Eco-Friendly Transportation system

وسيلتي

Waseelty

أوكساچون

OXAGON

**CPCS351-Software Engineering 1 Fall 2023- First semester**

# Eco-friendly transportation system

**Group No: 1**

| Student Name | Student Number |
|---|---|
| Danah Saleh Al-Malki | |
| Areej Abdullah Suleman | |
| Anfal Sultan Al-shihri | |
| Layan Turki Zaafarani (leader) | |

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# 1. Project Description

## 1.1 Introduction:

We, as a people, must contribute to the development of modern cities such as Oxagon, NEOM and The Line, so we created the idea of this project, "وسيلتي".

The transport system in NEOM is a zero-car environment, to support this environment without hindering the daily lives of the citizens we need to improve public and private transportation by making it more accessible, affordable, and reliable which is what we want to achieve through this project.

## 1.2 Problem description:

You may be wondering why we should switch to electrical vehicles from normal fuel-vehicles in the first place. Vehicles that burn fossil fuel produce large amounts of carbon dioxide "greenhouse gas". Greenhouse gases trap heat inside the atmosphere which is the biggest cause for global warming. To avoid such threats, we switch to electrical vehicles that use solar energy as their main source of energy.

Building this system will contribute to the environment and will help with the traffic problems tremendously. It will be one step closer to "zero-car environment". A zero-car environment means less accidents, less sacrificed lives and less time wasted in traffic.

Although we established the importance of electrical vehicles, we are yet to see them in action. as we do not have access to them everywhere. The main problem is the accessibility of the electrical vehicles, our system will solve this problem by giving you many options to choose from depending on your budget and location while guaranteeing you safe and fast transportations every day.

## 1.3 Project objectives:

The project objective is to create a user-friendly application to allow users to manage their transportation needs such as:

- Allow users to sign in/up and manage their subscriptions and/or purchase a one-time ticket.
- Create a map with all the stations and suggest the closest stations to the user to help him choose the most suitable option.
- Protect all vehicles so that you cannot use them unless you have a barcode of the receipt.
- Provide fast, clean, safe vehicles that follow the road rules.
- The app will have information about each vehicle with detailed specifications.

## 1.4 Project Team:

| Student Name | Student Number | Task |
|---|---|---|
| **Danah Saleh Al-Malki** | **2006346** | **Introduction, included & excluded, stakeholders, use case description, similar software, relationships within UML class diagram, Testing.** |
| **Areej Abdullah Suleman** | **1916786** | **Project goals, system's scope, domain analysis, difficult and risk analysis in the domain, domain model, UML class diagram, state diagram.** |
| **Anfal Sultan Al-shihri** | **2005034** | **Source of domain analysis Information, use case description, functional and non-functional requirements, similar software, system architecture, sequence diagram.** |
| **Layan Turki Zaafarani (leader)** | **2005070** | **Problem description, problem objectives, use case description, use case UML, domain model, UML class diagram, activity diagram.** |

# 1.5 Goals and Scope:

### 1.5.1 Project Goals:

Our project aims to facilitate traffic by reducing the number of cars that cause traffic congestion. It also protects the environment from vehicle exhaust and toxic gases emitted from it. Individuals can contribute to this using our platform, which provides several modes of transportation, including public means such as smart driverless electric-powered minibuses, and private means

that include bicycles and scooters. The main objective of the platform is to facilitate the process of booking these vehicles for users in line with their capabilities and needs. The user can book the vehicle he wants anywhere and anytime, as the application provides a map that helps in searching for the nearest station containing the desired vehicles.

### 1.5.2 Sources of Domain Analysis Information:

Our Project helps students, employee, tourist, or any part of the NEOM community. Schools and other employers can provide spatial transport vehicles for them. Anyone can get the "وسيلتي" application with IOS/Android/Microsoft devices that have a connection to the satellite.

Bus stations' locations will be connected to the "وسيلتي" application over the city. Also, scooters and bicycles have an embedded system (ASIC) that is connected to the application. "وسيلتي" shows the user the accessible vehicle on the application map. "وسيلتي" application map is like google map except that only stations, scooters, and bicycles lections appear on the map.

### 1.5.3 System's Scope:

"وسيلتي" will be a mobile application for both IOS and Android devices that provide the user with an easy-to-use interactive interface to reach and book the desired transportation, in addition to a map that enables the user to search for the nearest station to his location. The application provides different user interfaces based on the means of transportation, whether it is public or private, and depending on whether it is a one-time use or a monthly subscription. After the user has finished booking the appropriate vehicle and paying, the vehicle number and a barcode will appear to him as a key to operate the vehicle. Each station has a barcode reader that allows the user to operate the vehicle. The application also provides a tracking service. In each vehicle, there is a tracking chip that allows users, as parents, to track the vehicle and ensure the safety of their children's arrival at their destination. This project is expected to be ready by the end of 2032 and will be launched for use at that time.

#### 1.5.3.1 Include

The main features of our system Include:

- Viewing buses' timetables
- Reporting all accidents and damage
- Viewing and booking available vehicles
- Choosing a One-time use ticket or monthly subscription

#### 1.5.3.2 Exclude

Features excluded from the system are:

- Selling vehicles
- Accidents investigation
- Immediate repair services
- Commercial Use of vehicles
- Requesting buses outside their regular hours

#### 1.5.3.3 Stakeholders:

The government, staff, and users of the application are all stakeholders in this project.

# 2. Business Requirements Specifications (phase 2).

## 2.1 Domain analysis

Since Saudi Arabia does not have a large-scale public transportation system, we restored to research and investigate other transportation systems from around the world.

We concluded that the most important aspect for public transportation to succeed is a stable and suitable infrastructure, like dedicating lanes for buses and scooters. Fortunately, Neom city has plans for its infrastructure to support mobility.

Another thing that should be considered is the importance of communication and punctuality in these types of systems because of how greatly they influence the living style of the citizens and whoever benefits from it.

## 2.2 Functional Requirements & Non-Functional Requirements

### 2.2.1 Functional Requirements

*R1. The system will allow the users to register to the system*

r1. The system will allow the user to login with "نفاذ" platform.

r2. The system will allow the user to login without "نفاذ" platform.

r3. The system will allow the user to create an individual account.

r4. The system will allow the user to create a family account.

r5. The system will allow the user to register as guest.

*R2. The system will allow the user to pay through the application.*

r1. The system should allow the users to pay via virtual wallet such as (mada pay, apple pay, etc).

r2. The system should allow the registered users to subscribe to different bundles (family- bundles, induvial- bundles, company- bundles).

r3. The system shall allow guest users to pay before the trip without subscription depending on the destination.

r4. The system shall show/print the bill for guest users after/before the trip that include user and trip information.

r5. The system shall allow the user to view tickets.

r6. The system shall allow the user to cancel the tickets.

r7. The system shall allow the user to refund.

*R3. The system will provide maps.*

r1. The system has access to the user's mobile map.

r2. The system will track the user's journey.

r3. The system will provide Real-Time information about vehicles availability.

r4. The system will use the user location to indicate the closest stations.

*R4. The system will allow the users to book a ticket.*

*R5. The system will allow the users to explore the state of the vehicle.*

*R6. The system will guide the users with instructions to drive the vehicles.*

### 2.2.2 Non-Functional Requirements

*R1. The "وسليتي" application track and update the user location .*

*R2. The "وسيلتي" application support 5 languages (Arabic , English , Chinese , French ,Spanish )*

*R3. The "وسيلتي"application is available and supported 24/7.*

*R4. The "وسيلتي"application will implement secure application design and architecture.*

*R5. The "وسيلتي"application will secure the input validation and authorization.*

*R6. The user payment information is encrypted for maximum safety.*

## 2.3 Technique for Gathering Data

### 2.3.1 Survey

Since the goal of our project is to serve citizens and improve their lifestyles, we conducted a survey to measure the importance of building a public transportation system in Saudi Arabia.

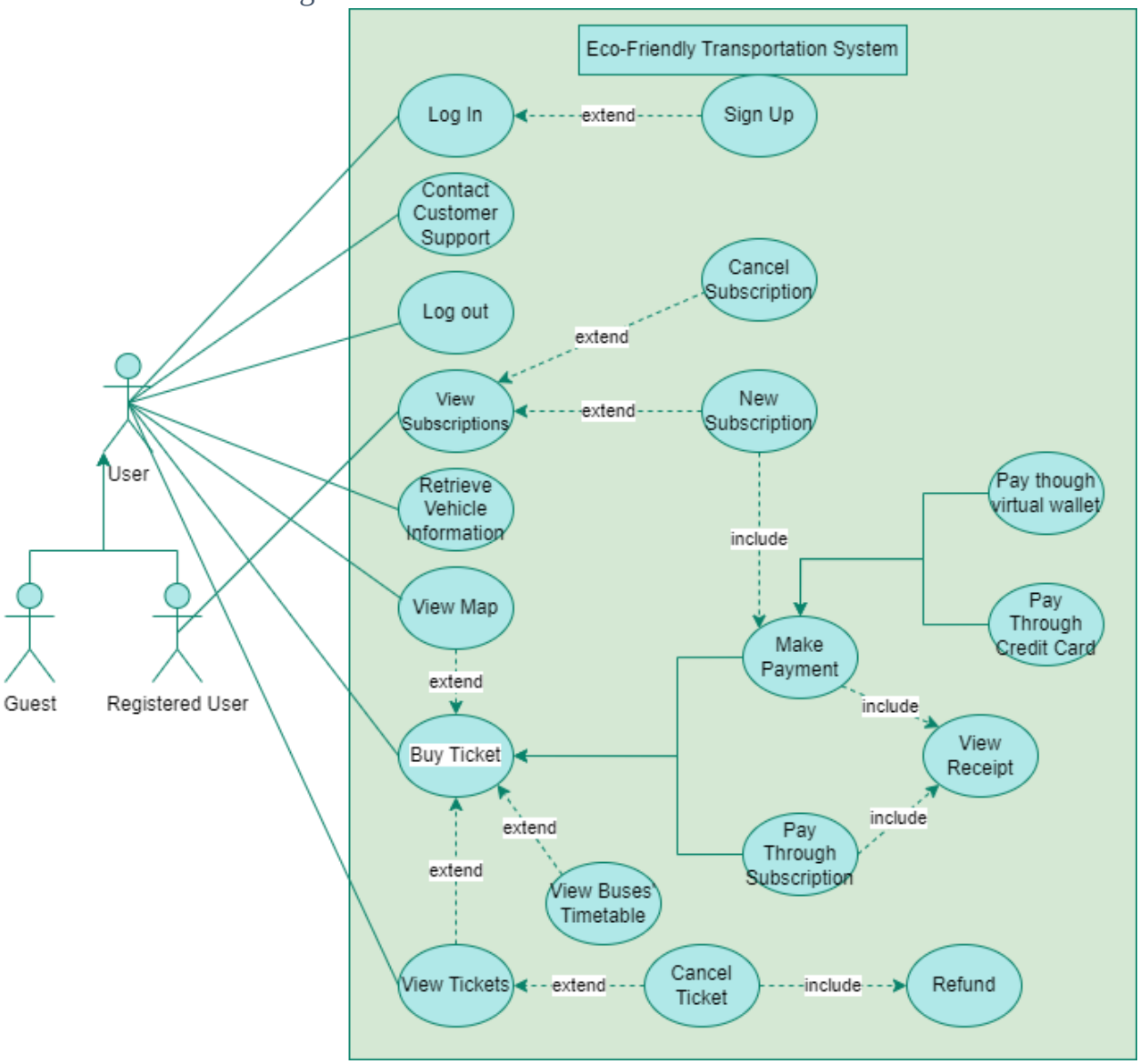
The result and statistics for the survey can be found in Appendix A, from which we can conclude that public transportation is a welcome and encouraged idea that a lot of people wish to achieve. We also found that miscommunication is a prominent problem when it comes to transportation, which this software will solve by providing a simple and easy to navigate user interface.

### 2.3.2 Similar software

For the buses system, we studied the South Korean bus transportation system TxBus through their website to aid us in this project. We adopted the basics of their ticket booking process but with an improvement such that instead of the user having to enter the trip information, the trips are presented in a timetable for each station. Also, each station is shown on a map for easier assessment for the user of the most suitable station.

For the scooter system, Saudi Arabia has Gazal application, which launches their operation to Real Estate, Cities, Campuses, and Medical Cities. We got inspired and would like to support the zero-car environment.

## 2.4 UML Use Case Diagram



## 2.5. Use Case Description

| Use Case 1 | |
|---|---|
| **Use Case ID:** | UC-01 |
| **Use Case Name:** | Add new subscription |
| **Use Case Description:** | Registered user accesses the system to view the subscription bundles, then selects a subscription bundle and proceed to pay for it. |
| **Actors: Registered User (Has an existing account)** | |
| Preconditions: | |
| User is logged into the system and opened the 'view subscription' page. | |
| **Flow of Events of the Primary Scenario:** | |
| 1- User press 'add new subscription'<br>2- User chooses one of the three subscription bundles<br>3- System shows the payment page<br>4- User chooses payment method<br>5- User enters the information of the chosen payment method<br>6- User verifies the payment<br>7- System shows the receipt for the payment | |
| **Flow of Events of the Alternative Scenarios:** | |
| None. | |
| **Flow of Events of the Exception Scenarios:** | |
| 5a. The payment information is incorrect.<br>---5a1. System displays error message saying payment information are incorrect.<br>---5a2. User either re-enter the payment information, or back out of this use case. | |
| **Extension Points:** | |
| None. | |
| **"Used" Use Cases:** | |
| - 'Make Payment'. | |
| **Postconditions:** | |
| - User has a new subscription which can be viewed in 'View Subscriptions'. | |

| Use Case 2 | |
|---|---|
| **Use Case ID:** | UC-02 |
| **Use Case Name:** | View Subscriptions |
| **Use Case Description:** | Registered users access the system to view their valid subscriptions. |
| **Actors: Registered User (Has an existing account)** | |
| Preconditions: | |
| User is logged into their account | |
| **Flow of Events of the Primary Scenario:** | |
| 1- User press 'View Subscriptions'<br>2- System displays all valid subscriptions<br>3- User chooses one subscription to view its information | |
| **Flow of Events of the Alternative Scenarios:** | |
| None. | |
| **Flow of Events of the Exception Scenarios:** | |
| 2a. User has no subscription, or all subscriptions are invalid.<br>--- 2a1. System displays error message saying no subscriptions are available and provide the option of adding a new subscription. | |
| **Extension Points:** | |
| - Cancel subscription<br>- Add new subscription | |
| **"Used" Use Cases:** | |
| Refund. | |
| **Postconditions:** | |
| - User's subscription details are available to view. | |

| Use Case 3 | |
|---|---|
| **Use Case ID:** | UC-03 |
| **Use Case Name:** | Cancel subscription |
| **Use Case Description:** | Registered user accesses the system to cancel the subscription |
| **Actors: Registered User (Has a subscription)** | |
| **Preconditions:** | |
| User had already a subscription. | |
| **Flow of Events of the Primary Scenario:** | |
| 1. The user logs in to the system.<br>2. The user opens the 'view subscription' page.<br>3. User chooses a subscription to view its details.<br>4. The user presses the cancel subscription button.<br>5. The user presses the confirm button to cancel the subscription. | |
| **Flow of Events of the Alternative Scenarios:** | |
| None. | |
| **Flow of Events of the Exception Scenarios:** | |
| None. | |
| **Extension Points:** | |
| None. | |
| **"Used" Use Cases:** | |
| None. | |
| **Postconditions:** | |
| - User's subscription is canceled. | |

| Use Case 4 | |
|---|---|
| **Use Case ID:** | UC-02 |
| **Use Case Name:** | Book Ticket (description) |
| **Use Case Description:** | Users access the system to choose and book a ticket for the wanted vehicle. |
| **Actors: Users.** | |
| Preconditions: | |
| No preconditions. | |
| **Flow of Events of the Primary Scenario:** | |
| 1. User press on the ‘Book Ticket’ option.<br>2. System displays all available vehicles and its time duration.<br>3. User chooses one of the vehicles’ tickets.<br>4. System displays payments options.<br>5. User chooses to purchase through ‘Make Payment’.<br>6. User chooses payment method.<br>7. User enters the information of the chosen payment method.<br>8. User verifies the payment.<br>9. System reserves the chosen ticket.<br>10. System shows the receipt for the purchase. | |
| **Flow of Events of the Alternative Scenarios:** | |
| 5a.1 User press on the ‘Book Ticket’ option.<br>5a.2 System displays all available vehicles and its time duration.<br>5a.3 User chooses one of the vehicles’ tickets.<br>5a.4 System displays payments options.<br>5a.5 User chooses ‘Pay Through Subscription’.<br>5a.6 System reserves the chosen ticket.<br>5a.7 System shows the receipt for the purchase. | |
| **Flow of Events of the Exception Scenarios:** | |

| |
|---|
| **Primary Scenario:**<br>7a. Payment information are incorrect.<br>--7a1. System displays error message saying payment information are incorrect.<br>--7a2. User either re-enter the payment information, or back out of this use case.<br>**Alternative Scenario:**<br>5a. No active subscriptions.<br>--5a1. System displays an error message with no active subscriptions.<br>--5a2. User can either cancel reservation or purchase through ‘Make Payment’. |
| **Extension Points:** |
| None. |
| **“Used” Use Cases:** |
| - ‘Make Payment’.<br>- ‘Pay Through Subscription’. |
| **Postconditions:** |
| - User has a ticket and can be viewed in ‘View Tickets’. |

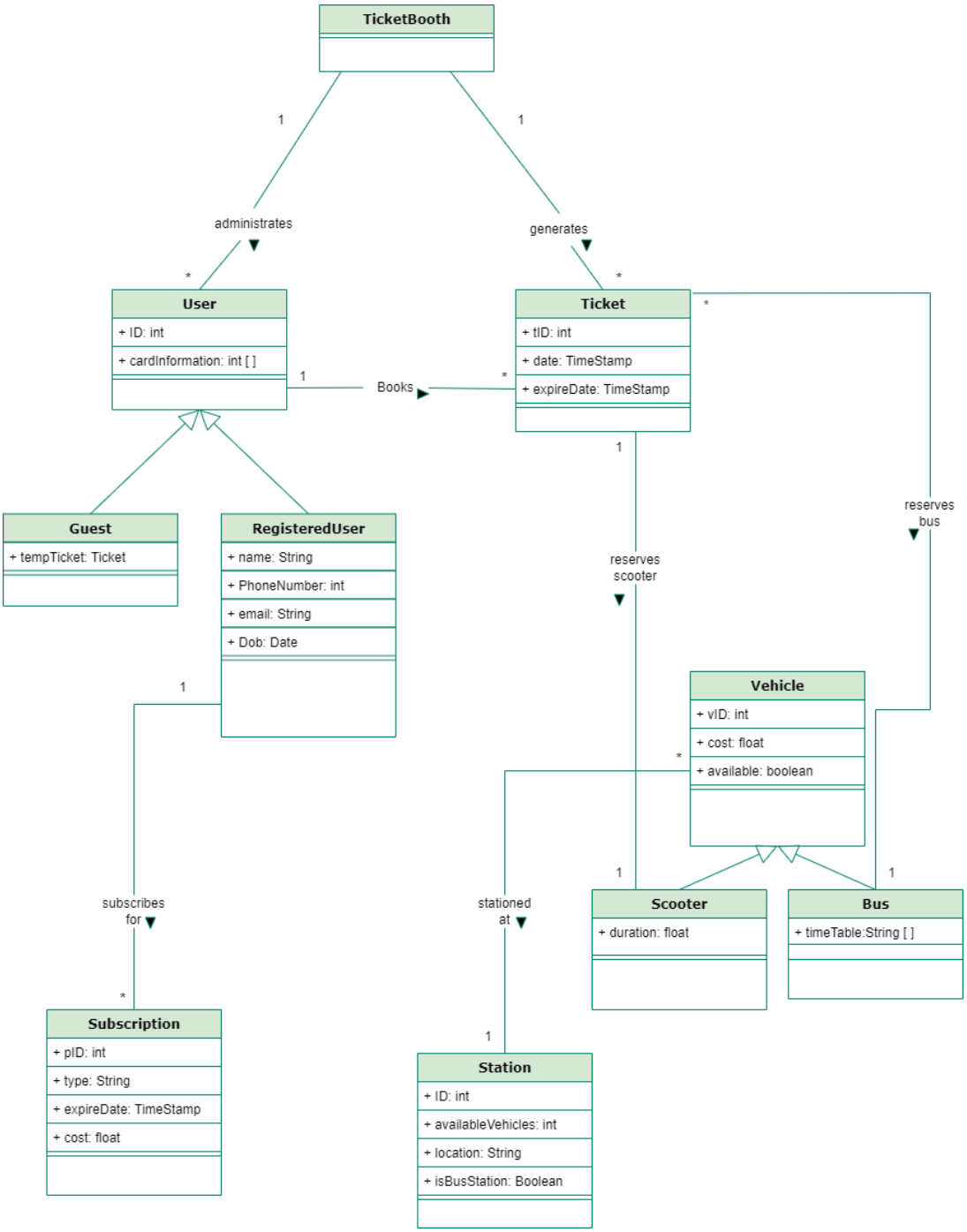
## 2.6 Difficulties & risk analysis in the domain

The difficulties we encountered while working on developing the system are:

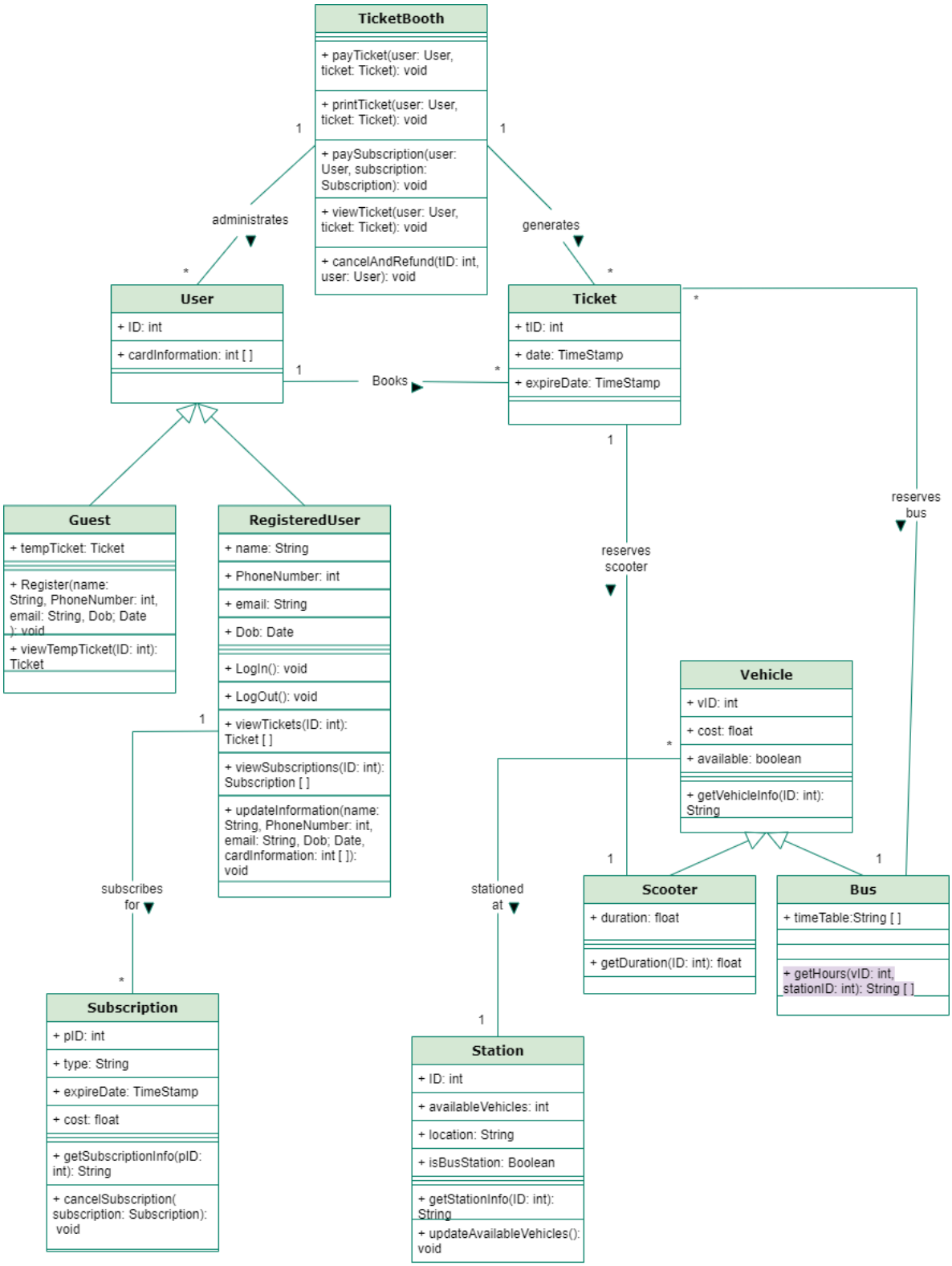
- Requirements are changeable during the development process.
- Difficulty in collecting data.
- Difficulty communicating with stakeholders.
- The existence of the infrastructure increases the chances of success of projects, but we lack a public transport system on a large scale here in Saudi Arabia.
- Vehicles are damageable as there is no guarantee of their safety.

# 3. Static Modelling (phase 3).

## 3.1. Domain Model



## 3.2. UML Class Diagram



### 3.2.1. Association Relationships and Their Multiplicity

1. **Administrates:** between Ticketbooth class and User class, one to many respectively.
2. **Generates:** between Ticketbooth class and Ticket class, one to many respectively.
3. **Books:** between User class and Ticket class, one to many respectively.
4. **Subscribes for:** between RegisteredUser class and Subscription class, one to many respectively.
5. **Reserves bus:** between Ticket class and Bus class, many to one respectively.
    - One bus can be reserved by multiple tickets, one ticket can reserve one bus only.
6. **Reserves scooter:** between Ticket class and Scooter class, one to one respectively.
    - One scooter can be reserved by only one ticket, one ticket can only reserve one scooter.
7. **Stationed at**: between Vehicle class and Station class, many to one respectively.

### 3.2.2. Generalization Relationships

1. RegisteredUser class and Guest class are a specialization of the User class.
2. Bus class and Scooter class are specializations of the Vehicle class.

### 3.2.3. Composition Relationships and Their Multiplicity

No composition relationship used in the UML class diagram.

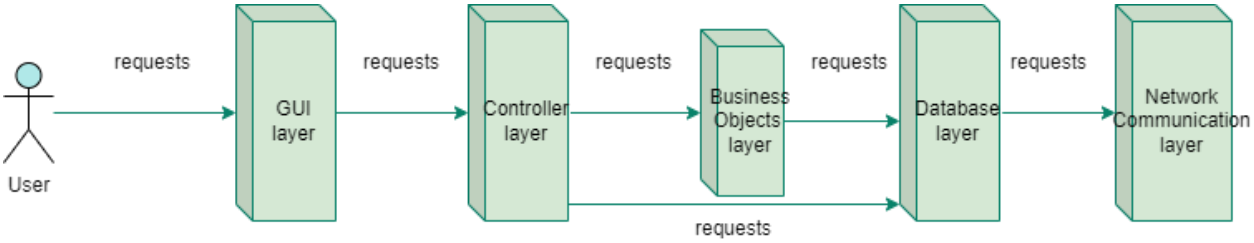
## 3.3. System Architecture

### 3.3.1. Type of System

The user can create an account or use the application as a guest. The user can use vehicles (bus, scooter) by booking tickets. The application will allow the user to view a map to see the nearest station to him. Once the user buys a ticket, the user must scan the QR given to him to use the vehicle. The user is interacting with the application, so the system is an interactive system.

### 3.3.2. Architectural Design

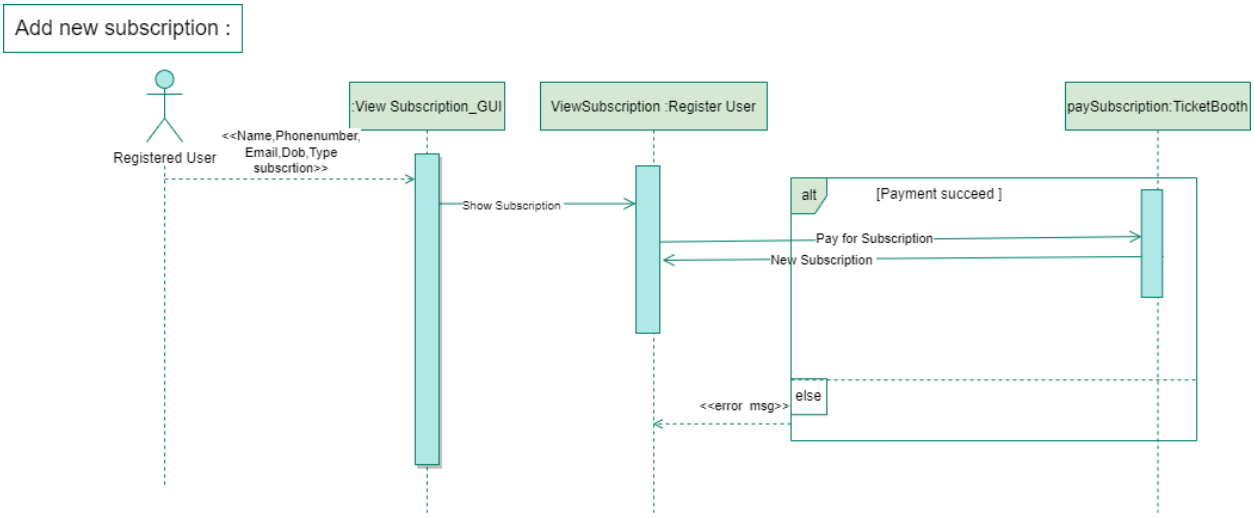
In this project we will use N-tire architectural design.



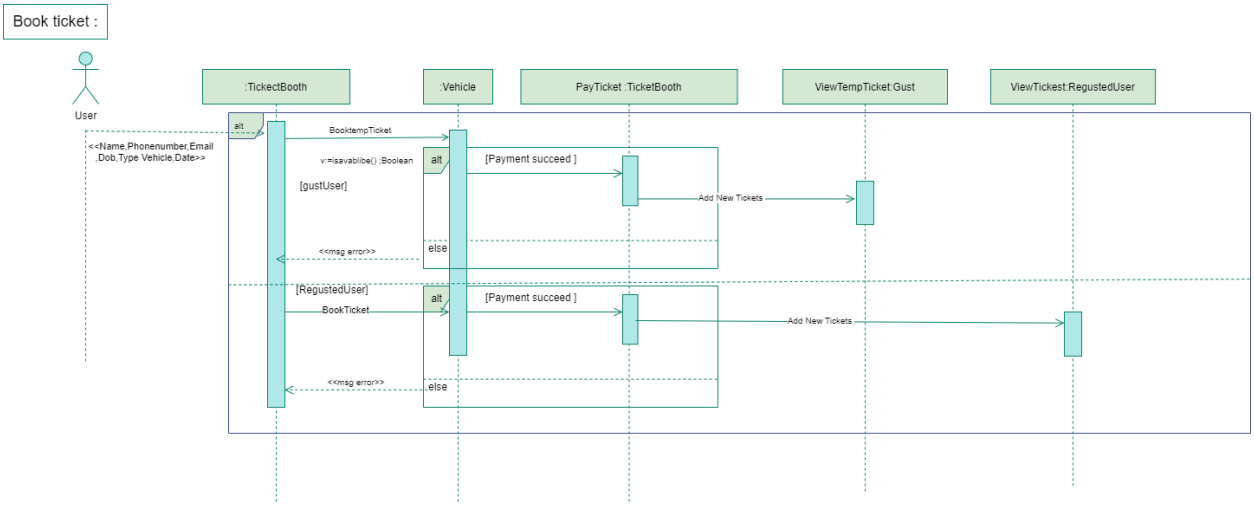
# 4. Dynamic modelling.

## 4.1. Sequence Diagrams.

### 4.1.1. Sequence Diagram (Add new Subscription ).

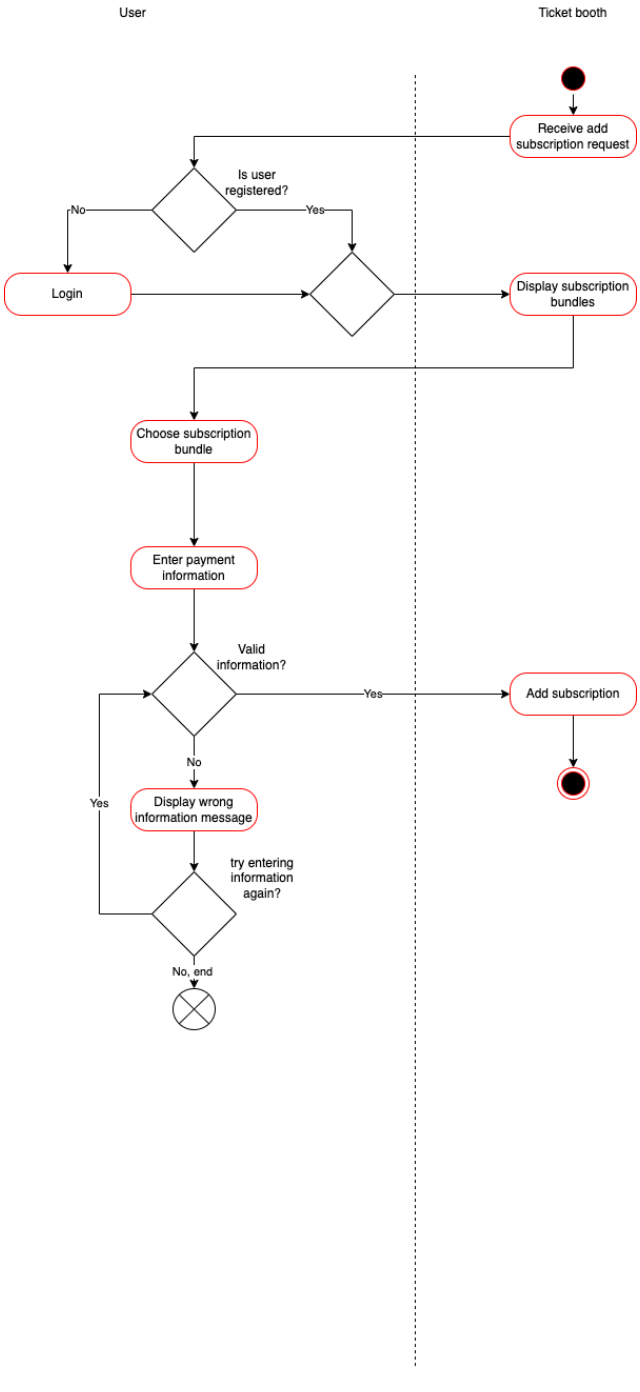



### 4.1.2. Sequence Diagram (Book Ticket ).

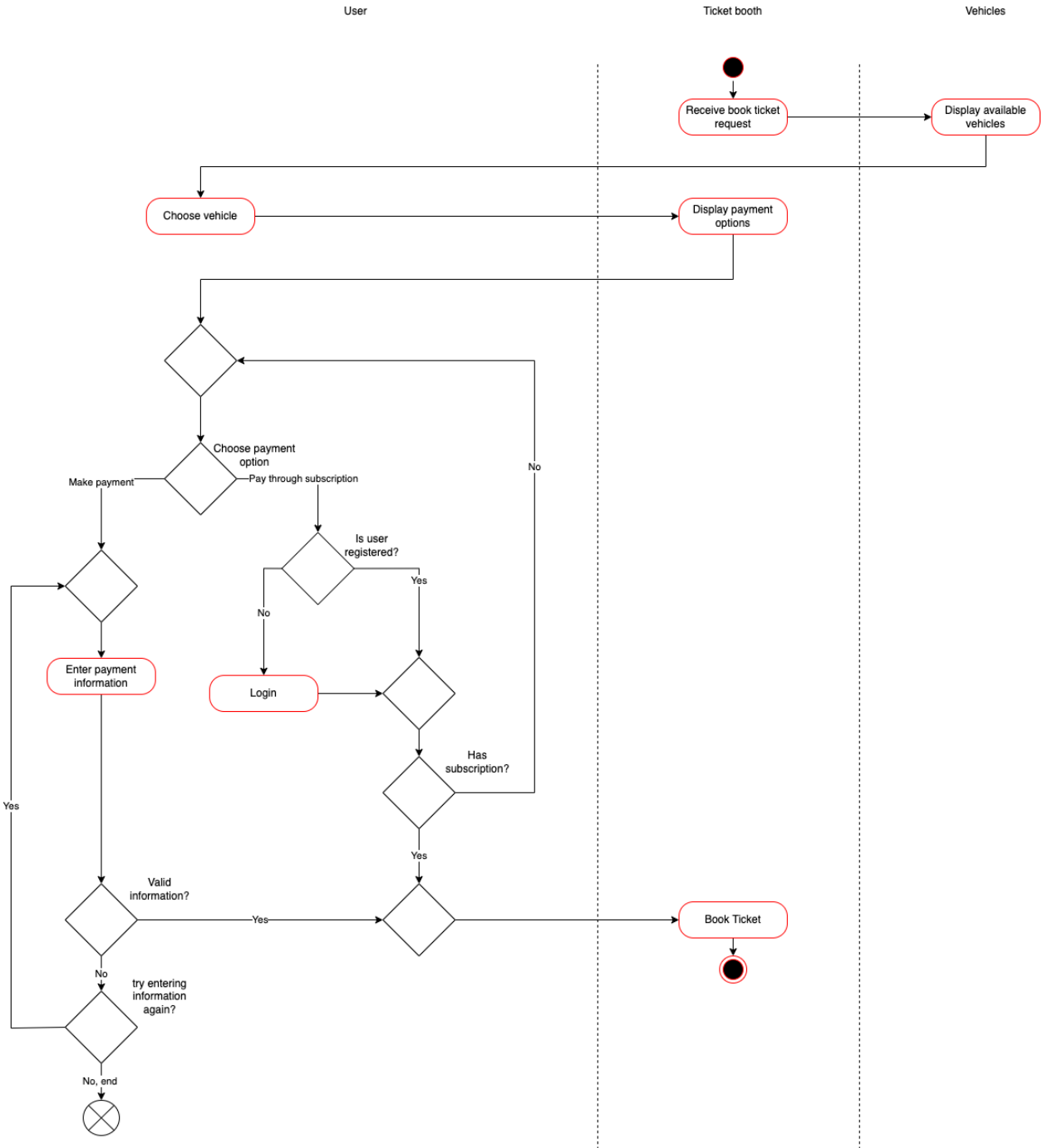


## 4.2. Activity Diagrams.

### 4.2.1. Activity Diagram (Add new Subscription).

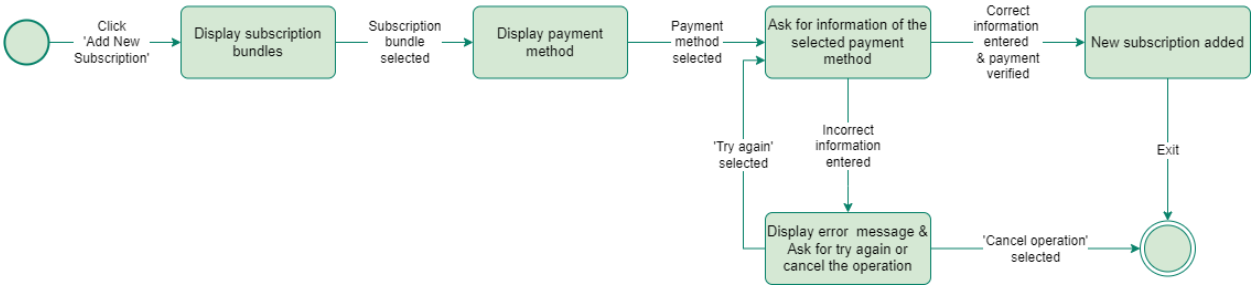


### 4.2.2. Activity Diagram (Book Ticket ).

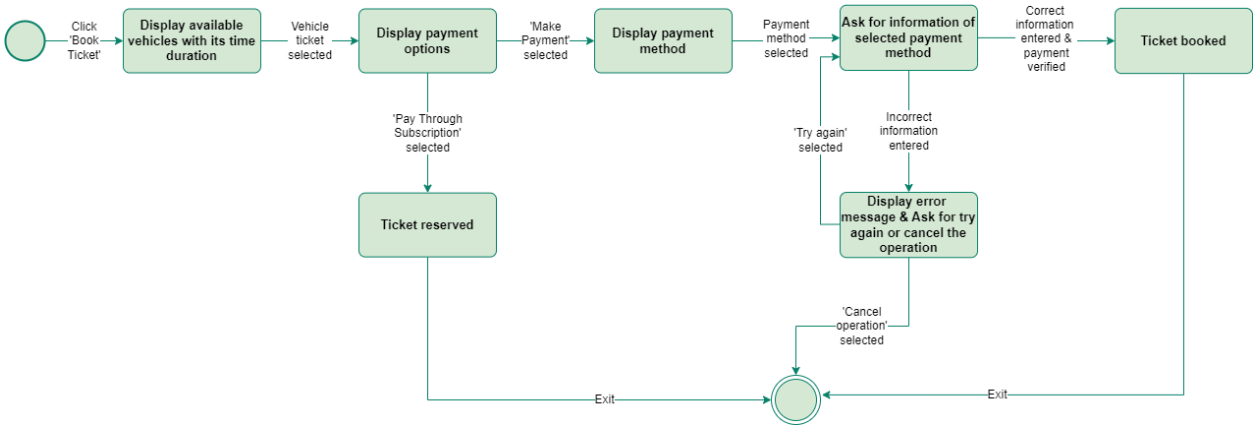


## 4.3. State Diagrams

### 4.3.1. State Diagram (Add new Subscription).




### 4.3.2. State Diagram (Book Ticket ).



## 4.4. Test Plan

### Objectives

The objective of this test is to make sure that WASILATY application run correctly and meet the expected specification and identifying possible bugs, errors, or defects. The test will execute the test cases described in the test plan.

### Strategy

The testing strategy for this test plan is Black Box Testing, specifically Functional testing for different functionalities in the system to confirm that the application meets system's functional requirements and produces expected results. The next section will further explain the details of test cases and the instructions to be followed with specific input data.

### Approach (Test Plan)

System: 'waseelty' application

## **Test Cases:**

| ID | Test Scenario | Test Steps | Expected Results | Actual Results | Pass/Fail |
|---|---|---|---|---|---|
| 1 | Test sign up username's restriction | - Open the application<br>- Click on 'sign up'<br>- Enter valid phone number and password<br>- Enter an invalid username | Error: invalid username | | |
| 2 | Test sign up password's restriction | - Open the application<br>- Click on 'sign up'<br>- Enter valid phone number and username<br>- Enter an invalid password | Error: invalid password | | |
| 3 | Test sign up phone number's restriction | - Open the application<br>- Click on 'sign up'<br>- Enter valid username and password<br>- Enter an invalid phone number | Error: invalid phone number | | |
| 4 | Test availability of customer support contacts | - Open the application<br>- click on 'contact customer support' | Customer support phone number and e-mail are displayed | | |
| 5 | Test the system behavior when an unregistered user tries to add a new subscription | - log into the system as a guest user<br>- click 'view subscription'<br>- click 'new subscription' | Error: feature is not available for non-registered users | | |
| 6 | Test the system behavior when a registered user tries to add a new subscription | - log into the system as a registered user<br>- click 'view subscription'<br>- lick 'new subscription'<br>- choose any bundle<br>- proceed to payment | New subscription added successfully | | |
| 7 | Test the system behavior when paying for a ticket using a credit card | - log into the system<br>- click 'book ticket'<br>- choose any of the available tickets<br>- click 'make payment'<br>- click 'pay through Credit Card'<br>- enter credit card number and pin | Successful payment and ticket added to the user's account if the card information is correct | | |

## Test cases description:

| Test case ID: 1 | test scenario: Test sign up username's restriction | |
|---|---|---|
| **Test Design Technique: Equivalence Partitioning** | | |
| **Invalid Partition** | **Valid Partition** | **Invalid Partition** |
| - 0 character<br>- 1 character<br>- 2 characters<br>- 3 characters<br>- 4 characters | - 5 characters<br>- 6 characters<br>- 7 characters<br>- 8 characters<br>- 9 characters<br>- 10 characters<br>- 11 characters<br>- 12 characters<br>- 13 characters<br>- 14 characters<br>- 15 characters<br>- 16 characters | - 17 characters<br>- 18 characters<br>- … |

| Test case ID: 2 | Test scenario: Test sign up password's restriction (8 to 20 characters) | | |
|---|---|---|---|
| **Test Design Technique: Boundary Value Analysis** | | | |
| **Invalid Partition – Valid Partition Lower Boundary** | | **Invalid Partition – Valid Partition Lower Boundary** | |
| **Boundary value just below the boundary** | **Boundary value just above the boundary** | **Boundary value just below the boundary** | **Boundary value just above the boundary** |
| 7 characters | 8 characters | 20 characters | 21 characters |

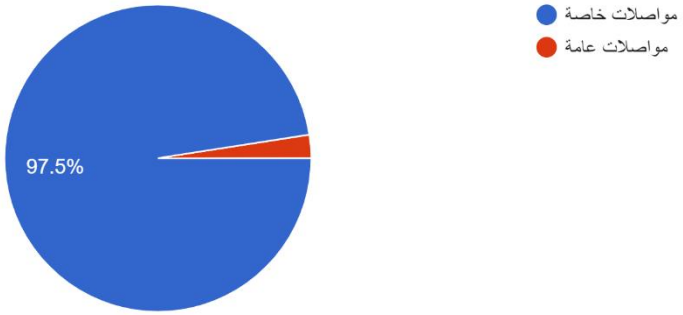
| Test case ID: 7 | Test scenario: Test the system behavior when paying for a ticket using a credit card | | | |
|---|---|---|---|---|
| **Test Design Technique: Decision Table Testing** | | | | |
| **Legend: T = correct card number/pin<br>F = incorrect card number/pin** | | | | |
| **Card number** | **T** | **T** | **F** | **F** |
| **Card pin** | **T** | **F** | **T** | **F** |
| **Expected result** | **Payment successful** | **Error: Card information incorrect** | **Error: Card information incorrect** | **Error: Card information incorrect** |

# Appendix A

## Result of the survey:

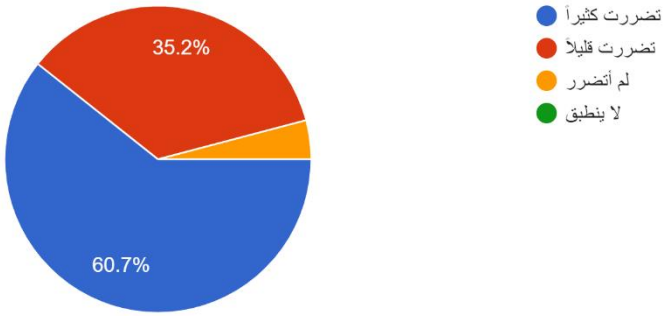
ماهي وسيلة التنقل التي تستخدمها غالباً؟

122 responses



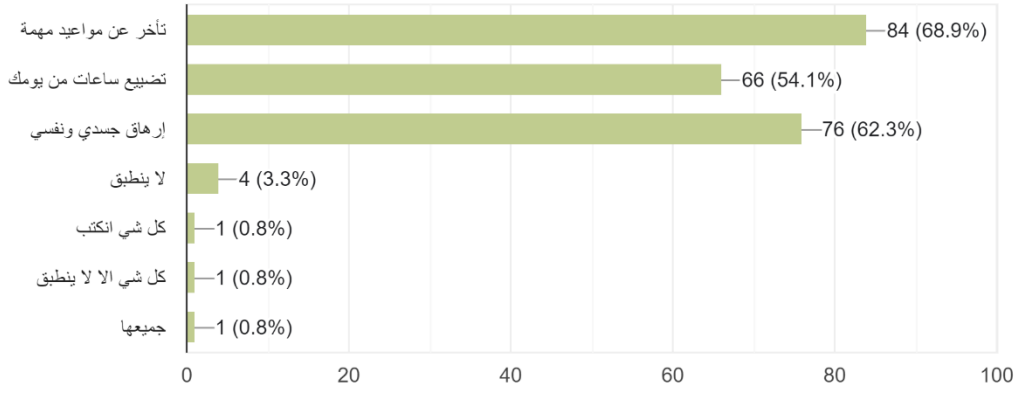

ما مقدار تضررك من الزحام المتزايد في الشوارع؟

122 responses

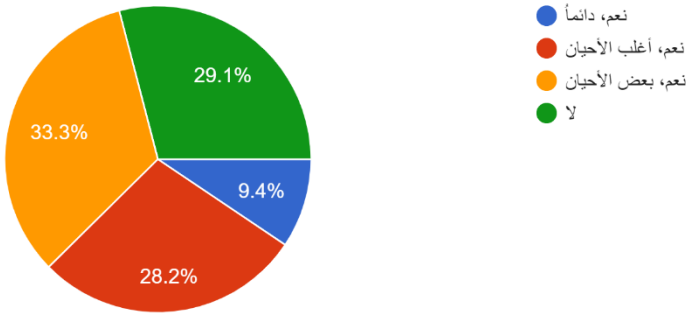



(ما هو الضرر الذي تسبب الزحام به لك؟ (يمكنك اختيار أكثر من إجابة واحدة

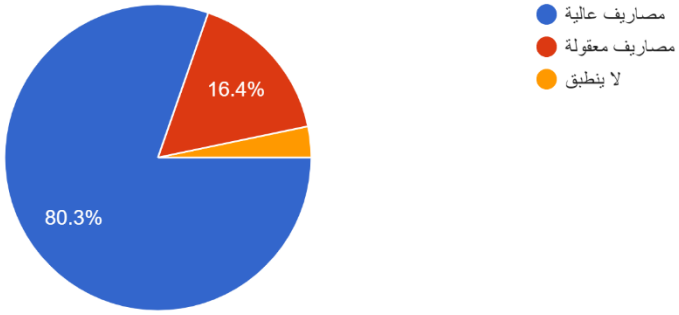
122 responses



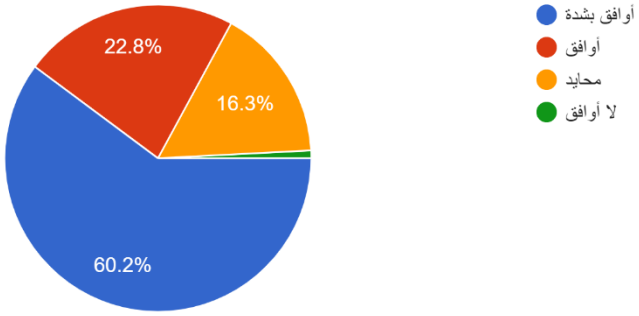
في حال تعاملك مع شركة مواصلات، هل قد سبب سوء التواصل بينك وبينهم بمشاكل وتأخر على الموعد أو المكان المتفق عليه؟
115 responses




ما رأيك بالمصاريف المتعلقة بوسيلة تنقلك الحالية مقارنة بمدى استفادتك منها؟ (أسعار الوقود، صيانة السيارات، أجرة اشتراك الحافلات، أو أجرة السائق الخاص)
122 responses




هل توافق أن وجود نظام مواصلات عامة موحد يمكنه حل المشاكل المذكورة أعلاه؟
122 responses



References:

https://education.nationalgeographic.org/resource/global-warming