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FACULTY OF COMPUTING
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DATA STRUCTURES & ALGORITHMS

MINI PROJECT:

CAR SERVICE SIMULATION IN C++ USING QUEUE

GROUP 6:

	Name	Matric Number
1	CH'NG SENG HONG	A23CS0058
2	MUHAMMAD AMIR ZAFRI BIN MOHD ADHAR	A23CS0120
3	TAQIA TAHMIDA	A23CS0026
4	NAM SOOK JING	A23CS5016

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SYNOPSIS

In this project, we created a Car Service Simulation program using a queue implemented with a linked list. This program allows customers to add their cars to the queue for servicing. Since we are using a queue, it follows the FIFO (First In, First Out) principle, where cars at the front of the queue are serviced first and removed once a service bay becomes available.

Customers' cars are added to the queue using the enqueue (Customer c, ServiceType s) function when they register for service, and they are required to choose the type of service they want. Once a car reaches the front of the queue, service technicians assign it to a service bay based on the availability of technicians. After servicing is completed, the car is removed from the queue using the dequeue () function. Customers can view their position in the queue, which helps them estimate the time for service completion.

Once a car is registered and serviced, it is added to the Service History. This feature enables customers to trace back the services performed on their car, as the Service History includes the date and type of service provided. This helps them easily schedule their next service.

Since we implemented a linked list in our code (Customer Linked List and Service Queue), we included a Node class as the foundation for both structures. This approach allows for dynamic memory allocation, eliminating concerns about fixed class sizes or wasting memory space.

OBJECTIVE

- To use ADTs to implement a queue system using linked list implementation
- To implement different queue functions like Enqueue and Dequeue properly
- To allow customers to add their car to the queue online using Enqueue function
- To allow customers to view where their car is in queue
- To allow service technicians to view the queue
- To allow system to delete cars from queue using Dequeue when it reaches the front of queue
- To allow service details to get added to the cars' information every time

SYSTEM REQUIREMENTS

Functional requirements:

- Allow customers to register their cars to the queue
- Allow customers to view their place in the queue
- Allow service technicians to view cars in queue
- Allow service technicians to assign cars to service bays
- Allow customers to view service history
- Allow service technicians to update service history

Nonfunctional requirements:

- Ensure code is readable and organized
- Ensure proper data encapsulation
- Ensure errors like empty queue and full queue are handled properly and return appropriate messages
- Ensure functions exclusive to different users are maintained and inaccessible to the other

ANALYSIS & DESIGN

System Requirement Use Case Diagram

Prepare by: Muhammad Amir Zafri bin Mohd Adhar & Ch'ng Seng Hong

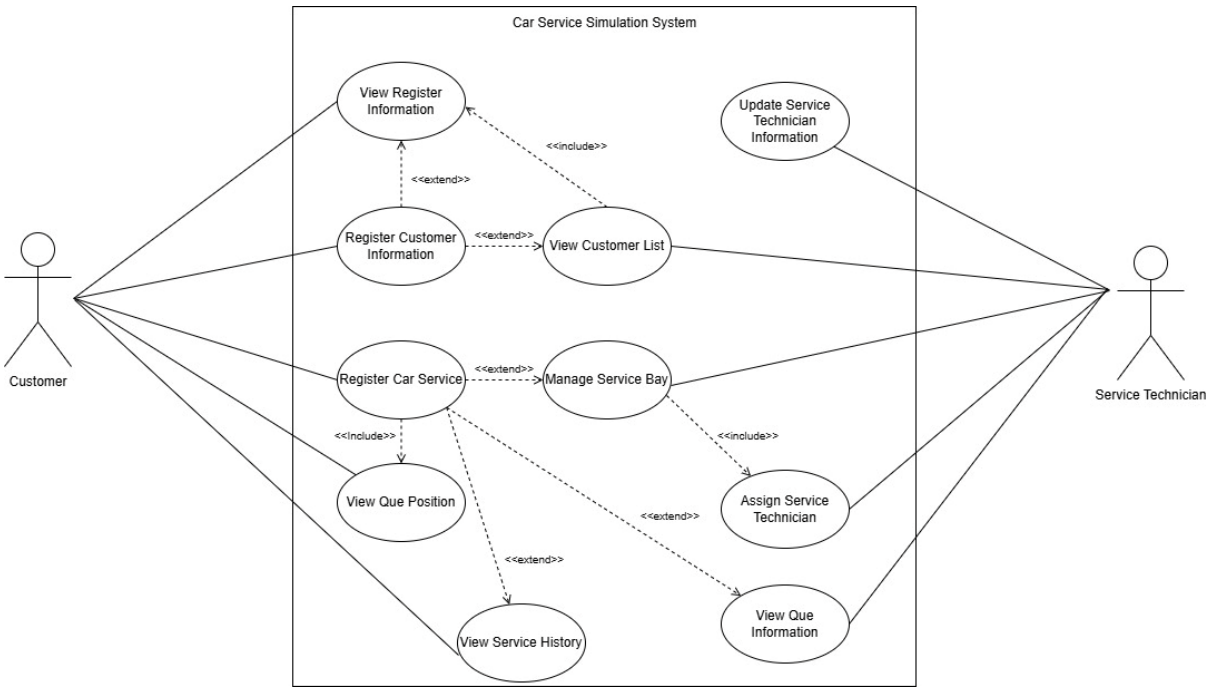

Figure 1: Use Case Diagram for Car Service Simulation system

Tasks Description for Car Service Simulation System Use Case

The system users are customers and service technicians.

Prepare by: Muhammad Amir Zafri bin Mohd Adhar

Actor	Task
Customer	– Select the service type for their car. – Register their car for servicing. – View the current service queue position. – View the service history to ensure the required services are performed.
Service Technician	– Assign the technician to the service bay. – View the queue of service car – Manage the service bay by remove the car that done service and assign the next car in the queue

Table 1: Task for each actor based on Car Service Simulation system use case diagram

Detailed Description for each Use Cases

The system has ten use cases.

Prepare by: Muhammad Amir Zafri bin Mohd Adhar & Ch'ng Seng Hong

Use Case	**Purpose**
Register Customer Information	Customers register their user information, and the car related information before moving in into the service registration.
View Register Information	Enable the Customer to view their information when registration.
View Customer List	Enable the Service Technician to obtain the customer list and their information.
Update Service Technician Information	Enable the Service Technician to update their information.
Register Car Service	Enable the Customer to register service for their car and enque the service into the queue.
View Que Position	Enable Customer to know their actual position in the que.
View Service History	Enable the Customer to view the service that been done before with the date of service
View Que Information	Display the queue to enable the service technician to know the actual information of the queue Customer.
Manage Service Bay	Used to remove the car that done service and assign new car to the service bay that available.
Assign Service Technician	Enable the Service Technician to assign themselves to the bay that lack of technician.

Table 2: Details description of Car Service Simulation system use cases

UML Class Diagram

Prepare by: Muhammad Amir Zafri bin Mohd Adhar, & Ch'ng Seng Hong

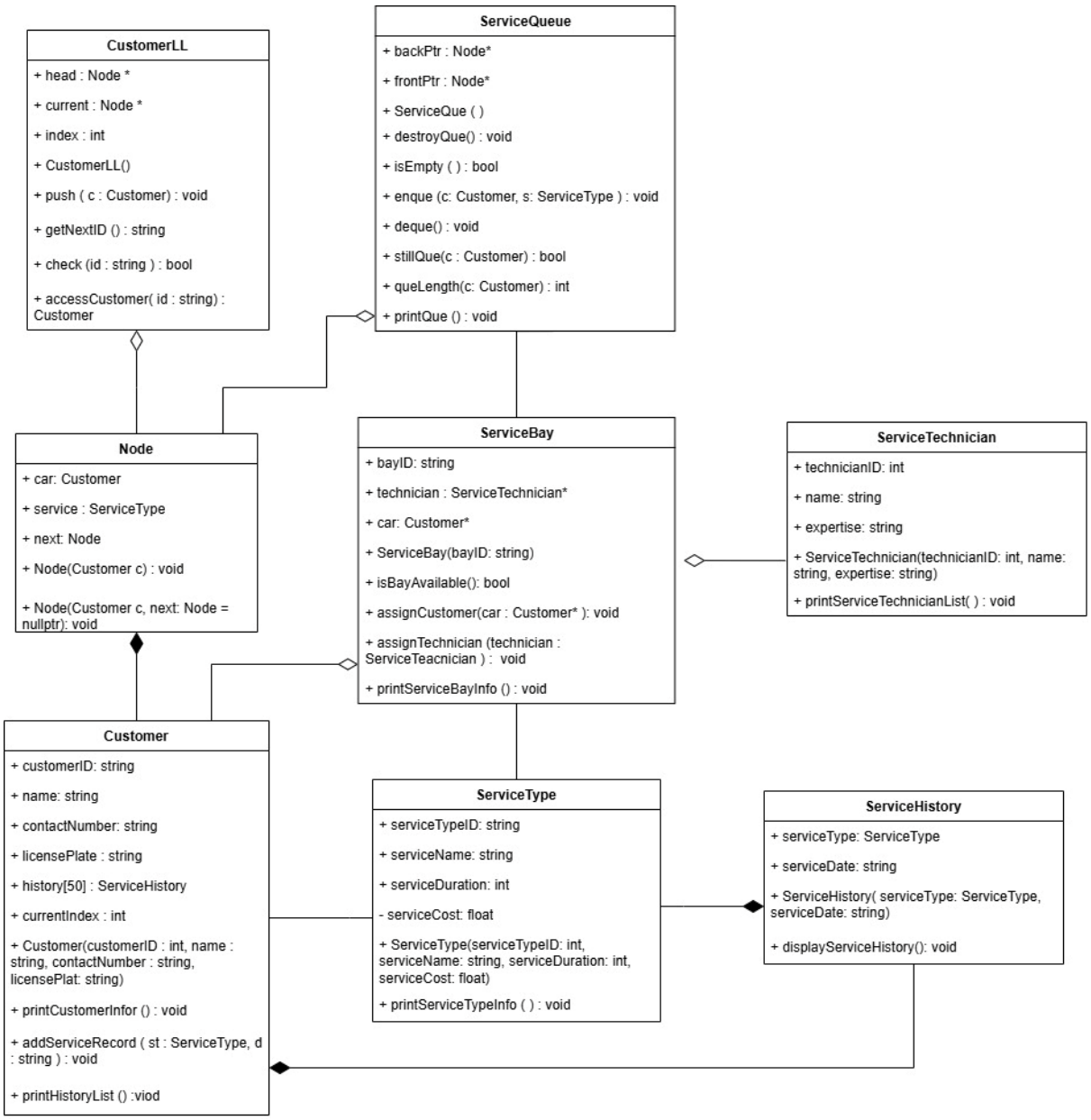

Figure 2: UML diagram for Car Service Simulation System

OUTPUT DESCRIPTION

While executing the system, it will shows the main menu of the system where there are two view for the user to enter which is the customer view and the service technician view.

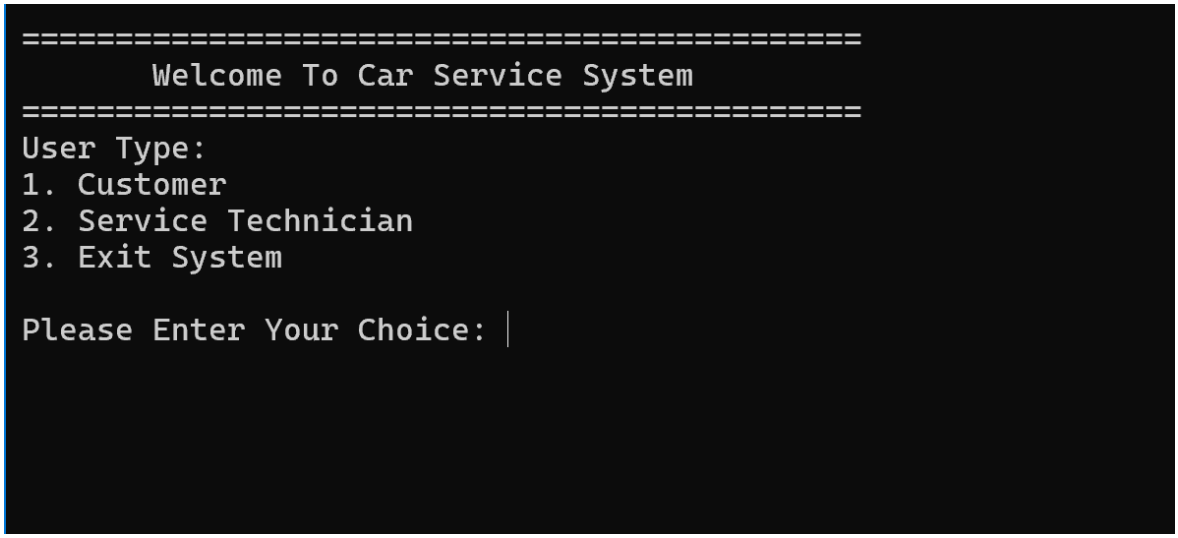

Figure 1: Main Menu

To access the customer view, the user should enter 2 and it will show the customer menu where option 1 is for the new customer to register and option 2 is for the existing customer.

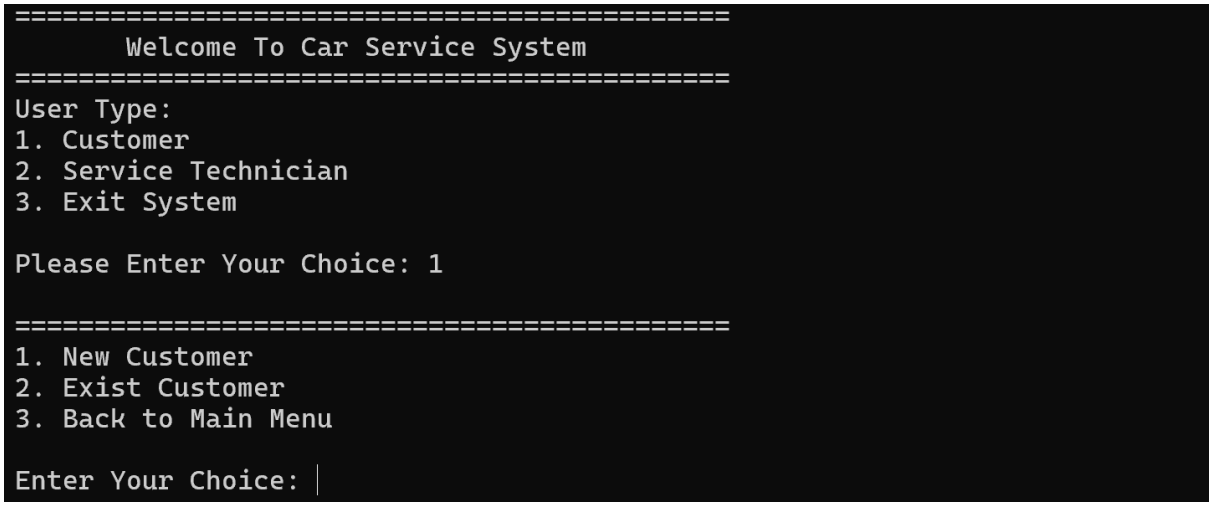

Figure 2: Customer Menu

After enter option 1, the user has to enter 1 again which act as a double confirm to register as a customer of the car service system.

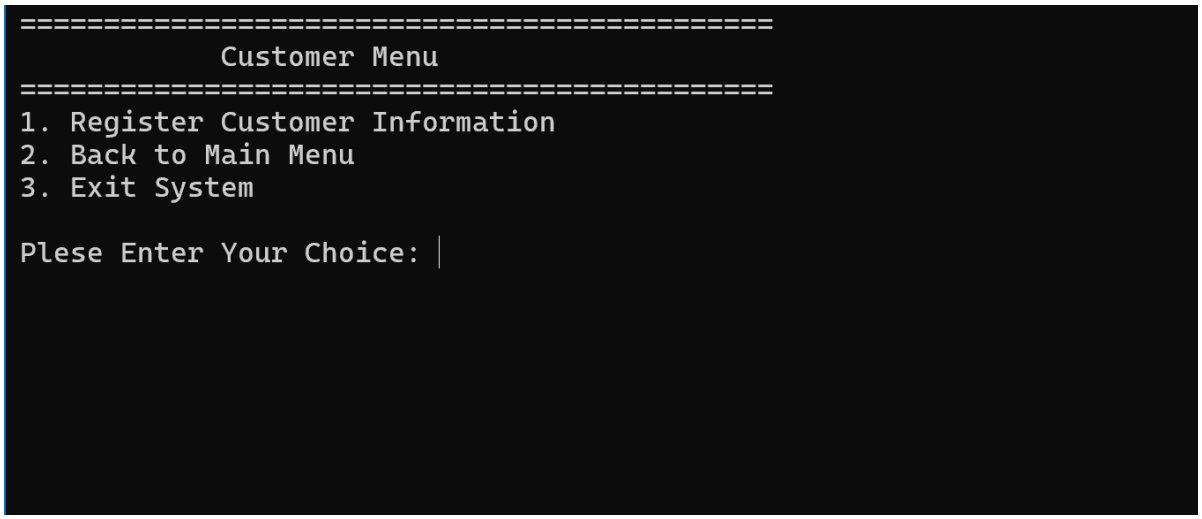

Figure 3: New Customer Menu

By entering to the register customer information page, system will require the user information and car information such as name of the customer, contact number, license plate number and so on. After the system receive the information, system will redisplay for the customer to double check the information they input whether is correct or no.

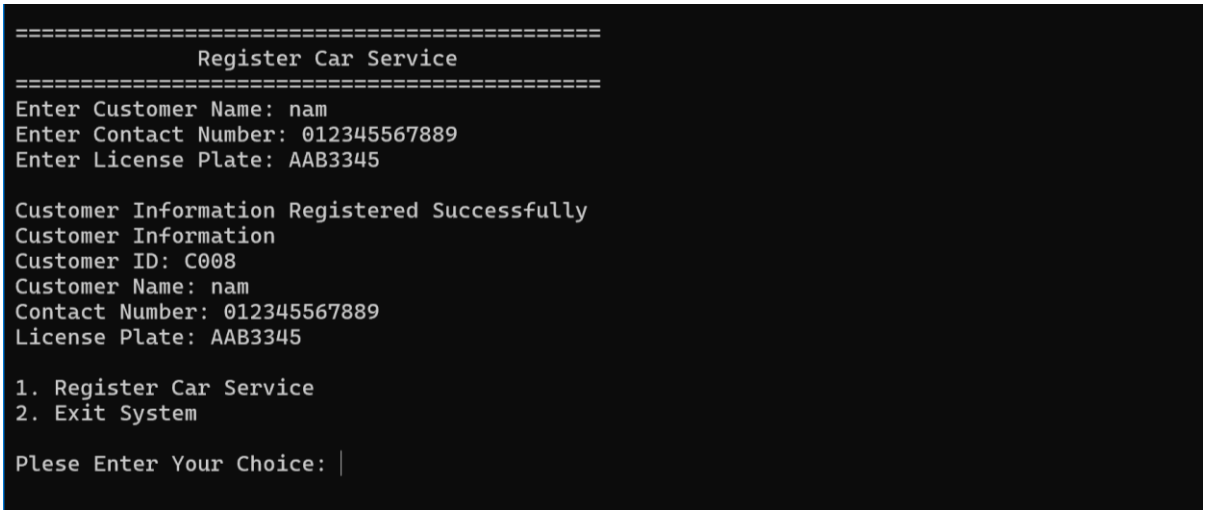

Figure 4: Register A New Customer

After registration, the user will be directed to this menu which is the same menu that user input option 2 at the customer menu. Before display the menu, the user are requiring entering their CustomerID to access the menu. Customer Menu contain 4 main functions which is the register car service, view service status, car service history and view register information

Figure 5: Existing Customer Menu

Option 1: Register Car Service is a function that push or enqueue the car information into the service que. While the service bay is empty, the car will be assigned to service that available to service. On the other hand, when none of the service bay is available, the service car will be enqueue and wait until the service bay is available.

Figure 6: Register Car Service

Option 2 – View Service Status enable customers to see the status of queueing or situation of the car service. While car still in queuing, it will display the accurate position of the car. When in service bay, it will show which service bay the car in.

```
Please Enter CustomerID: C007
==========================================
            Customer Menu
==========================================
1. Register Car Service
2. View Service Status
3. Car Service History
4. View Register Information
5. Back to Main Menu
6. Exit System

Plese Enter Your Choice: 2
Your Car is in Service Bay 1
Service by:
Technician Information
Technician ID: T001
Technician Name: John
Expertise: Engine


1. Back to Customer Menu
2. Exit System

Plese Enter Your Choice:
```

Figure 7: View Service Status

Option 4 will display list of service history that the customer has been done, which act as a record and reminder for the customer to make the next car service.

```
Service Type ID: S001
Service Name: Engine Oil Change
Service Duration: 30 minutes
Service Cost: $50
Service Date: 12/12/2021

Service Type ID: S002
Service Name: Brake Service
Service Duration: 45 minutes
Service Cost: $100
Service Date: 02/01/2022

Service Type ID: S003
Service Name: Suspension Service
Service Duration: 60 minutes
Service Cost: $150
Service Date: 20/03/2022

Service Type ID: S001
Service Name: Engine Oil Change
Service Duration: 30 minutes
Service Cost: $50
Service Date: 09/08/2022



1. Back to Customer Menu
2. Exit System

Plese Enter Your Choice:
```

Figure 8: Car Service History

Option 5 is to show the details of the customer.

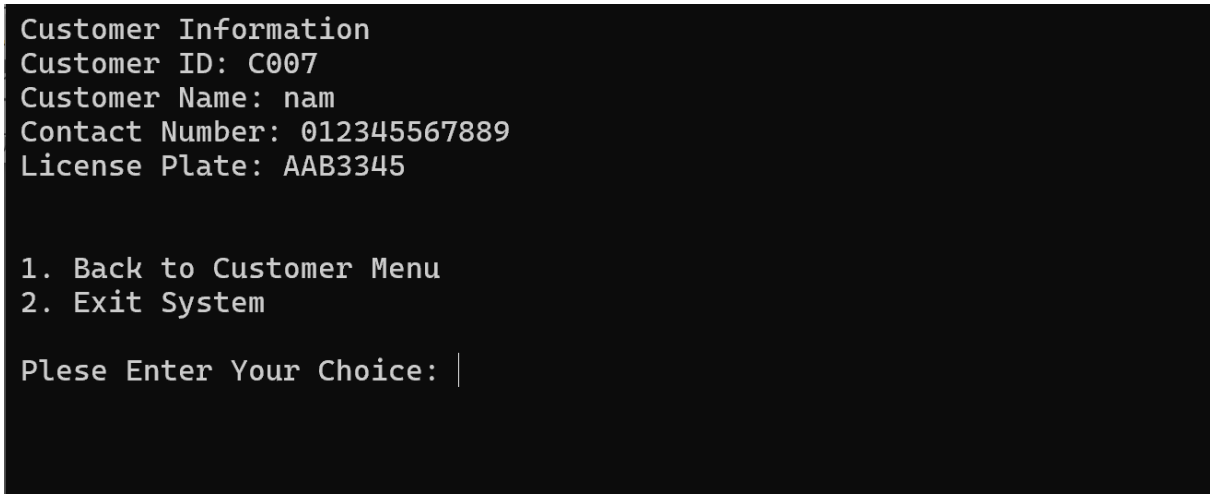

Figure 9: View Register Information

Technician Menu:
From option 2 of the main menu, user will enter the technician menu where contain 6 main function which is assign technician to service bay, technician list, updated technician information, view queue information, update service bay status and customer list.

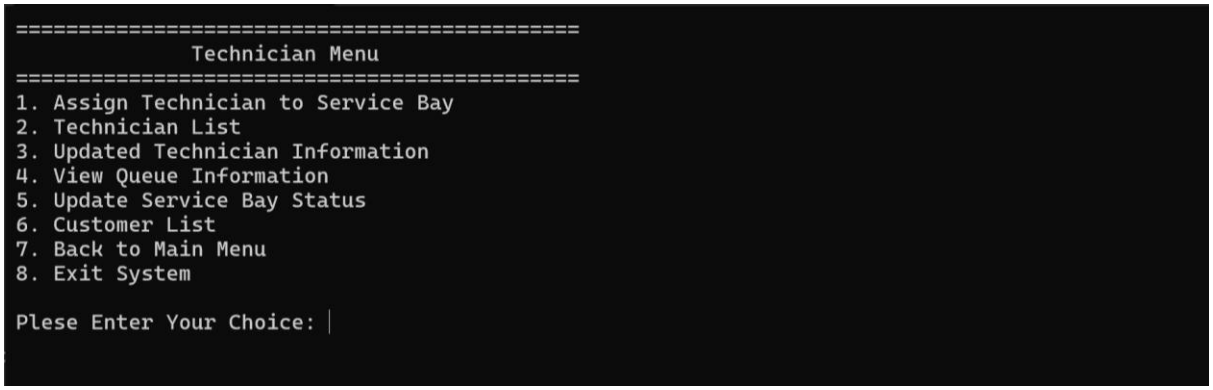

Figure 10: Technician menu

From the option of the technician menu, the system will display the status of the service bay with the technician and car assigned. While there is a service bay that is empty from technician, the system will required the user to assigned a technician to the service bay.

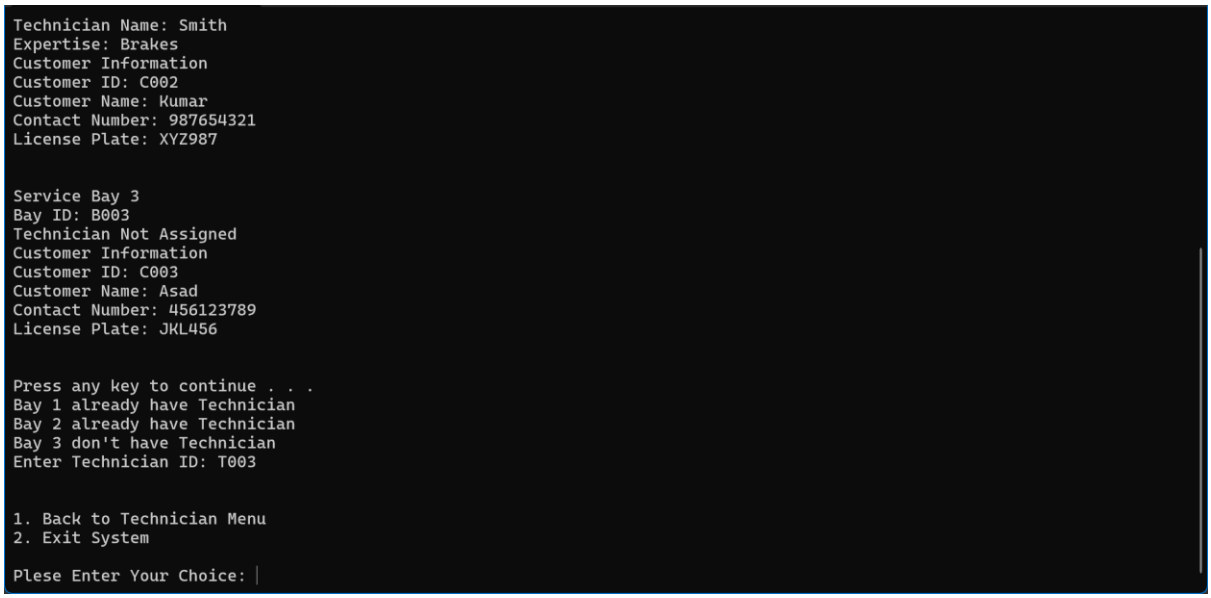

Figure 11: Assign Technician

Option 2 of the technician menu shows the technician list that currently employed by the car service center.

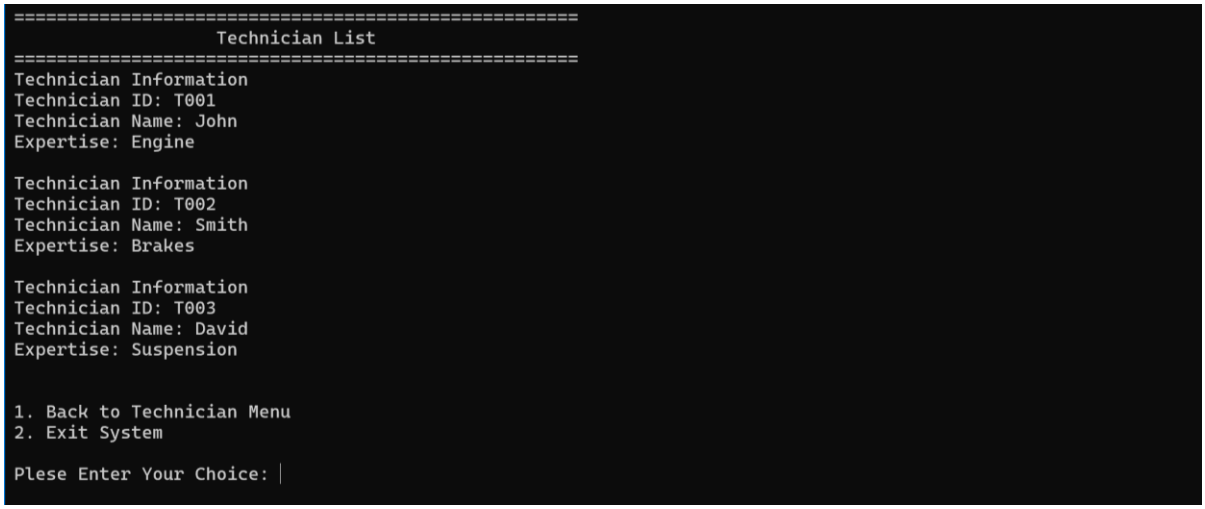

Figure 12: Technician list

Option 3 allows the technician to update their information such as the name expertise and so on.

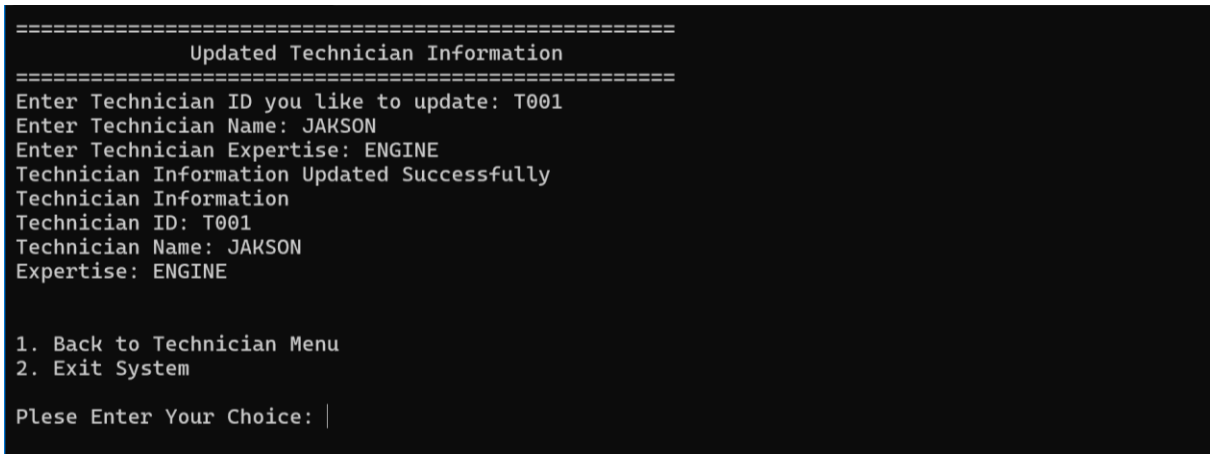

Figure 13: Update Technician Information

Option 4 will show the list of the queue situation include the customer's and car's information

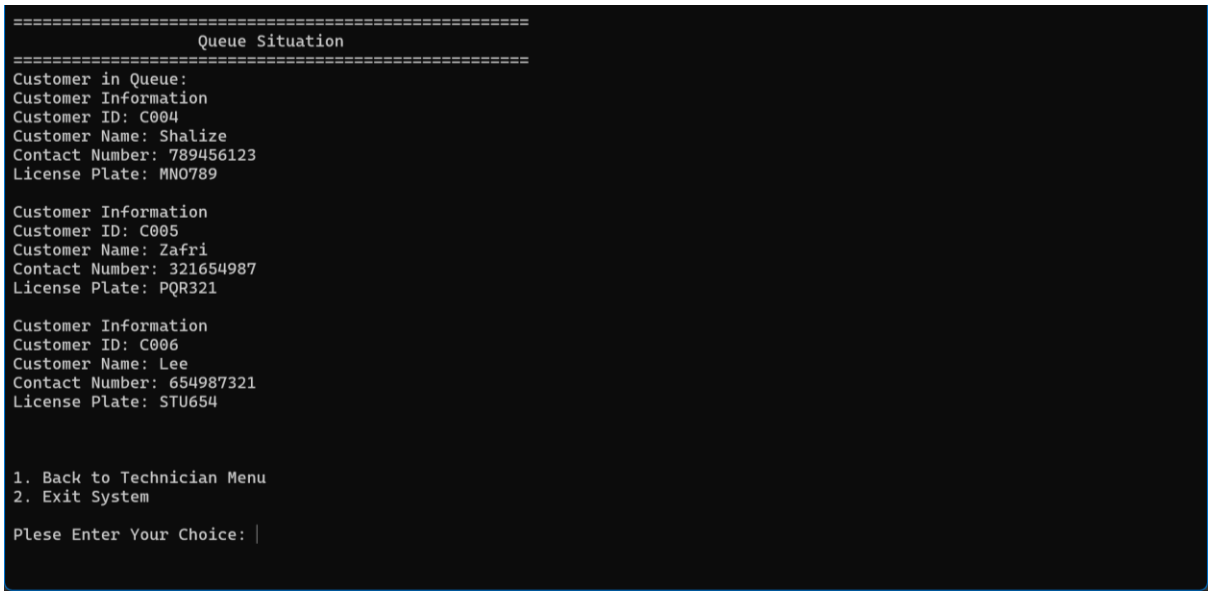

Figure 14: View Queue Information

Option 5 is for the technician when they done service for the car in the service bay, the will reassign another car to the service bay where the car will be deque from the service que and display the information.

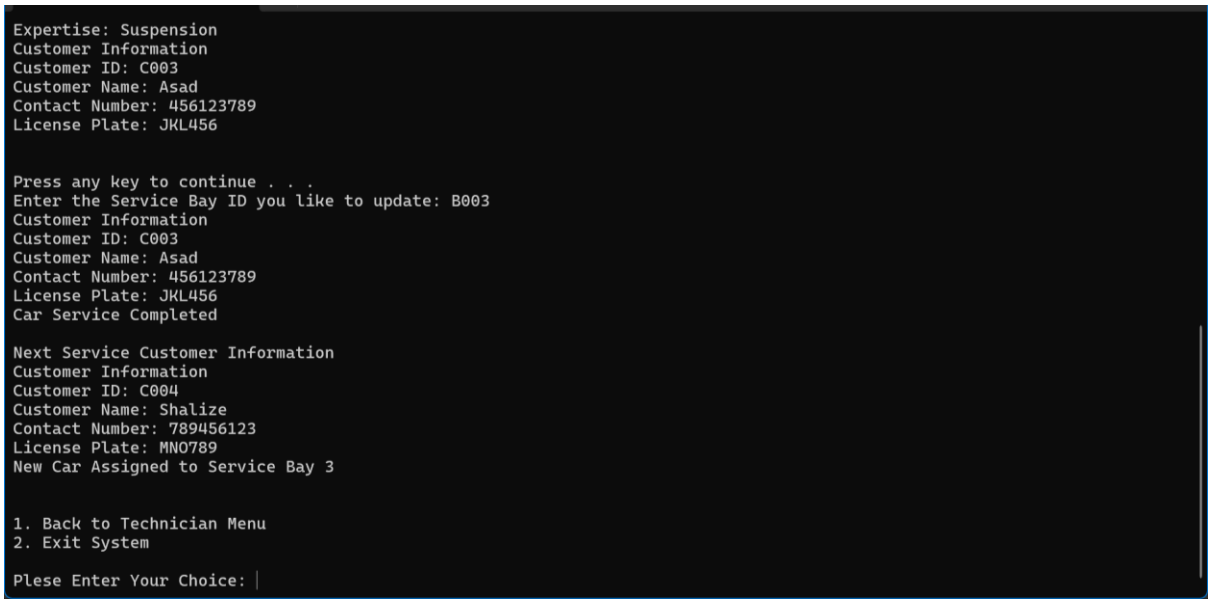

Figure 15: Update Service Bay Information

For option 6, it will show all the customer in a list.

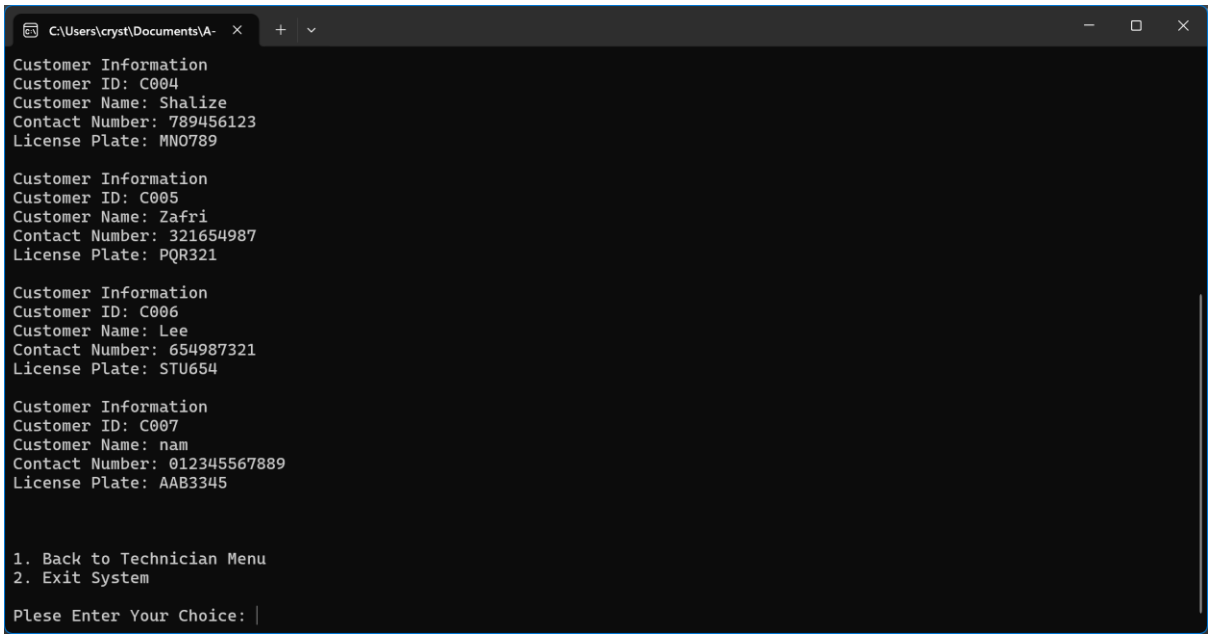

Figure 16: Customer List

APPENDIX

Demo video (YouTube)

https://youtu.be/WEnKjLy5_Lg