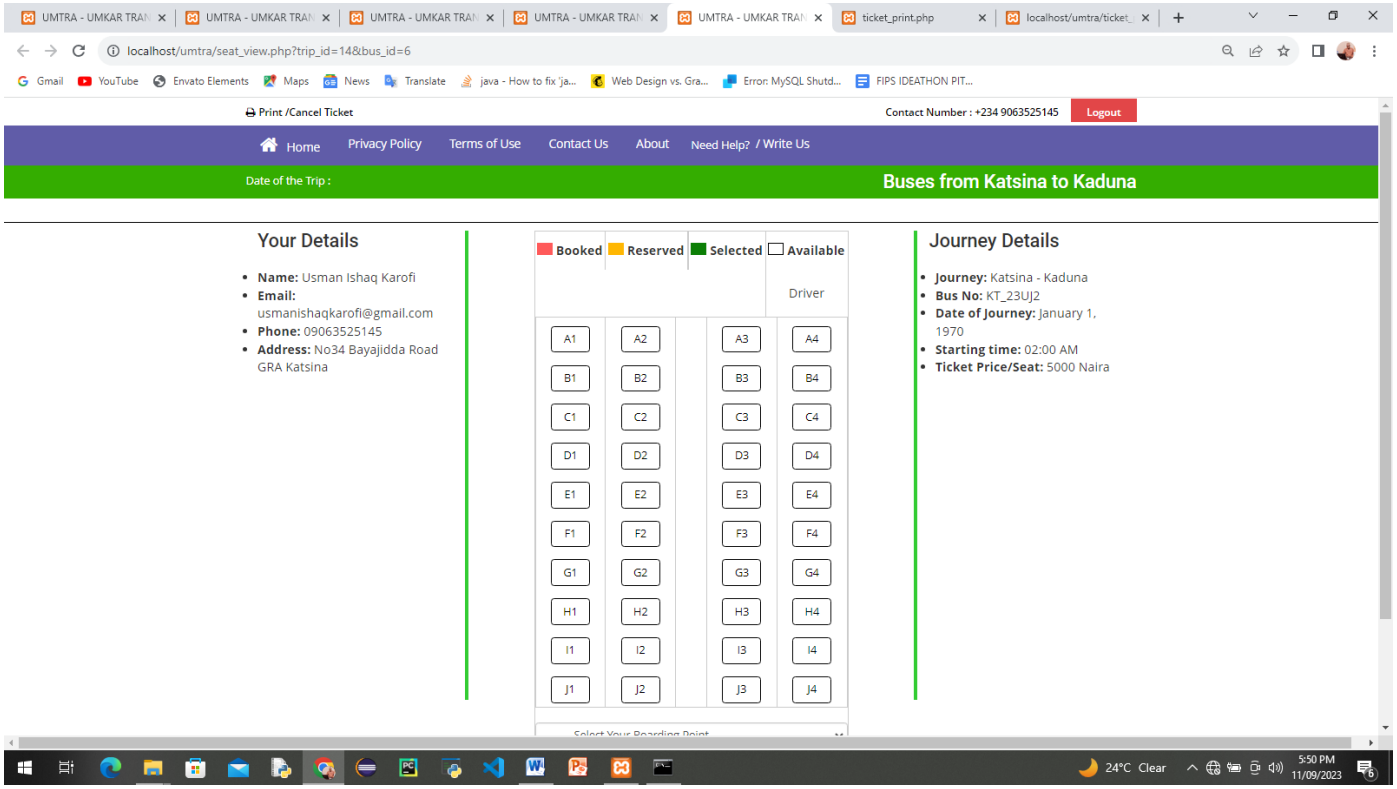

Figure A.v Booking Interface

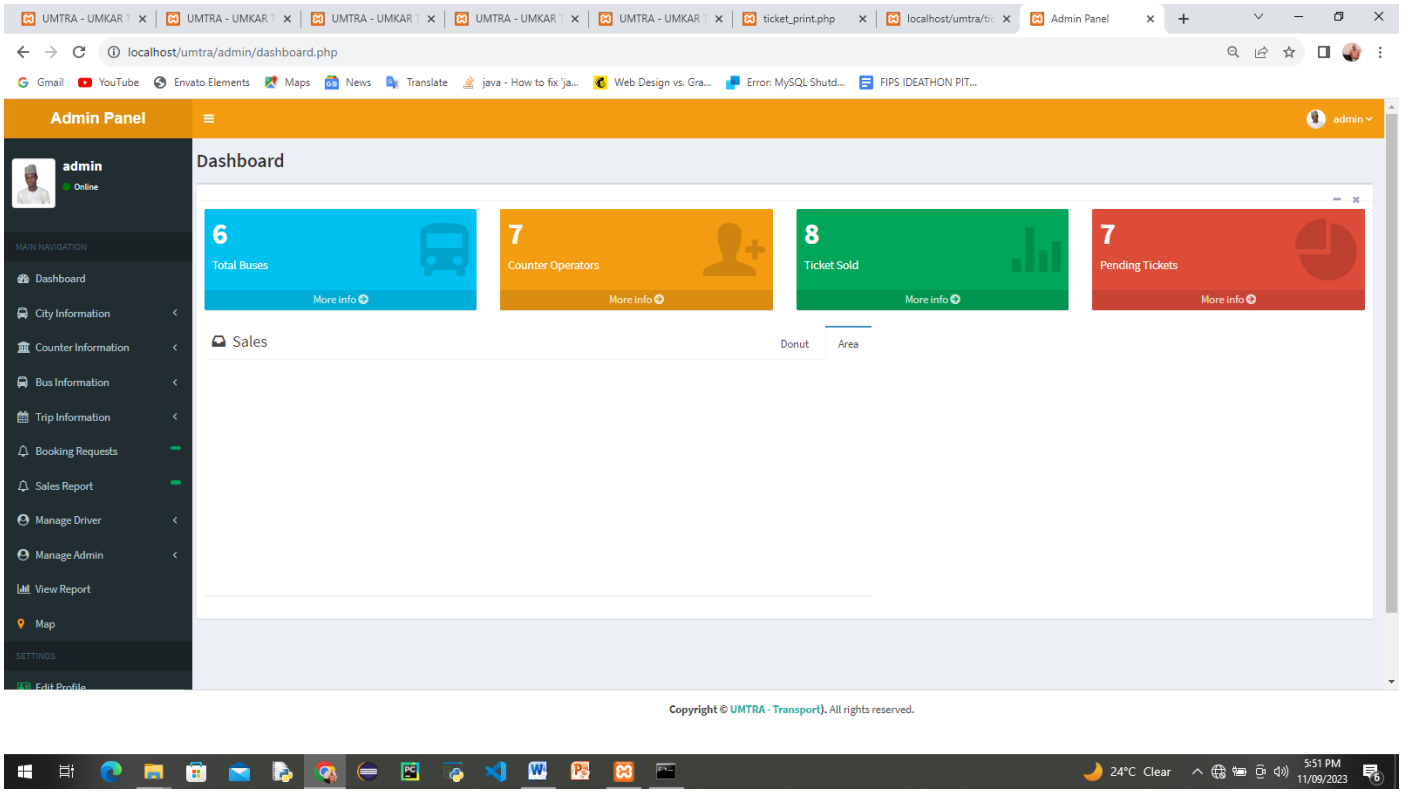

Figure A.vi Admin Dashboard

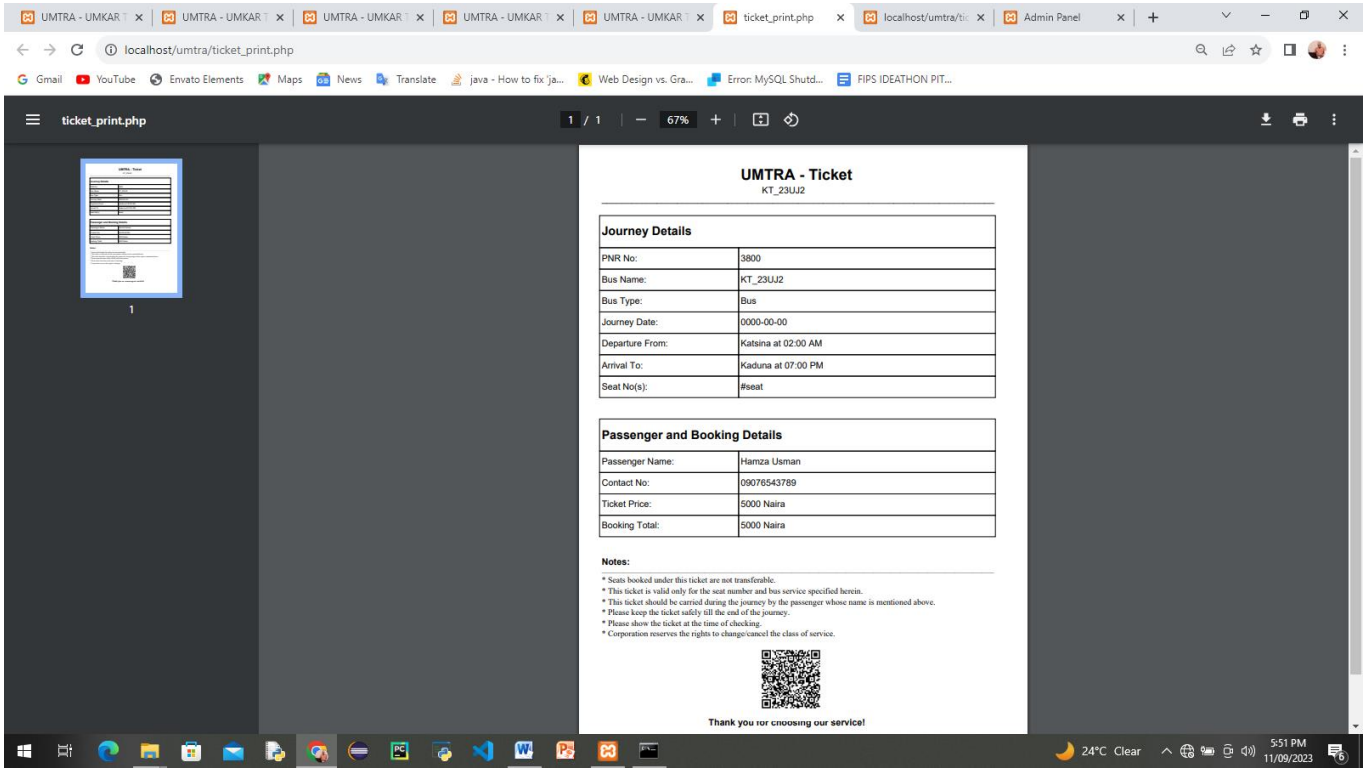

Figure A.vii Ticket Sample

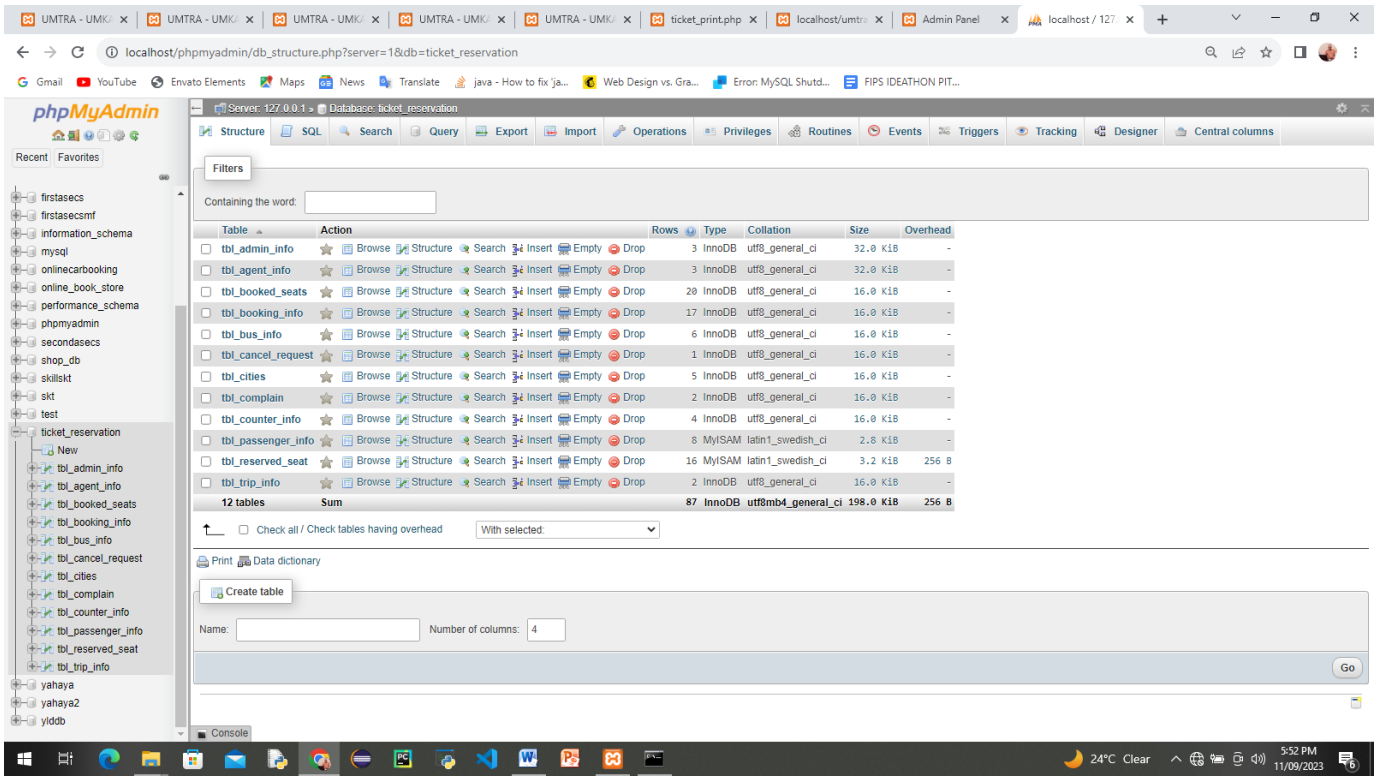

Figure A.viii Database Interface

APPENDIX B:

https://github.com/ussycoder/Umtra---Umkar-Transport-System.git