Module Title

Second Year Project

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Assignment Submission Date: 2023 April 14th

Supervisor Name: Enjina Ghimire

Title: Transit Pay

I confirm that I understand my coursework needs to be submitted online via My Second Teacher under the relevant module page before the deadline for my assignment to be accepted and marked. I am aware that late submissions will be treated as non-submission, and a zero mark will be awarded.

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1. Introduction

Transit Pay is a card-based payment system designed to modernize and simplify the payment process for public transportation in Nepal. This innovative system eliminates the need for cash transactions and minimizes the risk of theft and robbery associated with carrying Cash. The Transit Pay system uses a card that stores passengers' information, including their sign-up details, travel history, and payment details. It allows passengers and transportation operators to enjoy a hassle-free journey.

The Transit Pay system has several advantages over traditional cash-based systems. Eliminating the need for Cash reduces the risk of human error and improves accuracy in the payment process. Passengers benefit from faster, more convenient transactions and reduced exposure to cash-carrying risks. It uses radio frequency to transfer data between the system and the card. As a result, customers do not need to use a cash-in transaction. It calculates bus fares based on the distance customers cover in a bus and the fuel cost per kilometer, and it allows a bus operator to add fixed profit to the system.

The implementation of Transit Pay involves some risks and challenges, such as hardware availability and resistance to changing from traditional cash-based systems. However, contingency plans have been implemented to mitigate these risks, which are described below in more detail.

In our country where 97% of transactions in Nepal were still conducted using cash especially in rural areas according to September 2021. Implementing the Transit Pay system in vehicle can bring a lot of benefits in my view. However, according to a report published by the Nepal Rastra Bank, the central bank of Nepal, in fiscal year 2019/20 (mid-July 2019 to mid-July 2020), the number of card transactions in Nepal increased by around 27% compared to the previous fiscal year. The COVID-19 pandemic has also accelerated the adoption of digital payments in Nepal, as people are avoiding physical contact and looking for safer payment options. (Shrestha, 2021)

1.1 Problem Scenario

There are several problem scenarios that the Transit Pay system aims to solve. Some of the significant problems are listed below: -

i. Cash payment in public transportation can be time-consuming and inconvenient.
ii. Carrying Cash in public transportation can increase the risk of robbery and thief.
iii. Foreigners may not be familiar with the local currency and may have difficulty paying.
iv. Current payment of the system may lead to human error, inaccurate calculation, and no record keeping of transactions.
v. Payment demanded by the bus conductor becomes mandatory for the customer.
vi. The conductor can charge for service based on race, gender, or appearance, which promotes discrimination in public.
vii. Conductors can miss the bus fees from customers when collecting from many people.
viii. Hand-to-hand cash payment systems may lead to dangerous communicable diseases like Covid- 19, Ebola, Chickenpox, and many more.

1.2 Project As a Solution

The Transit Pay system will work as a solution to the various problems related to payment on buses. Using a card-based payment system instead of hand-to-hand Cash is more convenient and cost-effective. It makes the payment process faster, more convenient, and more cost-effective. Besides eliminating the risk of human error, the digital payment system also improves accuracy. It prevents drivers from carrying Cash, which reduces the risk of robbery and theft.

The cost of bus fares will be calculated per kilometer and fuel price basis, which means that every customer will be charged according to the fuel price and the distance they covered on the Bus. It makes tourists understand how Transit Pay works in Nepal, encouraging them to spend more to travel on local transportation. There is a database that stores all records of passengers using transportation, which even helps reduce crime rates. When a criminal uses public transport, investigators can determine their location at

a particular point in travel history. A bus can usually run on 1 liter of diesel for 3 to 5 kilometers, depending on the number of passengers. So then, each fare is calculated by the system using a Formula and i.e.

Bus Fare per Person = ((Distance x Fuel Cost per Kilometer) + (Fixed Profit)) * Number of Passengers

Were,

Distance = Distance covered by customer in Bus

Fuel = Cost of Fuel per Kilometer

Profit = Amount of money that the bus operator wants to add

Passengers = No. of Passenger

Overall, Transit Pay is a card-based payment system that offers a reliable and efficient solution for payment in public transportation, making it more convenient for passengers and improving the safety and efficiency of the system.

1.3 Current Scenario

The current scenario of Transit Pay is rapidly evolving as technology advances and society becomes more reliant on digital payment systems. With the ongoing COVID-19 pandemic, the transit industry's demand for contactless payment options has significantly increased. Transit Pay has become essential for passengers to make payments easily and efficiently. Many contactless payments has been started accepting digital payments, and new transit payment solutions are emerging to provide a seamless experience for riders. However, there are still challenges, such as ensuring security and privacy for riders' personal and financial information. Despite these challenges, Transit Pay is a promising solution to improve the passenger transit experience and help modernize the transit industry.

1.4 Aims

Transit Pay aims to provide a more efficient and convenient payment process for transportation where every Bus trip's fare is accurately calculated by IoT system and users need to sign up and verify their credentials to use the system.

1.5 Objectives

The objectives of Transit Pay that must be achieved to complete the project are listed below: -

i. To provide a modern payment system that makes it efficient and convenient for customers.
ii. To accurately calculate fares to customers on each trip.
iii. To provide a secure and reliable payment system to customers.
iv. To build a web application that allows a customer to verify their details to use the card.
v. To build a prototype using IoT, which regulates the system.

2. Expected Outcome and Deliverables

The completion of the Transit Pay system would make it possible to achieve the different tasks, some of which are listed below: -

i. Improved payment process: The card-based payment system makes the payment process fast and convenient for passengers.

ii. Cashless Transaction: Using a card will reduce the need for the conductor to handle Cash, which also helps to minimize the risk of robbery and theft.
   - Scanning cards on the system will store the location and user details in the database, which the admin can see as a travel log.

iii. Accuracy: It helps to eliminate human errors and improve the accuracy of every customer's fare calculation.

iv. Cost-effectiveness: Fare calculation based on fuel price and distance the customer covers lead to more cost-effectiveness for the passengers.

v. Increase tourism: The introduction of Transit pay will make local transportation more attractive to tourists, which will help to increase revenue.

vi. Prototype development: A prototype will be developed using IoT to demonstrate a modern payment system in transportation.

vii. Web – application: Transit Pay website will be developed where users must sign up and verify their credentials. Then a card will work on a prototype, and a customer can see the Transaction history.

3. Project Risks, Threats, and Contingency Plan

There are pros and cons to everything, and Transit Pay also has some risks and threats, and they are: -

i. Transit systems may lead to technical challenges during a developing and implementing process, such as system failure, bugs, and many more.
ii. Hackers could sell customer information if they find a vulnerable point to attacks.
iii. Some customers may prefer using Cash for transactions which could limit the Transit Pay system.
iv. A competitor may emerge with an advanced payment system, resulting in less use of Transit Pay.
v. There may be challenges when repairing equipment or replacing the system.

Following are some of the contingency plans that can be implemented to prevent and minimize the above risks: -

i. Backup hardware should be purchased for the smooth functioning of the system.
ii. Regular system backups should be performed to prevent data loss and customer information and security measures will be implemented to protect our customers' sensitive information, including encryption, password protection, and firewalls.
iii. Awareness and benefits about system will be done which promotes the system rather then a cash transaction.
iv. Proper research should be done about the price of fuel to update the system for accurate bus fares different version will be released.
v. Maintenance and checks should be performed on all system components to prevent unexpected system failures.

4. Methodology

The Rational Unified Process (RUP) is a software engineering process that provides a disciplined approach to assigning tasks and responsibilities within a development organization, with the goal of producing high-quality software that meets the needs of end-users within a predictable schedule and budget. RUP activities create and maintain models, rather than focusing on the production of large amounts of paper documents. In addition, it emphasizes the development and maintenance of semantically rich representations of the software system under development. (Kruchten, 1999) For the development of this project, I have decided to follow the Rational Unified Process (RUP) methodology. This methodology categorizes into four steps which are described below with figure (testbytes, 2019): -

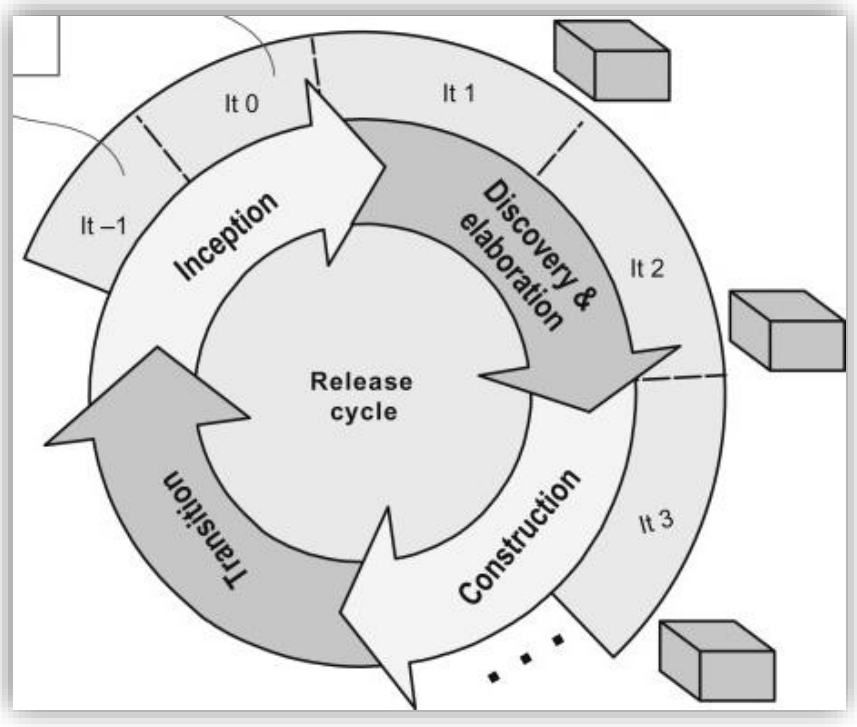


Figure 1 Diagram of Rational Unified Process

4.1 Inception

This is the first stage of this methodology, where the project idea is initiated. It mainly focuses on defining the project's scope, estimating its schedule and cost, and evaluating its feasibility. Also, this phase aims to identify the critical use cases that will drive the system's functionality and help establish at least one candidate architecture. (Castilla, 2014) Some of the Inception phases for this project are listed below:

i. By analyzing the market, technology, and resources, determine whether the project is feasible.
ii. Discussion about development and documentation procedures with the supervisor/s.
iii. Develop an estimate of the project's cost and schedule. Identify the risks and potential issues that may arise during the development process.
iv. Determination of hardware and software requirements.

4.2 Elaboration

The Elaboration Phase is the second phase of the software development life cycle. Its main goal is to establish, validate, and baseline the architecture, address significant risks, and evolve the project plan. During this phase, it is crucial to understand the critical requirements to ensure that they have been covered in the architecture. (Castilla, 2014) Some of the Elaboration phases for this project are listed below:

i. Hardware and software time and cost estimates should be reevaluated.
ii. Finalizing the circuit diagrams for the transit pay of IoT components.
iii. Design and develop essential diagrams for development, such as UML and ER diagrams.
iv. Document the project proposal Identify potential risks during development.

4.3 Construction

The Construction Phase is the third phase of the software development life cycle. The main goal is to complete the requirements, expand the design, develop the rest of the components and features, test them, and integrate them with the rest of the application. (Castilla, 2014) Some of the Construction phases for this project are listed below:

i. Creating an operational manual and a user manual for the system.
ii. The results and progress of the project must be documented.
iii. The system should be tested and kept backup in case of any errors.
iv. Ensure that the system is built according to the specifications and requirements.

4.4 Transition

The Transition Phase is the final phase of the software development life cycle, where the main goal is to deploy the software to the user community when the software has reached an acceptable level of quality. (Castilla, 2014) Some of the Transition phases for this project are listed below:

i. Deploy the software to the user community when the software has reached an acceptable level of quality and user documentation has been prepared.
ii. Carrying out beta testing to validate that the product meets users' expectations and making corrections and enhancements to ensure high performance and usability.
iii. Training users and maintenance people and evaluating the deployed version against the product's vision and acceptance criteria.
iv. Addressing issues that may emerge during this phase may require future product evolutions.

5. Software Requirement Specification

Transit Pay is an online payment system that allows customers to pay for their transit fares easily and securely. The system is designed to simplify the payment process and provide a user-friendly experience for the customers. The purpose of this document is to outline the requirements for the development of the Transit Pay system.

5.1 Functional Requirements:

5.1.1 Registration and Login:

The system shall allow users to register and create an account. Users shall be able to log in to their accounts using their credentials.

5.1.2 Transit Search:

The system shall provide a search feature for users to search for available transit routes, fares, and schedules.

5.1.3 Transit Card Management:

The system shall allow users to manage their transit cards by adding or deleting cards and viewing their card details such as balance and transaction history.

5.1.4 Payment Processing:

The system shall allow users to make payments for their transit fares using their stored payment methods such as credit cards, debit cards, or e-wallets.

5.1.5 Fare Calculation:

The system shall calculate the fare amount based on the selected transit route, distance traveled, and any discounts or promotions applied.

5.1.6 Transaction History:

The system shall maintain a record of all transactions made by the users, including the transaction date, time, amount, and transaction status.

5.1.7 Admin Dashboard:

The system shall provide an admin dashboard for the transit agency to manage and monitor the system's operation, user activity, and financial transactions.

5.2 Non-functional Requirements:

5.2.1 Performance:

The system shall be able to handle a high volume of traffic and process payments quickly and efficiently.

5.2.2 Security:

The system shall implement industry-standard security measures such as encryption, authentication, and authorization to ensure the safety of user data and financial transactions.

5.2.3 Usability:

The system shall be designed to provide a user-friendly and intuitive interface that is easy to navigate and understand.

5.2.4 Compatibility:

The system shall be compatible with a variety of devices and web browsers to ensure accessibility to a wide range of users.

5.3 Constraints:

5.3.1 Hardware:

The system shall require a stable internet connection and a device capable of accessing the internet such as a smartphone, tablet, or computer.

5.3.2 Payment Methods:

The system shall support a limited number of payment methods that are commonly used in the transit industry.

5.4 Assumptions and Dependencies:

5.4.1 Assumptions:

The system assumes that users have a basic understanding of how to use an online payment system and can navigate through the website with ease.

5.4.2 Dependencies:

The system depends on the availability and reliability of third-party services such as payment gateways and transit databases.

5.5 Glossary:

5.5.1 Transit Pay

The online payment system for transit fares.

5.5.2 Transit Card

A stored-value card that allows users to pay for their transit fares.

5.5.3 Fare

The amount charged for using a transit service.

5.5.4 Transaction

A payment made by the user for a transit fare.

5.5.5 Admin

The administrator of the Transit Pay system.

6. Resource Requirements

- The basic resources which are needed to complete this project are as below: -

6.1 Hardware Requirement

- Arduino Uno
- RFID Module
- Jumper Wires
- Node MCU
- GPS Module

6.2 Software Requirement

- Text Editor: VS-Code
- Frontend: HTML, CSS, JavaScript OR ReactJS
- Backend: NodeJS
- Database: Postgres or MySQL
- Version Control: GitHub
- Circuit Design: Filecroco

7. Project Gantt Chart

A GANTT chart is a project management tool that helps us schedule, plan and monitor our tasks. The system also facilitates the allocation of resources and the distribution of tasks fairly among members. It has a different schedule shown on the bar, like start and end dates for tasks, milestones, and dependencies between tasks and assignees. Hence, it is a chart, i.e., a Gantt Chart.

In terms of the Transit Pay project, RUP could help ensure that the software is developed in a structured, organized manner, with clearly defined goals and requirements. It could also help to identify potential risks and address them early in the development process. Ultimately, by using RUP, the Transit Pay project could deliver a high-quality software product that meets the needs of its users.

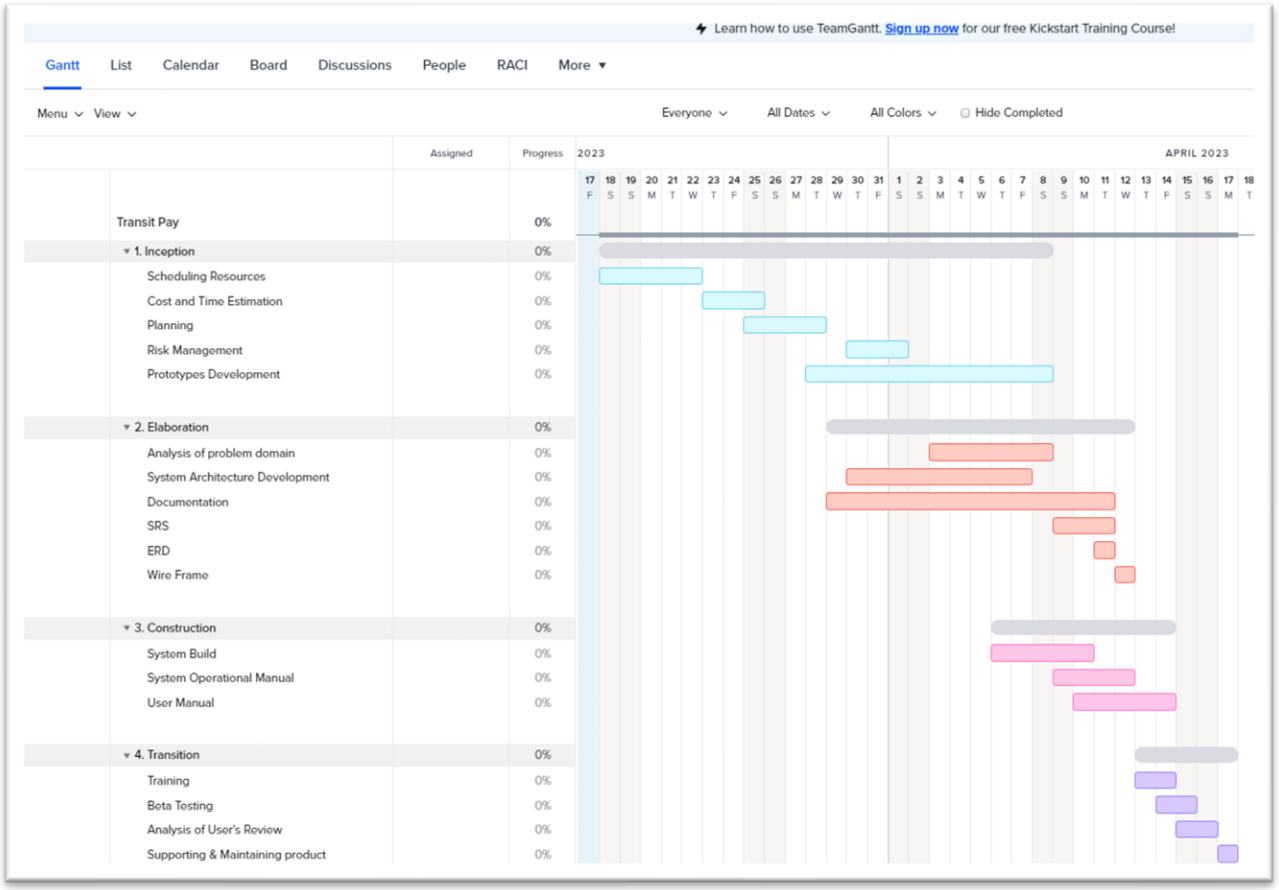


Figure 2 Figure of Gantt Chart

8. Initial ERD

An Initial Entity Relationship Diagram (ERD) is a beginning phase of a graphical representation that displays the relationship of entity sets stored in a database. It is based on three basic concepts: entities, attributes, and relationships. The main objectives of creating an Initial ER Diagram are to represent an appropriate final Entity relationship diagram with its correct details and relationship to entities. We create Entity RelationshipDiagrams using cardinality, the most significant element of an ERD that shows how one entity is related to another. Several types of lines can represent relationships, and they are as follows: -

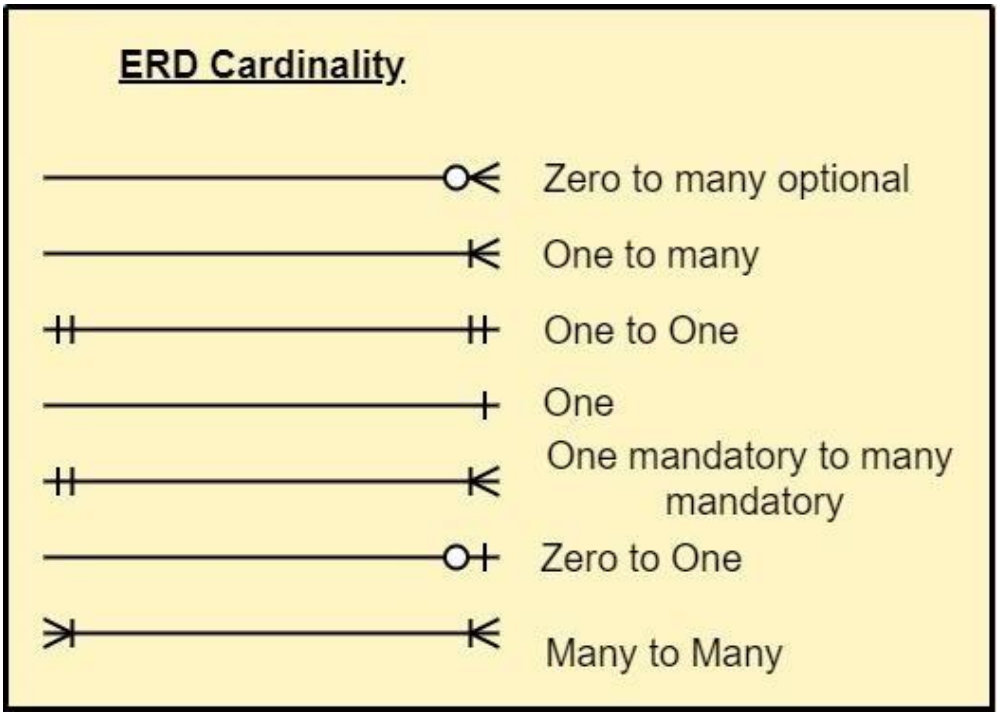


Figure 3 Figure of ERD Cardinality

In my initial ERD, there are five entities with their attributes. The five entities are Customer, Transit Search, Transit Card Details, Payment Transaction and Admin. All entities are related to each other.

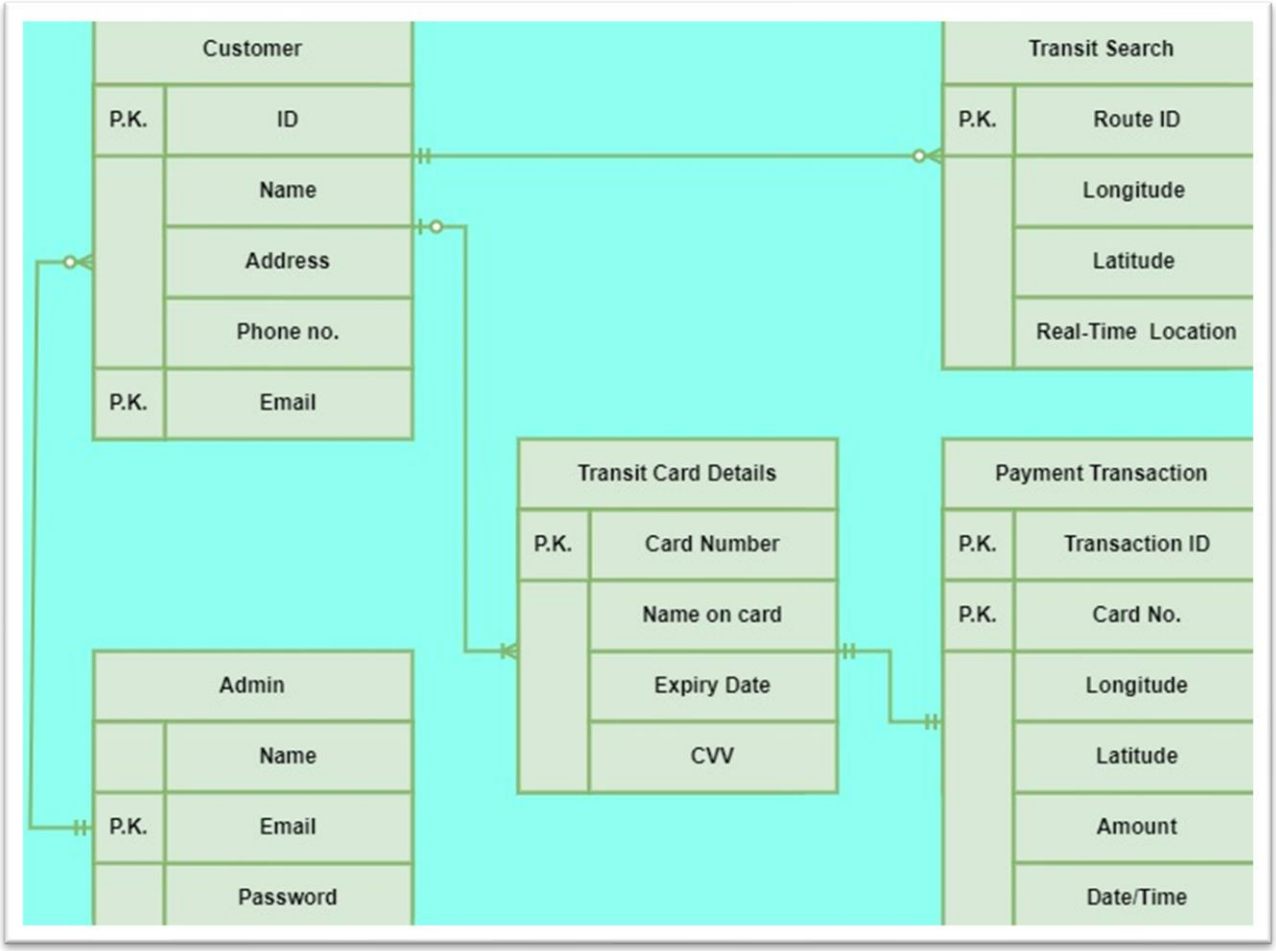


Figure 4 Figure of ERD Diagram

9. Use Case Module

The use-case diagram is used in UML to represent a system's behavior and capture its requirements. The diagrams provide a high-level overview of the system's functions, scope, and interactions between its actors. A good use case module demonstrates the relationship between use cases, actors, and systems.

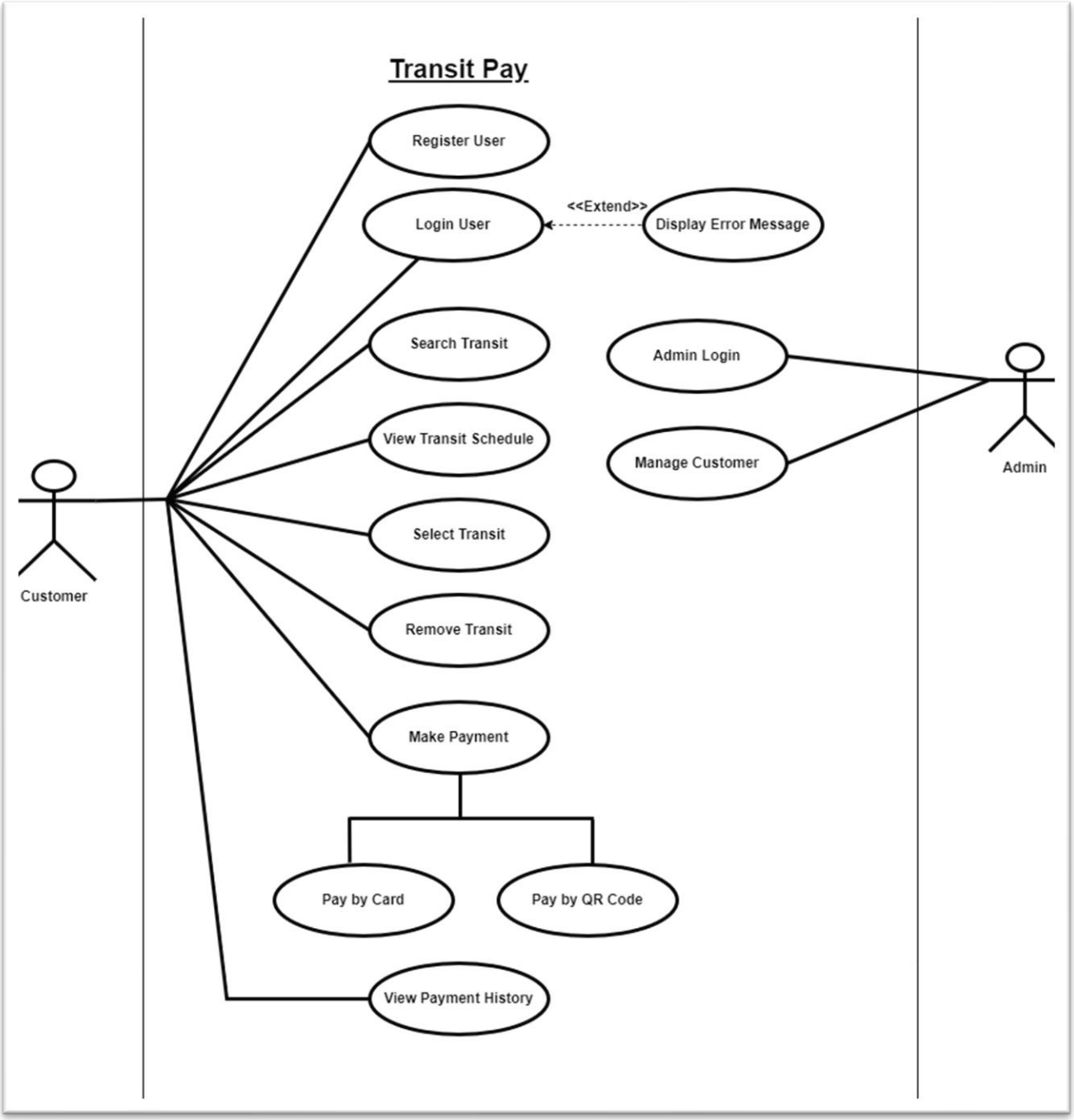


Figure 5 Figure of Use Case Diagram

9.1 Use case Diagram.

The use-case diagram visually represents a system's requirements and context. A complex system can be modeled with a single use-case diagram or broken down into many use-case diagrams to model individual components. An early use-case diagram is usually developed during the planning phase and used throughout development. This approach allows the team to keep track of high-level system functionality and requirements and ensure that the system meets those requirements as it is developed. (IBM, 2021) A helpful use case diagram can help to represent:

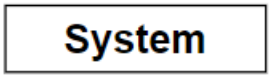
i. The system's functionality can be visualized clearly from the user's perspective.
ii. It provides clear concepts of system requirements and behavior.
iii. It lets us know how the system assists the various actor entities achieve their goals.
iv. It can serve as a framework for defining and tracking project progress by identifying system functional requirements.
v. It allows us to identify potential issues and errors in the system design.

The following components are used to describe the elements of a use case model:
System:

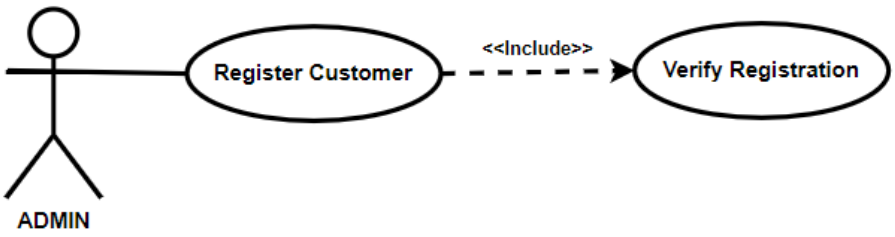
1. Use Case: The use case describes a system's function to achieve the user's goal, also known as system functionality. An oval shape always indicates a use case diagram, which is shown below:

2. Actor: An actor represents a user who interacts with the system use case, which can be a human, an organization, or another external system. Stick figures represent it. For example, an administrator manages a staff. Therefore, the administration is an actor. It is represented by the following image:

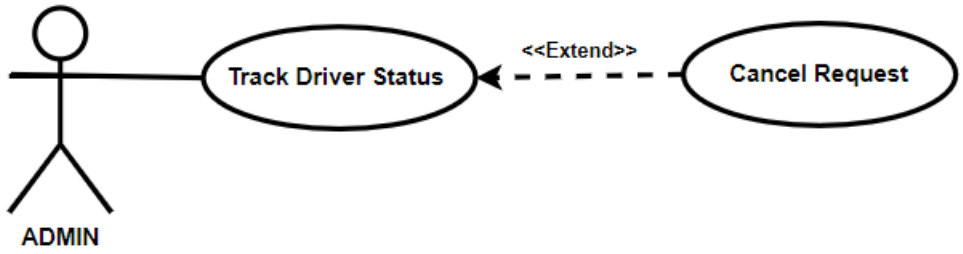
3. System: The system is represented by a rectangular shape enclosing the use cases and actors, visually representing the entire system. Lines connect the use cases to the system, illustrating the interactions and actions between each actor and the system. The following image represents it:



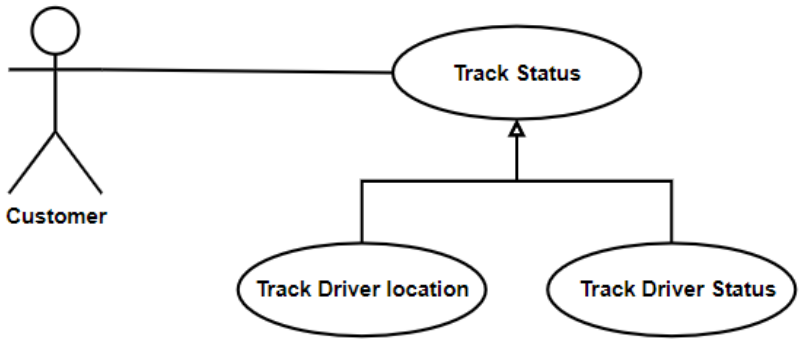
4. Relationship: Relationships can be used to clarify interactions between actors and use cases and dependencies among them. There are five relationship types, and some of them are described below:
   a. Include: Include refers to a relationship between two use cases. This represents a relationship between two use cases where one depends on the other to operate. A dashed arrow with an open arrowhead shows which use case is included, and the following image represents it:



b. Extend: It describes the relationship between two use cases that include another use case that may or may not be executed based on certain conditions. For example:

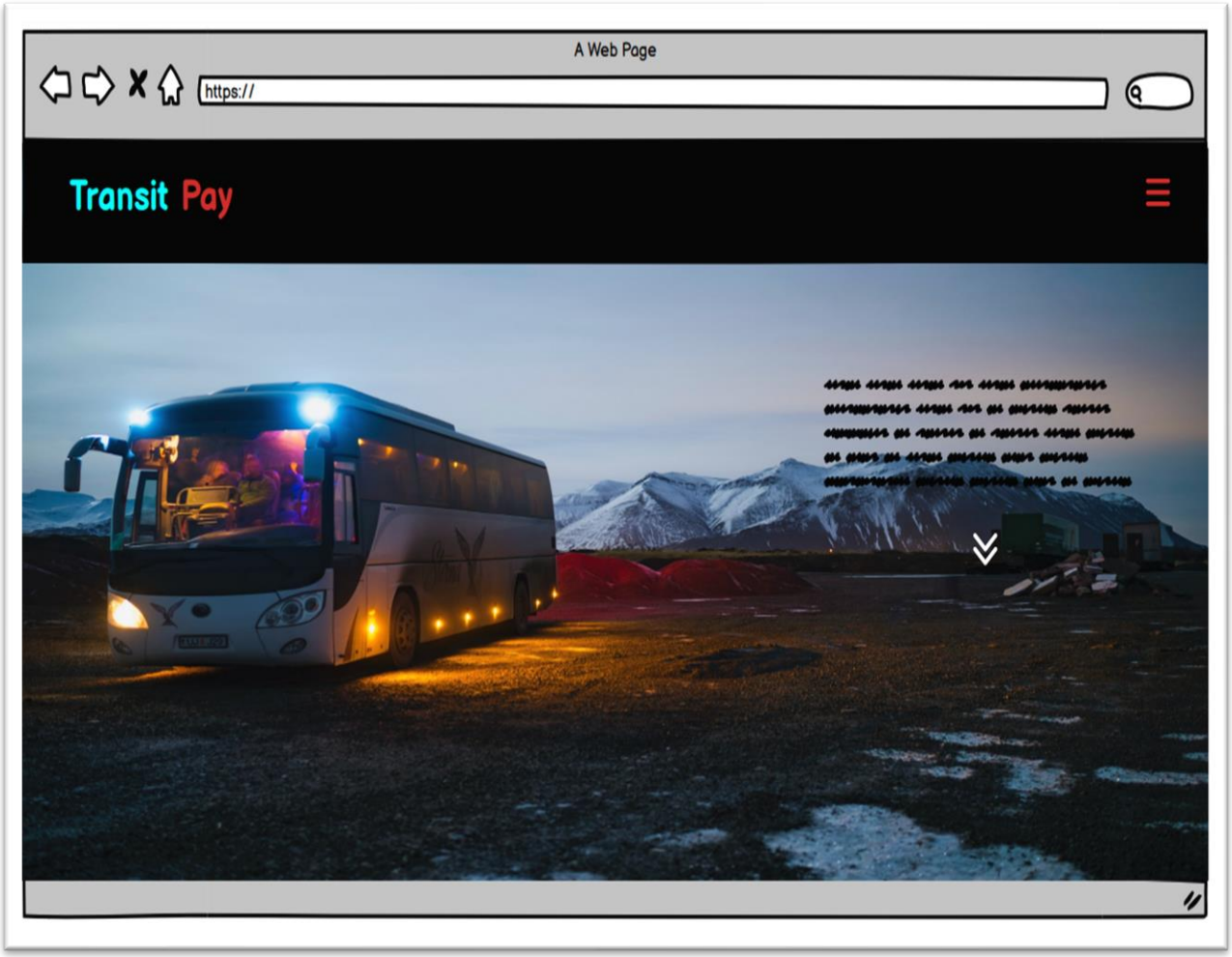


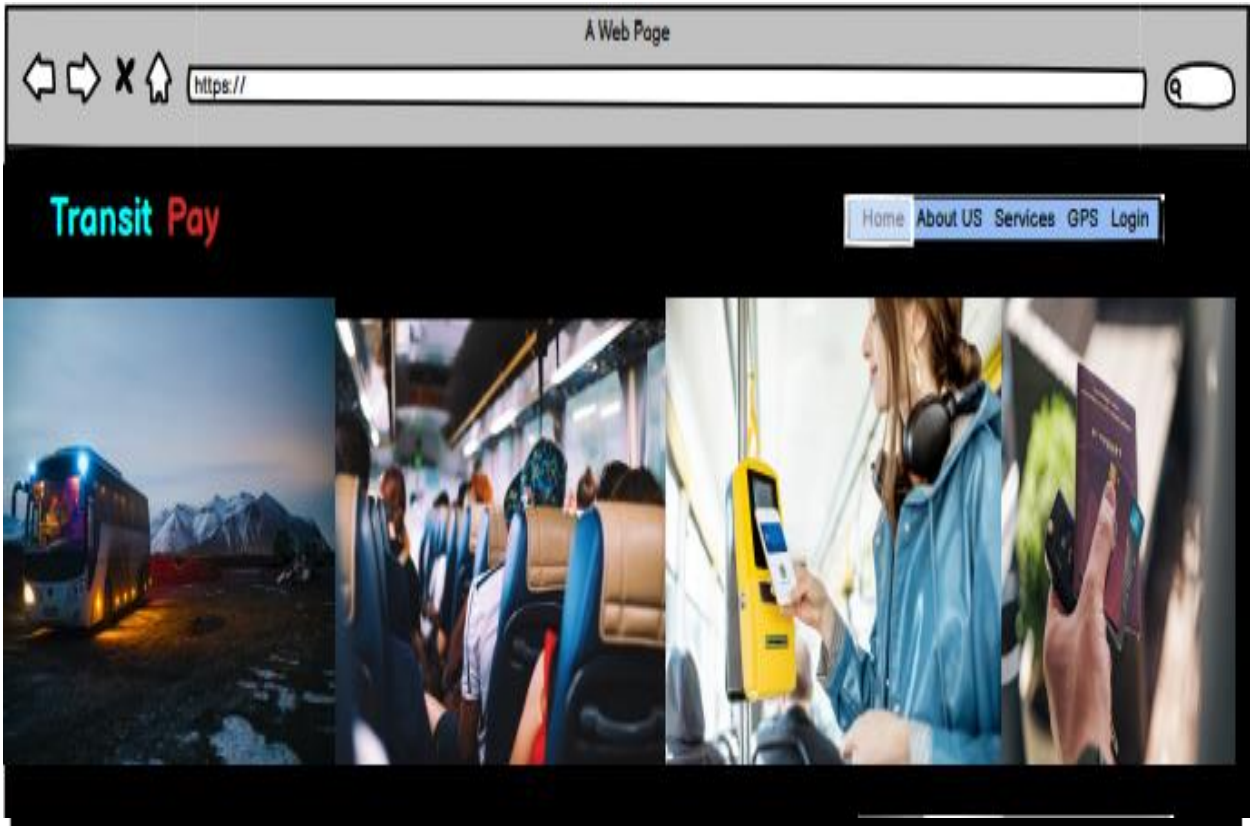
c. Generalization: Generalizations are relationships between use cases, actors, or classes of a system. It represents the inheritance of characteristics from one entity to another. It is represented by solid lines with hollow arrowheads pointing from child to parent. For example:

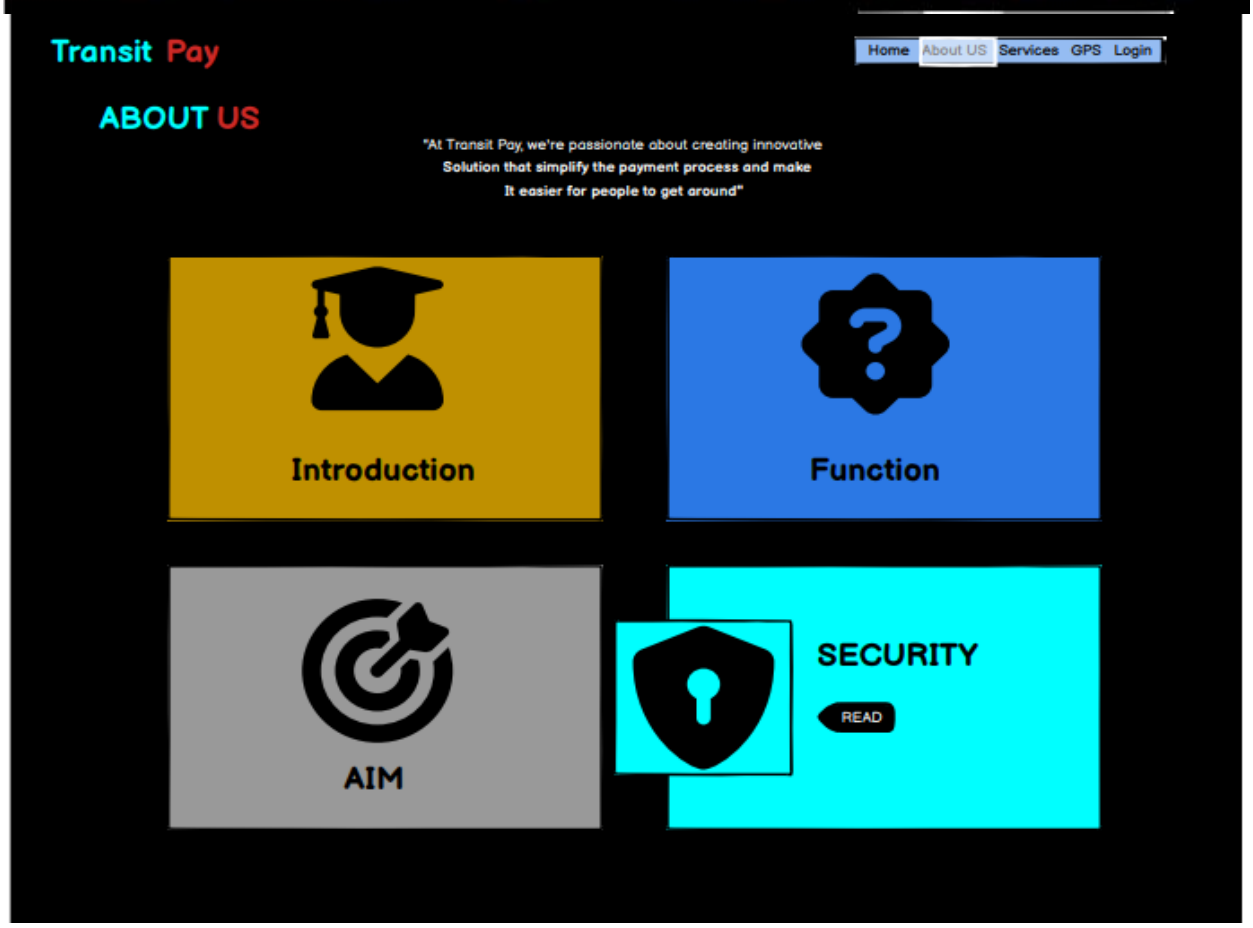


10. Wireframe

A wireframe is an essential visual representation of a website or application's user interface. It is a simplified layout that outlines the key elements and content of a page or screen without including design details like colors, fonts, or images. Wireframes are typically created early in the design process and guide the final product's development.




A Web Page
https://
Transit Pay
Home
About US
Services
GPS
Login


Transit Pay
Home
About US
Services
GPS
Login
ABOUT US
"At Transit Pay, we're passionate about creating innovative
Solution that simplify the payment process and make
It easier for people to get around"
Introduction
Function
AIM
SECURITY
READ

Transit Pay Services

Home About US Services GPS Login

Transit Calculator

Start Distance

END Distance

Fuel Type Petrol / Diseal

Fixed Profit

Passenger Passenger No.

Calculate

Transaction History

Your Daily Transaction Data

"We take your security seriously and it is our top priority."

S.N.	Card ID	Longitude	Latitude	Amount	Date/Time

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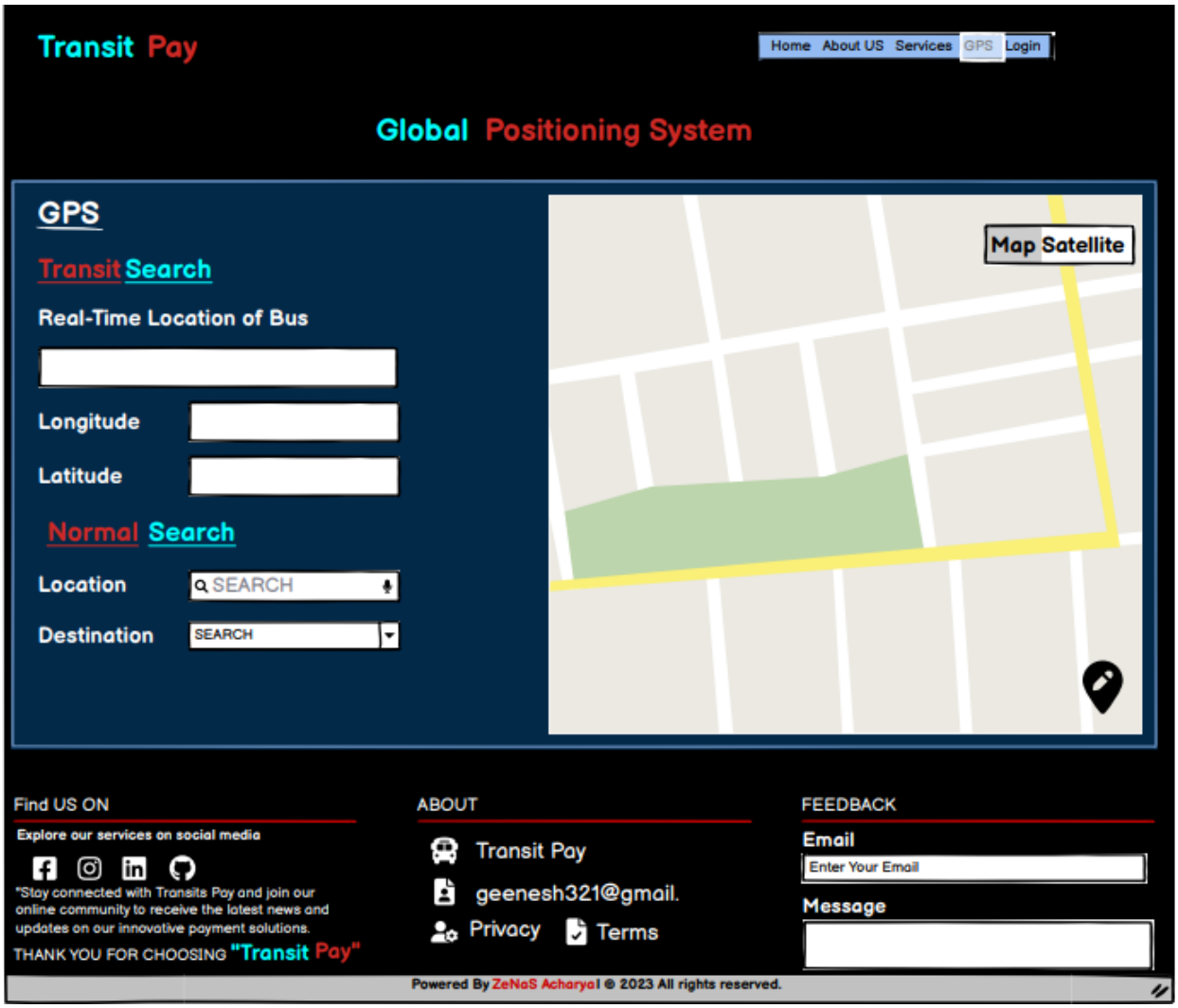
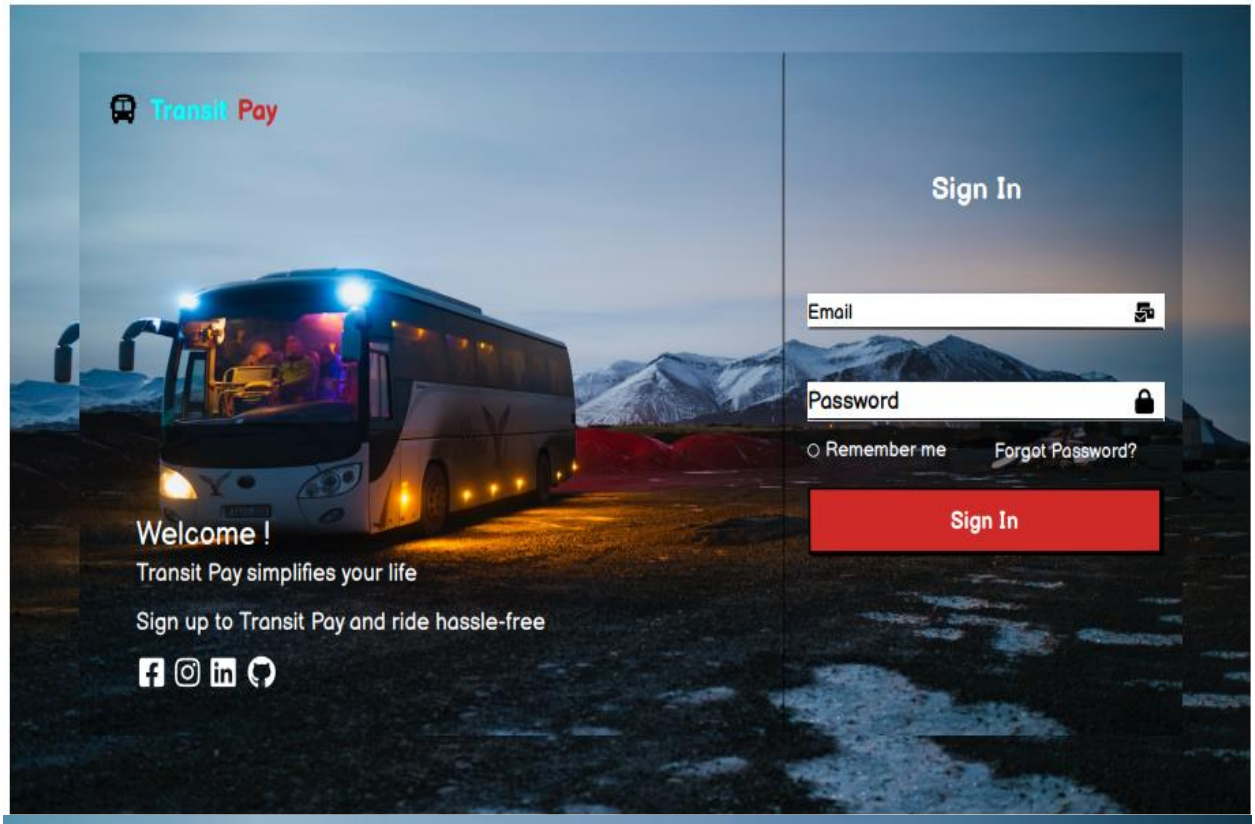
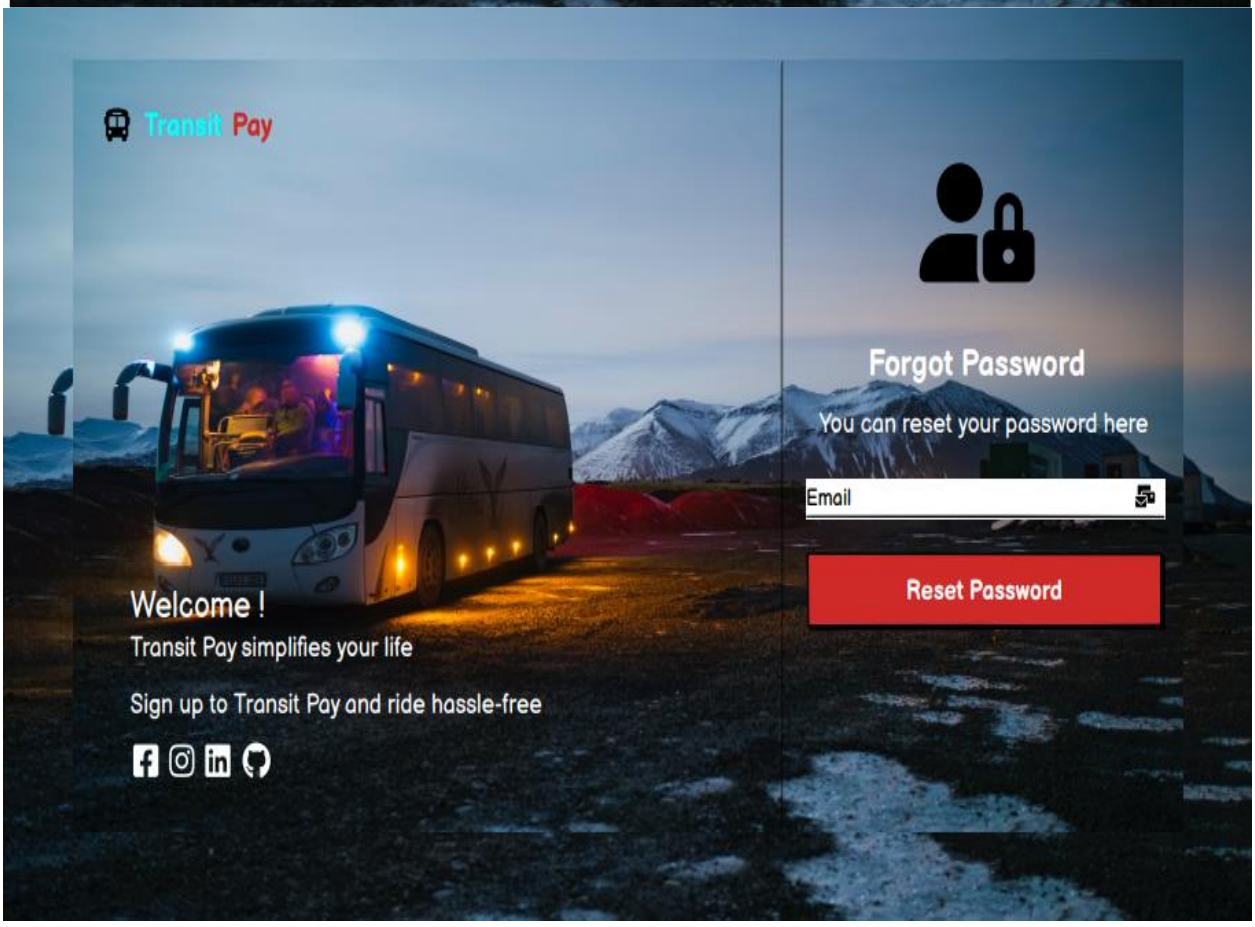
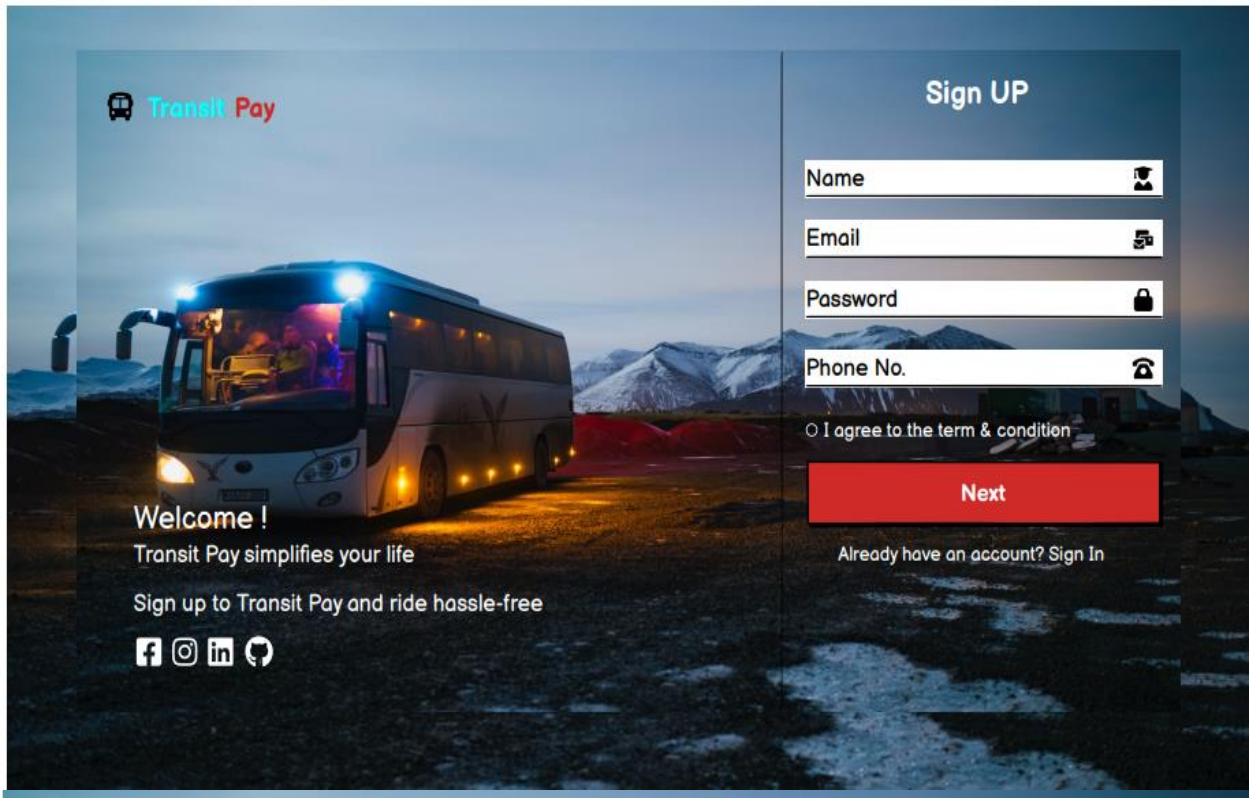
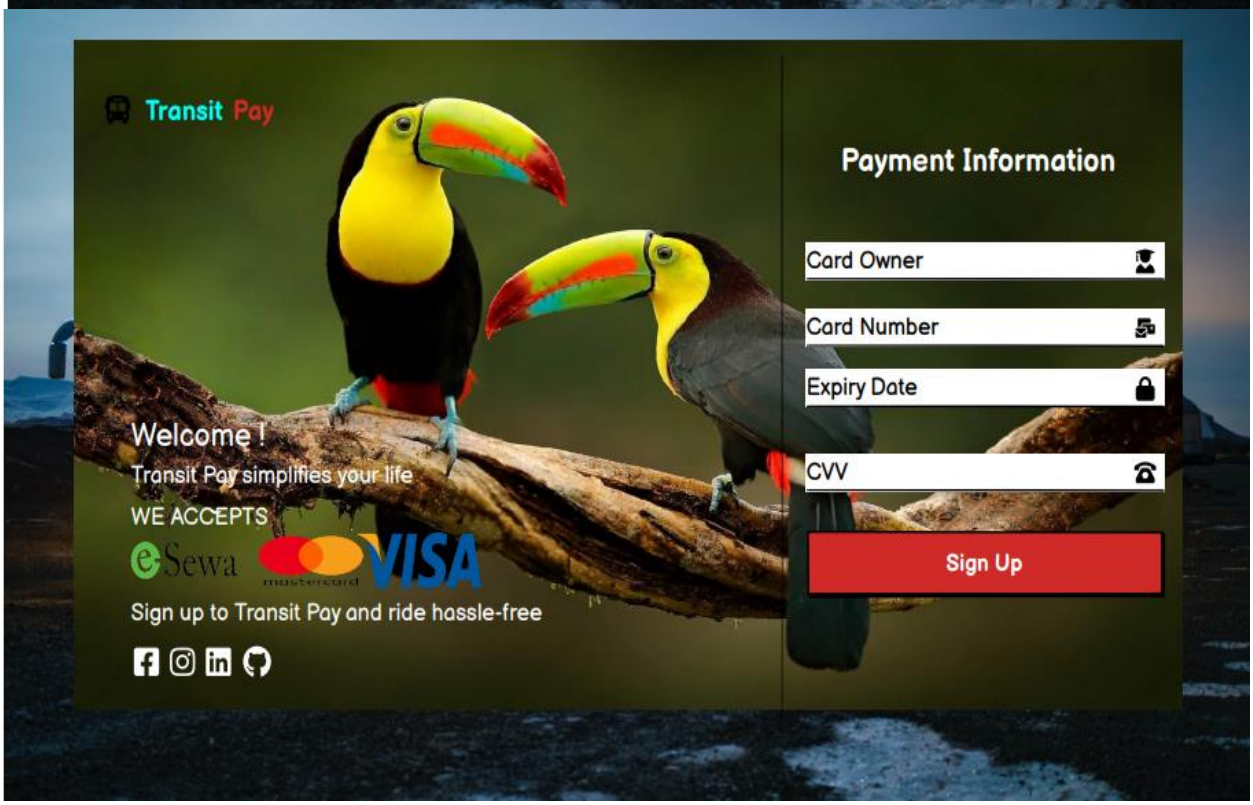

Transit Pay
Home About US Services GPS Login
Global Positioning System
GPS
Transit Search
Real-Time Location of Bus
Longitude
Latitude
Normal Search
Location
SEARCH
Destination
SEARCH
Map Satellite
Find US ON
Explore our services on social media
"Stay connected with Transits Pay and join our online community to receive the latest news and updates on our innovative payment solutions.
THANK YOU FOR CHOOSING "Transit Pay"
ABOUT
Transit Pay
geenesh321@gmail.
Privacy
Terms
FEEDBACK
Email
Enter Your Email
Message
Powered By ZeNaS Acharya © 2023 All rights reserved.


Transit Pay
Sign In
Email
Password
Remember me
Forgot Password?
Sign In
Welcome !
Transit Pay simplifies your life
Sign up to Transit Pay and ride hassle-free


Transit Pay
Forgot Password
You can reset your password here
Email
Reset Password
Welcome !
Transit Pay simplifies your life
Sign up to Transit Pay and ride hassle-free


Transit Pay
Sign UP
Name
Email
Password
Phone No.
I agree to the term & condition
Next
Already have an account? Sign In
Welcome !
Transit Pay simplifies your life
Sign up to Transit Pay and ride hassle-free


Transit Pay
Payment Information
Card Owner
Card Number
Expiry Date
CVV
Sign Up
Welcome !
Transit Pay simplifies your life
WE ACCEPTS
eSewa
VISA
Sign up to Transit Pay and ride hassle-free

11. Testing

Testing is assessing a system or its component(s) to determine whether it complies with the required specifications. In simple terms, testing is running a system to find any flaws, omissions, or gaps in the requirements. (Tutorials Points, 2023)

11.1 Validation on Email

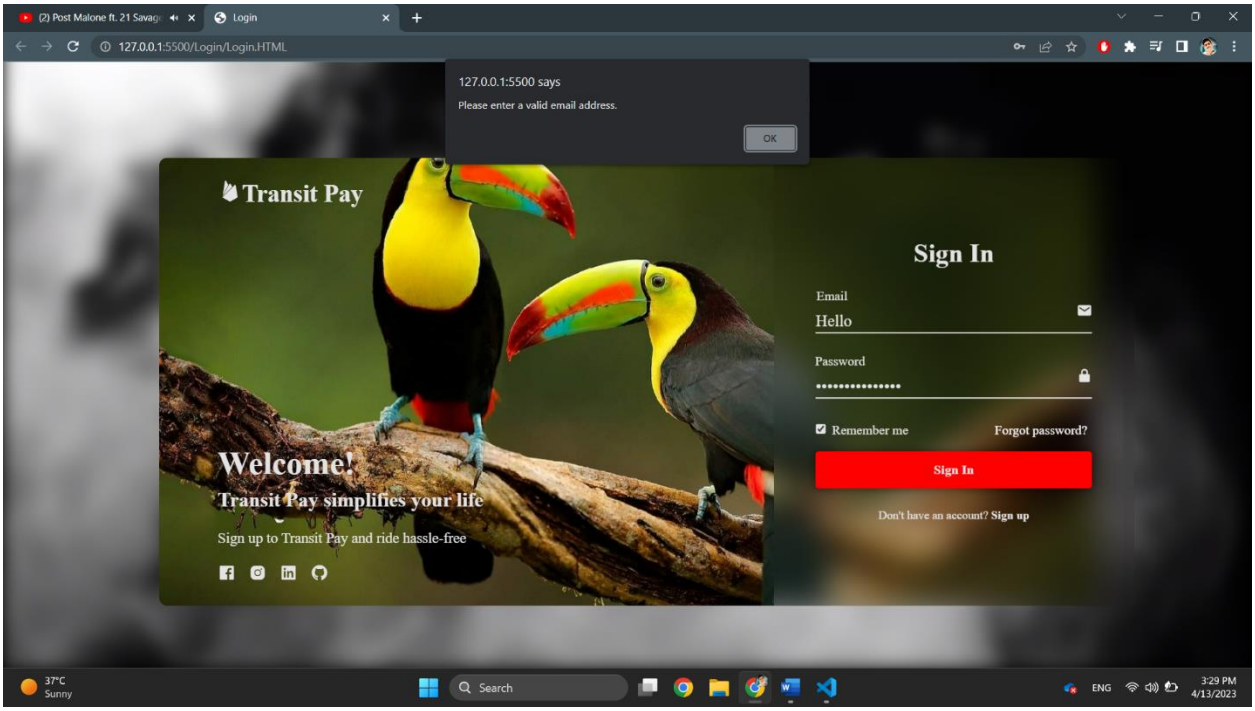


Figure 6 Email validation testing

- An email address must contain both the '@' symbol and the '.com' domain to be considered valid.

11.2 Validation on Password

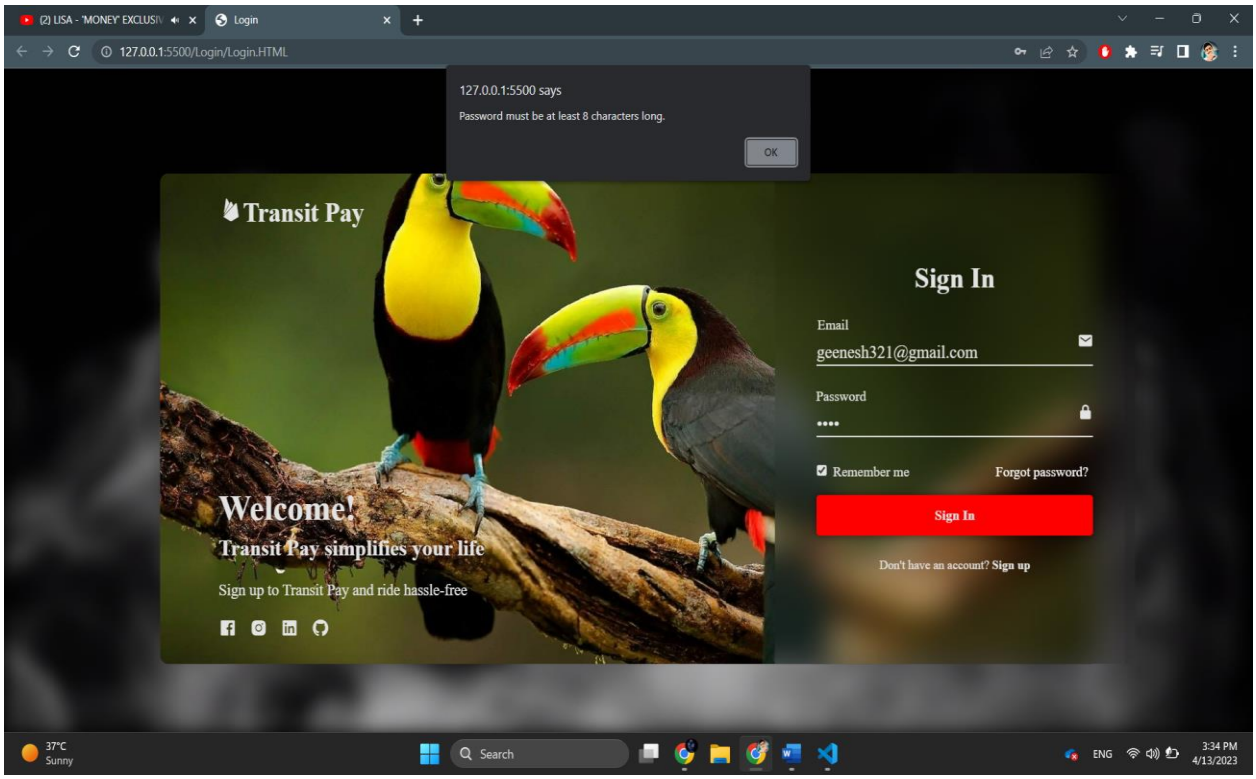


Figure 7 Figure of Validation on Password

- In order to log in, the password must be at least eight digits long.

11.3 Validation on Empty text field

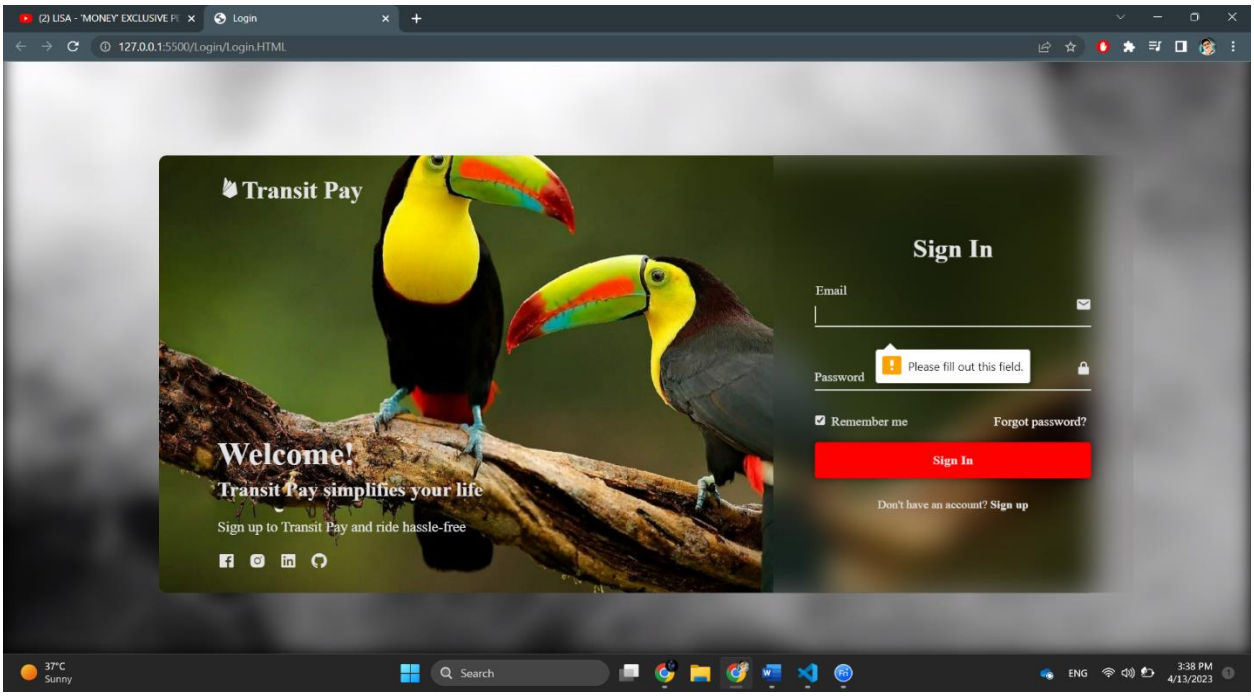


Figure 8 Figure of Empty Text field.

- Login is impossible if there are empty spaces in the text field.

11.4 Create User ID

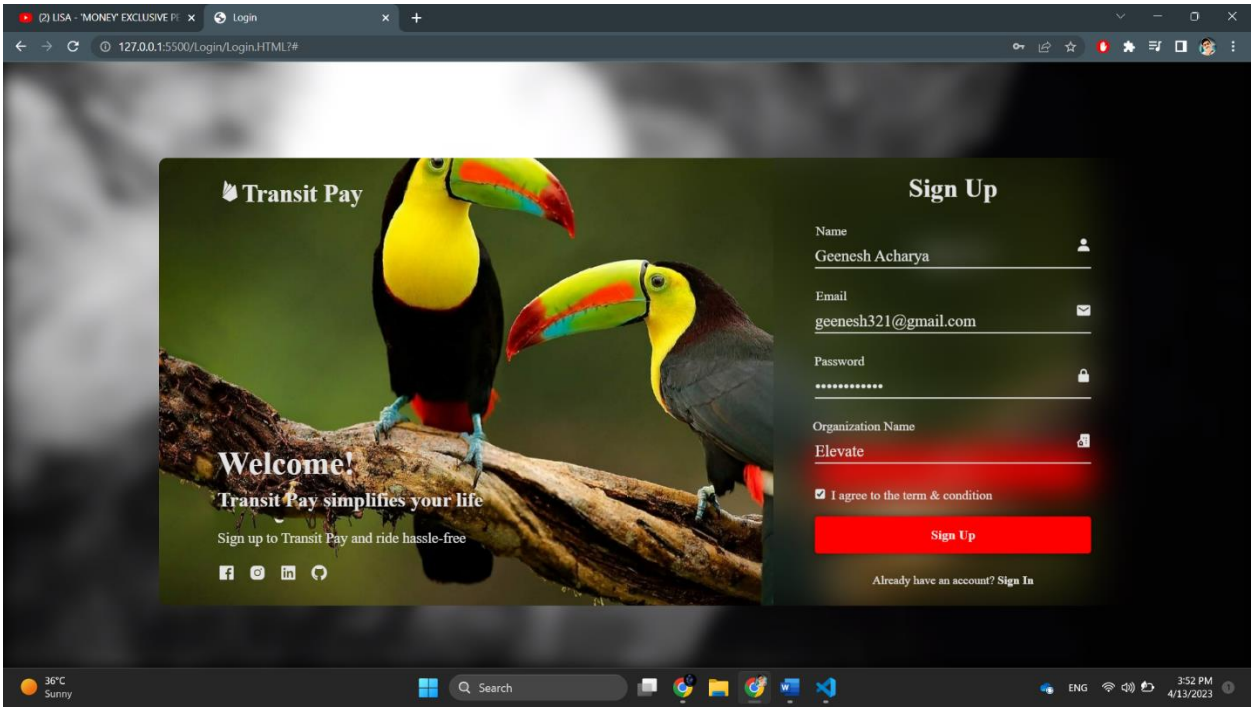


Figure 9 Figure of creating User ID

- In order to create a user, it is necessary to complete and submit the required data in the sign-up form.

11.5 Update Database

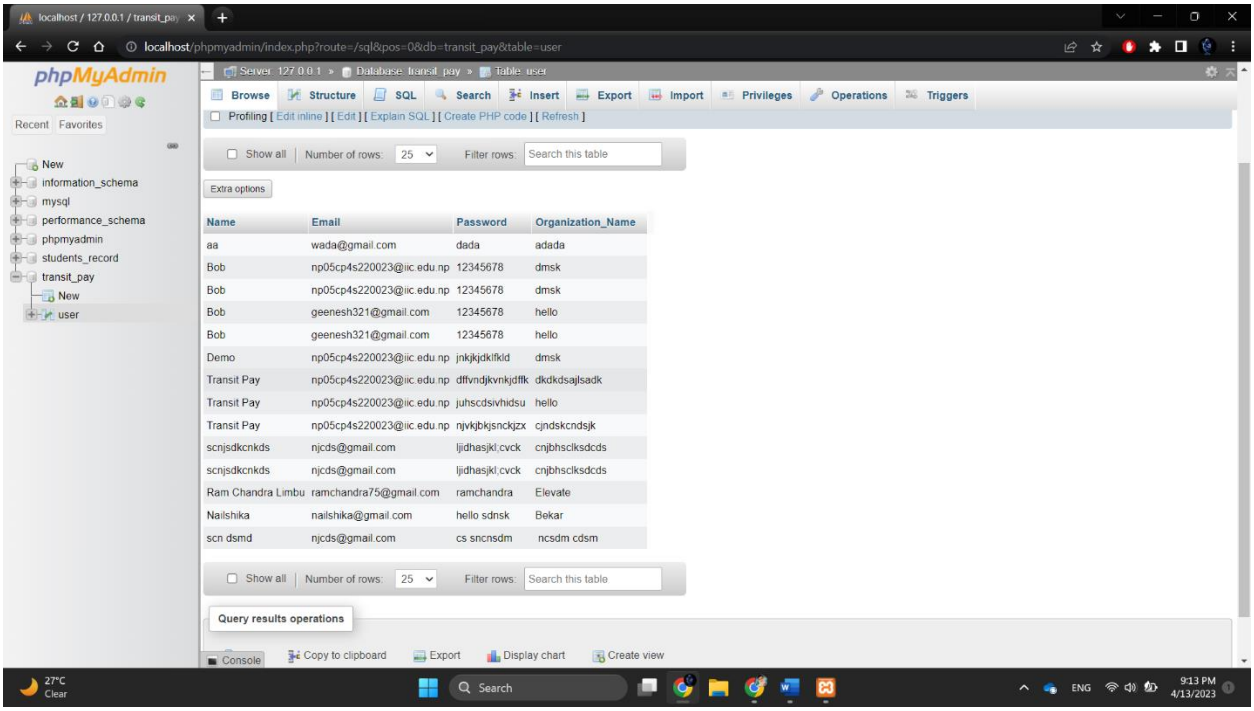


Figure 10 Figure of Updated Database after creating users.

- After user creation, the user's data is updated and stored in the database.

12. Conclusion

The Transit Pay system is a smart alternative to traditional bus payment systems that will lead the country to an advanced payment system. It aims to provide an efficient and cost-effective payment system using a card-based system to eliminate the use of a hand-to-hand cash payment system.

It has become common for most countries to have a system like a Transit pay system. This system has many benefits, such as reducing the risk of theft and human error and increasing accuracy in fare calculation. A centralized database of passenger records provided by Transit Pay can assist in reducing crime rates and providing better transportation services. Contingency plans can minimize the risks and threats associated with this project. Overall, Transit Pay has the potential to revolutionize public transportation in Nepal, making it more accessible and convenient for passengers.

12.1 Legal Issues

In addition to the technical and operational challenges, there are also legal issues that must be considered when implementing the Transit Pay system. One major concern is data privacy and security. The system will be collecting and storing sensitive information such as passengers' payment details and travel history. Therefore, it is crucial to ensure that the system is compliant with data protection laws and regulations. Another legal issue is related to liability in case of system failure or malfunction, which could lead to financial loss or personal injury. To mitigate this risk, it is important to have proper insurance coverage and liability agreements in place. Additionally, there may be regulatory and legal requirements that need to be met before implementing the system, such as obtaining necessary permits and licenses. It is essential to consult legal experts and regulatory authorities to ensure compliance with all relevant laws and regulations.

12.2 Social Issues

In addition to the technical and legal considerations, there are also social issues that need to be considered when implementing a transit payment system. For example, certain populations, such as low-income individuals, may not have access to the necessary technology or financial resources to utilize a digital payment system. This could lead to inequitable access to public transportation and further marginalize already disadvantaged communities. It is important to consider these social factors and ensure that any new transit payment system is inclusive and accessible to all members of society. Additionally, public education and outreach efforts may be necessary to ensure that users understand how to use the new payment system and can access any available resources or support.

12.3 Ethical Issues

In conclusion, there are several ethical issues that need to be considered when implementing the Transit Pay system. Firstly, the collection and use of personal data of passengers raises concerns about privacy and data protection. Secondly, there may be issues of equity and fairness in the pricing of the bus fare, especially if the fare calculation algorithm is not transparent and unbiased. Additionally, the use of facial recognition technology for passenger identification and payment raises questions about consent and the potential for misuse of the technology. It is important for the developers of the system to address these ethical concerns and ensure that the implementation of Transit Pay is done in a responsible and transparent manner.

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