

**WEB-BASED AUTOMOBILE SERVICE STATION
MANAGEMENT SYSTEM**

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WEB-BASED AUTOMOBILE SERVICE STATION MANAGEMENT SYSTEM

**A thesis submitted for the Degree of Master of Information
Technology**

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Declaration

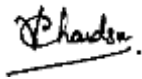
The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge, it does not contain any material published or written by another person, except as acknowledged in the text.

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This is to certify that this thesis is based on the work of Ms. R.V.R.Chandrasiri under my supervision. The thesis has been prepared according to the format stipulated and is of acceptable standard.

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Abstract

The Web-Based Automobile Service Station Management System is a well-prepared solution for most of the challenging requirements that arise in an automobile service station. The foremost issues in servicing and maintenance processes, of automobiles, will be addressed, and in addition, the opportunities to reduce the time required for the above processes will also be considered in order to provide an efficient service to the customer. Both customers and the management can be engaged with their day-to-day work efficiently and effectively using the web application. Satisfied customers are valuable assets for the business and, hence a higher profit can be gained by the management with the services provided via the Web-Based Automobile Service Station Management System.

A reliable, safe, and precise service will be provided to the customers by facilitating them to view their vehicle service history details in an easily accessible manner, which is introduced as one of the key aspects. Making and canceling reservations, sending confirmation emails, online purchasing automobile materials are some of the main features of the system. Correspondingly, the customers are allowed to provide feedback on the services they obtained at the service station. Nowadays, technology is on a boost. People wish to live a luxurious life with minimum physical work. Hence, the management can generate administrative and financial reports via the website as per their requirements, and maintaining a considerable customer base can lead to easy promotional activities. Considering the time factor, online stock maintenance will also be a profitable service from the management perspective.

Thus, the Web-Based Automobile Service Station Management System will be a profitable web application since it is efficient, accurate, user friendly and it goes hand in hand with the new-age technology.

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List of Acronyms

AOT	- ahead-of-time
ASP.NET	- Active Server Pages Network Enabled Technologies
CSS	- Cascading Style Sheets
ERD	- Entity Relationship Diagram
GB	- Gigabyte
HTML	- Hyper Text Mark-up Language
ICT	- Information and Communication Technology
JIT	- just-in-time
Mbps	- Megabits per second
MVC	- Model,View,Controller
PHP	- Hypertext Preprocessor
RAM	- Random Access Memory
SMS	- Short Message Service
SMTP	- Simple Mail Transfer Protocol
SQL	- Structured Query Language
UML	- Unified Modelling Language
UPS	- Uninterrupted power supply
VB	- Visual Basic
XML	- Extensible Markup Language

Chapter 1 - Introduction

1.1. Project Overview

Automobile Service Stations are places where it takes an enterprise for the maintenance and routine repair of motor vehicles. Diagnosing issues and changing of lubricants, major radiator replacements, vehicle wash, and vehicle services, repair of parts, fuel systems, and electrical equipment, and similarly auto detailing are some of the processes they are carrying out. The maintenance and repair areas are equipped with lifts, assembly and disassembly equipment, and various tool kits. Depending on the station's location, they are divided into two groups as follows:

- General Service Stations. – Roadside stations or the stations which are servicing small populations are considered general service stations.
- Specialized Service Stations. – Stations situated in large cities and providing services for specific types of vehicles are considered as Specialized Service Stations.

“The capacity of a service station is determined by the number of spaces provided for vehicles.” (“Service Station, Automotive,” 2003). Recently in Sri Lanka, automobile usage has been increased a significant amount with the development of technologies and trends in the automobile industry and consequently, huge business opportunities are arising in Sri Lanka. Most of the companies and individuals have started to make necessary changes and implementations to cater to these opportunities. By considering the reports relevant to vehicle imports in Sri Lanka within the past few years, it will be a profitable business trend to start or maintain an automobile service center.

The proposed web-based automobile service station management system will address most of the challenging requirements that arise in a service station and both customers and management will be satisfied with their work efficiently and effectively.

1.2. Motivation

According to the comments of some automobile service station owners, the following represents the major difficulties that they are currently experiencing, which directly affect both company productivity and customer satisfaction.

1. Placing a reservation

Currently, to place a reservation, customers should give a call to the Automobile Service Station. Most of the time there is no way to maintain a call center due to high cost, so whoever the person at the office has to answer them and it is very difficult to find whether there are any available time slots when the customer is requesting. Because he or she has to go through the reservation book, and also there is no way to check how many vehicles are already done and how many are pending at that time.

2. Cancellation of a reservation

When the customer has an intention of cancelling reservations that are already placed, there is no proper way of informing the service station about it. The requested slot will be vacated but it wouldn't be allocated for a new customer since the service station crew doesn't know about it. Likewise, customers don't have a way to get reminders about the reservation, sometimes the reservation will be cancelled automatically due to the forgetfulness of the customers.

3. Have to keep separate files for each customer.

Presently maintaining a few sets of files only for regular customs. But with the growing number of customers, it is very difficult to have physical files for each customer. For non-regular customers, the files are kept with the customer due to a lack of space at the service station. If a customer didn't bring the file there is no way to find the previous service details.

4. It will take a long time to find some details of a vehicle of a particular customer.

Even for regular customers, it is hard to find some details of a particular vehicle because it takes time to go through all the file numbers and find the relevant file and the relevant document. Since there is no backup methodology if something happens to those files no way to recover them and it will be a huge issue because most of the modern high-tech vehicles need to maintain proper and accurate service details.

5. Difficult to maintain the material stock.

This is one of the main issues at an Automobile Service Station. Employees always have to check the stores before buying new stocks. There is no way to track fast-moving items and unavailable items. Whoever the person at the cashier has to keep the details of different products in their mind to answer when a customer asks for a particular product.

6. Extremely hard to get monthly/weekly financial/status reports about the service station

To get management decisions, the owner has to have some knowledge about the areas such as financial status, customer details, what type of vehicles are commonly visited, number of services done in a week.

7. Lack of adequate crew at the service station.

Inability to provide services scheduled for the day due to a shortage of staff due to sudden illnesses of employees etc. and there is an issue of informing customers about the situation.

The motivation grows up to build a Web-based Automobile Service Station Management System, where it will be a help in several ways to overcome the above-mentioned issues. It is economically worth it when considering the future benefits. The system will provide a cooperative environment to continue day-to-day activities happening at the service stations effectively and efficiently. Similarly, to go in line with the market trends and social behaviors of the customers, it is important to consider the facilities which are provided by the other competitive Automobile Service Stations.

This Web-based Automobile Service Station Management System will be a great opportunity for a service station to gain a wider market and it helps to keep better interaction with the customers.

Even for the management, maintaining the stocks up to date and controlling the inventory will no longer be an issue.

1.3. Objectives

The proposed Web-based Automobile Service Station Management System will tend to acquire the following objectives.

- Allow users to maintain their vehicles in safe and comfort manner by providing an easily accessible method to their vehicle maintenance history details.
- Provide facility to allocate vehicle bays according to the customer service requirement and the available slots via the website. Customers can both make reservations and cancel them.
- Computerize, selected manual processes currently undertaken at any vehicle service station to provide an efficient service to the customers as well as a benefit to the management.

Such as,

- Facilitate maximizing the number of regular customers by enhancing customer attraction and interaction with the service station.
- Allow customers to view services and their corresponding prices and the promotions given by the Service Station.
- Generate invoices for a particular service and they can be printed.
- Provide facilities to order automobile materials online.
- Sending reminders and getting feedback from customers.
- Provide facilities to the management to access the web page and to get the required details from any place at any time. (Including report generation)
- Assigning existing employees for services effectively.

1.4. Background of the Study

Usually, most automobile service stations handle their day-to-day work manually. But, with the growth of the automobile industry, several competitive automobile service stations have arisen, and they have selected the technology touch with their daily processes. It was identified a lot of drawbacks with these manual processes executes at middle-scale automobile service stations. They are discussed in detail in the next chapter. To improve the quality of the product it was required to visit a service station and gather information regarding daily manual processes happening at the premises. Similarly, studying only on the middle-scale service stations was not sufficient. Some large-scale service stations managed by larger companies had to be studied to get a clear idea about an automobile service station.

Apart from the major difficulties mentioned in above 1.2. Motivation section, the following issues are also identified in most Automobile Service Stations.

1. Customer profile – It displays the service history logs of customers. Any of the websites of Automobile Service Stations don't display the service history logs of customers.
2. View time slots – Most of the websites of Automobile Service Stations allow customers to make reservations, yet they don't provide the facility to view the available time slots.
3. Displays price schedules - Most of them display only the services provided by them yet not the price schedules.
4. Online stock maintenance - Stock maintain is also becomes easier when it is done online. None of them seems to be handing this stock management online.

The proposed web-based automobile service station management system has addressed the above-mentioned issues as newly introduced functionalities when compared to the other middle-scale and large-scale auto care management systems.

1.5. Scope of the Study

The proposed Automobile Service Station Management System is a total web-based solution that provides customer satisfaction at the full level on his/her automobile and supports to make better managerial decisions for the management.

- From the customer's perspective,

Customers can view all the services and corresponding price schedules and special promotions given by the Automobile Service Station without logging in to the system. They can select whatever services they are willing to take and view all the available time slots and make online reservations by providing some details. To do that first they need to log in to the system. Similarly, if they need to cancel the reservation, it must be done 1hr before the reserved time. The system will send a reminder about the reservation to the customers 1-day prior via SMS/ Email. Furthermore, customers can purchase materials via web site without making a reservation. Since the home delivery option is not available the customer has to visit the premises and collect the order.

- From the management perspective,

The system will handle customer details, vehicle details, and logs of services of each vehicle separately. This is one of the major requirements which is going to fulfill by the system. Services provided by the Automobile Service Stations can be changed from time to time. Hence the system will provide a separate interface to add/edit/delete available services and their prices. once a service is done, an invoice will be generated by the system operator concerning the average price schedules displayed on the website and the materials purchased by the particular customer. Payments will be received to the account of the owner via payment gateways. Also, customers can give feedback via the site or filling the feedback form given at the premises, mentioning the service they got from the Automobile Service Station. The management/employees are encouraged to rate the customers who are already served by the Automobile Service Station. This will be a solution for the competition among customers while reserving time slots. Customers can be prioritized according to the rates they got.

The system provides the facility to reorder the required materials, whenever the amount of the material passes the limit. Notification is done via SMS or email. Admin users can view available stocks of each item and items can be added/edit or deleted with several restrictions. In the case of a shortage of staff, the customers are informed to renew the reservation and get the consent of the customer. If it happens during the daytime, any other available employee will be allocated to provide that particular service. Several reports can be generated through the system. Final reports are very important for any organization. This system will provide several customer-level reports and administrative-level reports.

Limitations in the system.

1. Due to practical scenarios, customers are not allowed to make payments online for the automobile services they get, except for purchasing items online.
2. Payments of the employees or employee management functionalities can be added as future developments. (Not included at this stage)
3. Keeping track of supplier details also can be added as future developments. (Not included at this stage)
4. Stock maintenance of consumable items at the premises will not be handled via the system at this stage.

1.6. Feasibility Study

A feasibility study is a significant method of ascertaining the probability of completing the project successfully by taking all of the project's relevant factors into account. Considering economic, technical, legal, and organizational factors, project managers use feasibility studies to discern the pros and cons of undertaking a project before they invest a lot of time and money into it.

Feasibility studies also can provide a company's management with crucial information that could prevent the company from entering blindly into risky businesses. (Kenton, 2021)

Since the system is providing the facility to make reservations in both online and offline manner, customers can fulfill their requirements accordingly. Management can easily perform their day-to-day work since maintenance of a computer system (website) requires very little staff adoption.

Correspondingly, updating stocks and handling inventory will be at the fingertips of the management since most of the functionalities are done via the internet.

1.7. Structure of the Dissertation

Chapter 2 – Background

Background study carried out with a comparison of available similar systems. An analysis of functional and non-functional requirements of an Automobile Service Station is included. A comparison of alternative technologies with the software used to build the system is discussed and alternative design strategies are included.

Chapter 3- Design Architecture

The design of the system is presented in this chapter. The system diagram, database structures, initial UML diagrams, and the methodological approach used in the system designing phase will be included.

Chapter 4 – Methodology

Since the requirements for this system are mostly clear and fixed. While some functionalities and requested enhancements evolve with the process of the development process. Hence the Iterative Model is used to develop the system. This chapter includes the main modules used in the system and the interactions among them. Similarly, the implementation environment of the system will be discussed.

Chapter 5 – Evaluation and Conclusion

This chapter includes whether the project meets up its objectives. If not, the reasons for the failure and lessons learned during the development of the system are included. The summary of the system and identified deficiencies in the final product and the future enhancements will be stated.

This will conclude the first chapter of the dissertation and the next chapter will convey an awareness of the background study of existing automobile service stations and their websites in Sri Lanka and International.

Chapter 2 – Background

2.1. Introduction

For the background study, had to visit an actual client who has an Automobile Service Station to get a clear idea about the process done in an Automobile Service Station and, the following facts were identified. This particular service station has been following a manual process to carry out its day-to-day activities from the establishment of the company. Service details and accounting details were maintained as a single section from the beginning. All the transactions were written down in a book with the service details. Through the expansion of the business, it has been very difficult to keep a track of records in a single book. At present, they are maintaining three separate books to keep records.

- Timekeeping book
- Services book
- Stock maintain book.

A section of a page from the existing time-keeping book which they use to keep the details of services carried out on a single date is depicted in Figure 2.1: Manual Processing Timekeeping Book. It is a manual document currently they are maintaining.

1	NB	1784	Jeep	08.30	08.45	10.45	11.50	R/W	D
2	JB	4574	Car	08.35	08.50	10.20	12.00	W/u	D
3	1	1609	Jeep	09.15	10.05	03.10	03.45	R/W	D
4	KD	7028	Car	09.40	12.45	03.30		R/W	R
5	GL	8857	VAN	11.30	03.35				
1	KC	0672	Car	09.10	09.15	11.00	12.25	R/W	D
2	64	6830	Jeep	09.20	09.25	11.55	05.25	W/u	T
3	PE	7210	Jeep	10.50	11.05	12.45	05.20	R/W	D
4	GY	5486	Car	01.15	04.45	5.40	07.35	R/W	N
5	18	400	Jeep	11.20	12.10	04.40	05.40	R/W	D

Figure 2.1: Manual Processing Timekeeping Book.

According to the timekeeping book, a single record describes details of,

1. Vehicle registration number
2. Vehicle type
3. Time vehicle reached the service center.
4. Time starts the service at hydraulic lift (to identify the waiting time of clients)
5. Time the vehicle brings down from the lift
6. Time the vehicle leaves the premises after other services.
7. The employee who did the wheel removing and fitting back (keep a record of the employee because this is an extremely responsible task)

A section from the service entry book which keeps the services carried out for a particular vehicle is illustrated in Figure 2.2: Section from the Service Entry Book.

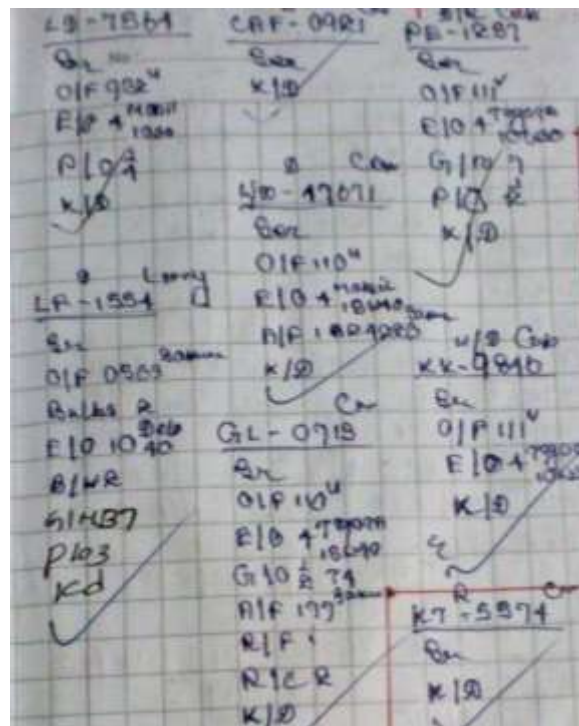


Figure 2.2: Section from the Service Entry Book.

Vehicle registration numbers have taken as the unique id here and set of services were written down in a shortened format,

- E/O- Engine Oil changed
- G/O- Gear Oil changed
- A/F- Air filter replaced.

- R/C- Radiator coolant
- A/F- AC filter changed.
- O/F- Oil filter changed.

A sample service card that has to be kept with the customers, is depicted in Figure 2.3:Service Card. Usually, the customer will bring the card at the time he is doing the service and the status after service will be written down by the owner and place his signature to verify the details. If this card has been lost, there is no way to recover service details.

Date	98178	104870	11238	117506	123357	129701	135979	140560	146036	152977	15977	164852	170754	17678
Mileage	98178	100570	107238	113505	119357	125701	131479	136560	142036	148815	154477	160252	166754	172100
Engine Oil	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Engine Flush	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gear Oil	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diff.Oil (Rear)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Front Axle Oil	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4 Wheel Box Oil	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Steering Oil	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
Brake Oil	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
Clutch Oil	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
Battery Water	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
Oil Filter	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fuel Filter (F/P)	OK	OK	-	-	-	-	OK	OK	OK	-	-	OK	OK	OK
Air Filter	✓	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
Radiator Coolant	OK	OK	TU	OK	OK	OK	TU	OK	OK	OK	OK	OK	TU	OK
Auto Gear Oil	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	TU	OK
Greasing	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Checked by	Manoj	Manoj	Manoj	Manoj	Manoj	Manoj	Manoj	Manoj	Manoj	Manoj	Manoj	Manoj	Manoj	Manoj
Authorized Signature														
Next Date	98178	104870	11238	117506	123357	129701	135979	140560	146036	152977	15977	164852	170754	17678

Changed TU Top UP

We Care For Your Car

Figure 2.3: Service Card.

The proposed Web-based Automobile Service Station Management System automates most of the manual processes ongoing at an Auto Care service station. Considering the above facts, total processes carried out by the Service Station are depicted in Figure 2.4: High-Level Use Case Diagram of Existing System.

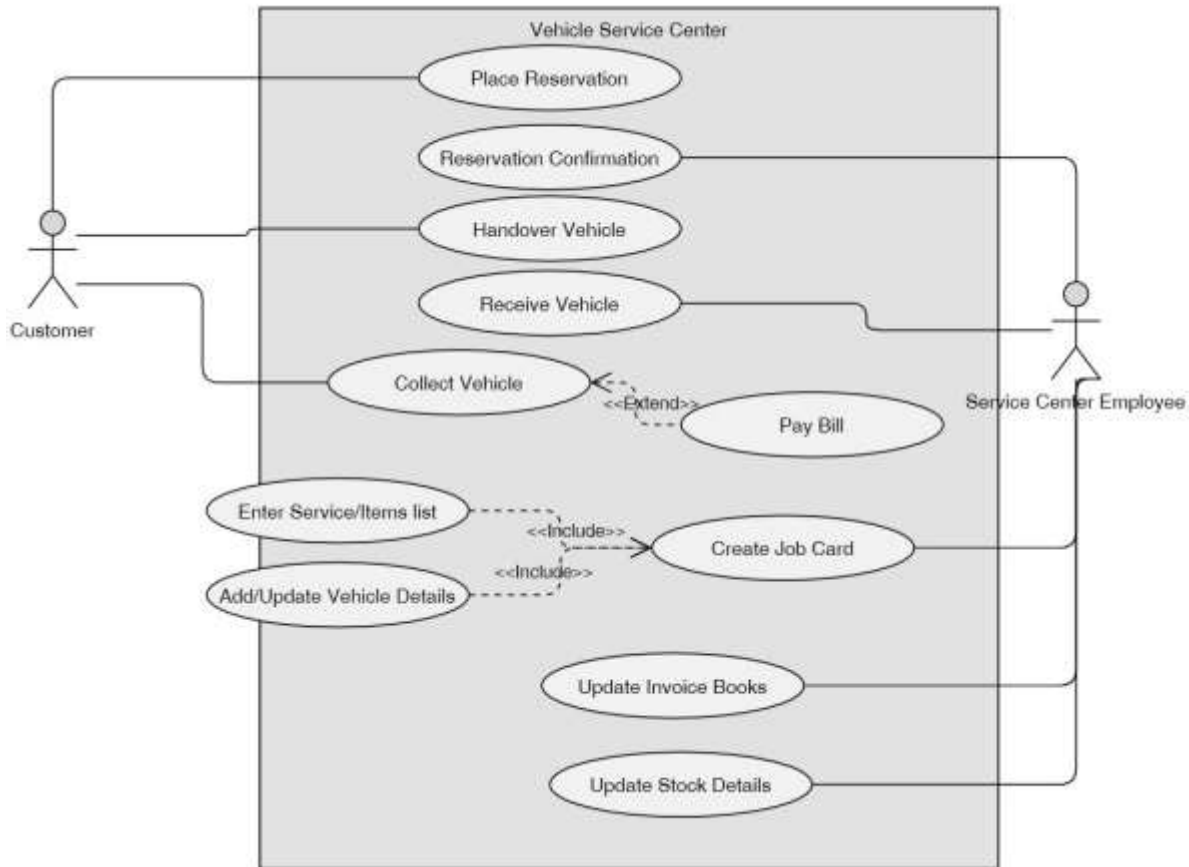


Figure 2.4: High-Level Use Case Diagram of Existing System.

2.2. Requirement Analysis

Requirement Analysis has to do a major role in the software development life cycle. Before converting a manually driven process into a computerized system it is very important to get a vivid idea about the problem domain and the user requirements. Following methods are used to gather requirements,

- Observation.
- Inspection of existing documentation.
- Interviews.
- Prototype.

There are two types of requirements identified in the system,

- Functional Requirements
- Non-functional Requirements

2.2.1. Functional Requirements.

1. Registration of customers. (Customer management module)
 - a. Customer Registration - Customers who wish to make a reservation, need to be registered on the site by providing their details which will be helpful to contact them later and to maintain their profiles. If they are making the reservation online at that moment personal details can be entered via the website. If they are making the reservation with the help of the system operator, the customer can provide the relevant information to the operator and the operator can feed the data into the system.
 - b. Customer details can be edited and deleted through the system.
 - c. Maintain customer login details.
2. Making and canceling reservations online. (Reservation management module)
 - a. Making a reservation – this can be done using the web page by the customer himself or through the system by the system operator.
 - b. The operator should be able to view both available and reserved slots from a grid view and allocate time slots for an appointment.
 - c. Customers are reminded about the reservation 1-day prior via SMS/ Email.
 - d. Canceling a reservation – both customer and system operator can cancel the placed reservations (at least before 1hr for the reservation) via the website.
3. Vehicle history management. (Vehicle management module.)
 - a. Vehicle details relevant to a particular customer must be entered into the system by the operator or the customer him/herself.
 - b. A set of vehicles can be entered under one customer.
 - c. Vehicle details can be updated or removed from the system.

4. Payments for the services. (Invoice generation module)
 - a. Invoices will be generated at the time customer doing the payments.
 - b. If the customer is willing to select a package, it can be selected directly. Services can be added separately. Total payment will be calculated accordingly.
 - c. The price of the services will be added to the invoice automatically. Must be able to change the price if needed.
 - d. After finalizing the invoice, the system will generate a printed copy.

5. Customers can provide feedback for the obtained services.

6. Online Item purchasing. (Item management module.)
 - a. Required materials or items can be entered with the quantities.
 - b. Payment for the selected items can be done online.
 - c. Payment receipt will be sent to the email of the customer and when collecting the order customer should provide the receipt to the person at the premises.
 - d. Maintain a set of selling items with prices.
 - e. Add, edit or delete items.
 - f. Item categories must maintain separately

7. Stock management module.
 - a. Track the availability – The system should provide a facility to maintain the stocks up to date.
 - b. Should keep separate price values for different items, because the prices can be changed from time to time when they are purchasing.
 - c. Reorder level of each item should be alerted.

8. Report generation module.
 - a. Customer handling reports.
 - i. Customer previous services.
 - ii. Customer total payments.
 - iii. Top-rated customers.
 - b. Appointment handling reports.

- i. Hot services (what are the most commonly requested services).
 - ii. Peak days and time slots in the week.
- c. Stock controlling reports.
 - i. Several stock maintaining reports.
- d. Income handling reports.
 - i. Daily, weekly, and monthly income reports
- e. Vehicle history reports.

2.2.2. Non-Functional Requirements.

1. Effectiveness – The system should directly affect the current procedures of the service stations.
2. Performance – The system should not take a long time to save invoices. The website should load appointment windows and registration process very quickly, else the customers get annoyed.
3. Reliability – Information contained in the system should be accurate. Usually measured as a percentage.
4. User Friendliness – Interacting with the system should be easy for the customer and the system operators must not get confused.
5. Availability – Web site should be available whenever the customer requires it. A little corruption can lead to a huge loss.
6. Quality – The system should maintain the quality of the services at all phases.

2.3. Quality of the solution

2.3.1. Review of Similar Systems

In Sri Lanka, there are a set of vehicle service centers that are already using computerized systems to do their activities. Even though the overall procedure is somewhat similar for service stations, these systems have been developed for individual requirements and procedures. For the reason of that increment of business competition, several systems consist of a set of client attractive features. A comparison of companies that handle larger-scale Auto Care Management Systems is depicted in Table 2.1: Comparison of Similar Systems.

Table 2.1: Comparison of Similar Systems.

	Company	Features
Sri Lanka	<ul style="list-style-type: none"> • Auto Miraj (“Auto Miraj- Over 25 years of service,” 2017) • CarePoint (“Carepoint Auto Services Colombo Sri Lanka,” 2018) • Platinum Auto Spa (Technologies, 2017) – 	<ul style="list-style-type: none"> • All websites contain all the services available and the promotions they provide. • Similarly, they display high-quality materials, chemicals, shampoo, and waxes they used. • They ensure that they are providing Internationally recognized Environment, Health, and Safety Standards.
	KleenPark (“KleenPark (Private) Limited,” 2020)	<p>Another automobile care specialist has a lot of similar functionalities with the proposed system.</p> <ul style="list-style-type: none"> • The website allows to place reservations online (allocate time slots for the customers). It will tend to save the precious time of the customers.

		<ul style="list-style-type: none"> • Also, it provides the facility to purchase materials via the website. Displays the services as well as the promotions they offer.
International	<ul style="list-style-type: none"> • JV (Japan) (“Japanese Vehicle Service Centre,” 2019) • Mahindra first choice services (India) (“Mahindra First Choice Services,” 2020) • Repco service (Australia) (“REPCO Authorised Service,” 2020) 	<ul style="list-style-type: none"> • These websites display the services available and the promotions they provide, and the locations of their branches. • These international sites also display high-quality materials, chemicals, shampoo, and waxes they used. • They ensure that they are providing internationally recognized Environment, Health, and Safety Standards.
	<ul style="list-style-type: none"> • Midas (Australia) (“Make a Booking Midas Service Centre,” 2018) • Ultratune (Australia) (“Ultra Tune,” 2020) • Minittune (USA) (“Auto Repair Services,” 2019) 	<ul style="list-style-type: none"> • These sites allow customers to make online reservations. • Some of the collect customer detail as well. • Apart from that, they also display the services and the promotions they provide.

All of the above systems are handled by larger-scale companies. They are Sri Lanka’s and international’s pioneer automobile care specialists with state-of-the-art service centers located across the country. They currently uphold a set of branches all over the country and they process through a centralized arrangement. When considering the cost factor these systems are in high-level range and they have some special features like,

- SMS confirmations.
- SMS reminders to registered customers.
- Feedback entering process.

The summary of the similarities and the differences of proposed web-based automobile services station management systems, when compared to other similar systems are illustrated in Table 2.2: Compare and Contrast of the Web-Based Automobile Service Station Management System.

Table 2.2: Compare and Contrast of the Web-Based Automobile Service Station Management System.

<p>Similarities with the Similar system (Available features)</p>	<ol style="list-style-type: none"> 1. Allows placing reservations online. 2. Provides the facility to purchase materials online. 3. Displays the services and high-quality materials, chemicals, shampoo, and waxes they used. 4. Displays promotions they offer and the locations of their branches. 5. Facilitates collecting customer details. 6. Facilitates SMS confirmations, SMS reminders to registered customers. 7. Provides the facility to enter feedbacks.
<p>Differences with the similar systems (Newly introduce features)</p>	<ol style="list-style-type: none"> 1. Customer profile – It displays the service history logs of customers. 2. View time slots – Allows customers to view the available time slots to make reservations. 3. Displays price schedules – Displays services with the corresponding price schedules. 4. Online stock maintenance - Stock maintain is also becomes easier when it is done online.

2.4. Related Technologies

When considering the related technologies of total web solutions that are available for a service center, most of them have been developed using PHP through content management systems like Joomla. There are a set of pros and cons when working with a web solution.

Pros:

1. Zero install
2. Reduce business costs
3. Centralized data is secure and easy to backup.
4. Quick and easy updates
5. Available 24 hours a day, 7 days a week.
6. Reach anybody, anywhere in the world.
7. Laptops or smartphones with low specifications can be used.
8. A common set of basic functions has been implemented considering the easy-to-learn process.
9. Customizable interface, because modules have been implemented as separate gadgets.

Cons:

1. In countries like Sri Lanka, availability issues can occur due to the speed of the internet.
2. The risk factor is high since all the data is in a remote location
3. Productivity always depends on the speed of the network (Some reports may take a long time to load)
4. Renewal costs can differ from year to year (can't guarantee a fixed amount).
5. Interfaces are often not as sophisticated
6. Can take longer to develop as they are more complex
7. Have to support different browsers and different versions
8. Security risks

The proposed system will be developed using ASP.NET with C# computer programming language. It will be implemented in IIS servers with an SQL database.

Microsoft Asp.Net Framework is a widely used development framework for building enterprise-level web applications, that today's programmers select to use. The Asp.Net framework is a highly popular one and relatively easy for the .Net developers to create compelling Asp.net applications by using Visual Studio. It is not limited to script languages, it allows you to make use of .NET languages like C#, J#, VB, etc. (“Advantages of ASP.NET Web Development,” 2020).

Currently, there is a huge number of individual engineers and software development companies that choose ASP.NET as their preferred web development technology. There are a lot of benefits to using Asp.Net. Below mentioned some of the advantages of using ASP.NET:

Pros:

1. Asp.Net is a purely server-side technology, so the code is processed on the windows server before it is displayed in the web browser. Therefore, ASP.net applications execute more quickly than interpreted scripts.
2. ASP.Net features such as early binding, JIT compilation, caching services and native optimization supports to get a high level of performance. With .NET you are not limited to JIT but have the option AOT if you want to eliminate start-up delays.
3. Asp.Net framework is language independent, which means you can choose any programming language (e.g., C#, J#, VB, etc) which best suited to your application.
4. The Common Language Specification data types in all .Net applications are similar, so no type conversion is necessary when calling .Net methods, C++, C# from Visual Basic, or Vice Versa.
5. ASP.NET provides full support for XML, CSS, and other new as well as established web standards.
6. Introduction of view state helps in maintaining a state of the controls automatically between the post backs events.
7. With the built-in configuration information, Asp.Net is easy to deploy. There is no need to register components because the configuration information is built-in.
8. Finally, Asp.Net reduces the line of code needed to develop large applications.

Cons:

1. Security
2. Costly
3. Documentation is not exactly up to the mark
4. Making changes in the app
5. Porting ASP applications from one server to another is expensive

2.5. Related Design Strategies

The system will be developed using the Iterative model because

- the requirements for this system are mostly clear and fixed.
- some functionalities and requested enhancements evolve with the process of the development process.
- there will be a little room for changes.
- considering the feedbacks of the clients the changes will be completed.

The iterative process is depicted in Figure 2.5: Iterative Model (“iterative_process_model”,n.d.)

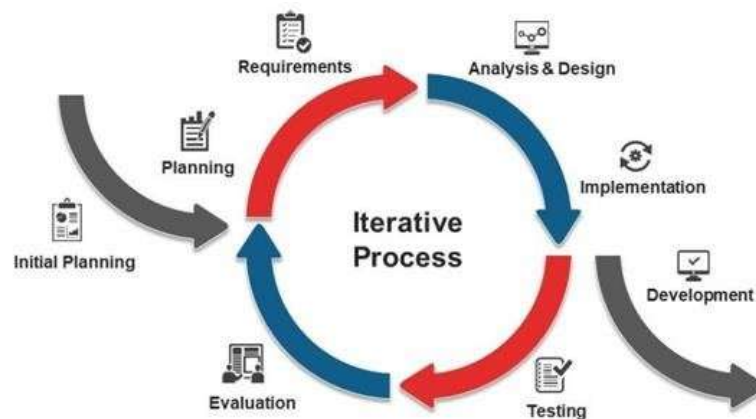


Figure 2.5: Iterative Model (“iterative_process_model,” n.d.)

Furthermore, the system is using Client-server architecture because,

- all the collected data can be controlled and managed centrally and users can have access to, manipulate, and present the data locally.
- Customers can place reservations from anywhere since the system provides remote access.
- The management will have the ability to get a backup of the data whenever it's necessary and it will provide a chance to make proper managerial decisions.

This will conclude the background chapter of the dissertation and the next chapter will deliver more clear and precise ideas about the system since it contains a lot of diagrams and tables.

Chapter 3 – Design Architecture

3.1. Introduction

The main focus of this phase is, to convert the defined requirements into detailed specifications in order to guide the work of the Implementation Phase. The web-based automobile service station management system is constructed using the Iterative Model because the gathered requirements can vary from time to time in slight amounts.

Firstly, it is expected to produce a general design of the system that will emphasize the functional features, and secondly a more detailed system design that expands the general design by providing all the technical detail. The architecture of the system is analyzed by using the gathered information in the previous phase and designing of the system is carried out by mainly focusing on the functions of the system such as,

- Decompose the system into modules.
 - Reservation module
 - Stock module
 - Invoice module
 - Vehicle module etc.
- Identify relationships between the modules.

3.2. System Architecture

The client-server architecture will be used in the web-based automobile service station management system. Because all the collected data can be controlled and managed centrally and users can have access to manipulate and present the data locally.

The website will be hosted on a web server with an SQL database. The customers, system operators, management can access them remotely from anywhere at any time.

Clients can place reservations from anywhere since the system provides remote access. The management will have the ability to get a backup of the data whenever it's necessary and it will provide a chance to make proper managerial decisions.

The system architecture of the web-based automobile service station management system is shown in Figure 3.1: System Architecture of the Web-based Automobile Service Station Management System.

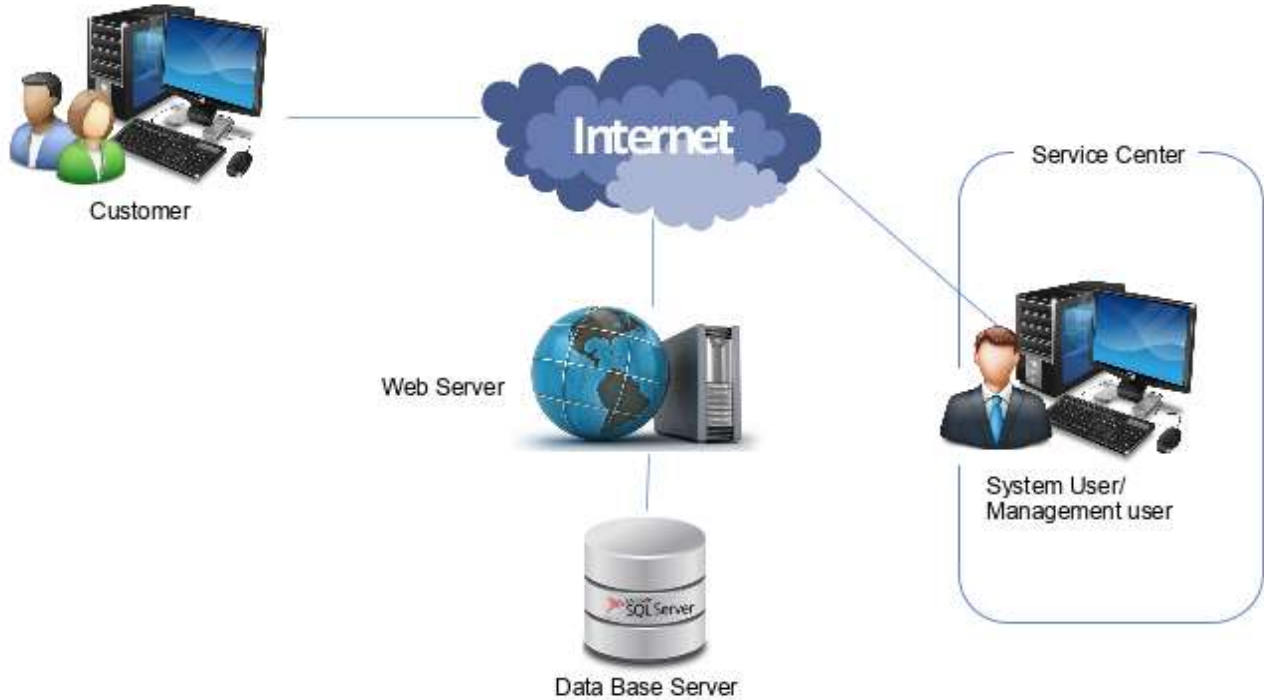


Figure 3.1: System Architecture of the Web-based Automobile Service Station Management System.

3.3. UML Diagrams

3.3.1. Use Case Diagram of the System

The main use case is represented in Figure 3.2: Use Case Diagram of the Web-Based Automobile Service Station Management System and, it is drawn according to the requirements considered by the system architecture of the web-based automobile service station management system depicts in Figure 3.1: System Architecture of the Web-based Automobile Service Station Management System.

The main actors of this system are,

- Customer
- System operator
- Management.

Customers can place an online reservation and the system operator will confirm the reservation if the requested timeslot is available. The system operator has to manage customers, inventory and stocks, vehicles, and invoices. To perform most of the functionalities, the actors must be logged in to the system. The management can generate several administrative, organizational and financial reports in order to make better managerial decisions.

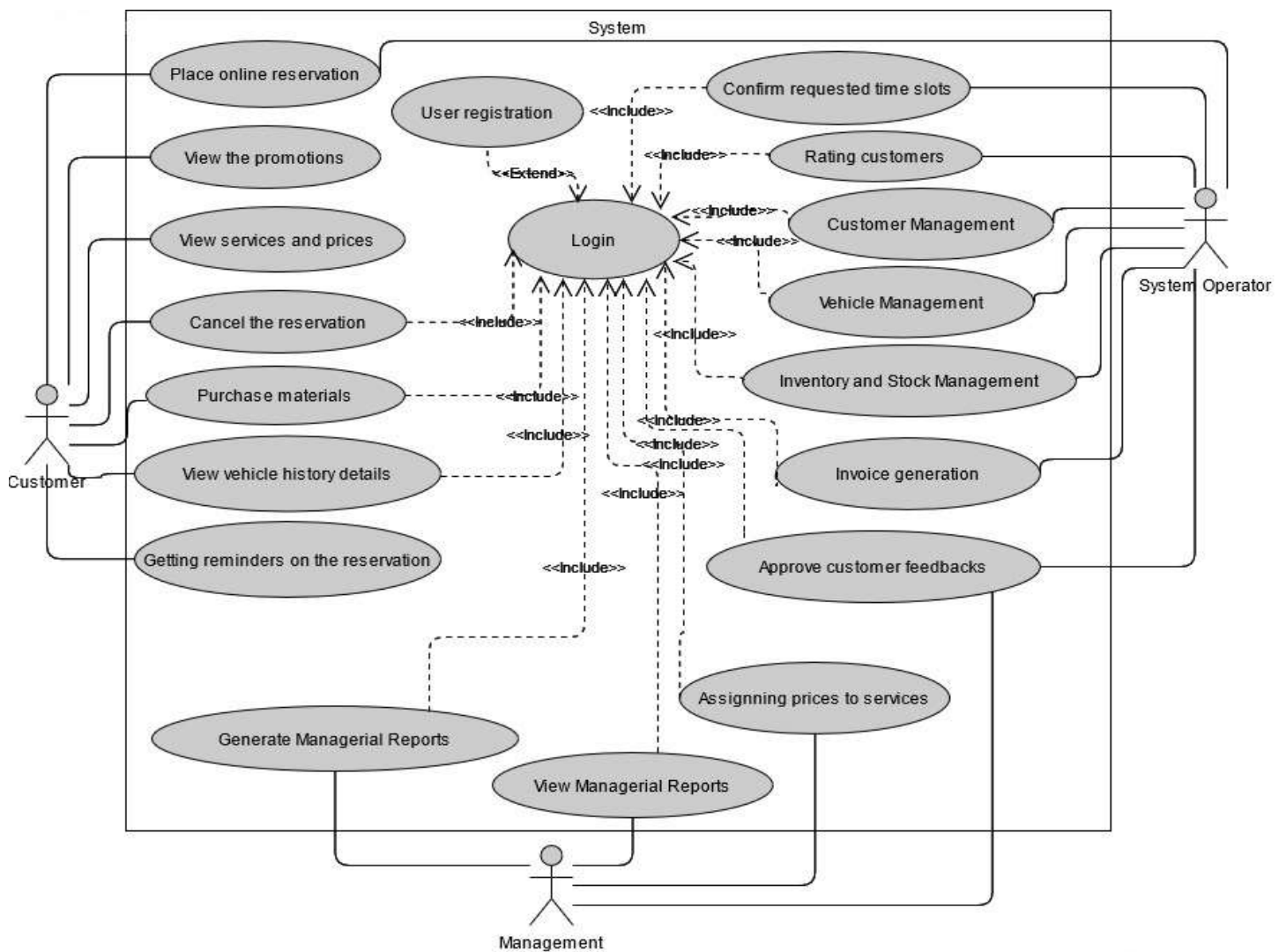


Figure 3.2: Use Case Diagram of the Web-Based Automobile Service Station Management System.

3.3.2. Use Case Scenarios

Some of the use case descriptions which are related to the above use case diagram are shown below.

The use case scenario related to the user registration use case is illustrated in Table 3.1: Use Case Scenario - User Registration.

Table 3.1: Use Case Scenario - User Registration.

Use Case ID	01	
Use Case Name	User registration	
Use Case Description	Register a new user in the system	
Actors	Customer, System operator, Management	
Basic flow	Actor	System
	<ol style="list-style-type: none"> 1. The user connects to the system and clicks the register button 2. Fill out the registration form 3. Submit the registration form 4. Receive notification of successful registration 	<ol style="list-style-type: none"> 1. Displays the registration form 2. If the form is correctly filled, accept it. Otherwise displays the error
Alternative Flows	In the basic flow, if the actor enters an invalid name and/or password, the system displays an error message (Invalid Name / Password). The actor can choose to either return to the beginning of the basic flow or cancel the login, at which point the use case ends.	
Pre-Condition	User must not be in the system User must provide all information required to register	
Post-Condition	Users will get an account created	
Trigger Event	When an actor has clicked the “Register” button	
Success End Condition	Successful registration	
Failed End Condition	Unsuccessful registration	

The use case scenario related to the login use case is depicted in Table 3.2: Use Case Scenario – Login.

Table 3.2: Use Case Scenario – Login.

Use Case ID	02	
Use Case Name	Login	
Use Case Description	User login to the web-based system to access the functionality of the system.	
Actors	Customer, System operator, Management	
Basic flow	Actor	System
	<ol style="list-style-type: none"> 1. The actor enters his/her name and password. 2. Receive notification of successful login to the system 	<ol style="list-style-type: none"> 1. The system requests that the actor enter his/her username and password. 2. The system validates the entered name and password
Alternative Flows	In the basic flow, if the actor enters an invalid name and/or password, the system displays an error message (Invalid Name / Password). The actor can choose to either return to the beginning of the basic flow or cancel the login, at which point the use case ends.	
Pre-Condition	-	
Post-Condition	If the use case was successful, the actor is now logged into the system. If not, the system state is unchanged.	
Trigger Event	When an actor has clicked the “Login” button	
Success End Condition	A successful login to the system	
Failed End Condition	Unsuccessful login to the system	

The use case scenario related to generating managerial reports use case is depicted in Table 3.3: Use Case Scenario - Generate Management Reports.

Table 3.3: Use Case Scenario - Generate Management Reports

Use Case ID	03	
Use Case Name	Generate Managerial Reports	
Use Case Description	Management can generate managerial reports such as, <ul style="list-style-type: none"> ➤ Daily weekly, and monthly income reports. ➤ Top-rated customers. ➤ Hot services (what are the most commonly requested services). ➤ Peak days and time slots in the week. ➤ Several stock maintaining reports. 	
Actors	Management	
Basic flow	Actor	System
	1. Select required reports	1. Display the reports accordingly
Pre-Condition	Management has to login to the system	
Post Condition	The requested reports will be viewed accordingly	
Trigger Event	When management selects the “Generate report” option.	

The use case scenario related to online reservations use case is depicted in Table 3.4: Use Case Scenario - Place Online Reservation.

Table 3.4: Use Case Scenario - Place Online Reservation.

Use Case ID	04
Use Case Name	Place Online Reservation
Use Case Description	A user places a reservation online, to get all required services after a successful login to the system
Actors	Customer, System Operator
Basic flow	This use case starts when an actor wishes to place a reservation online. <ol style="list-style-type: none"> 1. The services can be viewed as packages. 2. Actors can select services according to their requirements. 3. Actors have to provide the following details to place a reservation, <ul style="list-style-type: none"> ➤ vehicle number ➤ date ➤ the type of service which is willing to accomplish, other personnel details

Pre-Condition	Actors have to log in to the system
Post Condition	The System Operator will check for the pending reservations and the available timeslots and will confirm the reservation accordingly.
Success Condition: End	A reservation has been made.
Failed Condition: End	A reservation has not been made.
Trigger Event	When a user has clicked the button “Place a reservation”

The use case scenario is related to maintaining inventory and stocks. use case is depicted in Table 3.4: Use Case Scenario - Place Online Reservation.

Table 3.5: Use Case Scenario - Inventory and Stock Management.

Use Case ID	05	
Use Case Name	Inventory and stock management	
Use Case Description	How the system operator manages the inventory by checking the sales and stock before changing the stock	
Actors	System Operator	
Basic flow	System operator	System
	<ol style="list-style-type: none"> 1. Check the sales 2. Check the stock in and stock out of the product] check the that are still lest in the stock 3. Order the stock needed after checking 4. Update the stock 	<ol style="list-style-type: none"> 1. Displays all the list of sales 2. Displays the records of the sock in and stock out of product 3. Display all the stock available 4. Displays all the new added stock 5. Displays the update form of stock
Alternative Flow	System operator should check the supply to avoid understock and overstock	
Pre-Condition	The system operator has to login to the system	

Post Condition	The system operator will receive an acknowledgment that the process is successful or if not, a message explains the failure.
Trigger Event	System operator get the alert of the shortage of items in the stock

3.3.3. Sequence Diagrams of the System

To perform most of the functionalities in the system every user must be logged in to the system first by providing the username and the password. The sequence of the login process is depicted in Figure 3.3: Sequence Diagram – Login.

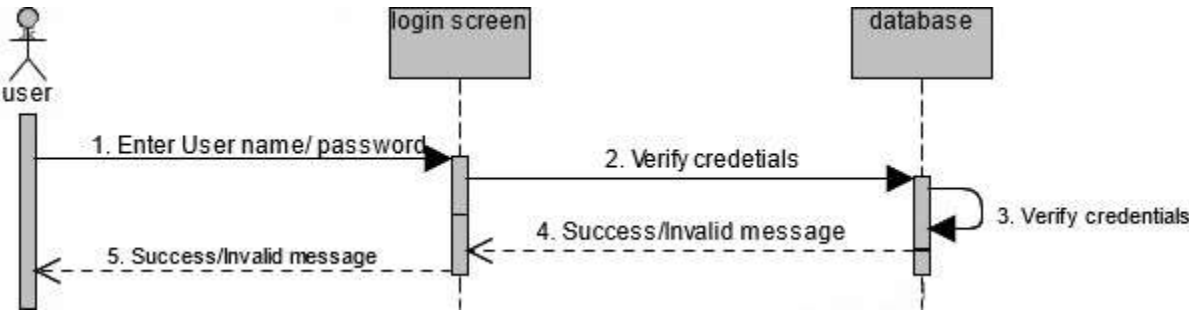


Figure 3.3: Sequence Diagram – Login.

For every successful login, the users need to register in the system by providing some details such as username, password, email, contact no, etc. The sequence of registering a user is displayed in Figure 3.4: Sequence Diagram – User Registration.

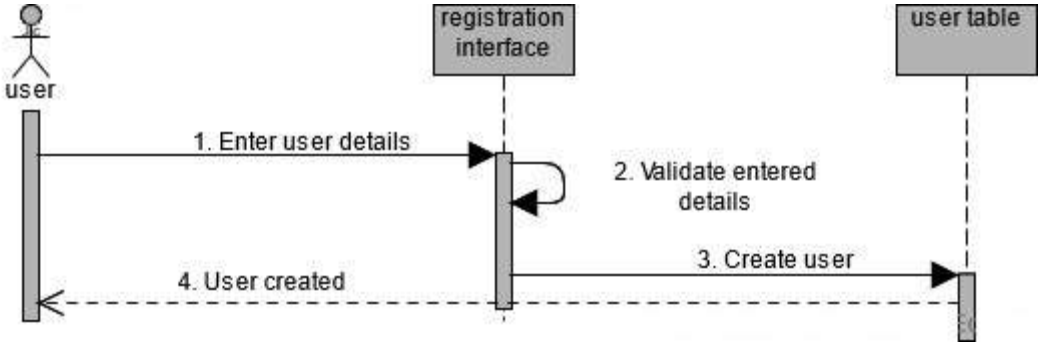


Figure 3.4: Sequence Diagram – User Registration.

One of the main functionalities of the system is placing online reservations. When a customer placed a reservation, the system operator will be alerted about it. The system operator will check for the pending reservations and the requested time slot and if the time slot is available, the approval will be given and a reservation confirmation message will be sent to the customer. The entire process sequence of making reservations is depicted in Figure 3.5: Sequence Diagram - Place Online Reservation.

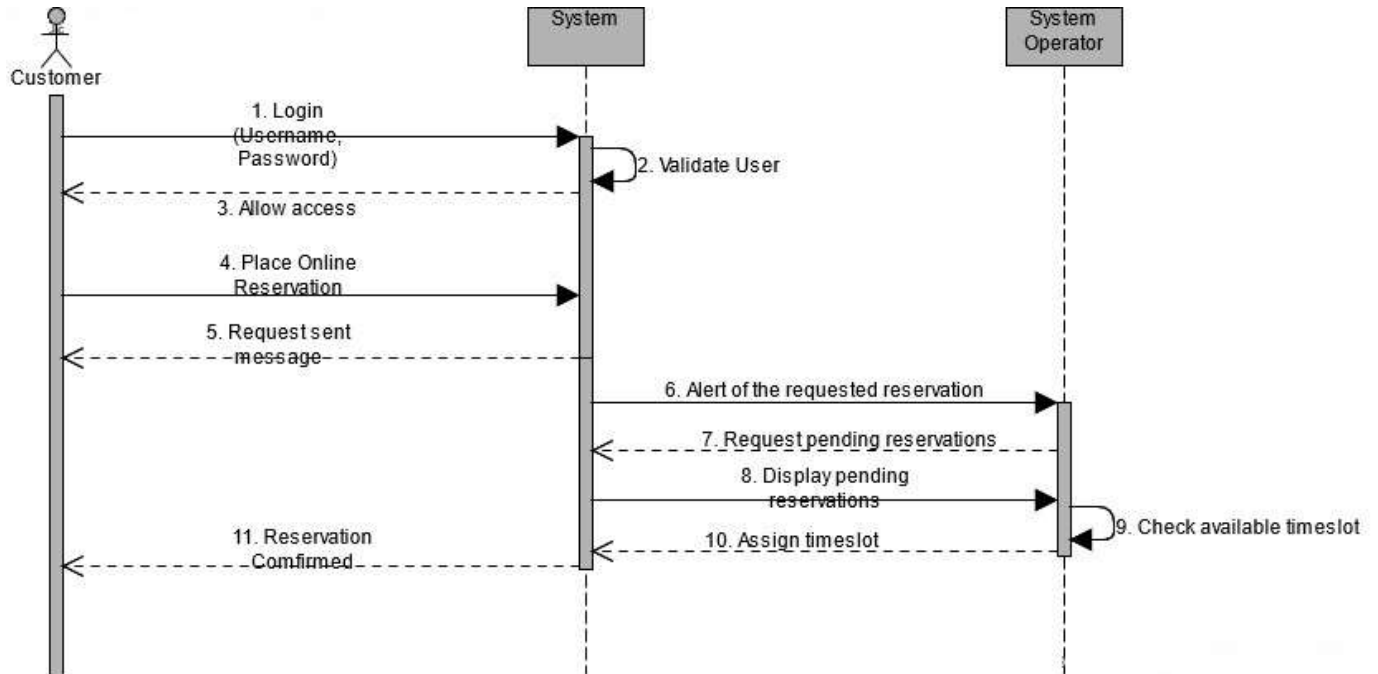


Figure 3.5: Sequence Diagram - Place Online Reservation.

The customers can purchase materials via the website even without getting a service from the service station. Since the home delivery option is not available, a reference number will be given to the customer and it is required to produce it when collecting the materials at the premises. The flow of purchasing materials via the website is shown in Figure 3.6: Sequence Diagram - Material Purchase.

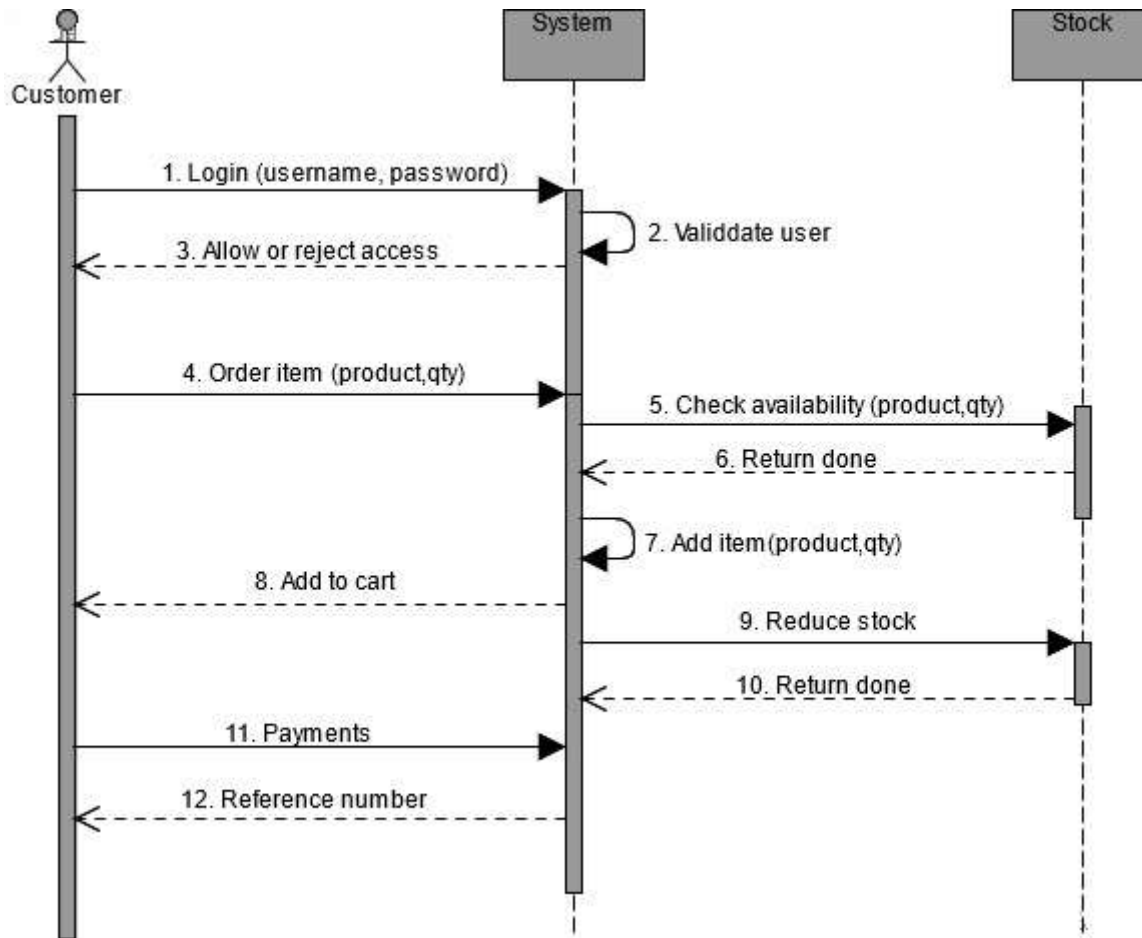


Figure 3.6: Sequence Diagram - Material Purchase.

3.3.4. Class Diagram of the System

The class diagram of the system is shown in Figure 3.7: Class Diagram of the System. The user class is inherited by the classes manager, System operator, and customer respectively. The appointment class contains all the appointment details and the customer class contains all the customer details. Similarly, all the other classes contain relevant information accordingly.

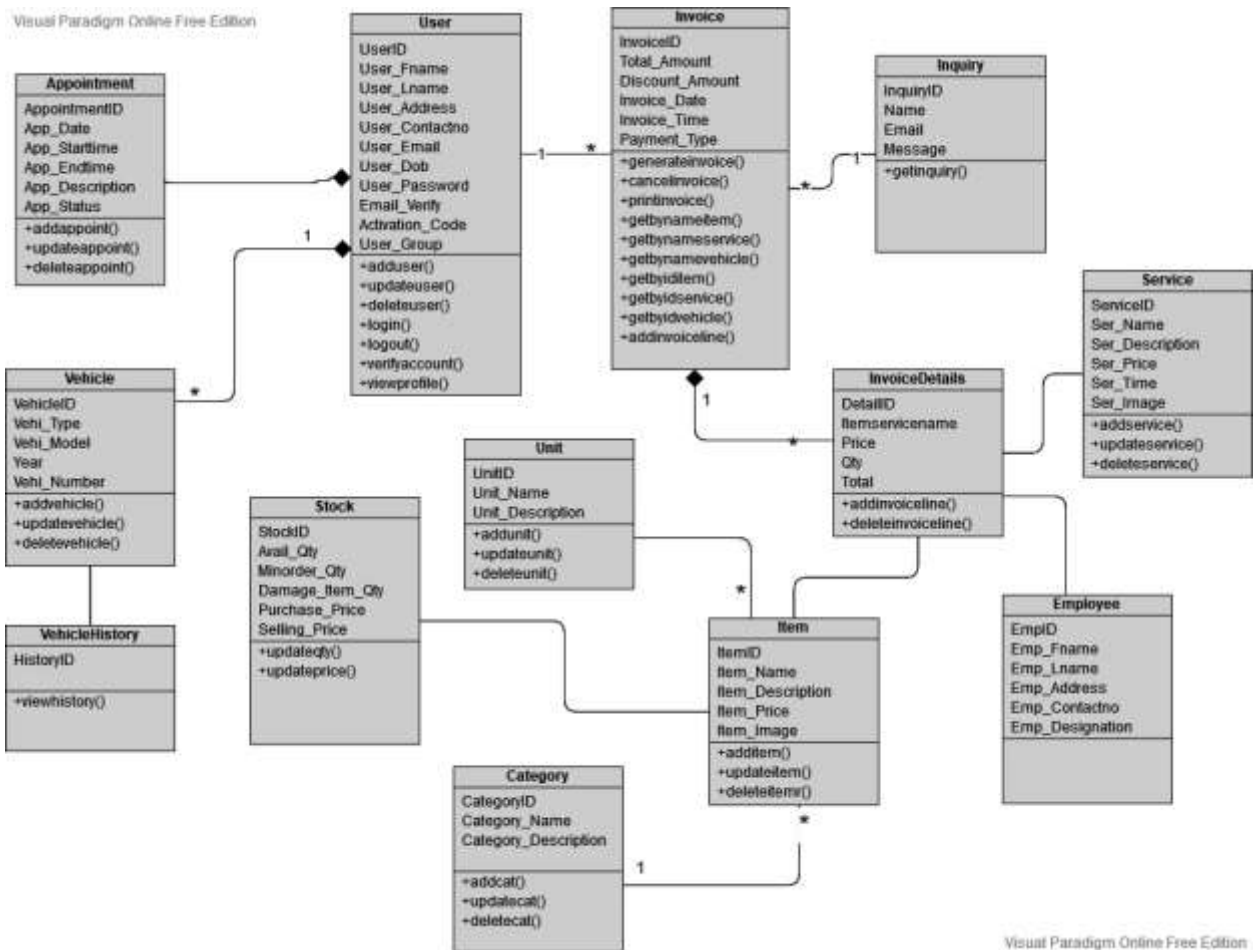


Figure 3.7: Class Diagram of the System

3.3.5. Activity Diagrams of the System

According to the activities performed in the Web-Based Automobile Service Station Management System, the flow of activities done during the process of creating a profile for the users when they get registered is depicted in Figure 3.8: Activity Diagram - User Registration.

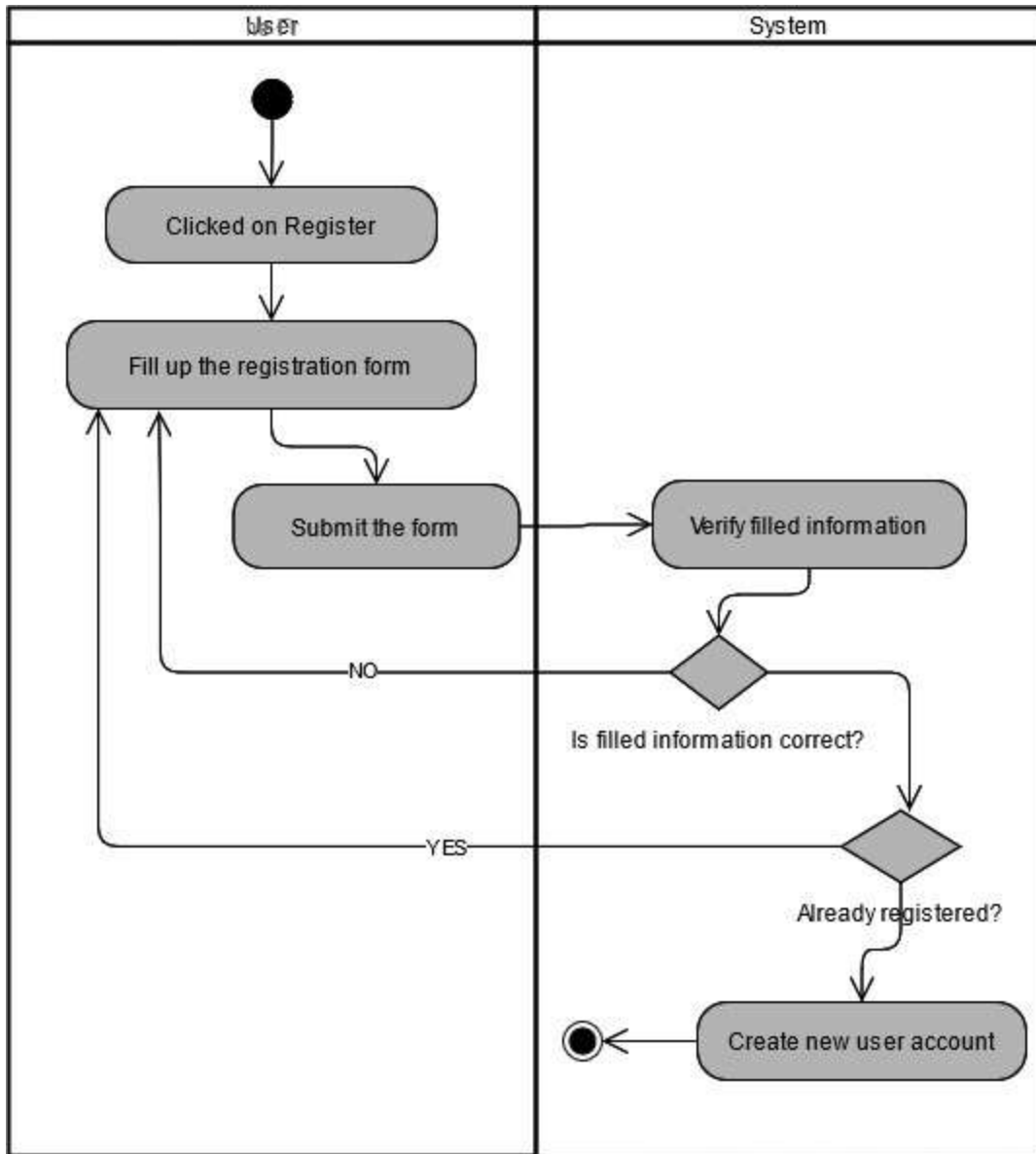


Figure 3.8: Activity Diagram - User Registration.

The flow of activities that occurs between the customer and the system during the process of placing a reservation is illustrated in Figure 3.9: Activity Diagram – Place Online Reservation.

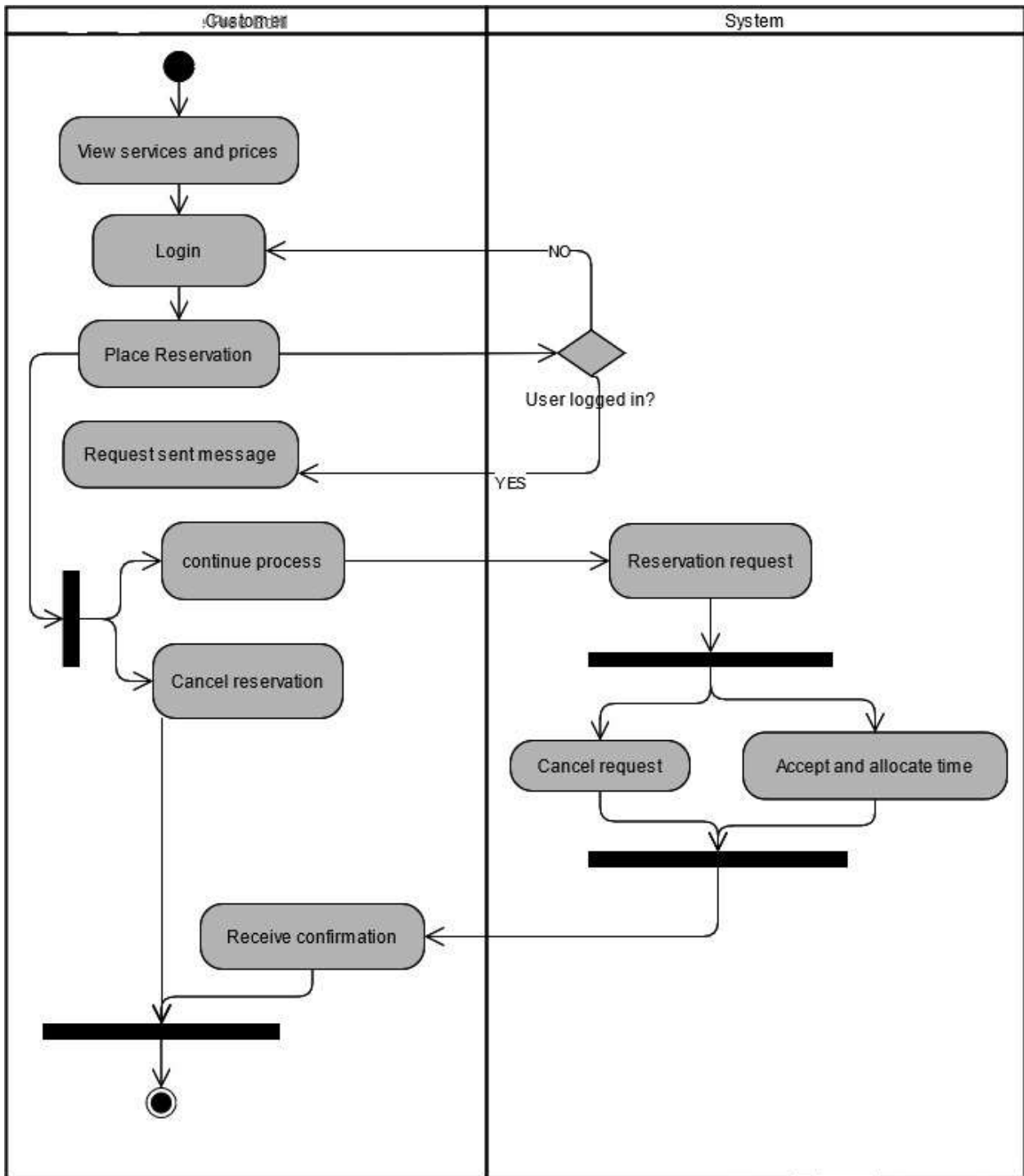


Figure 3.9: Activity Diagram – Place Online Reservation.

3.3.6. Database Structure

The database of the web-based automobile service station management system will be implemented using SQL server software. The table structure of the database is shown in below Figure 3.10: Database Structure. There will be 13-15 tables and both primary and foreign keys are shown in Figure 3.10: Database Structure.

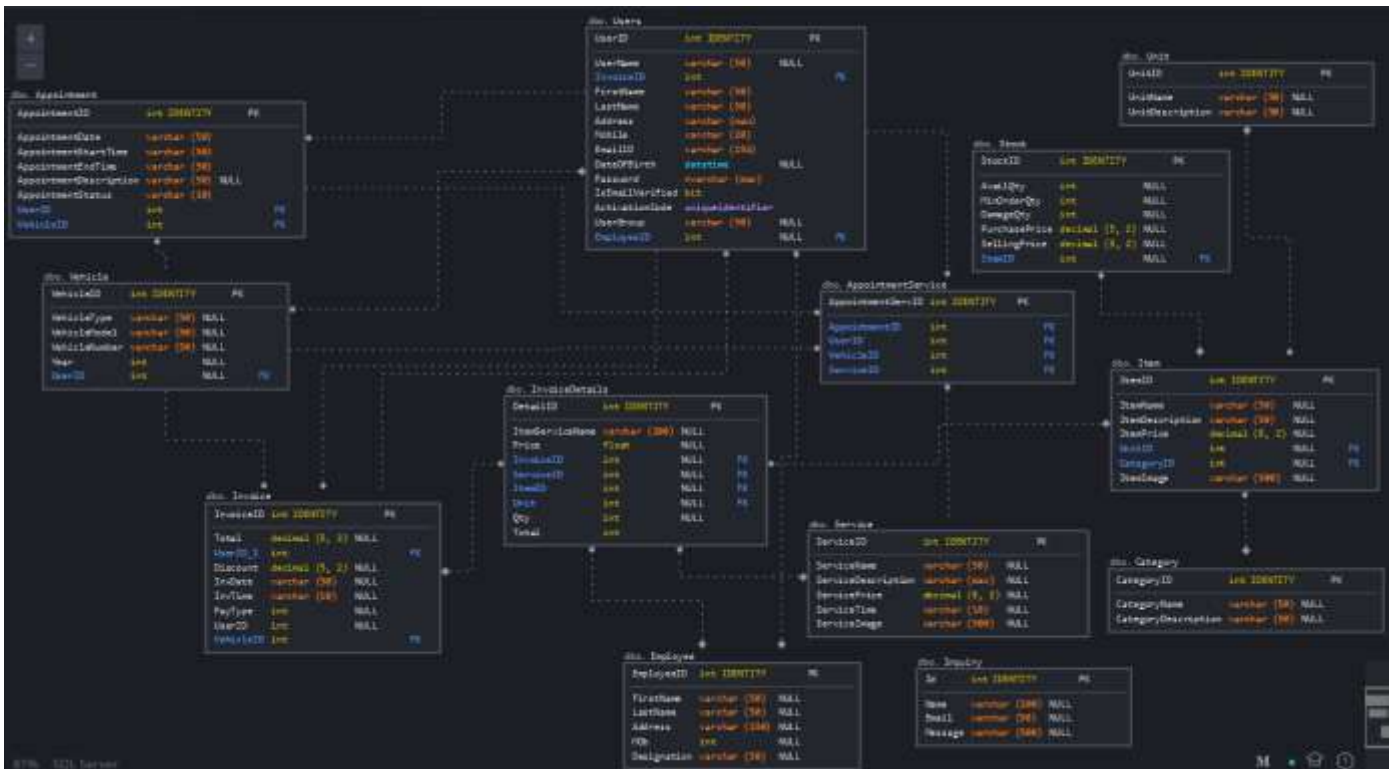


Figure 3.10: Database Structure.

3.3.7. Sample Input and Output Templates

Following are sample input and output layouts used in the system. The Login page is depicted in Figure 3.11: Login Interface.

Login

*
Email ID Vindhiz@gmail.com
Password ●●●●●●
Remember Me

SIGN IN
Don't have an account? [Register Now](#)

Figure 3.11: Login Interface.

Viewing the user profile is a newly introduced feature in the system. It is represented in Figure 3.12: User Profile.

User Profile

Personal Details

User Name: Vindhiz@gmail.com

First Name: Vindhiani

Last Name: Chandrasiri

Address: 147/C, Kalalgoda, Pannipitiya

Mobile: 0777327474

Email: Vindhiz@gmail.com

Vehicle Details

Type	Model	Number	Year	Edit	Delete
car	honda	CAF-5454	2010		
jeep	toyota	CAN-1212	2012		
van	nissan	PE-6161	2002		
car	toyota	aCC-4543	2002		

[Add New Vehicle](#)

Service History

Invoice Date	Customer Name	Vehicle Number	Service Type
3/1/2021	Vindhiani Chandrasiri	CAF-5454	Oil Changes

Figure 3.12: User Profile.

The online reservation interface used in the system is depicted in Figure 3.13: Online Reservations Interface.

Reservations

First Name: Vinith

Last Name: Ruki

Middle: 8777227476

Email: Vinithr@gmail.com

Select Your Vehicle

Select Vehicle

Allocated Time Slots

	7/11/2021	7/12/2021	7/13/2021	7/14/2021	7/15/2021	7/16/2021	7/17/2021
3 ^{PM}							
4 ^{PM}							
5 ^{PM}						1	
6 ^{PM}							
7 ^{PM}			1			1	
8 ^{PM}							
9 ^{PM}							
10 ^{PM}							
11 ^{PM}							

Appointment Date: mm/dd/yyyy

Appointment Time: --:--

RESERVE

Figure 3.13: Online Reservations Interface.

The management and the system operator will use the admin panel which is considered as one of the main interfaces in the system. The admin panel is illustrated in Figure 3.14: Admin Panel of the System.

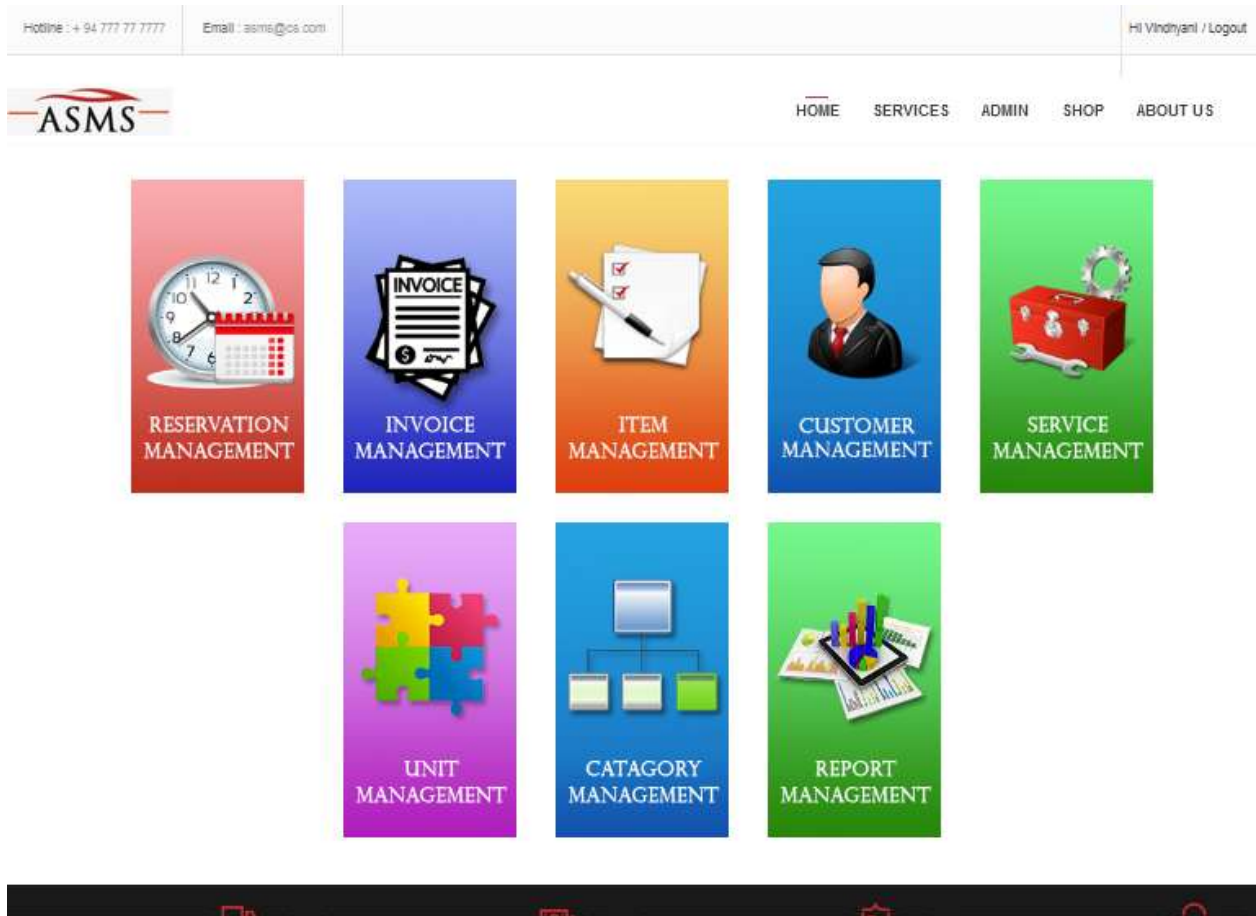


Figure 3.14: Admin Panel of the System.

The system produces both administrative and financial reports. Only admin users can only generate these reports according to the requirement. These reports give information on the day-to-day accounting processes, assisting in business choices and tracking the company's success. The system generates reports in .pdf format.

All the system-generated reports are in .pdf format and, it is shown in Figure 3.15: Report generation in .pdf format.

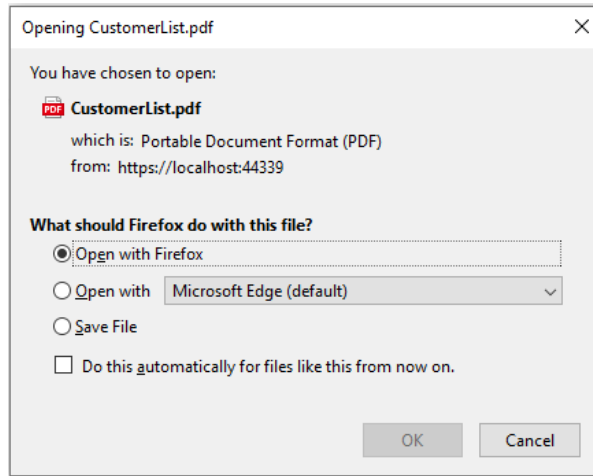


Figure 3.15: Report generation in .pdf format.

Sample administrative report templates produced via the system are shown in Figure 3.16: Administrative Report - List of Customers and Figure 3.17: Administrative Report - List of Services.

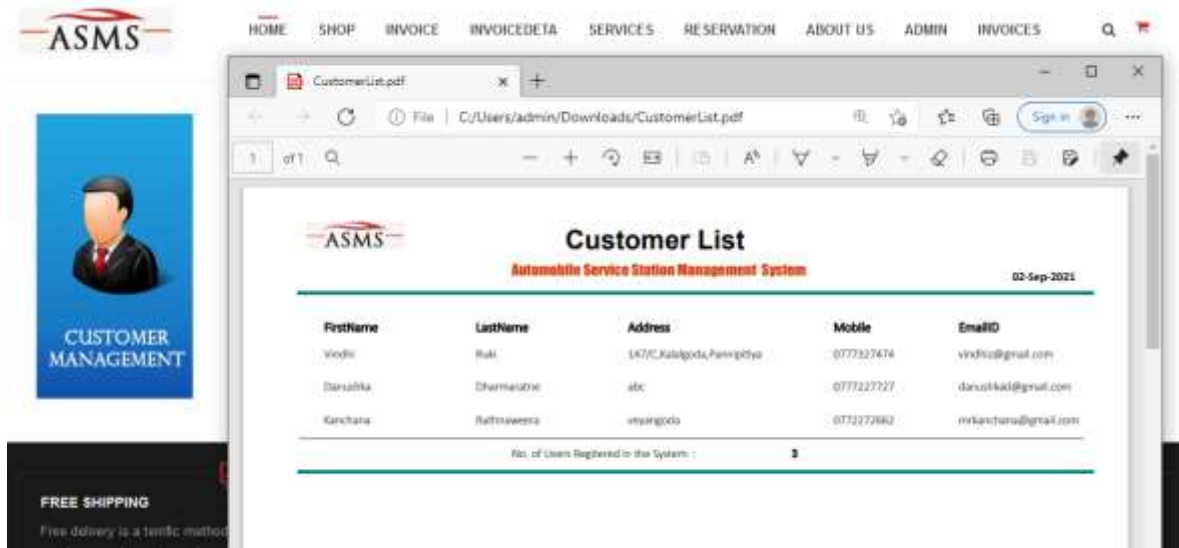


Figure 3.16: Administrative Report - List of Customers.

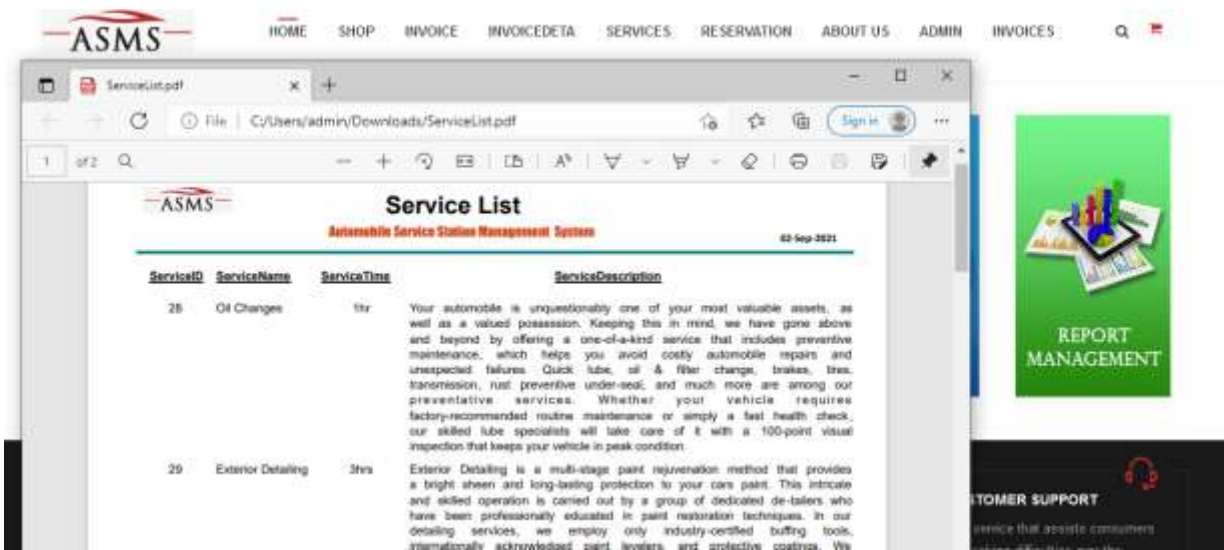


Figure 3.17: Administrative Report - List of Services.

After designing the entire system it's essential to identify the main modules and the connections in between them in the system. This will be done in the next chapter and the entire implementation process will be described in detail in the next chapter.

Chapter 4 – Implementation

This chapter describes the main modules in the system and their interconnections. The development phase should be carried out mainly considering the interactions between the modules. Selection of technology which use to perform the developments and the implementation of the system depends on a set of key considerations,

1. Cost of the software and software licensing fee.
2. Initial and maintaining costs for the hardware tools.
3. ICT literacy of the end-user.
4. The ambiguity of the set of requirements.

Since the requirements for this system are mostly clear and fixed, the incremental model is used to develop the Web-Based Automobile Service Station Management System. While some functionalities and requested enhancements evolve with the process of the development phase. Hence, there will be little room for changes. Considering the feedbacks of the clients the changes will be completed.

4.1. Module Structures.

The following depicts the module structures and their functionalities in the system.

Module 01 – Log in

- Get the username and the password of the users (Customer/System operator/ Management).
- Checking the validity of the credentials.
- Provide facilities to get registered in the system for unregistered users.

Module 02 - Customer Management

- Add a customer to the system/ registration of the customer.
- Update/Remove customer details in the system.
- View the list of customers and individual customer details in the system.

Module 2.1 - Vehicle Management

Note: This is a submodule of the customer module

- Add vehicle details to the system.
- Update/Remove vehicle details in the system.
- Assign vehicles to customers.
- View the list of vehicles or individual vehicle details in the system.
- View vehicle history logs in the system.

Module 03 - Reservation Management

- Add a new reservation to the system.
- View pending and confirmed reservations with their corresponding time slots for a given date.
- View available time slots for a given date.
- View the reservation requests sent through the web page and allocate requested time slots.
- Send confirmation message via SMS/Email.
- Update/Delete appointments.

Module 04 - Service Management

- Add a new service to the system.
- Update/Delete service details in the system.
- View the list of service or individual service details in the system.
- View all promotions given by the system.

Module 05 - Item Management

- Add a new item to the system.
- Update/Remove items in the system
- View the list of items or individual item details in the system.

Module 5.1 – Inventory/Stock Management

Note: This module is a sub-module of the item module.

- Add/Update/Remove stock details of selected items.
- View and maintain price values of stock items.
- Define alert values to maintain stock level.

Module 07 – Online Item Selling

- View items with their corresponding price values.
- Add selected items into the shopping cart.
- View items in the shopping cart.

Module 08 – Invoices and Payments

- Calculate the total price for the selected items.
- Produce Bill.
- Accept payments with relevant details.
- Print new invoices.
- Cancel invoices.
- Search and select items, services directly from the system.

Module 09 – Report

- View the available list of reports.
- View reports individually.

Module 10 – Category

- Maintain a set of item categories to use when adding items and report generation purposes.

Module 11 – Unit

- To define general types of units, use to handle different kinds of goods in the system.

4.2. Interaction between Modules.

The interaction between the modules in the system is illustrated in Figure 4.1: Interaction between Modules.

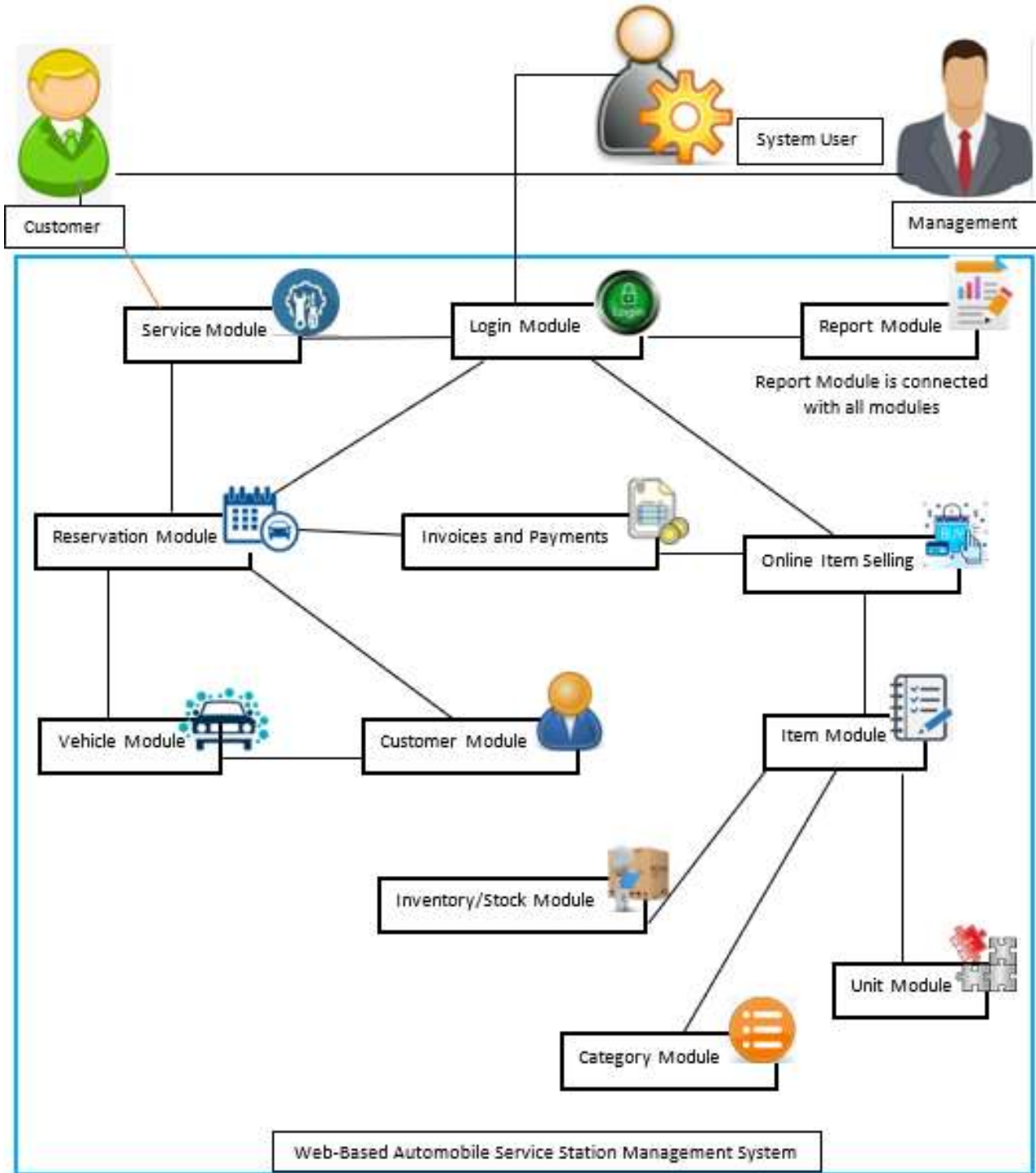


Figure 4.1: Interaction between Modules.

Initially, all user types should be registered in the system using the login module. The users should be logged in, to obtain facilities provided via the website, except for viewing services. Any customer can access the service module without a login but, to add, update, remove services a system operator must be logged in to the system.

After valid login, customers can place or cancel reservations using the reservation module. A successful reservation process requires the aid of customer, service, and vehicle modules. All four reservation, customer, service, and vehicle modules are connected.

Customers can purchase materials via the website using the online item selling module. When the items are purchased by the customers or when the items are added to the invoice, the item module should be updated, and if there are any reorder levels that occur it should be notified to the system operator. To fulfill that requirement, the inventory/stock module is connected with the item module. Category and unit are connected with the item module in order to provide a better service for the customer and management.

Whether a customer purchased items or placed a confirmed reservation via the website the payments will be done using the invoices and payments module.

Finally, management can view and print administrative and financial reports using the report module. Hence the report module is connected with all the other modules.

4.3. Implementation Environment of the System

Following requirements has to be fulfilled whenever a person is willing to use the Web-Based Automobile Service Station Management System.

4.3.1. Hardware Requirements

- A Computer with a browser that supports viewing websites created using HTML version 5.
- 4GB RAM (minimum)
- Black laser printer (HP/Canon)
- Keyboard, Mouse, and a monitor
- Internet connection (minimum speed 0.5Mbps)
- UPS (uninterrupted power supply)

4.3.2. Software Requirements

- Microsoft Windows Xp or above
- A browser compatible with HTML 5.0 and above
- Relevant Printer software

4.3.3. Development tools used

- Microsoft Visual Studio 2019
- SQL server
- Adobe photoshop cs6

4.3.4. Technologies used

- C# - Used to develop the web application
- HTML5 - used to do modifications to web pages
- SQL server – to develop the database

4.3.5. Major codes used in the System.

The website is built using asp.net with MVC architecture. The computer programming language is used is C#. The major code segments in the Web-based Automobile Service Station Management System are discussed below.

The login code snippet in the controller is depicted in Figure 4.2: Logging Code Snippet. Data will be fetched from the database based on the user inputs, and depending on the response, the user will be directed to the home page or an error message will be displayed.

```

var v = dc.Users.Where(a => a.EmailID == login.EmailID).FirstOrDefault();

if (v != null)
{
    if (!v.IsEmailVerified)
    {
        ViewBag.Message = "Please verify your email first";
        return View();
    }

    if (string.Compare(Crypto.Hash(login.Password), v.Password) == 0)
    {
        int timeout = login.RememberMe ? 525600 : 20; // 525600 min = 1 year
        var ticket = new FormsAuthenticationTicket(login.EmailID, login.RememberMe, timeout);
        string encrypted = FormsAuthentication.Encrypt(ticket);
        var cookie = new HttpCookie(FormsAuthentication.FormsCookieName, encrypted);
        cookie.Expires = DateTime.Now.AddMinutes(timeout);
        cookie.HttpOnly = true;
        Response.Cookies.Add(cookie);
        //----- Session Variable -----
        Session["UserID"] = v.UserID;
        Session["UserName"] = v.UserName;
        Session["FirstName"] = v.FirstName;
        Session["LastName"] = v.LastName;
        Session["Address"] = v.Address;
        Session["Mobile"] = v.Mobile;
        Session["Email"] = v.EmailID;
        Session["DateOfBirth"] = v.DateOfBirth;
        // Need to get the mobile number and set
        //----- End Session Variable -----
        if (Url.IsLocalUrl(ReturnUrl))
        {
            return Redirect(ReturnUrl);
        }
        else
        {
            return RedirectToAction("GetDashboard", "Dashboard");
        }
    }
    else
    {
        message = "Invalid credential provided";
    }
}

```

Figure 4.2: Logging Code Snippet.

Snippets of code segments relevant to creating a valid user account are shown in below Figures 4.3: Code Snippet of User Registration Interface, 4.4: Code Snippet of the User Registration, and 4.5: Code Snippet of the Password Hashing. Based on the input, the code will determine whether the entered email address already exists and if so, an error message will be displayed to the customer. Otherwise, the account information will be saved in the database. Passwords will be encrypted using SHA256 before being saved in the database.

```

@Html.ValidationSummary(true, "", new { @class = "text-danger" })
<div class="form-group">
  @Html.LabelFor(model => model.FirstName, htmlAttributes: new { @class = "control-label col-md-2" })
  <div class="col-md-10">
    @Html.EditorFor(model => model.FirstName, new { htmlAttributes = new { @class = "form-control" } })
    @Html.ValidationMessageFor(model => model.FirstName, "", new { @class = "text-danger" })
  </div>
</div>
<div class="form-group">
  @Html.LabelFor(model => model.LastName, htmlAttributes: new { @class = "control-label col-md-2" })
  <div class="col-md-10">
    @Html.EditorFor(model => model.LastName, new { htmlAttributes = new { @class = "form-control" } })
    @Html.ValidationMessageFor(model => model.LastName, "", new { @class = "text-danger" })
  </div>
</div>
<div class="form-group">
  @Html.LabelFor(model => model.Address, htmlAttributes: new { @class = "control-label col-md-2" })
  <div class="col-md-10">
    @Html.EditorFor(model => model.Address, new { htmlAttributes = new { @class = "form-control" } })
    @Html.ValidationMessageFor(model => model.Address, "", new { @class = "text-danger" })
  </div>
</div>
<div class="form-group">
  @Html.LabelFor(model => model.Mobile, htmlAttributes: new { @class = "control-label col-md-2" })
  <div class="col-md-10">
    @Html.EditorFor(model => model.Mobile, new { htmlAttributes = new { @class = "form-control" } })
    @Html.ValidationMessageFor(model => model.Mobile, "", new { @class = "text-danger" })
  </div>
</div>

```

Figure 4.3: Code Snippet of User Registration Interface.

```

if (ModelState.IsValid)
{
  #region //Email is already Exist
  var isExist = IsEmailExist(user.EmailID);
  if (isExist)
  {
    ModelState.AddModelError("EmailExist", "Email already exist");
    return View(user);
  }
  #endregion

  #region Generate Activation Code
  user.ActivationCode = Guid.NewGuid();
  #endregion

  #region Password Hashing
  user.Password = Crypto.Hash(user.Password);
  user.ConfirmPassword = Crypto.Hash(user.ConfirmPassword); //
  #endregion
  user.IsEmailVerified = false;

  #region Save to Database
  using (MyDatabaseEntities dc = new MyDatabaseEntities())
  {
    dc.Users.Add(user);
    dc.SaveChanges();

    //Send Email to User
    SendVerificationLinkEmail(user.EmailID, user.ActivationCode.ToString());
    message = "Registration successfully done. Account activation link " +
      " has been sent to your email id:" + user.EmailID;
    Status = true;
  }
  #endregion
}

```

Figure 4.4: Code Snippet of the User Registration

```

1 using System;
2 using System.Text;
3
4 namespace Ams
5 {
6     #region
7     public static class Crypto
8     {
9         #region
10        public static string Hash(string value)
11        {
12            return Convert.ToBase64String(
13                System.Security.Cryptography.SHA256.Create()
14                    .ComputeHash(Encoding.UTF8.GetBytes(value)));
15        }
16    }
17 }

```

Figure 4.5: Code Snippet of the Password Hashing.

The code snippet of the invoice generation is depicted in Figure 4.6: Code Snippet of the Invoice - Service Addition.

```
0 references
public ActionResult Getinvoicelineservice()
{
    InvDetail invoice = new InvDetail();
    sController = new ServiceController();
    try
    {
        invoice.ServiceList = sController.GetAllService(); //Accessing Unit controller and bind units to the dropdown
        Dictionary<int, string> dropList = new Dictionary<int, string>();

        foreach (var i in invoice.ServiceList)
        {
            dropList.Add(i.ServiceID, i.ServiceName);
        }
        invoice.ServiceDropList = dropList;
    }
    catch
    {
    }

    return View("Invoicelineservice",invoice);
}
```

Figure 4.6: Code Snippet of the Invoice - Service Addition.

The code snippet of the report generation is depicted in Figure 4.7: Code Snippet of Report Generation.

```
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45
46
47
48
49
0 references
public ActionResult Download_PDF()
{
    MyDatabaseEntities dc = new MyDatabaseEntities();

    ReportDocument rd = new ReportDocument();
    rd.Load(Path.Combine(Server.MapPath("~/Reports"), "CrystalReport2.rpt"));
    rd.SetDataSource(dc.Users.Select(c => new
    {
        UserID = c.UserID,
        FirstName = c.FirstName,
        LastName = c.LastName,
        Address = c.Address,
        Mobile = c.Mobile,
        EmailID = c.EmailID,
    }).ToList());


    Response.Buffer = false;
    Response.ClearContent();
    Response.ClearHeaders();

    Stream stream = rd.ExportToStream(CrystalDecisions.Shared.ExportFormatType.PortableDocFormat);
    stream.Seek(0, SeekOrigin.Begin);

    return File(stream, "application/pdf", "CustomerList.pdf");
}
```

Figure 4.7: Code Snippet of Report Generation.

The system generates financial reports, such as monthly sales, yearly sales, etc. The monthly sales report is illustrated in Figure 4.8: Monthly Sales Report



Monthly Sales of Invoices

Automobile Service Station Management System

13-Sep-2021

Invoice ID	Invoice Date	Total
<hr/>		
July		
4	7-Jul-2021	900.00
	Sales per Month:	900.00
<hr/>		
August		
3	7-Aug-2021	250.00
	Sales per Month:	250.00
<hr/>		
October		
11	7-Oct-2021	950.00
13	8-Oct-2021	500.00
	Sales per Month:	1,450.00
		Sales of the Year: 2,600.00

Figure 4.8: Monthly Sales Report

This will conclude the implementation chapter and the next chapter is the most important chapter of the dissertation. It will cover how the work is tested and/or evaluated.

Chapter 5 – Testing and Evaluation

Every project's success will depend on the testing process. Its goal is to determine whether the supplier's product promises, and the customer's needs are met to an acceptable level. This chapter explains how to check and validate a system in an organized and predefined manner.

Testing should be done not after the development stage but, at the early stages of the SDLC. Testing is the process of assessing a system or its component(s) to determine whether or not it meets the set requirements. Simply put, testing is the process of running a system to find any gaps, faults, or missing requirements that are not met by the real requirements.

According to ANSI/IEEE 1059 standard, Testing can be defined as - A process of analyzing a software item to detect the differences between existing and required conditions (that is defects/errors/bugs) and to evaluate the features of the software item. (“Software Testing - Quick Guide- Tutorialspoint,” n.d.)

5.1 Related Software Testing Types

Many testing types can be carried out by the testing teams. Such as,

- Black box testing
 - Acceptance testing
 - Unit testing

- White-box testing
 - Integration testing
 - System testing

Among the above-mentioned testing types, for the Web-Based Automobile Service Station Management System, the following testing methods were used in the website, in order to evaluate and maintain the quality of the product.

Unit Testing –

The system consists of several modules and it is mandatory to test each of them individually. Each of these modules is treated as a separate entity and is subjected to testing. It will specify a series of scenarios to be tested in a black-box environment. There will be a succession of inputs and predicted outputs in these scenarios. Without knowing how and where the inputs are processed, the tester will engage with the system's user interface by providing inputs and evaluating outcomes. Because the strategy clearly distinguishes the user's perspective from the developer's perspective, this technique is expected to be followed by one of the actual users in the firm.

Integrated Testing –

The above-tested units will be integrated and tested again as groups. Multiple methods are used to integrate and test modules as a group. A unit is defined as the smallest tested portion of the system in this context. Integration testing is used to identify any discrepancies between the components that are linked together. Integration testing can reveal issues with software component interfaces before they become difficulties in real-world program operation.

System Testing –

System testing looks for flaws in both the individual parts and the entire system. The observed behavior of a component or a system, when it is tested, is the result of system testing. System testing is performed on the entire system, either following system requirement requirements, functional requirement specifications, or both. System testing examines the system's design and behavior, as well as the customer's expectations.

Acceptance Testing –

User acceptance testing will go in line with the implementation of the system. The manual process also goes parallel with the preliminary implementation stage and the system will be tested by the exact end-user. Most of the time minor changes will capture at this stage. The testing process is almost completed at the end of this stage.

5.2. Test Cases

A test plan is made up of test cases, test schedules, test objectives, and testing methodologies in general. Test cases are one of the most important components in the process of reviewing the test strategy. The following are the main components of a test plan. A specific test case should have its ID, functionalities to be evaluated, testing technique, test data, expected results, and priority. Every test data should be chosen based on the specification, and all individual system modules should be tested against a variety of test cases.

To assure the system's quality, both functional and non-functional tests are performed.

A functional test is designed to determine how an action is performed, whereas a non-functional test is designed to determine “how” the program executes that action rather than “if” it can perform that action.

The test cases and corresponding test results are depicted in the following section.

5.2.1. Functional Test Cases

Following tables, 5.1 to 5.10 represent some of the functional test cases in the system.

- It is required to get Sign in/Sign up for a person who uses the system. Relevant test cases are depicted in Table 5.1: General functionalities for all users.

Table 5.1: General functionalities for all users.

Test Case ID	Functionality	Procedure	Expected Results	Test Data	Status
01.	Valid Login	Enter the valid username and the password	Home page with the welcome message and the username.	Username: vindhiz@gmail.com Password: 123456	Passed
02.	Invalid Login	Enter an invalid username and a password	An error message will be prompt mentioning the reason.	Username: vindhiz@gmail.com Password: ABC	Passed
03.	Logout	Click logout button	The user will be logged out and		Passed

			displayed the login window.		
04.	Registration	Enter all personal details asked by the system	Success message as a registered user.	First Name: Vindhiani Last Name: Chandrasiri Address: Kalalgoda, Panniptiya Mobile: 0777327474 Email ID: vindhiz@gmail.com Date of birth: 21/01/1987 Password: 123456 Confirm Password:123456	Passed

- Non-logged-in users can view Home Page with the following modules only. Relevant test cases are depicted in Table 5.2: Functionalities in Home (For all non-logged or logged users).

Table 5.2: Functionalities in Home (For all non-logged or logged users).

Test Case ID	Functionality	Procedure	Expected Results	Status
Functionalities in Home (For all non-logged or logged users)				
05.	Home Page	Click Home Page	Direct to the Home page.	Passed
06.	Shop	Click Shop module	Displays the shop product and shop cart menus.	Passed
07.	Services	Click Service module	Direct to the Service page.	Passed
08.	About Us	Click About Us	Displays the About Us, Gallery, and Contact Us pages.	Passed

- According to the user credentials, all logged-in users can view additional menus apart from the above four menus.
 - Users can view the following modules only (apart from the above four menus). Relevant test cases are depicted in Table 5.3: Functionalities in Home (For logged Customers).

Table 5.3: Functionalities in Home (For logged Customers).

Test Case ID	Functionality	Procedure	Expected Results	Status
Functionalities in Home (For logged User)				
09.	Reservation	Click Reservation module	Direct to the Reservation window.	Passed
10.	Profile	Click on 'Hi User'	Direct to the profile page of the corresponding user.	Passed

- Admin/System operator can view the following module (apart from the above all menus). Relevant test cases are depicted in Table 5.4: Functionalities in Home (For logged Admin/System operators).

Table 5.4: Functionalities in Home (For logged Admin/System operators).

Test Case ID	Functionality	Procedure	Expected Results	Status
Functionalities in Home (For logged Admin/System operators)				
11.	Admin	Click Admin module	Displays all administrative functionalities.	Passed
12.	Invoice	Click Invoice module	Direct to the Invoice page.	Passed

- Some main modules in the admin panel. Relevant test cases for the user management module are depicted in Table 5.5: User Management Test Cases.

Table 5.5: User Management Test Cases.

Test Case ID	Functionality	Procedure	Expected Results	Test Data	Status
User Management					
13.	User page load	Click the User menu from the sidebar	Interface to insert user details and a grid filled with existing user's details in the DB		Passed
14.	Add user (valid)	Enter all user details and click Add User button	User details should be added to the database and a unique user id will be allocated. A success message will be displayed. Newly inserted user details should be added to the grid.	First Name: Kanchana Last Name: Rathnaweera Address: Kalalgoda, Panniptiya Mobile: 0772272662 Email ID: mrkanchana@gmail.com Date of birth: 01/10/1986 Password: 123456 Confirm Password: 123456 User role: Admin	Passed
15.	Add user (invalid)	Enter user details with an invalid user detail	An error message will be prompt mentioning the reason.	First Name: Kanchana Last Name: Rathnaweera Address: Kalalgoda, Panniptiya Mobile: 0772272662 Email ID: vindhiz@gmail.com Date of birth: 01/10/1986 Password: 123456 Confirm Password: 123456 User role: Admin	Passed
16.	Edit	Select a particular user from the grid and click the Edit button	Load the user interface relevant user details selected from the grid.		Passed
17.	Update User	Click the update user button	Update user details in the database. A message will be displayed mentioning	First Name: Kanchana Last Name: Rathnaweera Address: Pannipitiya Mobile: 0777777777	Passed

			the update was a success.	Email ID: mrkanchana@gmail.com Date of birth: 01/10/1986 Password: 123456 Confirm Password:123456 User role: Admin	
18.	Delete user	Select a particular user from the grid and click Delete	A confirmation message should be given before deleting a user and delete user details in the database. A message will be displayed mentioning the delete was a success.		Passed
19.	Profile	Select a particular user from the grid and click the Profile button	Load the user profile with all relevant user details and corresponding vehicle and service history details.		Passed

Test cases related to unit management are depicted in Table 5.6: Unit Management Test Cases.

Table 5.6: Unit Management Test Cases.

Test Case ID	Functionality	Procedure	Expected Results	Test Data	Status
Unit Management					
20.	Unit page load	Click the Unit menu from the sidebar	Interface to insert units and a grid filled with existing units in the database.		Passed
21.	Add Unit (valid)	Enter all unit details and click Add Unit button	Unit details should be added to the database and a unique unit id will be allocated. A success message will be displayed.	Unit Name: Liters Unit Description: Measurement for liquids	Passed

			A newly inserted unit should be added to the grid.		
22.	Edit	Select a particular unit from the grid and click the Edit button	Load all input controllers with unit details corresponding to the selected unit id from the grid.		Passed
23.	Update	Click the update unit button	Update user details in the database. A message will be displayed mentioning the update was a success.	Unit Name: Liters Unit Description: Unit for liquids	Passed
24.	Delete	Select a particular unit from the grid and click the delete button	A confirmation message should be given before deleting a unit and deleting unit details in the database. A message will be displayed mentioning the delete was a success.		Passed

Test cases related to item management are depicted in Table 5.7: Item Management Test Cases.

Table 5.7: Item Management Test Cases.

Test Case ID	Functionality	Procedure	Expected Results	Test Data	Status
Item Management					
25.	Item page load	Click the Item menu from the sidebar	Interface to insert items. Unit and category dropdowns populated with details and a grid filled with existing items in the database.		Passed
26.	Add Item (valid)	Enter all item details	A message will be prompt mentioning the item added successfully. Inserted Items will be shown in a grid below the page	Item Name: Antenna Item Description: Antenna for cars Item Price: 500 Unit: Each Category: Accessories	Passed

27.	Add Item (invalid)	Enter all item details with an invalid item detail	An error message will be prompt mentioning the reason.		Passed
28.	Edit	Select a particular item from the grid and click the Edit button	Load all input controllers with item details corresponding to the selected item id from the grid.		Passed
29.	Update	Click update button	Update user details in the database. A message will be displayed mentioning the update was a success.	Item Name: Antenna Item Description: Antenna for vehicles Item Price: 500 Unit: Each Category: Accessories	Pending
30.	Delete	Select a particular item from the grid and click the delete button	A confirmation message should be given before deleting an item and deleting item details in the database. A message will be displayed mentioning the delete was a success.		Passed
31.	Go to stock	Click the stock button	Direct to the stock page with the relevant item code.		Passed

Test cases related to vehicle management are depicted in Table 5.8: Vehicle Management Test Cases.

Table 5.8: Vehicle Management Test Cases.

Test Case ID	Functionality	Procedure	Expected Results	Test Data	Status
Vehicle Management					
32.	Add Vehicle	Enter all vehicle details	A message will be prompt mentioning the vehicle added successfully. Inserted Vehicles will be shown in a grid	Vehicle Type: CAR Vehicle Make: HONDA Vehicle Model: GP5 Registration Number: CAB-7424 Manufactured Year: 2017	Passed

33.	Add Vehicle (invalid)	Missed any detailed field	An error message will be prompt mentioning the reason.	Vehicle Type: CAR Vehicle Make: HONDA Vehicle Model: GP5 Manufactured Year: 2017	Passed
34.	Edit	Select a particular vehicle from the grid and click the Edit button	Load all input controllers with vehicle details corresponding to the selected vehicle id from the grid.		Passed
35.	Update	Click update button	Update vehicle details in the database. A message will be displayed mentioning the update was a success.	Vehicle Type: CAR Vehicle Make: HONDA Vehicle Model: GP5 Manufactured Year: 2013	Passed
36.	Delete	Select a particular vehicle from the grid and click the delete button	A confirmation message should be given before deleting a vehicle and deleting vehicle details in the database. A message will be displayed mentioning the delete was a success.		Passed

Test cases related to reservation management are depicted in Table 5.9: Reservation Management Test Cases.

Table 5.9: Reservation Management Test Cases.

Test Case ID	Functionality	Procedure	Expected Results	Test Data	Status
Reservations					
37.	Reservation page load	Click reservation from the navigation	Particular user details with corresponding vehicles and the reserved time slots, services are loaded.		Passed
38.	Place Reservation (valid)	Select vehicles, date, time, and services accordingly	A message will be prompt mentioning the pending reservation is placed.	Appointment date: 05/06/2021 Appointment Time : 0300pm	Passed

				Selected Services: Oil change, Exterior Detailing Selected Vehicles: KF-3766	
39.	Invalid Reservation	Missed appointment date or time	An error message will be prompt mentioning the reason.	Appointment date: 05/06/2021 Selected Services: k-mat Selected Vehicles: KF-3766	Passed
40.	Cancel reservation	Click the cancel button on the profile page	A message will be displayed mentioning the reservation was canceled.		Passed

Test cases related to checking user profiles are depicted in Table 5.10: User Profile Test Cases.

Table 5.10: User Profile Test Case.

Test Case ID	Functionality	Procedure	Expected Results	Test Data	Status
Profile Management					
41.	Profile page load	Click the Hi(username) link on the top menu	The user's details, vehicle details, and service history will be loaded.		Passed

5.2.2. Non-functional Test Cases

Non-functional tests are just as essential as functional tests in terms of client satisfaction. These tests are intended to assess the application's readiness based on non-functional parameters that are never addressed in functional testing. Password verification test case depicted in Table 5.11 Password Verification Test Case.

Table 5.11: Password Verification Test Case.

Test Case ID	Functionality	Procedure	Expected Results	Test Data	Status
Password Verification					
01.	Verify whether the passwords are stored encrypted in the database	User registration and verifying the password field in the database.	Passwords should be stored encrypted in the DB.		Passed

Testcase relevant to viewing service history details is depicted in Table 5.12: View Service History

Table 5.12: View Service History

Test Case ID	Functionality	Procedure	Expected Results	Test Data	Status
View Service History					
02.	Load user's vehicle service history details	Click the Hi(username) link on the top menu	User's vehicle service history details will be loaded		Passed

5.3. User Evaluation

User evaluation will be performed as the final stage of the testing process. This is concerned with how successfully users can learn and use the application to perform the actions/functionalities. It also relates to how satisfied consumers are with the developed program. This information can be acquired from users using a variety of feedback collection methods. There were 25 members in the sample group, and all of them were given a questionnaire. Questionnaires are the primary data

collection tool in surveys, which will be used to obtain the aforementioned information from end-users. The questionnaire contains multiple-choice questions (MCQs) that address all of the user roles that will be connected with the application. The questionnaire and the collected responses are attached to Appendix B. The user-friendliness, functionality, load time, and overall rating are the four categories that have been evaluated. The following depicts the analytics derived from the user evaluation.

1. User Friendliness

The end-users are shown a clear representation of the application. Almost 90% of users are satisfied with the application's design, and they believe it is more user-friendly. It is shown in Figure 5.1: Evaluation Results - User Friendliness.

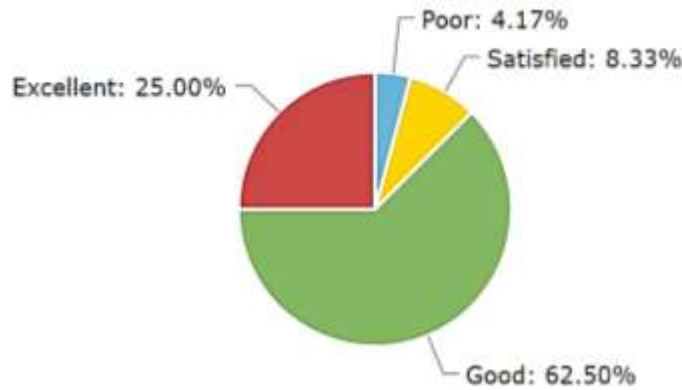


Figure 5.1: Evaluation Results - User Friendliness.

2. Functionality

Nearly 80% of users are satisfied with the application's features, claiming that they were able to complete their tasks with less effort and time. Figure 5.2: Evaluation Results - Functionality represented in detail.

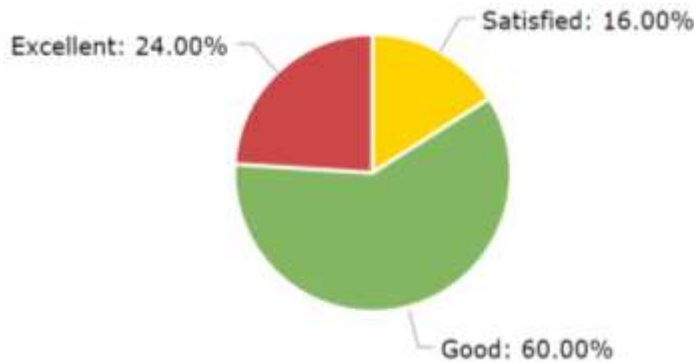


Figure 5.2: Evaluation Results - Functionality.

3. Load Time

Many users mentioned that the website is loaded without an issue on time. Figure 5.3: Evaluation Results - Functionality illustrates the results.

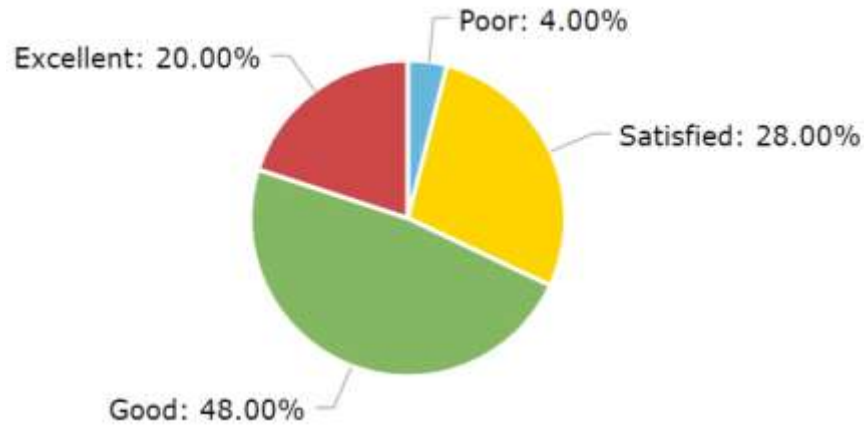


Figure 5.3: Evaluation Results - Load Time.

4. Overall Rating

When analyzing the overall rating assigned to the application, it is clear that the application's goals have been reached, and that other improvements can be made. The results are shown in Figure 5.4: Evaluation Results – Overall Rating.

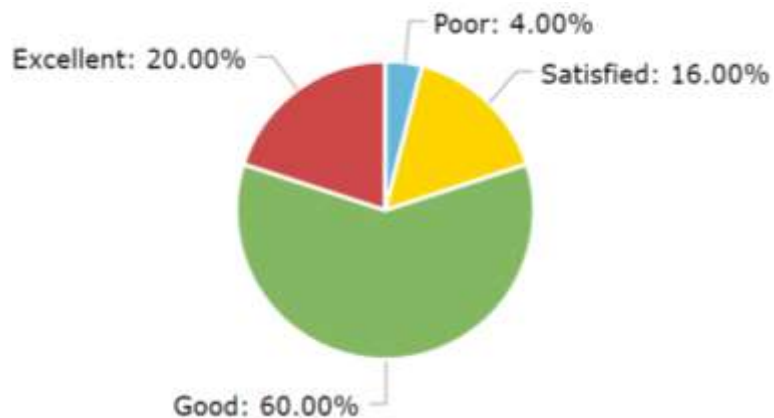


Figure 5.4: Evaluation Results - Overall Rating.

This will conclude this chapter and the next Conclusion chapter will illustrate a total overview of the developed system with its constraints, achievements, and drawbacks.

Chapter 6 – Conclusion

The conclusion chapter here illustrates a total overview of the developed system with its constraints, achievements, and drawbacks. And this will summarize the author's reflection on the whole project work including a critical appraisal of the successes and limitations of the project approach and the development of the system itself.

6.1 Critical Evaluation of the system

Efforts have been made throughout this project to create a web application for an automobile service station capable of catering all manually processed activities to a computerized environment. The project's goal was to provide an efficient and effective service to customers while maintaining a proper management process throughout an automated system.

As is customary, the Project began with an in-depth domain analysis conducted through formal sessions, interviews, document analysis, and the owners' personal experience in the auto service center industry. This requirement gathering and analysis process direct the problem domain into a more vivid and understandable state. The fundamental factors of the problem domains were ineffective record-keeping, pitiful accounting paperwork, unsatisfactory stock management, and so on. Techniques like interviews, observations, and prototyping aided in the clarification and prioritization of these types of needs.

Because the entire collection of needs was gathered around a small group of people, prototyping became more appropriate in providing an early experience to the user community as well as capturing and validating requirements. Rich images, UMLs, and ERDs were utilized to translate requirements into a visual form that is easier to express to both technical and non-technical users. The created web application is hosted by a content management system. The SMTP connection will maintain the contact between those two distinct portions.

Following a pre-defined comprehensive collection of test cases, plans, and procedures lead to an enhancement in the system's quality and accuracy.

6.2 Difficulties found

The requirement gathering stage was the most critical stage which happened during the development. For the reason, that of this prevailing pandemic situation in the country, visiting Service Station premises personally and collecting information has been a real challenge.

Therefore, making voice and data calls to actual clients has been the solution for overcoming this issue.

A few sets of problems were encountered at the developing stages and found suitable solutions to overcome them. Some of them are design level and some of the requirements need to change slightly.

Lack of knowledge in MVC architecture and the visual studio software has also been a real challenge in the development process. Correspondingly, sending confirmation messages/ emails from the system was also been challenged.

6.3 Future Enhancements

By means of future enhancements, the following features can be developed in the system,

- Allow customers to make payments for the automobile services they obtained, from the web application (Due to practical scenarios, at this stage customers are not allowed to make payments online for the automobile services they get, except for purchasing items online.)
- If a particular Service Station required a facility to provide discounts for some selected customers, it also can be developed as future works.
- Employee management and their payments can be developed and handled for better performance at the service station.
- Keeping track of supplier details is essential for a web application like this. Therefore, this feature can be added as a future enhancement.
- Stock maintenance of consumable items at the premises can also be included in the system.

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Appendix A - User Manual

The website will be loaded when you type <https://www.asms.lk> URL in the address bar. the home page of the system is illustrated in the following Figure A.1: Home Page of the Automobile Service Station Management System.

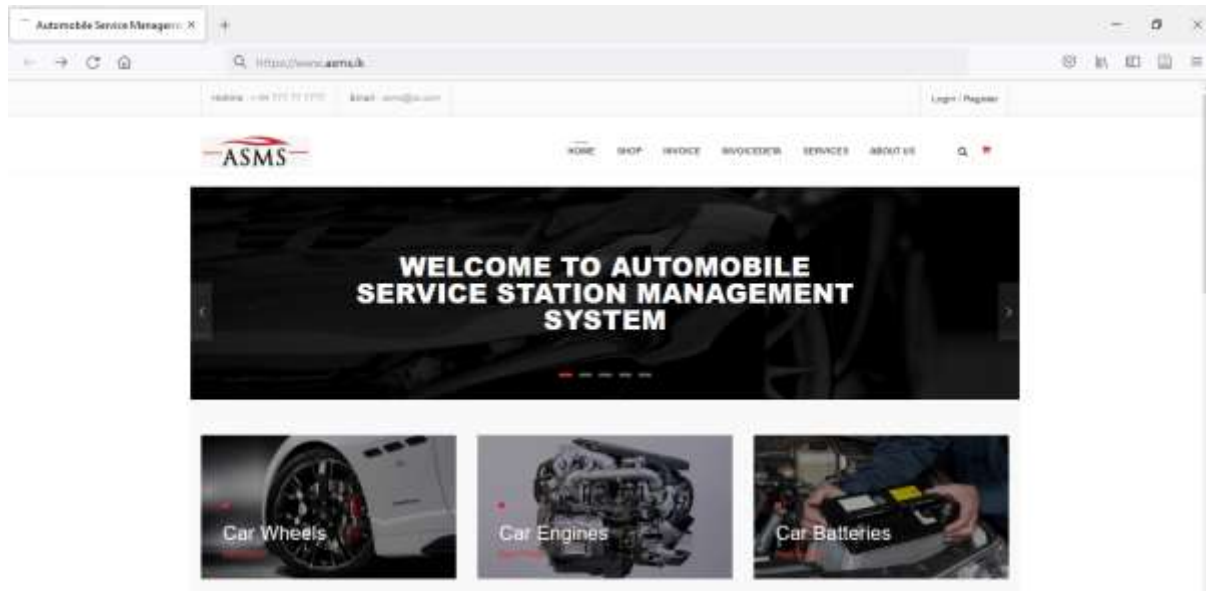


Figure A.1: Home Page of the Automobile Service Station Management System

Non-logged users

Without logging into the system, users can view the following pages respectively, available services, about us, gallery, and contact us. They are illustrated respectively in Figure A.2: Available Services Page, Figure A.3: About Us Page, Figure A.4: Gallery Page, and Figure A.5: Contact Us Page

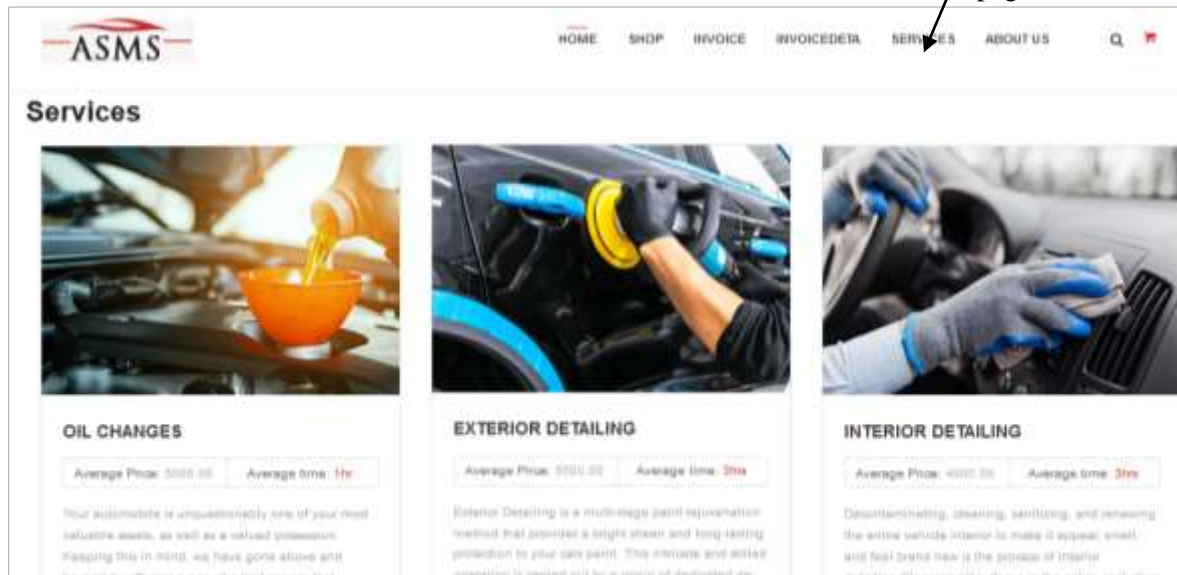


Figure A.2: Available Services Page

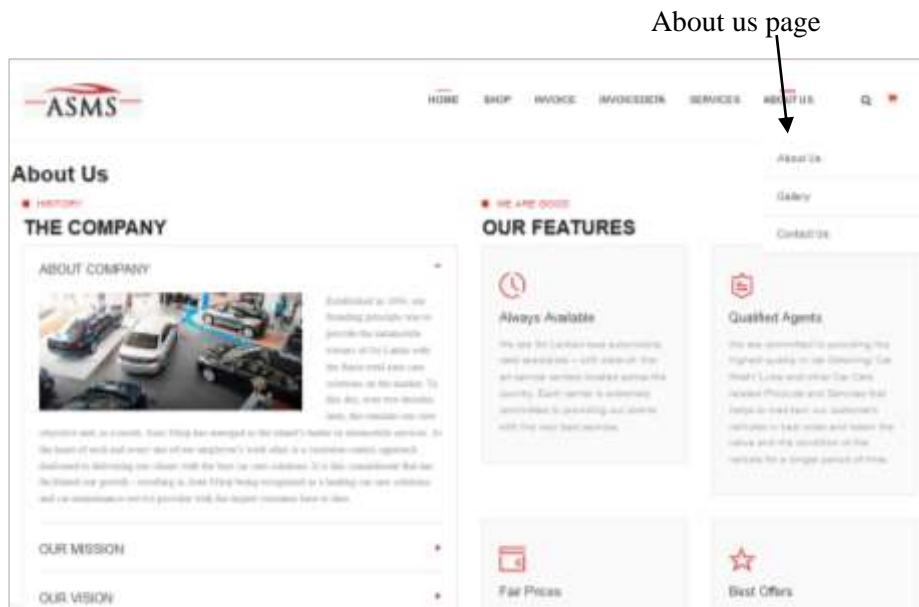


Figure A.3: About Us Page

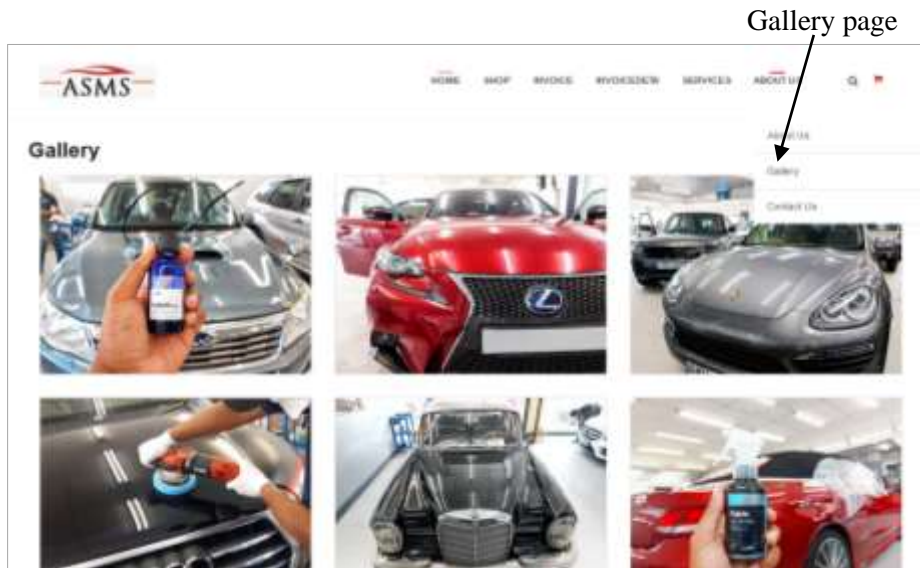


Figure A.4: Gallery Page

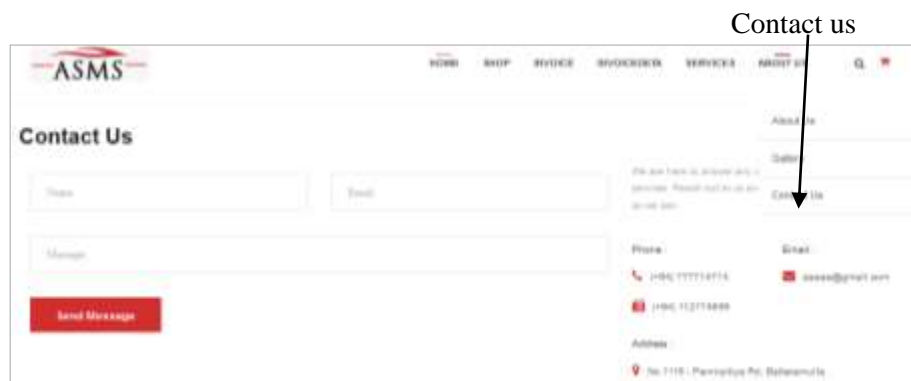


Figure A.5: Contact Us Page

Login

If you are a registered user, you can directly log in to the system. Figure A.6: Login Page illustrates the system login.



Figure A.6: Login Page

1. Enter email in the Email ID field
2. Enter the password in the password field
3. Click on the Sign-in button
4. The system will direct to the home page

A successful login will redirect the user to the home page in the system, displaying the user name and the logout. Figure A.7: The home page of logged-in users illustrates the home age of the logged-in users.

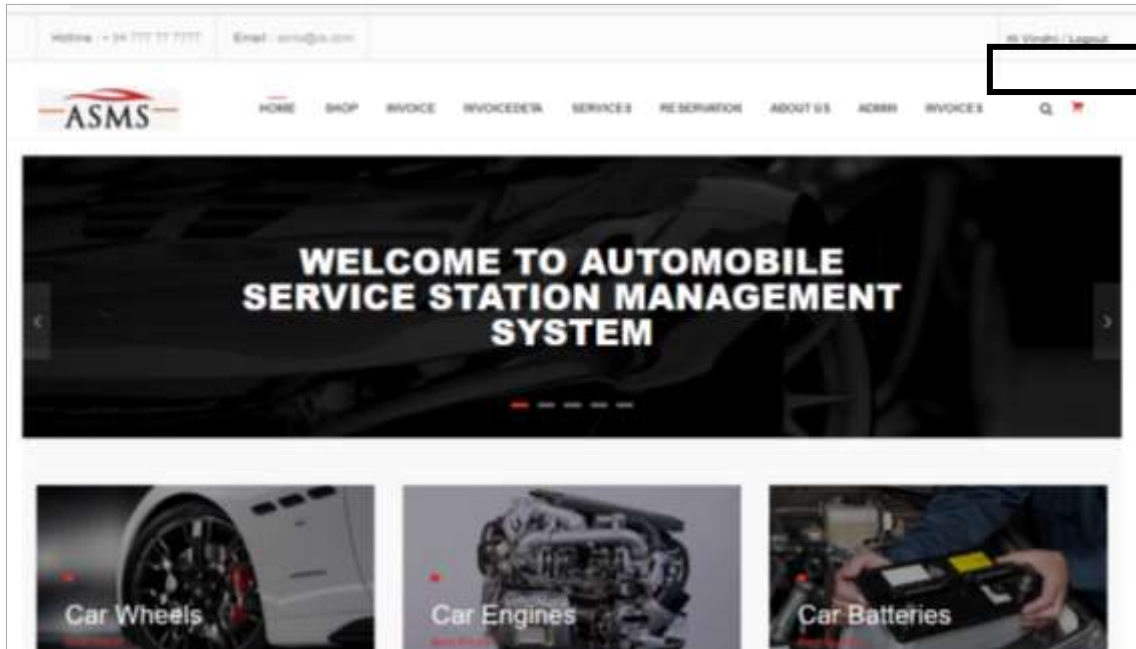


Figure A.7: The home page of logged-in users.

Invalid login

If the username or password is incorrect, an error will be provided. The error message will be illustrated in Figure A.8: Invalid Login Message.

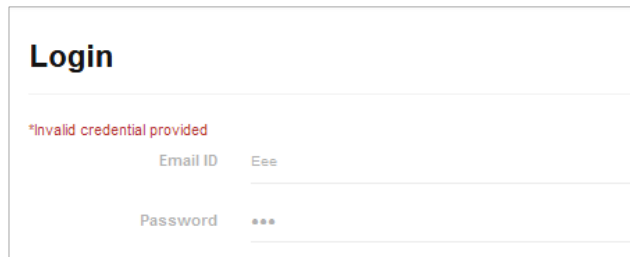


Figure A.8: Invalid Login Message

User Registration

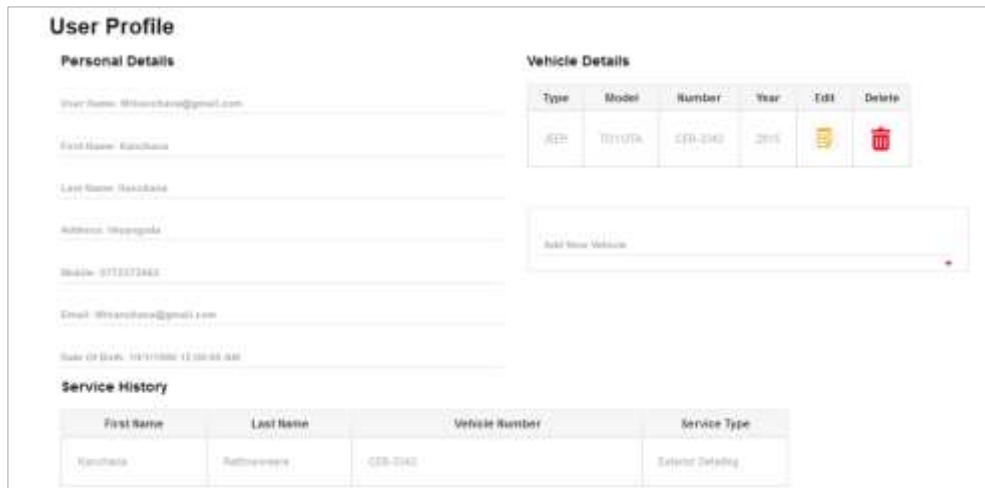
If a user is not a registered user, then they have to complete the registration page. Figure A.9: User Registration Form illustrates the registration form given in the system.



The registration form is titled "Registration" and contains the following fields: First Name, Last Name, Address, Mobile, Email, Password, and Confirm Password. Below the fields is a checkbox for "I agree to the Terms and Conditions" and a red "Sign Up" button.

Figure A.9: User Registration Form

User Profile



The user profile page is titled "User Profile" and is divided into three main sections: Personal Details, Vehicle Details, and Service History.

Personal Details

User Name: @kirancharan@gmail.com

First Name: Kirancharan

Last Name: Rakeshbabu

Address: Mysoreguda

Mobile: 9712272442

Email: @kirancharan@gmail.com

Date Of Birth: 19/11/1992 (13:00:00:00)

Vehicle Details

Type	Model	Number	Year	Edit	Delete
ICE	TOYOTA	CEB-2342	2015		

Service History

First Name	Last Name	Vehicle Number	Service Type
Kirancharan	Rakeshbabu	CEB-2342	Engine Overhaul

Figure A.10: User Profile Page

Users can view their user profiles by clicking on the username displayed on the home page. On the user profile page, users can manage their vehicle details. Above Figure A.10: User Profile Page illustrated the user profile in the system.

Online Reservations

Logged in users can make online reservations. Figure A.11: Online Reservation Page illustrates the reservation page in the system.

Reservations

First Name: Vindhi

Last Name: Ruki

Mobile: 0777327474

Email: Vindhiz@gmail.com

Select Your Vehicle

Select Vehicle ▾

Allocated Time Slots

Appointment Date: mm / dd / yyyy

Appointment Time: -- : -- --

Select Your Services

Oil Changes

Figure A.11: Online Reservation Page

Admin Panel

This system has three types of users and only the system operator and the management can view and work with this admin panel. Figure A.12: Admin Panel illustrates the admin panel.

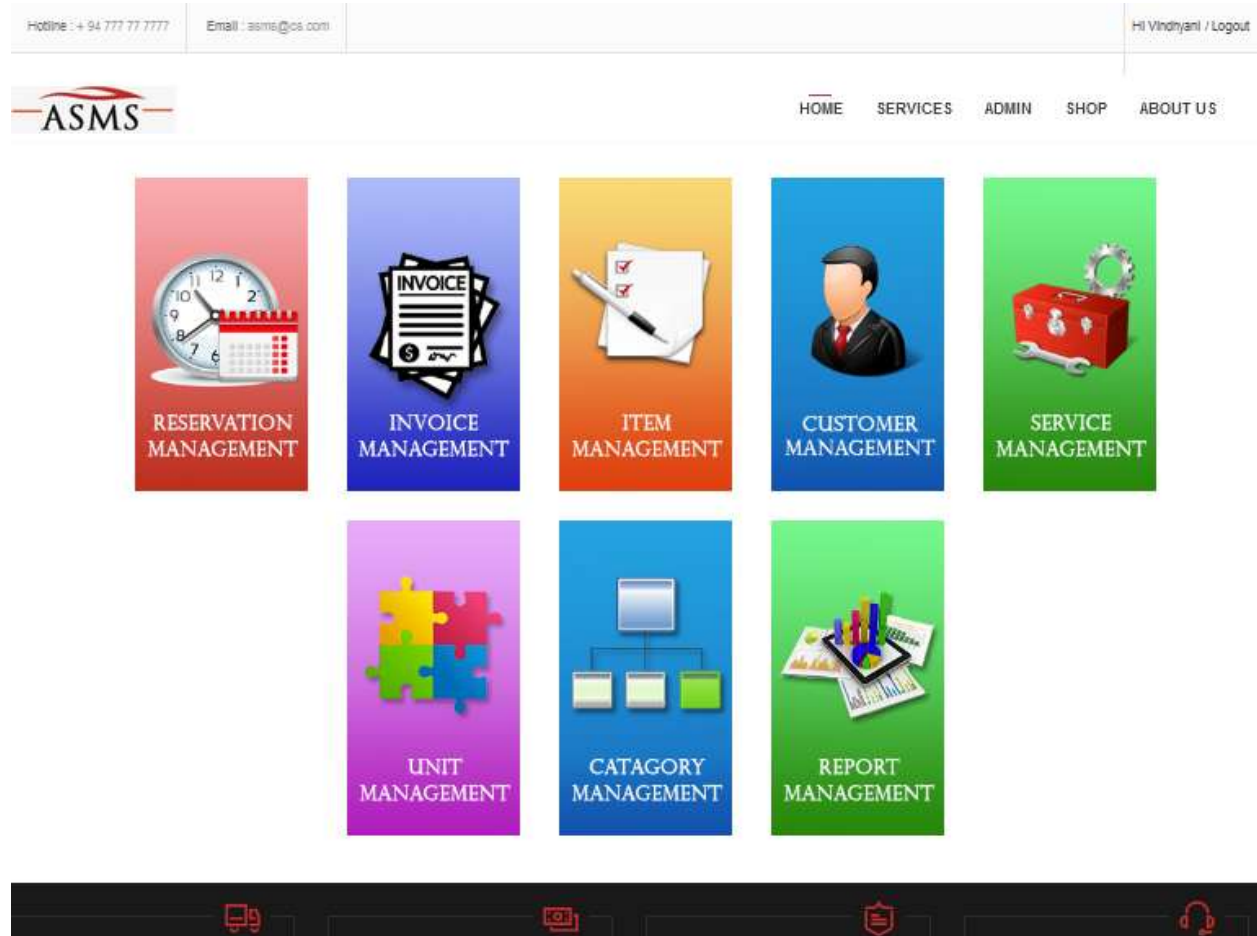


Figure A.12: Admin Panel

Customer Management



Add, Update, and Delete functionalities of customers will be handled in this module. The functionalities will be handled by the system operator or the management. The customer management module is represented in Figure A.13: Customer Management.

Figure A.13: Customer Management

When the customer management image is clicked the following page will appear. Fill in the customer details and click the “Add Customer” button and all the customer details will be added to the database. A message will be displayed accordingly.

The system operator’s customer management page is depicted in Figure A.14: Customer Management.

Registration

First Name: _____

Last Name: _____

Address: _____

Mobile: _____

Email ID: _____

Password: _____

Confirm Password: _____

User Group: _____

I agree to the Terms and Conditions
By creating Sign up, you agree to our terms and conditions and confirm that you have read our policies.

ADD CUSTOMER **UPDATE CUSTOMER**

Figure A.14: Customer Registration Form for System User

View All Customers

When customer details are successfully added the relevant record will be added to the grid and displayed.

Figure A.15: Customer Details Grid depicts all the registered customers in the system.

First Name	Last Name	Email/Username	Address	Mobile	User Group				
vindhyni	ruksala	vindhiz@gmail.com	colombo	0777327474	User				
Temp Customer	ASMS	automobileservicesms@gmail.com	ASMS	0777327474	Admin				
Vindhyani	Chandrasiri	vindhiz@gmail.com	147/C, Kalalgoda, pannipitiya	0777327474	Admin				

Figure A.15: Customer Details Grid

Unit Management



Add, Update, and Delete functionalities of units will be handled in this module. The functionalities will be handled by the system operator or the management. The unit management module is represented in Figure A.16: Unit Management.

Figure A.16: Unit Management

Add Unit

When the Unit Management image is clicked the following page will appear. Fill in the unit details and click the “Add Unit” button and all the unit details will be added to the database. Messages will be displayed accordingly, and it is illustrated in Figure A.17: Unit Addition and the Success Message

The image shows a web interface for 'Unit Management'. On the left, there is a form with two input fields: 'Unit Name' and 'Unit Description'. Below these fields are two red buttons: 'ADD UNIT' and 'UPDATE UNIT'. On the right, a modal window is open, displaying a success message: 'Unit added successfully' with a blue 'OK' button. The modal window title is 'localhost:44339'.

Figure A.17: Unit Addition and the Success Message

View All Units

When a unit is successfully added, it will be displayed in the grid. All the units added to the system is displayed in the Figure A.18: Unit Details Grid

Unit Name	Unit Description	Edit	Delete
Each	This unit is measured by each		
Liters	This is measured by each		

Figure A.18: Unit Details Grid

Update Unit

Click on the edit icon in the grid (yellow color label) and relevant details will be loaded to the window. When the required modifications are done click the “Update Unit” button and messages will be displayed accordingly, and it is displayed in Figure A.19: Unit Update and Success Message.



Figure A.19: Unit Update and Success Message

Delete Unit

Click on the delete icon in the grid (red color label) and the corresponding unit will be deleted. The messages will be displayed accordingly, and it is displayed in Figure A.20: Unit Deletion and Success Message.



Figure A.20: Unit Deletion and Success Message

Category Management



Add, Update, and Delete functionalities of categories will be handled in this module. The functionalities will be handled by the system operator or the management. The category management module is represented in Figure A.21: Category Management.

Figure A.21: Category Management

Add Category

When the Category Management image is clicked the following page will appear. Fill in the category details and click the “Add Category” button and all the category details will be added to the database. Messages will be displayed accordingly, and it is displayed in Figure A.22: Category Addition and Success Message.

Category Management

The screenshot shows a web form for adding a category. It has two input fields: 'Category Name' and 'Category Description'. Below these are two red buttons: 'ADD CATEGORY' and 'UPDATE CATEGORY'. A modal message box is open, displaying 'localhost:44339' and 'Category added successfully' with an 'OK' button.

Figure A.22: Category Addition and Success Message.

View All Categories

When a category is successfully added, it will be displayed in the grid. All the categories added to the system are displayed in Figure A.23: Category Details Grid.

Category Name	Category Description	Edit	Delete
Accessories	My Accessories		
Engine Spare Parts	Engine Spare Parts		
Spare Parts	Spare Parts		

Figure A.23: Category Details Grid

Update Category

Click on the edit icon in the grid (yellow color label) and relevant details will be loaded to the window. When the required modifications are done click the “Update Category” button and messages will be displayed accordingly, and it is displayed in Figure A.24: Category Update and Success Message.



Figure A.24: Category Update and Success Message

Delete Category

Click on the delete icon in the grid (red color label) and the corresponding category will be deleted. The messages will be displayed accordingly, and it is displayed in Figure A.25: Category Deletion and Success Message.



Figure A.25: Category Deletion and Success Message.

Item Management



Add, Update, and Delete functionalities of items will be handled in this module. The functionalities will be handled by the system operator or the management. The item management module is represented in Figure A.26: Item Management.

Figure A.26: Item Management

Add Item

Item Management

Item Name:

Item Description:

Item Price(Re):

Unit:

Category:

Item Image: No file selected.

localhost:44339

Item added successfully

Figure A.27: Item Addition and Success Message

View All Items

When an item is successfully added, it will be displayed in the grid. All the items added to the system are displayed in Figure A.28: Item Details Grid.

Item Image	Item Name	Item Description	Item Price	Unit	Category			
	Antenna	Vehicle Antenna	800.00	Liters	Accessories			<input type="button" value="STOCK"/>
	Armrest	Vehicle Armrest	500.00	Liters	Accessories			<input type="button" value="STOCK"/>
	Oil Filter	Oil Filter	500.00	Each	Spare Parts			<input type="button" value="STOCK"/>
	Brake Oil	This is breake Oil	800.00	Liters	Lubricants			<input type="button" value="STOCK"/>

Figure A.28: Item Details Grid

Delete Item

Click on the delete icon in the grid (red color label) and the corresponding item will be deleted. The messages will be displayed accordingly, and it is displayed in Figure A.29: Item Deletion and Success Message.



Figure A.29: Item Deletion and Success Message

Vehicle Management

Add, Update, and Delete functionalities of vehicles will be handled in this module. The functionalities can be handled by outside users as well as the system operator or the management.

Add Vehicle

Users can fill in the vehicle details and click the “Add Vehicle” button and all the vehicle details will be added to the database. Messages will be displayed accordingly, and it is displayed in Figure A.30: Vehicle Addition and Success Message.

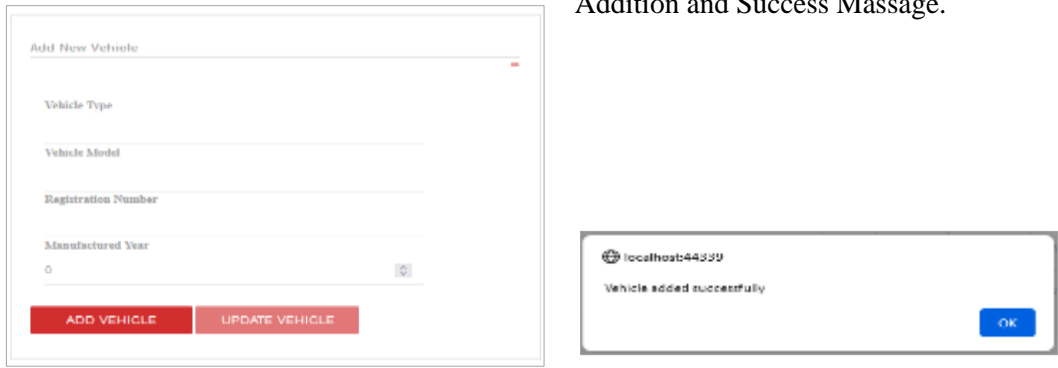


Figure A.30: Vehicle Addition and Success Message

View All Vehicles

When the user profile page is viewed by the customer, all the registered vehicles are displayed under that user's name will be displayed. It is illustrated in Figure A.31: Vehicle Details Grid.

Vehicle Details







Type	Model	Number	Year	Edit	Delete
car	honda	CAF-5454	2010		
jeep	toyota	CAN-1212	2012		
van	nissan	PE-6161	2002		

Figure A.31: Vehicle Details Grid.

Delete Vehicle

Click on the delete icon in the grid (red color label) and the corresponding vehicle will be deleted. The messages will be displayed accordingly, and it is displayed in Figure A.32: Category Deletion and Success Message.



Figure A.32: Vehicle Deletion and Success Message

Invoice Management



Only the system operator and the management can access the invoice management module. The invoice management module is represented in Figure A.33: Invoice Management.

Figure A.33: Invoice Management

Search service/items

The system operator or the management can search for the services or items by typing the relevant name or part of the name of the service or the item in the search bar. It will list down all the possible values relate to that word. When the required service or the item is selected, corresponding details will be loaded to the text boxes in the grid. Then, the system operator can add the displayed entry to the invoice grid. It is depicted in Figure A.33: Search Service/Item for the Invoice.



Figure A.34: Search Service/Item for the Invoice

Generate/Print/Cancel Invoice

Once the services or items adding process is completed, the total for the corresponding invoice can be displayed. Clicking the payment button invoice generation process will be completed. The print or cancel processes can be selected accordingly. Figure A.34: Invoice Generation illustrated the invoice generation process of the system.

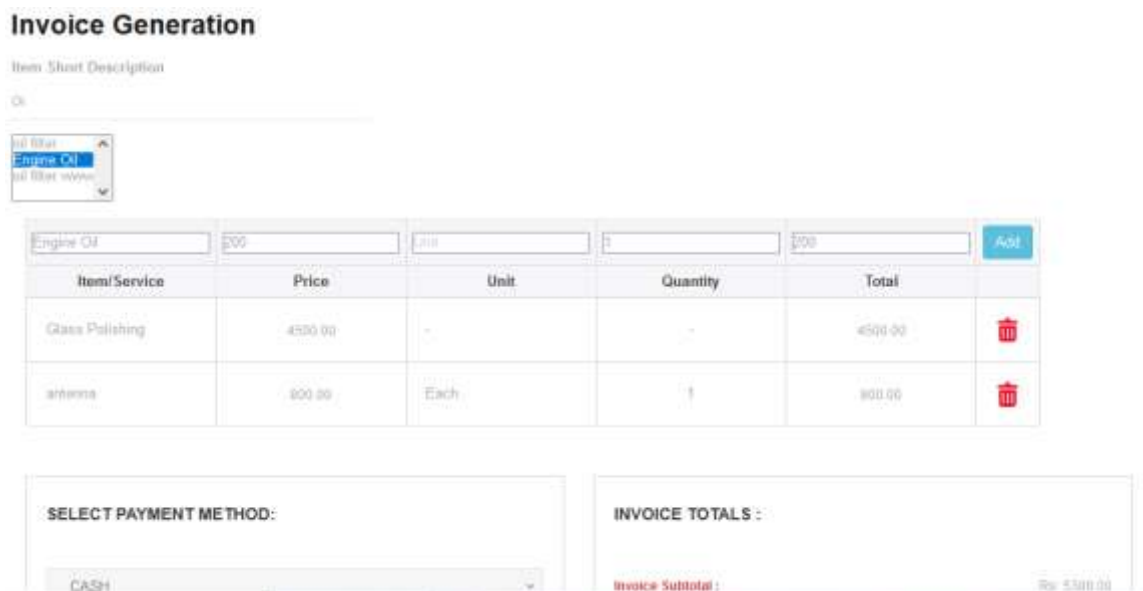


Figure A.35: Invoice Generation

View all Invoices

All invoices will be displayed in a grid and they can be printed as per the requirement. Figure A.36:Invoices Grid depicted all the invoices along with the date and time.

Invoices

Invoice ID	Invoice Date	Invoice Time	Total	
1	3/1/2021	10:00:00	500.00	Print
2	9/24/2021	10:30:00	500.00	Print
3	9/24/2021	10:00	1300.00	Print

Figure A.36: Invoices Grid

Reservation Management



The System operator and the management can access the reservation management module. The reservation management module is represented in Figure A.37: Reservation Management.

Figure A.37: Reservation Management

View All Reservations

All reservations are displayed in the below grid and the system user can confirm or cancel them accordingly, and a corresponding e-mail will be sent to the user. The grid of all reservations is depicted in Figure A.38: View All Reservations.

Reservations						
All Reservations Pending Reservations Confirmed Reservations View Available Time Slots						
Appointment ID	Appointment Date	Appointment Start Time	Appointment End Time	Appointment Status		
1	9/25/2021	10:00:00	12:00:00	Pending	Confirm	Cancel
3	9/25/2021	15:00:00	21:00:00	Pending	Confirm	Cancel
4	9/25/2021	19:00:00	21:00:00	Pending	Confirm	Cancel
5	9/19/2021	10:10:00	12:10:00	Pending	Confirm	Cancel
7	9/25/2021	15:00:00	17:00:00	Pending	Confirm	Cancel
8	9/25/2021	18:00:00	19:00:00	Confirmed		Cancel

Figure A.38: View All Reservations

Appendix B - Questionnaire

User Evaluation Form

01. Please select the category that best describes your role.
(i). Customer (ii). System Operator (iii). Admin
02. The registration of the website is easy?
(i) Poor (ii). Satisfied (iii). Good (iv). Excellent
03. Item filtering and searching process easy?
(i) Poor (ii). Satisfied (iii). Good (iv). Excellent
04. The placing reservation process was,
(i) Poor (ii). Satisfied (iii). Good (iv). Excellent
05. Satisfactory level of service history details,
(i) Poor (ii). Satisfied (iii). Good (iv). Excellent
06. The navigation of the website is easy?
(i) Poor (ii). Satisfied (iii). Good (iv). Excellent
07. The content presented on the website is understandable?
(i) Poor (ii). Satisfied (iii). Good (iv). Excellent
08. Organization of the admin functionalities in the admin panel,
(i) Poor (ii). Satisfied (iii). Good (iv). Excellent
09. Satisfactory level of the report generation process,
(i) Poor (ii). Satisfied (iii). Good (iv). Excellent
10. Overall rating of the system,
(i) Poor (ii). Satisfied (iii). Good (iv). Excellent

Results of the user evaluation

The responses collected from the users are shown below tables.

1. User-friendliness – the responses related to user-friendliness are depicted in Table B.1:

Response – User Friendliness.

Table B.1: Response - User Friendliness

Criteria	Responses
Excellent	8
Good	15
Satisfied	2
Poor	1
Total	25

2. Functionality - the responses related to functionality are depicted in Table B.2: Response – Functionality.

Table B.2: Response - Functionality

Criteria	Responses
Excellent	6
Good	15
Satisfied	4
Poor	9
Total	25

3. Load time - the responses related to loading time are depicted in table B.3: Response – Load time.

Table B.3: Response – Load time

Criteria	Responses
Excellent	5
Good	12
Satisfied	7
Poor	1
Total	25

4. Overall rating - the responses related to Overall rating is depicted in table B.4: Response – Overall rating.

Table B.4: Response - Overall rating

Criteria	Responses
Excellent	5
Good	15
Satisfied	4
Poor	1
Total	25