Automobile Workshop Management System for Roshan Motors

G.M.T.M. Bandara

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Automobile Workshop Management System for Roshan Motors

A thesis submitted for the Degree of Master of Information Technology

G.M.T.M. Bandara

University of Colombo School of Computing

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Supervisor Name: Prof. M G N A S Fernando

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Abstract

The Automobile Workshop Management System was developed to streamline the business processes of Roshan Motors, a well-established automobile workshop, and address the inefficiencies caused by its manual processes. The system aims to enhance operational efficiency and improve overall workflow management. It incorporates three core modules: Employee Management, Client Management, and Job Management, which cover the key aspects of the workshop's day-to-day operations.

Managing employees with their groups, grades and work schedules, managing clients and the vehicles and job handling with the job creation, assignment and performance along with appointment handling are some of the key features of the system. The dashboard has been introduced for every user level to make the system more user-friendliness. Security, performance and reliability had to be considered in the implementation stage and serve as a web-based system with real-time performance to achieve higher user satisfaction. Different levels of testing were carried out to verify the accuracy of the system process handling once the development was completed. At last, user training and evaluation were performed and the highest level of satisfaction was achieved for the system.

Acknowledgment

No one walks alone on the journey of life. Where I started to thank those who joined me, walked beside me, and helped me along the way continuously urging me to succeed in this project as a student at the University of Colombo School of Computing (UCSC). The effort I put into the project would not have been possible without many individuals and organizations' kind support and help. I would like to express my gratitude and appreciation to all those who gave me the possibility to complete this project.

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Table of Contents

List of Figures

List of Tables

List of Abbreviations

AWMS - Automobile Workshop Management System

SDLC - Software Development Life Cycle

PWA - Progressive Web Application

OOA - Object-Oriented Analysis

OOD - Object-Oriented Design

UML - Unified Modeling Language

IDE - Integrated Development Environment

Chapter 1. Introduction

Roshan Motors is one of the best Automobile paint solution workshops in ragama area. And it is highly specialized in Auto tinkering, Auto Painting, and Exterior Detailing for a wide variety of vehicles. Currently, there are about 40 employees are working in different areas relates to automobile repairs, services, and maintenance and owns four inspection slots that used to inspect and short-term repairs or parts replacement and another four slots for vehicle services. Furthermore, there are five more slots available for long-term repairs and paintings as well.

1.1. Motivation

Although in 1990, its operations were started with just five employees with the limited services offered to the customers. And it retains providing the best and quality services all the time was cause to get the high demand and the huge client base around them.
The workshop is growing day by day by fulfilling the service demands and the client's satisfaction and it led to an expansion of its services to provide even better solutions for its clients.

Services relates to the areas of vehicle troubleshooting and repairing, Part replacement, Air conditioning, and Annual services made a one-stop workshop for all the vehicle owners to fulfil their needs and it opens for 35 more people to start their careers with it as well.

Since the workshop handles all of the vehicle-related services, they are facing some problems due to maintaining and providing quality and uninterrupted services to the client as well as the expansion of the workshop. And also, following some manual processes to handle the operations and using some paper works to maintain records of the operations in the workshop affected the progress of the workshop as well.

Therefore, the following problems have been raised due to the situations mentioned above.

- It is very difficult to maintain inventory details since it is a manual process that updates on Excel sheets by a clerk. Duplicate/missing inventory items and inaccurate item details can be occurred because of the current manual process.
- There is no proper tracking process for items and services, therefore it is difficult to find all the related records of an item or service, and takes considerable time as well.

- There is a high probability to lose all the data related to the workshop due to the hardware malfunction of the computer that is used to store files or being damaging hardcopies.
- There are a huge number of telephone calls from clients regarding repairs and other services offered by the workshop. Therefore, the existing staff in the workshop is not enough to provide better service to the client.
- There are no techniques for interacting with existing clients and informing new clients about the services provided and introducing by the workshop.
- Without having proper management for the slots in the workshop, will make a long queue among clients, and waiting for services will lead the client dissatisfaction as well.
- No proper utilization technique for employees against the appropriate tasks. Therefore, it is difficult to manage the specific task duration.
- It is very difficult to manage proper vehicle repair history since it is a manual process and hard to track vehicle repairs performed by the workshop, therefore employees can't get a quick idea about the issues that vehicle has, and solutions that have to provide as well.
- There is no technique to check the current status of the repair or service of the vehicle without calling the workshop.
- Preparing an accurate report is a difficult task since the data accuracy is low and takes some considerable time and the minimum number of reports available there.

In order to address the above problems, the management has decided to go for a computerized system to reduce the manual processes and streamline the workflow of the workshop. Based on the problems that occurred while ongoing processes in the workshop and considering the new requirements, its hopes to develop an Automobile Workshop Management System.

1.2. Aims and Objectives

Developing an Automobile Workshop Management System for the workshop is the best solution to handle all the problems mentioned above more efficiently as well as more effectively, and it provides more functionality to the internal staff and the clients to do their business-related operations easily and enhance the capabilities of them.

The main objectives of the proposed system can be listed as follows,

- Provide facility to a low-cost, risk-free, centralized cloud-based data store to store data and files of the workshop.
- Reduce telephone calls and the workload of the staff by automating the user queries and the process.
- Enhance the customer relationship management processes and keep them updated about their vehicles and services.
- Introduce self reservation (time/slot) process for clients to service, inspect or repair their vehicles more conveniently.
- Improve the job assignments with the most suitable employees to handle the jobs more smoothly.
- Automate the payroll process (based on attendance and overtime relying on employee work schedules)
- Provide status of the service and provide estimates for replacements if needed.
- Retaining and expanding the client base by introducing Loyalty programs.
- Enhance the company decision-making process by generating highly reliable different types of reports.

1.3. Background Study

The Automobile Workshop Management System will develop by a client requirement and based on the several kinds of inter-related processes in the workshop currently running on. The client's requirement analysis and inspection of the processes in real-time are the main streams to get a better idea about the workshop and its workflow.

And based on the background studies of the other leading automobile workshops management systems, there are some features comparison of the client perspectives with the proposed system and other workshop management systems are mentioned below,

Table 1.1: Features Comparison and Contrast with Similar Systems

Features \ Workshop Management Systems	GaragePlug	Sayaaraa	TechMan	Garage Master	RAMP	Automobile Workshop Management System (Proposed System)	References
Employee Management	✓	✓	✓	✓		✓	(GaragePlug 2021), (Sayaaraa 2021), (TechMan 2021), (Mojoomla 2021)
Job Management	✓	✓	✓	✓	✓	✓	(GaragePlug 2021), (Sayaaraa 2021), (TechMan 2021), (Mojoomla 2021), (RAMP 2016)
Client Management	✓	✓	✓	✓	✓	✓	(GaragePlug 2021), (Sayaaraa 2021), (TechMan 2021), (Mojoomla 2021), (RAMP 2016)
Workflow Management	✓			✓		✓	(GaragePlug 2021), (Mojoomla 2021)
Inventory Management	✓	✓	✓	✓	✓		(GaragePlug 2021), (Sayaaraa 2021), (TechMan 2021), (Mojoomla 2021), (RAMP 2016)
Vendor Management	✓		✓	✓	✓		(GaragePlug 2021), (TechMan 2021), (Mojoomla 2021), (RAMP 2016)
Appointment Handling	✓	✓	✓	✓	✓	✓	(GaragePlug 2021), (Sayaaraa 2021), (TechMan 2021), (Mojoomla 2021), (RAMP 2016)
Service Reminder	✓	✓	✓			✓	(GaragePlug 2021), (Sayaaraa 2021), (TechMan 2021)
Live Service Updates	✓					✓	(GaragePlug 2021)
Digital Service Book				✓		✓	(Mojoomla 2021)
Loyalty Program	✓				✓	✓	(GaragePlug 2021), (RAMP 2016)
Manage Company Courtesy Vehicles			✓				(TechMan 2021)
Vehicle Sales			✓	✓			(TechMan 2021), (Mojoomla 2021)
Reports & Analytic Dashboard	✓	✓	✓	✓	✓	✓	(GaragePlug 2021), (Sayaaraa 2021), (TechMan 2021), (Mojoomla 2021), (RAMP 2016)

1.4. Scope

The proposed Automobile Workshop Management System will consist of four modules.

1. Employee Management
2. Job Management
3. Client Management
4. Reports

Employee Management

The main purpose of the module is to handle employee data and employee-based activities more conveniently.

- Manage employee's personal and employment data
- Manage employee's work schedules
- Handle attendances, absences, and overtime calculation process.
- Perform basic payroll process based on attendance and overtime relying on work schedules
- Manage employee Groups, Grades, and Roles
- Perform employee image upload operation
- Job assignment operation
- Employee tracking operation

Job Management

In this module, the main target will be a proper tracking process of client services and repairs called as jobs in real-time.

- Vehicle and client registration
- Job creation and manage
- Slot Management
- Perform job image (before, after) upload operation
- Employee assignment operation
- Payment handling

- Job tracking operation
- Service invoice generation

Client Management

This module will allow to create client accounts and will take care of all operations relates to the client's vehicles instantly. And allow internal staff to handle client-based operations as well.

- Create and manage client accounts
- Maintain annual services and repair history
- Annual service tracking and reminder
- Slot reservation
- Inquiries and appointments handling
- Perform Loyalty program

Reports

This module will generate all the reports that cover the data and operations related to the workshop to help for future management.

- Employee-related report generation
- Job-related report generation
- Client-related report generation

1.5. Dissertation Outline

The dissertation consists of six main chapters, and the Introduction chapter is chapter 1, which describes the company background, problems, aim and objectives, and the scope of the project.

Chapter 2 describes the background of the study along with the company-related processes and procedures, and an analysis of the requirements in both functional and non-functional are addressed here. Also, it includes reviews of similar existing systems and defined how they going to be useful to the proposed system.

Chapter 3 is the Design chapter that describes the architectural and detailed designs along with the comprehensive design model with appropriate design information, and also user interface designs are considered in this chapter.

The implementation chapter is the 4th chapter that describes the implementation of the system along with the explanation of all major codes and module structures and hardware and software requirements as well.

Chapter 5 is the Testing and Evaluation chapter, which describes the processes related to the testing and evaluation phases performed on the system and how the objectives of the system are satisfied by these processes.
The Discussion chapter is the final chapter that summarizes the problems identified by early stages, how they are achieved as defined as objectives, and identifies future improvements as well.

Chapter 2. Background

The Background chapter is mainly involving to present the background information about the workshop and the current status of the company processes and procedures used within the scope, and also provides the results of reviewing the similar systems by obtaining the similarities and the dissimilarities among the systems and it will guide to the better requirement analysis and better solutions for the problems that already exist in the workshop.

2.1. Current Process

Currently, Roshan Motors is handling all their services, repairs, and other operations related to the workshop manually. There is no computerized or systematic way to handle all the processes and procedures of the workshop, so the management has to maintain all the records by keeping the record books and excel sheets as well. All the detailed records of every service and repairs they have done, vehicle and client profiles maintained by them, employees working in the workshop, and other main information are very crucial to maintain and can have more possibility to get the data inconsistency when using the manual way. Moreover, there should be more effort and time to manage these processes as well.

And expanding the workshop by providing more operations and opening more job opportunities will make the company step up and make it no longer possible to manage all the stuff manually.

2.2. Analysis

After identifying the current processes and procedures of the workshop, the next main step is to perform a requirement analysis for a proposed system. In order to do that, it is required to perform requirement gathering from the end-users by using several Fact-Finding Techniques, identifying problems in the current processes, and providing the best-suited solutions through the proposed system.

2.2.1. Requirement Gathering

Requirements are the most essential part of a software project, so, they are the basement for any kind of project. According to the SDLC (Software Development Life Cycle), Requirement Gathering is the initial stage of the project workflow, which is the process of collecting all necessary requirements that satisfy the end-users. Requirements may base on the issues that already exist and modifications which fulfil the process improvements as well. Inconsistent requirements may cause to make problematic situations and has to pay additional development cost to make it consistent as well. So, this phase should have more attention in order to succeed the project and satisfy the end-users as well. There are several fact-finding techniques were used to get requirements for the software projects including examining documentation, interviewing, observation, research, and questionnaires.

2.2.1.1. Fact-Finding Techniques

Fact-finding techniques are widely used to get the requirements for software projects nowadays. It is a very effective and useful way to sort out consistent and reliable information from users and other sources.

There are several fact-finding techniques were used to get informed about the current processes and procedures that they are following and the requirements that they are going to seek through the proposed system from end-users.

As a result, several meetings were held on with the owner of the workshop, and some employees who handle the specific type of tasks in the workshop. In those meetings, an overall idea about the main processes and how they are interrelated with each process and the problems in some processes were identified. In addition, the suggestions expected to be available in the proposed system were discussed as well. Several rounds of meetings had to be taken to get the consistent requirements since some requirements conflicted with another.

Observation and reviewing the documents are other major requirement-gathering techniques that were used to get more details about the current process and procedures to learn and identify their drawbacks of them. So, it was more helpful to be clarified the requirements taken by the meetings and identified the flow of tasks performed in the workshop more practically. Reviewing the documents, such as manually maintained excel sheets, record books, client details, and records of services and repairs could be more helpful to investigate the historical data and take necessary requirements through the documents as well.

2.2.1.2. Problems and Proposed Solutions

After performing the requirement gathering process for the proposed system successfully, issues in the existing system were found and solutions for that issues were proposed to eliminate the drawbacks of the system.

Table 1 illustrate the identified problems and the proposed solutions for each problem.

Table 2.1 – Identified problems and the proposed solutions

Identified problem	Proposed solution
Duplicate or missing entries and inaccurate entry details are available	Each entry should have a unique ID and validate each data according to the data condition.
No proper procedure for services and repairs	Implement a step-by-step common procedure for handling services and repairs
No proper tracking process for services and repairs for the management and the clients	The system should be able to view all the related information of services and repairs in one place
There is a high probability of chance to lose the manually maintained documents due to hardware malfunction and being damaging hardcopies	Provide low-cost, risk-free centralized cloud-based data store to store data and files of the workshop
The huge number of telephone calls have to handle during working hours to manage client's inquiries	Reduce the telephone calls by providing a mechanism through the system to handle inquiries and set appointments from the client's accounts
No proper way to inform the special notices for the existing clients	Allow clients to create and manage their online accounts and let them inform special notices through the online account
Without proper management of the slots, balanced job allocation for each slot is not performed well. Due to that reason, some slots have long queues to get the service.	Introduce real-time status for all the slots in the workshop and let the supervisor assign and manage jobs to the appropriate slots accordingly
Difficult to manage vehicle repair and service history and hard to find related information since it is a manual process.	Storing all the details of services and repairs performed in the workshop and provide a way to find and filter out the specific details easily
There is no technique to check the current status of the repair and services of the vehicles without calling the workshop	Provide clients to check the progress of their vehicle maintenance through the client accounts.

Preparing reports is a difficult task Since the data accuracy is low and takes considerable time to perform. And the minimum number of reports are available and a new type of report generation is impossible due to the lack of data availability.	Collect all the data related to every aspect of the entries used in the workshop that is suitable for generating the various type of reports and provide more report types to help the management of the workshop
Couldn't identify the most valuable customers and provide them some special benefits for their services and repairs due to the lack of proper information handling	Introduce the client loyalty program through the system to handle and provide some special benefits for them and enhance the customer relationship

2.2.2. Requirement Analysis

Requirement analysis is the next step after performing the requirement gathering and it is a process of studying and identifying users' needs, clarifying and avoiding conflicts, and helping to find out the best solutions that satisfy the user expectation.

Mainly the system requirements can be divided into two groups, they are, Functional requirements and non-functional requirements. And identified functional and non-functional requirements for the Automobile Workshop Management system are listed as follows,

2.2.2.1. Functional Requirements

The key functional requirements gathered and identified from the requirement-gathering phase can be summarized as follows,

Employee Management

Admin should be able to add new employees with personal and employment details. In order to do that, the admin can able to create and manage employee groups and grades according to the workshop hierarchy and assign all the employees to the relevant groups and grades to handle jobs accordingly. Work schedule creation and management should be available to help to process the payroll-based processes, such as, attendance, leave, and overtime calculation, to handle employee salary allocation and paysheet generation. Role management should be available to assign functionalities to specific employees and provide supervisor-level accounts to handle the supervisor-level activities. Assign jobs, worksheets, and Employee statistics should be available to assign them to specific jobs and get the real-time information related to the currently processing jobs and historical information which the employee contributed, and the performance of each employee has to be visible to get an idea to the management.

Client Management

The client management module is able to add and manage clients and should be able to assign their vehicles. In order to do that, a vehicle list has to be maintained in the system including every detail relates to the vehicles, and able to set default service data by mileage and by duration to remind the clients about their future services. The logo of the vehicle manufacturer and model images have to be uploaded to preview their vehicles in the client accounts. Client account creation and management will allow the admin to create client accounts for the clients who have difficulties to create them. Set appointments from the workshop, able to create appointments to reference the future jobs, and has to capability to handle client's repair and service appointments as well. Job card creation through the appointment should be available and keeping all the records regarding the jobs is important. User inquiries handled by the admin and maintaining the loyalty program should be available under this module.

Job Management

Under this module, the admin or authorized supervisor level account should be able to create job cards for the jobs that have to be completed by the workshop by stating every detail relates to the tasks that have to be performed, vehicles and clients details to track all the related records through the system. Job assignment should available to assign a slot for the job and the supervisor to continue the job. The selected supervisor should be able to select relevant employees based on the skills or department they are assigned to perform operations smoothly. Task list modification and job card updation can be done under this module, and the availability of the real-time job card status viewer is important to get the current process of the job. The job card status modifier should be available in this section to update the job card status and image upload and file upload for the specific jobs. Slot management has to perform under this module, and Adding and Managing slots for the workshop should able to do in here. Sales Invoice generation and manage them have to be available to perform for the specific vehicle and specific jobs.

Report Generation

It is able to create various reports based on the above-mentioned three main modules and should be able to get reliable and consistent statistics regarding the operations and the assets in the workshop, to the management to forecast the progress of the workshop.

There should be able to manage three main account types with the specified functionalities.

Administrator

Admin should be able to carry out all the functionalities provided by the system to perform the day-to-day tasks in the workshop without restrictions. And have to create other administrative or supervisor level roles and attached them to the specified accounts to manage their employees and jobs accordingly. Accessibility will manage through the roles attached to the accounts and the admin can able to decide which accessibility provides for the roles.

Supervisor

Supervisor accounts are the second-level user account, that allows to manage jobs assigned to that account and can be able to handle specific employees or employee groups to perform relevant tasks. Requests which are related to the jobs or employees managed by the account should be able to generate through the system and inform to the super levels about the request.

Client

Clients can create their own online accounts through the workshop website and manage all their vehicles in one account. And it should allow for setting service or repair appointments and must visible estimated factors such as time and cost based on the requirement. Historical records relating to the service and repairs performed by the workshop should be accessed with some statistics to get an idea about the operations performed by the workshop as well. Reminders for upcoming services, insurance and revenue licence expirations should available to inform the clients in order to keep all the documents up to date. All the value-added services offered by the workshop should visible through the client account and be able to include them into future services.

2.2.2.2. Non-Functional Requirements

Unlike the functional requirements, Non-functional requirements are mainly concerned with the system attributes such as Usability, Reliability, security, etc. Following non-functional requirements were captured and concerned as highly obtainable from the Automobile Workshop Management System.

Reliability

Reliability describes the ability of the system or a component that can perform defined functionalities under specified conditions for a specific period. Availability of the system and failure rate of the system are mostly concerning things under this requirement, so the Automobile Workshop Management system should make the system more reliable by providing high availability and a fast recovery time when the failure occurs.

Usability

Usability defines the level of ease with which the users can achieve their goals through the system. And it is an essential non-functional requirement that has to be concerned more seriously and it can be achieved in several ways. Mainly, providing a user-friendly interface to perform tasks in the AWM System will increase the efficiency of the user and provide a proper flow of activities will affect the users to memorize the process and procedures used in the workshop as well. And it will help to get it back when the users are away from the system for a long time. System-generated messages should be clearly identifiable and understandable to get knowledge about, what the user has done with the system.

Security

Security ensures the system is protected from unauthorized access and the safety of the data that is used by the system as well. AWM System should have secure logins by getting Username and Passwords or using Google account logins to establish user sessions with different user roles. And AWM system should use cloud-based data storage to prevent accidental data losses happening by the physical devices as well.

Performance

Performance measures the system by evaluating the number of tasks done by the system in pre-defined time duration and the quality as well. The low performance will lead the user dissatisfaction and a negative user experience with the system. So the AWM System should have the capability of doing the system tasks efficiently and effectively and should use fast processing techniques in order to reduce the processing time for the tasks in the system.

Maintainability

Maintainability is a major non-functional requirement that has to be considered a high-priority requirement. It defines, how the system is capable to repaired or enhanced at any time without taking much effort. So AWM system should have to be maintainable to enhance the existing functionalities and meet the new requirements as well.

2.2. Review of Similar Systems

Many applications have been developed for support to manage automobile workshops and they help management to perform various operations through the application as well. When comparing these applications, they all have some similarities and dissimilarities each other and have to take some comprehensive consideration among them to identify the ideas behind the applications and their ultimate goal of them.

This section will provide a comprehensive review along with the latest details about the applications and how they achieve the goals to satisfy the user requirements.

2.2.1. GaragePlug

GaragePlug is a cloud platform for the Automotive service industry that allows it to perform various business operations efficiently and effectively. And it was founded in 2017 by Automobile Industry Veterans and now, it has more than 5000 users around the world. [1]

It is an All-in-one service software that facilitates the users to perform business operations by providing various features. Digital Inspections, Job cards, invoices and CRM, Workflow Management, Calendar, Scheduling, Track and Manage Technicians are some of the main features provided to the users.

Integrated communication tools, Automated follow-ups, and Reminders will make better communication with customers and provide Comprehensive reporting, Business Management Dashboard, and Remort Business Monitoring will help the management to get an idea about the current situation of the business and forecast the future works as well.

2.2.2. Sayaaraa

Sayaaraa is a fully automated Garage Management system (GMS) that facilitates garage management with CMS. It is a cloud-based mobile and responsive web application that allow users to control the entire automobile workshop through the system and manage the workshop website as well.

Quick Job Card, Book Service Appointment, Inventory Management, E-Invoicing, Service Reminder, and Reporting & Analytics are some of the main features that allow users to perform through the application.

The application is built by a group of automobile domain experts and it's fully customizable. For this reason, users can manage the way they are managing the workshop without controlling the processes that they are already familiar with. Quick setup, Simple and easy to use, full features support on all devices, and multi-user support are other reasons that many users decide to use to manage their workshops by using this application. And it provides system updates without taking any cost, so the users can experience the latest and updated features as well. [2]

2.2.3. TechMan

TechMan is a Garage Management System that provides perfect solutions for the operations of garages and workshops, efficiently and effectively. It's developed by UK based company with developers that have knowledge about specific areas of garage management and it provides simple, easy-to-use, and feature-rich garage management processes to the end-users to help manage their garage and workshops more conveniently.

It consists of several modules that cover all the areas that have to be managed within the workshop. Employee, Job, Client, Inventory, and Vendor management are the main modules offered by the system to handle all the aspects of the workshop through the application. Managing company courtesy vehicles and conducting Vehicle sales are added features that couldn't usually be seen on any other garage management systems as well. Providing more comprehensive reports and an Analytic dashboard will provide users to get an idea about the current status of the workflows of the workshop and take relevant actions to make the processes more efficient and effective and make the business more profitable as well. [3]

2.2.4. GarageMaster

GarageMaster is another popular Auto Service Management Software that allows users to handle their workshop or an auto service station more conveniently. By providing a step-by-step setup wizard, users can set up the application very easily, and providing user-friendly interfaces will make more customer attraction to the system. This also provides main modules to manage the workshop including Employee, Job, Client, Inventory, Vendor and in addition, Workflow management is also added to the system to handle the workflow of the workshop very easily. Clients of the workshop will receive access to their Digital Service Book, which allows them to track all the maintenance records of their vehicles on anytime, anywhere.

Part Sales Module, Compliance Module, Email templates, and Custom Fields Module are some

additional features that the system provides to the client to perform their task related to the workshop very easily and multiple language plugins are available to support different types of clients as well.[4]

2.2.5. RAMP

RAMP is a cloud-based automobile workshop management system that is fully automated and provides secure online and local data backups and provides complete data security to users. RAMP will provide many benefits to their clients to start or continue the operations on their automobile workshops with it. Unlimited users, Unlimited Stock items, Unlimited feature updates, Unlimited SMS alerts, and 700,000 per listed spare parts and services are some of the benefits that can experience for all their clients.

Along with the Job, Client, Inventory, and Vendor management modules, Booking Diary, CRM, and Coupons are some of the special features that users can utilize with their operations, and Disaster recovery will protect the operations data and back up the data to make the application consistent and reliable. And the remote access feature will provide the application mobility to the users as well. The loyalty program offers users to identify and treat the most valuable clients and keep them closer to the business. [5]

2.3. Comparison and Contrast with Similar Systems

According to the review of the above-mentioned similar systems can be summarized based on their features in following Table 2 – Comparison and Contrast with Similar Systems.

Table 2.2 – Features Comparison and Contrast with Similar Systems

Features \ Workshop Management Systems	GaragePlug	Sayaaraa	TechMan	Garage Master	RAMP	Automobile Workshop Management System (Proposed System)	References
Employee Management	✓	✓	✓	✓		✓	(GaragePlug 2021), (Sayaaraa 2021), (TechMan 2021), (Mojoomla 2021)
Job Management	✓	✓	✓	✓	✓	✓	(GaragePlug 2021), (Sayaaraa 2021), (TechMan 2021), (Mojoomla 2021), (RAMP 2016)
Client Management	✓	✓	✓	✓	✓	✓	(GaragePlug 2021), (Sayaaraa 2021), (TechMan 2021), (Mojoomla 2021), (RAMP 2016)
Workflow Management	✓			✓		✓	(GaragePlug 2021), (Mojoomla 2021)
Inventory Management	✓	✓	✓	✓	✓		(GaragePlug 2021), (Sayaaraa 2021), (TechMan 2021), (Mojoomla 2021), (RAMP 2016)
Vendor Management	✓		✓	✓	✓		(GaragePlug 2021), (TechMan 2021), (Mojoomla 2021), (RAMP 2016)
Appointment Handling	✓	✓	✓	✓	✓	✓	(GaragePlug 2021), (Sayaaraa 2021), (TechMan 2021), (Mojoomla 2021), (RAMP 2016)
Service Reminder	✓	✓	✓			✓	(GaragePlug 2021), (Sayaaraa 2021), (TechMan 2021)
Live Service Updates	✓					✓	(GaragePlug 2021)
Digital Service Book				✓		✓	(Mojoomla 2021)
Loyalty Program	✓				✓	✓	(GaragePlug 2021), (RAMP 2016)
Manage Company Courtesy Vehicles			✓				(TechMan 2021)
Vehicle Sales			✓	✓			(TechMan 2021), (Mojoomla 2021)
Reports & Analytic Dashboard	✓	✓	✓	✓	✓	✓	(GaragePlug 2021), (Sayaaraa 2021), (TechMan 2021), (Mojoomla 2021), (RAMP 2016)

Chapter 3. Design Architecture

3.1 Introduction

Software designing is a process of ideating and defining software solutions to address one or more identified problems to solve or satisfy the identified requirements and provide a smooth continuation of the business process and achieve its goals.

The Design Architecture chapter is mainly focusing on the software design including the architecture of the application, User Interfaces and database design.

The architecture of the application is the core part of the system and it defines the fundamental organization between components, how they are assembled and their relationship and communication between them.
User interfaces are used to represent the application to the users and make system-user interactions to enable users to control the system.
The Database design defines the data formats and structures used within the application and it focuses on how the data is stored and managed within the application to fulfil the desired processes.
The system design of the AWMS (Automobile Workshop Management System) will follow the iterative and incremental development methods which is the combination of the iterative design method with the incremental development. The concept behind this method is the smaller portion of the system development will allow to perform at a time with the involvement of the end-users and identify the improvements and set those to the next portion or the next version of the development. Through this method, the developer can identify the requirements of the users and can be able to refine those and deliver a system that the user's expectations fulfilled.

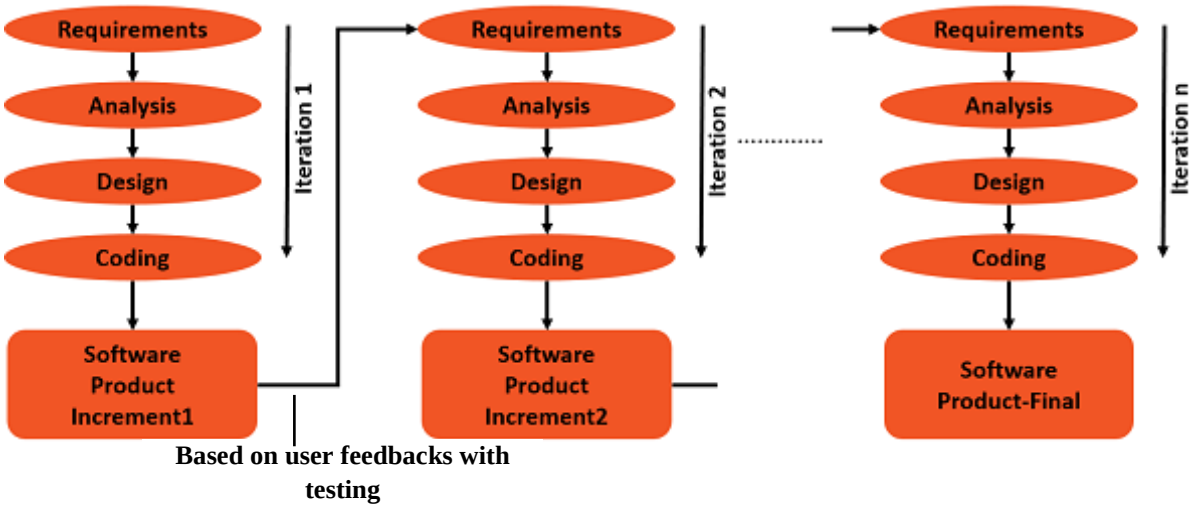

Figure 3.1: Iterative and Incremental Development Method

3.2 Related Design Strategies

3.2.1 Object-Oriented Analysis and Designing

Object-Oriented Analysis (OOA):

OOA is the process of understanding the problem domain and identifying the requirements with the object-oriented perspective and it provides a better software specification related to the system object models that represent the real-world objects.

The “object-oriented” is the main concept that differs from the other forms of analysis and the requirements identified by the analysis are organized around objects which includes both data and functions as well.

Object-Oriented Design (OOD):

OOD is an approach to implement the conceptual models generated by object-oriented analysis. It is a detailed description of how the system is going to be built on a specific technology. Implementing the data structures, algorithms, controls and associations are the main tasks of the OOD.

3.3 System Architecture

The Automobile Workshop Management System uses a client-server architecture and it is a web-based project with the PWA (Progressive Web App) feature enabled, that allows users to interact with the system as a web application or a mobile application as well.

Web Client (Front end)

The web client (front end) is the Graphical User Interface (GUI) provided by the system for the users to interact with the system. It is developed by VueJs and it is one of the latest frontend JavaScript frameworks to allow building user interfaces & single-page applications efficiently.

Backend Server

Firebase is the backend server of the application provided by Google. And it is a set of cloud computing services & application development platforms as well. And it is a one-stop for all backend services which is going to be used for the application with the advantages of manageability, scalability & trustworthiness.

Realtime Database, Cloud Storage, Authentication and Hosting will be used as the main services for the application from Firebase to develop the backend server in this study.

Realtime Database is a cloud-hosted NoSQL Database that allows to store and sync data between users in real-time.

Cloud Storage allows to store and access files such as images & documents quickly and easily.

Firebase Authentication is used to secure the application by providing comprehensive security using inbuilt Google authentication mechanisms and providing an end-to-end identity solution for the application as well.

Firebase Hosting allows to deploy the application without managing any infrastructure and it provides previews, deploy & rollback operations for the admin to manage deployments of the application.

Based on the actors defined in chapter 2, The high-level architecture is represented as follows,

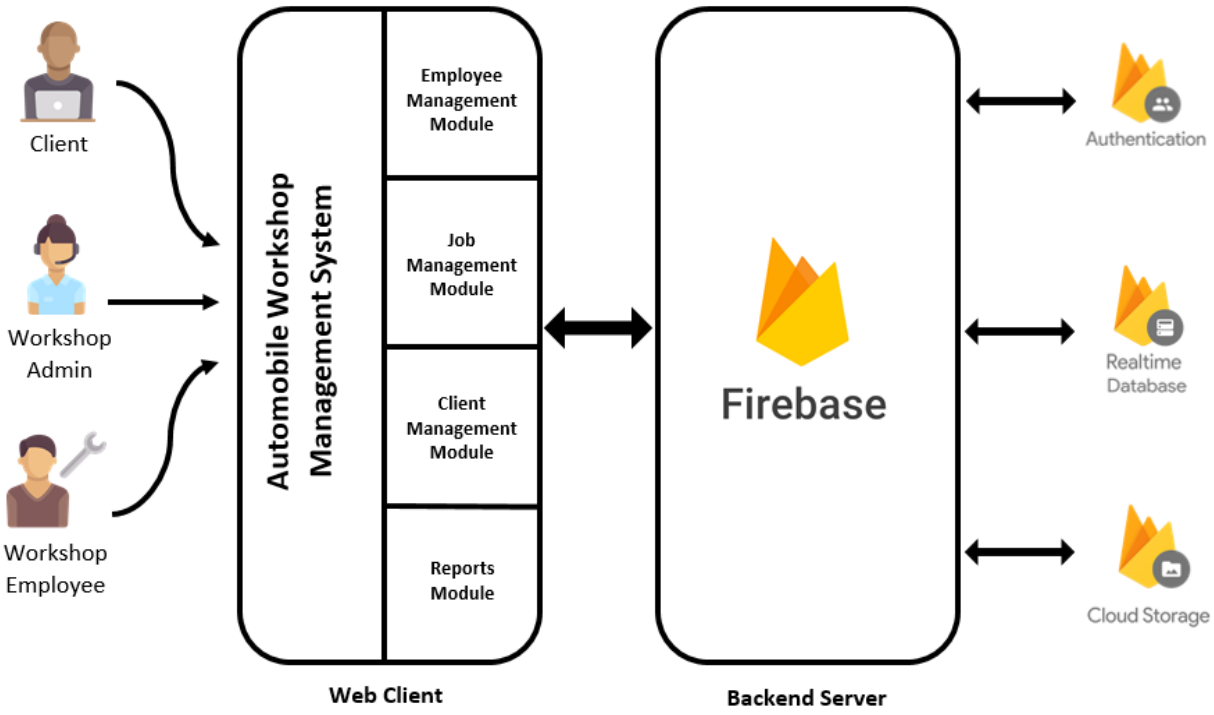

Figure 3.2: The high-level architecture of the system

3.4 System Design

The system design describes everything related to the system which the developers can understand the user requirements and uses to start to proceed the implementation of the system. System architecture, modules, components and their interfaces are the main aspects that have to be considered during this phase.

After a better understanding of the user requirements of the system, the processes were identified and designed the relevant workflows for the specific tasks and procedures to help the users to perform operations through the system.

The following figure describes the main workflow that the user is expected to perform by the system.

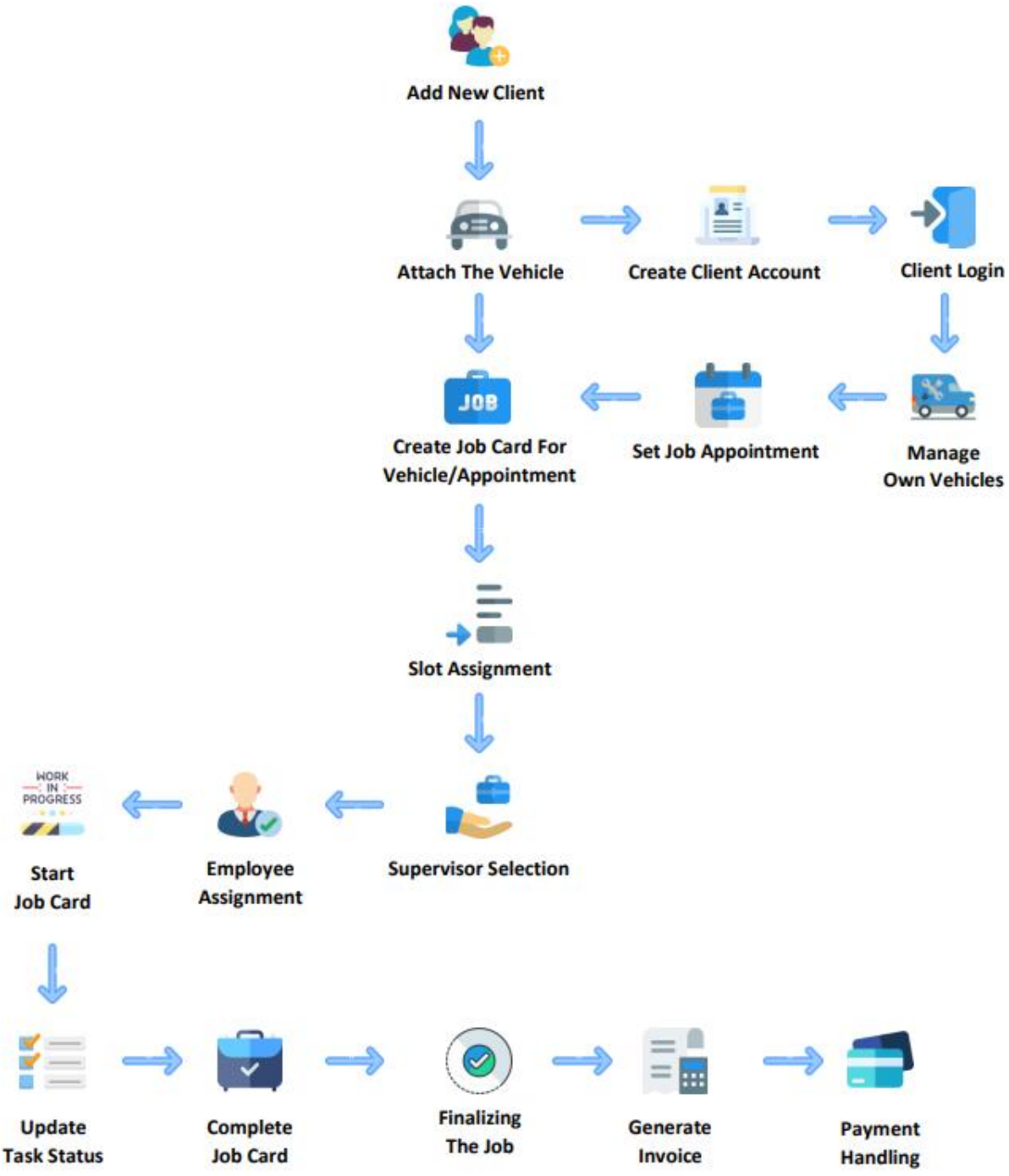

Figure 3.3: The high-level architecture of the system

3.4.1 UML Diagrams

The Unified Modeling Language (UML) is a visual modelling language and a modern approach used to visualize the design of the system in order to get a better understanding of the users, actions, process sequences, classes and many other aspects of the system.

3.4.1.1 Use Case Diagram

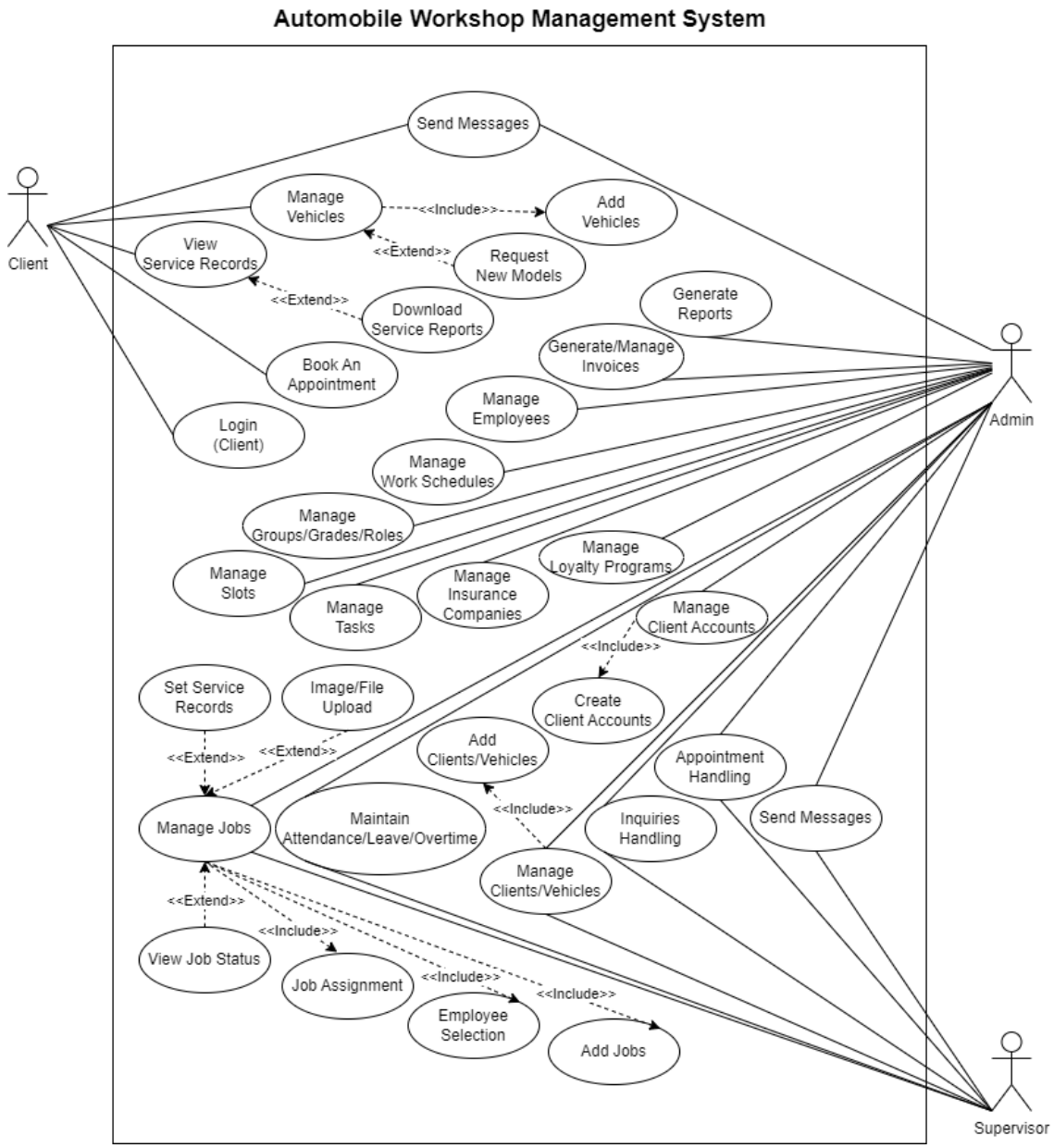

Figure 3.3: Use Case Diagram for the AWMS

The use case diagram provides an analysis of the higher-level requirements of the system using three main components.

Use case - visualize the functional requirement as a verb phrase describing the action

Actors - a person or a thing that can interact with the system

Relationship - Reside between the use case and the actor to visualize the actor-specific task.

The Use case diagram for the AWMS is as above and it summarises and visualizes the system's functionalities related to each user group.

3.4.1.2 Activity Diagrams

The activity diagram is one of the behavioural diagrams in the UML Diagram types and it describes how the specific activities are organized from the beginning point to the completion point step by step by specifying all the possible ways to happen when the activity is executed. The activity diagrams for the two major processes in the AWM system can be shown as follows. It shows all the activities included in the process of job card creation and the start of the job card with the employee assignment.

Job Card Creation (Perform by Supervisor/Admin)

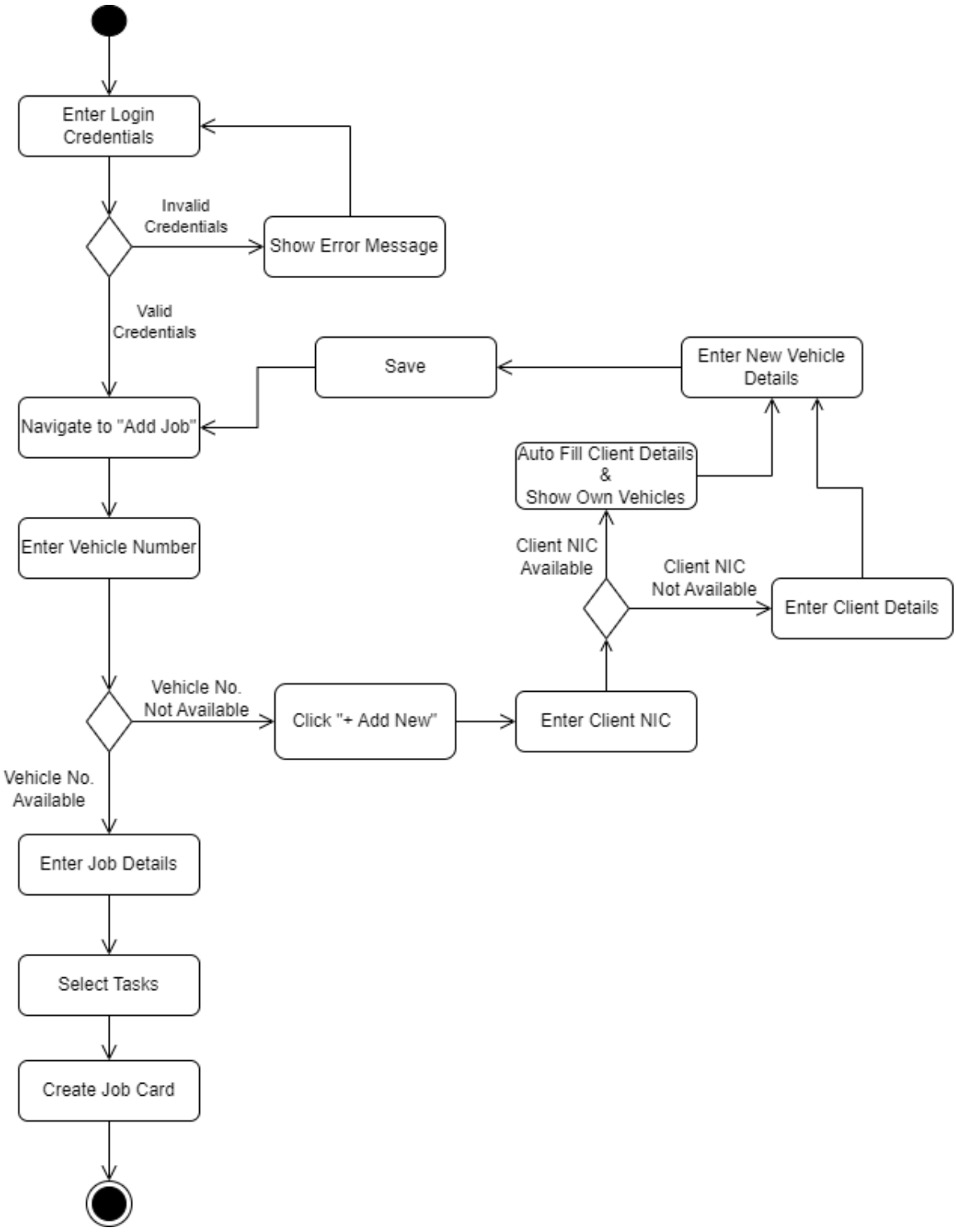

Figure 3.4: Activity Diagram for Job Card Creation in AWMS

Employee Assignment & Start the Job Card (Perform by Supervisor/Admin)

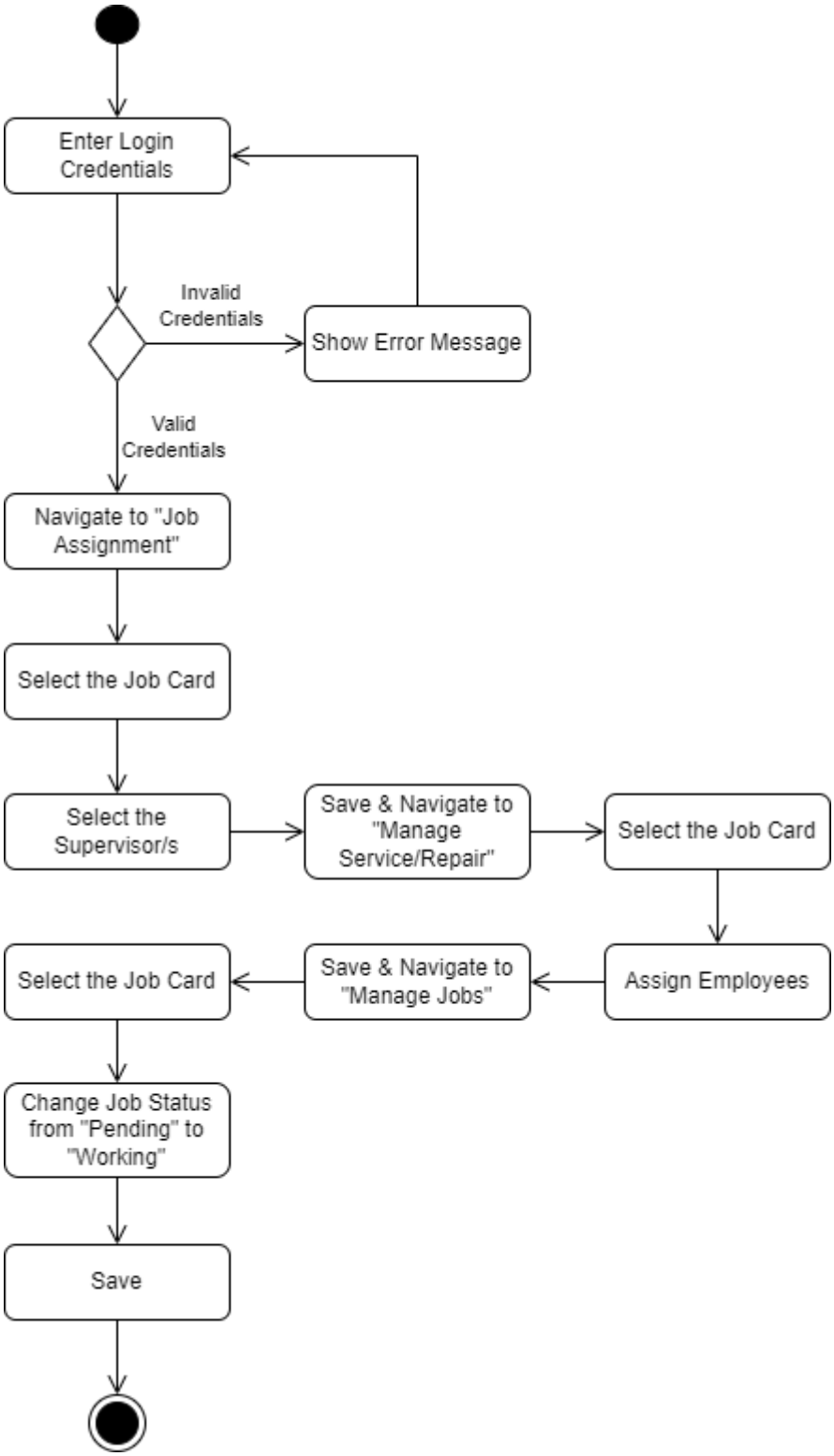

Figure 3.5: Activity Diagram for Employee Assignment & Start the Job Card in AWMS

3.4.1.3 Sequence Diagrams

The sequence diagram is an interaction diagram under behavioural diagrams in the UML Diagram types. It visualizes how the operations are carried out by capturing the interactions between objects that collaborate with the process. The sequence diagrams are time-focused and they show the message exchanges between objects within the process in a time manner.

The sequence diagrams for the two major processes in the AWM system can be shown as follows. It shows all the sequences included in the processes of employee assignment and job completion.

Supervisor Selection & Employee Assignment (Perform by Admin/Supervisor)

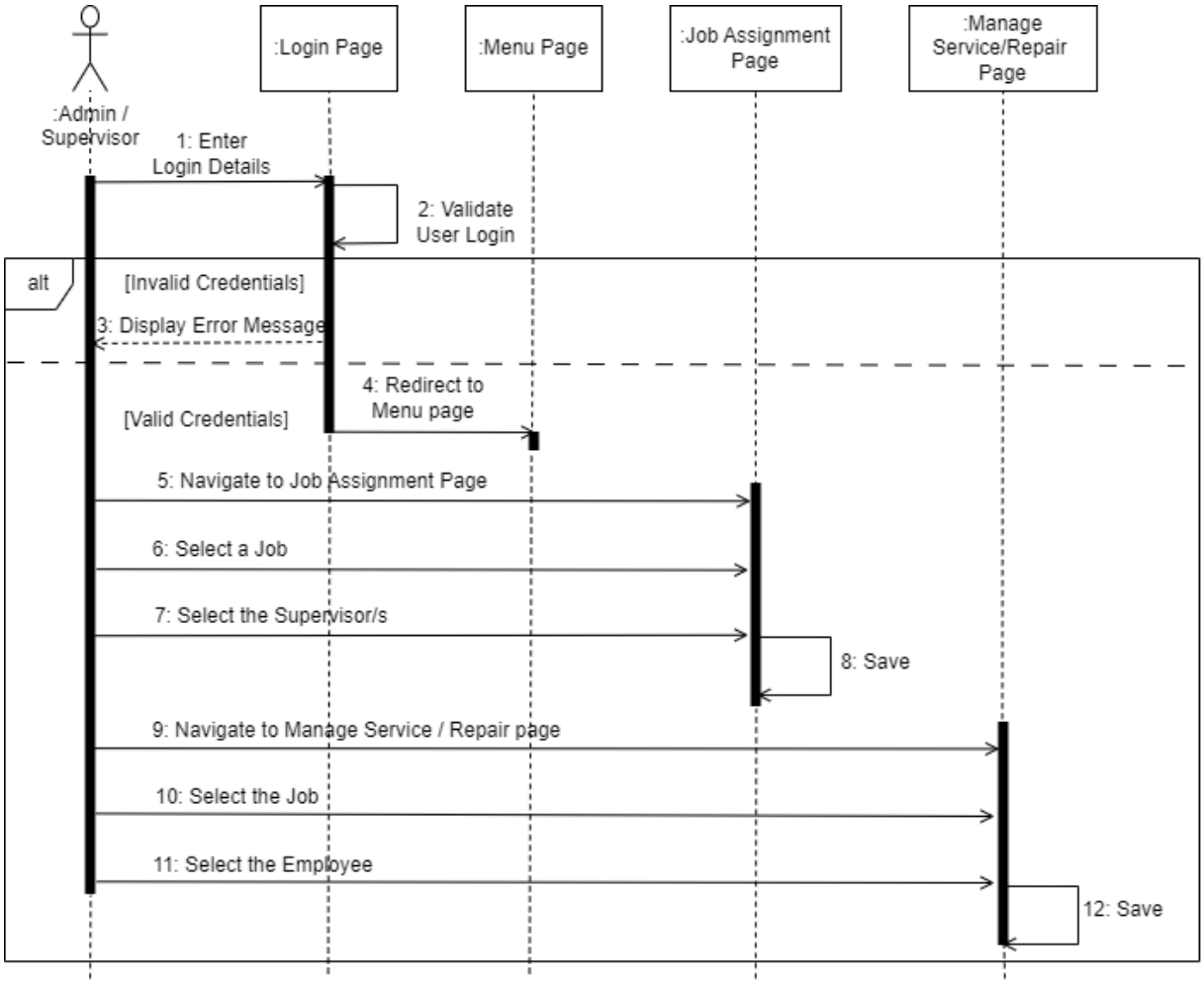

Figure 3.6: Sequence Diagram for Supervisor Selection & Employee Assignment in AWMS

Job Completion (Perform by Admin/Supervisor)

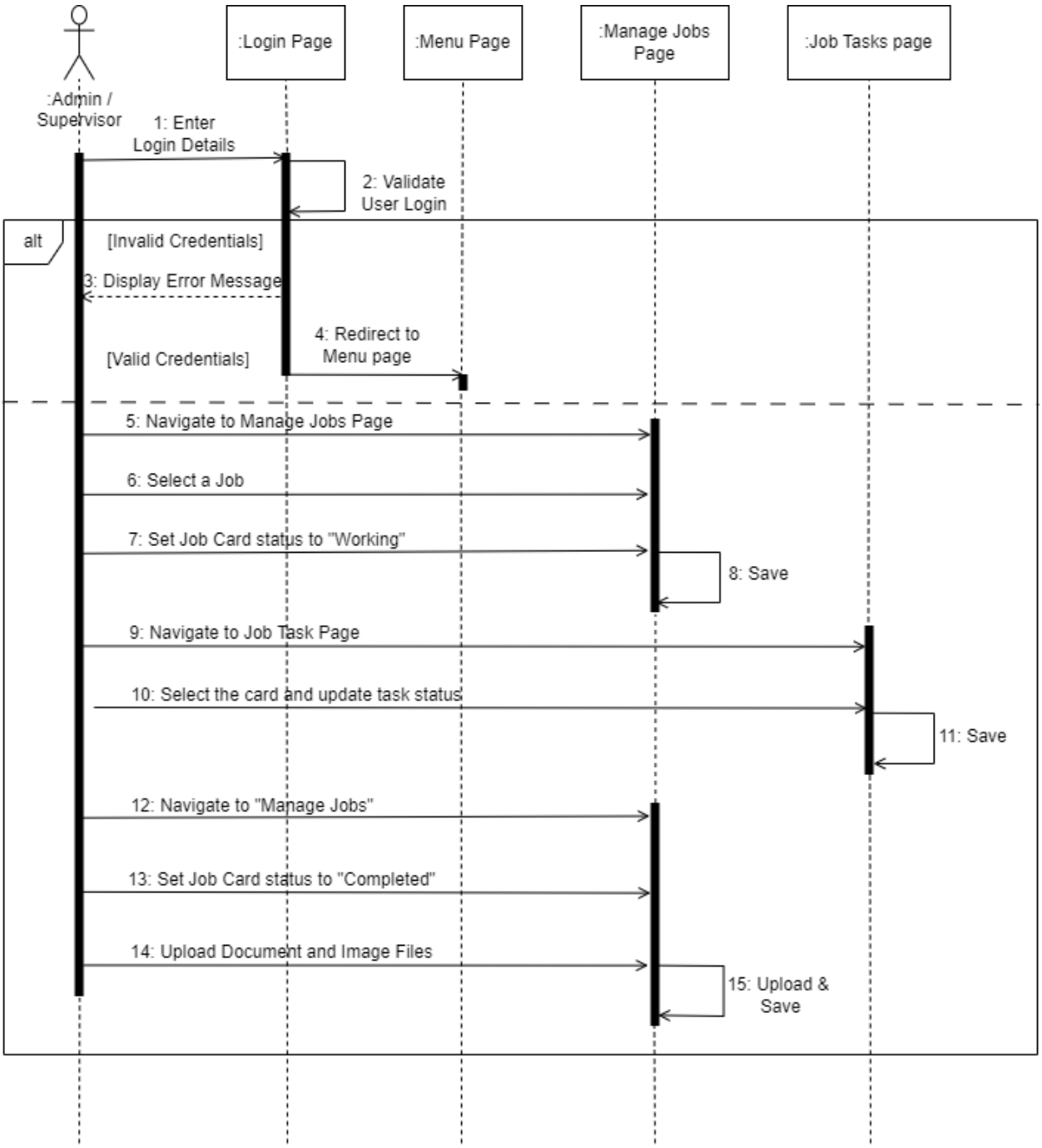

Figure 3.7: Job Completion in AWMS

3.5 Database Design

Database design is a process that mainly defines the organization of the data according to the data model. A proper database model provides better manageability of data and reduces the maintenance cost as well. As a result, data accuracy and the integrity of data will be high and the redundant data elimination will cause to increase the disc space as well. The accessibility of data can be provided in a useful and effective way to maximize the performance of the operations in the database as well.

Among the most popular database approaches, the NoSQL database approach has a significant place because of its structure of the data and the mechanism used for data storage. Mostly the NoSQL is referred to as a "non-relational" database and it doesn't have the concept of the Primary Key used in Relational Databases. It doesn't have any proper schema for data insertion to the database so, it will increase the database changes much faster than other approaches.

Nowadays, most applications rely on the NoSQL databases and it simplifies the development of the applications. The scalability of the application is higher than the relational databases and it is capable to processing a huge amount of data without having any performance issues. As a result, real-time applications are widely using this database approach to provide a better user experience to the users with the live interaction between the application and the user.

There are 4 types of NoSQL databases which differentiate from each other.

1. Document databases
2. Column-oriented databases
3. Graph databases
4. Key-value stores

Among these 4 types of NoSQL Databases, the Key-value store type NoSQL database is used in the AWM system and it is provided by Google as a backend service to the application. It is the simplest type of above mentioned 4 types of NoSQL databases and every element is stored as key and value pair.

Google Firebase is the backend server of the application and it provides a real-time database which is a cloud-hosted NoSQL database that allows to store and sync data in real-time. It provides a better management of data through its console and accessibility of the data is effortless.

As a client-specific application, the AWM system handles a huge amount of historical data about the Employees, Vehicles, Clients and their services. In the processes of application, most of this data will be used to generate specific outputs and being able to be available these

processed data with the specific conditions in real-time is the most beneficial thing that can be achieved by using this type of database.

The following Figure indicates the sample of the NoSQL database format (JSON formatted key-value store) of the AWM system.

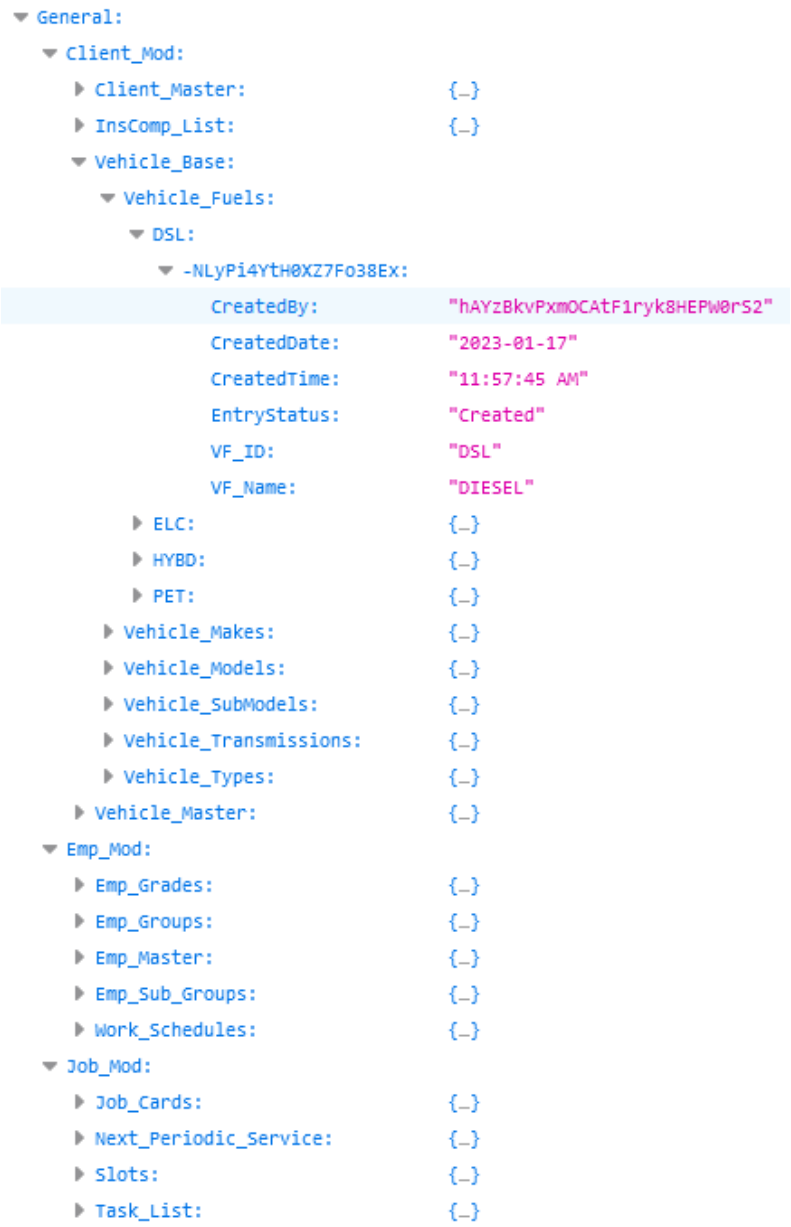

Figure 3.8: Sample of Firebase Real-Time NoSQL Database in AWMS

3.6 User Interface Design

User interfaces are used to connect and make the interaction between the users and the system. The user interface design is the most important phase during the development process where the gathered requirements are transformed into a visualized form to make a clear idea of the application that going to be developed for the product owners and have an abstract view of what the developers going to be developed as well.

Paper prototyping is one of the widely used user interface design techniques right now. Pen and paper are used in this technique and It is a process of paper representation of the digital application to make the concept of the application, and the demonstration of the navigations in the application. It allows us to make modifications very easily and more quickly is another advantage of this method as well.

The following Figures indicate some of the main user interfaces in the AWM system.

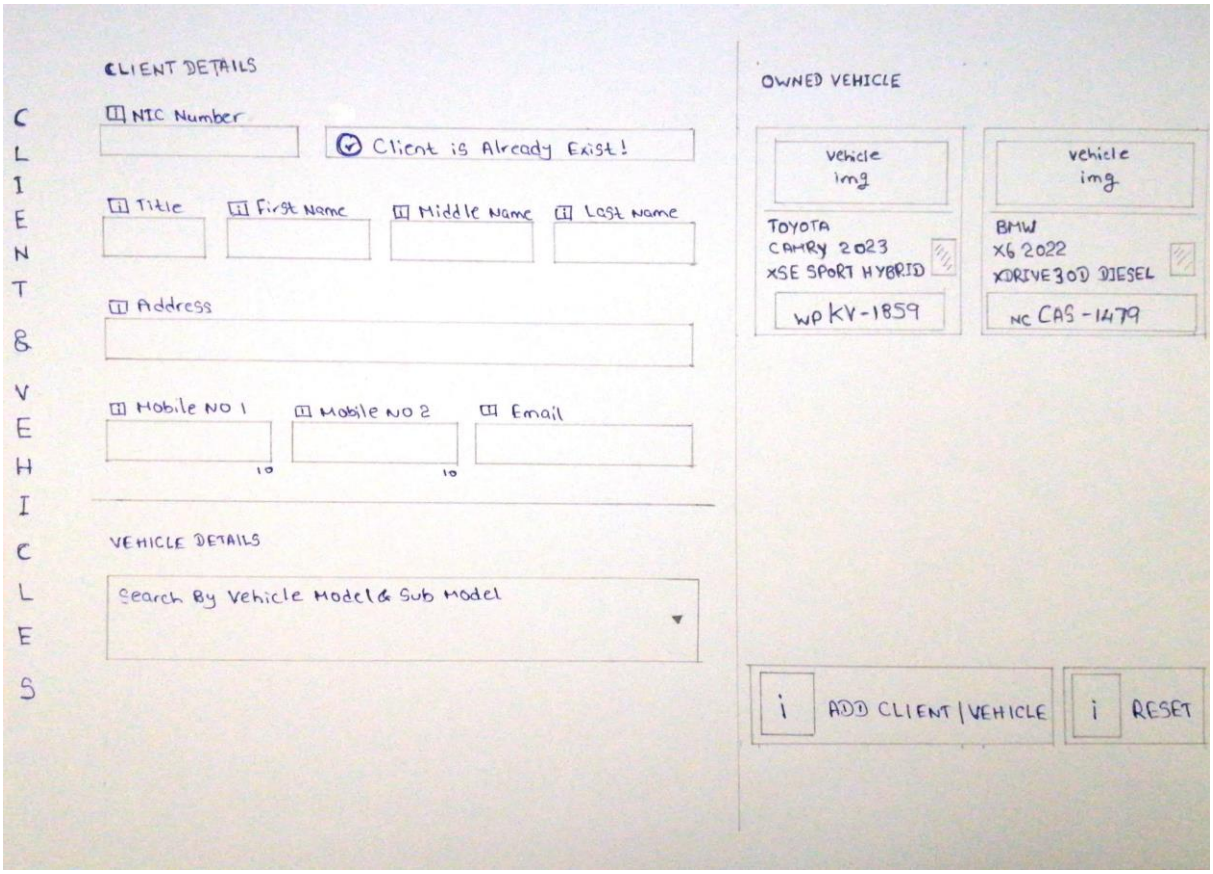

Figure 3.9: Client & Vehicle Creation Prototype

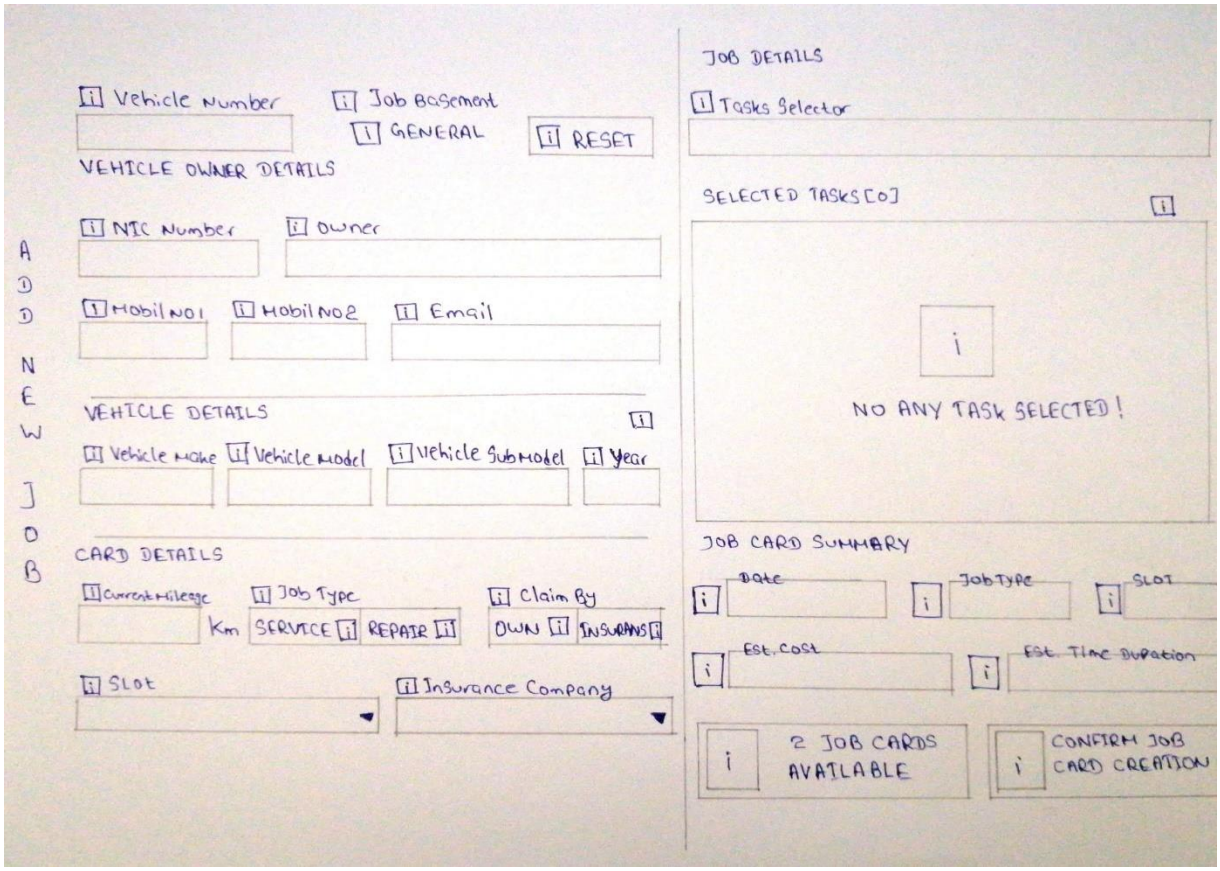

Figure 3.10: Job Card Creation Prototype

Chapter 4. Implementation

4.1 Introduction

As per the order of the stages in SDLC (Software Development Life Cycle), the Implementation stage has to be carried out after the successful completion of the design stage of the system. In this stage, everything that has been designed or planned in the design stage will carried out to achieve the ultimate goal of a fully functional executable system by using relevant tools and technologies.

As per the system architecture, there are three main modules which are interconnected with each to streamline the identified processes of the system. Before the development of the system, it has to be separated by functionality and isolate the modules as a unit for the development. The integration process has to be carried out once all the modules are developed and merged them back to act as a whole system.

Initially, it is mandatory to select the programming language that going to be used for the development of the system, and along with the programming language, all the implementation details including the implementation environment, tools that going to be used, techniques that going to be followed, the major code segments and some of the main user interfaces are mainly focused on this chapter.

4.2 Implementation Environment

The implementation environment consists of hardware and software specifications, and the system was developed under the following specifications mentioned below.

Hardware Specifications

- **Processor:** Intel(R) Core (TM) i7-4700MQ CPU @ 2.40GHz
- **Ram:** 12 GB
- **HDD:** 1 TB

Software Specifications

- **OS:** Microsoft Windows 8.1
- **Front-end Framework:** VueJs 2.6.11
- **UI Library:** Vuetify 2.4.0
- **Back-end Server:** Google Firebase
- **Code Editor:** Visual Studio Code

4.3 System Development Tools and Technologies

A brief introduction of the tools and the technologies used for the development of the system is as follows,

VueJs

VueJs is a JavaScript frontend framework used to build user interfaces more conveniently. It follows Model-view-viewmodel architecture and it allows to manage the clean separation between business logic and the user interfaces (UI) itself. It provides the facility to develop the Single Page Applications (SPA) and the Progressive Web Application (PWA) as well. VueJs uses a two-binding technique and it is easy to learn and can develop within a short time duration compared with the other frontend frameworks out there.

Vuetify

Vuetify is a user interface library that can be used to develop Vuejs applications. It has a collection of pre-design components that can be directly applied to the development of the application without having a deep knowledge of them.

Google Firebase

Firebase is a cloud-hosted computing service and application development platform that allows developers to develop mobile and web applications provided by Google. Realtime database, Authentication, Cloud storage, and Hosting are some of the main services it provides and numerous services for application development are available to use with some conditions as well.

Visual Studio Code

It is a source code editor developed by Microsoft. It is available for Windows, MacOS, and Linux platforms as well. It is not a fully featured IDE like a Visual Studio IDE but provides some more important features like debugging, auto code suggestions, and code refactoring for faster development.

4.4 User Interfaces

Following are some of the main user interfaces of the AWMS and they describe the functionalities and how the system interactions are made with them.

4.4.1 User Login

User Login is the first user interface that the user interacts with for the first time and it controls access to the system by checking the user credentials and redirecting to the appropriate user area by checking the user properties. The system allows users to Sign Up and Sign In by using their existing Gmail account credentials or can create new credentials with a valid email as well.

The following figure shows how the user login of the AWMS looks like,

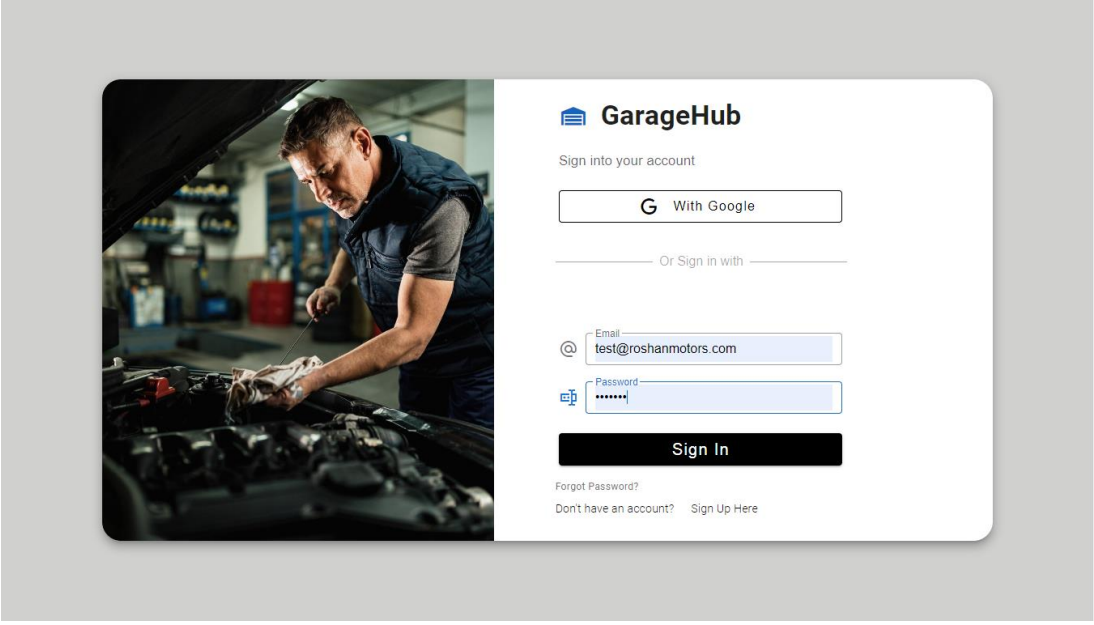

Figure 4.1: User Login Interface

4.4.2 Job Card Creation

Among the three main modules of the AWMS, the Job module takes the most significant place since it includes the core processes of the system. Creating a job card is the first step of the main process, and the system allows to create it to the System Admin or the Supervisor as a general job card with the selection of the service type or the client can be able to make a job reservation for the vehicle by placing an appointment through the client user login, and then it converted to the job card by the system admin or the supervisor end.

The Following figures show the relevant user interfaces that describe the above steps,

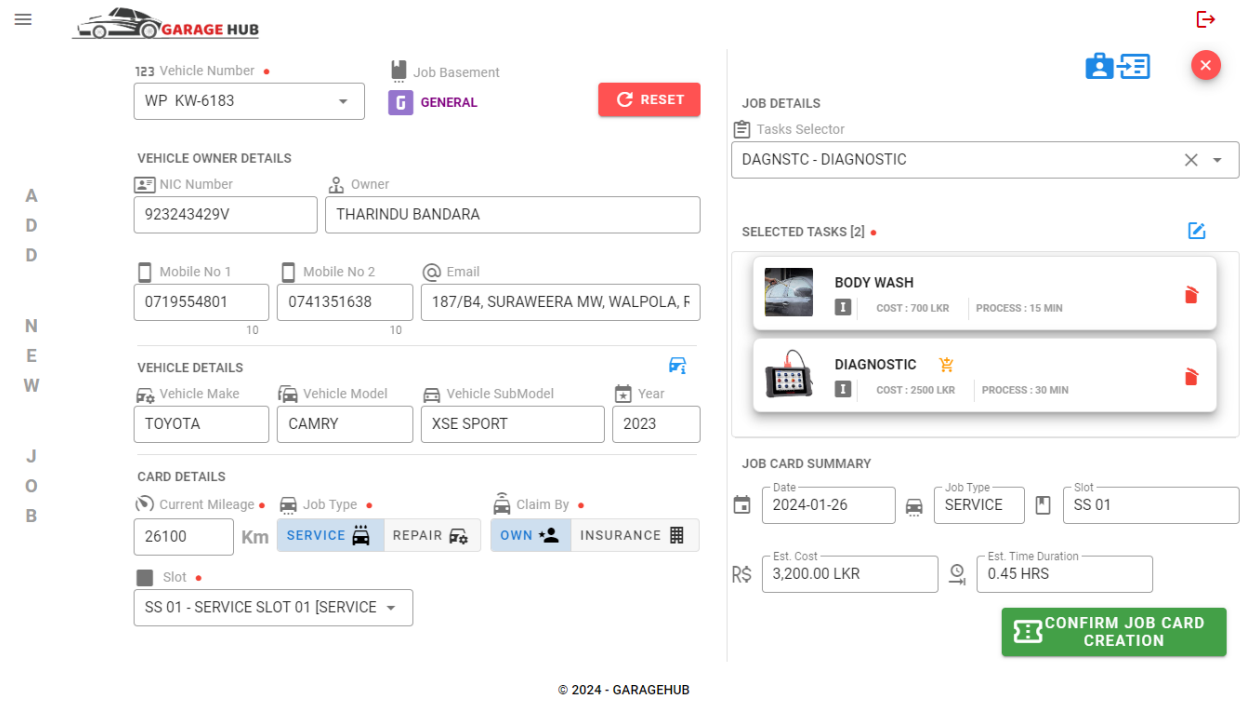

Figure 4.2: Add New Job Card – Admin / Supervisor View

In the AWMS, All of the user interfaces are designed to achieve the highest level of user-friendliness at its best. One of the key features of the above UI is the automatic data-loading operation with logical validations.

The user has to fill in only the Vehicle No. and the system will load the rest of the details including vehicle details, owner details, and job details as well. When the data loading of the job details, there are some number of validations that will be performed by the system to get

the relevant service type to do for the vehicle and it allows to select the options to choose the appropriate service type for the user as well.

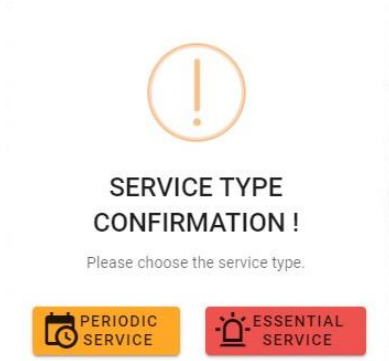

Figure 4.3: Service Type Selection – Admin / Supervisor View

As mentioned earlier, the client can place a reservation for a service through the client user login and it also minimizes the workload of the client to think about the service tasks that have to be done for the vehicle and also the system allows to skip unwanted tasks to the client as well.

Figure 4.4: Service Reservation – User View, shows how the client user view looks like for the service reservation as follows,

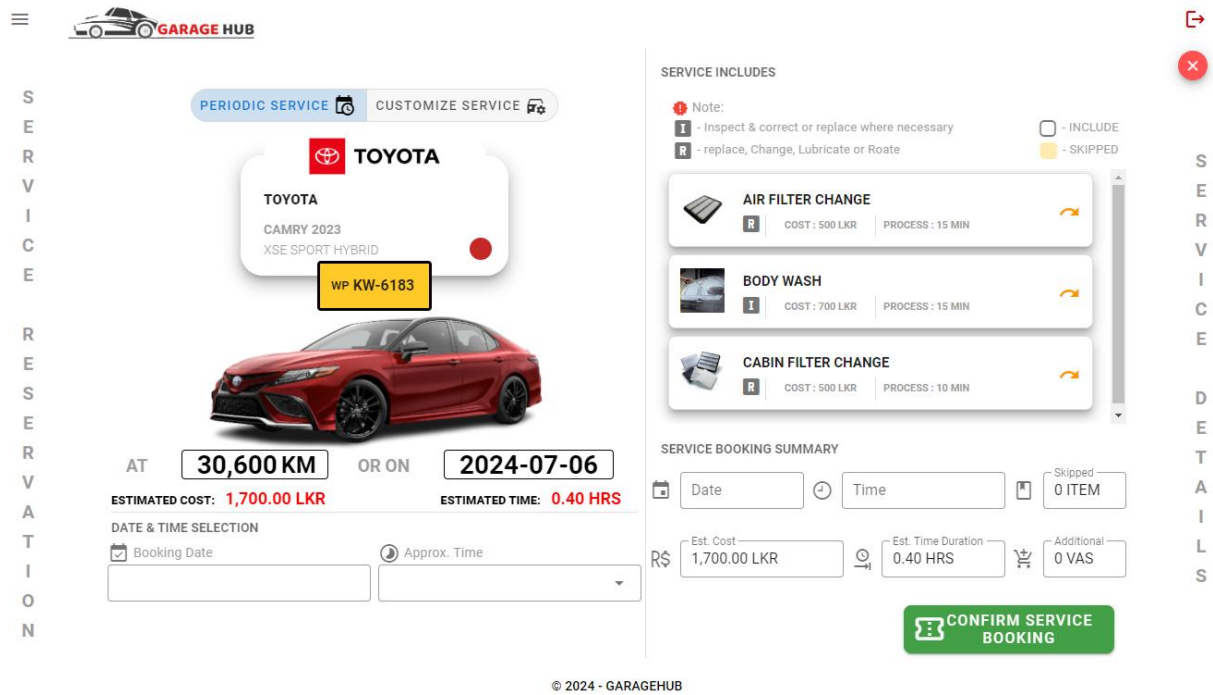

Figure 4.4: Service Reservation – User View

These are the initial steps of the job creation process and the beginning of the tasks that have to be done in the job module in the system. All the functionalities of the AWMS can be familiar referring to the user manual attached in Appendix A.

4.5 Major Code Segments

This section will briefly describe some of the major code segments along with a description of what it does and show how it is implemented to achieve the desired output.

4.5.1 Backend Server Connection

As mentioned before, under the System Architecture in Chapter 3 - Design Architecture, The Firebase is a backend server that provides a set of cloud computing services & Application development platforms for the web and mobile application development provided by Google. The real-time database is one of the main services used for the AWMS as a database and its special characteristics make the system more reliable, effective and convenient.
Before working with the Google Firebase Real-time database, it should have a Firebase account with a Firebase project which includes Real-time database service. Afterwards, it provides a configuration object with some IDs to link the application with the Firebase services that we requested. Then we have to initialize the application with that configuration object to establish the connection with the Google Firebase server and work with the Firebase services that they offer.
Below mentioned code snippet shows how the application initialized with the Google Firebase services.

Firebase.js

```
1   import * as firebase from "firebase";
2
3   export const config = {
4     apiKey: "JBqxUbHJKW2H5Q1BNasLOKUh2XD7G7PLWQ6IA7B",
5     authDomain: "roshan-motors-vue-pwa.firebaseapp.com",
6     databaseURL: "https://roshan-motors-vue-pwa.firebaseio.com",
7     projectId: "roshan-motors-vue-pwa",
8     storageBucket: "roshan-motors-vue-pwa.appspot.com",
9     messagingSenderId: "365874125478",
10    appId: "1:365874125478:web:8br5nad247bbf4nf448xsw",
11    measurementId: "F-XSQV6BFSDD"
12  };
13
14  firebase.initializeApp(config);
15
16  export default firebase;
17
```

4.5.2 Data Extraction from Google Firebase Real-Time Database

After the successful establishment of the Google Firebase services, the Following code segment is used to extract data from the real-time database.

The following code segment is used to get the Job Card list from the Firebase real-time database.

```
import firebase from "../../Firebase";


export default {
    components: {},

    data: () => ({
        JobCardList: [],

        ////Firebase DB Refs
        jobCard_Ref: firebase.database().ref("General/Job_Mod/Job_Cards/"),


    }),

    created() {

        ////--JobCard List
        this.jobCard_Ref.on("value", snapshot => {
            this.JobCardList = [];
           snapshot.forEach(childSnapshot => {
             childSnapshot.forEach(childSnapshot => {
               let jcl = childSnapshot.val();
               jcl.key = childSnapshot.key;
               this.JobCardList.push(jcl);
             });
           });
         });

    }
}
```

4.5.3 Login Handling

In the AWMS, There are two ways to handle the User SignUp and SignIn operations provided by the Google Firebase Authentication, they are Google Authentication and Email/Password Authentications. Selecting appropriate sign-in methods and Enabling them are the first steps before proceeding with the implementation.

The following code segments are used to sign up and sign in with the AWMS in the both ways mentioned above.

Email/Password Sign-Up Method:

```
validateEmailPasswordRegister() {
    if (this.$refs.formRegister.validate()) {
      if(this.reEnterSignupPassword == this.signupPassword){
        // --Register
        this.EmailPassword_SignUp();
      }else{
        //Error
        Swal.fire({
          icon: "error",
          title: "Oops...",
          text: "Please Check & Re-Enter Password !",
          showConfirmButton: false,
          toast: true,
          position: "top-end",
          grow: "column",
          allowEscapeKey: true,
          timer: 4000,
          timerProgressBar: false
        });
      }
    }
  },

  // --Register
EmailPassword_SignUp(){
this.isEmailVerificationSent = false;
var secondaryApp = firebase.initializeApp(config, "Secondary");
secondaryApp.auth().createUserWithEmailAndPassword(this.signupEmail, this.signupPassword)
.then((userCredential) => {

    // Signed in by Second Auth
  var user = userCredential.user;
  if(user.uid != ""){
    this.init_View = "signin";
    this.email = cloneDeep(user.email);

    //--Success
    Swal.fire({
      icon: "success",
      title: "User Signed Up Successfully!",
      showConfirmButton: false,
      toast: true,
      position: "top-end",
      grow: "column",
      allowEscapeKey: true,
      timer: 3750,
      timerProgressBar: false
    });

```

```
            secondaryApp.auth().currentUser.sendEmailVerification()
              .then(() => {
              // Email verification sent!
              this.isEmailVerificationSent = true;
            });
          }

          // Signed out by Second Auth
          secondaryApp.auth().signOut();

          // Delete Second Auth
          var firebasesecondaryApp = firebase.app("Secondary");
          firebasesecondaryApp.delete();
        })
        .catch((error) => {
          var errorMessage = error.message;

          Swal.fire({
            icon: "error",
            title: "Oops...",
            text: errorMessage,
            showConfirmButton: false,
            toast: true,
            position: "top-end",
            grow: "column",
            allowEscapeKey: true,
            timer: 4000,
            timerProgressBar: false
          });

          // Signed out by Second Auth
          secondaryApp.auth().signOut();

          // Delete Second Auth
          var firebasesecondaryApp = firebase.app("Secondary");
          firebasesecondaryApp.delete();

        });
      },

    }
}
```

Google Sign-Up & Sign-In Method:

```
GmailRegister(){
    this.loginType = "gmail";
    var provider = new firebase.auth.GoogleAuthProvider();

    provider.setCustomParameters({
      prompt: 'select_account'
    });

    // --PopupMethod--
    firebase.auth()
    .signInWithPopup(provider)
    .then((result) => {
      /** @type {firebase.auth.OAuthCredential} */
      var credential = result.credential;

      // This gives you a Google Access Token. You can use it to access the Google API.
      var token = credential.accessToken;
      // The signed-in user info.
      // var user = result.user;
      this.User = result.user;
      // alert(user.displayName);
      // IdP data available in result.additionalUserInfo.profile.
      console.log(token + "" + this.User);
      firebase
      .auth()
      .setPersistence(firebase.auth.Auth.Persistence.SESSION);
      this.Filtered_Login;

    }).catch((error) => {
      // Handle Errors here.
      var errorCode = error.code;
      var errorMessage = error.message;
      // The email of the user's account used.
      var email = error.email;
      // The firebase.auth.AuthCredential type that was used.
      var credential = error.credential;
    });
  },
```

Email/Password Sign-In Method:

```
EmailPassword_SignIn() {
    this.loginType = "emailpassword";
    firebase
      .auth()
      .signInWithEmailAndPassword(this.email, this.password)
      .then(() => {
        firebase
          .auth()
          .setPersistence(firebase.auth.Auth.Persistence.SESSION);
          this.Filtered_Login;
          // this.Conditional_Redirect();
      })
      .catch(err => {
        //Error
        Swal.fire({
          icon: "error",
          title: "Oops...",
          text: err.message,
          showConfirmButton: false,
          toast: true,
          position: "top-end",
          grow: "column",
          allowEscapeKey: true,
          timer: 4000,
          timerProgressBar: false
        });
      });
  },
```

4.5.4 Image/File Upload

The following code snippet shows how images and file upload operations were performed at the implementation level.

```
Upload_Job_File(job_ID, job_File_File, job_Vehicle_No, job_Ori_Name, job_Key, job_File_ID, job_File_Size, job_File_No){
    this.is_File_Uploads_Hold = true;
    var job_File_Path = "";
    const storageRef = firebase.storage().ref(`Job_Files/${job_Vehicle_No}/${job_ID}/${job_File_ID}`).put(job_File_File);

    storageRef.on(
      `state_changed`,
      snapshot => {
        this.fileUploadValue = 0;
        this.fileUploadValue = (snapshot.bytesTransferred / snapshot.totalBytes) * 100;
      },
      error => {
        console.log(error.message);
      },
      () => {
        this.fileUploadValue = 100;

        storageRef.snapshot.ref.getDownloadURL().then(url => {
          job_File_Path = url;
          if(job_File_Path != ""){
          var Job_File_Ref = firebase
            .database()
            .ref("General/Job_Mod/Job_Cards/" + job_Vehicle_No + "/" + job_Key + "/Job_Files/" + job_File_No);

          var update_Job_Key = Job_File_Ref.update(
          {
            Ori_File_Name: job_Ori_Name,
            File_Path: job_File_Path,
            File_Size: job_File_Size,
          }
          , function(
            error
          ) {
            if (error) {
              //Error
            } else {
              ////Success
              Swal.fire({
                icon: "success",
                title: "File Uploaded Successfully!",
                showConfirmButton: false,
                toast: true,
                position: "top-end",
                grow: "column",
                allowEscapeKey: true,
                timer: 3500,
                timerProgressBar: false
              });
            }
          }).key;

          var updated_Job_Card = this.JobCardList.filter(a => a.Job_ID == this.selected_state_filtered_job_card_obj.Job_ID)[0];
          this.Load_Job_Files(updated_Job_Card);

          this.is_File_Uploads_Hold = false;
          console.log("Updated Key :" + update_Job_Key);
        }
        });
      }
    );
  },
```

4.5.5 Excel Download

Report Module uses download functionality and it allows users to download reports in Excel format to perform further calculations easily.

The following code snippets show how the Excel download functionality is implemented in the system.

```
<v-tooltip left>
    <template v-slot:activator="{ on, attrs }">
        <v-btn fixed right top fab dark large color="green" :href="href" @click.stop="navigate;" v-bind="attrs" v-on="on" style="top:250px; right:21px;">
            <download-excel class="btn btn-default" :data="pass_Report_Data_JSON" worksheet="Daily Invoice Data Report" :name="download_Report_Name" style="right:180px;">
                <v-icon class="mr-1 mt-1" dark>mdi-microsoft-excel</v-icon>
            </download-excel>
        </v-btn>
    </template>
    <span>Download Excel</span>
</v-tooltip>
```

```
methods: {

    Generate_Excel_JSON(){

        this.pass_Report_Data_JSON = [];

        if(this.pass_Report_Data != null){
                this.pass_Report_Data.forEach(inv_Rec =>{
                        let arr = Object.assign(
                        { Inv_ID: inv_Rec.Inv_ID },
                        { Inv_DateTime: inv_Rec.CreatedDate + " " + inv_Rec.CreatedTime },
                        { Inv_Status: inv_Rec.Inv_Status },
                        { Inv_Vehi_No: inv_Rec.Inv_Vehi_No },
                        { Inv_Promo_Status: (inv_Rec.Promotions_Key == "") ? 'NO PROMO' : 'PROMO ADDED' },
                        { Inv_Total_Amount: inv_Rec.Inv_Total_Amount },
                        { Inv_Discount_Amount: inv_Rec.Inv_Discount_Amount },
                        { Inv_Net_Amount: inv_Rec.Inv_Net_Amount },
                        { Inv_Payment_Method: inv_Rec.Inv_Payment_Method },
                        { Inv_Payments: inv_Rec.Inv_Payment_Opt_1 },
                        { Inv_Earned_LP: inv_Rec.Inv_Earned_LP },

                    );
                    this.pass_Report_Data_JSON.push(arr);

                });
        }
    },

}
```

Chapter 5. Testing & Evaluation

5.1 Introduction

Testing and evaluation are the most crucial processes that have to be carried out once the software unit or the whole system is developed. It is also the next phase that has to be followed once the implementations have been completed by the developers. The ultimate goal of this phase is to gain confidence about the satisfaction of the client's requirements against the software requirements specification (SRS). Also, it helps to identify and avoid system errors, functional and non-functional issues, and missing requirements.

When considering the quality of the product, Verification and Validation processes take a significant place and they can be referred to as Software Quality Control as well.

The verification process is recursively applied from the beginning of the software development life cycle at certain points to verify the system is developed correctly. And the Validation process starts to validate the actual product once the implementation has been completed to check whether the user requirements are satisfied.

In this chapter, it will discuss the Testing strategies and evaluation methods used to increase the quality of the system.

5.2 Testing Strategies

The following test strategies are used to test the system.

1. Black Box Testing
2. White Box Testing.

5.2.1 Black Box Testing

Black Box Testing, also called Behavioral Testing, focuses only on how a system behaves from the outside. It doesn't look at the internal code or how the system is built. Testers without programming knowledge can use this method to find issues and check if the system meets expectations. It checks both functional and non-functional requirements based on the client's needs, ensuring the system behaves correctly with various inputs and usage scenarios.

5.2.2 White Box Testing

White Box Testing is very different from Black Box Testing because it focuses on the internal structure of the system. This type of testing looks at the system's code, data structures, and design. Testers have access to the source code and use it to create test cases that check the system's correctness, from individual programming units to the entire system. Testers need to understand the code, as this knowledge is essential for carrying out effective tests at various levels, such as unit, integration, and system testing.

5.3 Testing Levels

Specific types of tests have been conducted at specific levels according to the nature and the scope of the testing area. It varies according to the stages that they conducted with also. There are many testing levels available specific to its functionality and the Following are the testing levels which were used to verify and validate the AWMS.

5.3.1 Unit Testing

According to the Unit Testing, The Unit is the smallest part that can be tested and it can be either a method or a piece of testable code which is isolated at the logical level. In this stage, all the units are identified and performed unit testing for all of them to verify the functionality of the units are same as designed. It helps to identify the errors at the earliest as possible and it allows to make them correct at the first step of the development as well.

5.3.2 Integration Testing

Integration testing is the next step once the unit testing has been completed. The units which are unit tested at the earlier stage are merged with relevant units together to make them as groups or modules and they are the bases for this type of testing used to verify their functionality. It ensures the system modules are performed as designed and it verifies the data exchanges and the interactions between them without having any issues. It helps to identify the integration issues earlier and can avoid the risk of failures of modules as well.

5.3.3 System Testing

System testing is carried out after the integration testing is performed. Once all the modules or components are integrated, it performs and evaluates the system as a whole to validate that the system's functionality aligns with the user's requirements. In this method, testers are not required to have knowledge of the internal code, because the system testing mainly focuses on the functional and the non-functional requirements of the system.

5.3.4 User Acceptance Testing

All the issues raised by the unit testing, integration testing and system testing were resolved when the user acceptance testing came into action, this testing also ensures the functionality of the system and the satisfaction of the user’s requirement by an acceptable level by the end users before going to the production.

5.4 Test Cases

When performing the test on a system, it is necessary to identify all the possible test scenario that covers every aspect of the system related to the system requirements. The test cases are the specifications which are used to identify whether all the identified scenarios are aligned with the user specifications or not. The structure of a test case includes the description of the test case, Pre-conditions which satisfied before the test case run, steps, expected result and the actual result along with the status of the test case.

The AWMS followed the above-mentioned tests at certain levels and the following are some of the major test cases prepared and executed for.

Table 5.1 – Major Test Cases for AWMS

ID	Description	Pre-condition	Steps	Expected Result	Actual Result	Status (Pass, Fail)
1	SignUp with Google Authentication (As an Unregistered Client in AWMS)	1. The user should be on the SignUp Page	1. Click the "G With Google" Button. 2. Enter the Google Credentials & click Next 3. Enter Email related Mobile no. to get the OTP 4. Enter OTP and click Next	The user login into the System & will be directed to the "Client & Vehicle Assignment" Page	The user logged into the System & directed to the "Client & Vehicle Assignment" Page	Pass
2	SignUp with Google Authentication (As a registered Client in AWMS)	1. The user should be on the SignUp Page	1. Click the "G With Google" Button. 2. Enter the Google Credentials & click Next 3. Enter Email related Mobile no. to get the OTP 4. Enter OTP and click Next	The user login into the System & direct to the Client Dashboard	The user logged in into the System & directed to the Client Dashboard	Pass
3	SignUp with an invalid Re-Enter Password (Email/Password method)	1. The user should be on the SignUp Page	1. Enter a valid Email & Password. 2. Enter an invalid Password in the Re-Enter Password field. 3. Click the SignUp button	The System will show an Error message "Please Check & Re-Enter Password !"	The System showed an Error message "Please Check & Re-Enter Password !"	Pass
4	Verify sending the Verification Mail when SignUp with the Email/Password method	1. The user should be on the SignUp Page	1. Enter a valid Email & Password. 2. Enter the Password again in the Re-Enter Password field. 3. Click the SignUp button	The User should redirect to the SignIn page and show a successful SignUp alert & "Verification	The User was redirected to the SignIn page and showed a successful SignUp alert & "Verification	Pass

				Email has Sent" message on the SignIn Page & Verify Email should be sent to the registered email	Email has Sent" message on the SignIn Page & Verify Email received to the registered email	
5	Login with a valid Email & Password for Client Account (With Email/Password Method)	1. The user should be already registered in AWMS. 2. Load the SignIn Page	1. Enter a valid email & password & click Sign In Button	The user login into the System & will be directed to the Client Dashboard	The user logged in into the System & directed to the Client Dashboard	Pass
6	Login with an invalid Email & Password for Client Account (With Email/Password Method)	1. The user should be already registered in AWMS. 2. Load the SignIn Page	1. Enter an invalid email or password & click Sign In Button	The System will show an Error message & remain on the SignIn Page	The system showed an Error message & remained on the SignIn Page	Pass
7	Login with an empty Email or Password (With Email/Password Method)	1. Load the SignIn Page	1. Leave the Email or Password field empty & click the Sign In button.	The relevant empty textbox color should change to red & remain on the SignIn Page.	The relevant empty textbox color changed to red & remained on the SignIn Page.	Pass
8	Change the Default vehicle with another & load the relevant vehicle data into the Client Dashboard	1. The client should have more than one registered vehicle. 2. The client Logs into the account & Load the Client Dashboard	1. Click the "Change Vehicle" button to redirect to the Vehicle selection view. 2. Select another vehicle & Click the "Default" button. 3. Click the Close button to navigate to the Client Dashboard	Selected vehicle images and other relevant data should be displayed on the client's dashboard	Selected vehicle images and other relevant data are displayed on the client's dashboard	Pass

9	Set the First Periodic Service Appointment for own vehicle through the Client Dashboard	1. The client Logs into the account & Loads the Client Dashboard. 2. The client should have a vehicle that never performed a job in the workshop. 3. The client should set as default that vehicle.	1. Click the "Book A Service" button. 2. It Shows the Initial Service Message & click OK. 3. Select Booking Date & Approx. Time. 4. Click "Confirm Service Booking".	It will redirect to the Client dashboard & show an appointment notification under the "Periodic Service Appointments " section on the Dashboard.	It redirected to the Client dashboard & showed an appointment notification under the "Periodic Service Appointments " section on the Dashboard.	Pass
10	Set a Periodic Service Appointment with an empty Date & Time	1. The client Logs into the account & Loads the Client Dashboard.	1. Click the "Book A Service" button. 2. Leave Booking Date & Approx. Time fields empty. 3. Click "Confirm Service Booking".	Shows a Warning message to inform to fill in the required fields.	Showed a Warning message to inform to fill in the required fields.	Pass

5.5 User Evaluation

User Evaluation is the next step that has to be carried out after the testing phase is completed. Before the user evaluation starts, the deployment of the system has to be carried out in the live environment and provide accessibility to the users.

Initially, accessibility was granted to the system admins and the supervisors to evaluate the system from their point of view and track all the user feedback and suggestions through the User Evaluation Form after two weeks of live deployment. There were some suggestions that

the system could be improved and modified accordingly. Then it allows clients to create and use their accounts. Client User Evaluation has been performed online and can be able to succeed the client user evaluation as well.

Common User Evaluation Form has been designed to survey admin, supervisor and client user levels. It has made caring about the aspects of the user understanding levels and the simplicity of the form design led to a considerable count of user evaluations as well.
The following figure demonstrates the User Evaluation Form used to evaluate the AWMS.

GARAGE HUB

User Evaluation Form

Auto Mobile Workshop Management System

Please take a moment to complete this survey and help us to identify the system's weaknesses and improvements to provide you with the best services in the country.

Thank You!

GarageHub Team

Please place a tick '✓' to the most appropriate answer

	Very Good	Good	Fair	Poor	Very Poor
User Interface					
1. Attractiveness of the User Interfaces					
2. Color/Icon Combinations of the Interfaces					
3. Informativeness of the Help Messages					
4. Meaningfulness of the Error Messages					
5. Responsiveness of the Interfaces					
6. Easiness of being used					
System Operations					
1. Handling steps of System Operations					
2. Inclusiveness of Decision-Making strategies					
3. Easiness of System Operations Completion					
System Quality					
1. Performance of the System					
2. Responsiveness of the System					
3. Reliability of the System					
4. Accuracy of the Information Used in the System					
5. Easiness of being used of the Whole System					
Training					
1. Easiness of being learned					
2. Informativeness of the Documentations					
3. The usefulness of the User Manual					
Comment					

Figure 5.1: User Evaluation Form

The summarization of user evaluation results can be demonstrated as follows,

Table 5.2 – Summarization of the Results of User Evaluation

	Very Good (%)	Good (%)	Fair (%)	Poor (%)	Very Poor (%)
User Interface					
1. Attractiveness of the User Interfaces	83.3	10	6.7	0	0
2. Color/Icon Combinations of the Interfaces	76.7	13.3	10	0	0
3. Informativeness of the Help Messages	80	16.7	3.3	0	0
4. Meaningfulness of the Error Messages	76.7	13.3	10	0	0
5. Responsiveness of the Interfaces	80	13.3	6.7	0	0
6. Easiness of being used	76.7	20	3.3	0	0
System Operations					
1. Handling steps of System Operations	90	6.7	3.3	0	0
2. Inclusiveness of Decision-Making strategies	86.7	10	3.3	0	0
3. Easiness of System Operations Completion	83.3	10	6.7	0	0
System Quality					
1. Performance of the System	93.3	6.7	0	0	0
2. Responsiveness of the System	83.3	10	6.7	0	0
3. Reliability of the System	96.7	3.3	0	0	0
4. Accuracy of the Information Used in the System	90	6.7	3.3	0	0
5. Easiness of being used of the Whole System	90	6.7	3.3	0	0
Training					
1. Easiness of being learned	80	6.7	13.3	0	0
2. Informativeness of the Documentation	86.7	10	3.3	0	0
3. The usefulness of the User Manual	90	10	0	0	0

To easily analyze and get a clear view of the user evaluation result, a Bar chart was generated and depicted as follows,

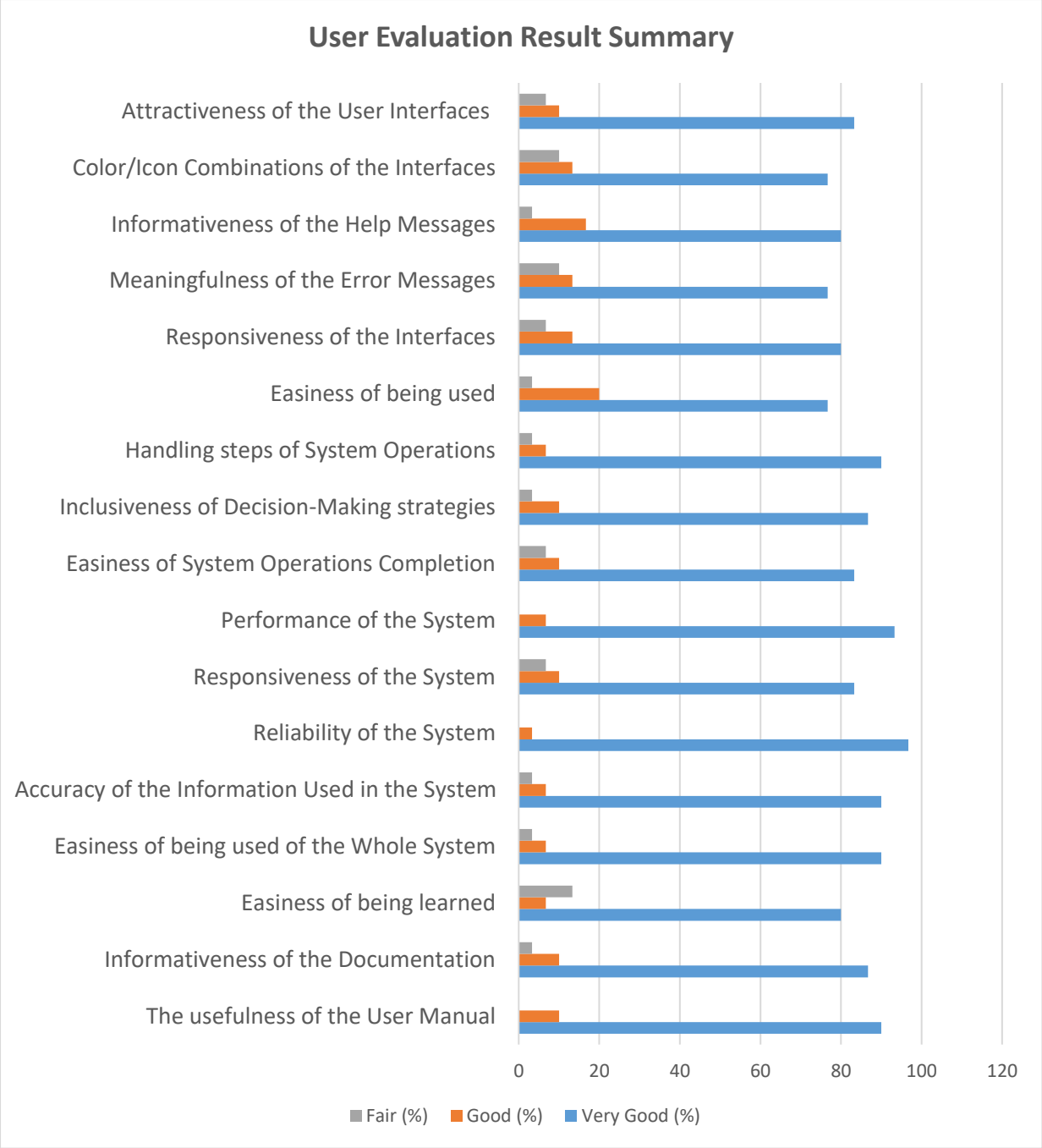

Figure 5.2: User Evaluation Result Summary Bar Chart

According to the above analysis and the bar chart, more than 75% of the users are satisfied with the new AWMS by voting “Very Good” status on every evaluation factor, whereas the “Good” and “Fair” statuses have the lesser votes which prove they are also satisfied with the new system. No votes for “Poor” and “Very Poor” made the new AWMS satisfy every level of users in every aspect.

Chapter 6. Conclusion / Discussion

This chapter will describe all of the work done from the start to the end to achieve the ultimate goal with its problems and limitations, drawbacks and achievements. This will reflect the author's point of view of the entire work done for the project, including the achievement which had to be achieved followed by the objectives through the system, Critical assessments, encountered problems and the way they are handled, the identified system weaknesses and the future enhancements of the system as well.

6.1 Introduction

Considering the objectives of the system mentioned in the introduction chapter, the achievements gained by the system are at a highly satisfactory level.

As objectives, the low-cost, centralized, and cloud-based data store is used for the system to store and render data and files more quickly and in real-time to increase the system's performance and responsiveness.

Introducing the systematic processes for the most wanted tasks such as Job reservations and Job status inquiries reduced the workload of the employees and enhanced the customer relationships with the workshop as well. Introducing the self-reservation process, customers can able to reserve their services and repairs without contacting the workshop and it allows them to predefine the tasks that the job should include. Also, customers are able to track their job status through the Job Status Tracker as well.

The system offered a dashboard for every registered customer to handle their vehicles more conveniently and it could achieve the highest level of satisfaction of the customers against the workshop and the processes it follows. All the details about the services and repairs along with the appointment, job card and invoice details are freely available to check through the user account and all the periodic service and maintenance are displayed with the period that the customer should perform to maintain the vehicle at the right time.

In this system, a Customer Loyalty Program was introduced and every transaction related to the invoices follows the customer loyalty program in order to retain and expand their customer base.

As mentioned above, all of the tasks have aligned systematically and enhanced the process flow to achieve the highest results from the system. The main flow From starting the job creation, supervisor and employee assignment, and managing jobs has improved to increase the productivity of the employees and the workshop as well.

Providing highly reliable reports with the analysis dashboards made the decision-making processes more easier than ever, and the top management was able to forecast the workshop growth by setting some goals and achieving them as well.

6.2 Lesson Learnt

As a student, who is pursuing a master's degree, I have been able to apply all the theoretical knowledge that I have learnt to real-world scenarios while working on this project. As I followed the SDLC for the development of the system, from the first phase to the last, I have gained some special abilities such as specified requirement gathering skills while improving confidence and communication skills, analysis and design skills to provide better solutions for every aspect of issues, and the knowledge about the cutting-edge technologies, programming languages and the coding skills with the coding standard along with the best practices are main of them.
Also, I have improved my management skills to manage my time and the things to do with the limited period to complete this project as well.

6.3 Critical Assessments

As with every system, the database is a main aspect that has to be considered very seriously because of its characteristics. According to the requirements of the AWMS, there should be a database or a data source that is capable of providing a considerable amount of data without affecting the performance of the system in real-time.

According to the above requirement, the traditional database approaches such as relational databases of MySQL or MS SQL Server do not fulfil the requirements that suit the system and have to do some additional developments to make it align with the system requirements as well. To make it possible, the Firebase Real-Time Database is used as the database of the system and it fulfils all the data-related requirements without doing any additional developments. It provides requested data in JSON format and it can be utilized easily. It fetches the data every time that the specific data set has updated automatically and triggers back to the system with the latest data set will update the system environment on a real-time basis.

User login is another aspect that has to be considered, because of the system's characteristics. Unlike most used applications such as social media applications, AWMS usage is lesser compared with them. As a result, the ratio of users who have forgotten user credentials will be high when using the Emil/Password authentication method for the system.

To overcome this issue, the implementation of Google Authentication along with the Email / Password method has been planned. It allows the customers to sign up and sign in to their user accounts with a single touch and no need to remember the credentials to log into this system. The system maintains both authentication methods to make the system more user-friendly and it allows all the users to use their own user account in the AWMS without filtering only for the Google account owners as well.

6.4 Problems Encountered

When in the requirement gathering and analysis stage, there were some problems encountered. As the nature of this system environment, we have to deal with the employees who haven't any knowledge about computers or IT-related things. Therefore, a harder situation has to be faced when gathering consistent requirements from them. So, several meetings were conducted to get the correct requirements from several user groups since some of the requirements were not consistent and conflicted with one another. And had to spend more time in this phase until get the accurate requirements to develop the system as well.

After the system deployment is performed to the live environment, user training has to be conducted for the users to train and familiarize the AWMS. It was a hard situation since more employees did not know the IT-related things and had lesser usage of the computer-aided

systems as well. However, the user training was successfully concluded, since the system modules and the processes are well-defined and easy to understand.

6.5 System Weaknesses

The AWMS has been designed based on to achieve effectiveness and user-friendliness. When it comes to the client user dashboard, all the information related to the defaulted vehicle has to be visible and the operations that allow access for the client have to be placed. Considering this matter, a bigger screen area was required and the system was developed to achieve that requirement. Therefore, limited screen resolutions are compatible whereas others have some alignment issues on the user interfaces.

6.6 Future Enhancements

Considering the system usage of various user groups, the web application is not enough to satisfy the user requirements. In this new era, mobile applications are the most useful application type and they can be accessed at any time anywhere. Everyone has a mobile device in their pocket and providing a mobile application along with this web application will be more convenient and very useful.

The current web application doesn't include any online payment method whereas every client has to come/wait and check their vehicle after the job has finished. So the workshop can handle the invoice amount by cash, card or loyalty points. It is hard to use when it comes up with the web application which requires a laptop or a computer at the time when the payment has to settle for a client.

Providing a mobile application with the capability of modern online payment facilities such as Payment QR code scanning will increase the usage as well as the effectiveness and efficiency of the application.
The current system consists of four modules (Employee Management, Client Management, Job Management and Report) which cover essential processes in the workshop. Therefore the system can be extended further by adding some more modules to cover the entire workshop process. As the next phase, the Inventory Management module can be developed and extend the workshop process defined in the AWMS.

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APPENDIX A: Client User Manual

System Overview

GARAGEHUB is an Automobile Workshop Management System (AWMS) offered by Roshan Motors to its clients to provide the best services while enhancing client satisfaction.
Clients are welcome to create and manage their own accounts to handle their own vehicles and this is the best way to handle all of the vehicle-related tasks in one place.

Following are the user guides to make the specific task complete by yourselves.

User Registration

As the initial step to own an account of AWMS, the User Registration or Sign Up process has to be followed.
To Sign Up, Open the browser and navigate to the URL https://roshan-motors-vue-pwa.web.app/. It will direct you to the system Login page and Click the "**Sign Up Here**" button to navigate to the User Sign Up section which is shown under Figure A.1.

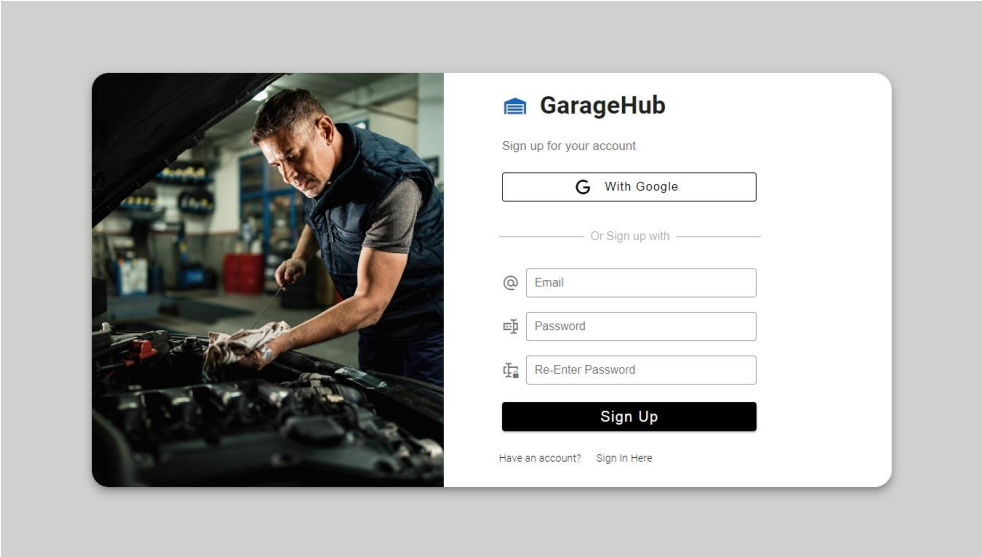

Figure A.1 – AWMS User Sign-Up View

The system allows the users to two sign-up methods to register with the system. One is Google Authentication, and the second one is the Email / Password Authentication.

Sign up with Google Authentication

This is the easiest way to register with the system with one click. Just click the **G with Google** button. Then it prompts all the logged-in Gmail accounts and selects the appropriate Gmail address. Then enter the Gmail password to validate the Gmail account. Then enter the correct mobile number that is associated with the Gmail to perform the Two-way authentication factor. You will receive a code sent from Google and enter the code to verify your identity with the Gmail account.

Success registration will be directed to the **Client & Vehicle Assignmen**t page or **Client User Dashboard** based on the client user properties.

Sign up with Email / Password Authentication

This is the second way to perform user registration, The user has to enter a valid email address which is active in the **Email** text box. Enter a strong password and re-enter the same password in the **Password** and **Re-Enter Password** text boxes respectively. Click the **Sign Up** button and the system will send the **Verification email** to the registered email address.

Then the user will navigate to the Sign In Page with auto-completing the Emai address.

User Login

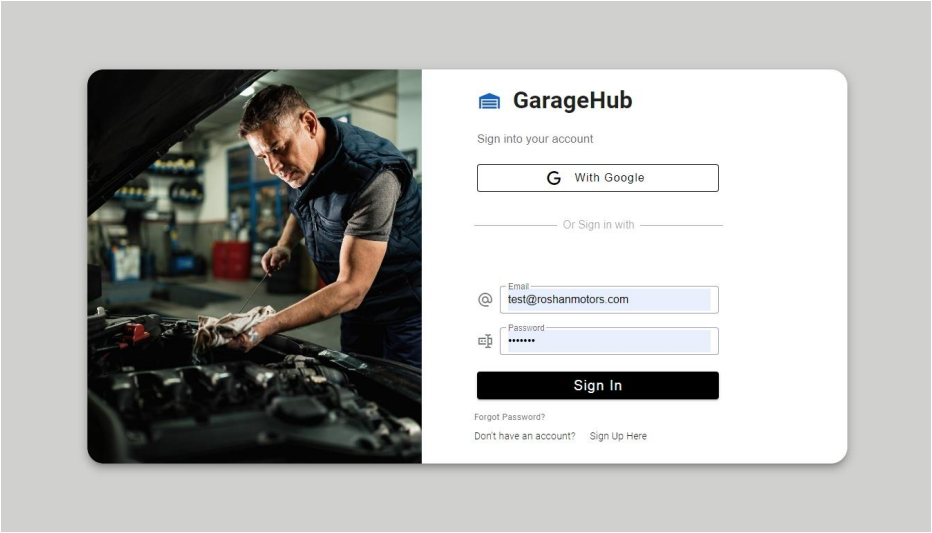

Figure A.2 – AWMS User Sign-In View

Figure A.2 shows the User Sign-In view with the two sign-in methods which the users can use to log into the system and it is relevant to the user registration method.

Sign in with Google Authentication

The users, who are signed up with Google can only use this method. Click the **G with Google** button on the view, and select the relevant Gmail account. According to some conditions, Google will request to enter the password and will perform the Two-way authentication to verify. Otherwise, it will automatically navigate to the **Client & Vehicle Assignmen**t page or **Client User Dashboard** based on the client user properties.

Sign in with Email / Password Authentication

Enter the registered Email and the password. Then click the **Sign In** button. it will automatically navigate to the **Client & Vehicle Assignmen**t page or **Client User Dashboard** based on the client user properties.

Client & Vehicle Assignment

Only the users who are new to the workshop and have no records related to the jobs performed in the workshop will navigate to this page. Figure A.3 and A.4 show the initial message and the Client & Vehicle Assignment page. Read the **Initial message** very carefully and follow the steps to complete this step.

Enter the user's **NIC Number** and the system will check and autofill all the fields with the registered vehicles when the user is already in the system. The only the user wanted to do is add another vehicle if the user has one. Otherwise user has to fill in all the required fields and select vehicles by entering vehicle details and linking all together by clicking the **Add Client | Vehicle & Link** button. **The reset** button will be set to the initial state of the page.

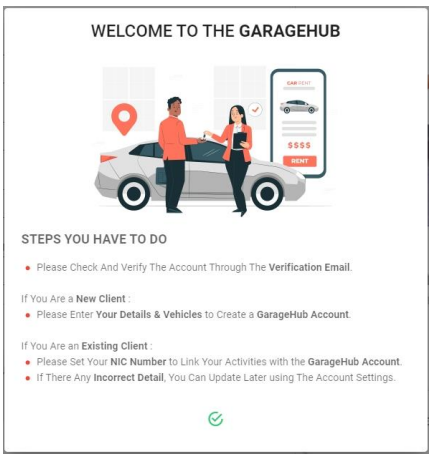

Figure A.3 – Initial Message

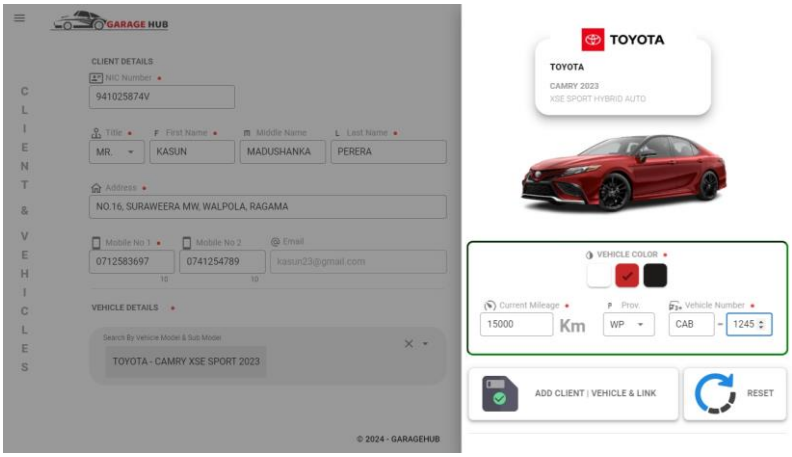

Figure A.4 – Client & Vehicle Assignment

Successfully linked user with the vehicle, will be redirected to the Client User Dashboard. Following Figure A.5 shows the Client User Dashboard page in the system.

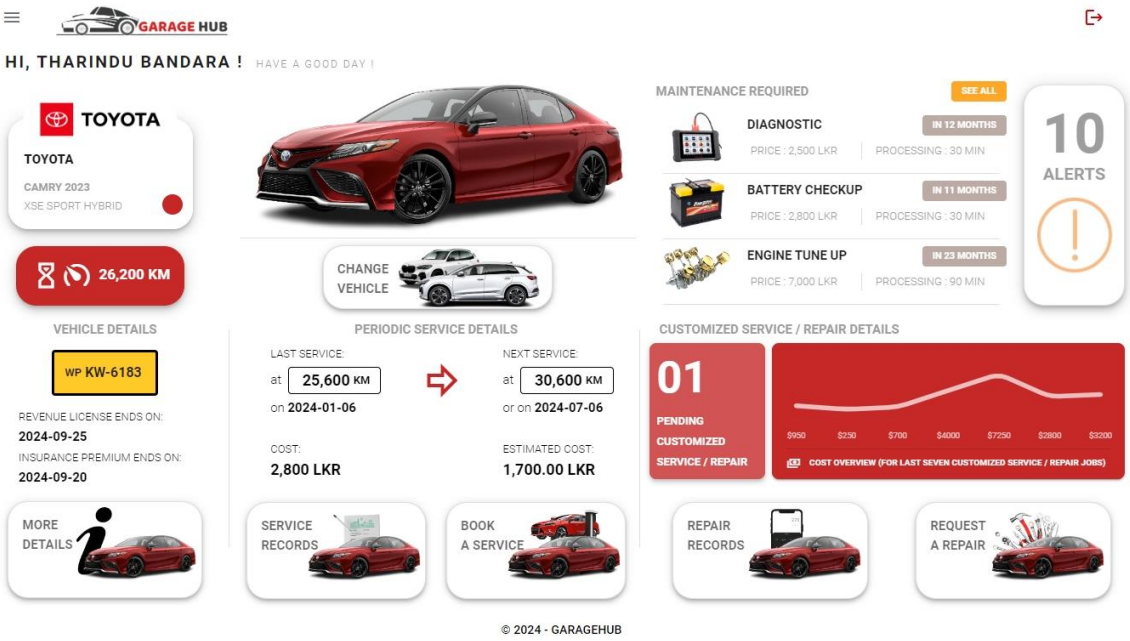

Figure A.5 – Client User Dashboard

Dashboard Sections

There are four sections which will show several details related to the defaulted vehicle. There are,

1. Vehicle Details Section
2. Periodic Service Details Section
3. Customized Service / Repair Details Section
4. Maintenance Required Notification Section

Vehicle Details Section

This section will display the defaulted or selected vehicle details including the vehicle number, the dates of Revenue Licence and Insurance Premium Ends for the vehicle.

Complete Details! button notify to complete the vehicle-related missed details. Click and update all the required details accordingly.

From time to time It will be required to update the current mileage of the vehicle to generate service notifications accurately. Click the **Mileage** button to update the current mileage of the vehicle.

The Change Vehicle button is used to select the default vehicle among more than one owned vehicle list.

All the figures related to the above-mentioned operations are as follows,

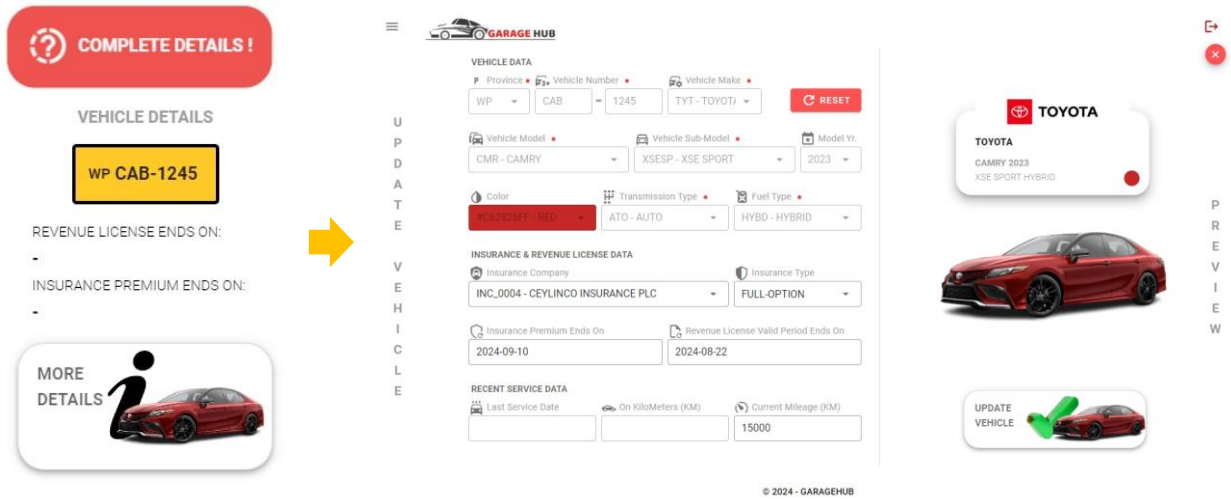

Figure A.6 – Complete Vehicle-Related Details

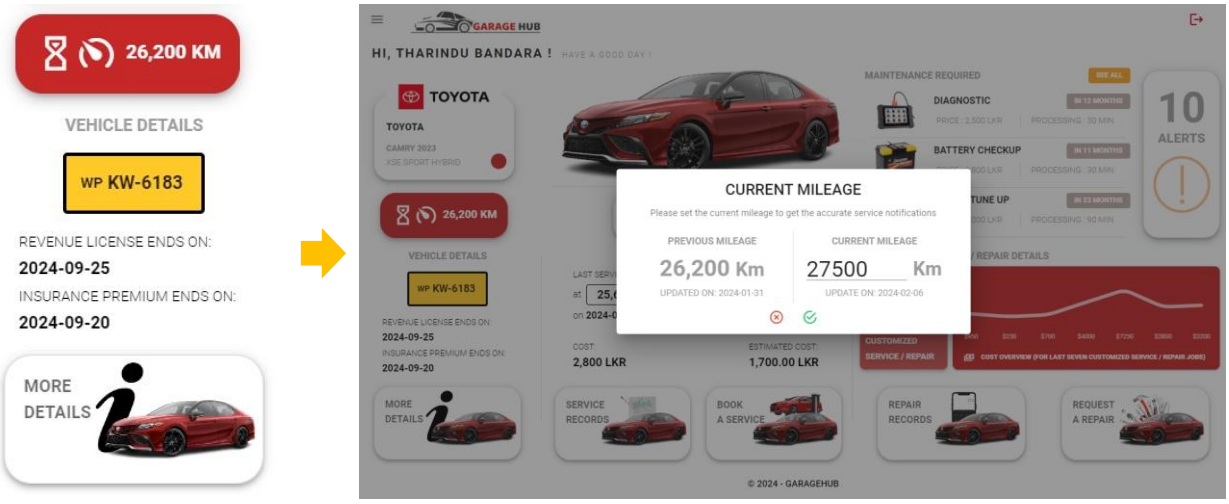

Figure A.7 – Periodic Vehicle Mileage Update

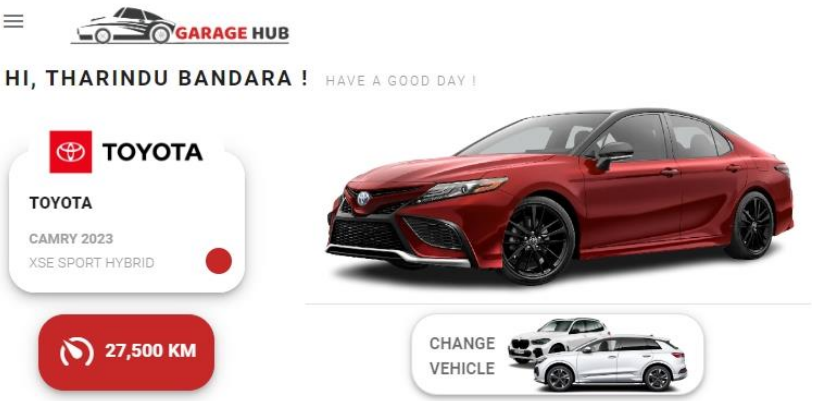

Figure A.8 – Change Vehicle

The **Change Vehicle** button redirects to the user-owned vehicle collection and it allows users to **Add New Vehicles**, **Select** and **Update Vehicles And View Vehicle information**. Also, the user can select the default vehicle that the dashboard has to load relevant data to it by clicking the **Set As Default** button after choosing the vehicle from the vehicle list. The following figures show the steps to complete the above-mentioned tasks.

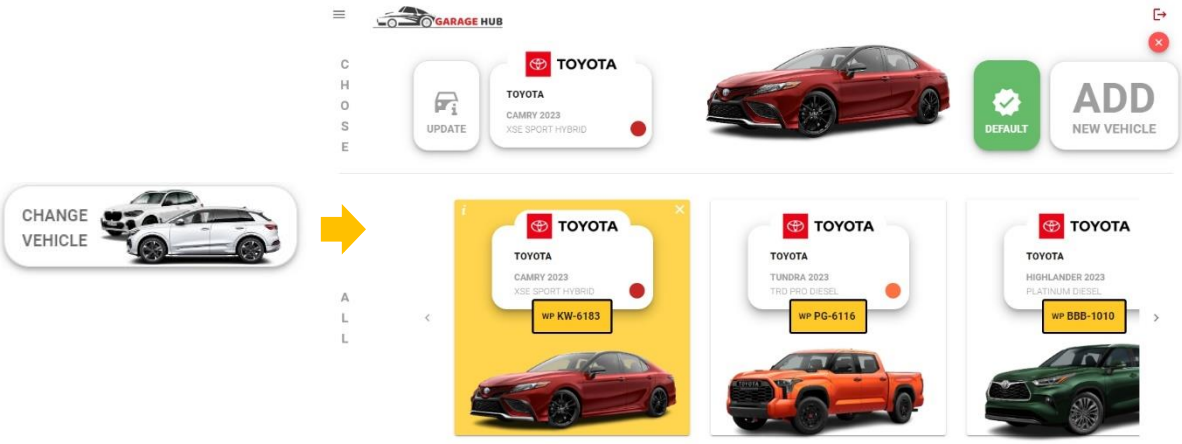

Figure A.9 – Own Vehicle List

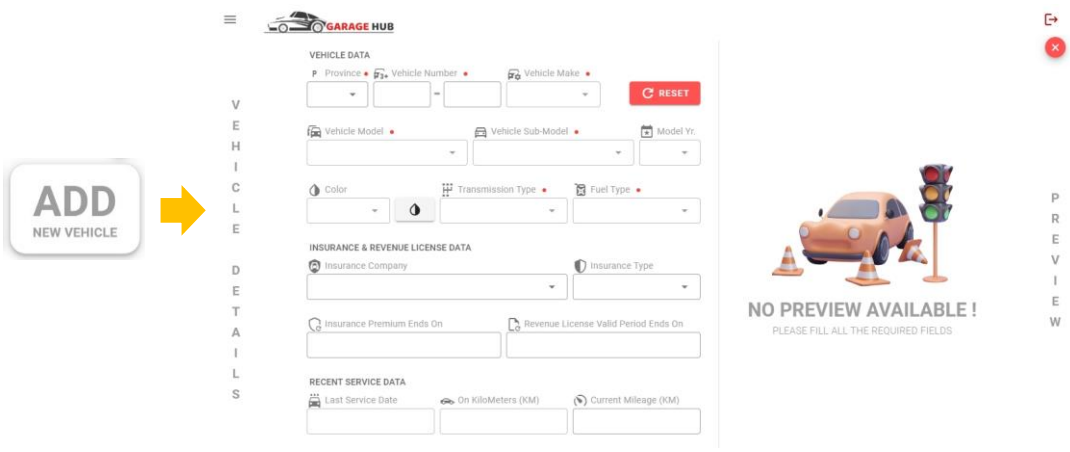

Figure A.10 – Add New User Vehicle

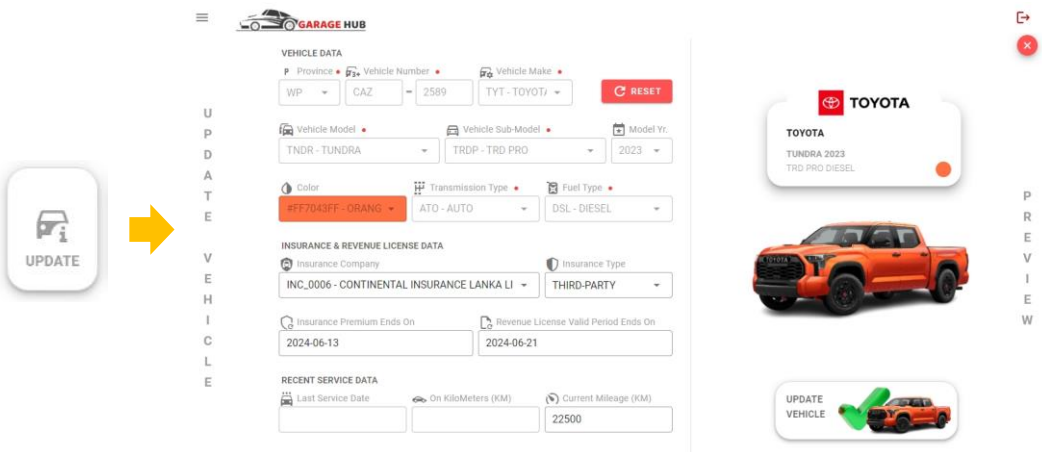

Figure A.11 – Update User Vehicle

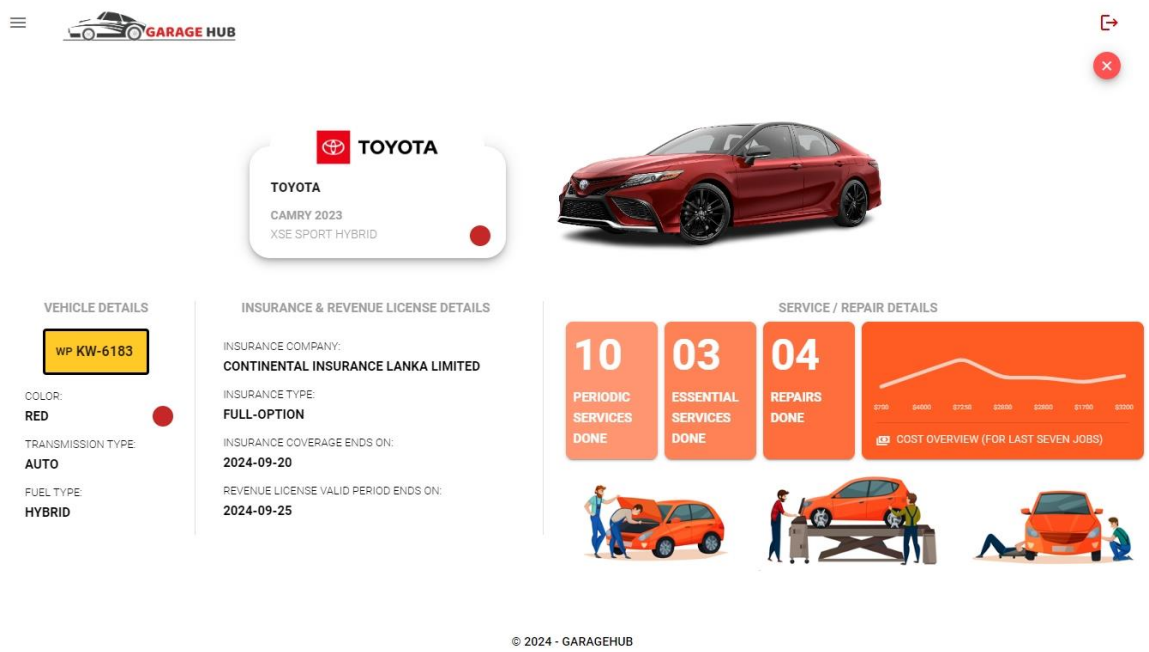

Figure A.12 – Vehicle Information View

In this vehicle information view, all the vehicle-related details are shown along with the number of Periodic and Essential services and Repairs that have been done for the vehicle. Users can navigate to see the history details of the Periodic, Essential and Repair jobs by clicking relevant buttons.

Periodic Service Details Section

This section will display periodic service details of the selected vehicle including the summary of the Last service which contains mileage, date and cost spent for the service and indicates the next service mileage and the estimated date and cost for the vehicle. The system allows users to make a service reservation by clicking the **Book a Service** button. And can be able to view **Past Periodic Service Details** by clicking the **Service Records** button.

Book A Service

Users can able to make a service reservation by clicking a single button and in the **Periodic Service section,** the system will pick all of the tasks for the service automatically and calculate the estimated cost and the time as well. The system allows users to Skip tasks which unwated for that moment and everything will update accordingly.

Fill in the **Booking Date** and **Approx. Time** fields and then click the **Confirm Service Booking** button to make a periodic service reservation for the vehicle.

Same as per the above steps, the user can able to make a reservation for the **Customized Service** which can specify tasks by selecting tasks through the Task Selector as well.

The following figure shows the Service Reservation view of the system.

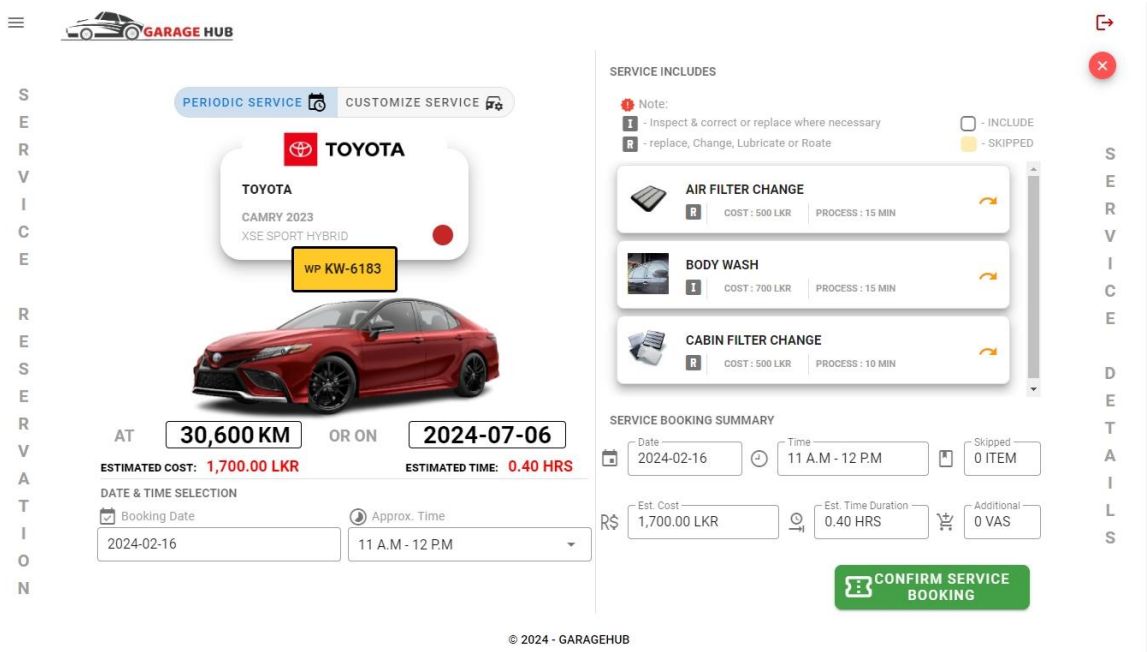

Figure A.13 – Vehicle Service Reservation View

Service Records

The user can be able to check historical periodic service details and it provides the status of each task along with the Appointment & Job card details and Payment Invoice details as well.

Figure A.14 shows the Periodic Service Detail View which tracks all the service records of the vehicle.

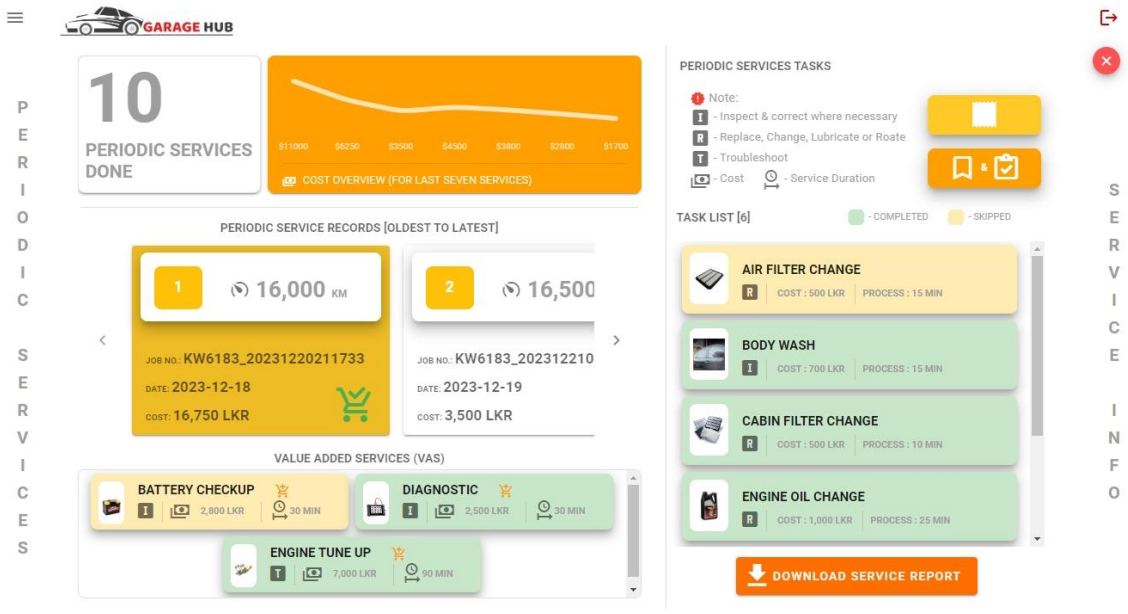

Figure A.14 – Periodic Service Detail View

Check Past Periodic Service with Appointment and Job Card Details

Click this button  to check the **Appointment and Job Card Details** of the service.

It will direct to the **Service Appointment** Page including all the details related to the Service job appointment and its view as follows.

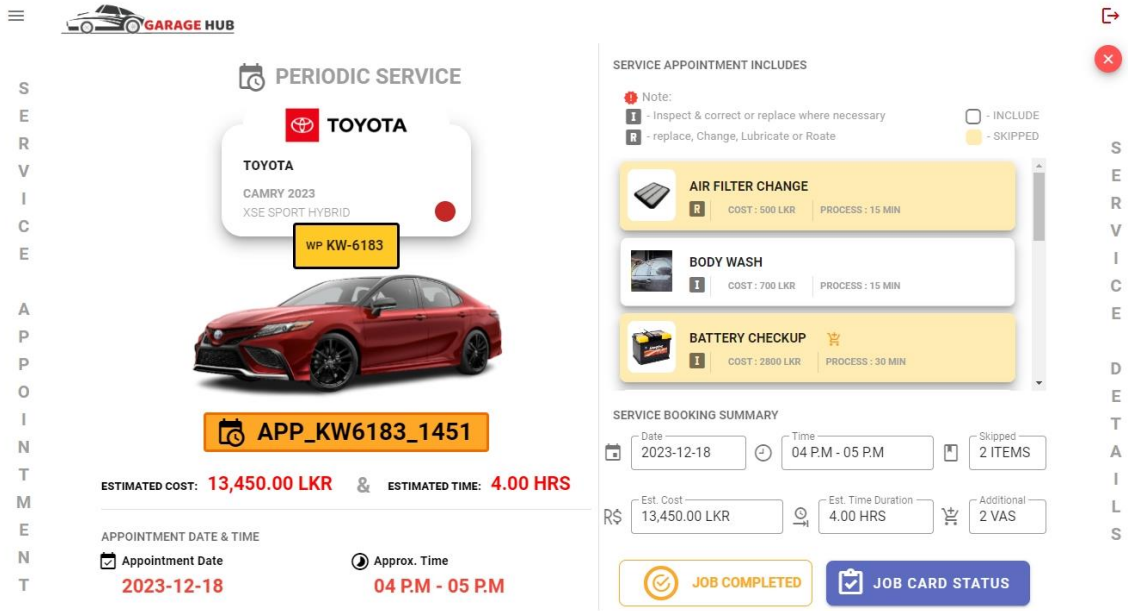

Figure A.15 – Service Appointment Detail View

Clicking **Job Card Status** will navigate to the Job Card Status page and it will show all the related details about the job that has been done for the vehicle related to the appointment. The following figure shows the Job Card Status view of the relevant service Appointment.

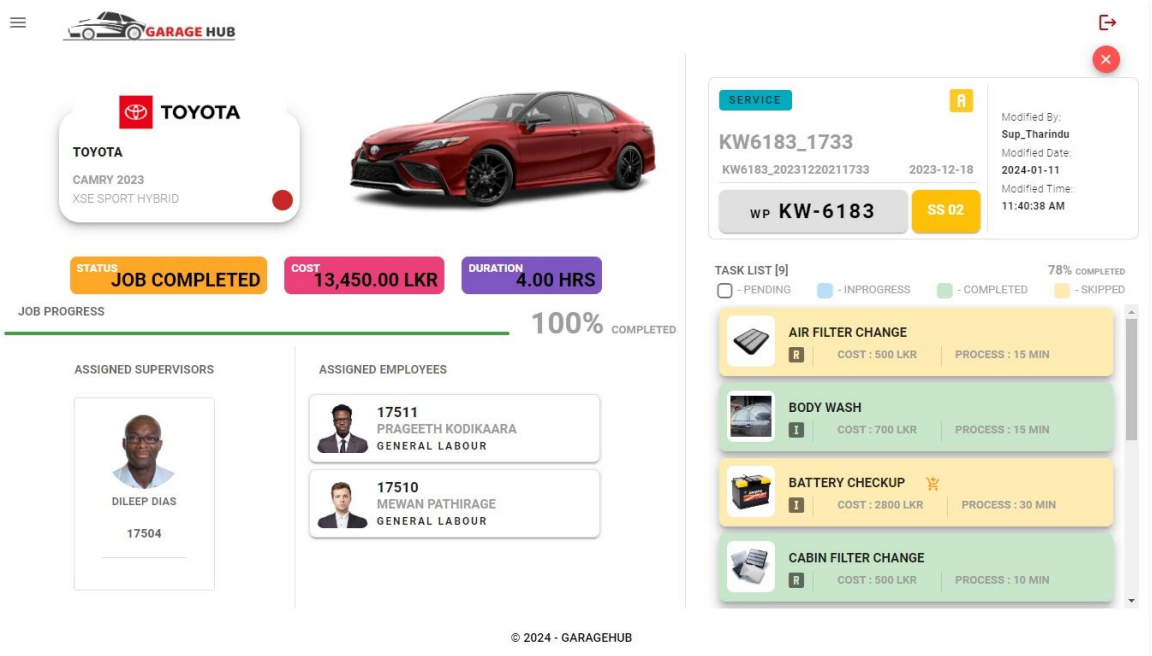

Figure A.16 – Job Card Detail View

Check Past Periodic Service with Invoice Details

Click this button  to check the **Invoice Details** of the service.

It will navigate to the Job Invoice Page and all the invoice-related details are shown as follows,

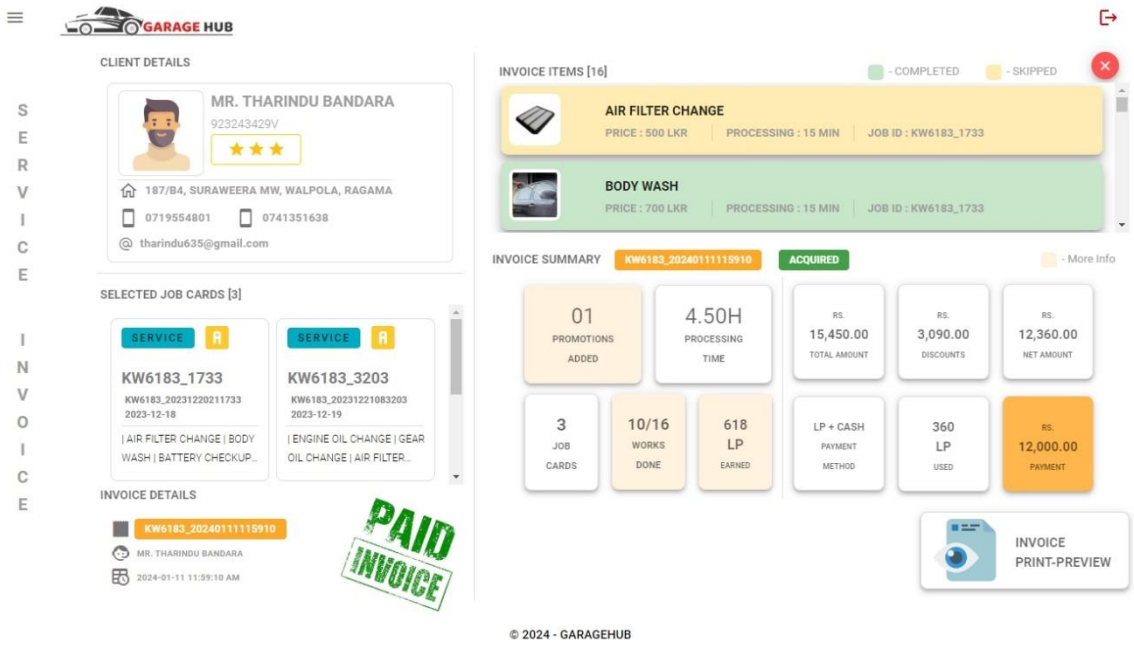

Figure A.17 – Service Invoice Detail View

The user can download the service invoice by clicking the **Invoice Print-Preview** button.

Customized Service / Repair Details Section

This section shows Customized Services and Repair details with the pending appointments and pending and ongoing job cards related to that type of service and repairs. It shows a quick overview of the cost of the last seven jobs spent, with a chart to identify how the cost variation happened to services performed.

This section also consists of two operations which are used to make a repair reservation and to view the Repair Records.

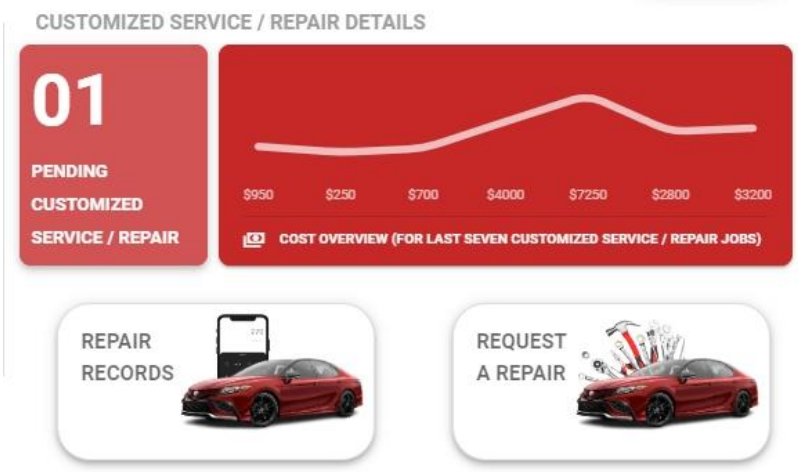

Figure A.18 – Customized Service / Repair Detail Section

Request A Repair

This is used to make an appointment for a repair only, not for the services.

The following figure shows the Repair Reservation view of the system.

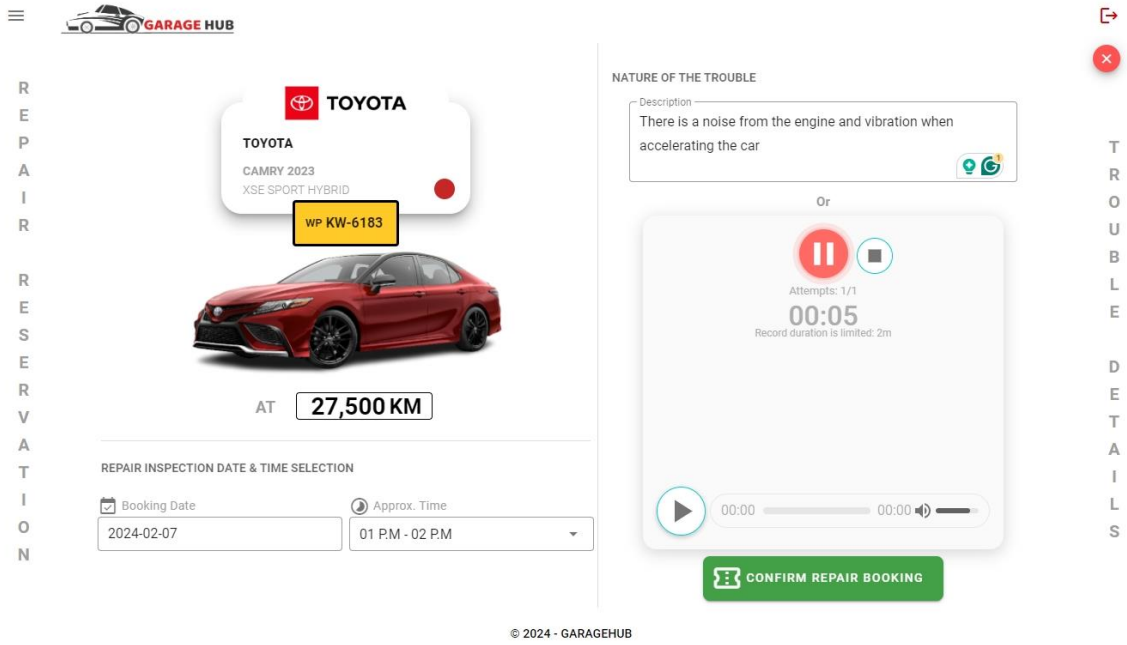

Figure A.19 – Repair Reservation View

Set a date for the **Booking Date** field and a time for the **Approx. Time** field and describe the nature of the trouble by yourself by entering a small description or the system allows users to send voice through the system to improve the workshop user understandability about the issue that the client has. Then click the **Confirm Repair Booking** button to make an appointment for the workshop.

Repair Records

Similar to the **Service Records,** Past Repair Records are also available to check and view later. Please follow the same process to achieve the **Check Past Repair with Appointment and Job Card Details** and **Check Past Repair with Invoice Details** as mentioned above.

Figure A.20 shows the Repair Detail View which tracks all the repair records of the vehicle.

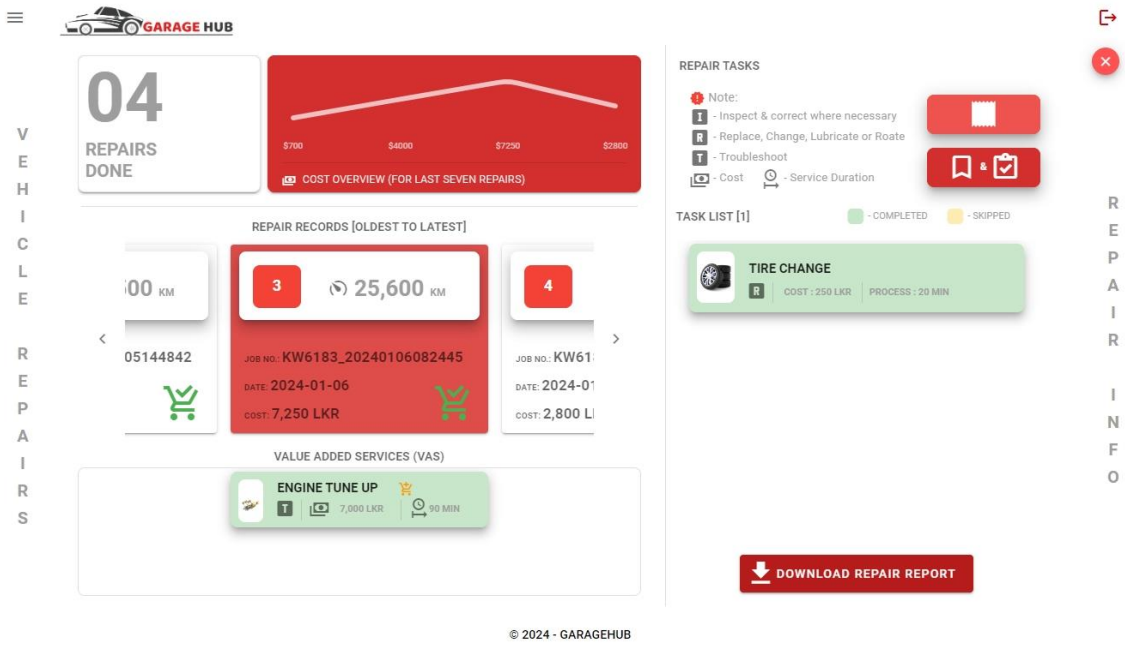

Figure A.20 – Repair Detail View

Maintenance Required Notification Section

This section indicates what the next services or repairs have to be maintained with the duration to identify and perform jobs on time and helps to make the vehicle issue-free.

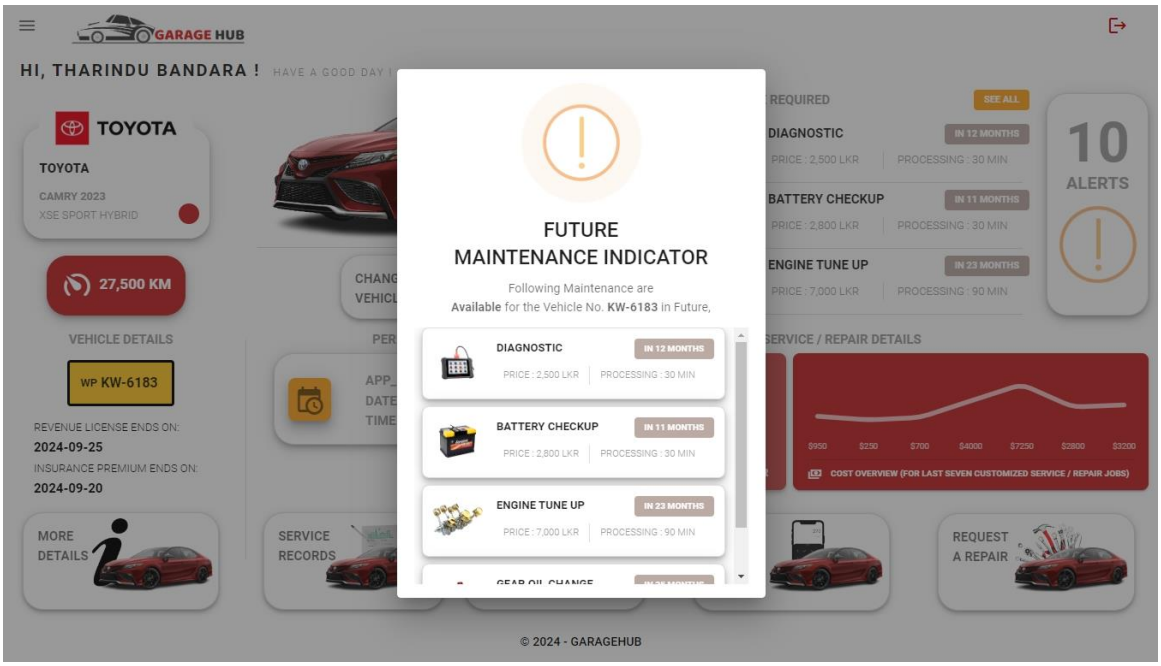

Figure A.21 – Future Maintenance Indicator View

APPENDIX B: Admin/Supervisor User Manual

System Overview

GARAGEHUB is an Automobile Workshop Management System (AWMS) offered by Roshan Motors to its clients to provide the best services while enhancing client satisfaction.
This is the User Manual for User levels of the Workshop. The Admin and Supervisor Level users have very specific tasks that have to perform in order to manage workshop jobs such as services and repairs smoothly.

Following are the user guides to make the specific task complete by yourselves.

User Login

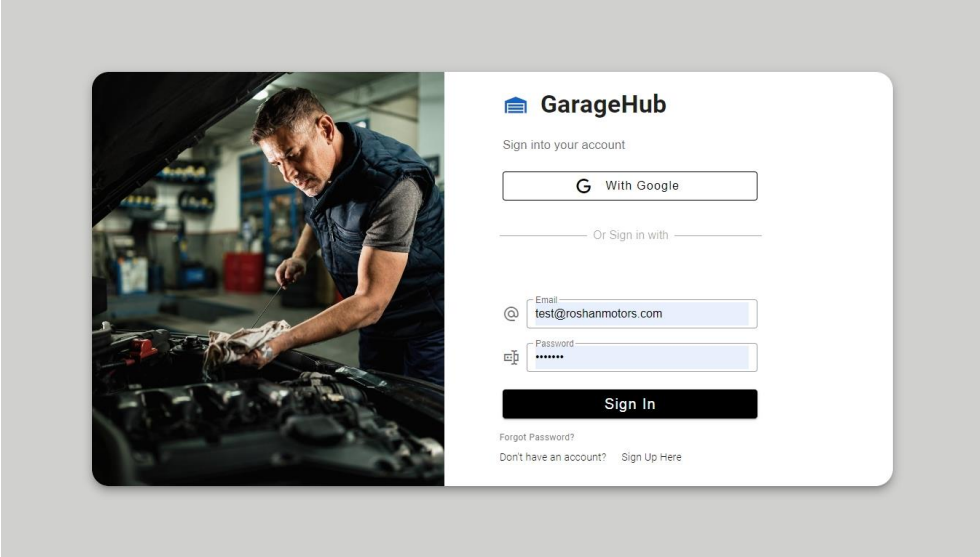

Figure B.1 – AWMS User Sign-In View

Figure B.1 shows the User Sign-In view with the two sign-in methods. But for the Admin/Supervisor users have to use the Email/Password method to access the system instead of using Google authentication. Usually, the Admin/Supervisor Level authentication will be created for the Email/Password method to reserve their private Gmail address used for registering as a client for the workshop as well.

Sign in with Email / Password Authentication

Enter the registered Email and the password. Then click the **Sign In** button.

Successful Sign-In will be redirected to the User Dashboard. Following Figure B.2 shows the Admin/Supervisor User Dashboard page in the system.

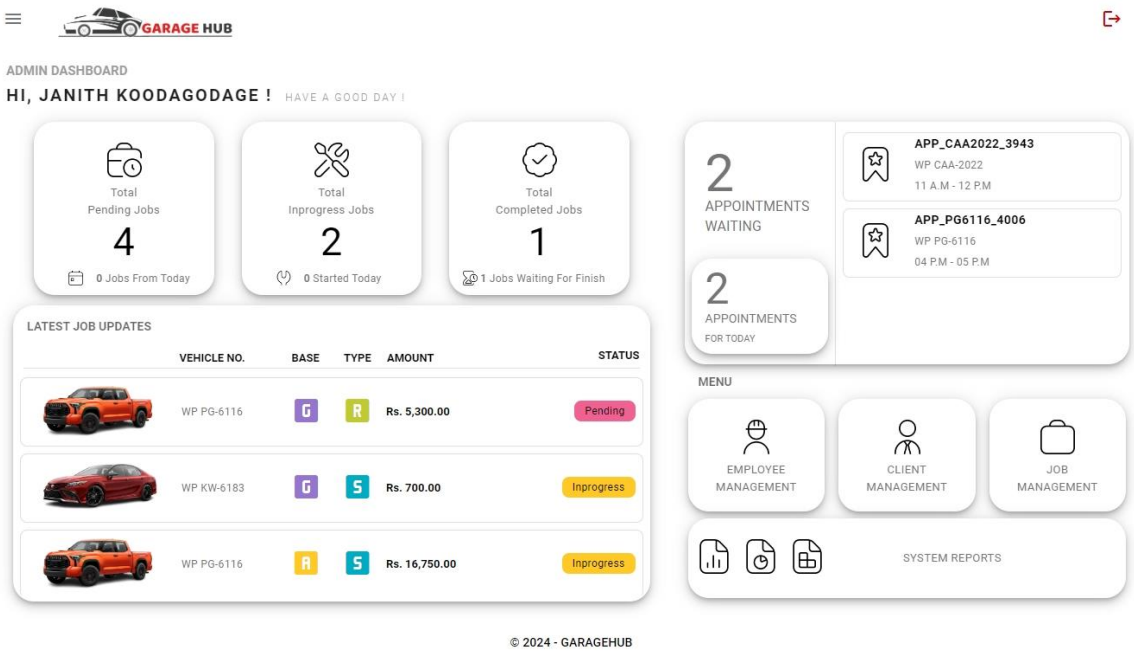

Figure B.2 – Admin/Supervisor User Dashboard

Dashboard Sections

There are three sections which will offer the most frequently used operations of the system. There are,

1. Current Status of Job Cards
2. Appointment Details Section
3. User Menu Section

Current Status of Job Cards

This section shows the Current State of the Job cards generated in the workshop. It mentions three categories of job status and the number of job cards available right now. The total number of Pending, In progress and Completed jobs are clearly visible and the user can do specific tasks related to them.

The following figure shows the Current Job card summary of the workshop.

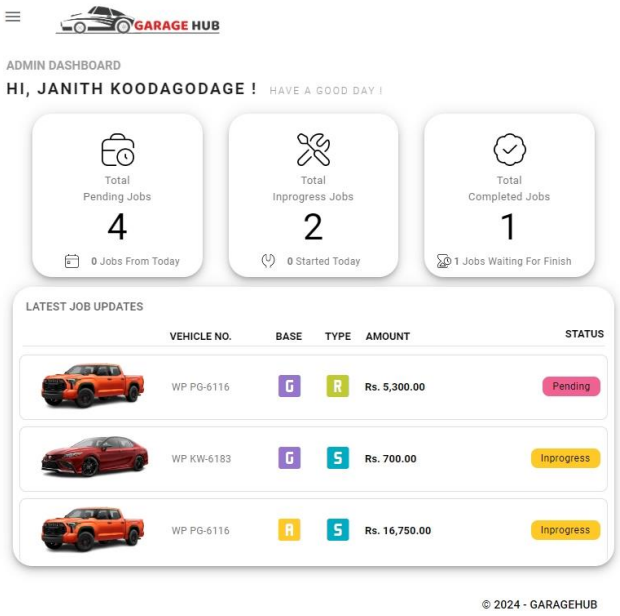

Figure B.3 – Current Job Card Status Section

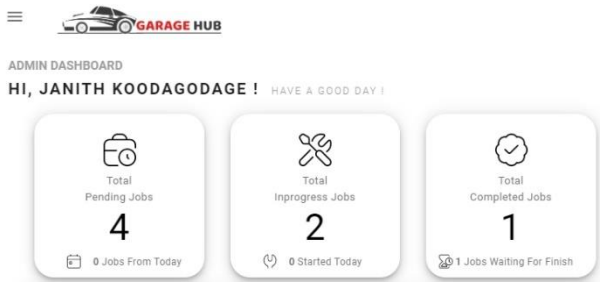

Figure B.4 – Status Cards

Clicking these status cards, the User will be redirected to the **Current Job Status** page and it will allow the user to view the status of the job as well.

Figure B.4 shows the **Current Job Status Page view** of the system to identify the current status of the workshop.

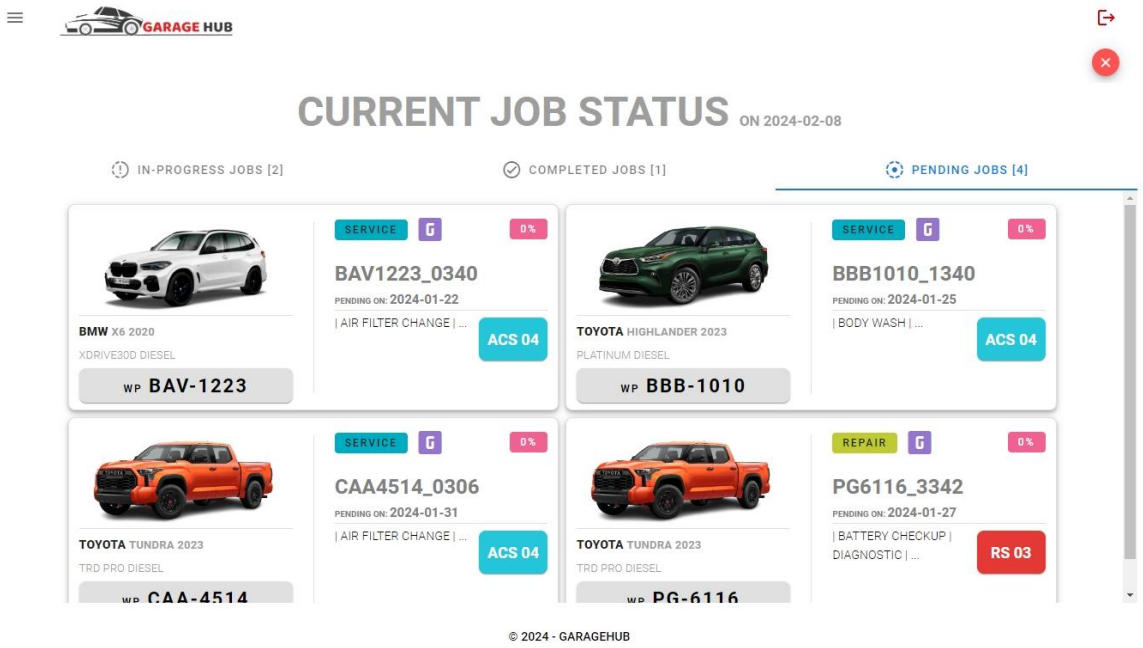

Figure B.5 – Current Job Status View

The latest Job Updates section mentioned in Figure B.3 shows some sort of details of the job cards and clicking on them, the user navigates to the specific page to perform operations according to the job card status.

Appointment Details Section

In the dashboard, This section visualizes the Today's appointments available for the workshop. Users can easily check and navigate to the **Manage Appointment** page through this section and can create job cards accordingly.

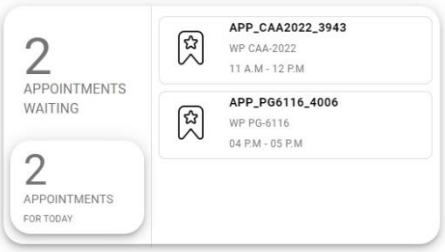

Figure B.6 – Appointment Detail Section

User Menu Section

This section will allow users to navigate all the operations available in the system, it has separated and visualised the operations by Module to improve the organization of the task.

The following Figure shows the User Menu Section that the user can access through the Dashboard.

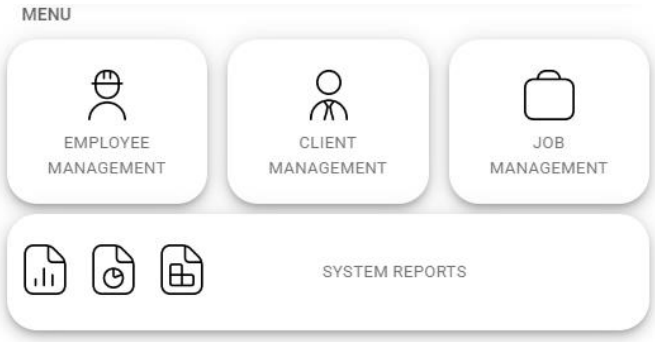

Figure B.7 – User Menu Section

As per the Above Figure B.7, There are Four modules in the system and every task that the workshop is performing is included within these four modules.

Employee Management Module

Access Level: **Admin**

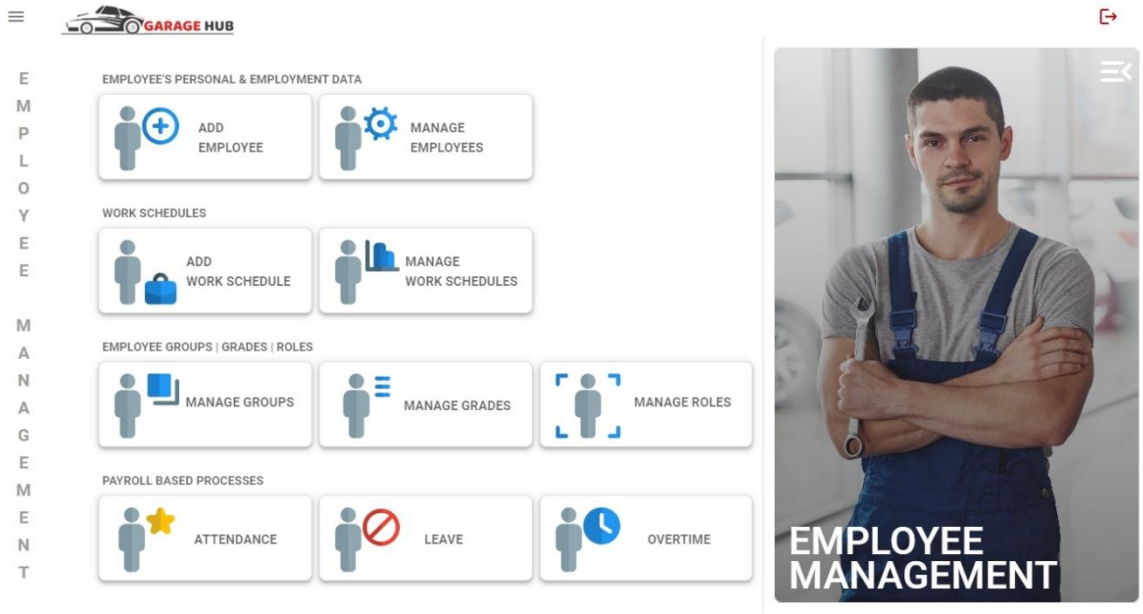

Figure B.8 – Employee Management Module

The above Figure shows the task included in the Employee Management Module.

Users can access it by clicking the **Employee Management** button in the **User Menu Section** and all the employee-related tasks are available here including Add and Manage Employees, Work Schedules, Groups, Grades and also Employee Attendance, Leave and Overtime.

The following are the detailed descriptions of tasks in the Employee Management Module.

Add & Manage Employees

Access Level: **Admin**

These sections allow users to add and manage employees to the system.

The user has to enter every detail including Personal and Employment details required from the **Add Employee** view correctly.

Figures B.9 and B.10 show the Add Employee view with the Personal and Employment data insertion fields.

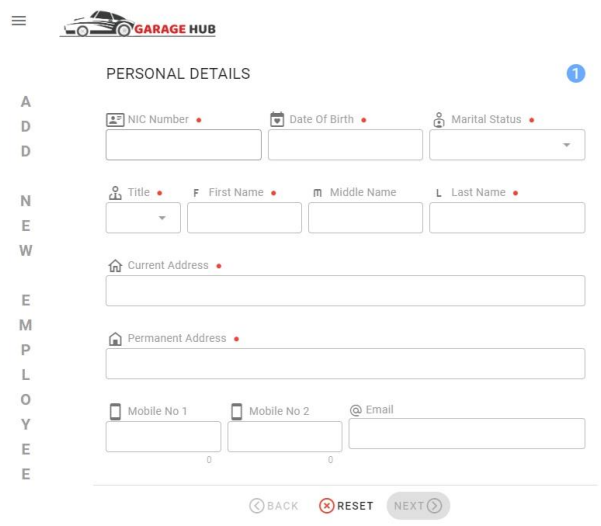

Figure B.9 - Add Personal Detail View

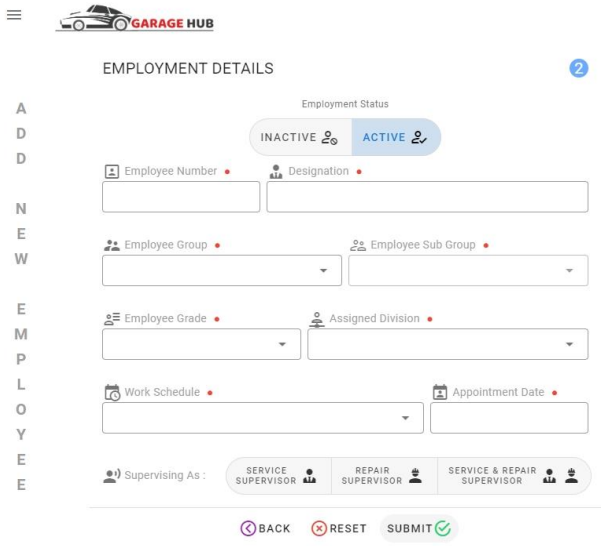

Figure B.10 - Add Employment Detail View

Fill in all the Employee's personal and employment details and upload an employee's photo to make the employee assignment task easy to identify the employee and click the Submit button to add a new employee.

Manage Employee section allows users to manage employees by Updating Employee Info, Removing the Employee from the System, Assigning jobs, and Viewing worksheets and Employee Statistics.

Users can perform these tasks by clicking relevant buttons situated under the **Operations section** in the **Manage Employees** view.

The following Figure Shows the **Manage Employee View.**

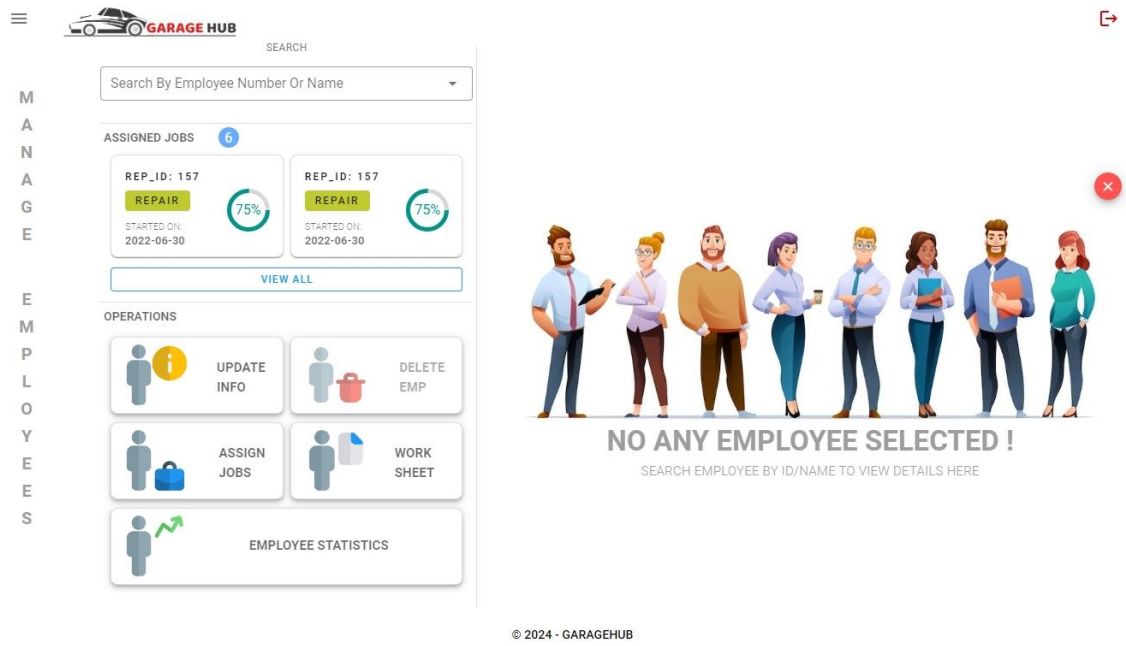

Figure B.11 – Manage Employee View

Add & Manage Work Schedules

Access Level: **Admin**

The work Schedule defines the employee's working period in the workshop and it should be attached to the employee when Adding the Employee. It is used to identify employee attendance and used to calculate Overtime as well.

Figure B.12 shows the **Add Work Schedule View** in the system.

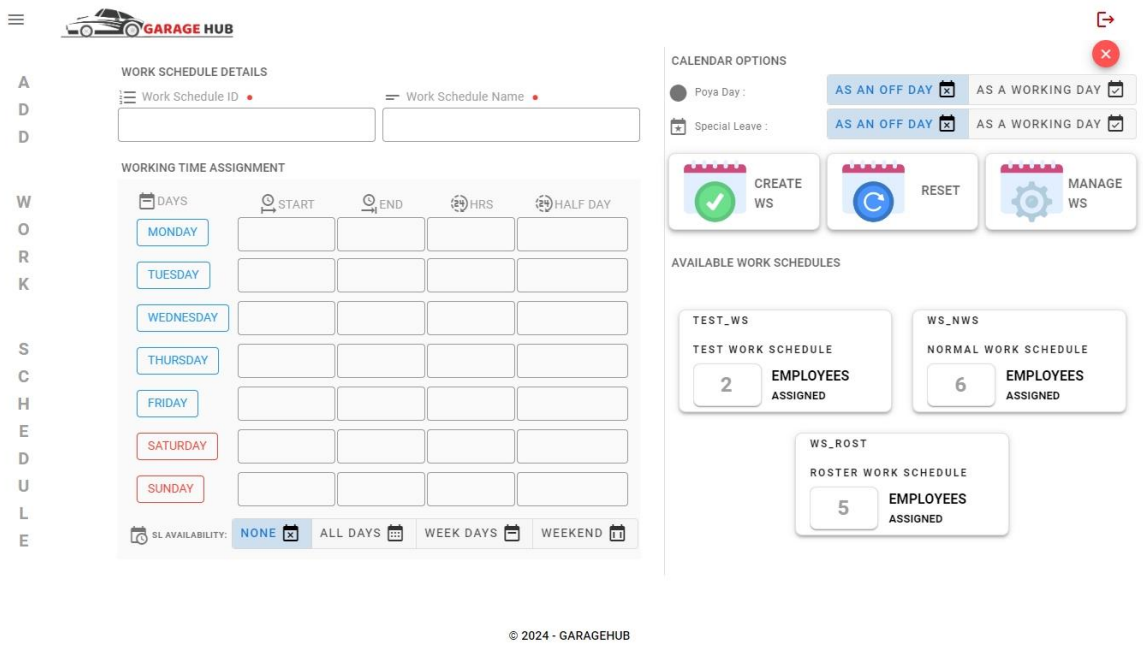

Figure B.12 – Add Work Schedule View

The user has to define a work schedule ID and a Name. Then should indicate the Working Start Time and the End time for each day of the week and it automatically shows the Working Hours. The user should define the Half-Day starting time for each day in the relevant field. Then choose the appropriate options mentioned under the calendar options for Poya Day and Special Leaves. Then click the **Create WS** button to create a Work Schedule.

The **Reset** button can be used to clear all the fields.

The **Manage WS** button can be used to navigate the Manage Work Schedule page.

Available Work Schedules can be clicked and view the schedule details along with the assigned employees as well.

The **Manage Work Schedule** page allows the Users to Update and move Employees from one work schedule to another and Delete the Work Schedules as operations.

The Following Figure shows the **Manage Work Schedule** Page.

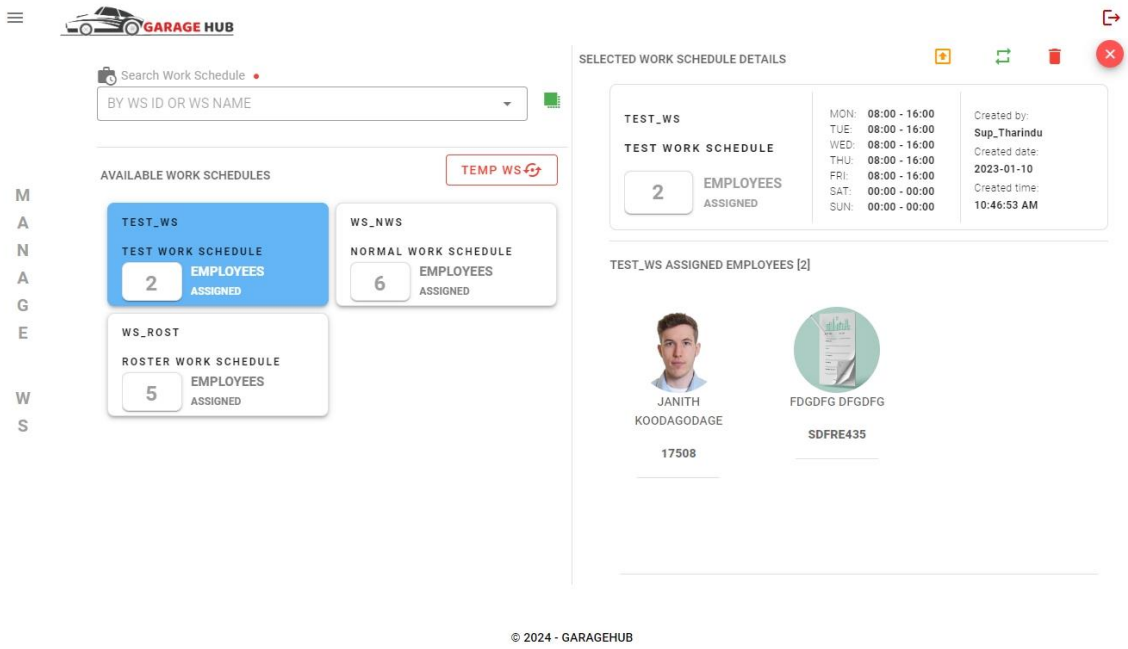

Figure B.13 – Manage Work Schedule View

Manage Groups

Access Level: **Admin**

The User can create new Employee Groups along with the Sub Groups for management purposes.

Enter a valid employee Group ID and Name in the appropriate fields and click the **Add** button to create a New Employee Group.

Then create a **Sub Groups** for the above-created **Employee Group**. To do that, click the **Employee Subgroup** tab on top of the section, then it loads relevant fields to insert data.

First, choose the employee group that was earlier created from the **Emp Group** drop-down. Then enter the suitable sub-group ID and Name for the sub-group in the **Emp Sub Group ID** and **Name of Emp Sub Group** respectively.

Creating **Employee Groups** operation has to perform first before adding the employee to the new Employee Group. Also, it should be attached to the employee when Adding or Updating the Employee.

The **Available Employee Groups/SubGroups** shows all the available Groups/SubGroups and it shows assigned employees relevant to the Groups/Subgroups as well. Users are allowed to move employees from one group/subgroup to another by using this page.

Figure B.14 shows the **Manage Employee Group View** in the system.

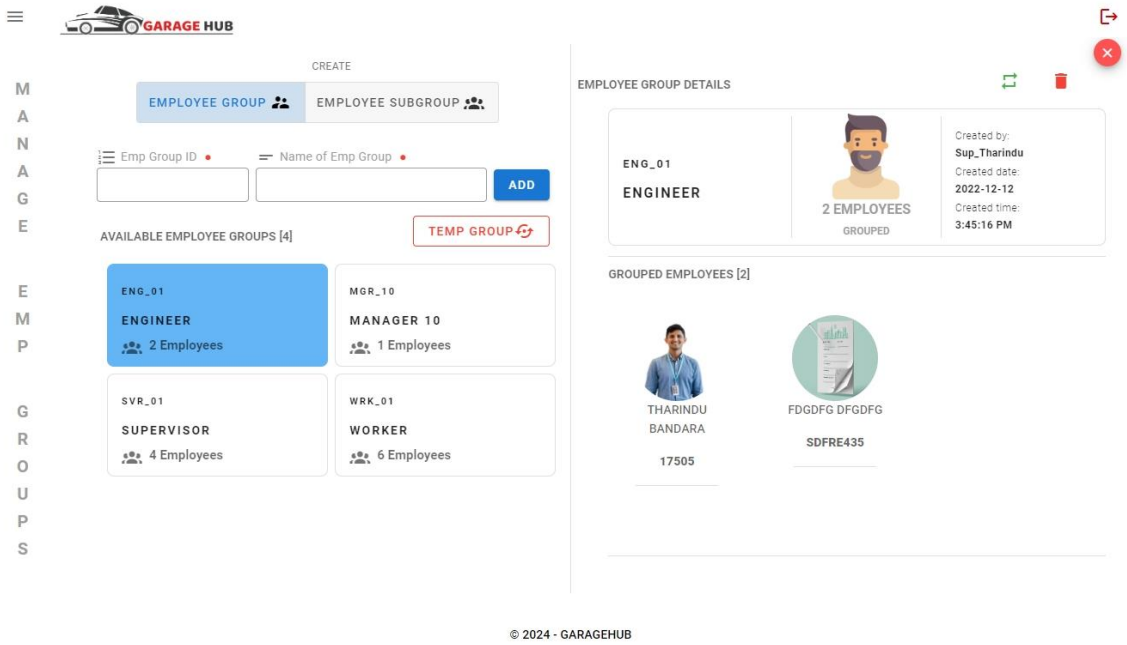

Figure B.14 – Manage Employee Groups View

Manage Grades

Access Level: **Admin**

The User can create new Employee Grades as **Executive** and **Non-Executive** for management purposes.

Select the appropriate employee group from the top of the section then enter a valid Employee Grade ID and Name in the appropriate fields. Enter the Minimum OT duration allowed for that Grade and the Amount for the Minimum OT Duration in relevant fields and then click the **Add** button to create a New Employee Grade.

Creating **Employee Grades** operation has to be performed first before adding the employee to the new Employee Grade. Also, it should be attached to the employee when Adding or Updating the Employee.

The **Available Employee Grades** shows all the available Grades and it shows assigned employees relevant to the Grades as well. Users are allowed to move employees from one garde to another by using this page.

Figure B.15 shows the **Manage Employee Grade View** in the system.

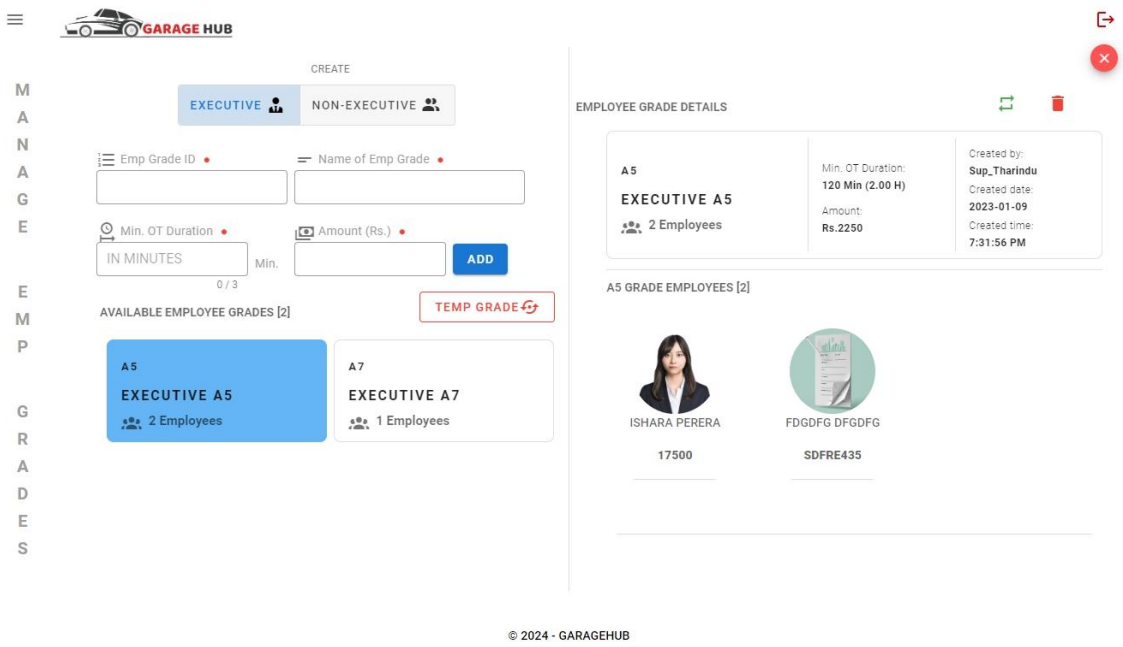

Figure B.15 – Manage Employee Grades View

Attendance

Access Level: **Admin**

Under this view of the system, the user can be able to view the employee's attendance. It initially shows "Today's Attendance" to identify the presence of employees to work on the current date. The user can be filtered out by the employee-wise attendance for a period of a month by selecting a specific employee and a month and can be able to see the specific employee's attendance records month-wise.

This process is happening by automating the fingerprint records processing to the online server, but the system allows the user to add manual attendance records employee-wise when the process has some issues.

The following Figure shows the **Attendance View** in the system.

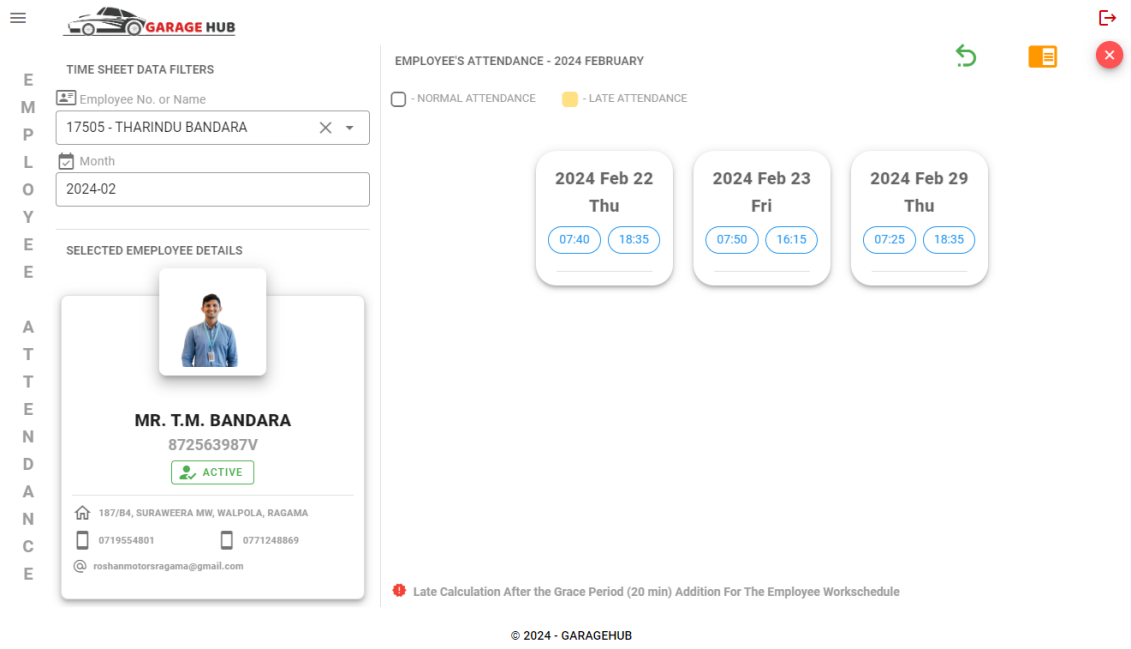

Figure B.16 – Attendance View

Leave

Access Level: **Admin**

This view shows the employee's leave-related details. The view initially shows the employees who have taken leave on the current date. And like the attendance view, the user can be able to view the leave of a specific employee for a specific month. The user has to be entered on or before a leave entry for employees to maintain the leave records for the employees.

The user has to select the employee and the date of leave with the reason for it to set a leave for the employee.

Figure B.17 shows the **Leave View** in the system.

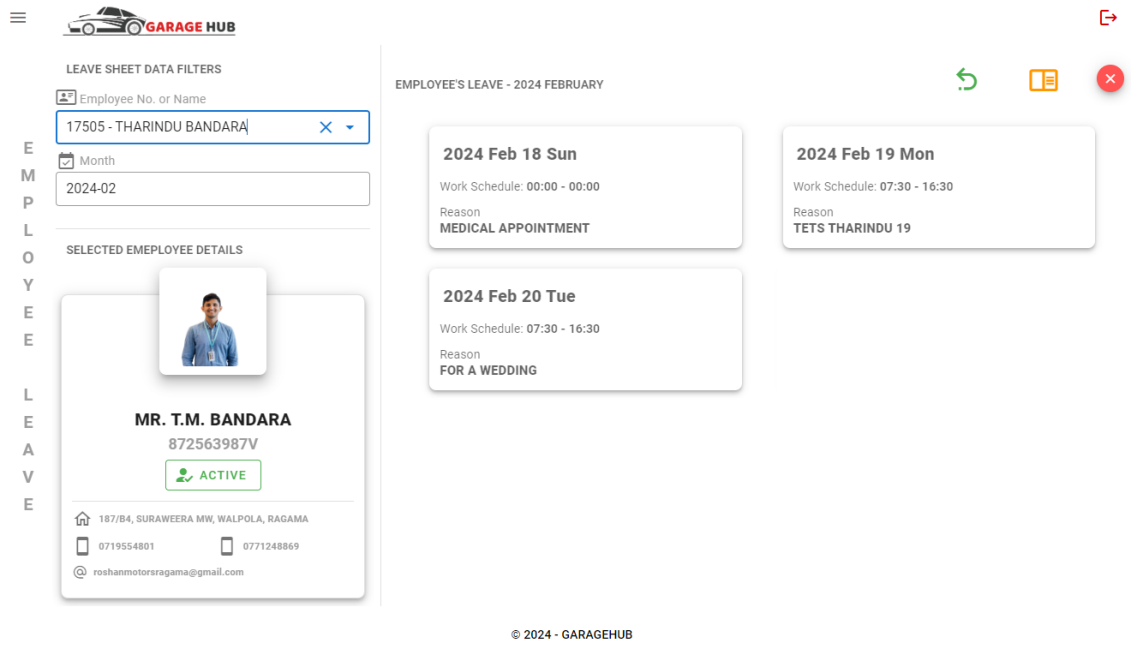

Figure B.17 – Leave View

Overtime & Payroll

Access Level: **Admin**

This section relates to the employee Overtime and Salary calculation. The system will automatically calculate the overtime and salary of all the employees based on their overtime worked duration and the lates. It is mandatory to maintain consistent attendance records whereas the late calculation performs the late covering from the excess time the employee worked and salary deduction if the conditions are not met. The user can see the summary of the results of overtime and Payroll calculations for employees as well as the company. **Finalizing the overtime and payroll** will confirm the final results of the calculation and it usually happens on the last day of a month as well.

The following Figures show the **Overtime View** and the **Payroll View** of the system.

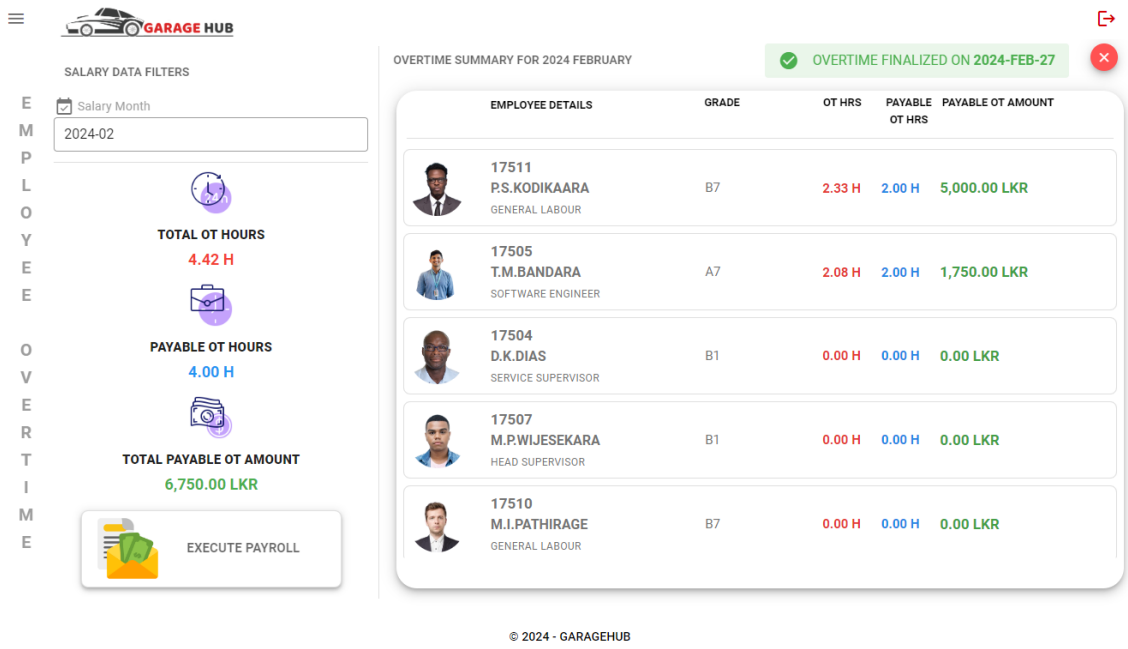

Figure B.18 – Employee Overtime View

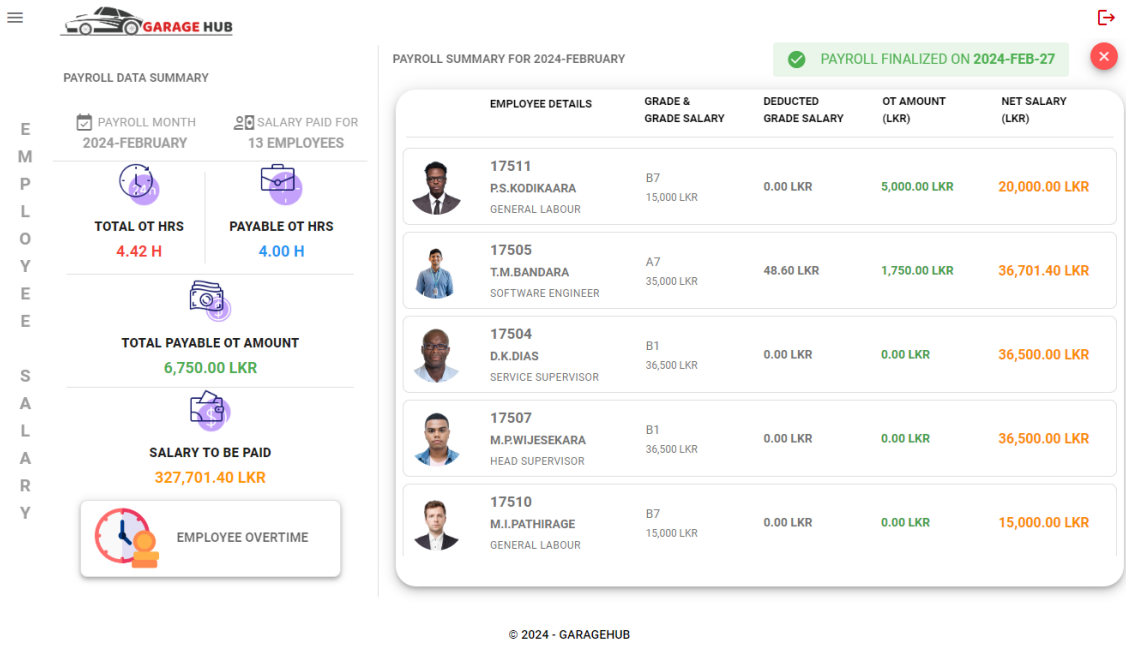

Figure B.19 – Employee Payroll View

Client Management Module

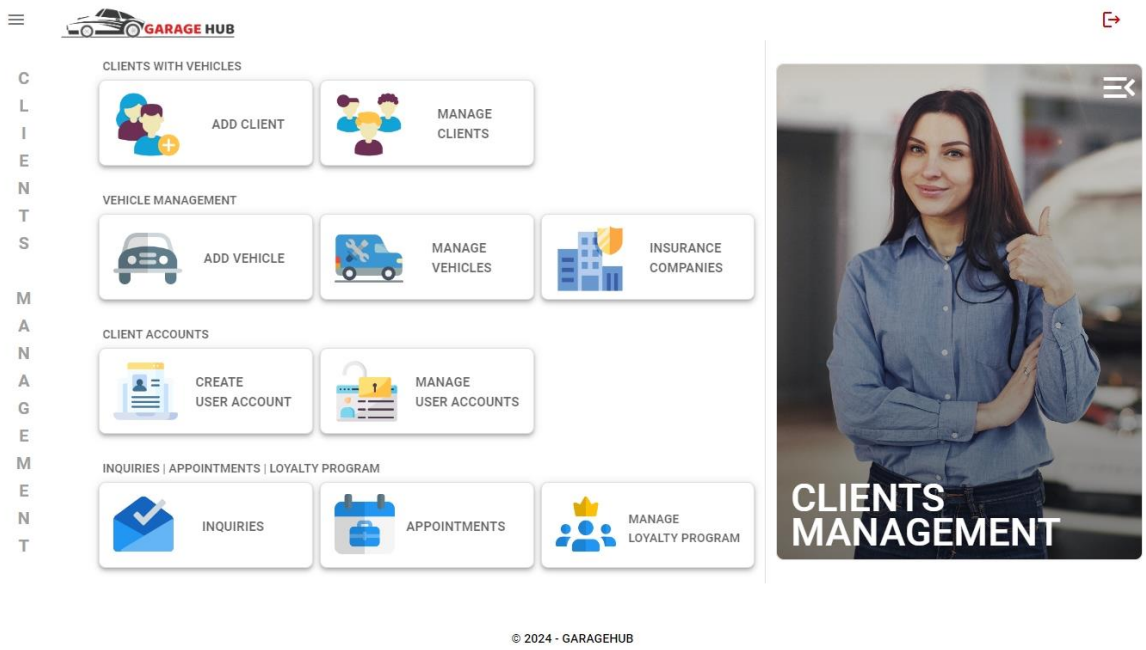

Figure B.20 – Client Management Module

The above Figure shows the task included in the Client Management Module.

Users can access it by clicking the **Client Management** button in the **User Menu Section** and all the client-related tasks are available here including Add and Manage Clients and Vehicles, Insurance companies, Create and Manage User Accounts, Inquiries, Appointments and Loyalty Programs.

The following are the detailed descriptions of tasks in the Client Management Module

Add & Manage Vehicles

Access Level: **Admin**

These tasks perform the master vehicle creation and management process. The User will create a vehicle by filling in all the required fields. Then the user has to upload the vehicle image to give a better user experience to the client and the color list of the vehicle has to be defined to select the client's vehicle color as they want. The user will get a preview of the uploaded image with the relevant components to check and adjust the uploaded image accordingly.

The following Figure shows the **Add New Vehicle View** of the system.

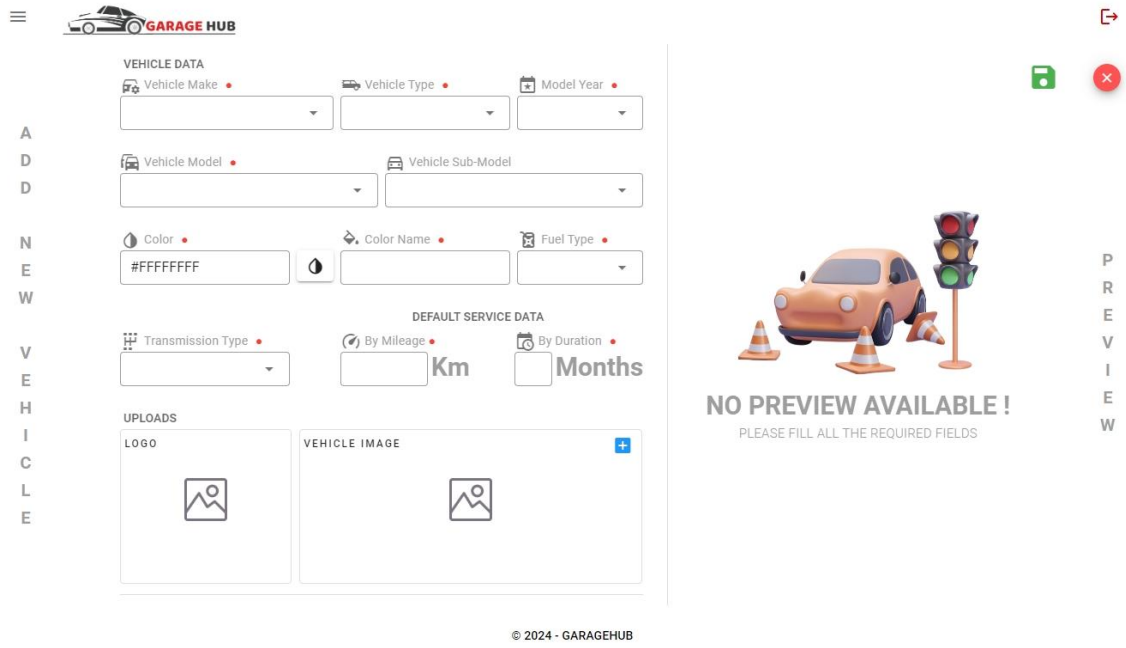

Figure B.21 – Add New Vehicle View

Manage Vehicles view provides the facilities to view specific vehicle details and the list of clients who own this vehicle along with the functions of Update Vehicle and Delete Vehicle. It provides search and filtration options to easily filter out and get the details of the vehicle. Under the Operations section, two shortcuts for Add Client and Add Vehicle are available.

Figure B.22 shows the **Manage Vehicles View** as follows,

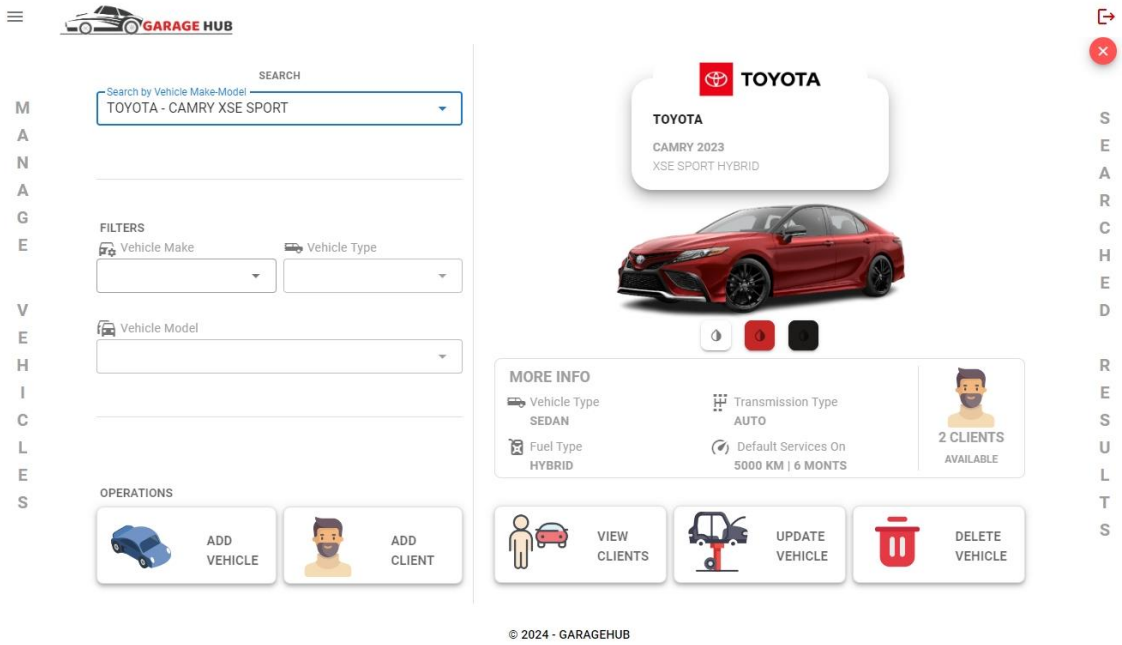

Figure B.22 – Manage Vehicles View

Add & Manage Clients

Access Level: **Admin & Supervisor**

This section allows the users to add clients for the workshop to handle job card operations. It is not required for the client should register with the online account but for the records maintenance.

This task should be performed before the job card is created. Since the client's availability is a must for the job card.

For Adding a Client to the system, first of all, Enter the NIC number of the client. The system will search and fill all the fields relevant to the NIC number when the client is already available in the system, Otherwise, the user has to fill in all the required fields along with the vehicle/s to manage their vehicles by workshop.

The following Figure shows the **Add Client & Vehicle View** as follows,

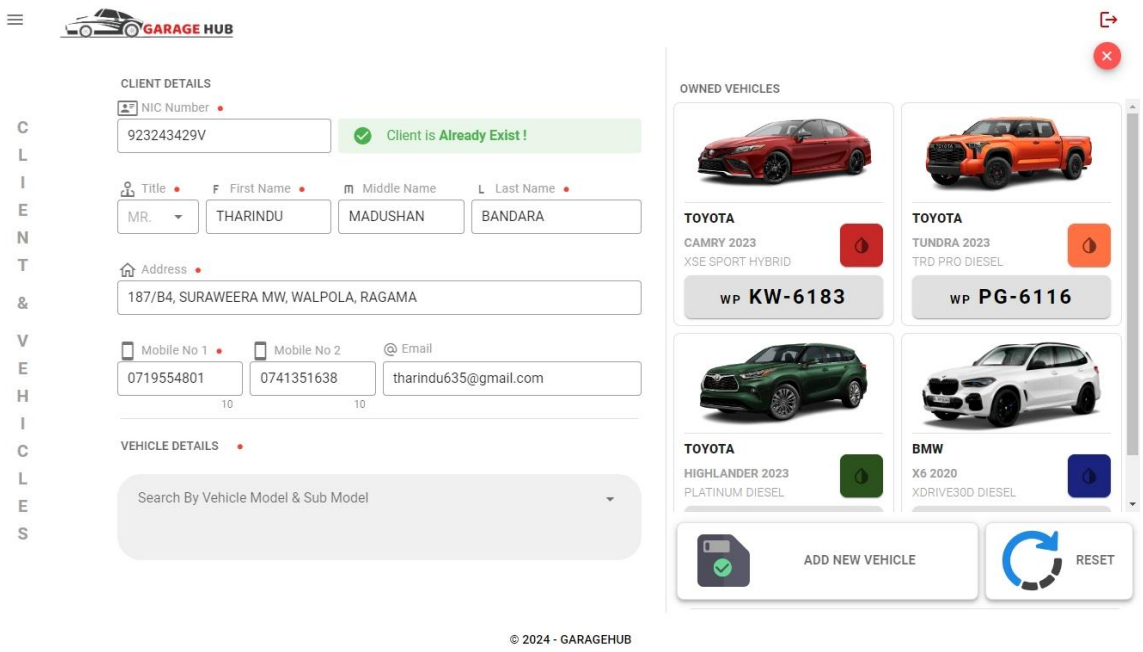

Figure B.23 – Add Client & Vehicles View

The **Manage Clients** view allows users to filter the specific client by NIC or a Name or a client group by the Loyalty level. It allows users to view and update Vehicle Info and the Client Details and Client Delete operations.

The Following Figures show the above-mentioned tasks in the system,

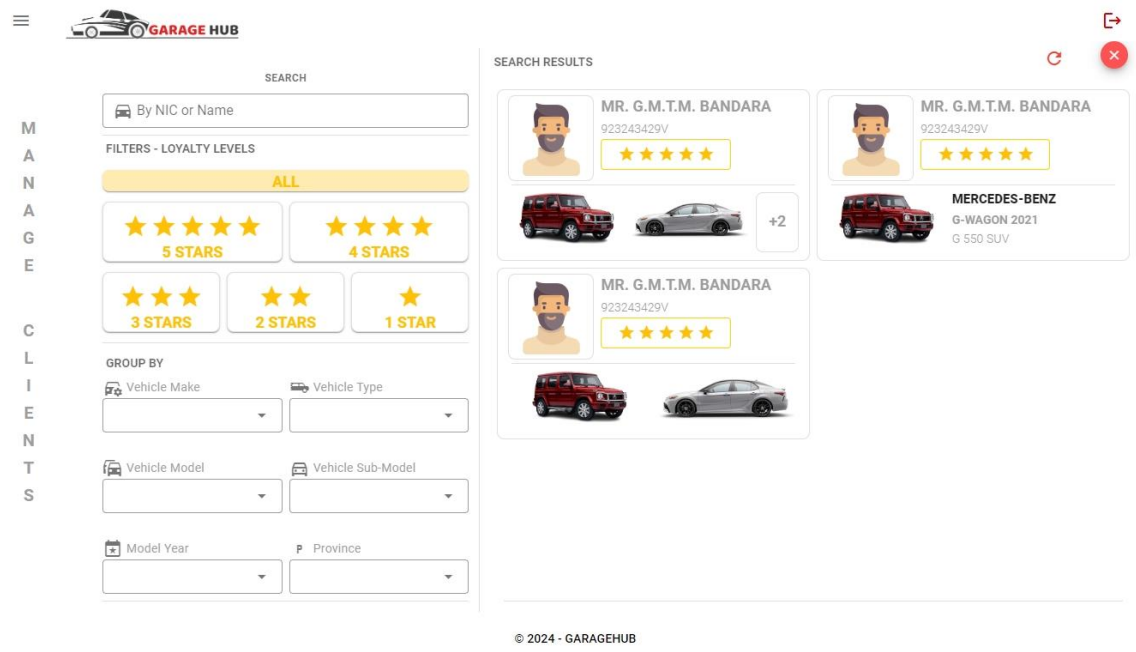

Figure B.24 – Manage Clients View

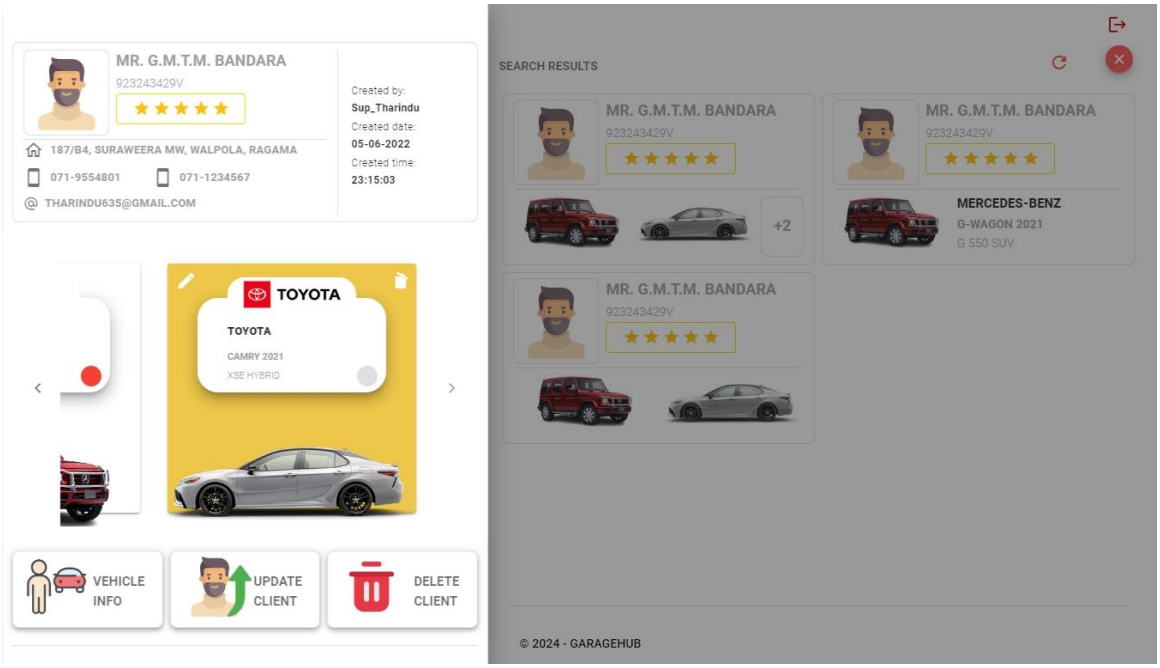

Figure B.25 – Specific Client Operations View

Insurance Companies

Access Level: **Admin**

The system should maintain all the Insurance companies that the workshop handles. It is used to create job cards which claimed by insurance. Just providing the Insurance Company ID and Name will create an insurance company-related record and it will be used to further processes.

The following Figure shows the Add Insurance Company View,

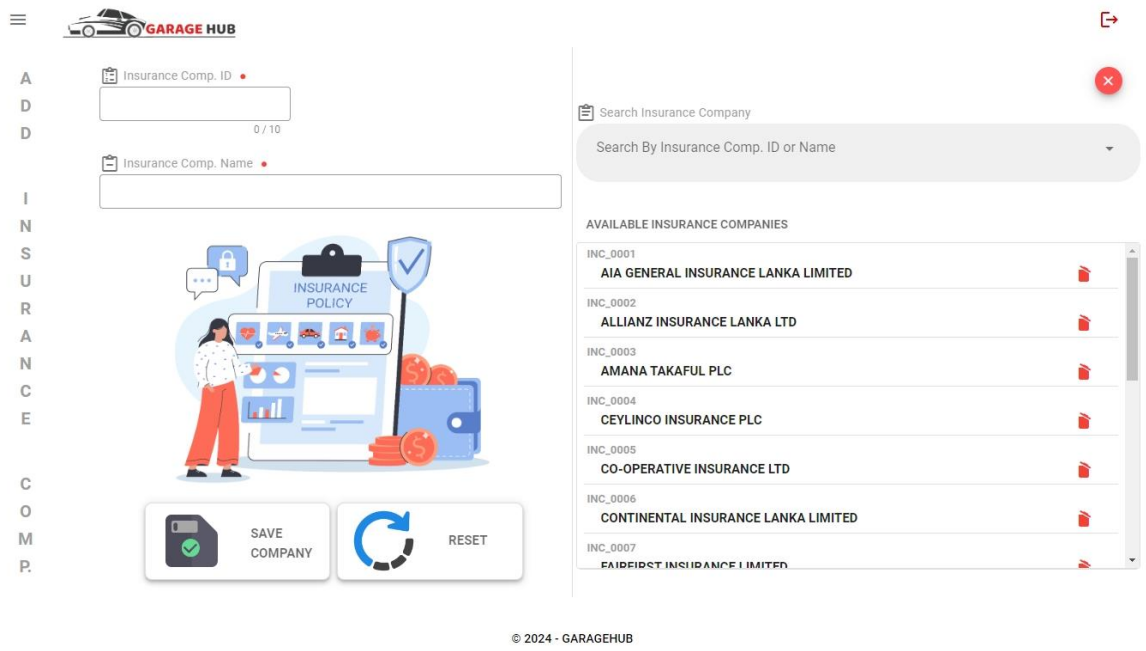

Figure B.26 – Add Insurance Company View

Create User Accounts

Access Level: **Admin**

This page is used to create user logins for the user levels of the system which are Admin, Supervisor and the Client. It is used to create an Email/Password method to create user credentials for the system. As the workshop users, the Admin and the Supervisors have specific views compared with the client view. Defining here will help to identify the user level in the user login and direct to the specific pages accordingly.

Before creating Credentials for a client/employee, you should select the user type at the top of the section, and then search for a specific client/employee. It will show if he/she has credentials for the system otherwise user has to fill in all the required fields to create a user account.

Figure B.27 shows the **Create User Account View** of the system,

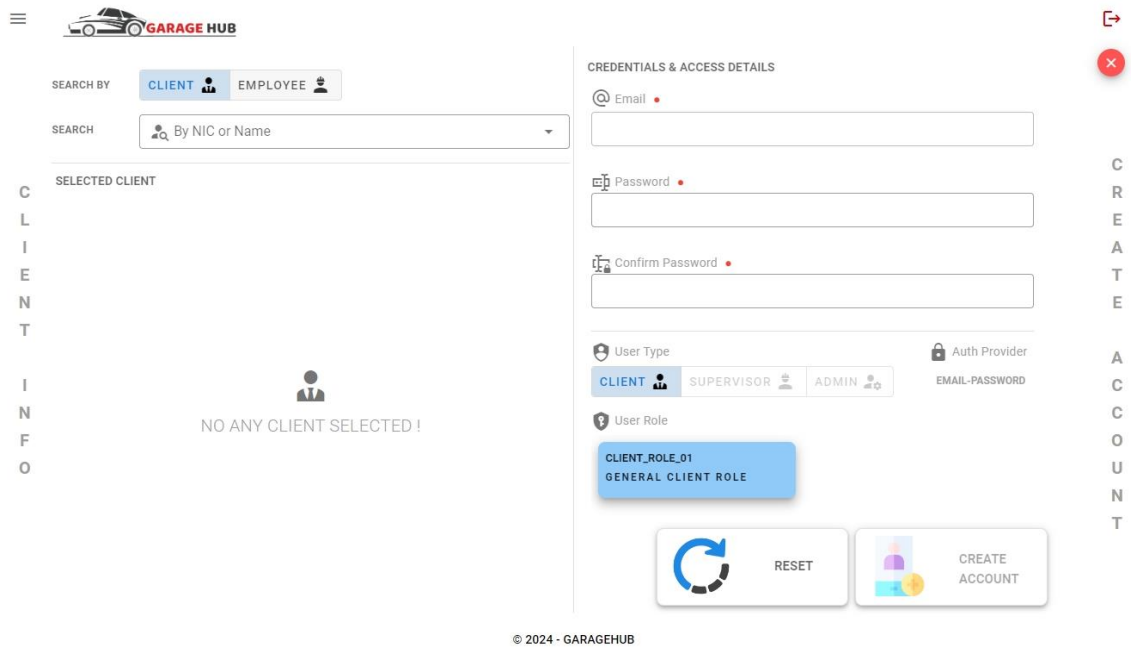

Figure B.27 – Create User Account View

Inquiries

Access Level: **Admin & Supervisor**

It's a messaging system that connects every user level in the system, It will allow the admin/supervisor to compose a message for a specific client or a group very easily. Also, Client inquiries will be handled there and clients can communicate with the workshop more conveniently.

The following Figure shows the Inquiries View of the system,

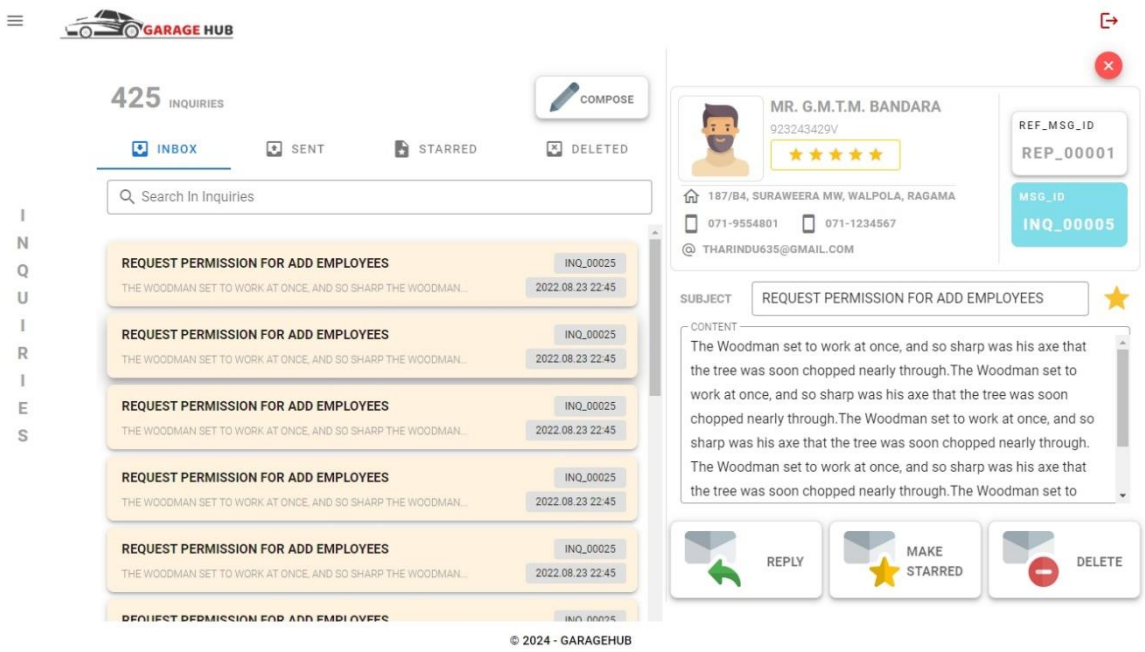

Figure B.28 – User Inquires View

Appointments

Access Level: **Admin & Supervisor**

The **Appointment View** handles all the user appointments for the services and repairs. Every appointment that is reserved from the Client user account is visible here and the Admin or the Supervisor can access it to create appointments at the workshop as well. For the easiness, the job card creation related to the appointments is allowed by the system and it can be achieved by going through the appointment.

To place an appointment, select the Appointment Type and fill in all the required fields of Appointment Date, Period, Vehicle Number and Priority Level. If there are any additional notes to inform when the job card is created, leave the note in the appropriate text field as well. Then click the **Set Appointment** button**.** It will show the created appointments under the **Available Appointments** section. Users can able to click an appointment and it shows the details of the appointment and the operations for Delete appointment and for the Job card creation as well. Click the Create Job Card button to create a job card relevant to the appointment.

Filtering options are available to filter out the previous and current appointments for inspections as well.

Figure B.29 shows the **Appointment View** of the system.

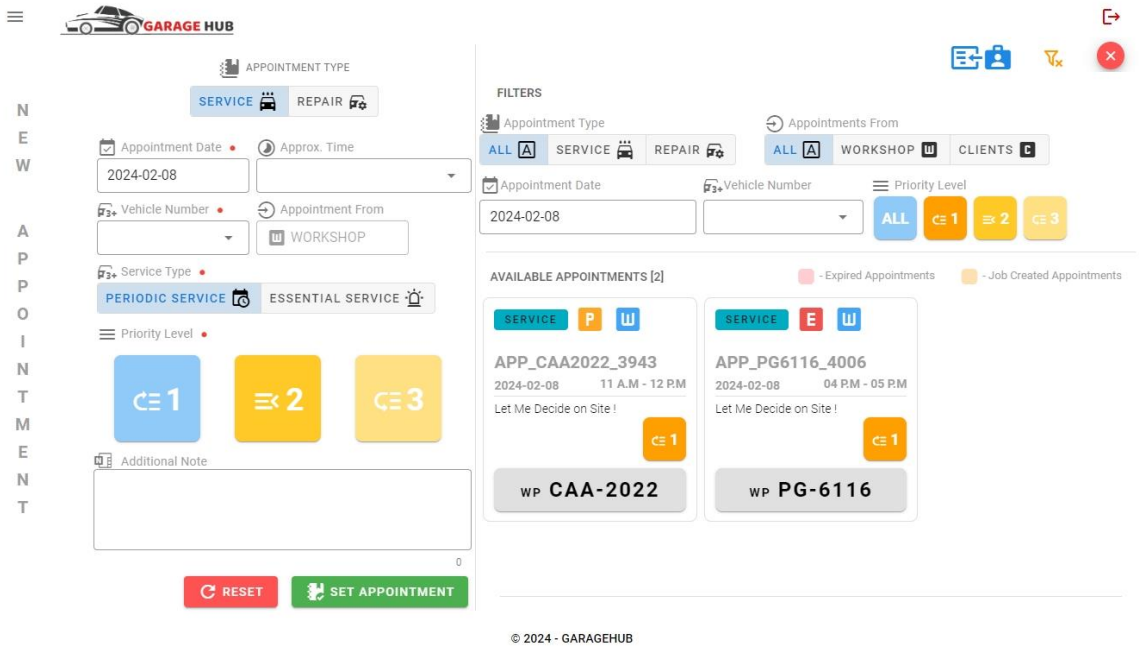

Figure B.29 – Appointment View

Manage Loyalty Program

Access Level: **Admin**

The Loyalty Program defines all the promotions that the workshop offers to its clients. The user has to set the conditions through the input fields including the promotion start and end time and it automatically indicates when the invoice generation for the job cards according to the conditions.

Figure B.30 shows the **Manage Loyalty Program View** of the System.

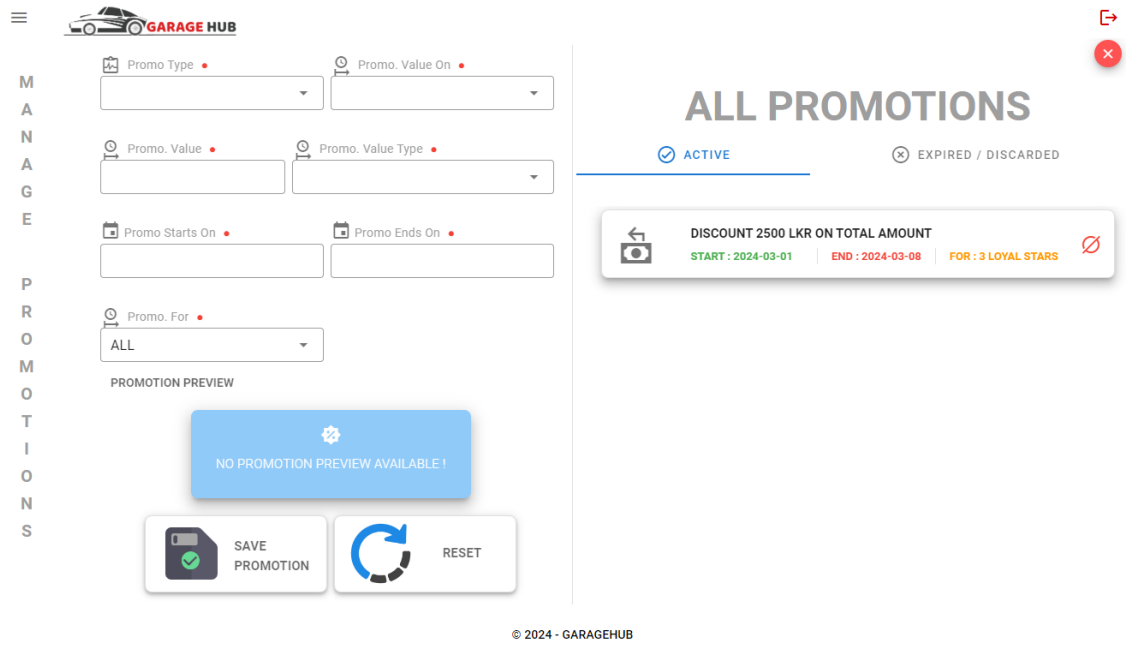

Figure B.30 – Manage Promotions View

Job Management Module

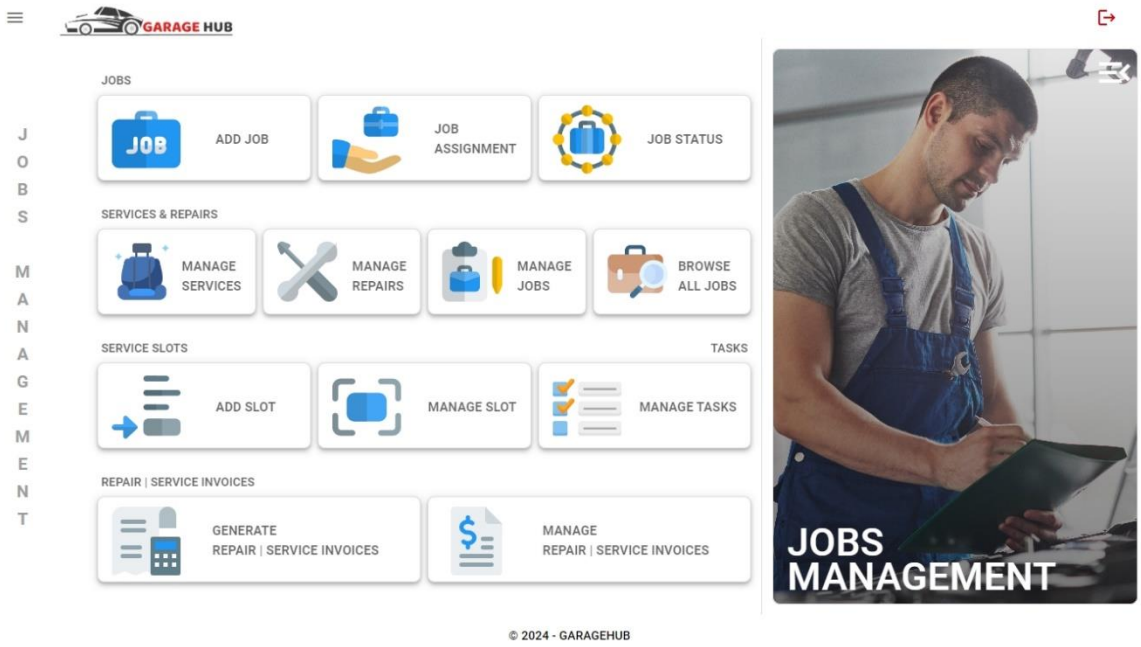

Figure B.31 – Job Management Module

The above Figure shows the task included in the Job Management Module.

Users can access it by clicking the **Job Management** button in the **User Menu Section** and all the job-related tasks are available here including Add and Manage Slots and Tasks, and the main process of Job creation including Add Job, Job Assignment, Manage Services & Repairs, Manage Jobs, Browse all Jobs, Current Status of the Workshop and Generate and manage Job Invoices.

The following are the detailed descriptions of tasks in the Job Management Module

Add & Manage Slots

Access Level: **Admin**

When defining the workshop, Add Slots to the Workshop for the system is mandatory since it uses the job cards to assign specific slots in the workshop to perform the job cards.

To do this, the user has to specify the Sub Type from the list which defines the condition of the service or repair and it automatically fills up some required fields that are common to that sub-

type, also it shows already defined slots under the **Available Slots** section. The user has to enter a valid Slot ID and Name and then click the **Add to Workshop** button only.

If the user wants to define a new sub-type for the workshop, leave the Sub Type empty, then the user is able to select Slot Type and all the relevant fields including Sub Type Color, Icon, Assigned Division, Slot ID and Name. Slot Preview shows the final result of the slot according to the entered data.

The following figure shows the **Add Slots View** in the System.

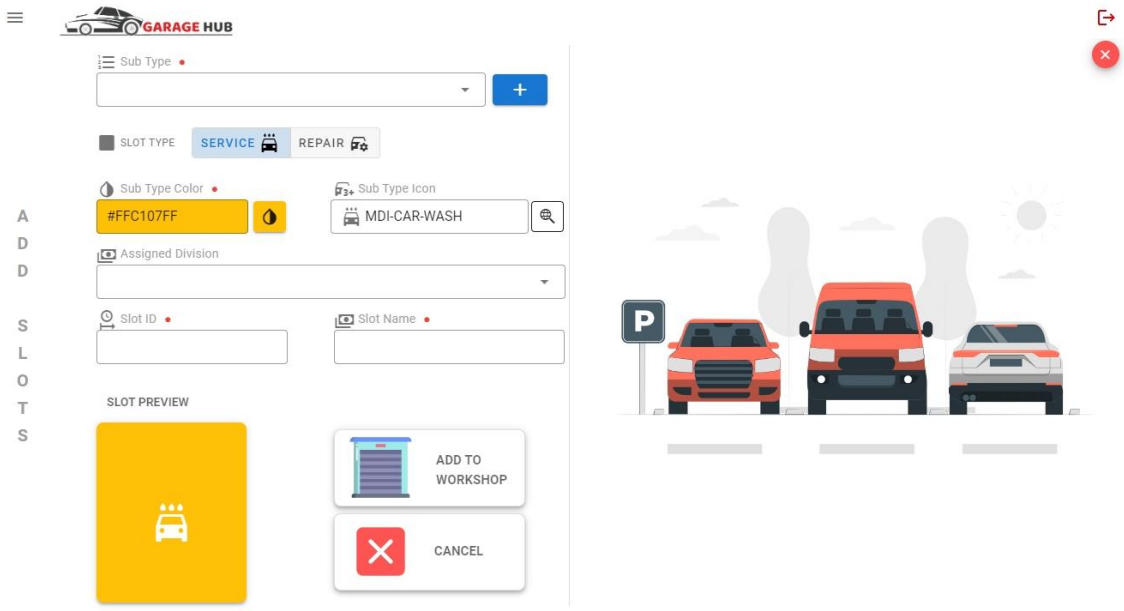

Figure B.32 – Add Slot View

Manage Slots view allows users to check all the defined slots and their functions including viewing more info about specific slots with the details of slot assigned job details and it offers to do slot info updates as well as delete slot operation.

The following Figure shows the **Manage Slots View** in the system.

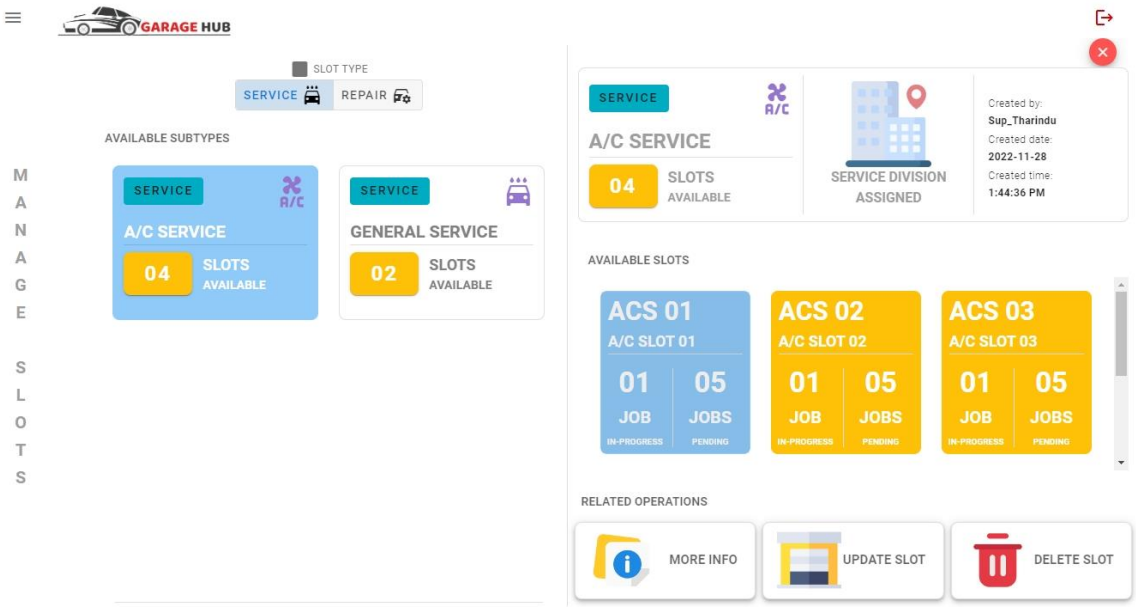

Figure B.33 – Manage Slot View

Add & Manage Task

Access Level: **Admin**

This is also an initial step that has to be carried out before creating a job card. The user has to define all the tasks that the workshop performs including relevant details.

To do this, fill in all the required fields of the **Add New Task** view and upload a task image to visualize on the dashboard to help to identify tasks quickly.

On the same page, it shows all the defined tasks and users can update or delete a task as per the user requirements.

The following Figure shows the **Add New Task View** in the system,

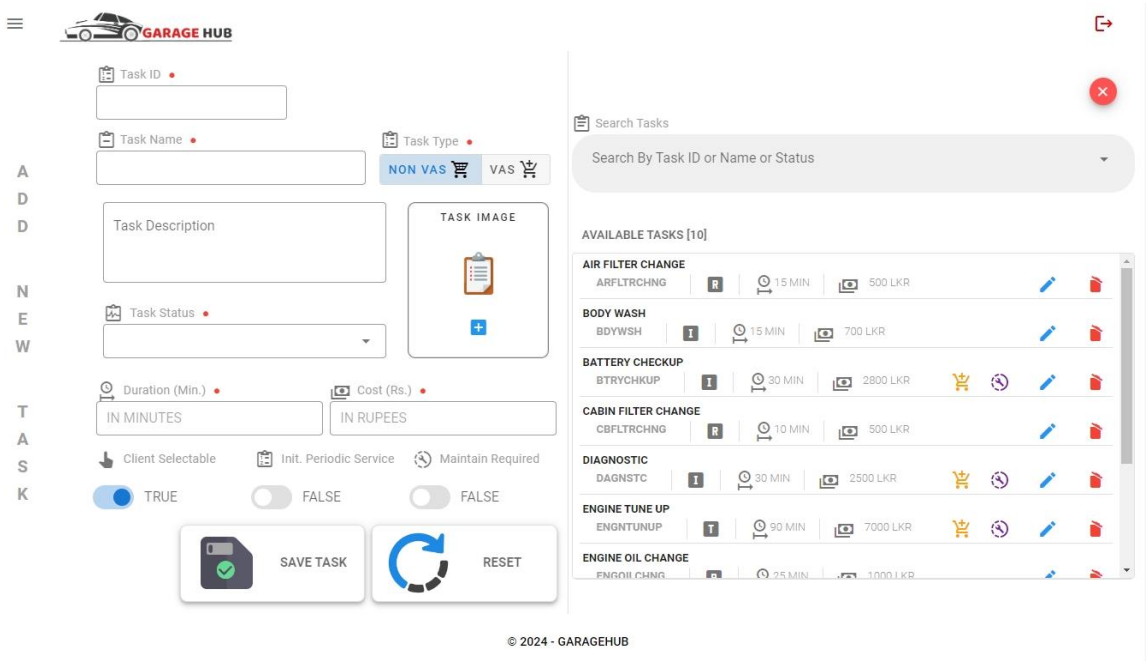

Figure B.34 – Add & Manage TasksView

Add Jobs

Access Level: **Admin & Supervisor**

This task is the entry point of the main process of the workshop. Before every job starts, a job card relevant to the vehicle has to be created and include all the tasks that the vehicle has to do. Clients can specify specific tasks through their client user account as an appointment or in the workshop before the job card starts as well.

To create a Job Card, the Vehicle Number has to be inserted in the relevant field and the system will check and load all the relevant details suitable for the vehicle number. Otherwise, the user has to fill in all the required details accordingly. When checking the vehicle number, the system also checks the appropriate services available for the vehicle that is required to do, if it has, it pops up and notifies the user about it, the user can select that suggestion to proceed with it. Otherwise, the user has to include every task that the vehicle has to do. It shows the estimated cost and the duration for the job card and it will be helpful for the client too.

Select the slot to assign the job and it will carry out this job. After clicking the **Confirm Job Card Creation** button to complete the Job Creation task.

The following Figure shows the **Job Card Create View** in the system.

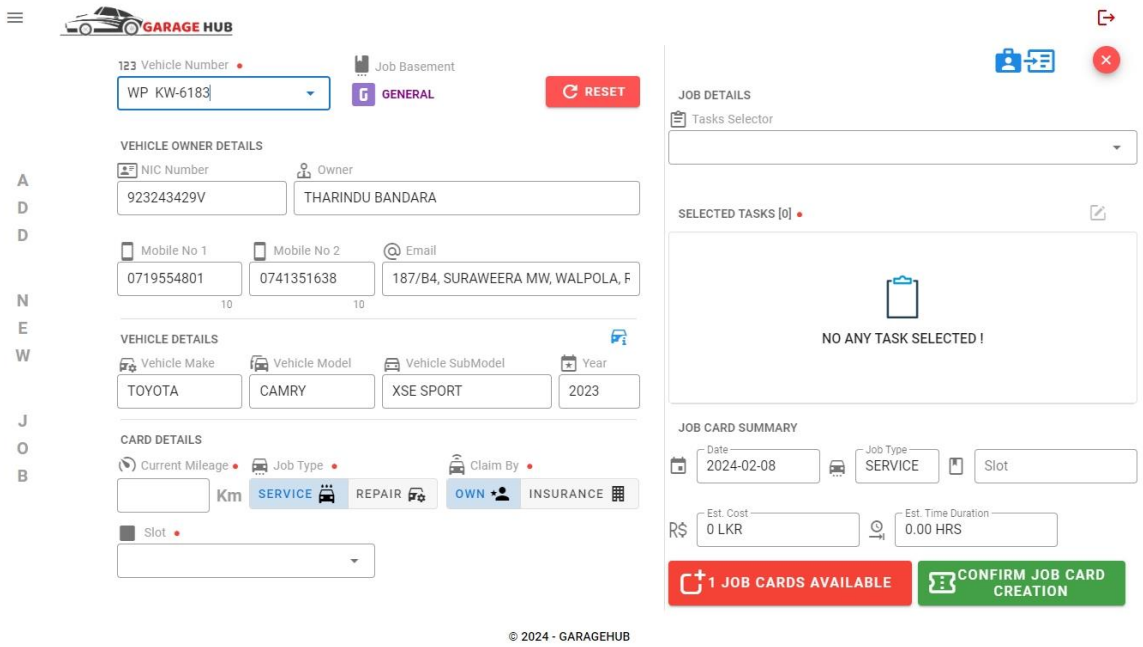

Figure B.35 – Job Card Create View

Job Assignment

Access Level: **Admin & Supervisor**

The next step of the Job card handling is **Job assignment,** in here, one of the supervisors will be assigned by the admin to supervise the job card. It selects the relevant supervisor type by the job card type and can perform the slot changes if any changes have to do with the slot assignment as well. After the supervisor selection, click the **Save** button to save the assignment and pass it to the next phase.

The following Figure shows the **Job Assignment View** in the system.

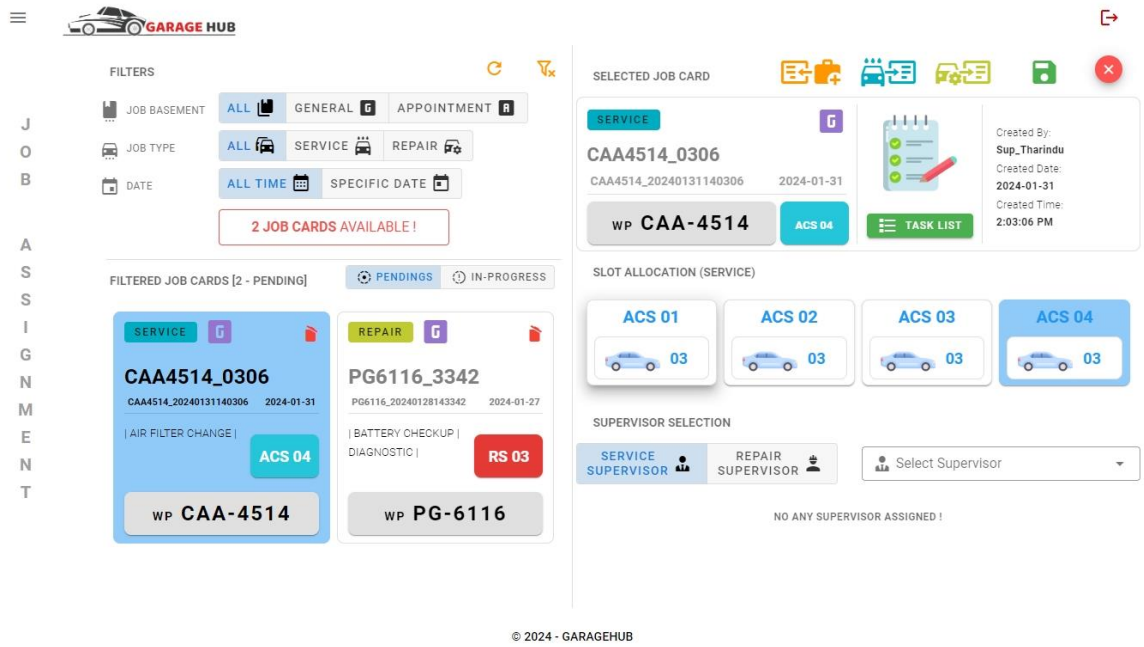

Figure B.36 – Job Assignement View

Manage Services/Repairs

Access Level: **Admin & Supervisor**

In this phase, the employee assignment has to be performed for the job cards. It can be done by the Admin or the relevant supervisor.

Select the most appropriate employees to carry out the job cards.

Figure B.37 shows the **Manage Service View** in the system.

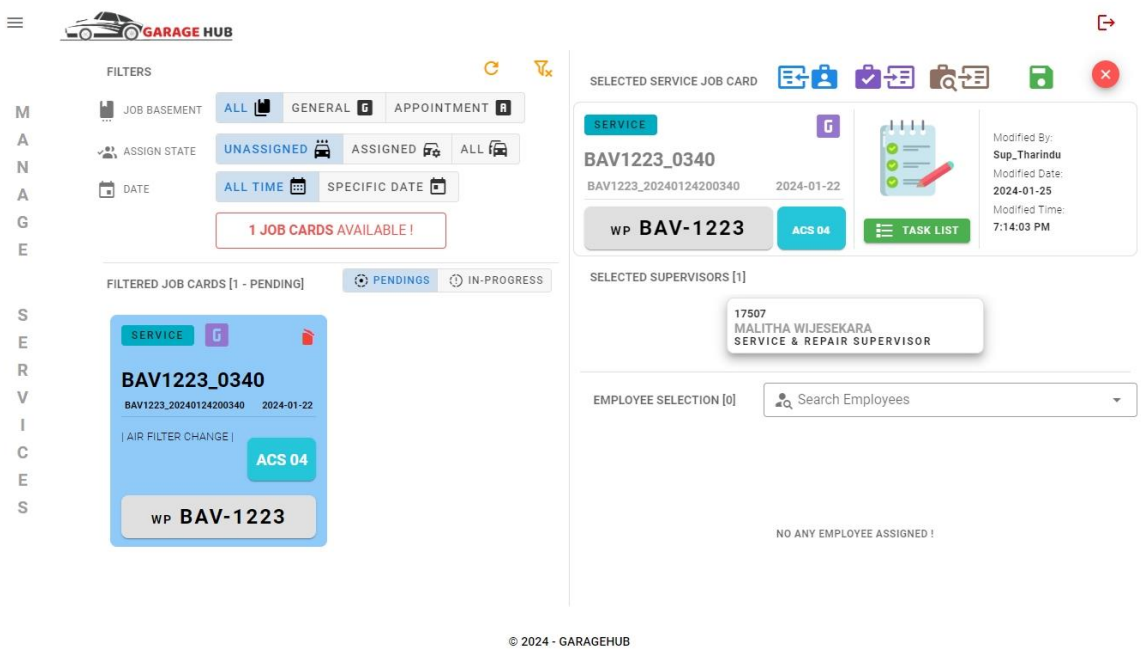

Figure B.37 – Manage Services View

Manage Jobs

Access Level: **Admin & Supervisor**

Manage Jobs view, allows the users to modify the job card status, and it offers some operations such as Job card Updation, viewing job card Status and Vehicle information along with the previous job history. It allows the user to upload some images relevant to the job or the vehicle and also important files as well.

The following Figure shows the **Manage Jobs View** in the system.

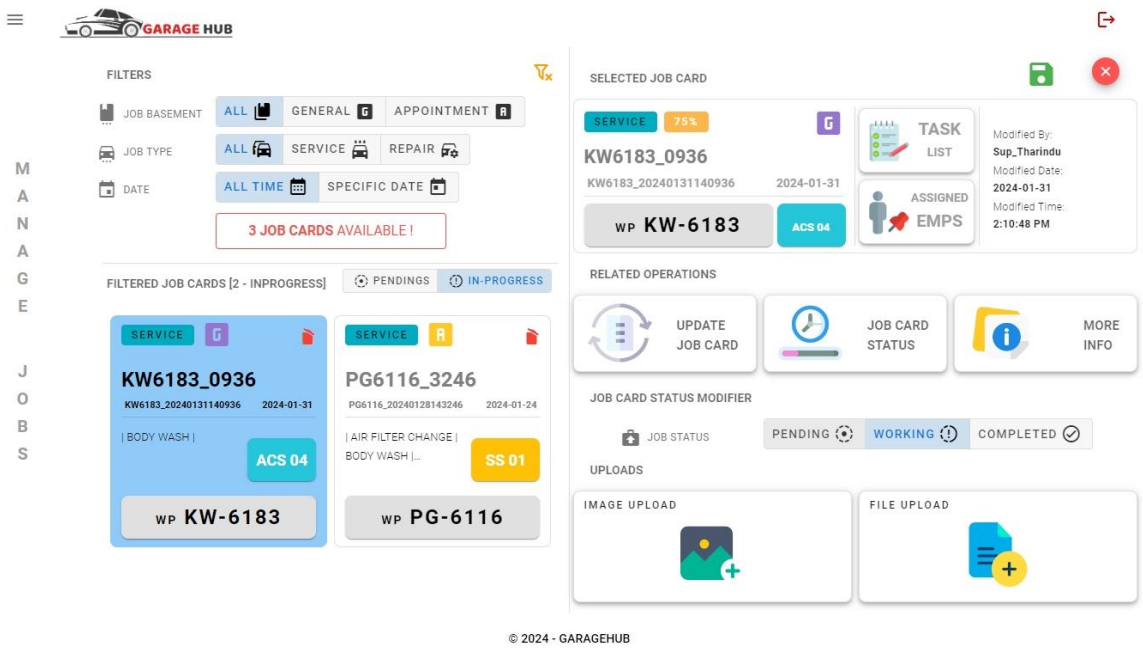

Figure B.38 – Manage Jobs View

Generate and Manage Invoices

Access Level: **Admin**

This page allows the users to generate the Invoice for job cards. Select the Vehicle Number and it populates the completed job cards that have to be invoiced. Select job cards and click the **Next** button to navigate the Invoice Generation.

The service Invoice page shows all the details of the selected job cards with important information including Total Job Cost, Duration, Earned LPs and users allowed to give discounts and payment method selection in this section. Click the **Generate Invoice** button to generate the Invoice for the selected Job cards.

The following figures show the relevant User views in the system.

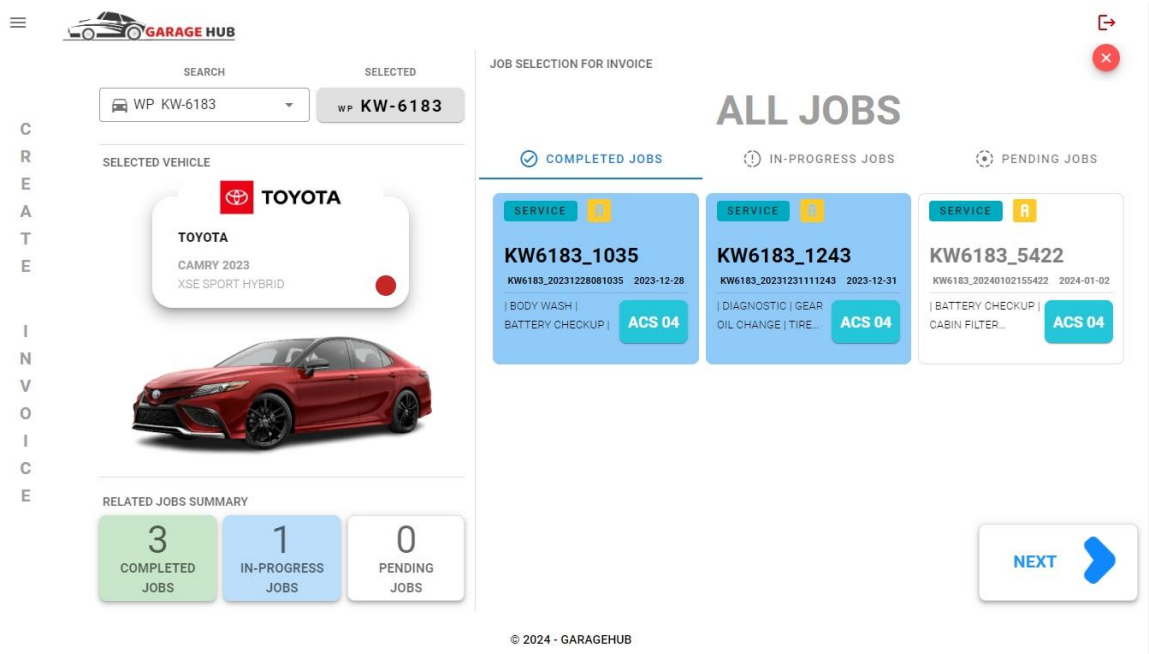

Figure B.39 – Create Invoice View

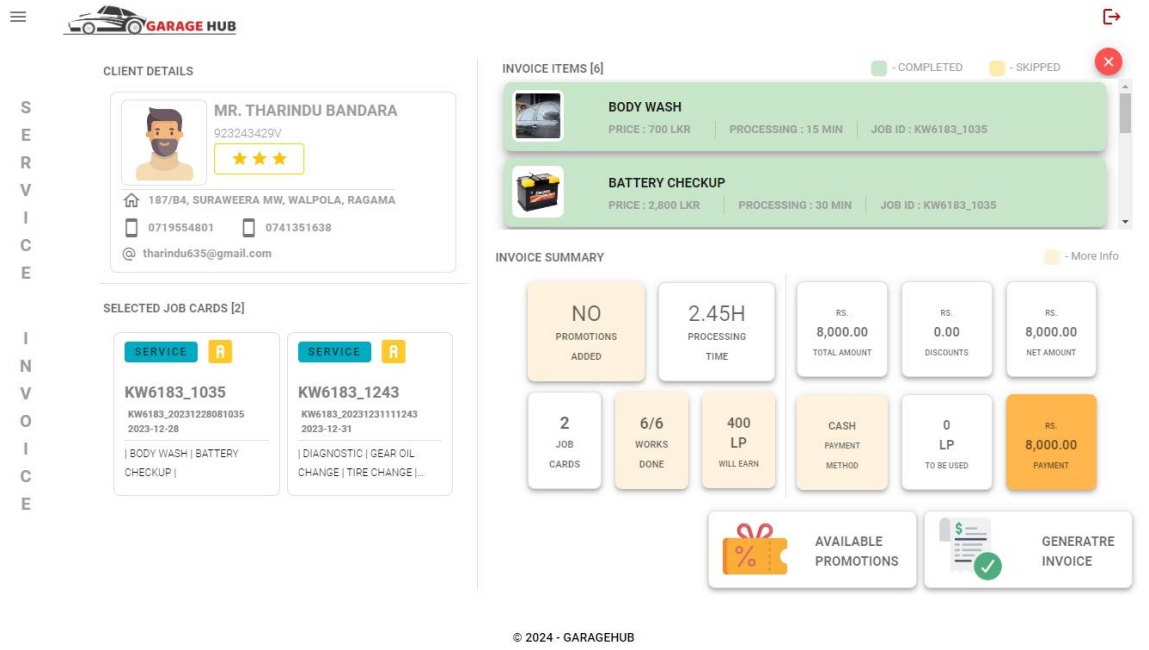

Figure B.40 – Job Invoice View

Manage Invoice Page gives the capability of viewing previous invoices of the vehicle, and it allows to discard invoices with a reason when the mistakes have been made for the invoice. All the discarded invoices are also shown under the Discarded section as well.

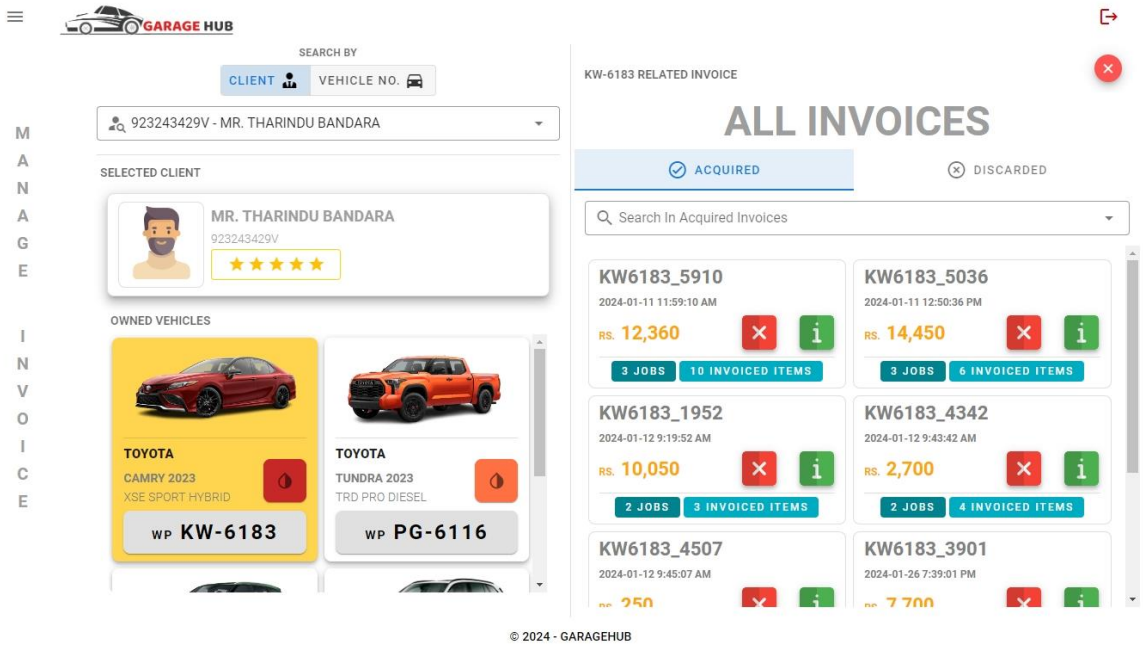

Figure B.41 – Mange Invoice View

Job Status

Access Level: **Admin & Supervisor**

This page allows the users to get an idea about the current job progress of the workshop. It is divided into three sections and aligns job cards accordingly. Clicking the job card will navigate to the Job Card Detail View and it contains necessary details about the job card.

The following Figures show the Job Status related views in the workshop.

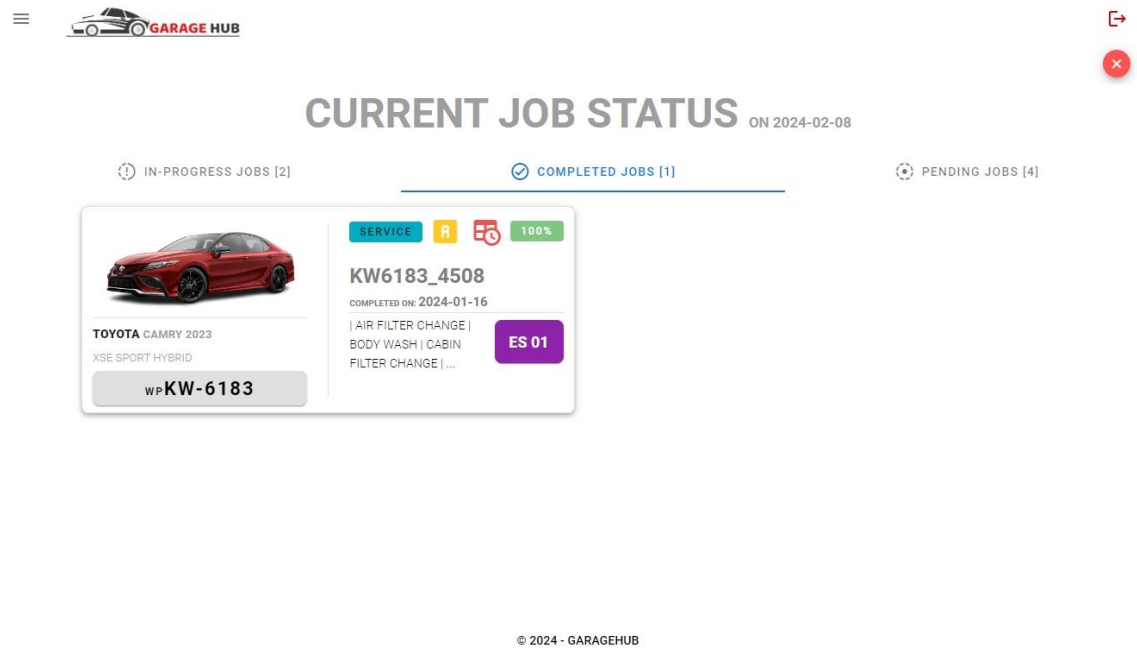

Figure B.42 – Job Status View

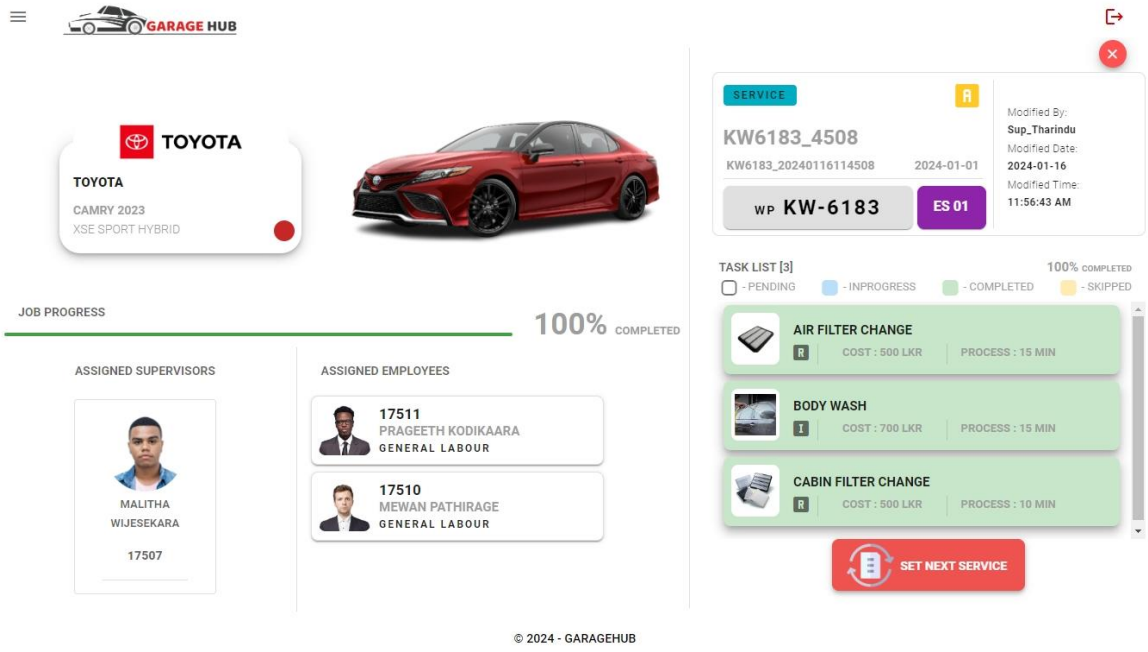

Figure B.43 – Job Detail View

Browse All Jobs

Access Level: **Admin & Supervisor**

This is the place where all the job cards including past and present job card details can be shown. Users have filters to filter out specific job cards and it allows them to view Invoice details and job card details along with the vehicle details containing previous service info, and dates of job status changes. And also it allows to view the uploaded photos and files through this view.

The following Figure shows the **Brows All Jobs View** in the system.

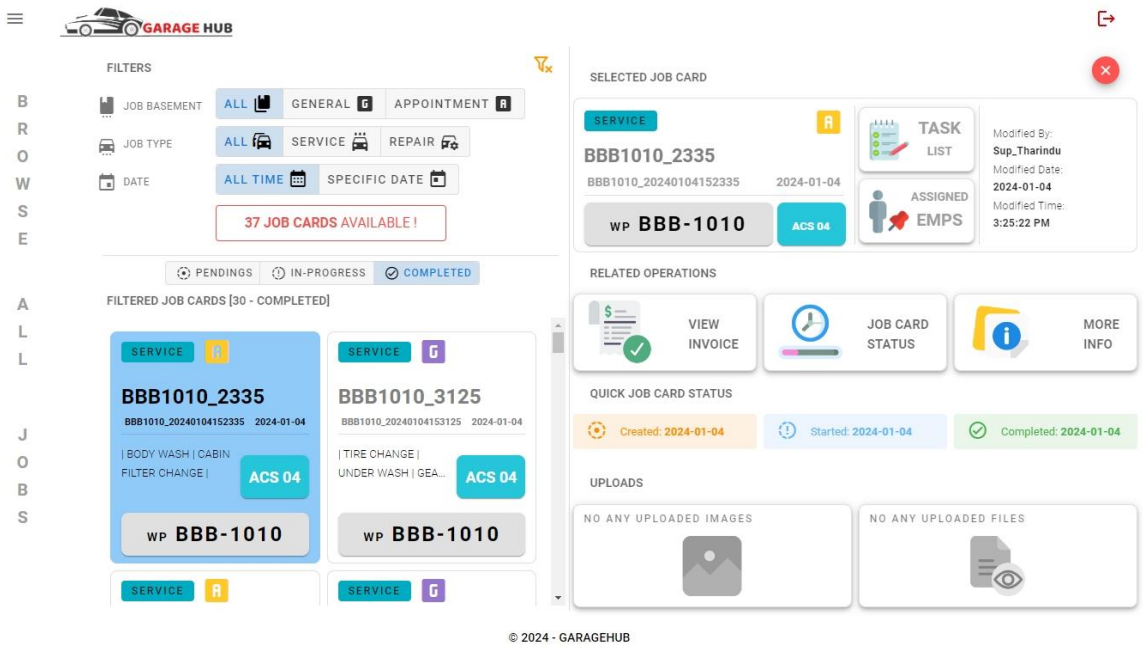

Figure B.44 – Browse All Jobs View

Report Module

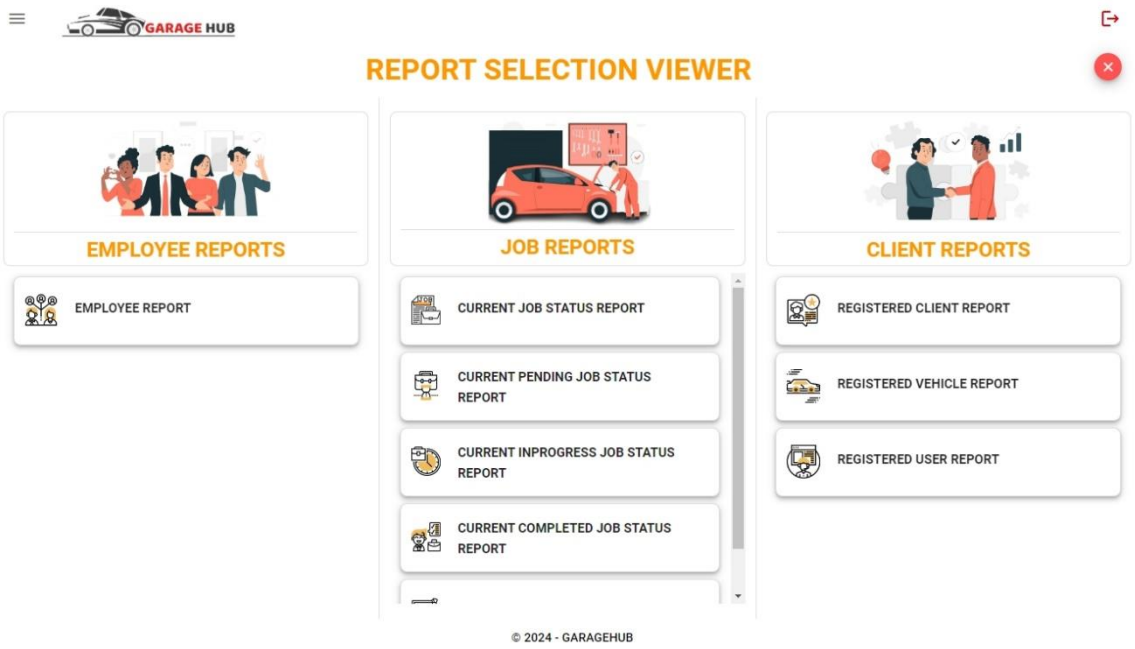

Figure B.45 – Report Module

The above Figure shows the reports included in the Report Module.

Users can access it by clicking the **System Reports** button in the **User Menu Section** and all the reports are available here.

The following are the available reports in the Report Module

1. Employee Report
2. Current Job Status Report
3. Current Pending Job Status Report
4. Current Inprogress Job Status Report
5. Current Completed Job Status Report
6. Daily Invoice Report
7. Registered Client Report
8. Registered Vehicle Report
9. Registered User Report

Every report has a Chart view and a Data view. Chart view gives the users to the analysis capability by filtering various data fields. according to the filtration, the Data view will be generated and it can be downloaded as a PDF format or an Excel worksheet.

The following Figures show the Chart view and Data view of a report.

Figure B.46 – Chart view of Employee Report

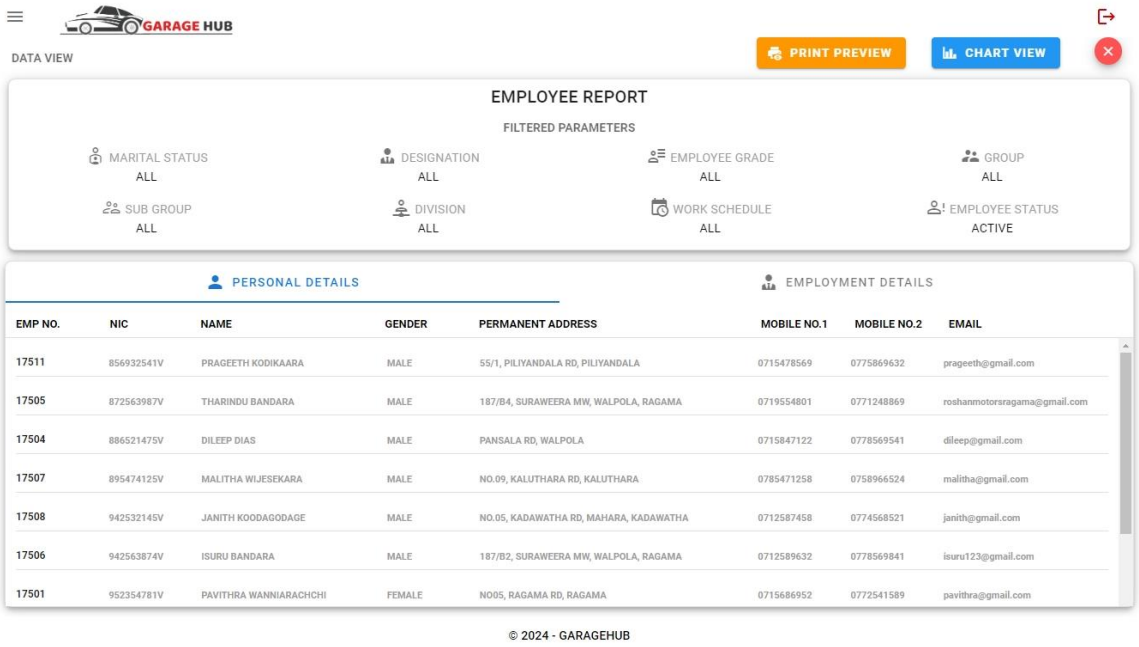

Figure B.47 – Data view of Employee Report

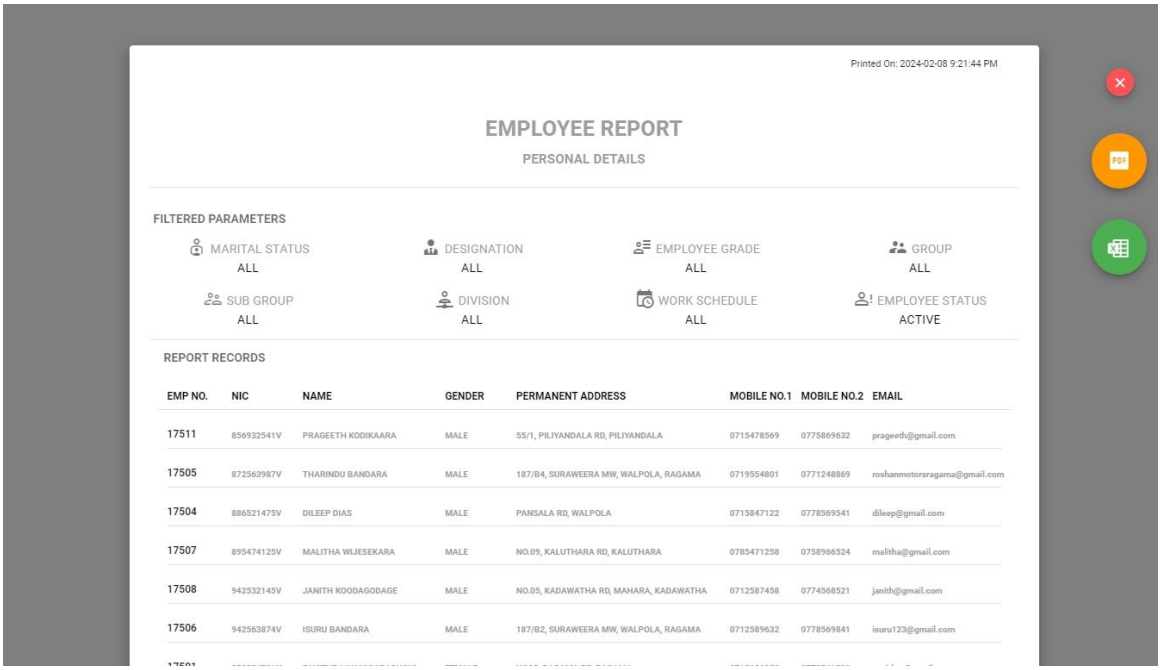

Figure B.48 – Print Preview of Employee Report

APPENDIX C: MIS Reports

Introduction

MIS Reports are the most crucial part of every system that allows the top management to get insights into their organization's status such as the performance of the organization, capacities, and capabilities of what they are doing and so on. And it helps the management to make quicker, more effective and more reliable decisions that affect the growth of the organization as well.

In AWMS, one of the core parts of the system is the MIS Reporting. It allows the management of the workshop to explore and dive deep into every aspect of the organization to get a comprehensive overview of the workshop as well as the core sections which cover the entire business.

As mentioned above, the Employee, Client and Job modules are the core sections of the organization and these three modules are interrelated and interconnected with each other to provide the best and quality services. Managing, maintaining and forecasting are the main tasks that the top management of the organization have to do as decision-makers of the workshop and, On the other hand, the system will play a crucial role in maintaining master and transactional data records to fulfil the base requirement of the decision-making process as well.

According to the report module in AWMS, there are altogether nine report templates available related to the three core modules in the system, and it offers the functionality to filter out specific fields to generate customized report data according to the management needs. Also, every reporting template has a chart view with multiple charts differentiating from each other to view the different aspects of the final data set to get the knowledge of a vast area of relevant sections.

The following are the nine report templates along with the relevant core module currently available in the AWMS.

Table C.1: System Reports in Module Wise

Employee Module	Job Module	Client Module
Employee Report	Current Job Status Report	Registered Client Report
	Current Pending Job Status Report	Registered Vehicle Report
	Current Inprogress Job Status Report	Registered User Report
	Current Completed Job Status Report	
	Daily Invoice Report	

Evidence of the reports

Report Selection Viewer

The following figure shows the Report Selection Viewer where all the reports appear to the management user.

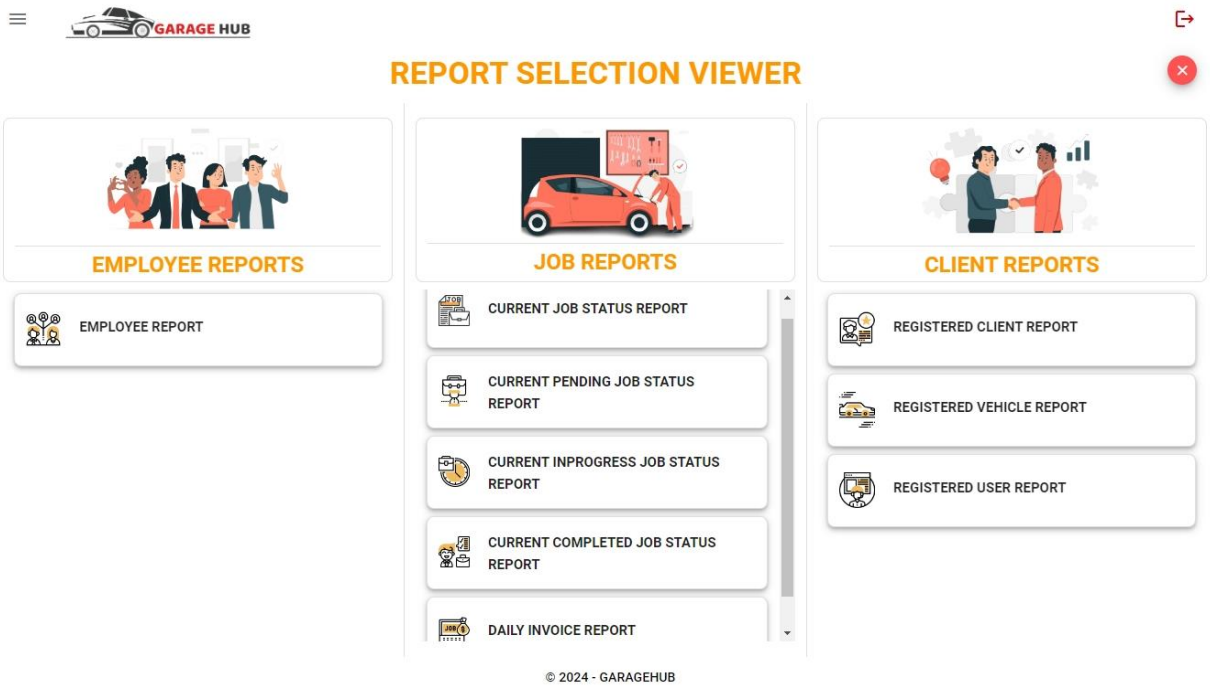

Figure C.1: Report Selection Viewer

Report Download Options

Every report has a Chart view that acts as a dashboard for the management user to quickly do the filtration and get the result in a second and a Data view is also available to check what the final result consists of.

In the Print Preview interface, users can download the reports in PDF formats as well as Excel documents to perform further calculations to use in the decision-making process later.

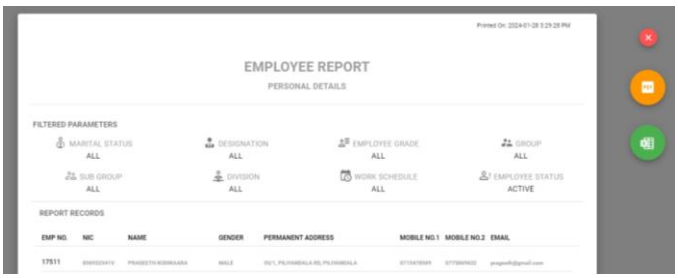

Figure C.2: Report Download Options

Employee Report

The Employee report exists with various filters to filter out specific employees by their personal and employment properties.

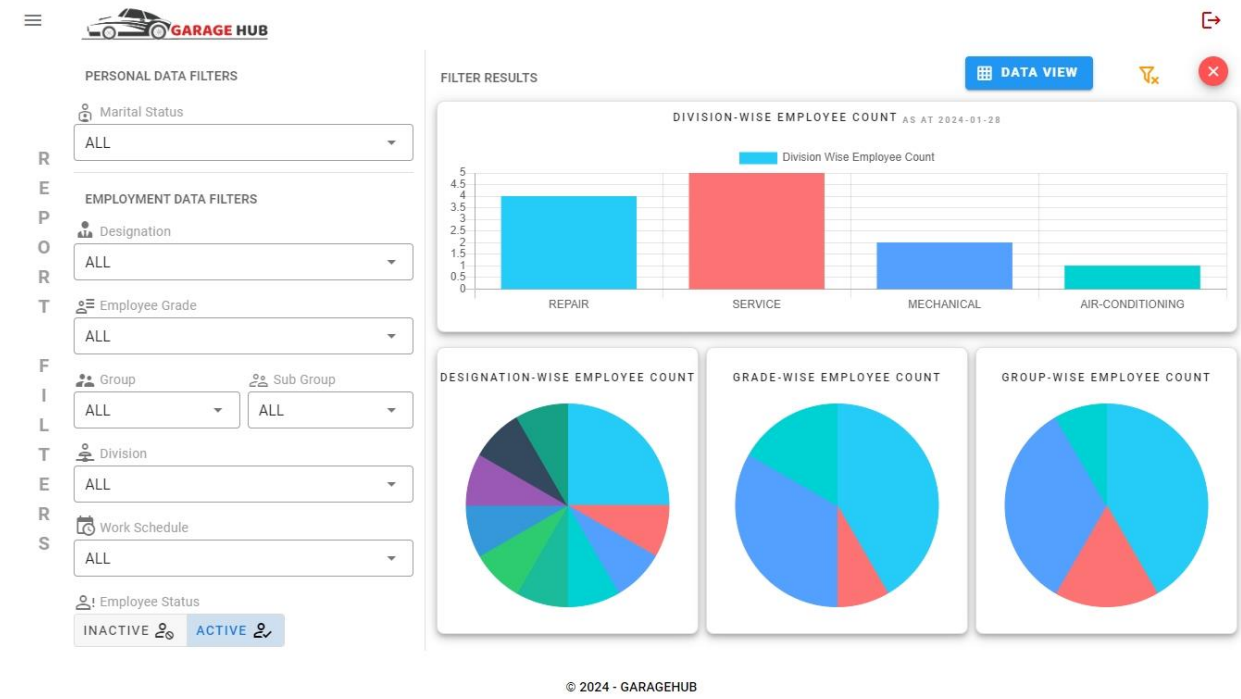

Figure C.3: Employee Report Chart View

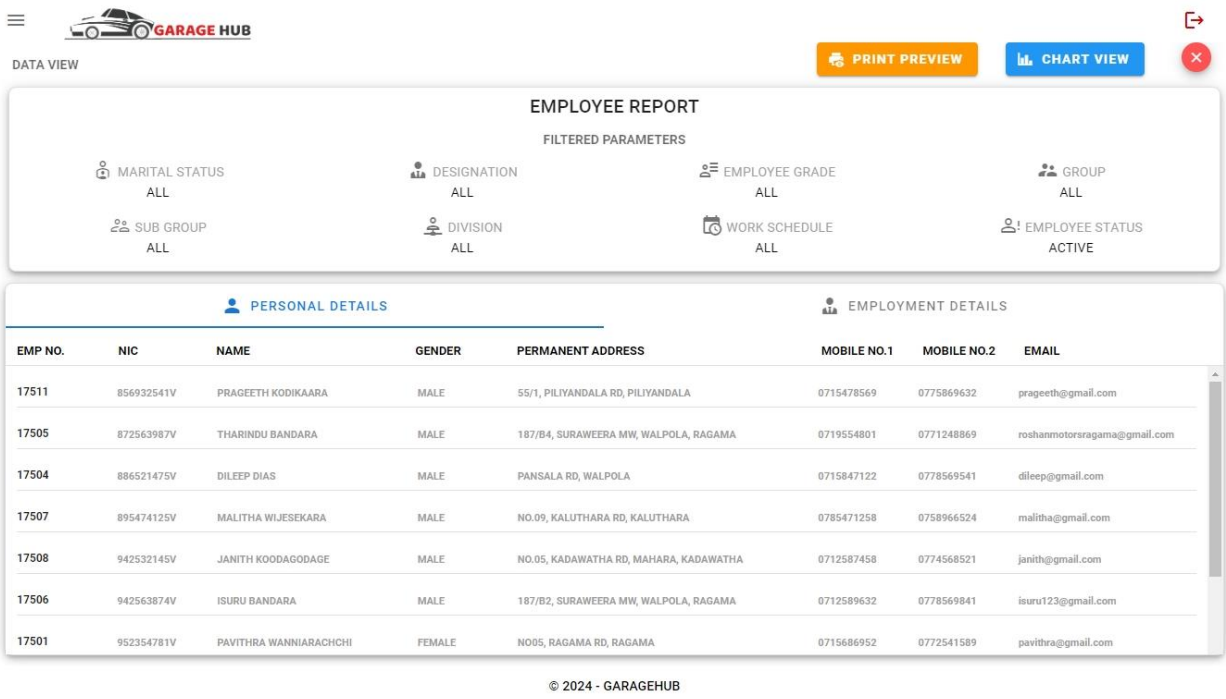

Figure C.4: Employee Report Data View

Current Job Status Report

This report visualises the current status of the workshop related to the job cards created within a day. It is very useful to the supervisors to manage job cards and perform relevant operations to complete the jobs and satisfy the client's requirements on time. And also, management users can identify the drawbacks of the current processes of job handling and improve them accordingly.

Figure C.5: Current Job Status Chart View

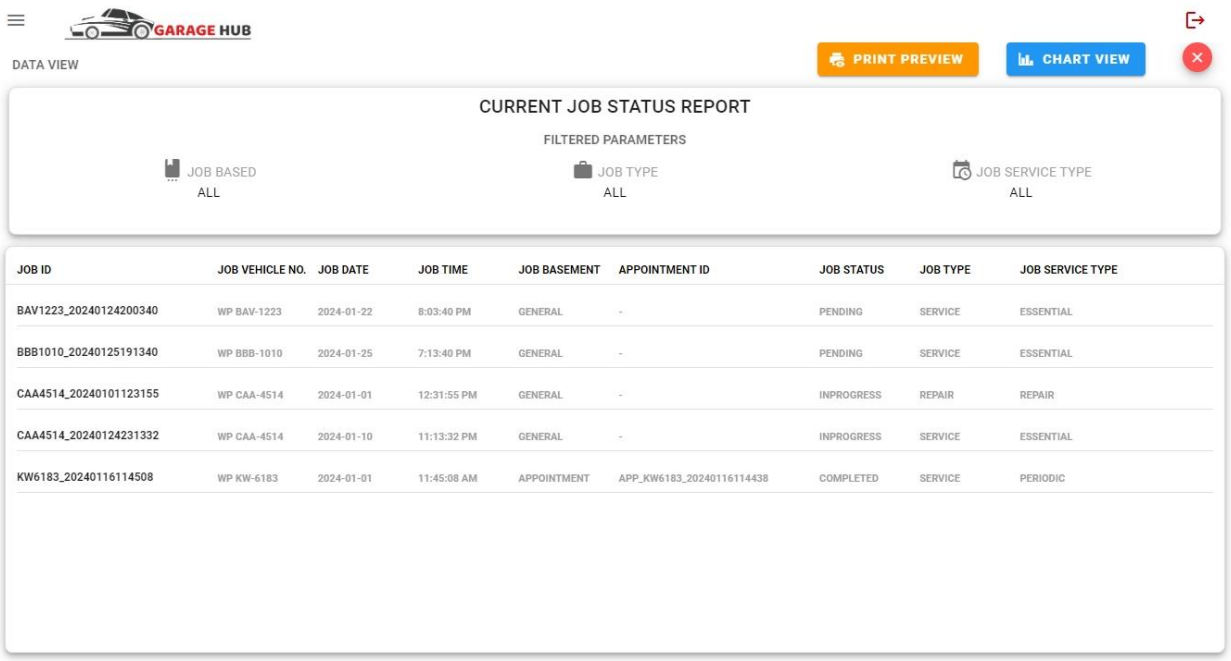

Figure C.6: Current Job Status Data View

Current Pending Job Status Report

It gives only the pending jobs with the pending duration to get an idea about how many days, the job card has been waiting since it was created. As a result, management can be able to come up with an effective and efficient way to handle pending jobs while mitigating the issues raised by the clients.

Figure C.7: Current Pending Job Status Chart View

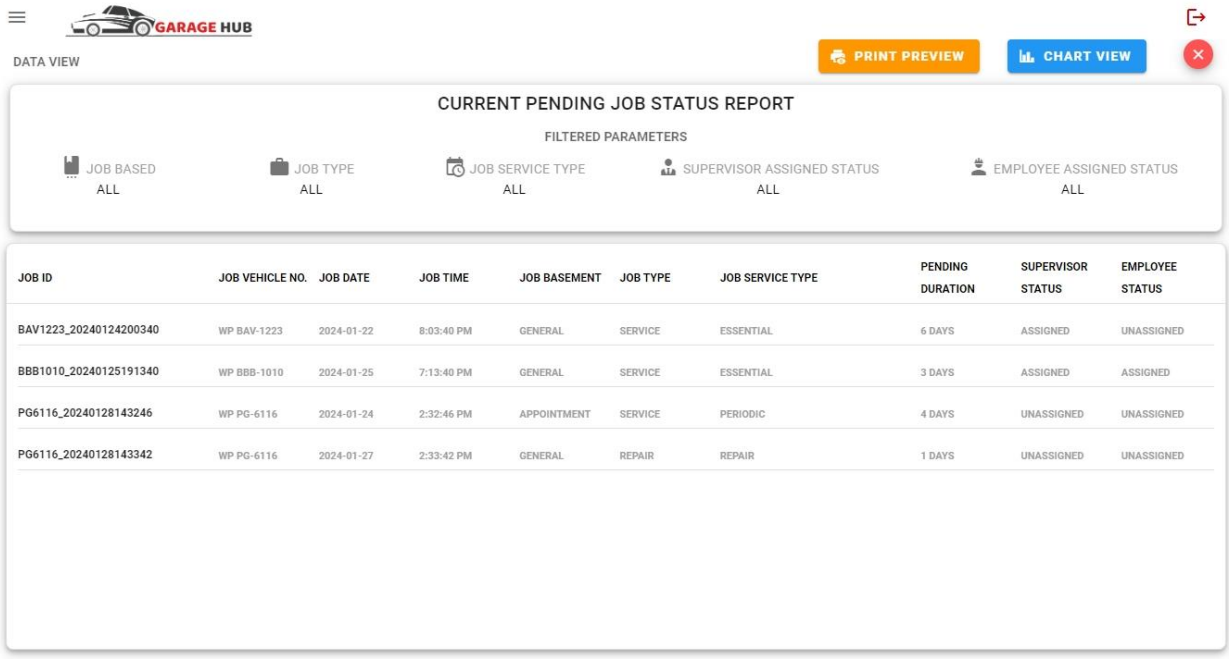

Figure C.8: Current Pending Job Status Data View

Current Inprogress Job Status Report

This report visualizes the pending and in-progress durations per job card. So it can be able to get a clear idea about the time taken for a job by comparing these two factors easily.

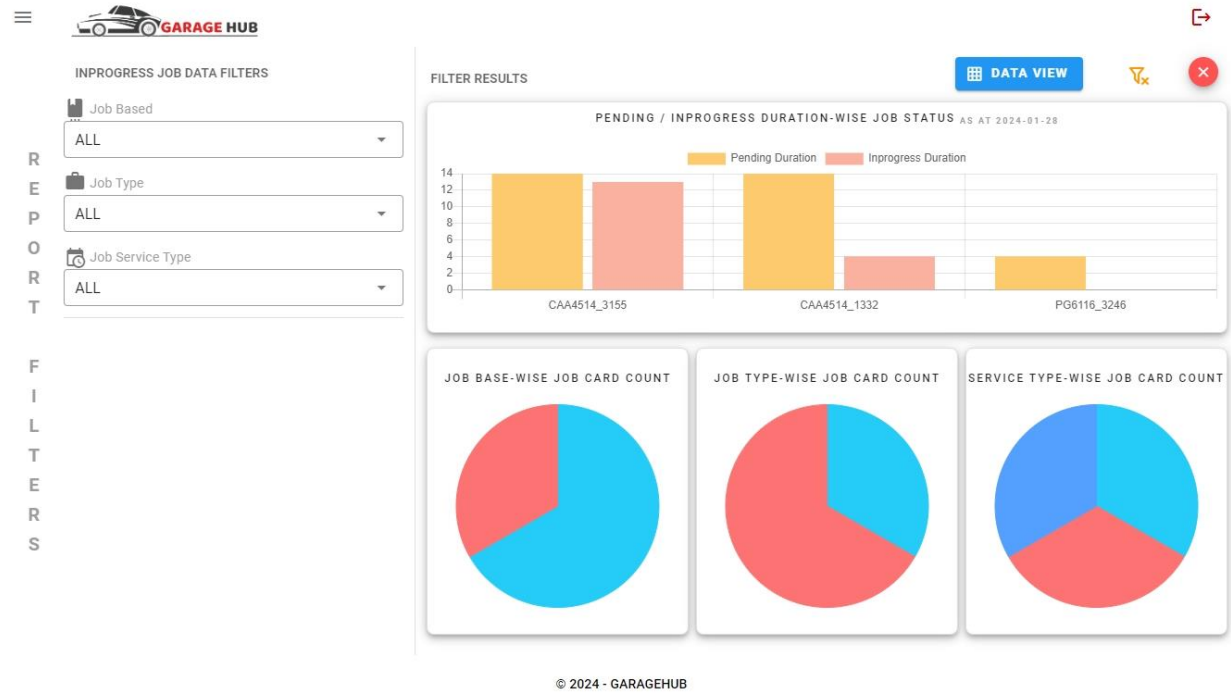

Figure C.9: Current Inprogress Job Status Chart View

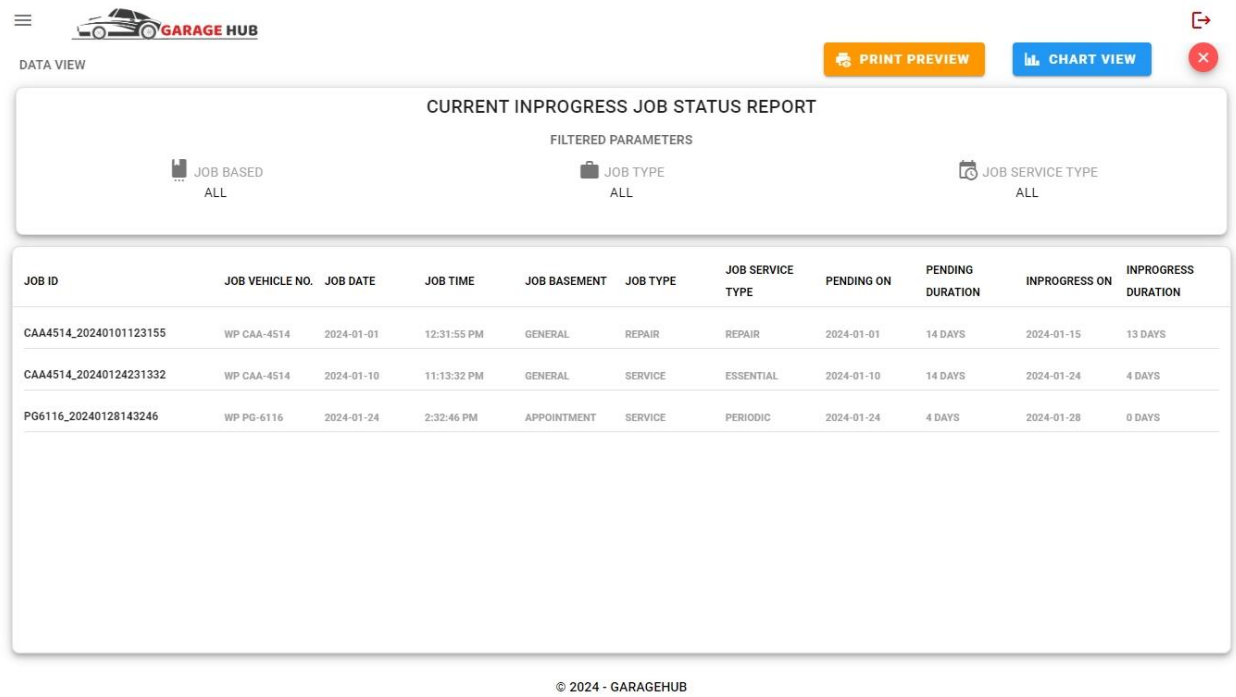

Figure C.10: Current Inprogress Job Status Data View

Current Completed Job Status Report

The current completed job status report will populate the completed jobs on the report-generated date and also show the completed but not finalized jobs to make them fully completed on that day easily.

Figure C.11: Current Completed Job Status Chart View

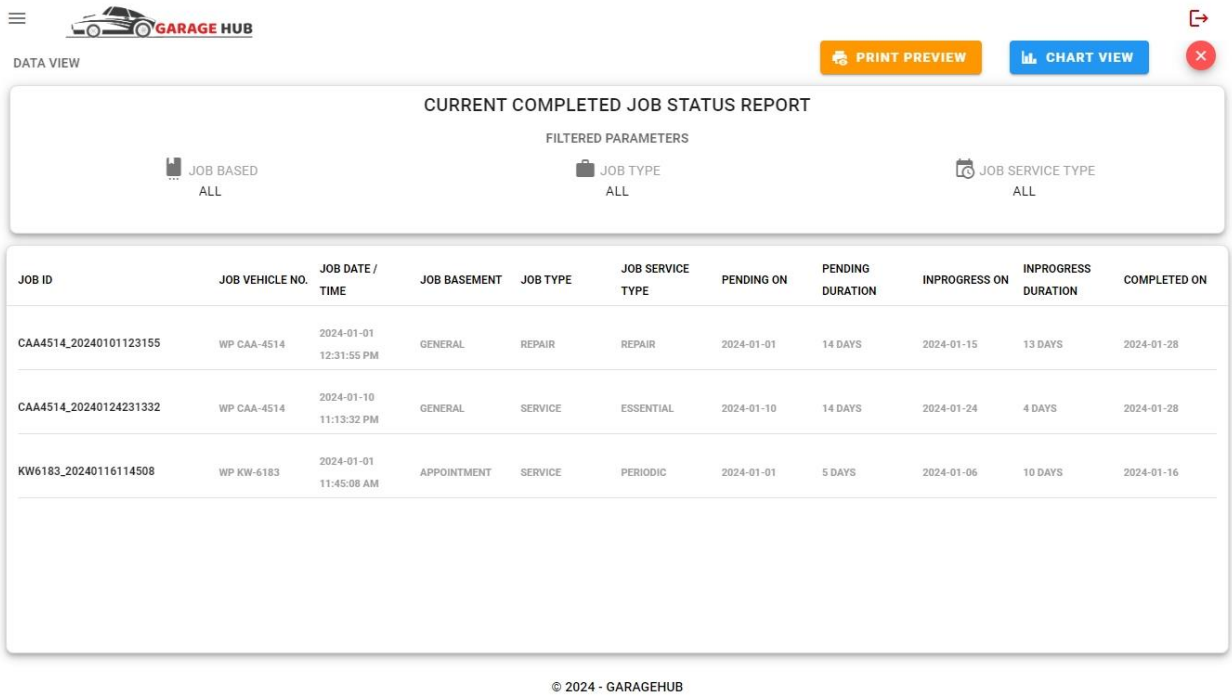

Figure C.12: Current Completed Job Status Data View

Daily Invoice Report

This report visualizes the invoices generated on a specific date and it shows the invoice status along with how each invoice payment has been handled in a comparison view.

Figure C.13: Daily Invoice Chart View

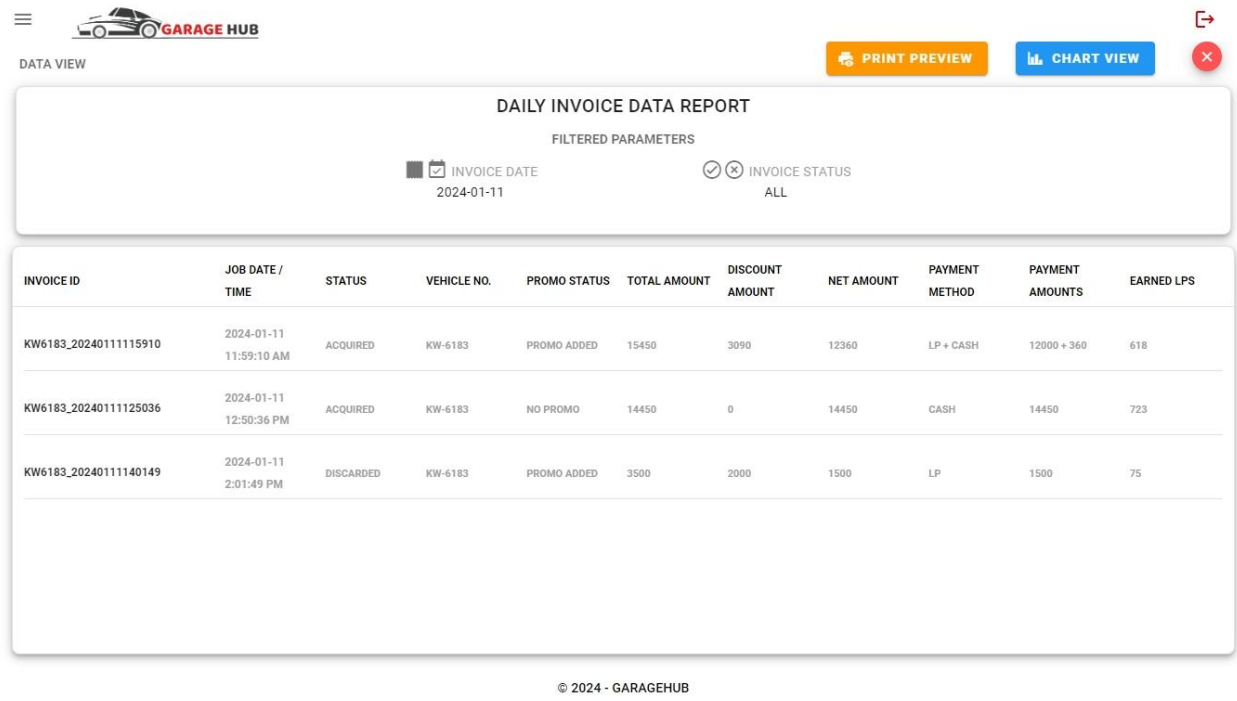

Figure C.14: Daily Invoice Data View

Registered Client Report

This report populates all the clients who engage with the workshop whether they are registered or not in the online account. It has a special filtration to get and identify loyal customers by the loyalty star levels and it helps management to set promotions specific to client groups to gain more attraction to the workshop as well.

Figure C.15: Registered Client Chart View

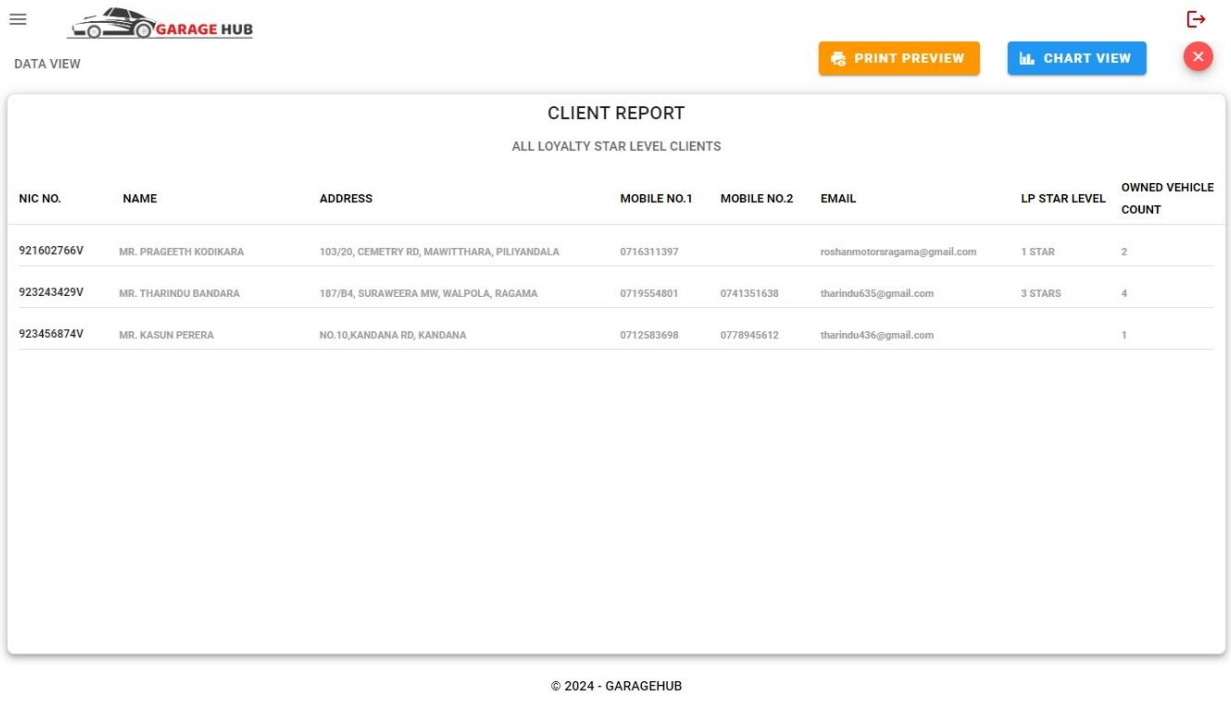

Figure C.16: Registered Client Data View

Registered Vehicle Report

The Registered Vehicle Report shows all the client's own and registered vehicles to be maintained by the workshop. It helps management to manage the workshop inventory and can be able to make decisions related to the purchases as well.

Figure C.17: Registered Vehicle Chart View

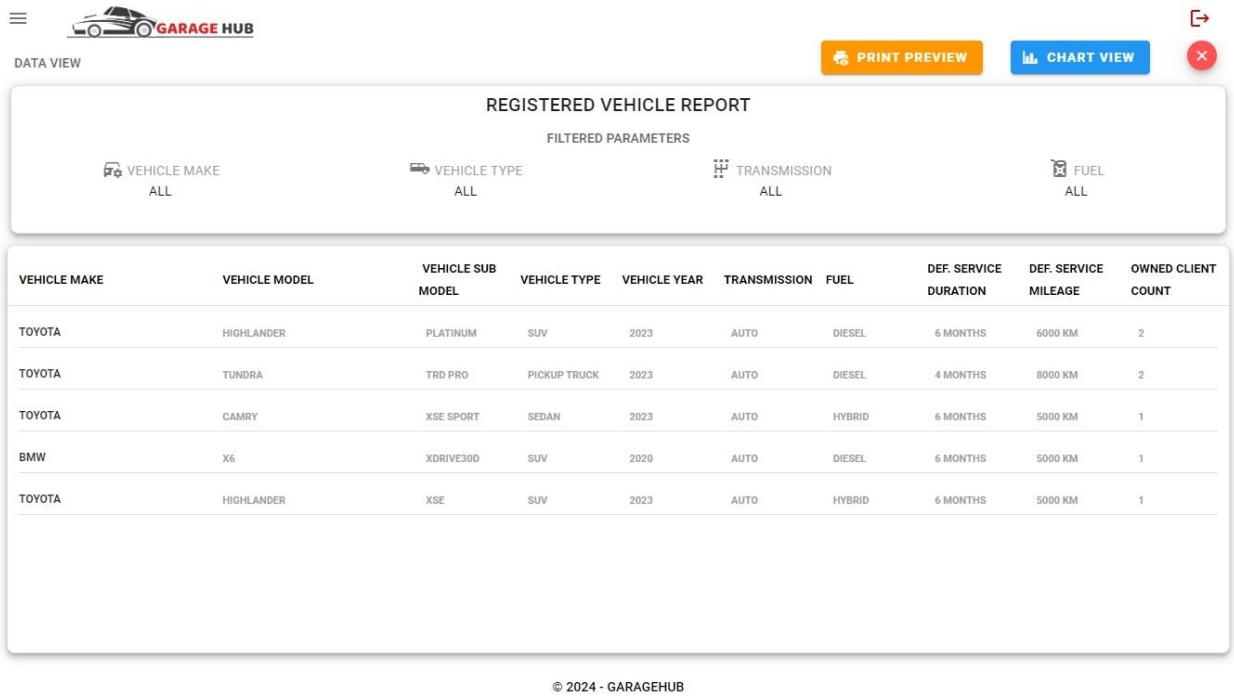

Figure C.18: Registered Vehicle Data View

Registered User Report

This report shows all the users registered with the system and it is easy to identify how many users are available relevant to the user types. Also, the management can be able to get the relevant decisions to increase the online client user accounts and digitalise all the manual processes through the online system.

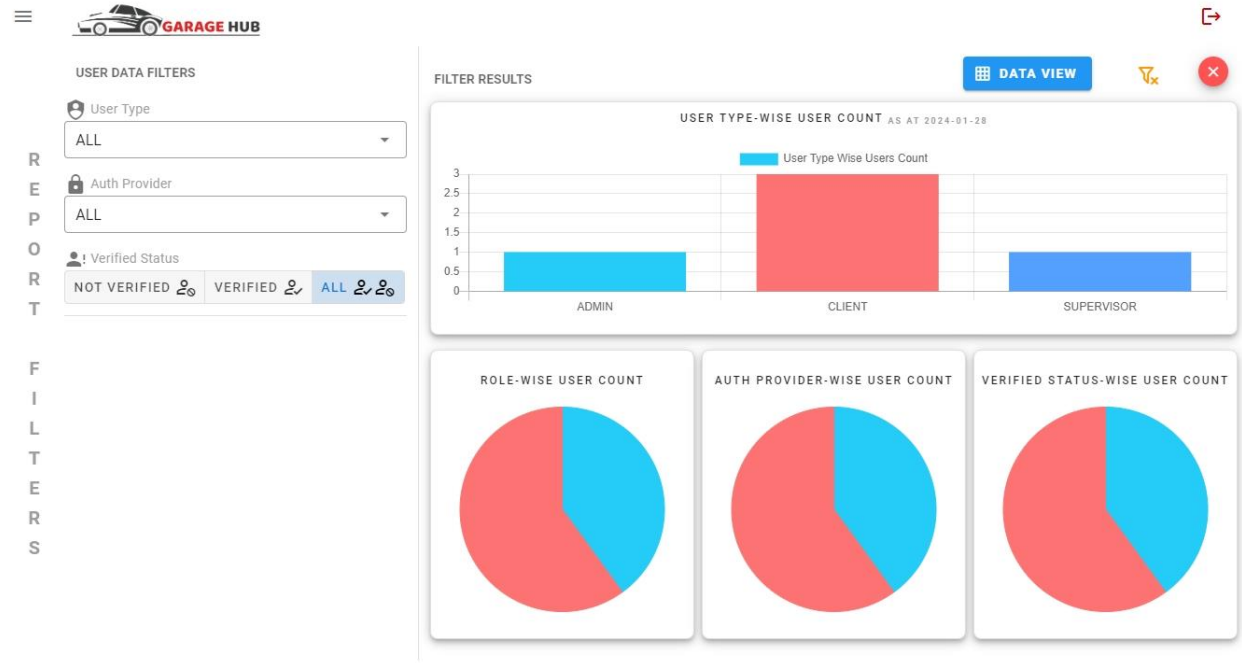

Figure C.19: Registered User Chart View

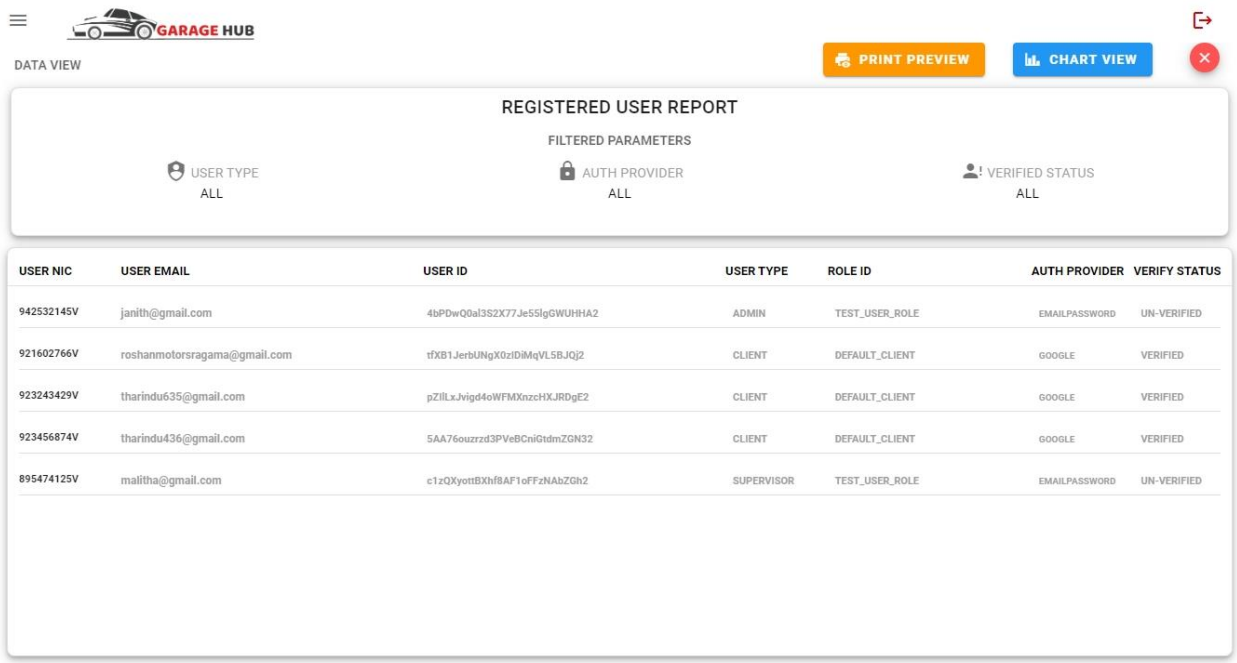

Figure C.20: Registered User Data View