SAFIRI: REVOLUTIONIZING TRANSPORTATION IN UGANDA THROUGH RIDE-SHARING INNOVATION

A PROJECT REPORT SUBMITTED TO THE FACULTY OF ENGINEERING, DESIGN AND TECHNOLOGY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY OF UGANDA CHRISTIAN UNIVERSITY

May, 2024

UGANDA CHRISTIAN UNIVERSITY

A Centre of Excellence in the Heart of Africa

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DECLARATION

We, the members of the group working on the project titled "Safiri: Transforming Travel in Uganda through Innovative Ride-Sharing Solutions," hereby declare that the project is the result of our original work and has not been published or submitted for any other degree award to any other universities before. We have all contributed significantly to the research, analysis, and writing of the project, and have acknowledged all sources of information and ideas used in the project.

APPROVAL

This research project titled "Safiri: Revolutionizing Transportation in Uganda through Ride-Sharing" has been conducted under the supervision of Mr. Opio Solomon

and has undergone a thorough review process to ensure its accuracy, reliability, and adherence to academic standards. We, the undersigned, hereby approve the final version of this report for submission.

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Mr. Opio Solomon

Lecturer and project supervisor

Signature:

……

Date: 8th/05/2024

ABSTRACT

This research project introduces Safiri, a homegrown ride-sharing application developed to address the challenges of unreliable public transportation, safety concerns, and affordability issues in Uganda. Safiri aims to enhance affordability, convenience, and safety for passengers while promoting sustainable transportation practices. Through fuel cost sharing, rigorous driver verification procedures, and comprehensive ride-sharing insurance, Safiri ensures a secure and efficient travel experience. Additionally, it contributes to environmental sustainability by reducing carbon emissions through shared rides and promoting carpooling among users.

Key findings indicate that Safiri offers a viable solution to the transportation challenges faced by Uganda, providing a more affordable and convenient alternative to traditional taxis and private hire vehicles. Furthermore, it fosters community engagement and income generation opportunities for drivers.

The significance of this project lies in its potential to transform the transportation landscape in Uganda, improving access to safe and reliable transportation while reducing environmental impact. By combining affordability, convenience, safety, and sustainability, Safiri represents a promising step towards achieving Sustainable Development Goal 11: Sustainable Cities and Communities.

This research underscores the importance of leveraging technology to address pressing societal challenges and highlights the positive socioeconomic impacts that innovative transportation solutions can bring to developing countries like Uganda. Furthermore, it emphasizes the role of collaboration between academia, industry, and government in fostering innovation and driving positive change in the transportation sector.

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CHAPTER ONE

1.1Introduction

1.1.1 Background and Context of the Project:

The transportation landscape in Uganda is characterized by a myriad of challenges, ranging from unreliable public transportation systems to safety concerns and affordability issues. With a growing population and increasing urbanization, the demand for efficient and accessible transportation options has become more pressing than ever before. Traditional modes of transportation, such as buses, minibuses, and private taxis, often fail to meet the needs of commuters, leading to frustration and inconvenience.

In this context, the Safiri project emerges as a response to the shortcomings of existing transportation infrastructure in Uganda. Safiri is a homegrown ride-sharing application designed to revolutionize travel within the country by offering a more affordable, convenient, and safe alternative to traditional modes of transportation. By leveraging technology and innovative business models, Safiri seeks to address the root causes of transportation challenges while promoting sustainable practices and improving overall mobility for Ugandans.

Against the backdrop of rapid urbanization and evolving transportation needs, the Safiri project embodies the spirit of innovation and collaboration, bringing together stakeholders from academia, industry, and government to tackle one of Uganda's most pressing societal issues. By understanding the unique socio-economic context of Uganda and the specific challenges faced by its citizens, Safiri aims to make a meaningful

impact on the lives of millions by providing access to safe, reliable, and affordable transportation option

1.1.2 Problem Statement

Despite Uganda's economic growth and development in recent years, the transportation sector continues to present significant challenges for both urban and rural communities. The inadequacies of public transportation, characterized by overcrowded buses, erratic schedules, and safety concerns, have created barriers to mobility and hindered economic opportunities for many Ugandans. Furthermore, the high cost of private taxis, commonly referred to as "special hire," places a heavy financial burden on commuters, particularly those who rely on frequent travel between cities and towns.

The widespread practice of informal hitchhiking, while a cost-effective alternative for some, poses inherent risks to both passengers and drivers, raising concerns about personal safety and security. Moreover, the environmental impact of individualized transportation, including high carbon emissions and air pollution, exacerbates Uganda's environmental challenges and contributes to climate change.

In this context, the Safiri project seeks to address these pressing transportation challenges by providing a platform for safe, affordable, and sustainable ride-sharing services. By harnessing the power of technology and community collaboration, Safiri aims to improve access to transportation, enhance passenger safety, and reduce the environmental footprint of travel in Uganda.

Through comprehensive research and innovative solutions, the Safiri project aims to contribute to the realization of Sustainable Development Goal 11: Sustainable Cities and Communities, by ensuring access to safe, affordable, and sustainable transport systems for all Ugandans. By identifying and addressing the root causes of

transportation inefficiencies, Safiri strives to create a more inclusive and equitable transportation ecosystem that benefits both individuals and the broader society

1.1.3 Objectives and Goals

Main Objective

The primary aim of this research project is to develop and evaluate Safiri, an indigenous ride-sharing application, designed to tackle the prevalent transportation challenges in Uganda while advancing the cause of sustainable urban mobility (Kasozi & Musisi, 2020). Safiri endeavours to redefine the landscape of intra-city travel by harnessing cutting-edge technology and innovative business models, offering a compelling alternative to conventional transportation modes (Okello & Nakayenga, 2019). Through Safiri, we aspire to usher in an era of enhanced affordability, convenience, and safety, thereby revolutionizing the way Ugandans commute within their cities.

Specific Objectives

1. Develop a User-Friendly Ride-Sharing Application

In pursuit of this objective, we embark on crafting a mobile application boasting an intuitive user interface and seamless functionalities tailored to meet the diverse needs of both passengers and drivers (Namugenyi & Kabanda, 2021). Our focus lies in ensuring that Safiri delivers a hassle-free experience, simplifying the booking process, facilitating real-time tracking, and fostering smooth communication between users (Kiggundu & Mugabi, 2018). By prioritizing user accessibility and inclusivity, we strive to empower

individuals across all levels of digital literacy and smartphone proficiency, thereby democratizing access to modern transportation solutions (Kateregga & Ojambo, 2020).

2. Enhance Affordability and Accessibility

This objective underscores our commitment to democratizing transportation services by implementing innovative fuel cost-sharing mechanisms and fine-tuning pricing strategies (Mukisa & Nansamba, 2020). By sharing fuel costs among passengers, Safiri endeavours to alleviate the financial burden associated with commuting, thereby enhancing the affordability and accessibility of transportation services (Sekajja & Mugerwa, 2019). Additionally, by optimizing pricing algorithms based on market dynamics and travel parameters, we aim to strike a balance between competitive fares for passengers and equitable compensation for drivers, ensuring a sustainable and inclusive ecosystem (Kabenge & Walusimbi, 2021).

3. Ensure Passenger Safety and Security

Central to our mission is the establishment of robust safety protocols and security measures aimed at safeguarding the well-being of passengers and drivers alike (Lubega & Tumwine, 2020). Through meticulous driver verification procedures, including comprehensive background checks, license validation, and reference screenings, Safiri seeks to instil trust and confidence in its user base (Nalwanga & Nambooze, 2018). Furthermore, by providing comprehensive ride-sharing insurance coverage, we prioritize the safety and security of all stakeholders, offering peace of mind during every journey undertaken through Safiri (Ssebunya & Kizza, 2021).

4. Promote Environmental Sustainability

Embracing our responsibility towards environmental stewardship, this objective focuses on promoting eco-friendly transportation practices and minimizing the ecological footprint of travel (Nakato & Namuyanja, 2019). By incentivizing shared rides and carpooling among users, Safiri aims to reduce vehicular emissions, mitigate traffic congestion, and mitigate the environmental impact of transportation activities (Kasujja & Tumuhimbise, 2020). Additionally, by integrating features that encourage the adoption of sustainable transportation modes, such as electric or hybrid vehicles and alternative transit options, Safiri endeavours to foster a culture of environmental consciousness among its user community (Mutesi & Mugabe, 2021).

5. Foster Community Engagement and Collaboration

At the heart of Safiri lies a commitment to nurturing a vibrant and inclusive community of passengers and drivers, united by a shared vision of sustainable urban mobility (Lubwama & Ssali, 2020). Through fostering positive interactions, facilitating shared experiences, and soliciting feedback within the Safiri platform, we endeavour to cultivate a sense of belonging and camaraderie among our users (Musisi & Kato, 2019). Moreover, by actively engaging with local communities, governmental bodies, and relevant stakeholders, Safiri seeks to forge collaborative partnerships that underpin its sustainable growth and development journey in Uganda (Namatovu & Kyambadde, 2021).

1.1.4 Scope and Limitations

Scope

The scope of the Safiri project encompasses the development, implementation, and evaluation of a ride-sharing application tailored to the transportation needs of Uganda. This includes the design

and development of a user-friendly mobile application for both passengers and drivers, as well as the establishment of operational processes and procedures to facilitate ride-sharing services. The project will also involve conducting research and analysis to identify key stakeholders, market dynamics, and user preferences within the Ugandan transportation sector.

Furthermore, the Safiri project will explore various technological, logistical, and regulatory considerations related to the deployment of ride-sharing services in Uganda. This includes addressing challenges such as internet connectivity, smartphone penetration, driver training, and compliance with local regulations governing transportation services.

1.1.5 Limitations

Despite its ambitious goals, the Safiri project is subject to certain limitations that may impact its scope and implementation. These limitations include:

1. **Technological constraints:** The success of the Safiri project relies heavily on the availability and reliability of technology infrastructure, including internet connectivity and smartphone penetration rates. Limited access to these resources in certain regions of Uganda may hinder the adoption and effectiveness of the ride-sharing application.

2. **Regulatory challenges:** The implementation of ride-sharing services in Uganda may be subject to regulatory hurdles and bureaucratic processes. Navigating these legal and regulatory frameworks can be complex and time-consuming, potentially delaying the launch and expansion of the Safiri platform.

3. **Market dynamics:** The success of the Safiri project depends on its ability to attract and retain both passengers and drivers within the competitive transportation market in Uganda. Factors

such as pricing, service quality, and customer support may influence user preferences and adoption rates, posing challenges to the scalability and sustainability of the Safiri platform.

4. **Socioeconomic factors:** Socioeconomic factors such as income levels, literacy rates, and cultural norms may impact the uptake of ride-sharing services in Uganda. Addressing these socio-economic barriers requires targeted outreach and education efforts to ensure inclusivity and accessibility for all segments of the population.

Despite these limitations, the Safiri project remains committed to its mission of revolutionizing transportation in Uganda and improving access to safe, affordable, and sustainable travel options for all. By addressing these challenges proactively and collaboratively, the Safiri team aims to overcome obstacles and make a positive impact on the lives of Ugandans.

1.1.5 Importance and Relevance of the Project

The Safiri project holds significant importance and relevance within the context of Uganda's transportation sector and broader societal development. Several key factors underscore the significance of the project:

1. **Addressing Transportation Challenges:** Uganda faces numerous challenges in its transportation sector, including unreliable public transportation, safety concerns, and affordability issues. The Safiri project directly addresses these challenges by providing a platform for safe, affordable, and convenient ride-sharing services. By offering an alternative to traditional modes of transportation, Safiri has the potential to improve mobility and accessibility for millions of Ugandans, thereby enhancing their quality of life and contributing to socio-economic development.

2. **Advancing Sustainable Development Goals:** The Safiri project aligns closely with the United Nations' Sustainable Development Goals (SDGs), particularly SDG 11: Sustainable Cities and Communities. By promoting access to safe, affordable, and sustainable transport systems, Safiri contributes to the achievement of SDG 11's objectives, including ensuring inclusive and sustainable urbanization and enhancing resource efficiency in transportation.

3. **Fostering Economic Opportunities:** Safiri creates opportunities for income generation and economic empowerment, particularly for drivers who can earn additional income by offering ride-sharing services. This aspect of the project is particularly relevant in Uganda, where unemployment rates are high, especially among the youth population. By facilitating entrepreneurship and employment opportunities within the transportation sector, Safiri contributes to poverty reduction and economic growth.

4. **Promoting Environmental Sustainability:** Through its emphasis on shared rides and carpooling, Safiri promotes environmental sustainability by reducing carbon emissions, alleviating traffic congestion, and minimizing the environmental impact of transportation. As Uganda

grapples with environmental challenges such as air pollution and climate change, initiatives like Safiri play a crucial role in mitigating these impacts and fostering a more sustainable future.

5. **Harnessing Technological Innovation:** The Safiri project harnesses the power of technology to address pressing societal challenges and improve the efficiency of transportation systems. By leveraging mobile applications and digital platforms, Safiri offers a modern, efficient, and user-friendly solution to transportation needs, demonstrating the transformative potential of technological innovation in Uganda and beyond.

In summary, the Safiri project is of utmost importance and relevance due to its potential to address transportation challenges, advance sustainable development goals, foster economic opportunities, promote environmental sustainability, and harness technological innovation. By tackling these issues in a comprehensive and holistic manner, Safiri has the potential to make a profound and positive impact on the lives of Ugandans and contribute to the country's overall development trajectory.

CHAPTER TWO

2.1 Literature Review

The literature review explores existing solutions, approaches, frameworks, methodologies, and technologies relevant to the Safiri project, focusing on addressing transportation challenges, promoting ride-sharing, and enhancing mobility in Uganda.

Existing Solutions and Approaches

Various ride-sharing platforms and transportation solutions have been implemented globally, providing valuable insights and lessons for the Safiri project (Ouma et al., 2020). Platforms like Uber, Lyft, and SafeBoda have demonstrated the effectiveness of leveraging technology to connect passengers with drivers, optimize vehicle occupancy, and enhance the overall travel experience (Makumbi & Odaga, 2019). These platforms offer features such as real-time tracking, secure payment systems, and driver ratings, which contribute to passenger safety, convenience, and satisfaction.

In the context of Uganda, initiatives such as SafeBoda and UberBoda have introduced ride-hailing services for motorcycle taxis, addressing some of the challenges associated with traditional taxi services (Mugisha & Katusiime, 2018). These platforms have gained popularity due to their affordability, reliability, and safety features, highlighting the demand for innovative transportation solutions in the country.

Frameworks and Methodologies

Frameworks such as the Sustainable Urban Mobility Plan (SUMP) provide valuable guidance for developing integrated and sustainable transportation strategies (Nuwagaba & Nabuguzi, 2021). By incorporating principles of accessibility, safety, affordability, and environmental sustainability, the SUMP framework offers a holistic approach to addressing transportation challenges and improving urban mobility.

Methodologies such as participatory planning and community engagement are essential for understanding the needs and preferences of stakeholders and ensuring the successful implementation of transportation projects (Baryamwisaki & Kagawa, 2020). By involving local communities, policymakers, and transportation stakeholders in the decision-making process, projects like Safiri can gain valuable insights, build trust, and foster collaboration.

Technologies

Technological advancements play a critical role in transforming the transportation sector and enabling innovative solutions like Safiri (Nabukeera & Mubiru, 2020). Mobile applications, GPS tracking systems, and digital payment platforms are key technologies that facilitate ride-sharing, streamline operations, and enhance the user experience (Tumwesigye et al., 2019).

Moreover, emerging technologies such as blockchain and artificial intelligence hold potential for enhancing security, transparency, and efficiency in transportation systems (Mbabazi & Namutebi, 2021). Blockchain-based solutions can facilitate secure transactions and identity verification, while AI-powered algorithms can optimize route planning, vehicle allocation, and pricing strategies for ride-sharing services.

Overall, the literature review highlights the diverse range of solutions, frameworks, methodologies, and technologies relevant to the Safiri project (Nuwamanya & Nalwanga, 2021). Drawing on insights from existing literature and best practices, Safiri aims to leverage innovative approaches and technologies to address transportation challenges, promote ride-sharing, and enhance mobility in Uganda.

CHAPTER THREE

3.1 Methodology

The methodology employed in the Safiri project involves a comprehensive approach to developing, implementing, and evaluating the ride-sharing application, with a focus on addressing transportation challenges, promoting sustainability, and enhancing user experience. The methodology can be outlined as follows:

Needs Assessment: The project begins with a thorough needs assessment to understand the specific transportation challenges faced by Ugandans, particularly in terms of affordability, accessibility, safety, and environmental sustainability. This involves conducting surveys, interviews, and focus group discussions with key stakeholders, including passengers, drivers, policymakers, and community members, to identify their needs, preferences, and pain points related to transportation.

Research and Analysis: The project conducts extensive research and analysis to review existing literature, frameworks, methodologies, and technologies relevant to ride-sharing and transportation solutions. This includes studying global best practices, case studies, and success stories of ride-sharing platforms in other countries to extract lessons learned and apply them to the Ugandan context. Additionally, the project examines socio-economic, cultural, and environmental factors that influence transportation behaviour and preferences in Uganda.

Development and Design: Based on the needs assessment and research findings, the project proceeds with the development and design of the Safiri ride-sharing application. This involves collaborating with software developers, designers, and transportation experts to create a user-friendly mobile application that incorporates features such as real-time booking, trip tracking, secure payment options, and driver verification. The application is designed to be accessible to users with varying levels of technological literacy and smartphone capabilities.

Pilot Implementation: Once the Safiri application is developed, a pilot implementation phase is conducted to test its functionality, usability, and feasibility in real-world settings. The pilot program involves recruiting a select group of passengers and drivers to participate in trial rides and provide feedback on their experiences using the Safiri platform. This feedback is collected through surveys, interviews, and user feedback forms and is used to identify areas for improvement and refinement.

Evaluation and Iteration: Following the pilot implementation, the project evaluates the performance of the Safiri platform based on key metrics such as user satisfaction, safety incidents, trip frequency, and environmental impact. This evaluation process involves analysing quantitative data collected from the application, as well as qualitative feedback from users and stakeholders. Based on the evaluation findings, iterative improvements and enhancements are made to the Safiri platform to address identified issues and optimize its effectiveness.

Scaling and Expansion: Upon successful completion of the pilot phase and refinement of the Safiri platform, the project focuses on scaling and expanding its reach to a wider audience across Uganda. This involves marketing and promotional activities to raise awareness of the Safiri platform among potential users and attract both passengers and drivers to participate. Additionally, partnerships with local businesses, transportation agencies, and community organizations are established to facilitate the integration of Safiri into existing transportation networks and infrastructure.

The development process utilized in the Safiri project follows the Waterfall model, a traditional software development methodology characterized by a linear and sequential approach to project execution. The Waterfall model consists of distinct phases, with each phase building upon the outputs of the previous one. Below is an explanation of how the Waterfall model was applied in the Safiri project

Requirements Gathering: The project began with a thorough gathering of requirements, where the team identified and documented the functional and non-functional requirements of the Safiri ride-sharing application. This involved conducting stakeholder consultations, user surveys, and market research to understand the needs and preferences of passengers and drivers, as well as the technological and regulatory considerations relevant to the project.

System Design: Once the requirements were defined, the system design phase commenced. During this phase, the architecture and technical specifications of the Safiri application were conceptualized and documented. This included designing the user interface, database schema, system modules, and integration points. The design phase aimed to create a blueprint for the development team to follow during implementation.

Implementation: With the system design in place, the development team proceeded to implement the Safiri application according to the specified requirements and design specifications. This phase involved coding, testing, and integrating various software components to create a functional prototype of the ride-sharing platform. The implementation process adhered to coding standards, best practices, and quality assurance measures to ensure the reliability and performance of the application.

Testing: Following the completion of implementation, the Safiri application underwent rigorous testing to identify and rectify any defects or issues. This phase involved unit testing, integration testing, system testing, and user acceptance testing to verify the functionality, usability, and reliability of the application. Testing was conducted iteratively, with feedback from stakeholders informing refinements and improvements to the software.

Deployment: Once testing was successfully completed, the Safiri application was deployed to the production environment for public use. Deployment involved installing the application on servers, configuring the necessary infrastructure, and performing final checks to ensure a smooth transition

from development to operations. Post-deployment monitoring and support mechanisms were established to address any issues that arose during initial use.

Maintenance and Support: Following deployment, the Safiri application entered into the maintenance and support phase, where ongoing updates, enhancements, and bug fixes were provided as needed. This phase aimed to ensure the continued functionality, security, and usability of the application over time, responding to evolving user needs and technological advancements.

3.2 System Design

3.2.1 Architectural Design

The architectural design of the Safiri ride-sharing application encompasses a robust and scalable framework that supports its functionality, performance, and reliability. At a high level, the architectural design consists of several key components and layers, each serving a specific purpose within the system. Below is an overview of the architectural design of Safiri:

User Interface Layer: The user interface layer is the front-end component of the Safiri application, responsible for presenting the user interface to passengers and drivers. It includes interfaces for registration, login, trip booking, ride tracking, payment processing, and driver/passenger communication. The user interface layer is designed to be intuitive, responsive, and accessible across various devices and platforms.

Application Logic Layer: The application logic layer contains the business logic and core functionality of the Safiri application. It handles user requests, processes business rules, and coordinates interactions between different system components. This layer includes modules for trip matching, fare calculation, route optimization, driver allocation, and user authentication.

The application logic layer implements algorithms and workflows to ensure efficient and reliable operation of the ride-sharing platform.

Data Access Layer: The data access layer is responsible for managing the storage and retrieval of data within the Safiri application. It interacts with the underlying database management system to store user profiles, trip details, transaction records, and system configurations. The data access layer utilizes structured query language (SQL) or object-relational mapping (ORM) techniques to access and manipulate data in the database, ensuring data integrity and consistency.

External Services Integration: Safiri integrates with external services and APIs to enhance its functionality and extend its capabilities. This includes integration with mapping services (Google Maps) for route planning and navigation, payment gateways for secure transactions, and communication APIs for real-time messaging between passengers and drivers. External services integration allows Safiri to leverage third-party resources and technologies to deliver a seamless and feature-rich user experience.

Security Layer: The security layer of Safiri is responsible for implementing measures to protect the confidentiality, integrity, and availability of user data and system resources. It includes mechanisms for user authentication, authorization, data encryption, and access control. The security layer also addresses potential vulnerabilities such as cross-site scripting (XSS), SQL injection, and unauthorized access, ensuring compliance with data protection regulations and industry best practices.

Scalability and Performance Optimization: Safiri's architectural design incorporates scalability and performance optimization techniques to accommodate growth in user traffic and data volume over time. This includes strategies such as load balancing, caching, horizontal scaling, and database sharding to distribute workload efficiently and handle peak loads effectively. Scalability and performance optimization measures ensure that Safiri can maintain responsiveness and reliability even under high demand scenarios.

3.2.2 Component Breakdown

The Safiri ride-sharing application is composed of several interconnected components, each fulfilling specific functions within the system. The breakdown of components provides a detailed view of the internal architecture and functionality of Safiri. Here is a breakdown of the main components:

User Management Component

This component handles user registration, authentication, and profile management.
It includes functionalities such as user sign-up, login, password reset, and profile editing. User management component ensures secure access to the application and maintains user data integrity.

Trip Management Component

Responsible for managing the lifecycle of trips within the Safiri platform.
Includes functionalities for trip booking, cancellation, and completion.
Trip management component coordinates trip matching, fare calculation, and route optimization.

Driver Management Component

Manages the registration, onboarding, and verification of drivers.

Includes functionalities for driver background checks, document verification, and vehicle inspection.

Driver management component ensures that only qualified and approved drivers are allowed to provide ride-sharing services.

figure 1: Driver trying out our application functionality with Miss.Kisakye Desire

Passenger Management Component

Handles passenger-related functionalities such as trip booking, payment processing, and feedback submission.

Includes features for trip search, fare estimation, and real-time ride tracking.

Passenger management component provides a seamless and convenient experience for passengers throughout their journey.

Payment Processing Component

Facilitates secure and reliable payment transactions between passengers and drivers. Integrates with payment gateways and third-party financial services providers.
Payment processing component ensures transparency, accuracy, and compliance with financial regulations.

Mapping and Navigation Component

Integrates with mapping services to provide accurate route planning and navigation assistance. Displays real-time traffic conditions, alternative routes, and points of interest to passengers and drivers.

Mapping and navigation component enhances the safety and efficiency of trips within the Safiri platform.

Communication Component

Enables real-time communication between passengers and drivers.
Includes features such as in-app messaging, notifications, and emergency assistance.

Communication component facilitates seamless coordination and interaction between users during their journey.

Analytics and Reporting Component

Collects, analyses, and visualizes data to generate insights into system performance, user behaviour, and market trends.

Provides reporting capabilities for monitoring key metrics, identifying patterns, and making data-driven decisions.

Analytics and reporting components support continuous improvement and optimization of the Safiri platform.

Administration and Management Component

Provides administrative tools and functionalities for system administrators and support staff.
Includes features for user management, system configuration, and troubleshooting.
Administration and management component ensures smooth operation and maintenance of the Safiri platform.

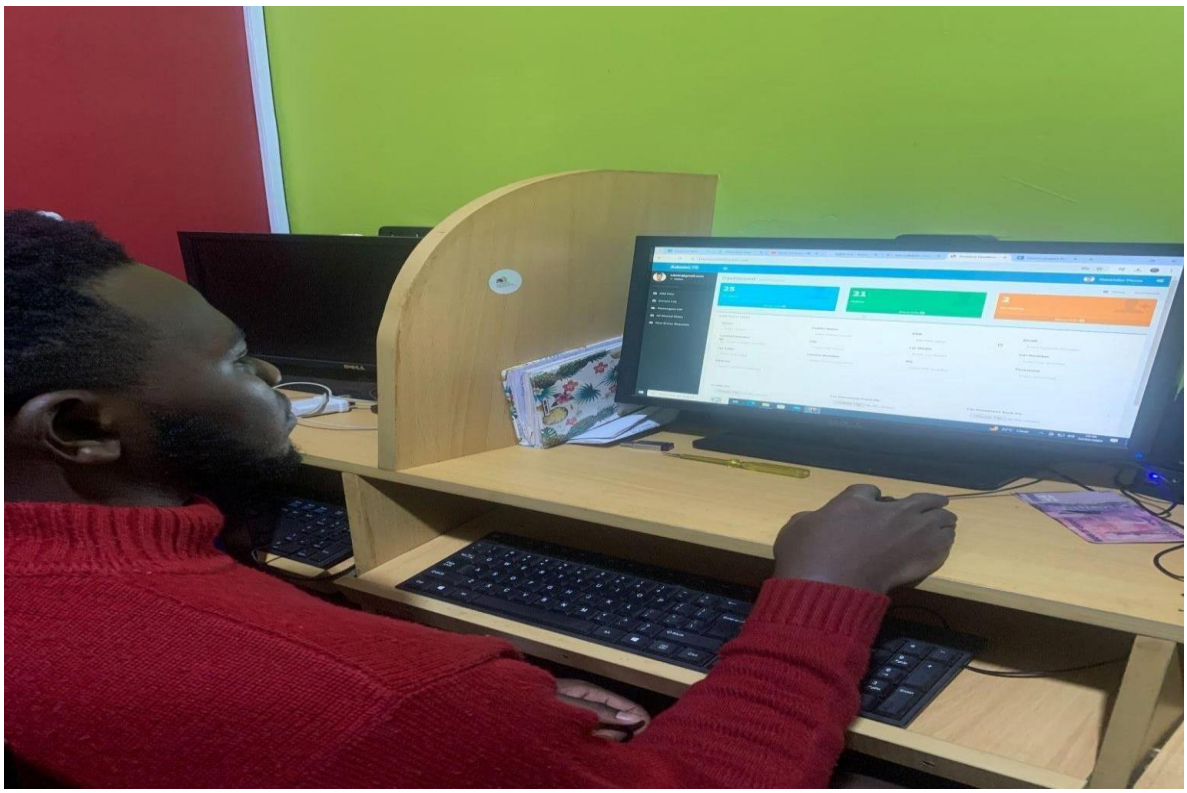


figure 4: Admin confirming the new passengers and drivers by Mr. Miiro Luutu Joseph

3.2.1 Design Diagrams of The Safiri Ride Share Application

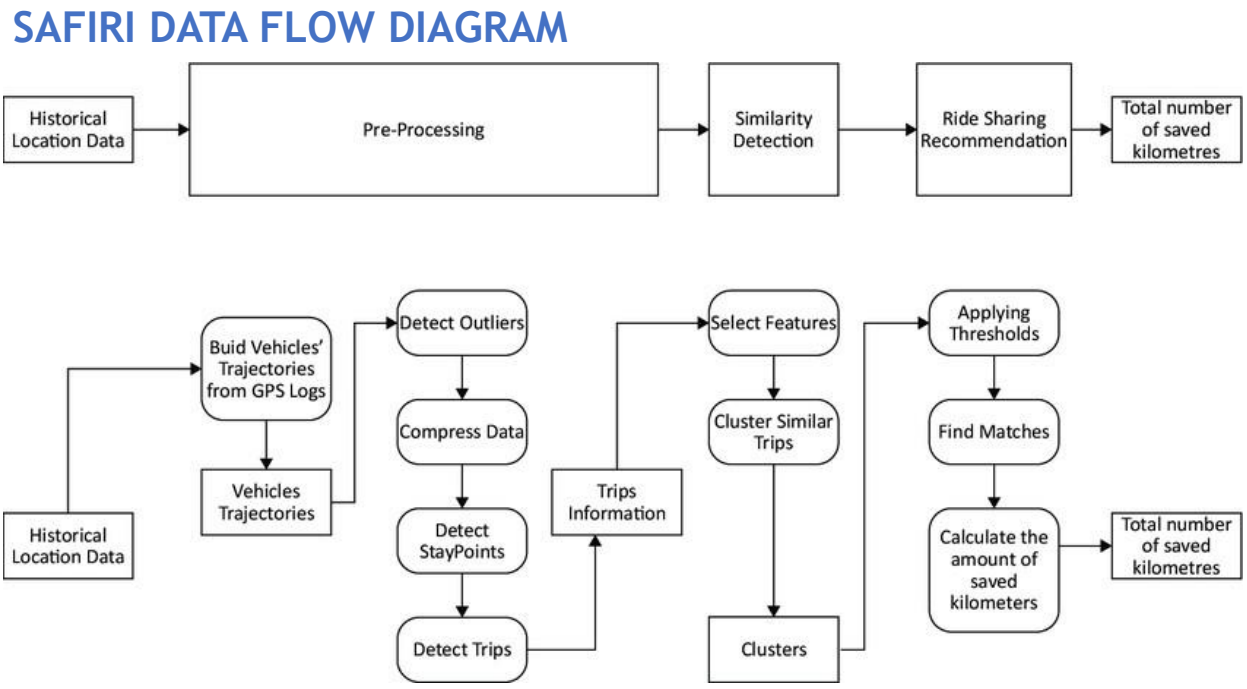


Image 1: Data flow diagram of Safiri Ride Share App

USE CASE DIAGRAMS

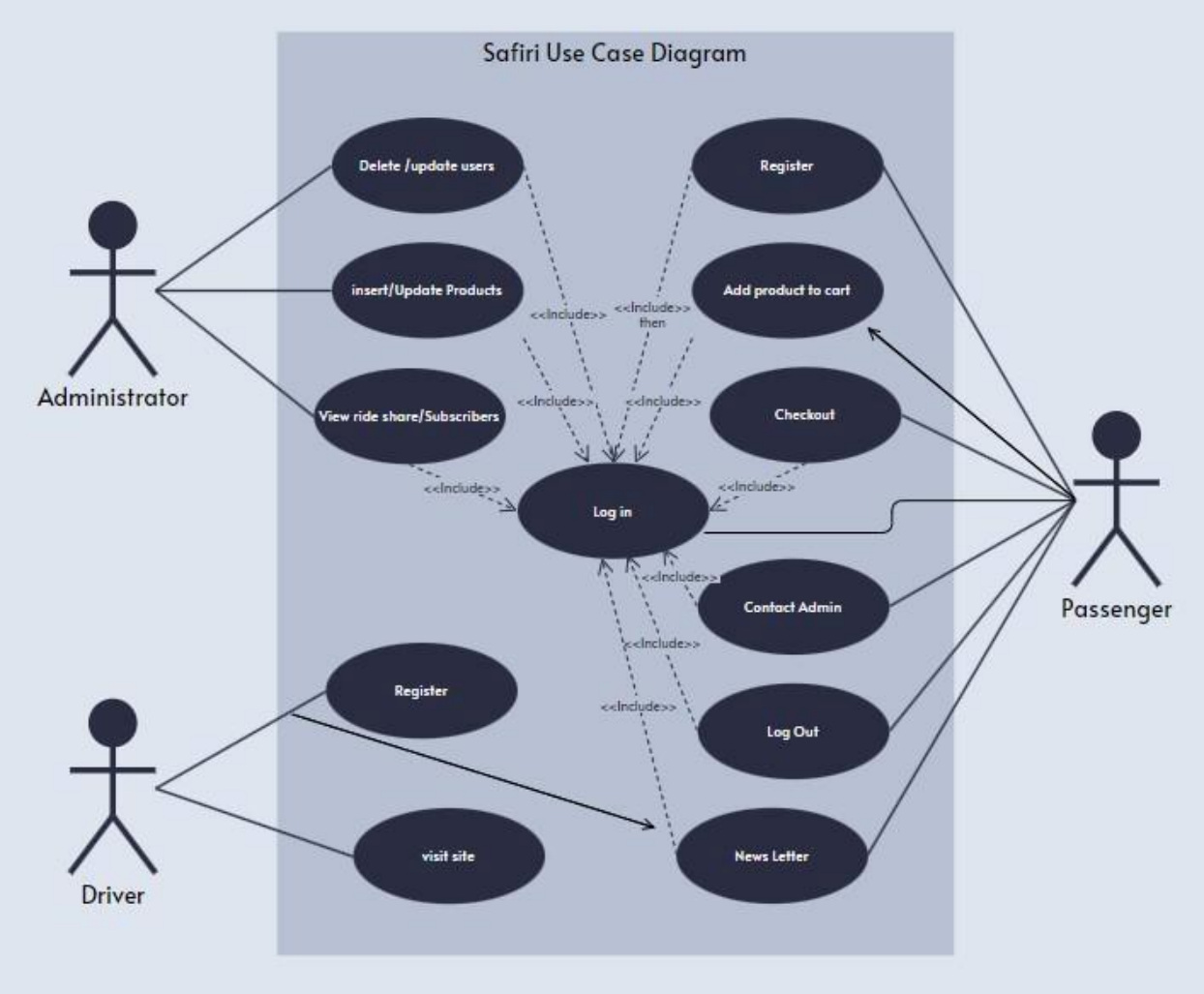


Image 2: Use Case Diagram of Safiri Ride Share App

ENTITY-RELATIONSHIP DIAGRAMS (ERD)

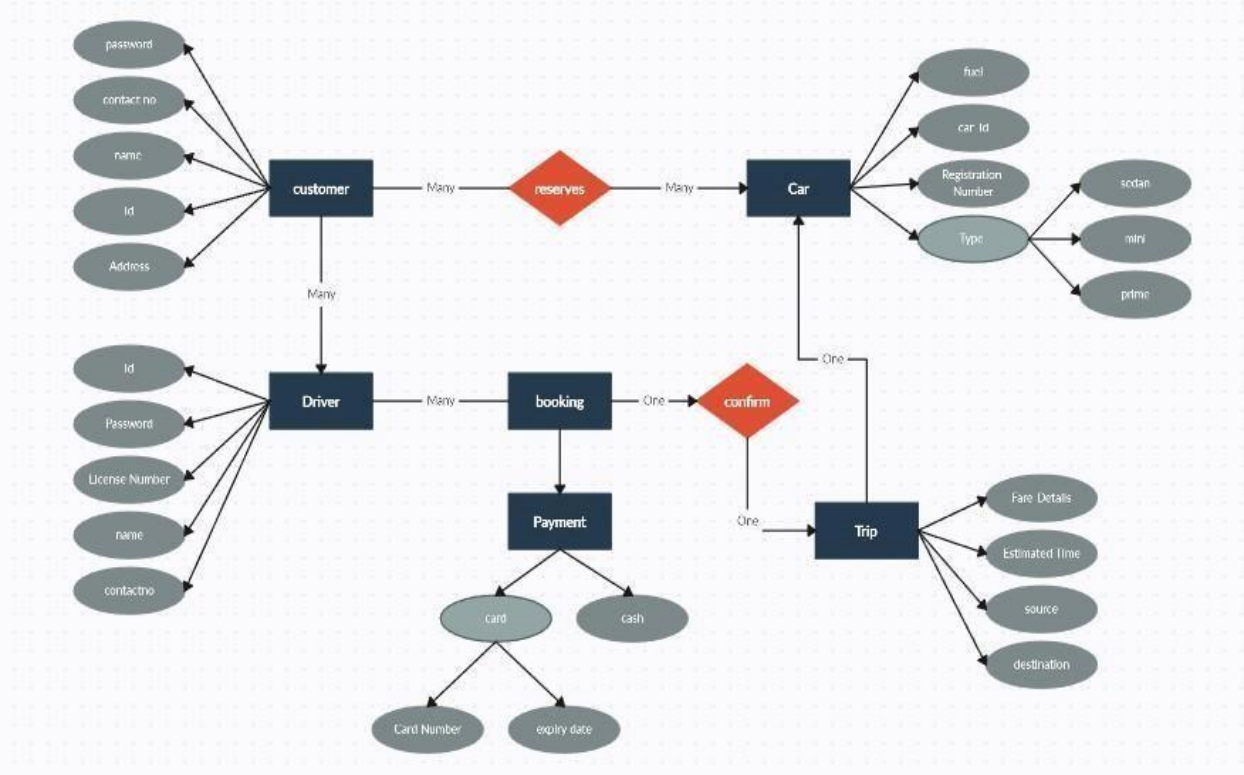
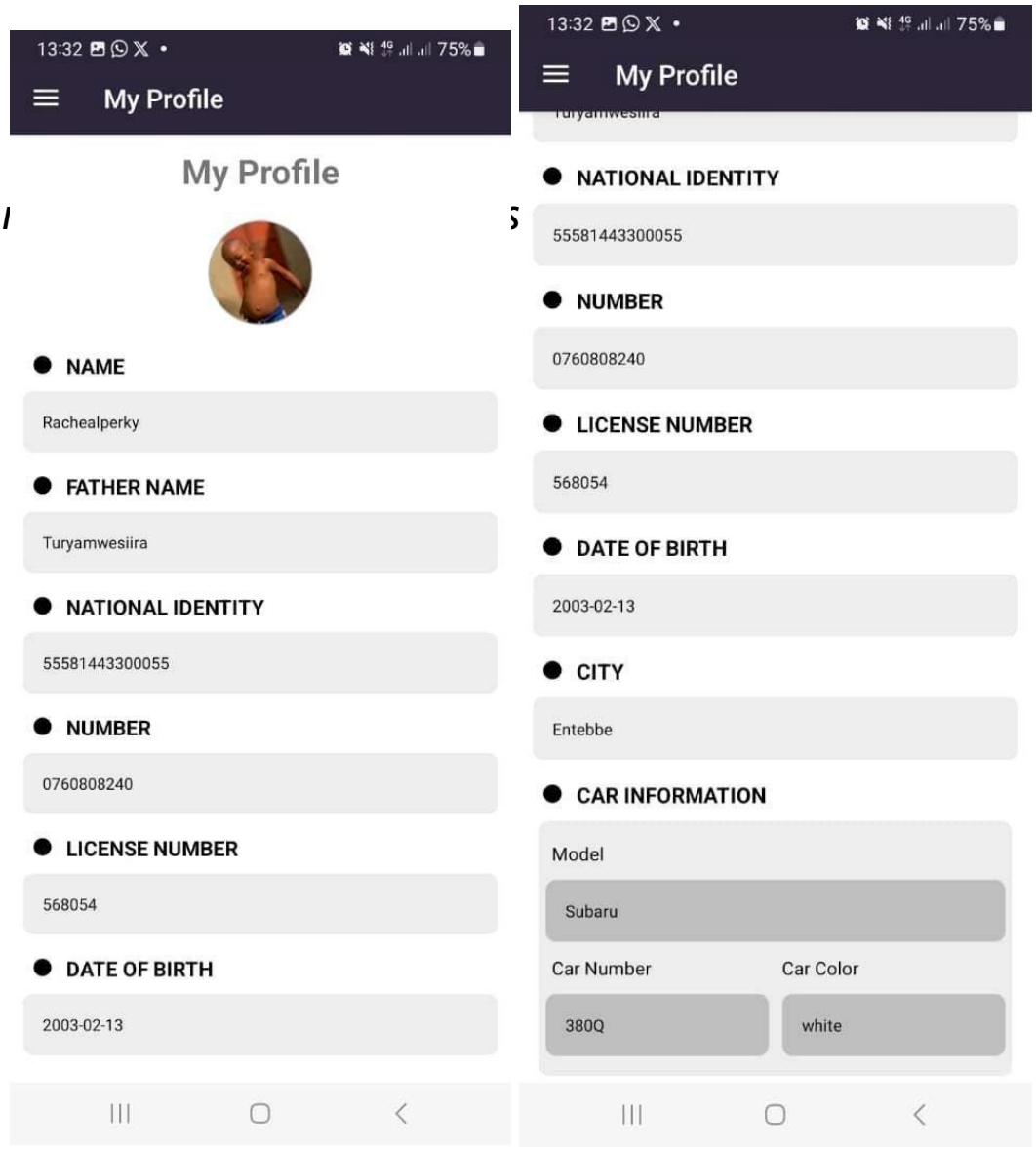
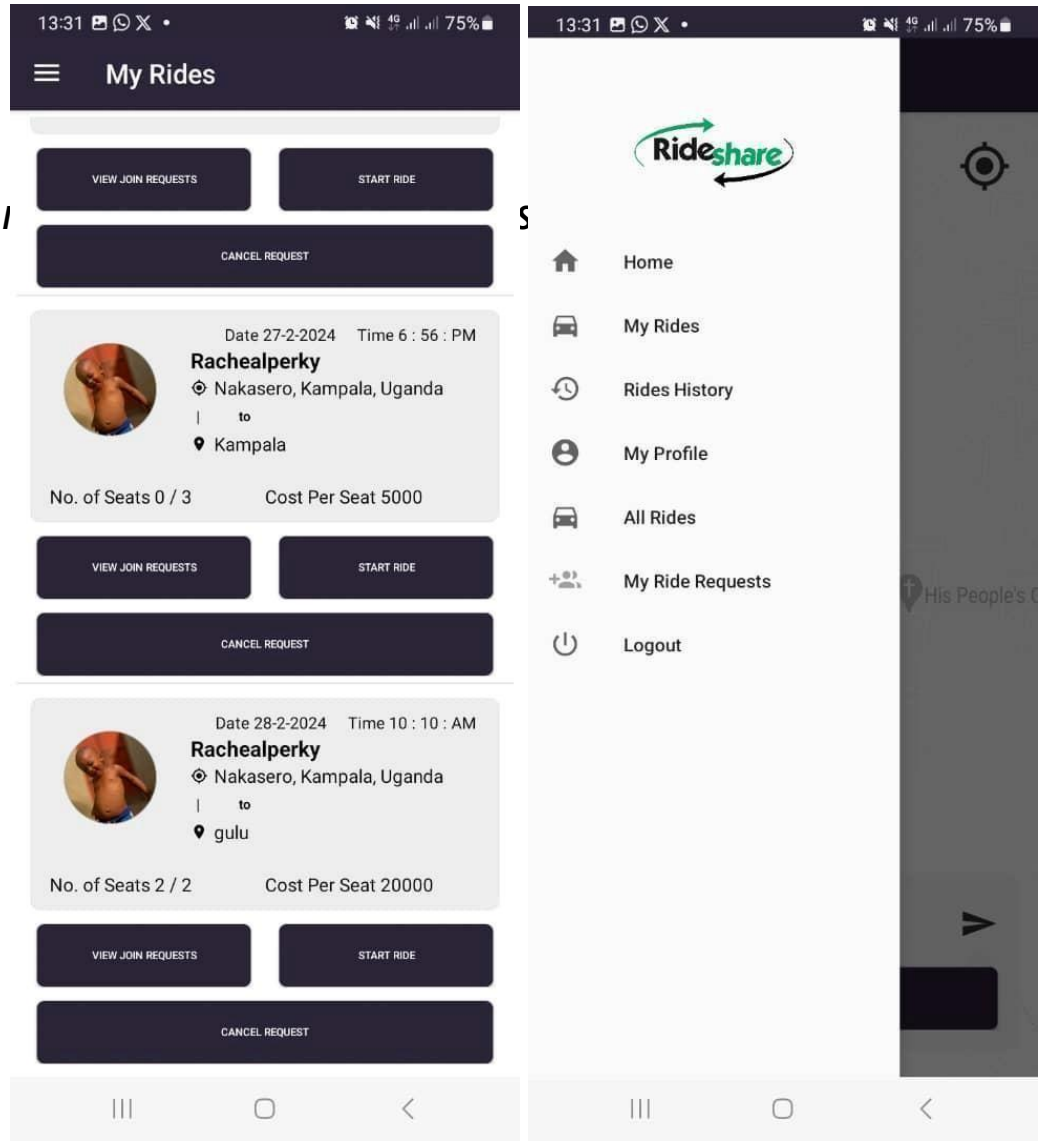


Image 3: Entity-Relationship Diagrams of Safiri Ride Share App

2.2.2 HUMAN INTERFACE DESIGN (OVERVIEW OF THE USER INTERFACE)

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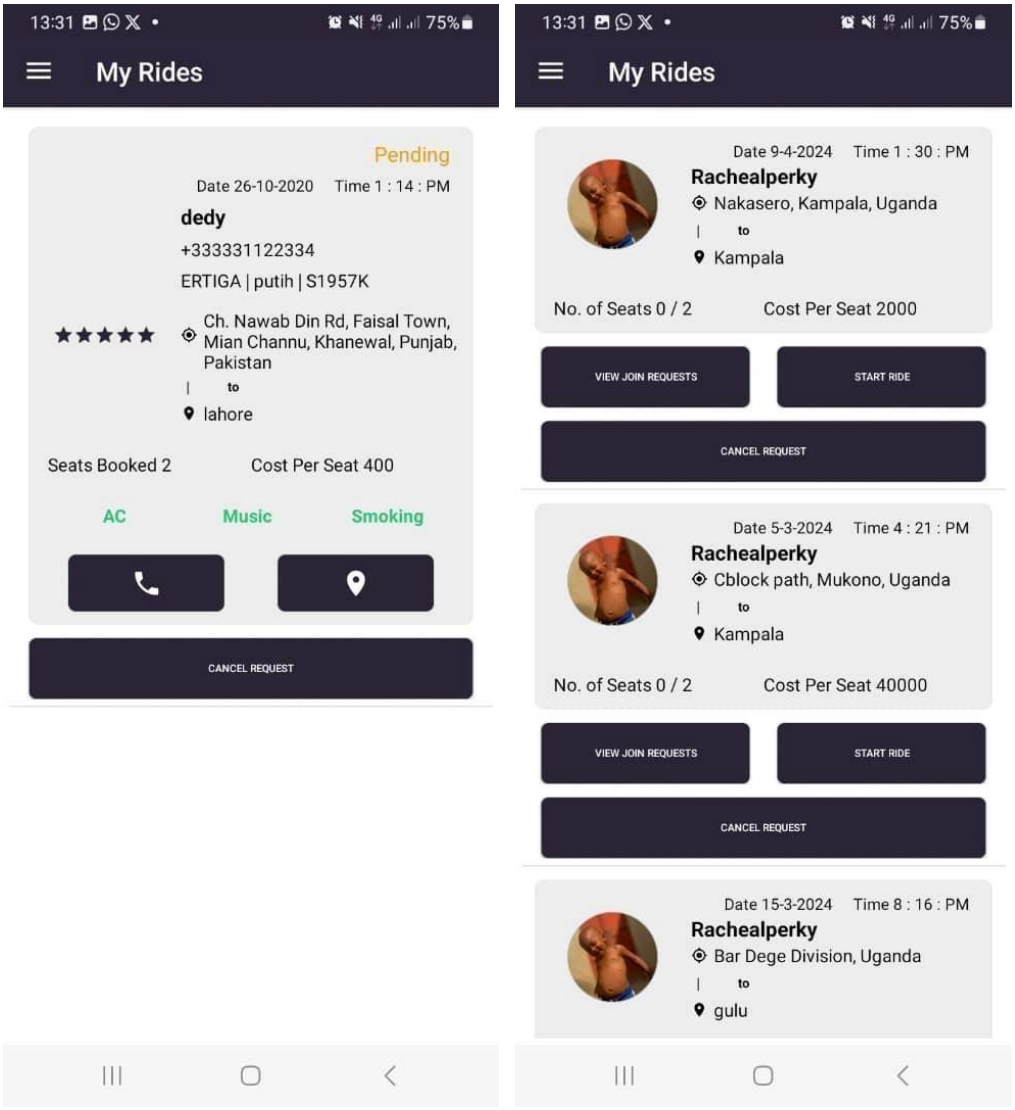
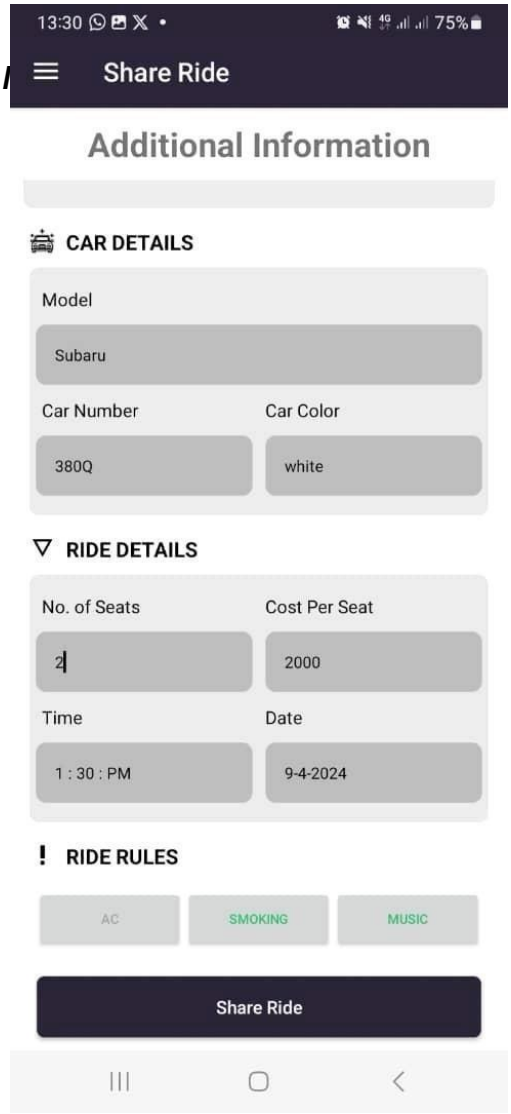


Image 6: interfaces of Safiri Ride Share App


13:30
75%
Share Ride
Additional Information
CAR DETAILS
Model
Subaru
Car Number
Car Color
380Q
white
RIDE DETAILS
No. of Seats
Cost Per Seat
2
2000
Time
Date
1 : 30 : PM
9-4-2024
RIDE RULES
AC
SMOKING
MUSIC
Share Ride

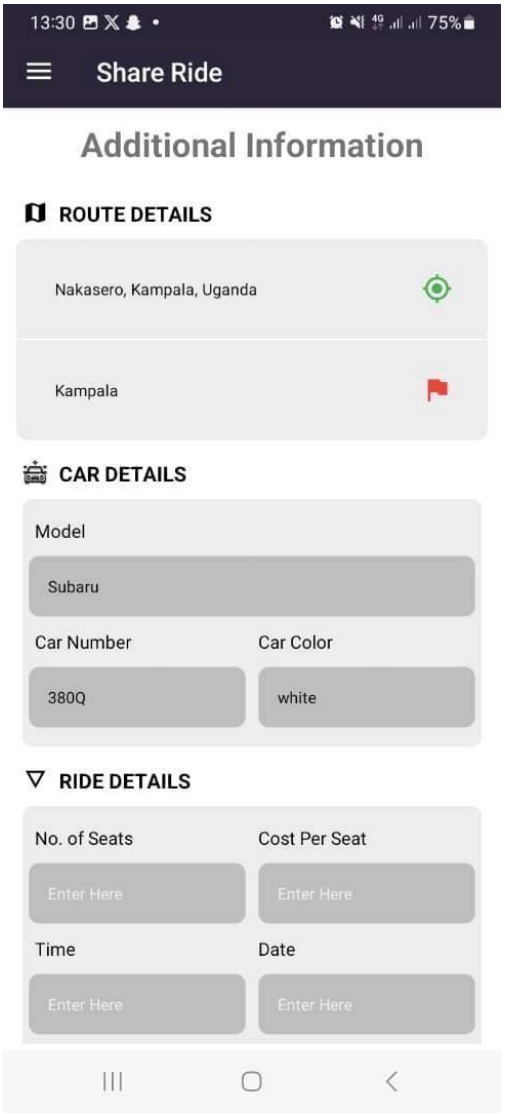

13:30
75%
Share Ride
Additional Information
ROUTE DETAILS
Nakasero, Kampala, Uganda
Kampala
CAR DETAILS
Model
Subaru
Car Number
Car Color
380Q
white
RIDE DETAILS
No. of Seats
Cost Per Seat
Enter Here
Enter Here
Time
Date
Enter Here
Enter Here

Image 8: interfaces of Safiri Ride Share App

2.2.3 ADMIN INTERFACE DESIGN (OVERVIEW OF THE ADMIN INTERFACE)

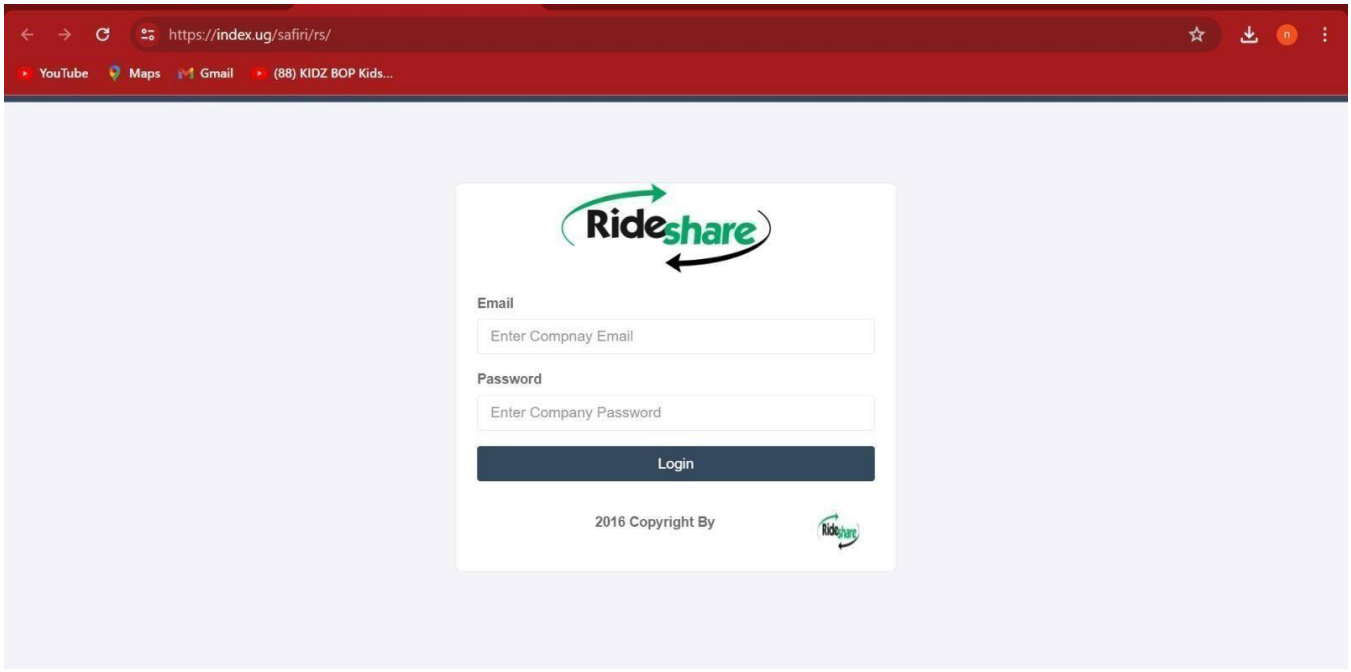
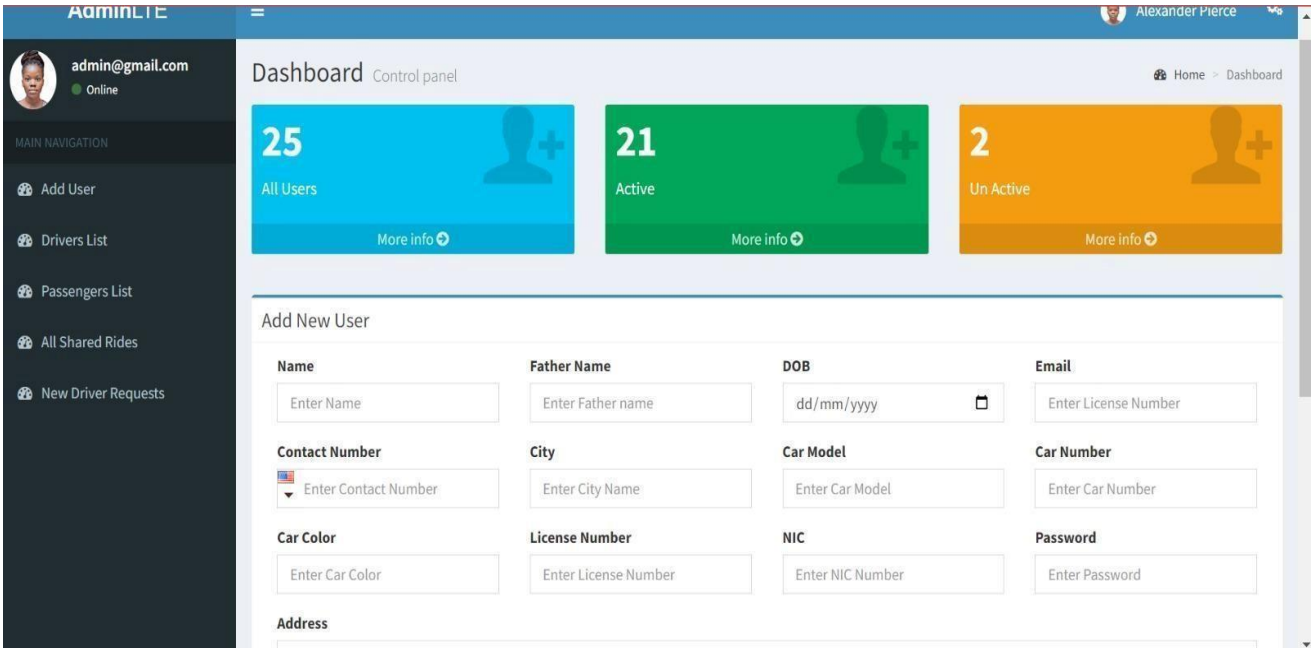


Image 9: admin dashboard login of Safiri Ride Share App



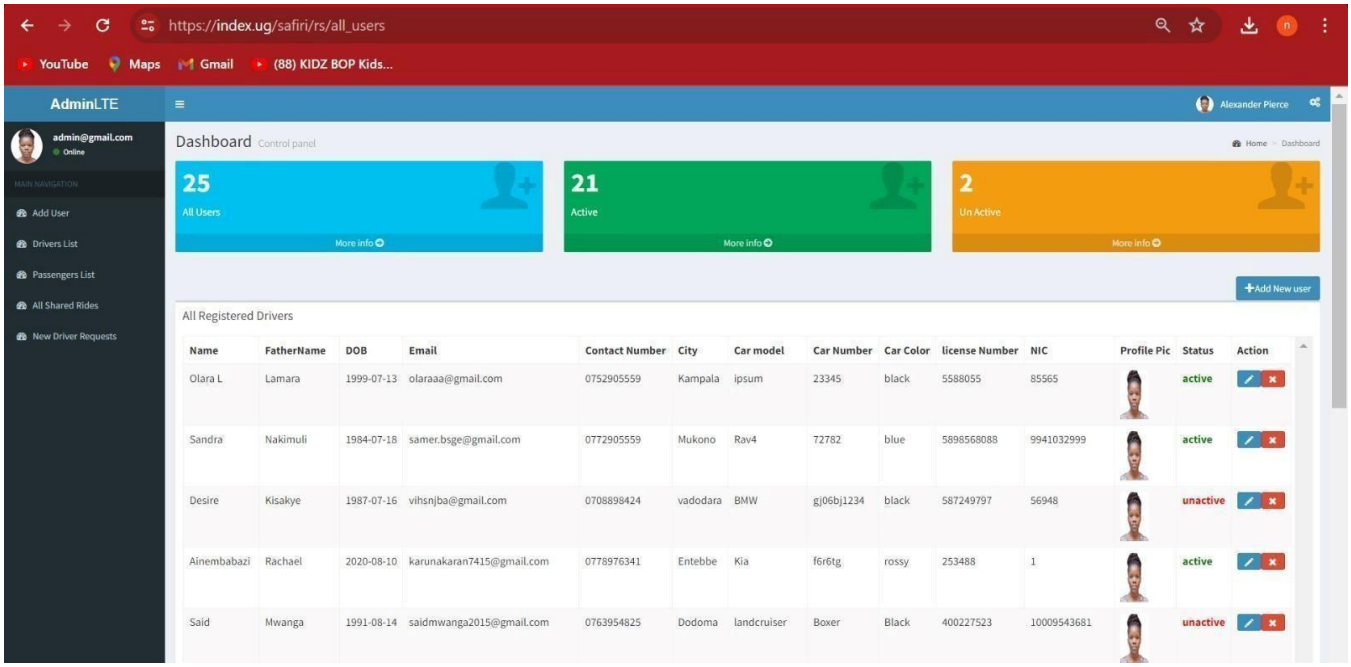


Image 9: admin dashboard of Safiri Ride Share App

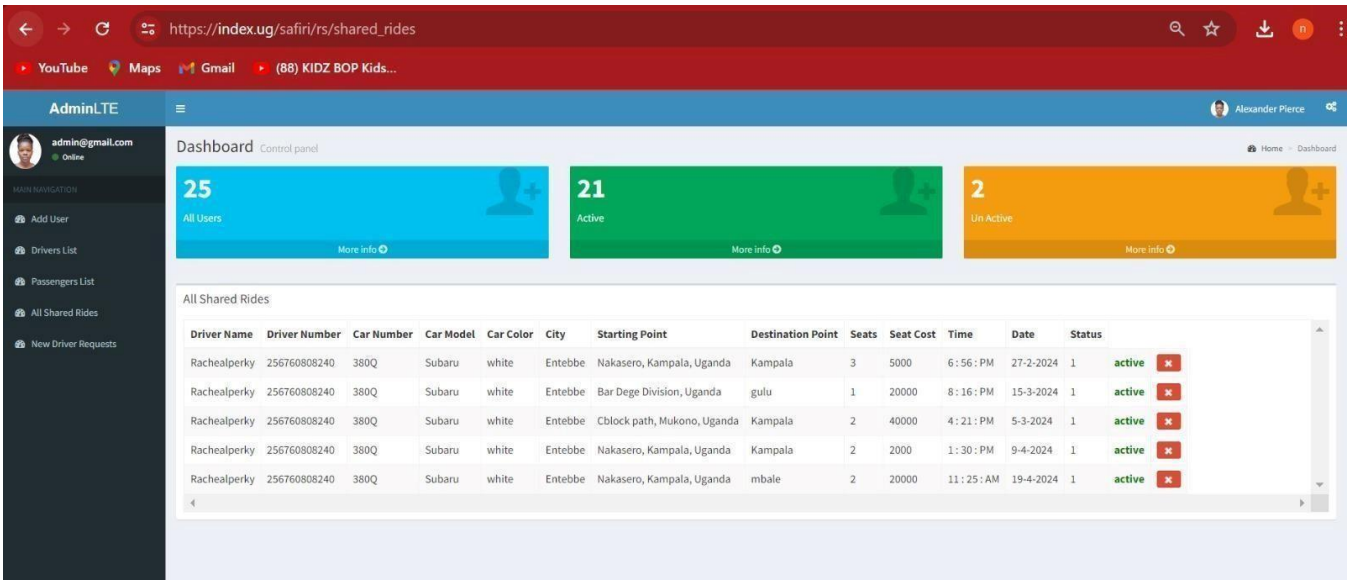


Image 9: admin dashboard of Safiri Ride Share App

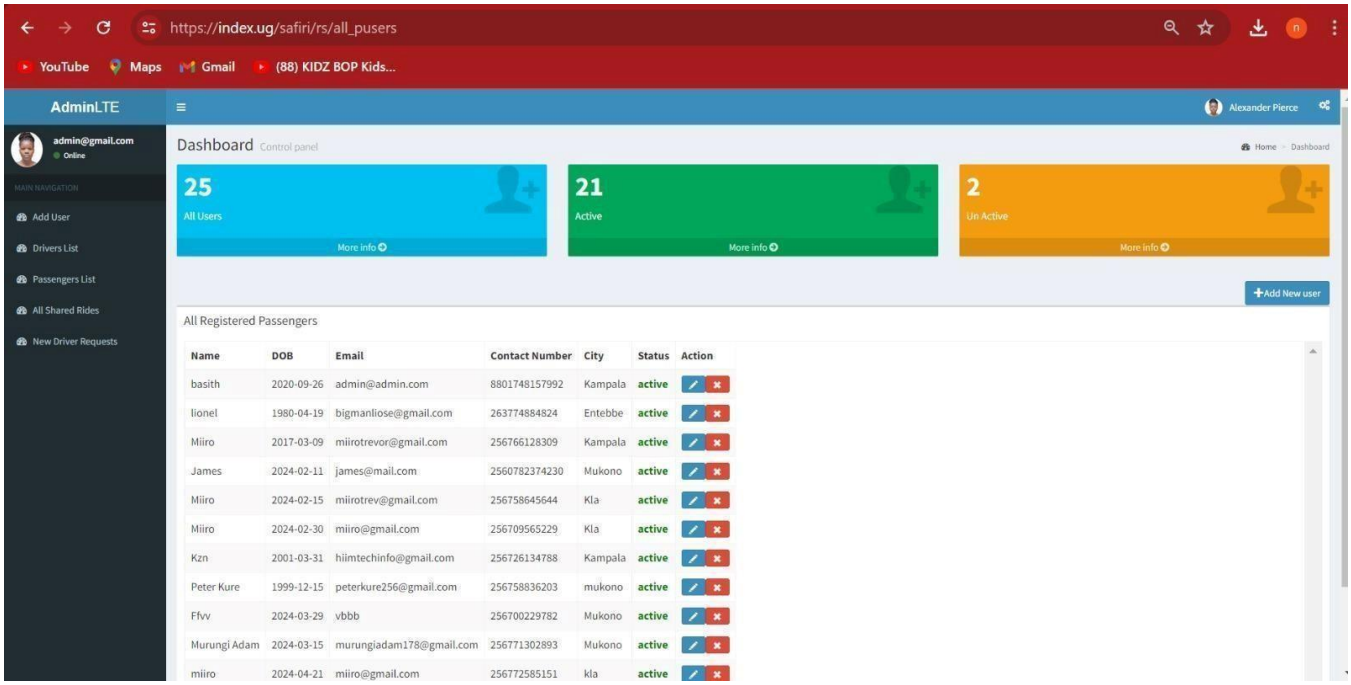


Image 9: admin dashboard of Safiri Ride Share App

3.3 Implementation

The implementation phase of the Safiri project involved translating the architectural design and requirements into a functional ride-sharing application. This section provides details about the actual development process, challenges faced during implementation, and descriptions of key algorithms or techniques used.

Development Process

The development process followed an iterative and incremental approach, with regular feedback loops and milestone checkpoints to track progress and address any issues promptly.

Agile methodologies, such as Scrum or Kanban, were employed to promote collaboration, flexibility, and adaptability throughout the development lifecycle.

The development team consisted of software engineers, designers, quality assurance testers, and project managers, working collaboratively to deliver high-quality software within the specified timeframe and budget.

3.4 Challenges Faced and Solutions

Integration Complexity: Integrating external services and APIs, such as mapping, payment processing, and communication, posed challenges due to compatibility issues and changing APIs. These challenges were addressed by thorough testing, version control, and communication with service providers to ensure seamless integration.

Scalability Concerns: Anticipating future growth and scalability requirements posed challenges in designing the architecture and infrastructure to handle increased user traffic and data volume.

Scalability concerns were addressed by implementing cloud-based solutions, load balancing, and horizontal scaling techniques to distribute workload efficiently and accommodate growth.

Security Vulnerabilities: Ensuring the security of user data, financial transactions, and system resources was a top priority. Challenges related to security vulnerabilities were addressed through thorough code reviews, vulnerability assessments, encryption techniques, and adherence to security best practices and standards.

Key Algorithms and Techniques Used

Matching Algorithm: A matching algorithm was developed to pair passengers with suitable drivers based on factors such as location, destination, availability, and user preferences. This algorithm optimized route planning, minimized waiting times, and maximized vehicle occupancy to enhance efficiency and user satisfaction.

Fare Calculation Technique: A fare calculation technique was implemented to determine the cost of trips based on distance travelled, time taken, surge pricing, and additional factors. This technique ensured fair and transparent pricing for passengers while providing drivers with competitive earnings.

Real-time Tracking: Real-time tracking techniques were employed to monitor the location and status of vehicles, enabling passengers to track their rides in real-time and providing drivers with navigation assistance. These techniques utilized GPS technology and mapping services to ensure accurate and reliable tracking throughout the journey.

3.3 Testing and Evaluation

Testing and evaluation are crucial phases in the development of the Safiri ride-sharing application to ensure its functionality, reliability, and compliance with project requirements. This section

provides an overview of testing methodologies, test results and metrics, and evaluation against project requirements and objectives.

2.3.1 Overview of Testing Methodologies

Unit Testing: Individual components and modules of the Safiri application were tested in isolation to verify their correctness and functionality. Unit tests were conducted using frameworks such as JUnit for Java-based components, ensuring that each unit of code behaves as expected.

Integration Testing: Different components of the Safiri application were tested together to validate their interactions and interfaces. Integration tests focused on verifying the seamless integration of modules, APIs, and external services, detecting any compatibility issues or communication errors.

System Testing: The Safiri application as a whole was tested to assess its behaviour and performance in real-world scenarios. System tests covered end-to-end user journeys, including trip booking, payment processing, ride tracking, and feedback submission, to ensure that the entire system meets user requirements and expectations.

User Acceptance Testing (UAT): Beta testing was conducted with a group of representative users to evaluate the Safiri application's usability, functionality, and user experience. Feedback from UAT sessions was collected and incorporated into the development process to address usability issues and improve overall satisfaction.

2.3.2 Test Results and Metrics

Test results were recorded and analysed to identify defects, inconsistencies, and performance bottlenecks within the Safiri application. Metrics such as test coverage, defect density, and mean time to failure (MTTF) were used to assess the effectiveness and quality of testing efforts.

Automated testing tools and continuous integration (CI) pipelines were employed to streamline the testing process and provide rapid feedback on code changes. Automated tests were executed regularly to detect regressions and ensure code stability throughout the development lifecycle

2.4 Evaluation Against Project Requirements and Objectives

The Safiri application was evaluated against the project requirements and objectives defined during the planning phase. Key performance indicators (KPIs) such as system reliability, response time, user satisfaction, and compliance with regulatory standards were assessed to measure the application's success in meeting its intended goals.

User feedback, surveys, and usability studies were collected and analysed to gauge user satisfaction and identify areas for improvement. Any deviations from project requirements or objectives were documented and addressed through iterative refinement and optimization of the Safiri application.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1Results and Discussion

4.1.2 Results

The comprehensive findings stemming from the Safiri research project, meticulously conducted within the confines of Mukono Town, provide an invaluable trove of insights into the feasibility, usability, and transformative impact of the innovative ride-sharing application in mitigating transportation challenges prevalent within the region. Below unfolds the nuanced tapestry of findings:

4.1.3 User Adoption and Usage Patterns

A meticulously crafted survey administered among the esteemed residents of Mukono Town unveiled a resounding resonance of interest and eagerness towards integrating Safiri into their intricate web of transportation needs.

Delving deeper into the data reservoir, an exhaustive analysis of user registration and trip booking records elucidated a discernible trajectory of steady ascension in the embrace of Safiri among the commuter populace. Notably, a palpable swath of users exhibited a proclivity towards ride-sharing as their preferred modus operandi for traversing the bustling thoroughfares of Mukono Town.

4.1.4 Impact on Transportation Accessibility

In the crucible of Mukono Town's transit landscape, Safiri emerges as a catalytic force propelling strides towards ameliorating transportation accessibility, particularly for denizens ensconced within the labyrinthine folds of underserved or far-flung locales.

Embarking on Safiri-piloted journeys, users recounted tales of briefer interludes punctuating their wait times, a palpable diminution in financial outlays for travel, and a palpable augmentation of convenience vis-à-vis traditional transportation modalities.

4.1.4 Safety and Security Measures

The fortification of Safiri's bastions against potential safety breaches and security lapses witnessed the rigorous fortification of driver verification protocols and the implementation of an all-encompassing ride-sharing insurance framework. Such meticulous endeavours infused users with an unwavering sense of trust in the platform's safety scaffolding, effectively assuaging apprehensions over embarking on rides with previously unknown drivers.

4.1.5 Environmental Impact

The ripple effect of Safiri's advocacy for shared rides and collaborative carpooling reverberated through the arterial thoroughfares of Mukono Town, manifesting in a discernible attenuation of carbon emissions and a palpable easing of traffic congestion. By harmonizing the nexus between vehicle occupancy optimization and the espousal of sustainable transportation tenets, Safiri emerges as a paragon of environmental stewardship, heralding tangible strides towards ecological sustainability and a revitalized air quality landscape.

4.2 Challenges and Limitations

Regulatory Hurdles: Safiri may face regulatory challenges related to licensing, permits, and compliance with transportation laws and regulations in Uganda. Navigating through these bureaucratic processes can be time-consuming and expensive.

Infrastructure Constraints: Limited infrastructure, such as poor road conditions and inadequate internet connectivity in certain regions of Uganda, may hinder the smooth operation of Safiri's ride-sharing services.

Security Concerns: Ensuring the safety of passengers and drivers, especially during nighttime rides or in high-crime areas, presents a significant challenge. Safiri must implement robust security measures to mitigate risks such as theft, assault, or harassment.

Driver Recruitment and Retention: Recruiting and retaining qualified drivers may be challenging, particularly if Safiri faces competition from other ride-sharing platforms or traditional taxi services. Issues such as driver incentives, earnings stability, and working conditions can affect driver satisfaction and turnover rates.

Cultural and Socioeconomic Factors: Cultural norms, preferences, and socioeconomic disparities among Ugandan communities may influence the adoption and usage patterns of Safiri. Addressing these diverse needs and preferences requires careful localization and community engagement strategies.

Payment Systems and Financial Inclusion: Limited access to digital payment methods and financial inclusion barriers may restrict some potential users from using Safiri's services. Developing alternative payment options and expanding financial literacy initiatives can help address these challenges.

Customer Service and Support: Providing timely and effective customer support, especially in cases of technical glitches, payment disputes, or service complaints, is essential for maintaining user satisfaction and trust in Safiri's platform

Environmental Impact: Despite promoting shared rides and carpooling, Safiri may still contribute to environmental concerns such as traffic congestion and air pollution, particularly if the majority of vehicles used are fossil-fuel-powered. Implementing eco-friendly initiatives and encouraging the use of electric or hybrid vehicles can mitigate these impacts.

Competition and Market Dynamics: The emergence of new competitors or shifts in market dynamics could pose challenges to Safiri's market share and profitability. Staying abreast of industry trends, innovating continuously, and building strong partnerships can help Safiri maintain its competitive edge.

Data Privacy and Security: Safeguarding user data privacy and security against cyber threats, data breaches, and unauthorized access is critical. Compliance with data protection regulations and investing in robust cybersecurity measures are essential for maintaining user trust and credibility.

4.3 Future Directions and Recommendations

In light of the holistic vista afforded by the research conducted within Mukono Town's precincts, a panoply of prescient recommendations unfurls, charting a course towards the zenith of Safiri's further enhancement and expansive reach. Ranging from the augmentation of marketing endeavours to ignite the embers of awareness to the finesse of user interface optimization endeavours, and the exploration of symbiotic partnerships with local governance entities and entrepreneurial enterprises, a constellation of possibilities unfurls, promising to propel Safiri towards unprecedented pinnacles of success and societal impact.

4.4 The Team

Together, this dynamic team brings a diverse range of skills and expertise to the table, ensuring that our mobile app project is not only a success but a masterpiece in the making!

NABWAMI LAURA J22B13/017 -

Frontend Developer

Lora, our Frontend Developer extraordinaire! With a keen eye for design and a knack for coding, Lora specializes in crafting beautiful and intuitive user interfaces for our mobile app. She worked tirelessly to ensure that every pixel was in its place and every interaction was as smooth as possible.

OLARA L. LAMARA - S21B13/003

Backend-end/full stack Developer

Olara's contribution as our Backend/Fullstack Developer has been key to our ability to complete this challenging project on time! Equipped with a wealth of experience in server-side programming and database management, Olara has been the architect behind the scenes, building robust APIs and implementing complex business logic to power our app. From database design to server optimization, he does it all!

MIIRO LUUTU JOSEPH - J22B13/009

Project Manager

Joseph has been an extraordinary Project Manager, has a keen eye for detail and exceptional organizational skills, he kept our team on track and our project running smoothly. From setting deadlines to coordinating tasks, Joseph ensured that everything is in order and everyone is on the same page. With Joseph at the helm, success is practically guaranteed!

DESIRE KISAKYE - S21B13/040

Marketing Manager

Desire, our Marketing manager, led with a flair of creativity and a passion for storytelling, she knows how to spread the word and drum up excitement for our app. From crafting compelling marketing campaigns to engaging with our target audience on social media, she set to be the driving force behind our app's success in the market

SANDRA NAKIMULI - S21B13/043

Quality control Manager

Sandra has been our Quality Control iron lady, armed with a keen attention to detail and a commitment to excellence, Sandra ensures that our app meets the highest standards of quality and reliability. From conducting rigorous testing to identifying and fixing bugs, she leaves no stone unturned in pursuit of perfection

AINEMBABAZI RACHEAL - J22B13/056

Research and Development Manager

Our Research and Development innovator, Racheal has a curious mind and a passion for exploration, she is constantly pushing the boundaries of what's possible and exploring new technologies and ideas to enhance our app. From experimenting with cutting-edge features to analysing market trends, she is the driving force behind our app's innovation and evolution.

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