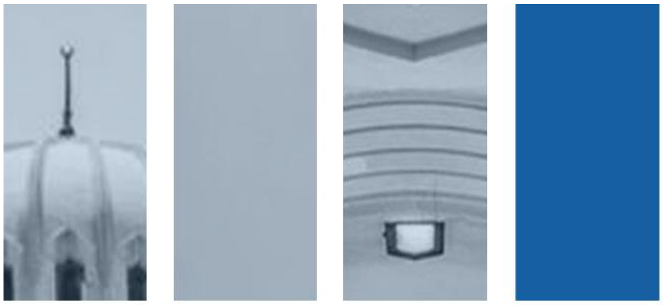
Ain Shams University
Faculty of Engineering



Project Submission

Course Code: CSE334
Course Name: Software Engineering

Project Description Document

Team Members:

Mariz Essam Sobhy Ghaly	1808421
John Magdy William	1808270
Karen Bassem Thabet	1803720
Kirolos Amgad Nabil	1808128
Nadine Wafaa Khalil	1806360
Mayar Mohamed Saeid	1808551
Mark Abdelsayed Soliman	1804731

Submitted to:
Dr. Gamal Abdel Shafy Ebrahim
Eng. Sally Shaker

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Garage Management System

1. Software Requirement Specification (SRS) document

Introduction:

Design a desktop application for a garage parking system. When a client check-in the garage, it should ask the client whether he is handicapped or not. He enters his name, and his arrival time is saved. A map for the garage showing taken and empty slots should be provided for the client from which he chooses a parking slot. In case of handicapped, all parking slots should be available for the client to choose from. On the other hand, if the client is not handicapped, he shouldn't be able to choose from handicapped slots.
At check-out, the system should show the available users to choose the one that will sign out. After choosing the user's name, it shows the name and spot and start time, duration, and the payment. Payment is calculated by hours or full day (1 hour : charges 10 pounds & full day: charges 80 pounds) [1 min scales to 1 hour & 6 minutes is considered full day].
The system design should be user friendly. The system should also be responsive and fast within 10 milliseconds.
As Parking is an often overlooked – but undoubtedly essential – service for every brick-and-mortar business. With the right parking control systems, it can be a significant revenue generator, too. Requirements and regulations are often one of the first considerations for businesses when they start thinking about parking management. Having a simple, accessible parking can attract prospective customers and instill loyalty in existing ones. Meanwhile, a lack of readily available parking has been proven to deter potential customers. Therefore, we decided to do parking spaces which need to be accessible for all kinds of cars and customers and Handicapped spaces are to be located at the front with accommodations for challenged patrons. Next, parking should be visible. Customers should be able to clearly identify where to enter the property to park. Parking Management System (PMI) can direct drivers from the main road and can help them determine which spaces are appropriate to park in. It can help the owner to find the car's location and facilitates the checking out.

Target Beneficiaries of the Project:

1. Any Huge Business Location that has a parking lot.
2. Car's owners.
3. Challenged persons who need special services.

Garage System User Manual

Thank you for using the garage system application. You can read this manual to fully understand the functions that the application provides to make you more comfortable.

Contents

The Main Functionalities

There are many functions the application provides to make for the easiness of the entrance and departure of the cars avoiding the crowding and the collision.

The Prices Information: The application gives you information about the prices of parking in different cases as it provides the price of spending only 1 minute till spending a full day.

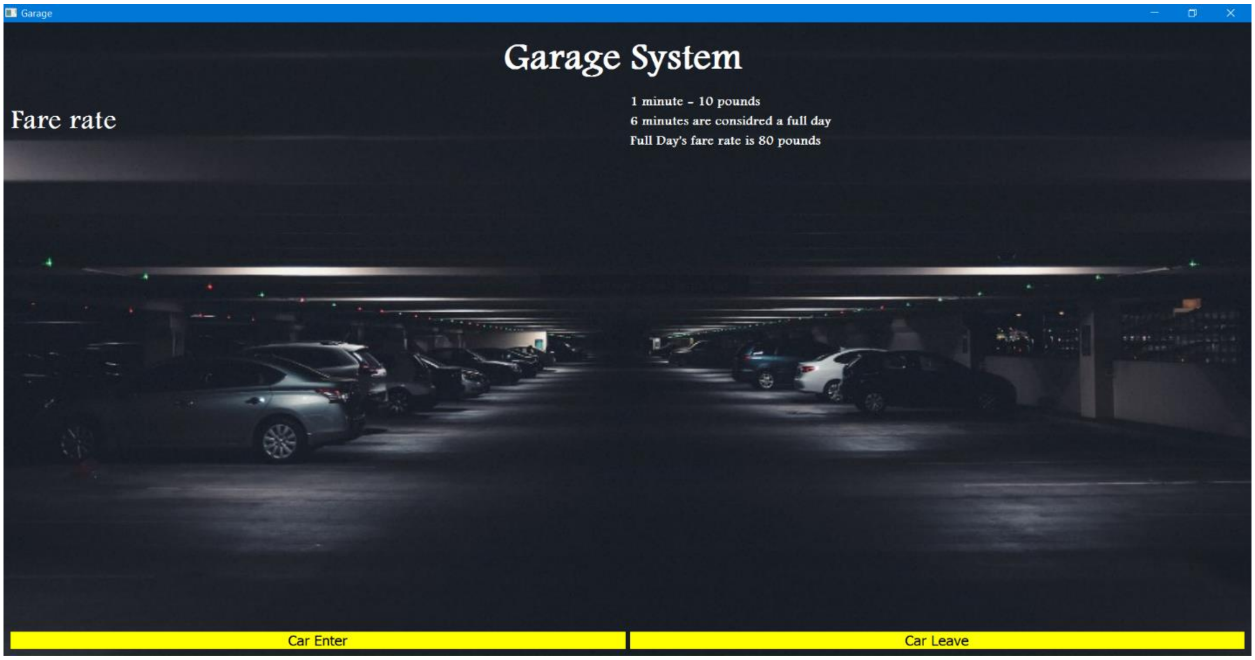
Handicapped Option: The application takes care of handicapped persons and provides them special places which are closer to the doors.

Mapping the Availability of the spots: You can see all the spots and where there are located and choose the most suitable spot by confirmation then you can enter that spot.

Departure Function: You will be provided by all needed information as your name, spot's number, entrance time, duration, and the fees of the service

The Main Screen:

When you open the application, you will see the below screen which is provided by the fare rate and there are two main functions you have to choose between them either (Car Enter) if you will park and searching for spots or choose (Car Leave) if you will leave the garage.



Garage System

Fare rate

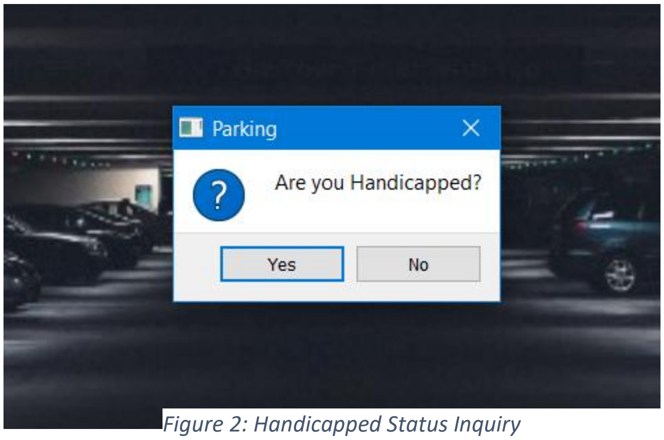
1 minute - 10 pounds
6 minutes are considred a full day
Full Day's fare rate is 80 pounds

Figure 1: Main Screen

The Car Entrance:

After choosing (Car Enter) from the main screen, there are few steps you have to follow to get your sport.

First, the handicapped option will be press yes if you are a handicapped and no if not.



Are you Handicapped?

Figure 2: Handicapped Status Inquiry

Second, there will be another screen which ask you to write your name.

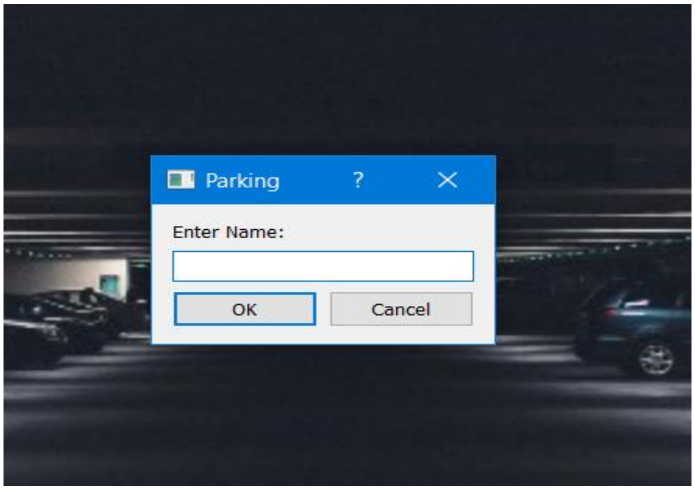
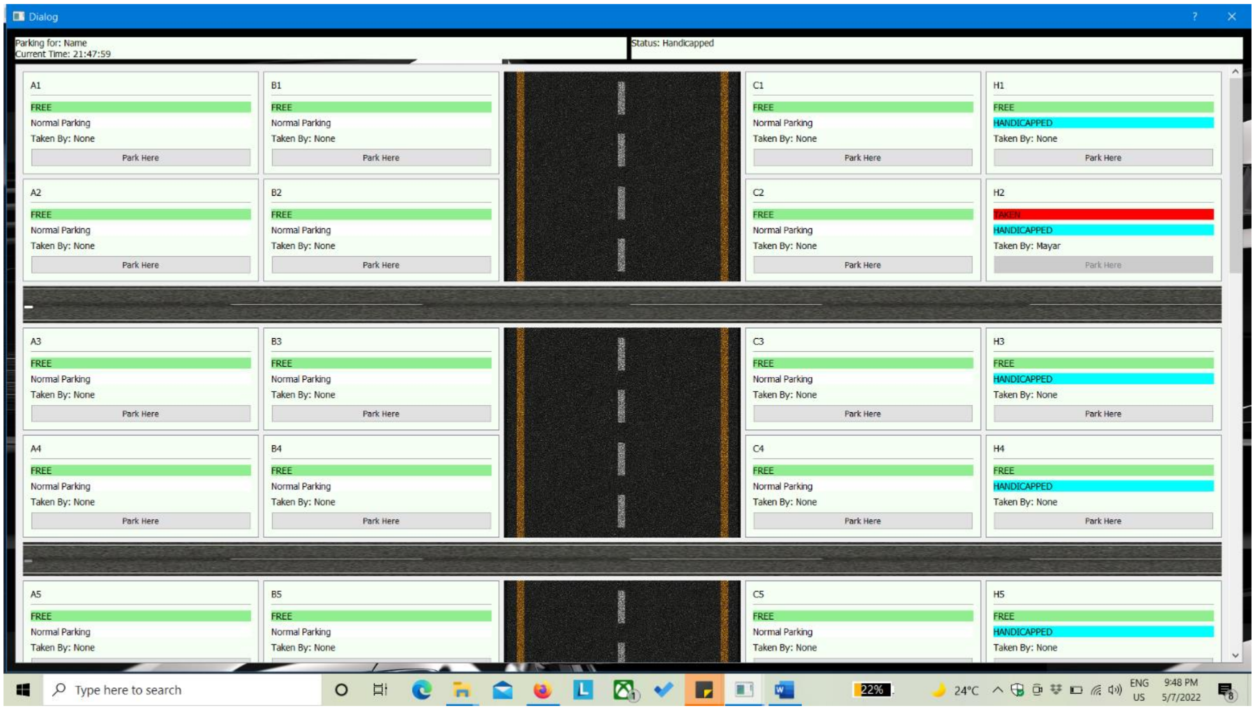


Figure 3: Name Textbox

Finally, you will be provided with spots mapping that you will just choose the suitable spot and know its location and then you will be asked to confirm, and the confirmation box will provide you with the start time, spot's number, and you can go directly to that spot.

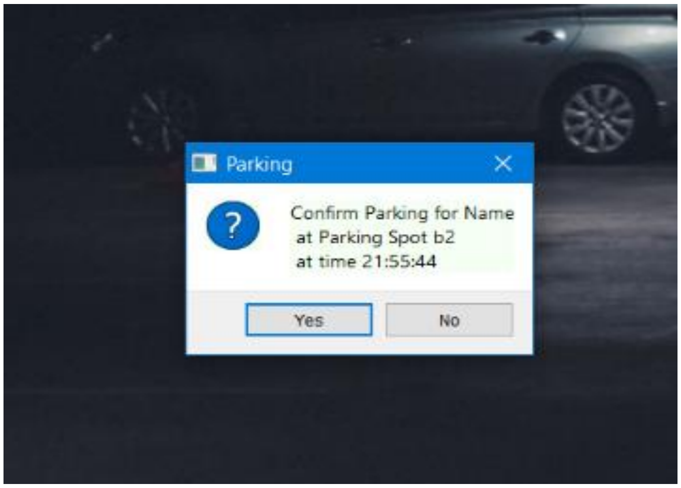


Parking for: Name
Current Time: 21:47:59

Status: Handicapped

A1 FREE Normal Parking Taken By: None Park Here	B1 FREE Normal Parking Taken By: None Park Here	C1 FREE Normal Parking Taken By: None Park Here	H1 FREE HANDICAPPED Taken By: None Park Here
A2 FREE Normal Parking Taken By: None Park Here	B2 FREE Normal Parking Taken By: None Park Here	C2 FREE Normal Parking Taken By: None Park Here	H2 TAKEN HANDICAPPED Taken By: Mayar Park Here
A3 FREE Normal Parking Taken By: None Park Here	B3 FREE Normal Parking Taken By: None Park Here	C3 FREE Normal Parking Taken By: None Park Here	H3 FREE HANDICAPPED Taken By: None Park Here
A4 FREE Normal Parking Taken By: None Park Here	B4 FREE Normal Parking Taken By: None Park Here	C4 FREE Normal Parking Taken By: None Park Here	H4 FREE HANDICAPPED Taken By: None Park Here
A5 FREE Normal Parking Taken By: None	B5 FREE Normal Parking Taken By: None	C5 FREE Normal Parking Taken By: None	H5 FREE HANDICAPPED Taken By: None

Figure 4: Mapping of Parking Spots

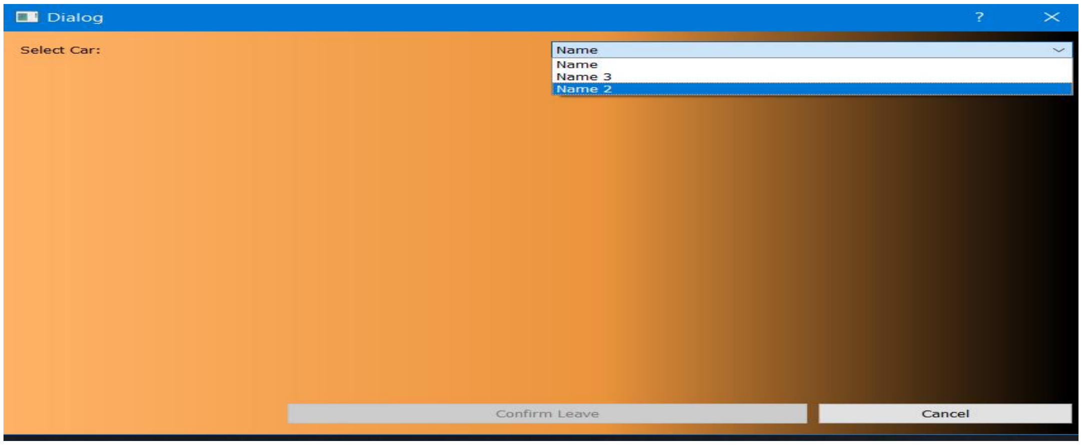


Confirm Parking for Name
at Parking Spot b2
at time 21:55:44

Figure 5: Confirmation Box

The Car Departure:

After choosing (Car Leave) from the main screen, you will get a screen which asks you to select your car by selecting your entered name.

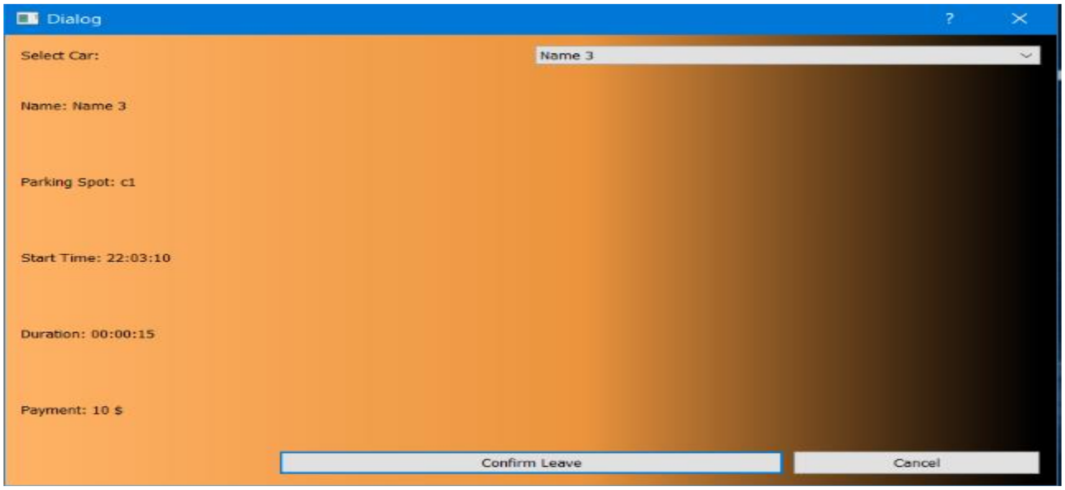


Select Car:

Name
Name 3
Name 2

Figure 6: Selection Users

After passing by selection phase, you will receive fees information and there will be a confirmation button at the bottom you have to press it to go the next phase or press cancel if you have chosen a wrong car.


Select Car:

Name: Name 3

Parking Spot: c1

Start Time: 22:03:10

Duration: 00:00:15

Payment: 10 $

Figure 7: Payment Details

Finally, you will get the last fees confirmation screen. Press Yes if you are done or No if there is any mistake.

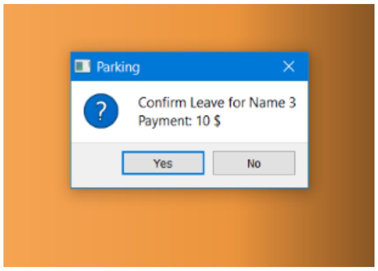

Confirm Leave for Name 3
Payment: 10 $

Figure 8: Payment Confirmation

Conclusion

This software is useful for many business locations as malls, or any place that has a parking lot. This software will facilitate the user experience throughout the entire parking session from checking it till payment. The software is intended to be simple and user-friendly ass to allow any user from any background to use the system without any complications.

The Software allows the user to do many functions as:

- Checking in
- Choosing preferred parking spot
- Checking out
- Generating required payment for customers and printing the receipt.

The Software assumed that the only available payment method is cash. There will be a cashier that can access the required payment which will be shown to both the cahier and the user.

Sensors in the parking lot are provided to update the system about any variations, or any unexpected movements and alert the system. It also updates the system after every check in and check out.

The following diagrams describes the system thoroughly in order to facilitates the implementation of the code, and to make sure that all the user and business requirements are met successfully and are fully understandable by the development team.

Feasibility Analysis

We will limit our Feasibility analysis into 3 main aspects, and look at every one with more detail, first we have the financial aspect, then the technicality aspect and finally the time and resources aspect.

Financial Feasibility:

- Being a simple desktop application Garage will have an associated hosting cost (since we won't run the system on just one machine, therefore a host will be needed, and synchronization will be required).
- Since the system doesn't consist of any multimedia data transfer, bandwidth required for the operation of this application is very low.
- The system will follow the freeware software standards. No cost will be charged from the potential customers.
- Bug fixes and maintaining tasks will have an associated cost after releasing the initial alpha and beta versions.
- At the initial stage the potential market space will be the local malls and parking lots large enough to use our software. Beside the associated cost, there will be many benefits for the customers. Especially the extra effort that is associated with paper making and marking will be significantly reduced while the effort to create descriptive statistical reports will be eliminated, since reports generation is fully automated.

- **Conclusion:**
  From these it's clear that the garaging system project is financially feasible.

Technical Feasibility:

- Our project is a complete desktop application.
- The main technologies and tools that are associated with it are
  - C++
  - QT
  - Visual Studio
  - MySQL (in case a database is used)

- Each of the technologies are freely available and the technical skills required are manageable. Time limitations of the product development and the ease of implementing using these technologies are synchronized.
- Initially the desktop will be hosted in a free web hosting space, but for later implementations it will be hosted in a paid hosting space with a sufficient bandwidth. Bandwidth required in this application is very low, since it doesn't incorporate any multimedia aspect.

- **Conclusion:**
  From these it's clear that our project is also technically feasible.

Resource and time Feasibility:

Resource feasibility Resources that are required for out project includes,

- Programming device (Laptop)
- Hosting space (freely available)
- Programming tools (freely available)
- Programming individuals

- **Conclusion:**

So, it's clear that out project also has the required resource feasibility.

System Requirements:

Functional Requirements:

1. When a client check-in the garage. It should ask the client whether he is handicapped or not.
2. He enters his name, and his arrival time is saved.
3. A map for the garage showing taken and empty slots should be provided for the client from which he chooses a parking slot.
4. In case of handicapped, all parking slots should be available for the client to choose from.
5. On the other hand, if the client is not handicapped, he shouldn't be able to choose from handicapped slots.
6. At check-out, the system should show the available users to choose the one that will sign out.
7. After choosing the user's name, it shows the name and spot and start time, duration, and the payment.
8. Payment is calculated by hours or full day (1 hour: charges 10 pounds & full day: charges 80 pounds) [1 min scale to 1 hour & 6 minutes is considered full day].

Non – Functional Requirements:

Product Requirements:

9. It should be a desktop application.
10. The system design should be user friendly.
11. The system should also be responsive and fast within 10 milli-secs.

Organizational Requirements:

12. C++ is the programming language required for the project (using QT).
13. It should conform to IEEE and ISO standards.

External Requirements:

14. The system should conform to all applicable local and international laws.

Requirements Validation

Requirements traceability matrix:

	1	2	3	4	5	6	7	8
1								
2								
3	D	R		R	R	R		
4	D	R	R					
5	D	R	R					
6	D	D						
7	D	D				R		D
8	D	D				D	R	

Figure 9: Requirements Traceability Matrix

Assumptions:

- Requirement 3 (Map Showing) is dependent on both checking in function (Requirement 1), and the fact that the user must enter his name (Requirement 2). It is also related to whether the user is handicapped or not as the output depends on this choice (Requirement 4,5)

- Requirements 4,5,6,7,8 depends on the fact that the check in has occurred (Requirement 1).

- Both Check out (Requirement 6, 7) and calculate payment (Requirement 8) depends on the arrival time of the user (Requirement 2).

Source traceability matrix:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Non-Disabled Client	✓	✓	✓		✓	✓				✓	✓			
Handicapped Client	✓	✓	✓	✓		✓				✓	✓			
Developer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Tester	✓	✓	✓	✓	✓	✓	✓			✓	✓			
Project Manager	✓					✓		✓	✓	✓	✓		✓	✓

Figure 10: Source Traceability Matrix

Assumptions:

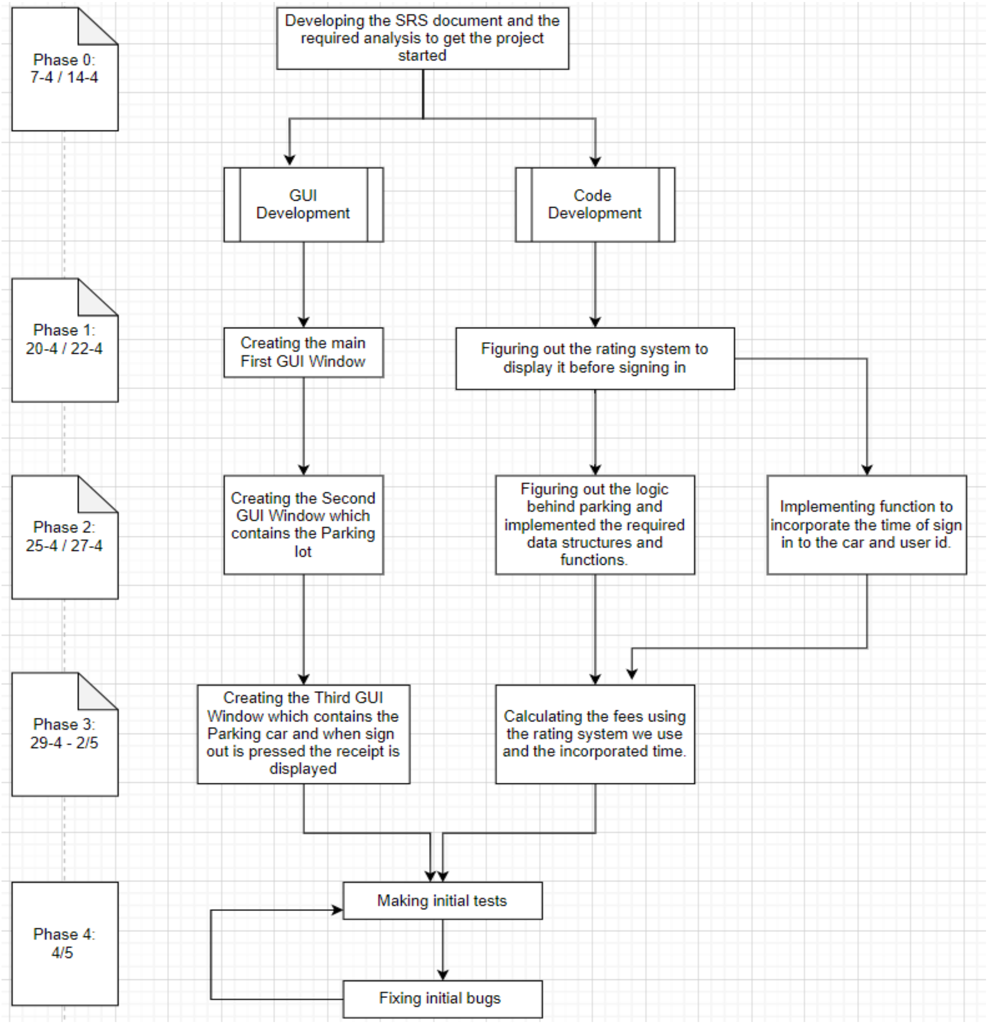
- Project manager checks on the main functionalities of the system as check in and check out functionalities. He is also interested in making sure that the non-functional requirements are properly achieved.

- Developer works on every are in the code so each aspect in the code affects him

- Tester is concerned in system testing.

- Any Client is affected by the functional requirements and will use it through the system. However, handicapped is concerned about showing spots for handicapped, and non-disabled person is concerned about the ordinary spots.

Time Plan:



Phase 0:
7-4 / 14-4
Developing the SRS document and the required analysis to get the project started
GUI Development
Code Development
Phase 1:
20-4 / 22-4
Creating the main First GUI Window
Figuring out the rating system to display it before signing in
Phase 2:
25-4 / 27-4
Creating the Second GUI Window which contains the Parking lot
Figuring out the logic behind parking and implemented the required data structures and functions.
Implementing function to incorporate the time of sign in to the car and user id.
Phase 3:
29-4 - 2/5
Creating the Third GUI Window which contains the Parking car and when sign out is pressed the receipt is displayed
Calculating the fees using the rating system we use and the incorporated time.
Phase 4:
4/5
Making initial tests
Fixing initial bugs

Figure 11: Time Diagram

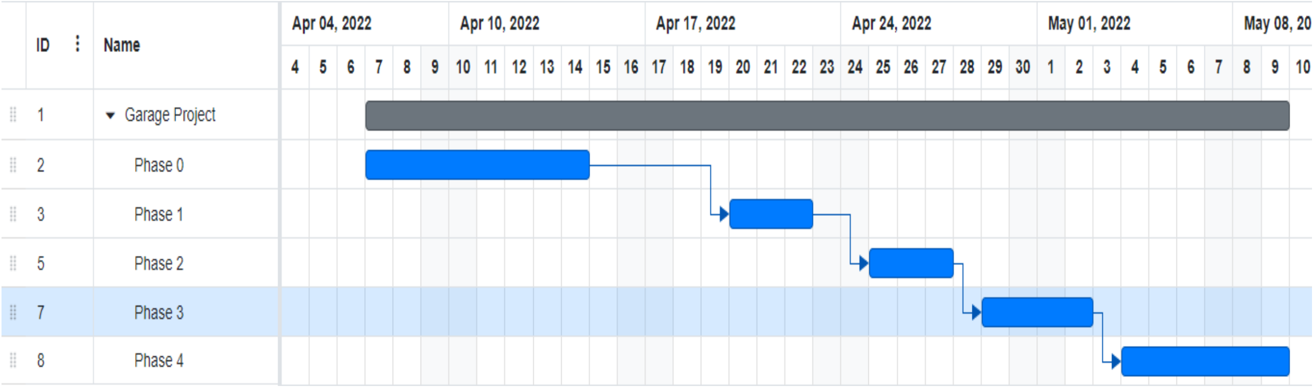


Figure 12: Gantt Chart

Analysis and Design document

Use-Case Diagram:

When a client check-in the garage, it gives the user handicapped options, and it saves his arrival time info. After that the availability of free spots is checked for handicapped and normal people. In case of handicapped, all parking slots should be available for the client to choose from. On the other hand, if the client is not handicapped, he shouldn't be able to choose from handicapped slots.

At check-out, the system should show the available users to choose the one that will sign out. After choosing the user's name, it shows the name and spot and start time, duration, and the payment.

The client will give the teller the needed amount of money and the teller will have no interaction with the system

Assumption:

Both client and cashier can press on the (PAY) button, so the cashier is considered a secondary actor for the calculate payment function, as the payment is shown for both the client and the cashier

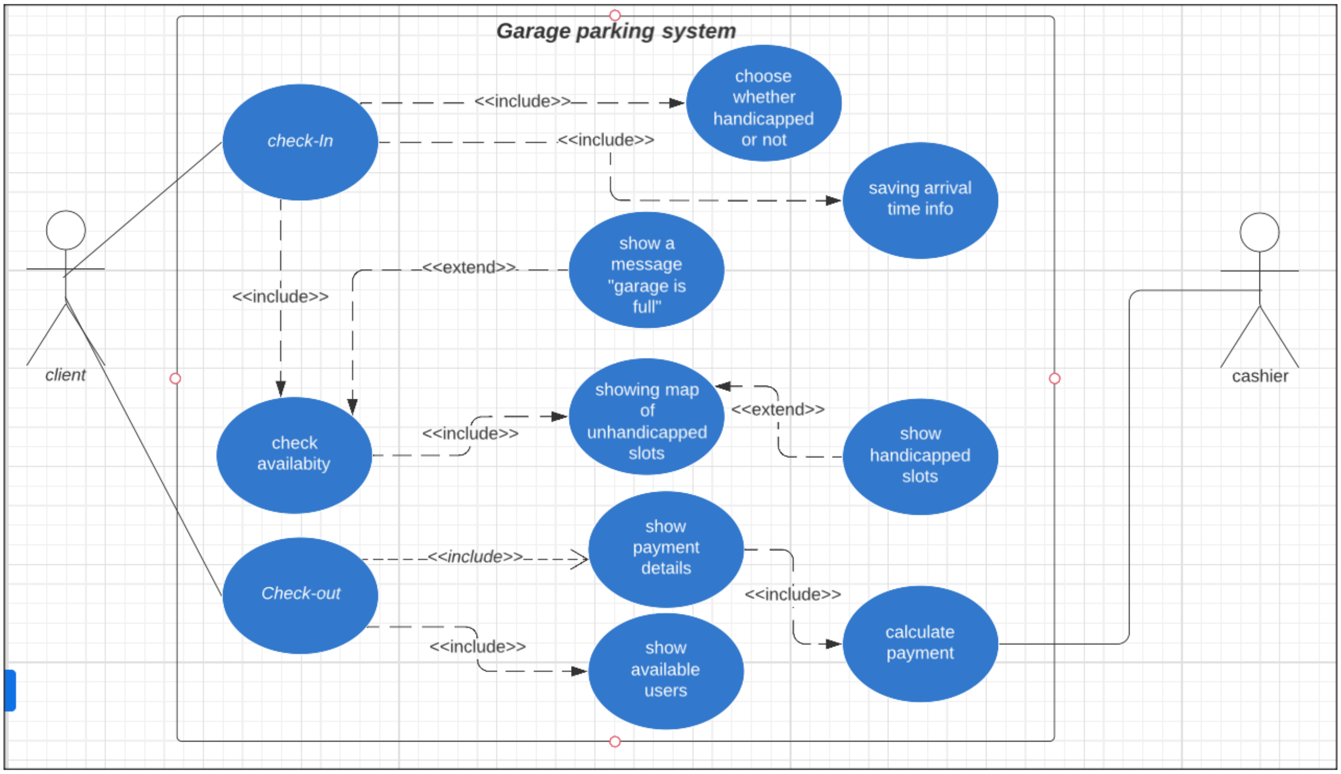


Figure 13: Use Case Diagram

Narrative Use-Cases:

Use Case Name: Check availability
Related Requirements: 1 & 2
Goal in Context: System check if there are available places in the garage.
Preconditions: Client has checked in.
Successful End Condition: The system shows a message telling user there is no free spot if the garage is full or show the map of available spots instead.
Failed End condition: Showing wrong data for the available spots.
Primary actors: Client.
Secondary actors: None.
Trigger: Client checked in and entered his name.
Included Cases: Showing map of unhandicapped slots.
Main flow: 1- The system checks for the availability of free parking spots.
- Include: Show the available places of unhandicapped.
2- the system shows all the free non-disabled parking spots.
3- the user chooses the desired free parking spot.
4- the system changes the status of the chosen parking spot from available to unavailable.
5- the system saves the check in time of the user parking.
Extension: 1.1 Show a message “the garage is full”.
1.2 The system closes.

Use Case Name: Check in
Related Requirements: None.
Primary Actor: Customer.
Secondary Actors: None.
Goal in context: To check in the parking system to get the parking slot.
Preconditions: User must be registered.
Successful End Condition: User checked in successfully.
Failed End Condition: System failed to make a check in
Trigger: Customer wants to park in the parking area
Main Flow: 1. Customers drive into the check-in counter.
2. Customer sign in by pressing check in button.
3. The user chooses whether he is a handicapped or not.
4. The user enters his name.
5. The system stores the starting parking session time.

The Swimlane Diagram:

Swimlane For Check in Use Case:

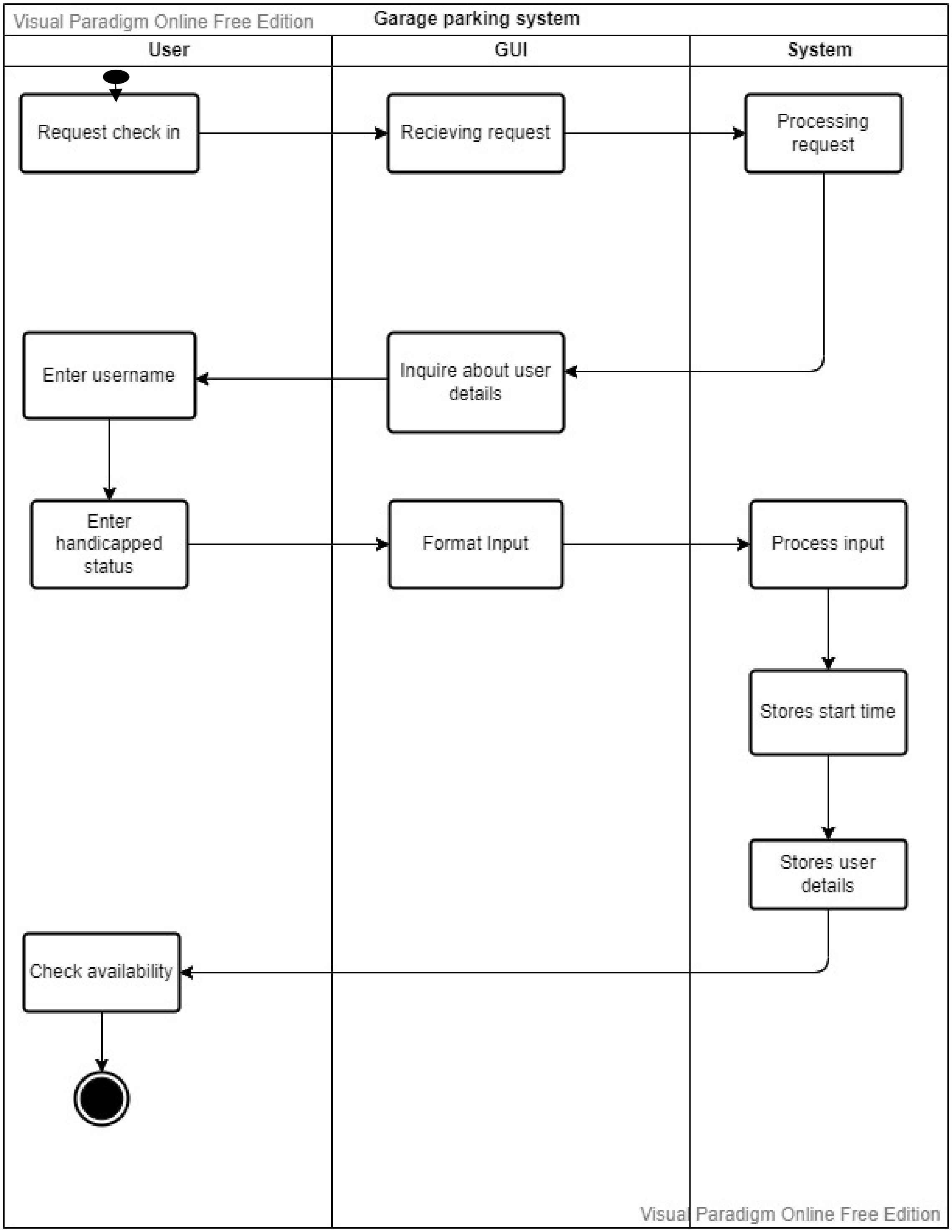


Figure 14: Swimlane For Check in Use Case

Swimlane For Check Availability Use Case:

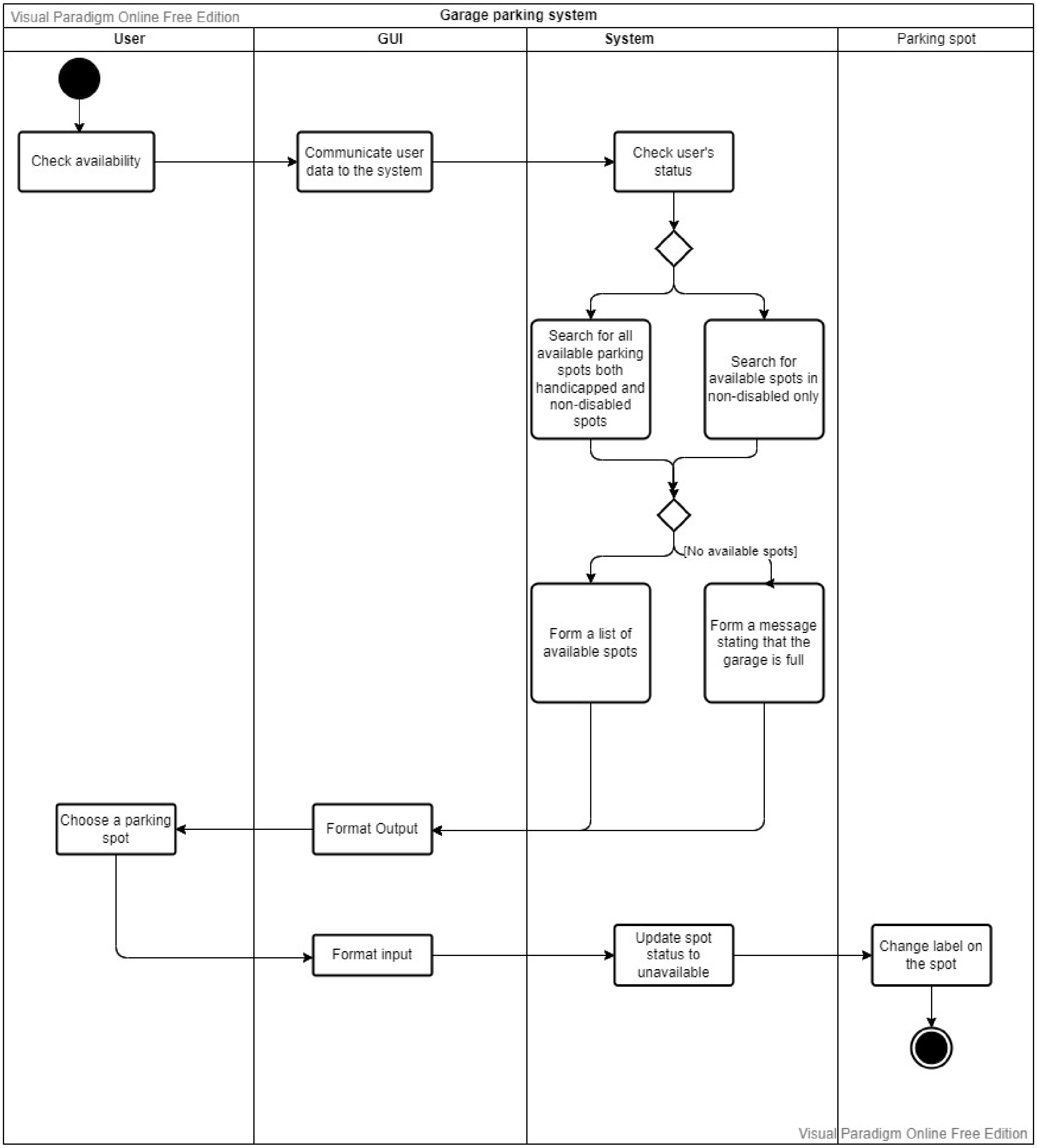

Visual Paradigm Online Free Edition
Garage parking system
User
GUI
System
Parking spot
Check availability
Communicate user data to the system
Check user's status
Search for all available parking spots both handicapped and non-disabled spots
Search for available spots in non-disabled only
[No available spots]
Form a list of available spots
Form a message stating that the garage is full
Choose a parking spot
Format Output
Format input
Update spot status to unavailable
Change label on the spot
Visual Paradigm Online Free Edition

Figure 15: Swimlane For Check Availability Use Case

Summarized Swimlane

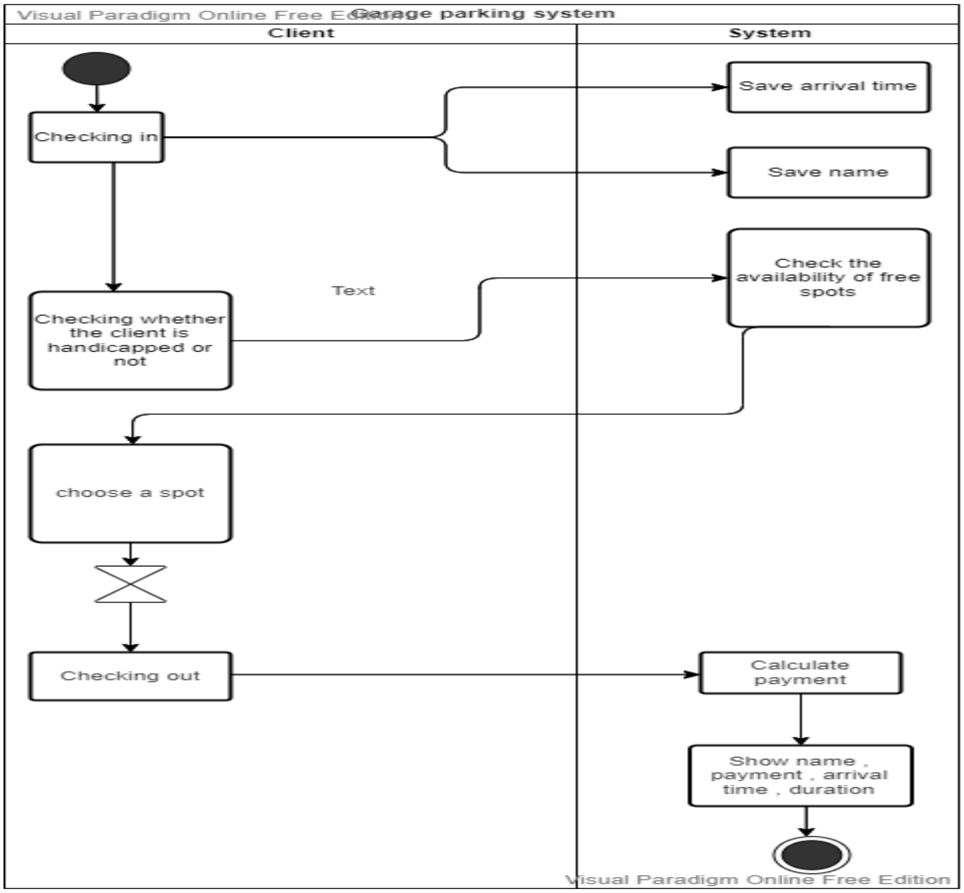

Visual Paradigm Online Free Edition
Garage parking system
Client
System
Checking in
Save arrival time
Save name
Text
Checking whether the client is handicapped or not
Check the availability of free spots
choose a spot
Checking out
Calculate payment
Show name , payment , arrival time , duration
Visual Paradigm Online Free Edition

Figure 16: Summarized Swimlane

Interaction Diagrams:

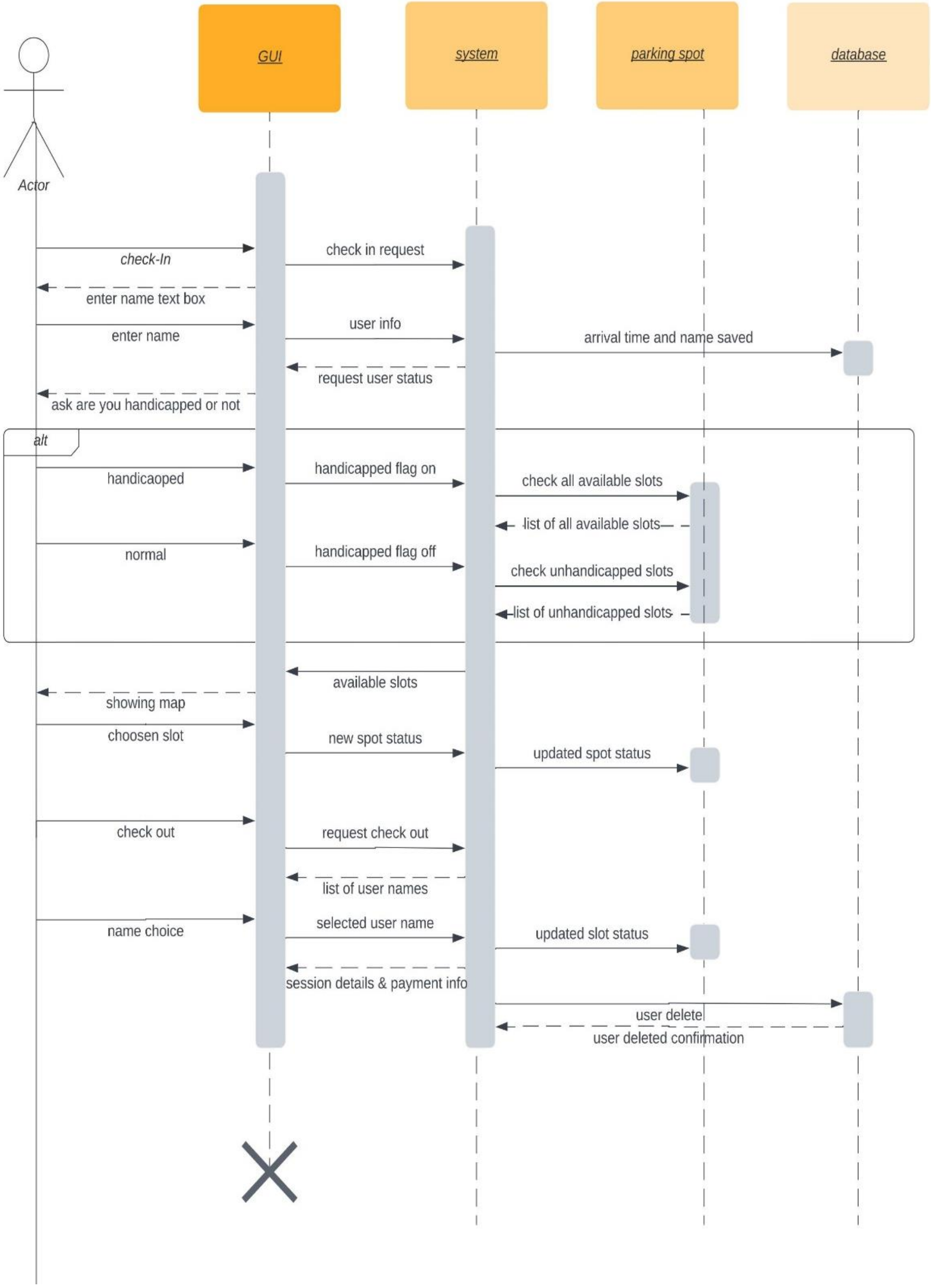


Figure 17: Sequence Diagram

State Diagram:

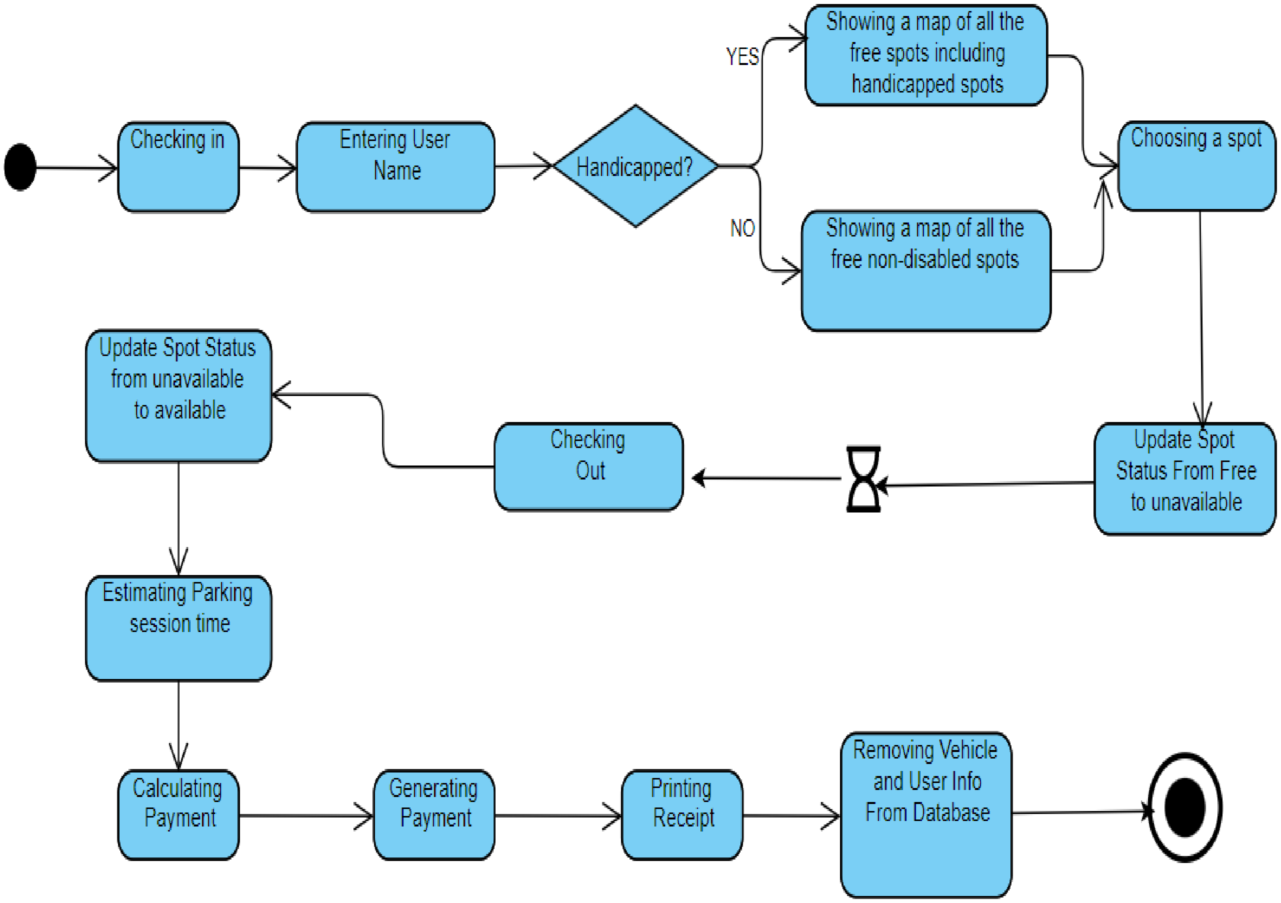

Checking in
Entering User Name
Handicapped?
YES
NO
Showing a map of all the free spots including handicapped spots
Showing a map of all the free non-disabled spots
Choosing a spot
Update Spot Status From Free to unavailable
Checking Out
Update Spot Status from unavailable to available
Estimating Parking session time
Calculating Payment
Generating Payment
Printing Receipt
Removing Vehicle and User Info From Database

Figure 18: State Diagram

Data Flow Diagrams:

Context Diagram:

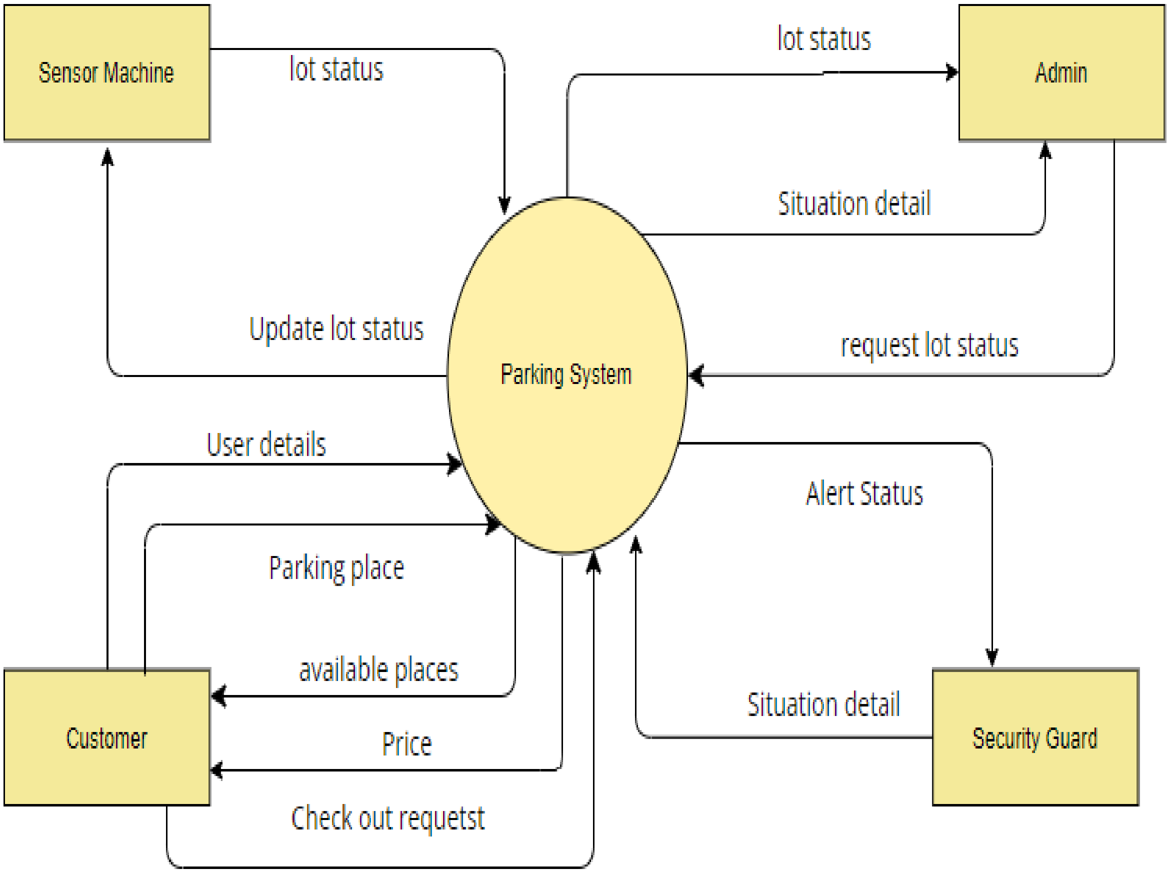


Figure 19: Context Diagram

Level 0

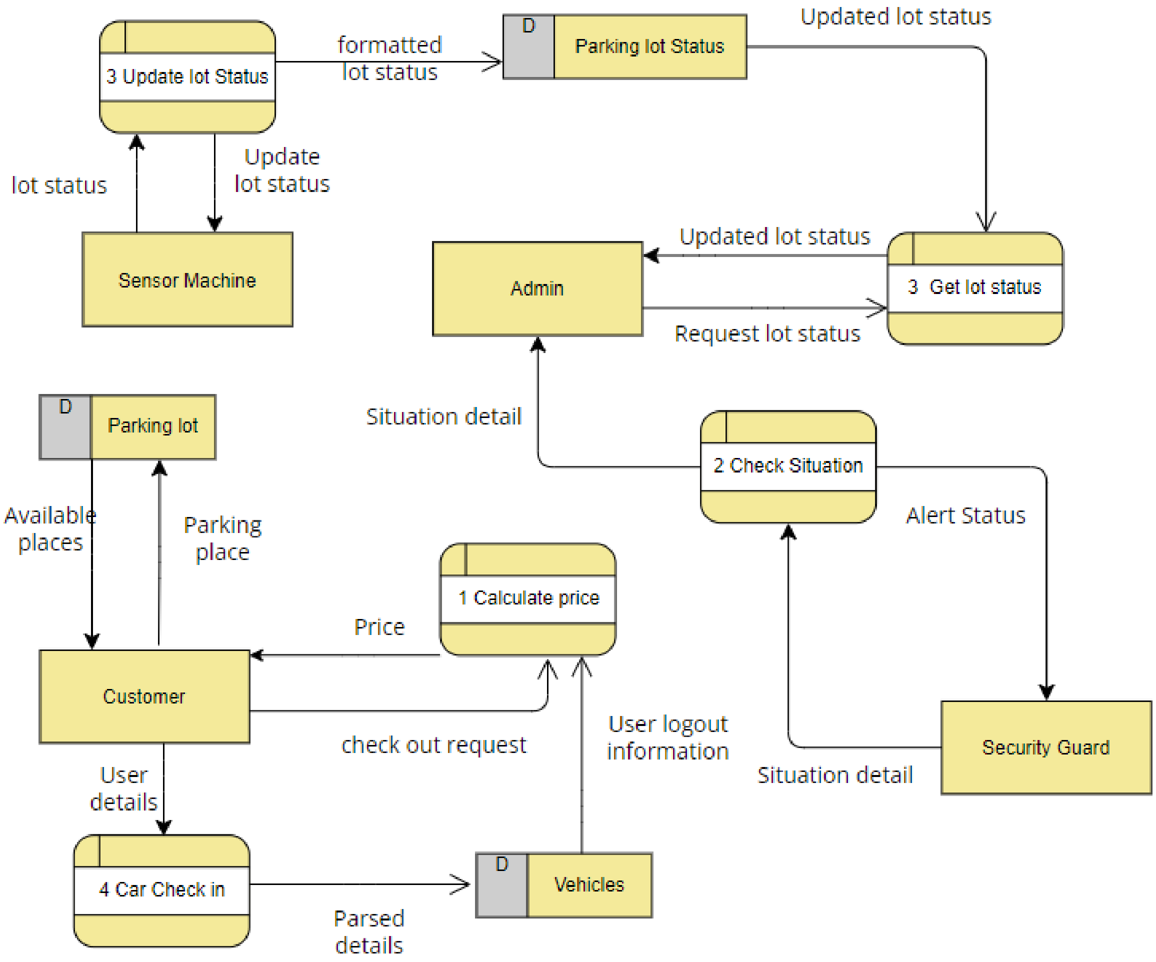


Figure 20: Level 0 DFD

Level 1

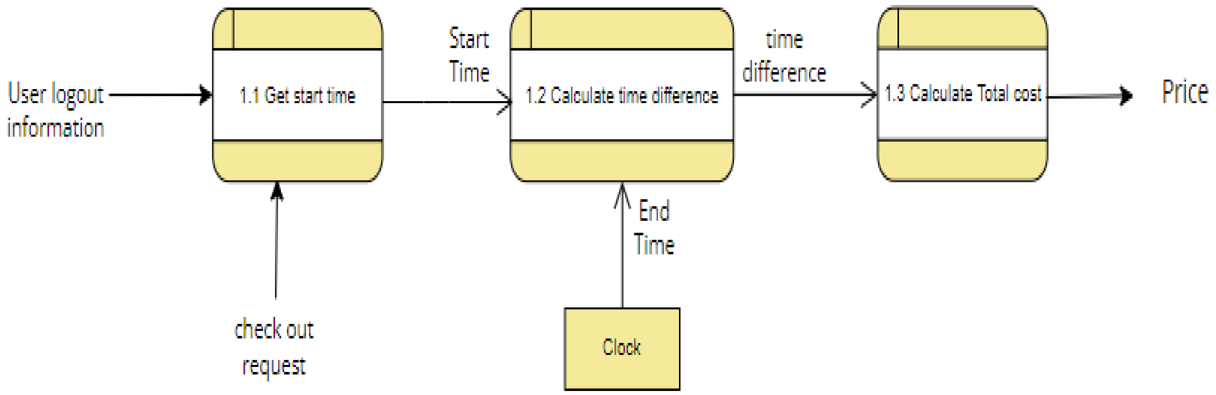


Figure 21: Level 1 Process 1

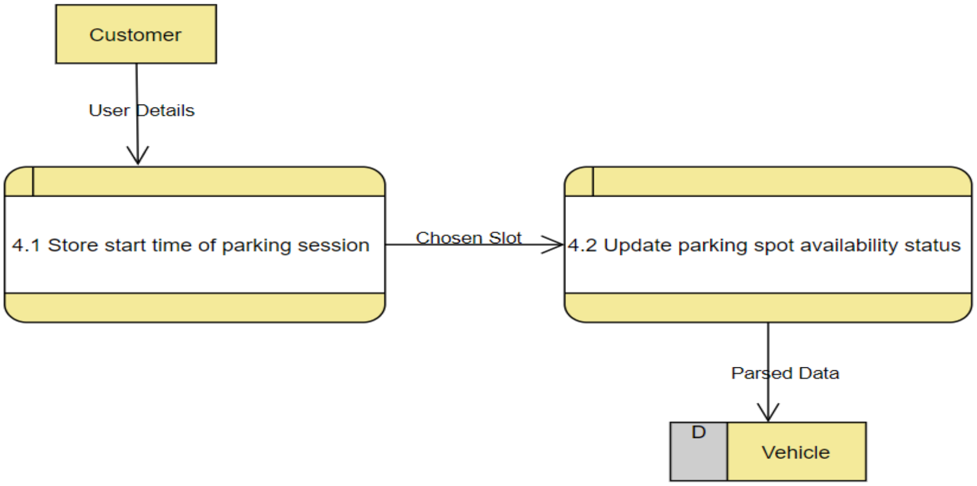

Customer
User Details
4.1 Store start time of parking session
Chosen Slot
4.2 Update parking spot availability status
Parsed Data
D
Vehicle

Figure 22: Level 1 Process 4

System Architecture:

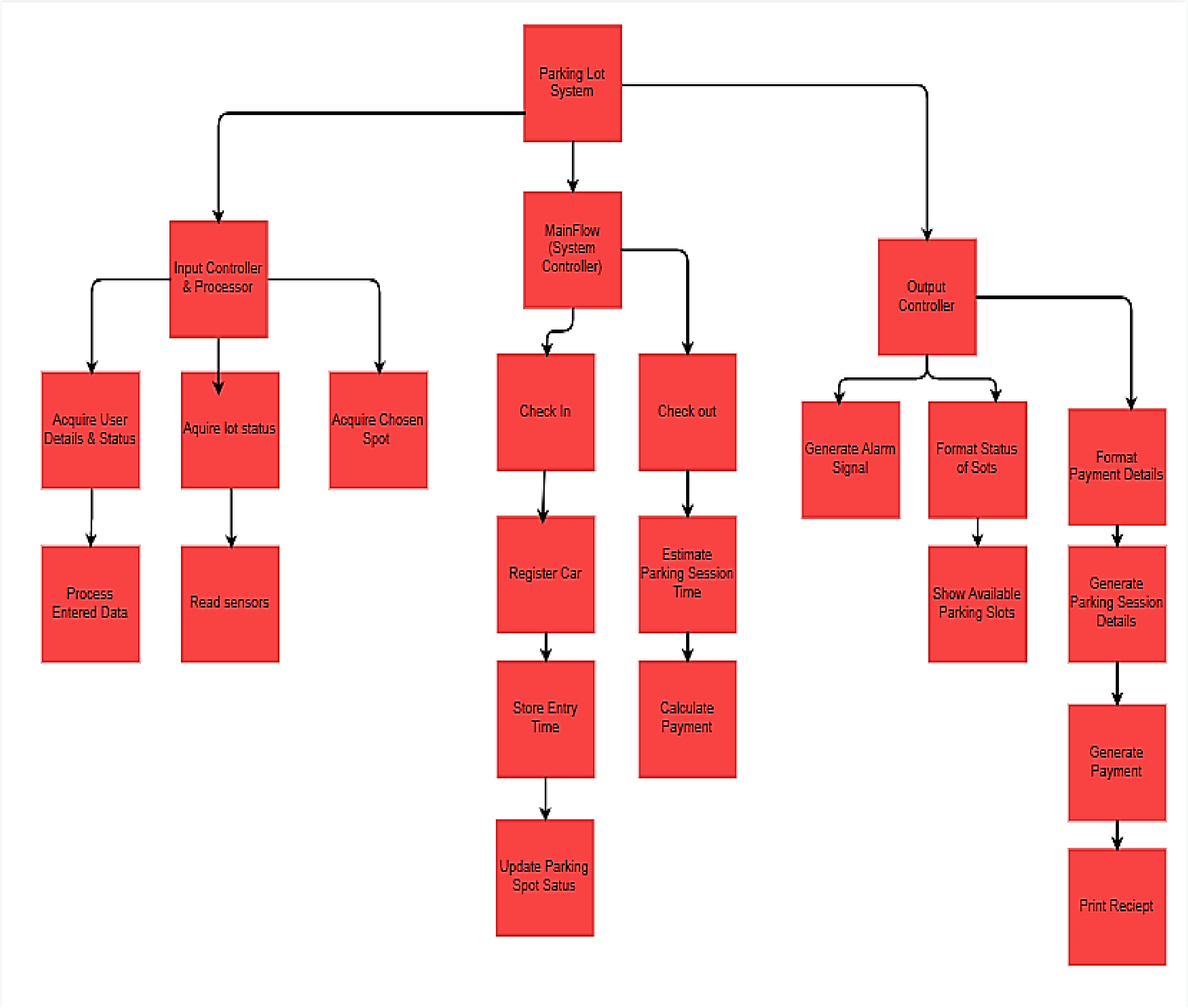


Figure 23: System Architecture

Component Diagram:

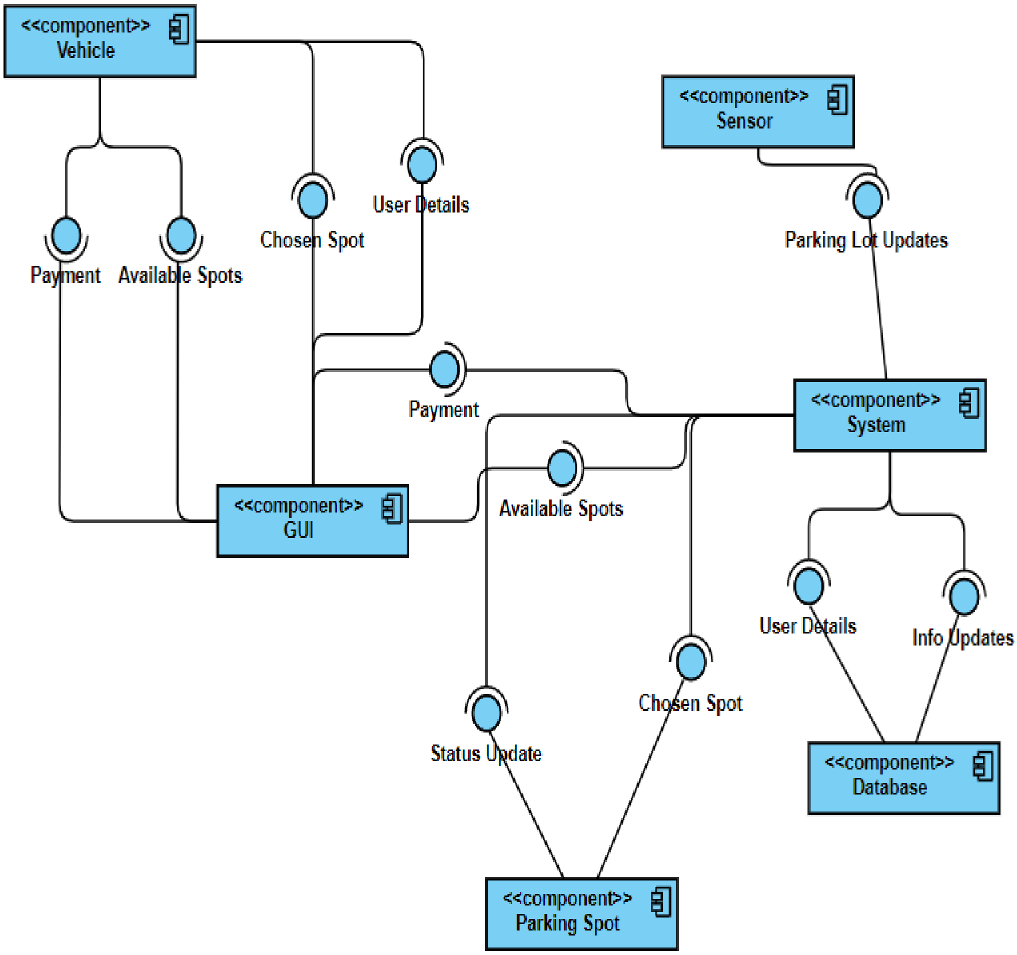


Figure 24: Component Diagram

Class Diagram:

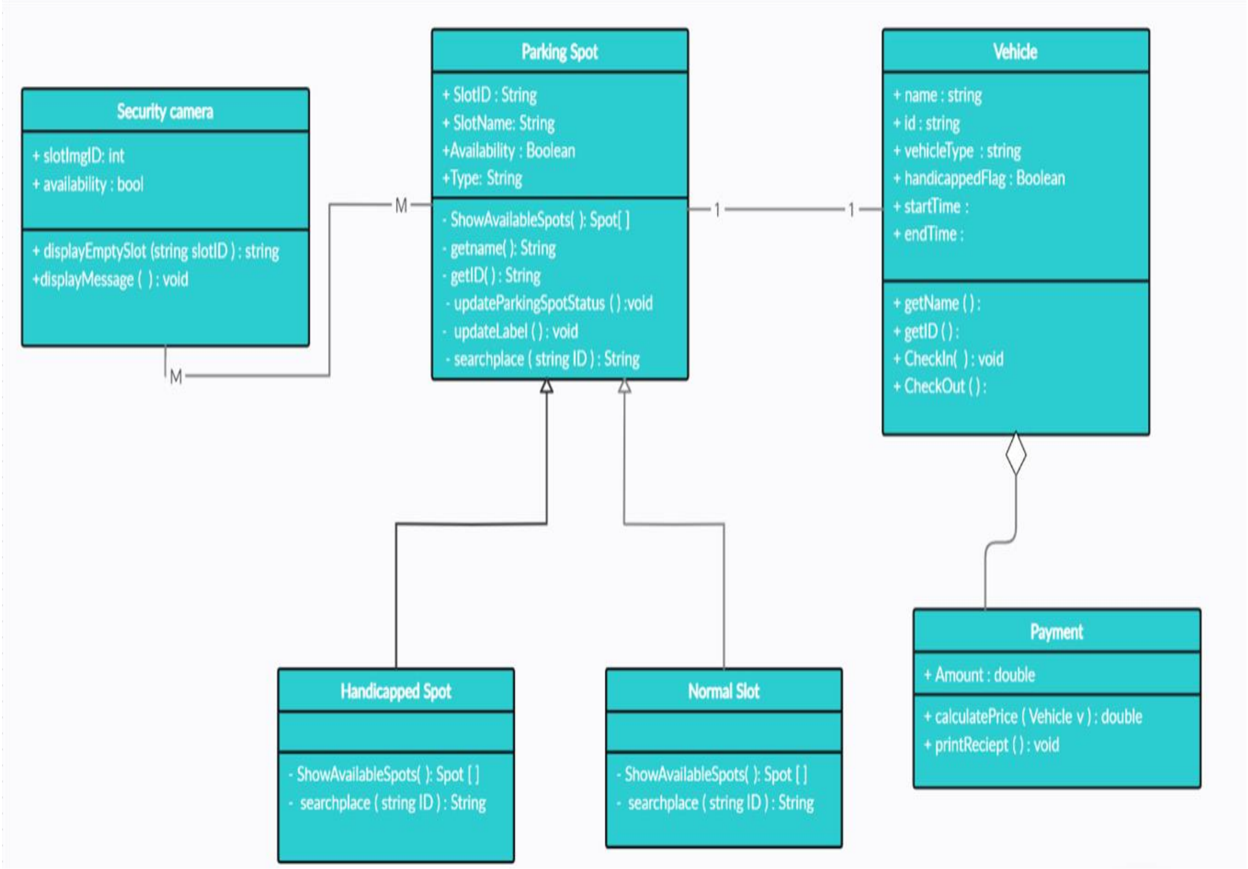
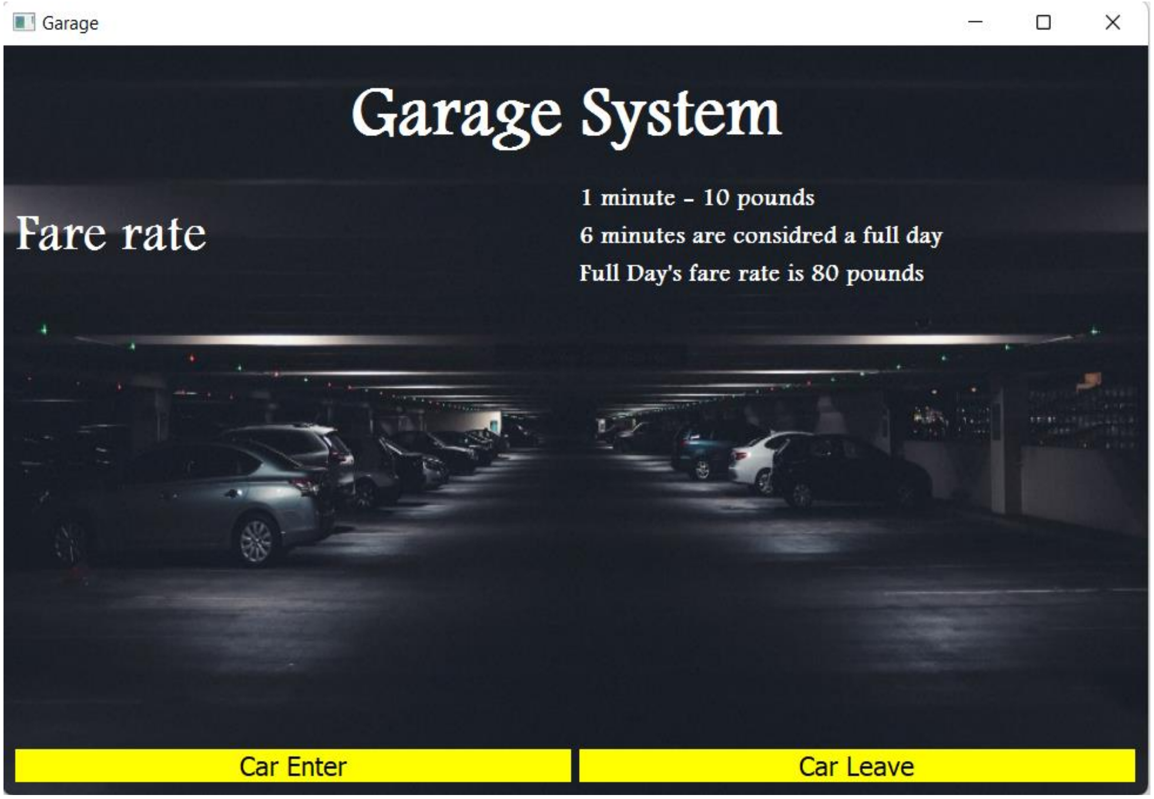

Security camera
+ slotImgID: int
+ availability : bool
+ displayEmptySlot (string slotID) : string
+displayMessage ( ) : void
M
M
Parking Spot
+ SlotID : String
+ SlotName: String
+Availability : Boolean
+Type: String
- ShowAvailableSpots( ): Spot[ ]
- getname( ): String
- getID( ) : String
- updateParkingSpotStatus ( ) :void
- updateLabel ( ) : void
- searchplace (string ID) : String
1
1
Vehicle
+ name : string
+ id : string
+ vehicleType : string
+ handicappedFlag : Boolean
+ startTime :
+ endTime :
+ getName ( ) :
+ getID ( ) :
+ CheckIn( ) : void
+ CheckOut ( ) :
Handicapped Spot
- ShowAvailableSpots( ): Spot [ ]
- searchplace (string ID) : String
Normal Slot
- ShowAvailableSpots( ): Spot [ ]
- searchplace (string ID) : String
Payment
+ Amount : double
+ calculatePrice (Vehicle v) : double
+ printReciept ( ) : void

Figure 25: Class Diagram

User Interface Design

First Screen

The purpose of this screen is simply to show the user the welcoming screen and the faring system.
We made it simple and to the point for ease of use.



Garage System

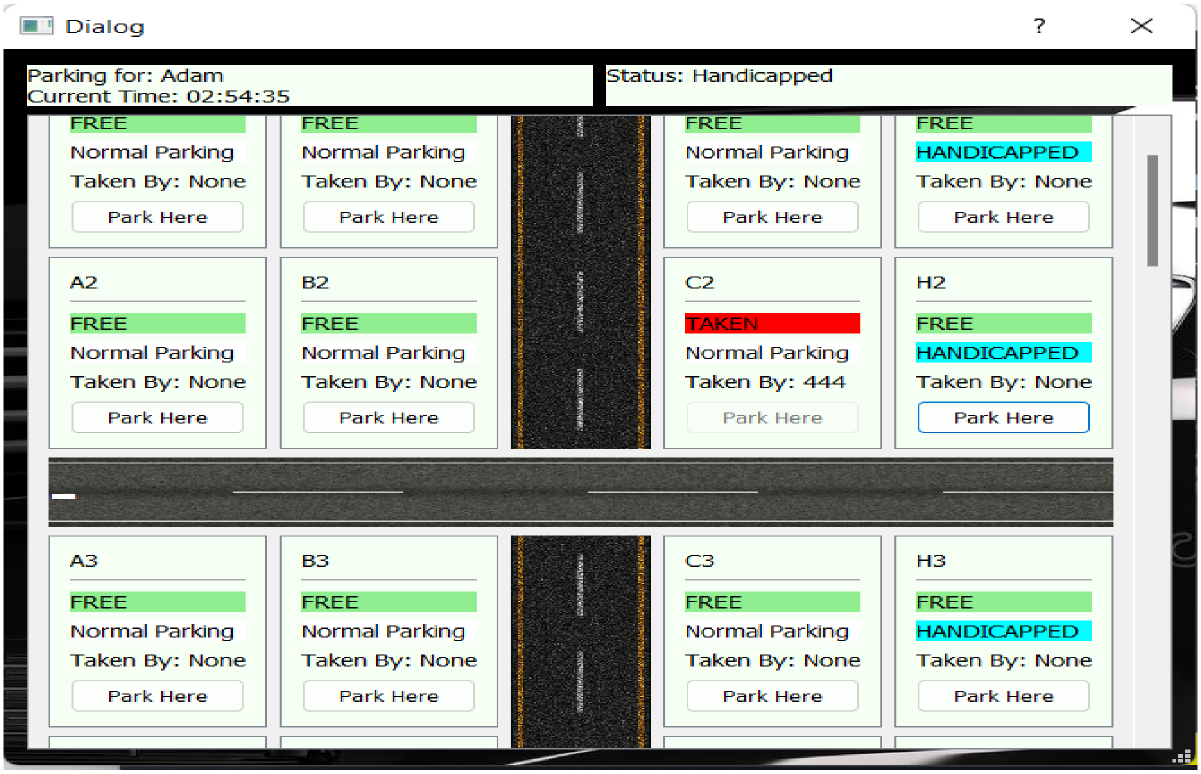
Fare rate

1 minute - 10 pounds
6 minutes are considred a full day
Full Day's fare rate is 80 pounds

Figure 26: First Screen

Second Screen

Invoked on pressing the car Enter button after taking the user's name.
Its purpose is showing the available places and dividing the garage into a place for handicap and the other section.
Its design is simple and elegant and have a schematic of the place and the name of the parking lot and the directions to take to reach that place.
The user presses park here if the place isn't taken and then it displays a confirming window after which the program returns to the first window.



Parking for: Adam
Current Time: 02:54:35

Status: Handicapped

FREE
Normal Parking
Taken By: None

FREE
Normal Parking
Taken By: None

FREE
Normal Parking
Taken By: None

FREE
HANDICAPPED
Taken By: None

A2
FREE
Normal Parking
Taken By: None

B2
FREE
Normal Parking
Taken By: None

C2
TAKEN
Normal Parking
Taken By: 444

H2
FREE
HANDICAPPED
Taken By: None

A3
FREE
Normal Parking
Taken By: None

B3
FREE
Normal Parking
Taken By: None

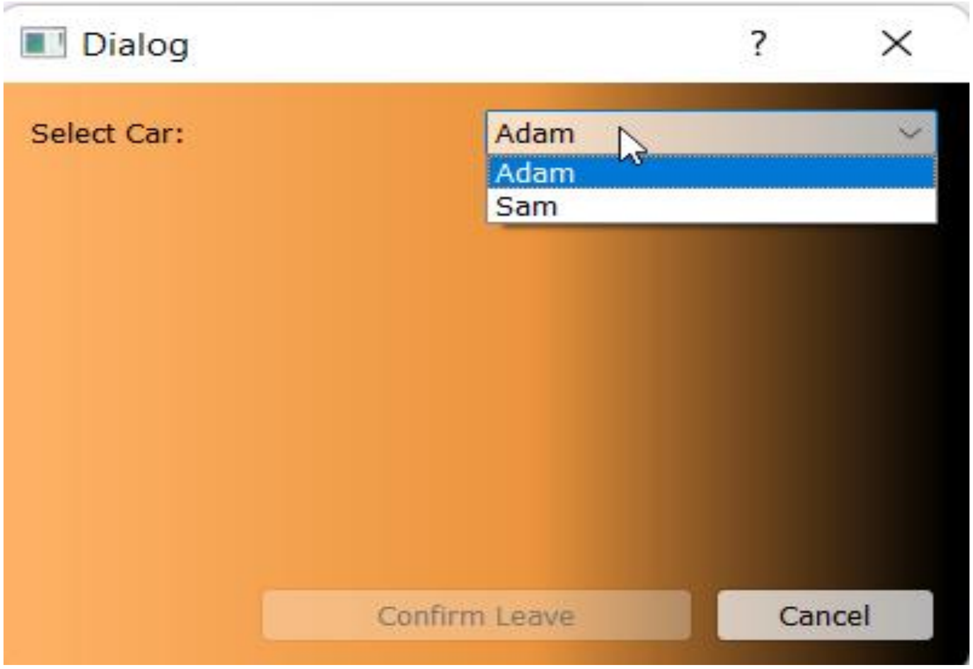
C3
FREE
Normal Parking
Taken By: None

H3
FREE
HANDICAPPED
Taken By: None

Figure 27: Second Screen

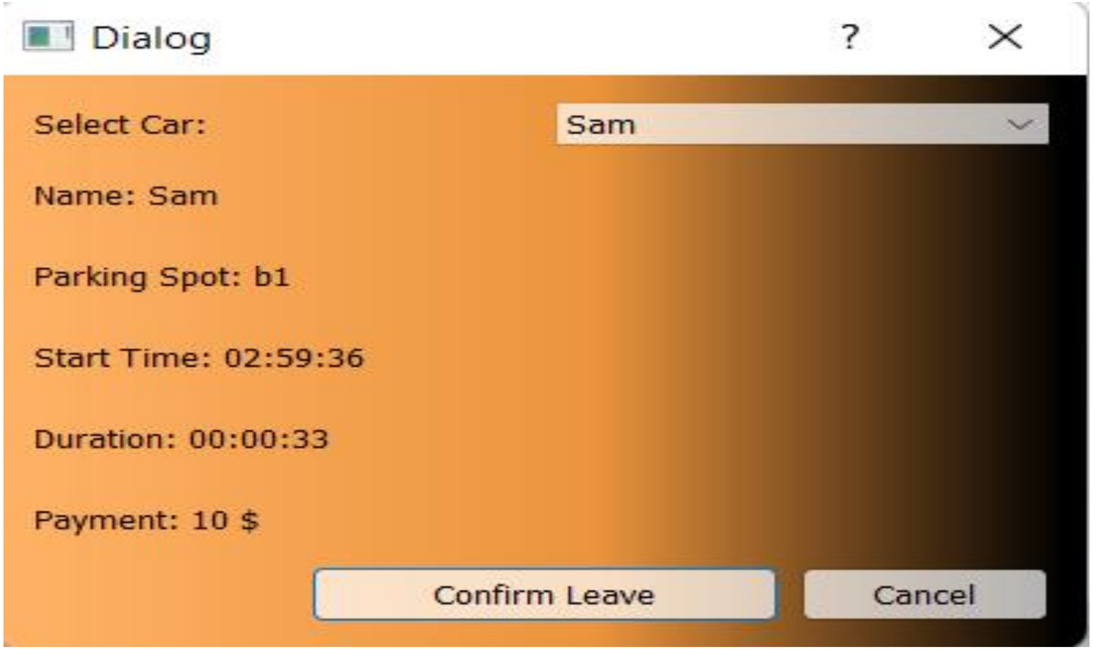
Third Screen

- Invoked on pressing the car Leave button after.
- Its purpose is showing the available users to choose the one that will sign out.
- After choosing the user's name, it shows the name and spot and start time, duration, and the payment.
- The user presses Confirm Leave, and it displays a confirming window after which the program returns to the first window.



Select Car: Adam

Figure 28: User Selection Box



Select Car: Sam

Name: Sam

Parking Spot: b1

Start Time: 02:59:36

Duration: 00:00:33

Payment: 10 $

Figure 29: Confirmation Screen