

# **HI-TECH GARAGE**

**24-FYP-223**



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BACHELOR OF SCIENCE

In

SOFTWARE ENGINEERING

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## DECLARATION

We affirm that the documentation for our project, "**Hi-Tech Garage**", is an authentic and original creation, developed by **Salihah Sadiq, M. Muneeb Shahid, and Manal** under the guidance of **Mr. Abdul Qadeer**. This comprehensive project documentation adheres strictly to technical standards and regulatory requirements. It is presented in a clear, concise, and precise manner to ensure accuracy and compliance with established norms.

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Following the completion of the project development, we are formally submitting it to the Department of Computer Science at the **National Textile University, Faisalabad**. This submission is a key milestone in meeting the criteria for obtaining the Bachelor of Science in Software Engineering. The project was structured across distinct weeks, with collaborative efforts from the team. The cumulative workload is equivalent to 28 weeks of full-time academic engagement.

## CERTIFICATION

This final year project is developed by **Salihah Sadiq** (21-NTU-CS-1369), **M. Muneeb Shahid** (21-NTU-CS-1355), and **Manal** (21-NTU-CS-1335) under the direction of their supervisors and approved by all the members of the FYP committee, has been presented to and accepted by the Department of Computer Science, in the partial fulfillment of the requirement of the degree of Bachelor of Science in Software Engineering.

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## **List of Abbreviations**

AI = Artificial Intelligence

CBA = Cost Benefit Analysis

ERD = Entity relationship diagram

FR = Functional Requirements

NFR = Non-Functional Requirements

UML = Unified Model Language

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**Manal**

**Muneeb Shahid**

## ABSTRACT

In the evolving landscape of online automobile services, **Hi-Tech Garage** is an innovative web-based platform designed to bridge the gap between vehicle owners and workshops, providing seamless access to roadside assistance, workshop bookings, and at-home maintenance services. Traditional automobile service solutions often lack real-time connectivity, efficient booking systems, and automated assistance, leading to delays and inconvenience for users.

Our system addresses these limitations by integrating AI-powered chatbot assistance, real-time workshop listings, and an automated service request system to enhance user experience. Key features include roadside assistance requests, workshop appointment scheduling, at-home vehicle servicing, an AI chatbot for customer support, and an admin panel for system monitoring and management. The platform ensures a smooth, user-friendly interface where users can access services without requiring login credentials, making the process swift and hassle-free.

Validation of our solution includes rigorous testing, system security implementations, and initial user feedback, demonstrating its effectiveness in providing a reliable, efficient, and responsive automobile service platform. By offering a comprehensive and accessible service network, Hi-Tech Garage aims to streamline vehicle maintenance and support, benefiting both workshop owners and vehicle users while ensuring an improved and technology-driven automobile service experience.

# Chapter 1

## Introduction

People interact and rely on vehicles more. That is the reason having proper and effective vehicle maintenance is crucial due to the high demand for vehicles. Factors such as insufficient preparation for potentially emergency scenarios, absence of roadside assistance, and the extensive amount of time needed to be spent at workshops create many challenges and disadvantages for vehicle owners. **Hi-Tech Garage** plans to solve some of these mentioned challenges by providing an advanced online system aimed at reducing barriers for the interaction and transaction between a user and a workshop. This platform allows its users to perform each, and every activity required such as booking a slot on a shared calendar effectively eliminating the need for home services and vehicles for delay in reaching the workshop. Furthermore, the system enables users to make bookings through a website making it easier for them to locate the workshop and reach the required services [1] .

AI-Chatbot should reduce waiting time, allowing customers to interact with customer support over any question requiring immediate attention. The platform will in turn enable workshop owners to increase their efficiency through having better booking systems, being prepared to manage and accept requests for help or questions and guarantee certain activities will be performed over the system to please customers more. The aim of this project is to enhance the user experience and the productivity of the workshop by adding the features of instant notifications, enhanced account security, escalation of disputes, and periodic system changes, which cater to all the parties involved.

### **1.1. Background**

Over the past few years, fences have been ripped off because automobiles are becoming a crucial part of our daily life. But an unplanned increase in vehicle usage has left many challenges for both vehicle owners as well as workshops. Situations like getting a flat tire or breaking down in the middle of nowhere, waiting for hours in the line outside garages, and unorganized and untrustworthy garage services make it all seem very chaotic.

Usually, tourists get their vehicles serviced by neighborhood garages, which require them to call the garage and book an appointment. The problem is the entire process wastes a lot of time

as most workshops don't have an effective way to utilize their resources. Whereas in big cities, if someone's vehicle breaks down in rural areas, there is a risk of being abandoned without a spectrum of routes available. The initial idea was to create an online workshop website for such cases. The concept was to create a website where the garage and the owner could be virtually connected to book time slots, roadside assistance and interact with AI Chatbot. The idea is simple, but the website integrates various technologies allowing it to achieve effectiveness and provide its users with quality service.

This project has evolved from the ongoing digital transformation of the automotive industry with a goal to create an easy, fast, and reliable platform that connects consumers with workshops.

## **1.2. Problem Statement**

Vehicle owners have often faced issues of not getting timely roadside assistance, inefficient booking processes for workshop appointments and long waiting times at workshops for their vehicles, causing inconvenience and delays in servicing their vehicles. This project addresses these issues by creating a platform that streamlines workshop interactions and ensures dependable, on-demand assistance.

## **1.3. Purpose**

This project aims to solve the common issues that vehicle owners typically face with maintenance and repair work. And amongst those challenges are the unforeseen breakdown in areas which are hard to access, lack of immediate on-road support, and inefficiencies that come with booking through traditional workshops. This project is all about delivering a user-friendly platform to connect vehicle owners and the workshops so that they can get maintenance solutions quickly and efficiently.

Our platform has a unique ability to provide location-based services for roadside assistance. If someone has a breakdown, the users can press an emergency button, and it will communicate with nearby workshops, so they get there fast. This guarantees not only that users can get help sooner without wasting time, but also safer and more comfortable travel. The same way, the platform's home maintenance booking feature helps users get vehicle serviced, all from the comfort of their home.

As the project addresses workshops, it brings them great features regarding slot management and booking with which they can manage their resources in an easy way and minimize the waiting time for their users. The platform simplifies these interactions via digitization while also empowering workshops to enhance customer outreach, service offerings, and operational efficiency.

This project gives a one stop solution of vehicle maintenance using technology taking advantages of easy to do, reliability and user satisfaction. The automotive tech solution aims to create an ecosystem that facilitates seamless interactions and builds trust between the owner and workshops for the betterment of all parties involved.

## 1.4. Project Goals

- Enable users to easily book workshop services, whether at home or at a workshop, and get available time slots instantly.
- Provide workshops with a structured system to easily create, update and manage their accounts.
- Allow users to request emergency roadside assistance and receive immediate assistance from a nearby workshop.
- Ensure that all workshops are verified, pricing is clear, and users receive high-quality, professional services.
- Allows admin to monitor system activity, user interactions and service requests to maintain the smooth operation of the platform.
- Enable admin to resolve disputes by managing workshop accounts to ensure a fair and trustworthy platform.
- Design an intuitive, secure, and responsive website to enable smooth interaction between users, workshops and admin.
- Integrate AI chatbot to assist users with inquiries, provide service suggestions and troubleshooting guides.
- Maintain system efficiency by implementing updates and improvements to meet future needs and technological advancements.

## 1.5. Objectives

1. To allow users to book vehicle services from home or at available workshops.
2. To enable users to request emergency vehicle assistance anytime and anywhere.

3. To provide real-time AI-driven support for user inquiries and service guidance [2].

## **1.6. Project Scope**

Hi-Tech Garage is an advanced web-based solution designed to enhance vehicle service experience by connecting users with verified workshops, providing seamless service booking, instant assistance, and AI-driven support. The platform serves as a centralized hub for vehicle owners, workshops, and technicians, ensuring efficient service delivery, transparent communication, and a worry-free experience. By integrating modern technology, it bridges the gap between customers looking for reliable vehicle services and workshops aiming to streamline operations.

### ***1.6.1. Workshops and Service Providers***

Workshops have access to a centralized system where they manage service requests, schedule bookings, and provide immediate roadside assistance. The platform only provides proven professional workshops to ensure fair competition. Additionally, powered by AI, workshops can increase customer engagement and optimize service efficiency, thereby increasing customer trust and satisfaction.

### ***1.6.2. Vehicle Owners and Customers***

Car owners benefit from a user-friendly interface that allows them to easily book services, request roadside assistance, and interact with an AI chatbot for instant guidance. The platform allows customers to choose from multiple workshops based on their service needs, ensuring convenience, transparency, and reliability.

### ***1.6.3. Emergency Assistance and Roadside Support***

The platform plays a vital role in providing instant roadside assistance to users facing unexpected vehicle breakdowns. By connecting customers with available workshops nearby, Hi-Tech Garage ensures prompt response and professional support, minimizing the disruption caused by vehicle breakdowns. This feature significantly improves driver safety and convenience on the road.

### ***1.6.4. Industry Standards and Service Integrity***

The platform upholds industry standards by ensuring that all listed workshops meet strict verification and service quality standards. It promotes fair pricing, professional conduct and customer satisfaction while maintaining transparency in all service transactions. Hi-Tech

Garage sets the benchmark for ethical and high-quality vehicle service management by providing an AI-driven [3], performance-based approach to workshop recommendations.

## 1.7. Proposed Solution

Hi-Tech Garage is an innovative solution designed to revolutionize vehicle maintenance and roadside assistance. It empowers vehicle owners by providing seamless access to an extensive network of workshops, ensuring efficient management of vehicle services at home and on the road.

With an easy-to-use platform, Hi-Tech Garage solves familiar challenges such as vehicle breakdowns in remote locations and long waits in workshops. The platform allows users to instantly request roadside assistance, notifies nearby workshops, allowing users to select the most suitable workshops based on availability and reviews. In addition, users can also choose a convenient time to schedule vehicle maintenance services at home. For those who visit the workshop, the system provides an appointment function to eliminate waiting time and ensure that the workshop is prepared for required services in advance. Integrated chatbot further enhance the user experience by providing instant support [4]. The solution provides a comprehensive, user-friendly approach to vehicle service management, benefiting both vehicle owners and workshops.

## 1.8. Risks and Risk Mitigation

This section identifies potential risks and uncertainties that may arise during Hi-Tech garage operations, as well as strategies to effectively mitigate these risks. Risk mitigation is an important aspect of risk management that involves planning and developing methods to minimize threats that may affect project success.

### 1.8.1. *Fraudulent User and Workshop Registration*

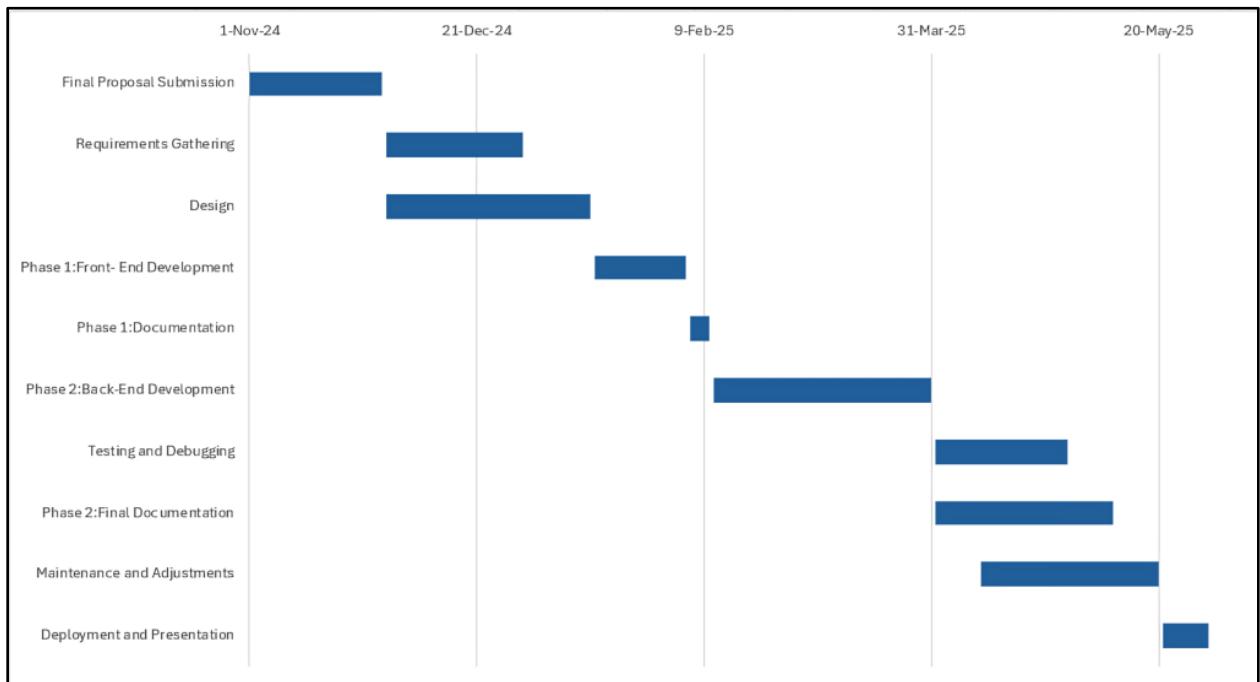
To protect the system from fraudulent activity, a strong registration verification process implementation is important. This process should ensure that both the user and the workshops are authentic. Admin must perform authentication checks, such as phone number and email verification, and verify workshop credentials through official documentation and reviews to prevent false registrations. By doing so, the system maintains the integrity and authenticity of the user base, ensuring that only legitimate car owners and service providers have access to the platform.

### **1.8.2. Role-Based Access Control**

Implementing role-based access control (RBAC) is critical to maintaining security and organization in your Hi-Tech garage. The system will define distinct roles for users, workshops and admin, each with specific permission. For example, car owners can only access bookings and request services, while workshop staff can manage service availability and bookings. Admin will have full access to manage workshops and oversee overall system operations. This hierarchy will help prevent unauthorized access and ensure that sensitive information and critical system functions are protected.

## **1.9. Project Scheduling**

This section outlines the project scheduling and how we are managing the complete process leading from proposal submission to deployment and presentation phase.



*Figure 1. 1. Gantt Chart*

The above figure 1.1 is a Gantt chart representing a project timeline from November 2024 to May 2025.

## 1.10. Cost Benefit Analysis

Cost-benefit analysis (CBA) is an important financial evaluation tool that assesses the economic feasibility of a project by systematically comparing expected costs to expected benefits. For the High-Tech Garage project, this analysis plays a critical role in determining whether investments in platform development and maintenance will generate significant value in the long term. The cost-benefit analysis (CBA) considered various expenditures, including technology acquisition costs (such as domain hosting and database subscriptions), training costs (such as user training sessions), as well as developer salaries and ongoing maintenance efforts. In terms of benefits, the analysis highlighted increased efficiency, automation of shop floor operations, reduced administrative workloads, improved user satisfaction, and enhanced business visibility and scalability. By thoroughly reviewing both one-time and recurring costs and evaluating them based on tangible and intangible benefits, a cost-benefit analysis (CBA) provides a comprehensive understanding of a project's ROI and long-term sustainability, ensuring informed decisions and resource allocation throughout the project lifecycle.

Table 1. 1 Cost Analysis

Component	Description	Cost (PKR)
Technology Acquisition	Domain and Hosting	Rs. 20,000 per year
Infrastructure	Vercel	Free
Training	User Training Programs Development	Rs. 30,000 one-time costs
	User Training Sessions	Rs. 20,000
Maintenance	Ongoing System Maintenance	Rs. 75,000 annually
	System Updates and Upgrades	Rs. 100,000 annually
Developer Salaries	The salaries you need to pay to the developers for 7 months of developing this project	Rs. 300,000 per developer

Table 1.1 provides a comprehensive breakdown of the financial investments required for high-tech garage projects [5]. It details the costs associated with acquiring the technology, including the cost of domain purchasing, maintenance, updates and development costs. In addition, it considers training costs for user training.

Table 1. 2. Benefit Analysis

Benefit	Description	Value (PKR)
Efficiency	Reduction in manual workshop booking and management	Rs. 300,000 annually
User Experience	Improved customer satisfaction and service accessibility	No cost
Analytics	Insights on customer behavior and service demand	Rs. 150,000 annually
Automation	Reduced administrative workload for workshop owners	Rs. 1,200,000 annually
Competitive Advantage	Increased workshop visibility and business expansion	Rs. 50,000 annually

Table 1.2 highlights the benefits of implementing a “Hi-Tech garage” platform. The analysis highlights that by reducing manual workshop management tasks, efficiency gains and ultimately cost savings can be achieved. It emphasizes enhanced user experience, ensuring customer satisfaction through seamless service booking and tracking. The table also demonstrates the value of analytics, enabling workshops to make data-driven decisions based on customer behavior and service needs. Additionally, the benefits of automation were considered, as the platform significantly reduces the administrative workload of workshop owners by streamlining appointment scheduling and roadside assistance requests. Finally, the table illustrates the competitive advantages gained by increasing workshop visibility, attracting more customers, and expanding business opportunities. This benefits analysis shows how the project will lead to operational improvements and long-term profitability.

## 1.11. Summary

This chapter provides an overview of the “High Tech Garage” project, which addresses the challenges of traditional car maintenance and the need for digital solutions. It defines the issues of roadside assistance delays, lack of transparency in services and booking inefficiencies and highlights that the project aims to streamline these processes through an online platform. This chapter outlines key objectives, including improving customer experience, automating service, and enhancing shop floor management. It also details the project scope, risk assessment and mitigation strategies, and a timeline for structured development. Finally, a cost-benefit analysis

highlights financial investments in technology, infrastructure and maintenance while demonstrating benefits such as increased efficiency, reduced workload, and better business opportunities, providing a solid foundation for project execution.

# Chapter 2

## Literature review

In this significant section, we analyze existing services and platforms that structure the workshops to improve our online car workshops. A complete understanding of this area is imperative, empowering us to recognize deficiencies, evaluate the qualities of current arrangements, and characterize the novel incentives that our workshops offer. While certain sites and applications give essential car parts delivery or service booking, others offer restricted virtual help for car maintenance. However, significant gaps remain in user-friendly, comprehensive, and complete solutions for vehicle care on the web. The platform addresses these gaps, developing the best solution for modern car owners desiring convenience, expert guidance, and efficiency.

### **2.1. Related work**

Explore existing efforts aimed at reducing car service process time by developing an online-based service ordering application for Sinar Jaya workshops. The system also provides information about workshop services to a client. Using the waterfall model for software development, the study involves stages such as data analysis, system analysis, design, implementation, and testing. The online platform allows clients to obtain information and place orders without having to visit the workshop, saving time and streamlining the service process. It also simplifies data handling for admin, making the entire process more efficient.

#### *2.1.1. RepairPal*

- Service Booking: Clients can search for workshops, get cost estimates, and book services online.
- Diagnostic Tool: A user-friendly monitoring tool helps users recognize car problems based on symptoms.
- Price Estimates: Provide transparent and service price estimates to help clients make informed decisions.
- Certification: Includes certified workshops to ensure reliability and quality [6].

### *2.1.2. Fixd*

- Diagnostic Tool: Car diagnostic tools are available to help identify problems through a smartphone app that connects to the car's OBD-II port.
- Service Recommendations: Recommend services based on the user's car's health and maintenance needs.
- Tracking and Reminders: Track the vehicle's service history and send maintenance reminders.
- Service Locator: Help users find nearby repair workshops and book appointments.

### *2.1.3. GoMechanic*

- Car Service Booking: Clients can schedule appointments for numerous services, including repairs and maintenance, with a detailed price list.
- Workshops Network: Works with a network of workshops to allow users to select services based on reviews and location.
- Service Packages: Offers value-for-money service packages and discounts.
- Car Health Checkups: Provides diagnostic tests and car health checkups [7].

## **2.2. Why an online car workshop?**

An online car workshop offers some key benefits that make it a convincing decision for the mechanics and clients. Here are the primary reasons why online car workshops are useful:

### **1. Convenience for Customers**

- Timesaving: The online appointment function eliminates the need for customers to go to the workshop in person to make an appointment, thereby reducing waiting time.
- Easy Access: Customers can book services and get information about their cars from their homes or offices in their comfort.

### **2. Increased Operational Efficiency**

- Automated Scheduling: Customers can reduce the administrative workload and ensure appointments are managed efficiently and selecting available time slots.

### **3. Enhanced Customer Experience**

- Real-Time Updates: Clients can track the status of their car which is repaired in real-time and improves the transparency.

#### **4. Better Data Management**

- Efficient Record-Keeping: All service data and client information can be accessed and stored digitally, allowing management of the workshop and analysis of information of the workshop.
- Analytics: Insights into customer behavior, preferences, and maintenance trends can help the workshop optimize its operations and improve its services. Gaining insights into client behavior, maintenance trends, and preferences, can help the workshop to optimize operations and improve service.

#### **5. Scalability**

- Growth Potential: Online platforms can be easily expanded to include new features, additional service offerings, and even new locations without requiring significant investments in physical infrastructure.

#### **6. Competitive Advantage**

- Adaptation to Modern Trends: As more industries turn to digital solutions, online car workshops help businesses keep up with the competition in the digital world.
- Differentiation: A convenient online service platform can differentiate a company from traditional workshops and attract more clients.

#### **7. Improved Inventory Management**

- Integrated Inventory: Online platforms can connect to inventory systems, ensuring parts are in stock and orders are processed efficiently, helping avoid delays.

#### **8. Customer Loyalty and Retention**

- Reviews and Feedback: Online platforms make it simpler for clients to leave feedback, helping organizations improve and keep a positive reputation.

### **2.3. Reason to Develop**

There are certain basic reasons to develop this platform, some of them are explained below.

#### *2.3.1. Lack of centralized platform:*

One of the major challenges faced by vehicle owners is the lack of a centralized platform where reliable and certified workshops can be found. Many existing solutions either list only a limited number of workshops or provide incomplete or false information about their services. This lack of accessibility forces users to rely on personal recommendations or time-consuming searches, often leading to uncertainty about service quality. Hi-Tech Garage solves this

problem by providing a comprehensive workshop website with service details, technician expertise and customer reviews, ensuring users can make informed decisions.

### *2.3.2. Inefficient Appointment System*

The traditional way of walking into a workshop often results in long wait times, overcrowding, and scheduling conflicts. Many users experience delays due to absentee mechanics, unavailability of tools or lack of coordination in workshop scheduling. In some cases, users may have to leave their vehicles in the workshops for an extended period, causing inconvenience. Hi-Tech Garage has launched an efficient platform with a booking feature that allows users to schedule appointments in advance, ensuring they receive timely service without unnecessary delays. The system benefits customers and workshop owners by optimizing workflow and reducing waiting times [8].

### *2.3.3. Limited Access to Emergency Assistance*

A major problem faced by car owners is the difficulty in obtaining roadside assistance when their vehicle unexpectedly breaks down. Finding a mechanic or towing service near you can be time-consuming and stressful, especially in an unfamiliar location or during non-business hours. Many users rely on random calls to workshops, but these workshops may not be able or equipped to handle emergency repairs. Hi-Tech Garage provides real-time roadside assistance, connecting users to the nearest registered workshop, allowing them to quickly request emergency repairs. This ensures faster response times and enhances road safety by reducing the risks associated with vehicle failure [9].

### *2.3.4. Absence of AI-Based Customer Support*

Workshops regularly receive numerous customer inquiries regarding service, pricing, availability and general vehicle maintenance. However, most small to medium-sized workshops lack the resources to provide 24/7 customer support. As a result, customers often struggle to get immediate answers, leading to frustration and potential loss of business. Hi-Tech Garage includes an AI-driven chatbot that provides users with instant answers to frequently asked questions, guides them through the booking process and even suggests relevant services based on the user's query [10]. This automation reduces workshop's staff workload and enhances the overall customer experience.

### *2.3.5. Unclear Pricing and Service Transparency*

Many users are hesitant to visit a workshop due to uncertainty about service costs, hidden fees, and a lack of trust in the workshop's expertise. Without clear cost breakdowns and past customer reviews, it's often difficult for users to compare different workshops and their products. This may lead to price-related disputes and dissatisfaction with the service. Tech Garage eliminates this problem by offering a transparent pricing system, with workshops showing the cost of their services, along with details of available technicians and customer ratings. This ensures trust and credibility between the workshop and customers, creating a more reliable automotive service market.

## **2.4. Summary**

In this chapter, the existing services and platforms of online car workshop platforms are reviewed to identify limitations and gaps. The chapter discusses some platforms like RepairPal, Fixd, and GoMechanic, and points out their Limitations in areas such as service user experience, booking capabilities, and service transparency. The review found the need for an advanced online car workshop solution, that aims to provide a comprehensive platform for seamless online booking, real-time service tracking, personalized service recommendations, and enhanced transparency, that addresses the limitations of existing platforms. Additionally, the chapter includes the main reasons that were important for the development of our platform.

# Chapter 3

## System Requirements

The online workshop platform aims to modernize and optimize automotive service management by providing features such as real-time workshop assistance, online booking, and efficient time slot management. This chapter provides a detailed overview of the system requirements, divided into functional and non-functional aspects. These requirements form the basis for the design, development, and deployment of the platform, ensuring that it meets user expectations and industry standards [11].

### **3.1. Functional Requirements**

Functional requirements specify the main functions and services that the system must provide to achieve its goals. The requirements are outlined for the different user roles in the system: **Admin (Business Owner), Workshop Staff, and Customers (End Users)**.

#### *3.1.1. Admin (Business Owner) Requirements*

The admin oversees the operation of the platform, ensuring smooth functionality and efficient resource management. The main requirements include:

Table 3. 1. Admin Requirements

Requirement Number	Description
FR-1	Create and manage workshop profiles and service categories.
FR-2	Monitor real-time service status and staff availability.
FR-3	Manage customer notifications.

#### *3.1.2. Workshop Staff Requirements*

Workshop staff interact with the platform to efficiently process bookings and manage service delivery. The workshop can also view all their booking on dashboard and cancel any booking anytime. Their requirements are:

Table 3. 2. Workshop Requirements

Requirement Number	Description
FR-4	View assigned tasks and upcoming appointments.
FR-5	Real-time updates on the status of ongoing services.
FR-6	Communicate with customers (notifications, inquiries) through the platform.

### 3.1.3. *Customer Requirements*

The platform provides customers with seamless experience and allows them to access services conveniently. Their requirements include:

Table 3. 3. Customer Requirements

Requirement Number	Description
FR-7	Search and view nearby workshops based on location and services.
FR-8	Book appointments with date, time, and service preferences.
FR-9	Provide feedback and rate services upon completion.
FR-10	Manage their bookings and access invoices.

## 3.2. Non-Functional Requirements

Non-functional requirements define the overall quality attributes, system behaviors, and operational constraints that the software must adhere to in addition to the functional aspects. These requirements play a key role in ensuring that the platform is not only reliable and secure, but also efficient, scalable, and user-friendly, ultimately improving the overall user experience and system performance under various conditions. Non-functional requirements cover important aspects such as system availability, response time, data integrity, ease of use, maintainability, and compliance with industry standards. They guide the design decisions and architecture of the system to ensure that the system can handle the expected workload, recover from failures efficiently, and protect user data from potential threats. By meeting these elements, non-functional requirements help developers create a robust and reliable platform that both meets user expectations and achieves complete business goals [12].

Table 3. 4. Non-Functional Requirements

Requirement Category	Description
<b>Performance</b>	The system must handle 500 concurrent users without degrading performance.
<b>Scalability</b>	Additional workshops and user roles should be supported without re-architecting.
<b>Security</b>	User data must be encrypted during storage and transmission.
<b>Usability</b>	The platform must provide an intuitive user interface for all roles.
<b>Availability</b>	Ensure 99.9% uptime and minimize maintenance downtime.
<b>Compatibility</b>	Accessible on multiple devices (desktop, mobile, tablet).

### 3.3. Use Case Diagrams

Use case diagrams are an important component of the Unified Modeling Language (UML) and are an effective and intuitive method to represent the interactions between users (actors) and the functional components of a system. In the Hi-Tech Garage system, Use case diagrams play a vital role in illustrating how various actors interact with different system functionalities. These diagrams simply define which components or services each actor (e.g., admin, workshop, or user) can access, initiate, or influence. Use case diagrams help identify system requirements, clarify roles, and guide system design by providing a high-level overview of user goals and system responses. This structured approach ensures that all potential interactions are mapped out and understood by developers and stakeholders, contributing to a more efficient, user-centered system development process. [13].

### 3.3.1. Use Case for Admin

The Use Case Diagram of the Admin is displayed in Figure 3.1.

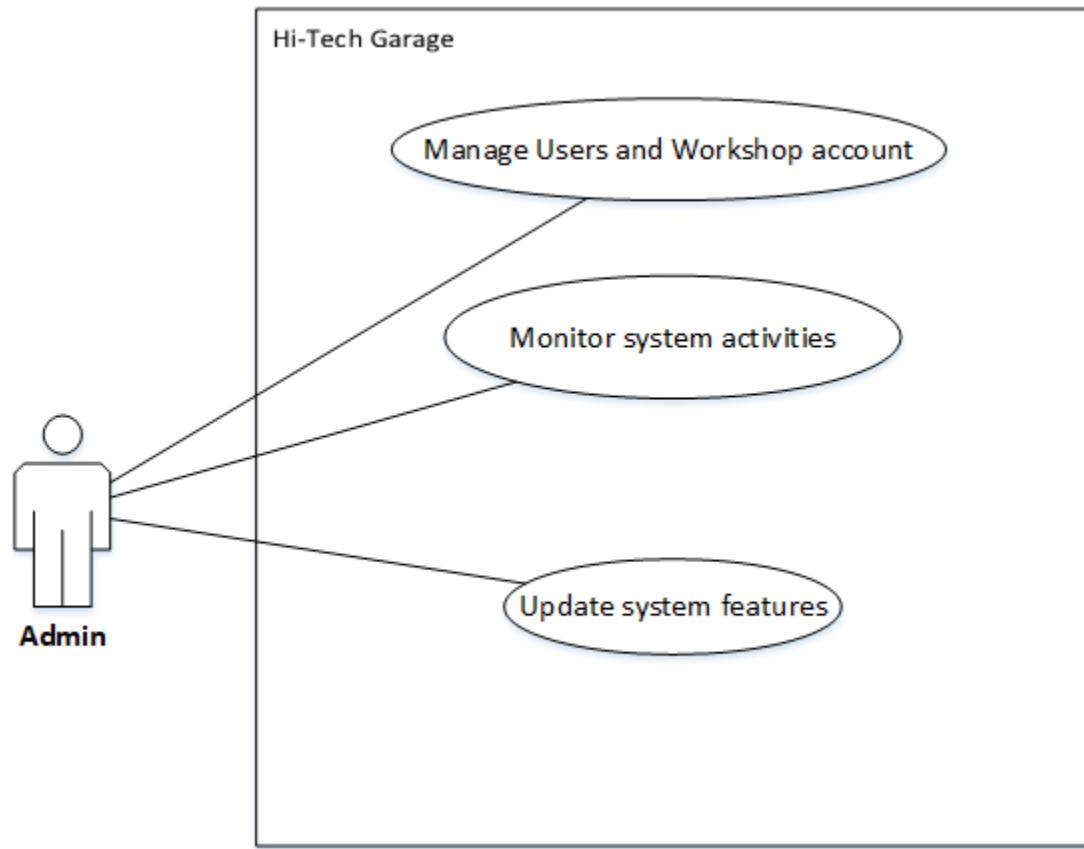


Figure 3. 1. Use case for Admin

### 3.3.2. Use Case for Workshop

The Use Case Diagram of the Workshop is displayed in Figure 3.2.

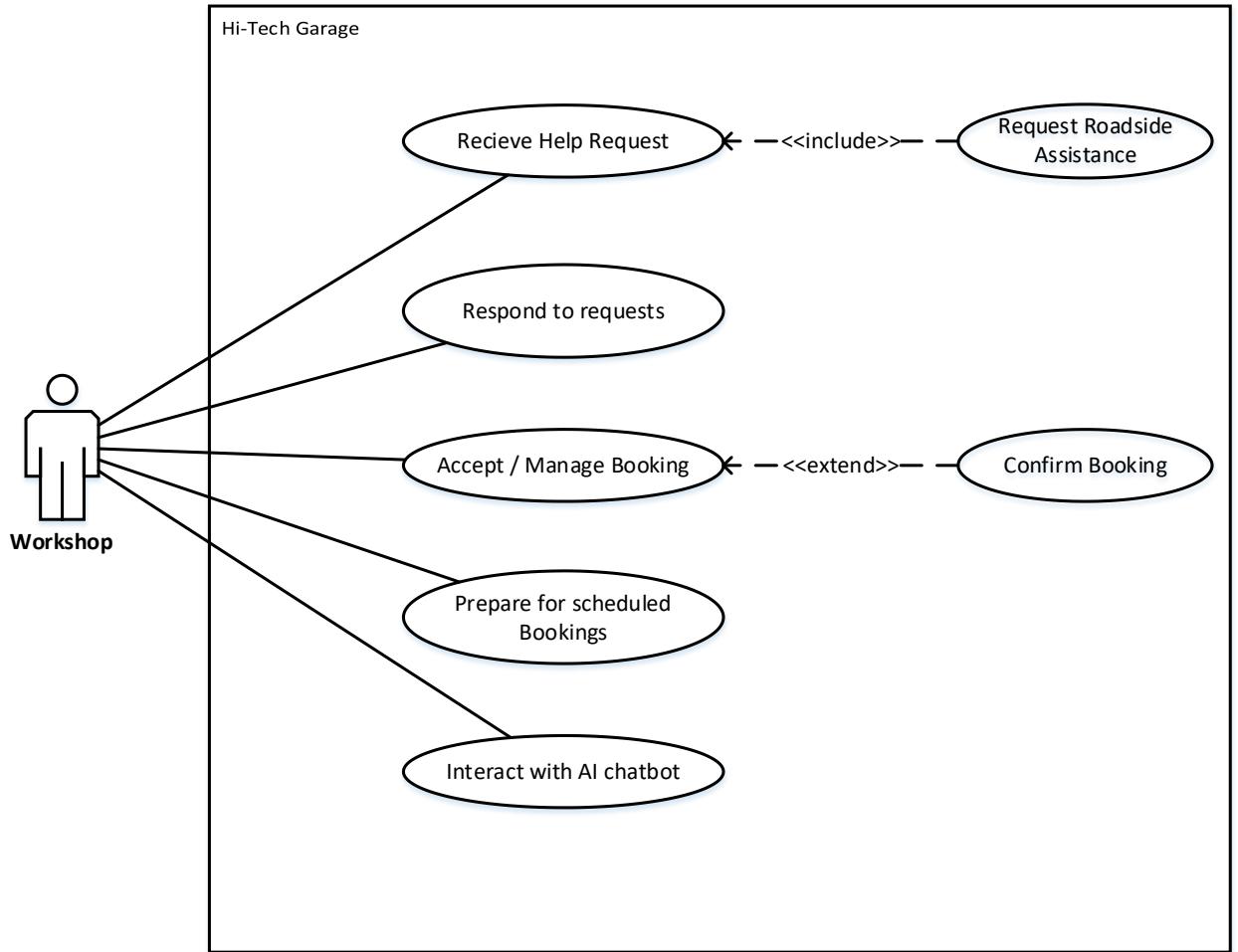


Figure 3. 2. Use case for Workshop

### 3.3.3. Use Case for User

The Use Case Diagram of the User is displayed in Figure 3.3.

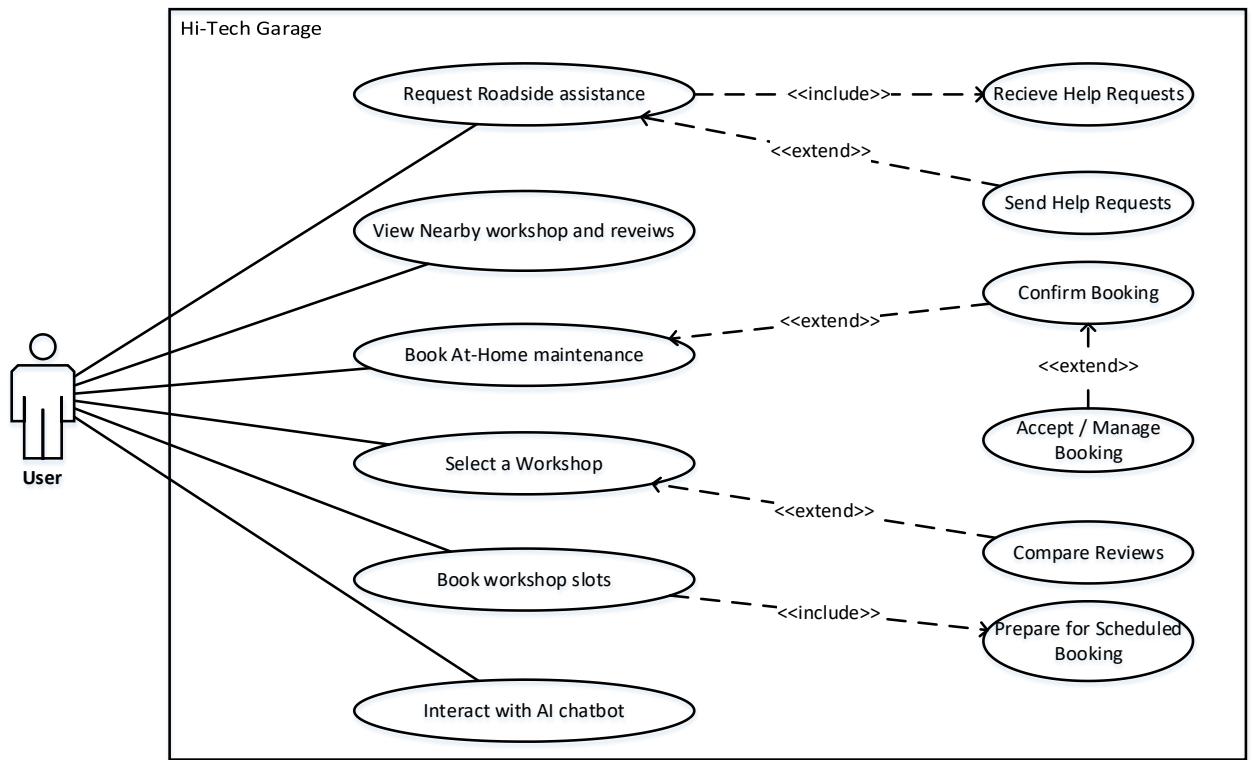


Figure 3. 3. Use case for User

### 3.3.4. Use Case for Hi-Tech Garage System

The Use Case Diagram of the Hi-Tech Garage System is displayed in Figure 3.4.

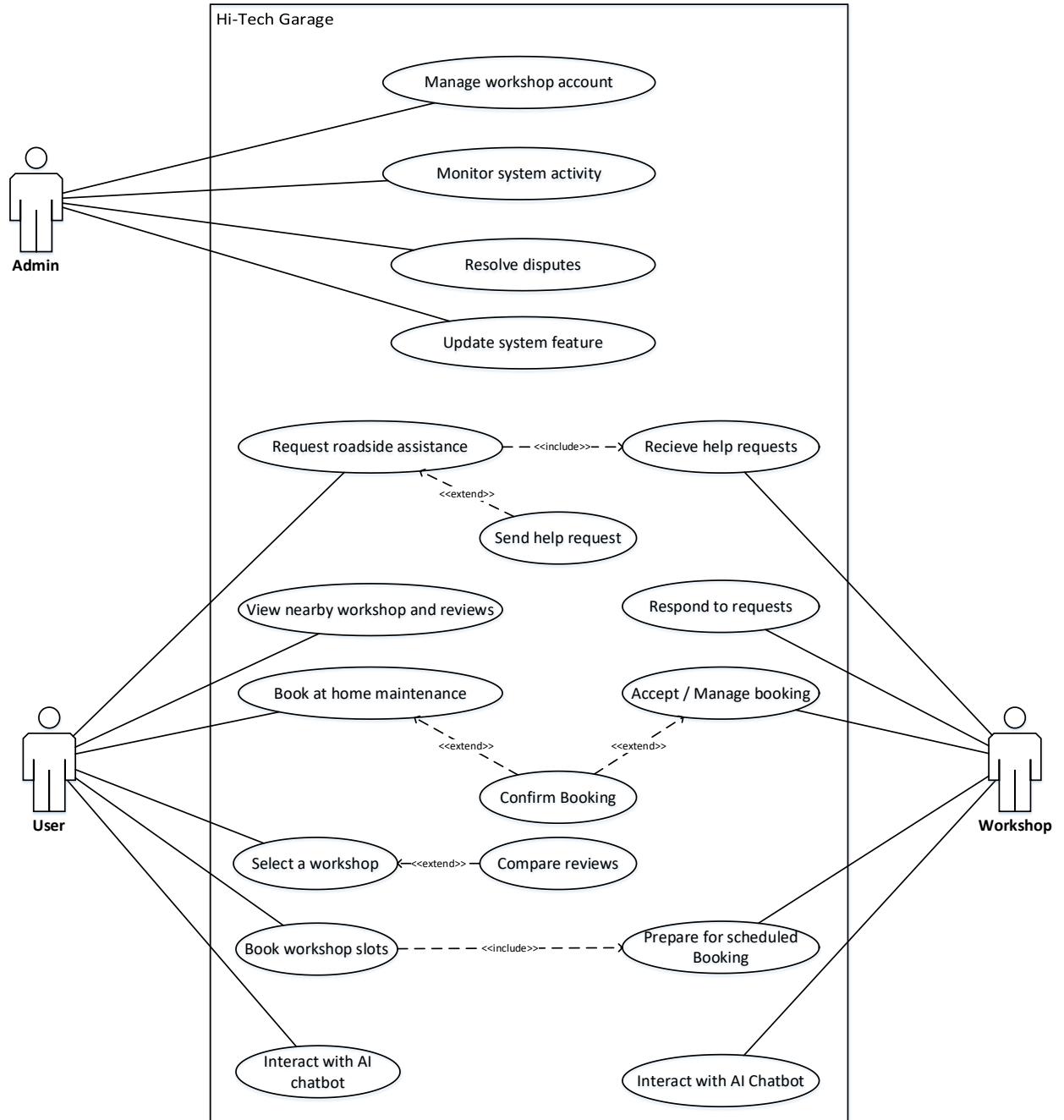


Figure 3. 4. 5 Use case for Hi-Tech Garage System

## 3.4. Use Case Analysis

The functionality of a system is modeled using use cases, which describe the interactions between actors and the system.

### 3.4.1. Actors

1. **User:** An individual in need of vehicle assistance or repair services.
2. **Workshop:** A service provider that provides vehicle repair and maintenance.
3. **Admin:** System admin ensures smooth running of the system and resolves disputes.

### 3.4.2. Use Case Description

#### 3.4.2.1. Use Case 1: Request Roadside Assistance

Use Case for Requesting Roadside Assistance can be seen in Figure 3.5:

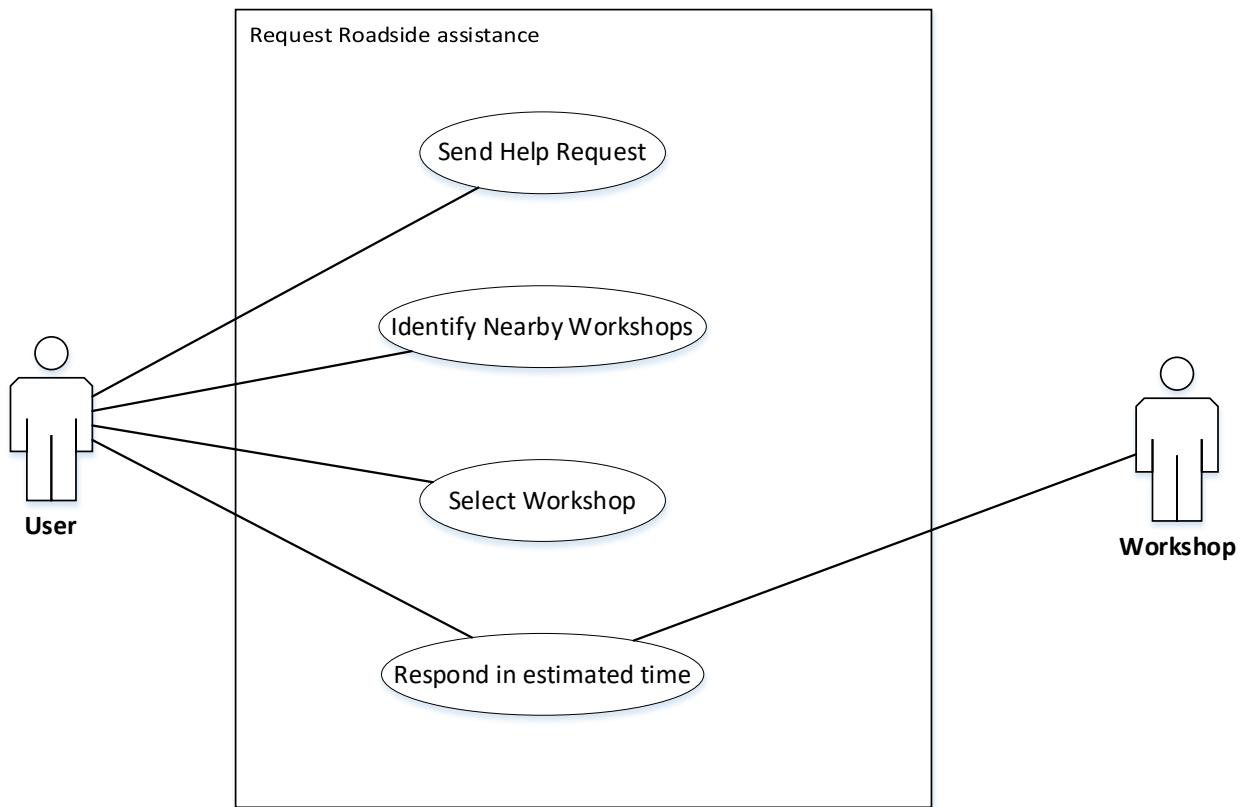


Figure 3. 5. Use case for Requesting Roadside Assistance

This Use case focuses on providing **emergency support** to users when their vehicle breaks down. The system enables users to send requests for help to nearby workshops, ensuring a

quick response. The system's intelligent matching process improves efficiency by identifying workshops based on the user's location and vehicle issues. Exceptional handling handles situations where no workshop is available, keeping users informed.

Table 3. 5. Use case for Request Roadside Assistance

<b>Use Case ID</b>	<b>01</b>
<b>Use Case Name</b>	Request Roadside Assistance
<b>Actors</b>	User, Workshop
<b>Description</b>	When a vehicle breaks down, users can request help. The request is sent to a nearby workshop, which responds with an estimated time of arrival.
<b>Pre-Conditions</b>	<ul style="list-style-type: none"> <li>The system enables and has access to the user's location services.</li> <li>Workshops providing roadside assistance services are registered in the system.</li> </ul>
<b>Post-Conditions</b>	<ul style="list-style-type: none"> <li>User receives help confirmation with estimated arrival time.</li> <li>The request for assistance has been successfully fulfilled.</li> </ul>
<b>Flow of Activities</b>	<p><b>Actor:</b> User submits a help request with details (location, vehicle type, and problem).</p> <p><b>System:</b> Identifies nearby workshops, sends requests, and displays confirmation of estimated arrival time.</p>
<b>Exception Condition</b>	If there is no response from any workshop, the user will be notified that it is unavailable.

### 3.4.2.2. Use Case 2: View Nearby Workshops and Reviews

Use Case for View Nearby Workshop and Reviews can be seen in Figure 3.6:

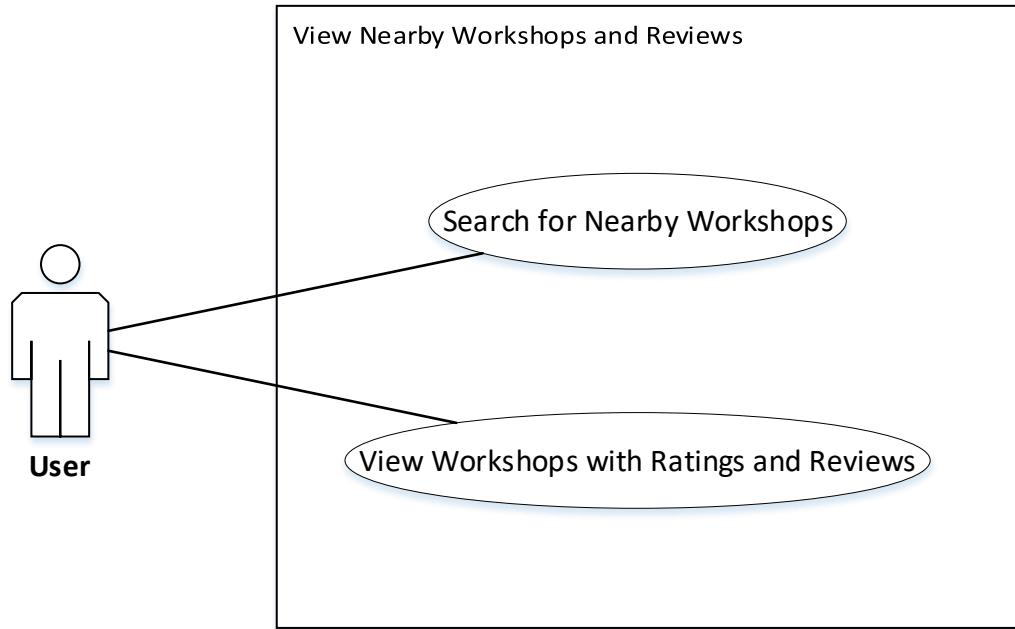


Figure 3. 6. Use case for View nearby Workshops and Reviews

The goal of this Use case is to help users find reliable workshops by providing ratings and reviews. This ensures transparency and empowers users to make informed decisions. The system is designed to support filtering and comparison, making it easier for users to select workshops. Exceptions are made to ensure user satisfaction by notifying the user if no workshop meets the criteria.

Table 3. 6. Use case for View Nearby Workshops and Reviews

<b>Use Case ID</b>	02
<b>Use Case Name</b>	View Nearby Workshops and Reviews
<b>Actors</b>	User
<b>Description</b>	Users can search for nearby workshops, view ratings and compare reviews.
<b>Pre-Condition</b>	User has access to the Platform and enables location services.
<b>Post-Condition</b>	Workshop details are displayed.
<b>Flow of Activities</b>	<p><b>Actor:</b> User searches for workshops based on location or service type.</p> <p><b>System:</b> Displays a list of workshops with reviews and ratings for the user to select from.</p>
<b>Exception Condition</b>	If a workshop is not found, the user will be notified.

### 3.4.2.3. Use Case 3: Book At-Home Maintenance

Use Case for View Book At-Home Maintenance can be seen in Figure 3.7:

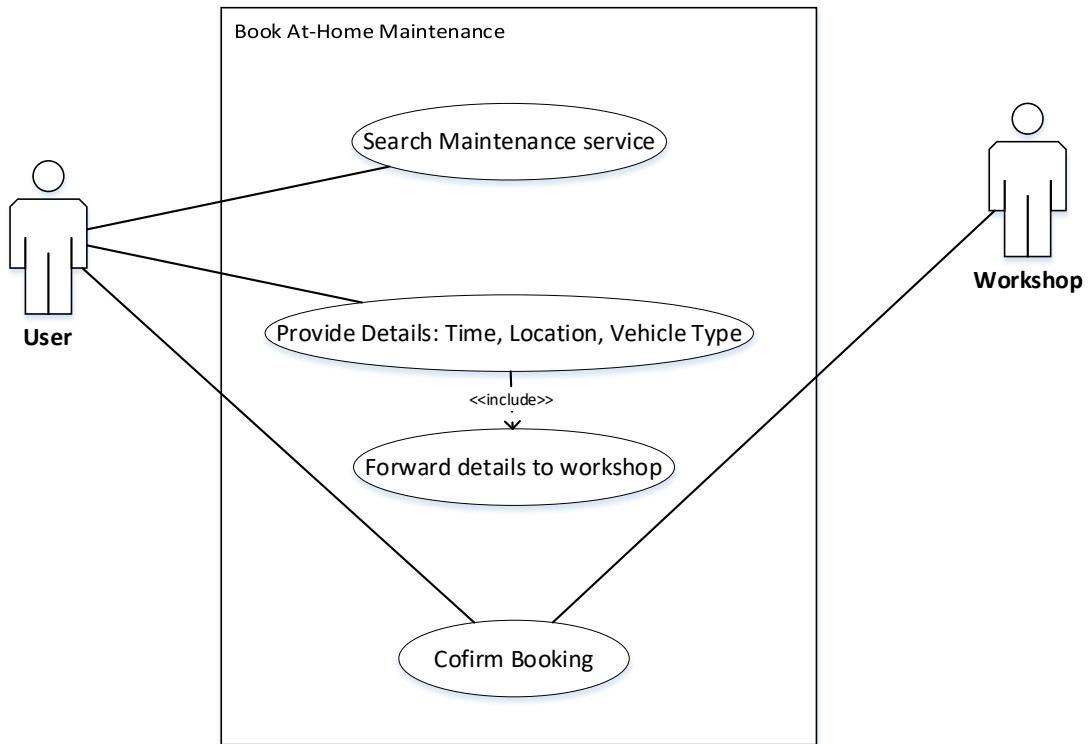


Figure 3. 7. Use case for Book At-Home Maintenance

This Use case allows users to schedule maintenance services at their preferred location. It streamlines the booking process by forwarding requests to workshops and confirming availability. The system ensures user convenience by providing a simple interface to specify details such as time, location and vehicle type. Exception handling includes notifying users when no workshops are available for booking, thus maintaining clear communication.

Table 3. 7. Use case for Book At-Home Maintenance

<b>Use Case ID</b>	03
<b>Use Case Name</b>	Book At-Home Maintenance
<b>Actors</b>	User, Workshop
<b>Description</b>	Users can make door-to-door vehicle maintenance service appointments.
<b>Pre-Condition</b>	Users can access the platform and provide valid booking details (time, location, vehicle type).
<b>Post-Condition</b>	The maintenance service appointment was successful.
<b>Flow of Activities</b>	<p><b>Actor:</b> User selects a repair service and provides details (time, location, vehicle type).</p> <p><b>System:</b> Forwards the booking request to the selected workshop and notify the user upon confirmation.</p>
<b>Exception Condition</b>	Users will be notified if no workshop booking is confirmed.

#### 3.4.2.4. Use Case 4: Book Workshop Slots

Use Case for Book Workshop Slots can be seen in Figure 3.8:

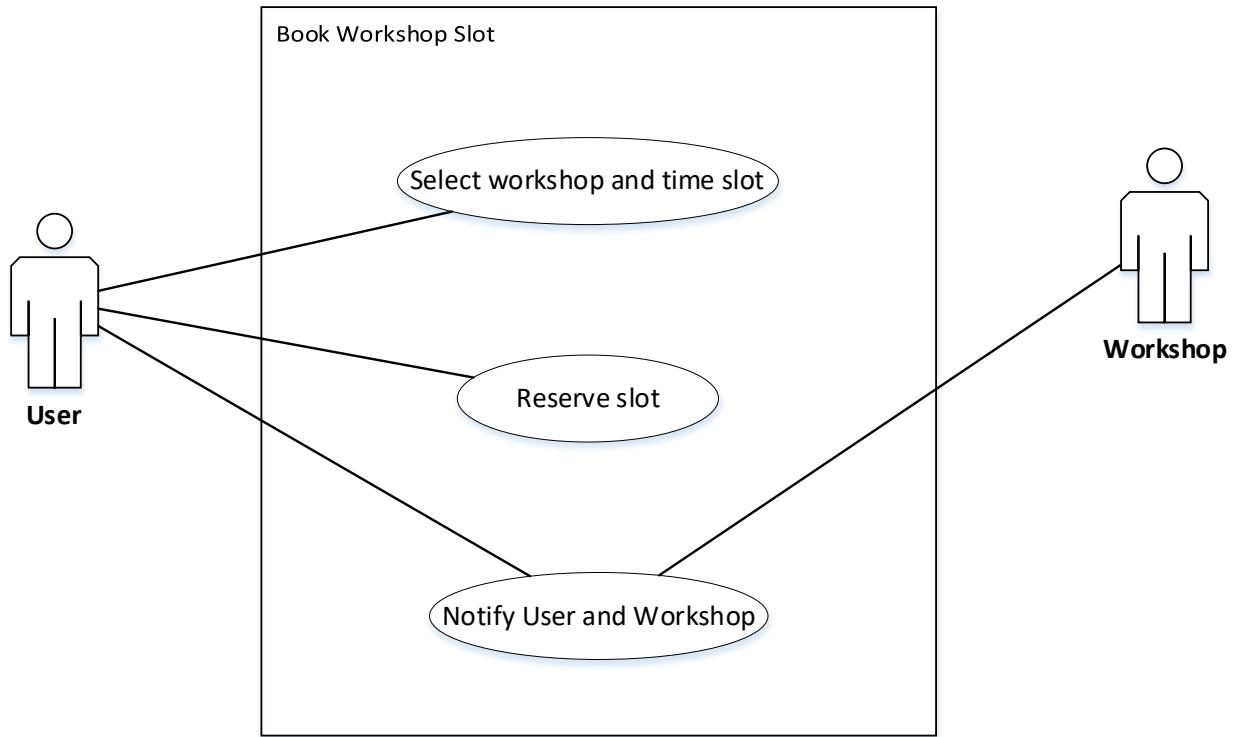


Figure 3. 8. Use case for Book Workshop Slots

This use case enables users to reserve a specific time slot for vehicle repairs at a workshop. By allowing users to book slots in advance, it reduces waiting times and ensures workshops can manage their schedules efficiently. The system's notification mechanism keeps users and workshops informed of booking status. If an unavailability occurs, exceptions ensure users are notified promptly to avoid frustration.

Table 3. 8. Use case for Book Workshop Slots

<b>Use Case ID</b>	04
<b>Use Case Name</b>	Book Workshop Slots
<b>Actors</b>	User, Workshop
<b>Description</b>	Users can make an appointment for vehicle repair time at the workshops.
<b>Pre-Conditions</b>	<ul style="list-style-type: none"> <li>The workshop is listed and available in the system.</li> <li>The system has real-time period availability data.</li> <li>The user provides the necessary details (name, contact details, vehicle details).</li> </ul>
<b>Post-Condition</b>	The workshop slot has been reserved successfully.
<b>Flow of Activities</b>	<b>Actor:</b> User selects the workshop and available time slots. <b>System:</b> Reserve slots and notify workshops and users.
<b>Exception Condition</b>	If there are no slots available, the user is notified.

### 3.4.2.5. Use Case 5: Interact with AI Chatbot

Use Case for Interact with AI Chatbot can be seen in Figure 3.9:

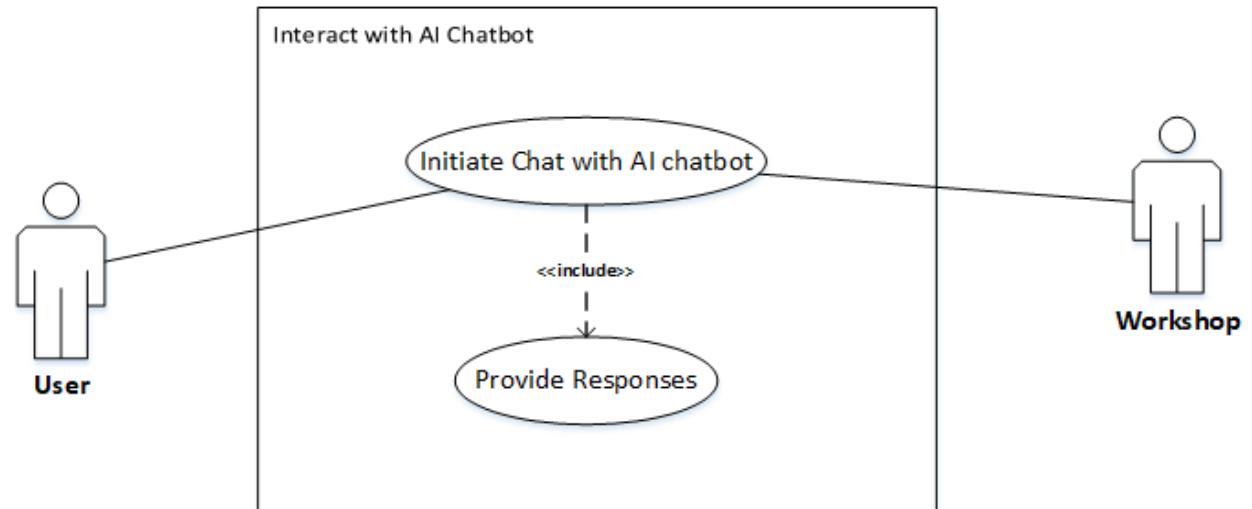


Figure 3. 9. Use case for Interact with AI Chatbot

This Use case enhances user experience by providing instant assistance through an **AI chatbot** [14]. The system simplifies query parsing and redirects users to the appropriate support channel when needed. It ensures users receive fast and accurate responses, increasing overall satisfaction.

Table 3. 9. Use case for Interact with AI Chatbot

<b>Use Case ID</b>	05
<b>Use Case Name</b>	Interact with AI Chatbot
<b>Actors</b>	User
<b>Description</b>	Users can interact with AI chatbots to get help.
<b>Pre-Conditions</b>	AI chatbot is accessible. Users have questions or issues that need to be resolved.
<b>Post-Condition</b>	User questions are resolved, or support is provided.
<b>Flow of Activities</b>	<b>Actors:</b> Users initiate conversations with the chatbot. <b>System:</b> Provides responses to queries.
<b>Exception Condition</b>	If the chatbot is unable to resolve the query, the user will be notified about the unavailability.

### 3.4.2.6. Use Case 6: Manage Accounts

Use Case for Manage Accounts can be seen in Figure 3.10:

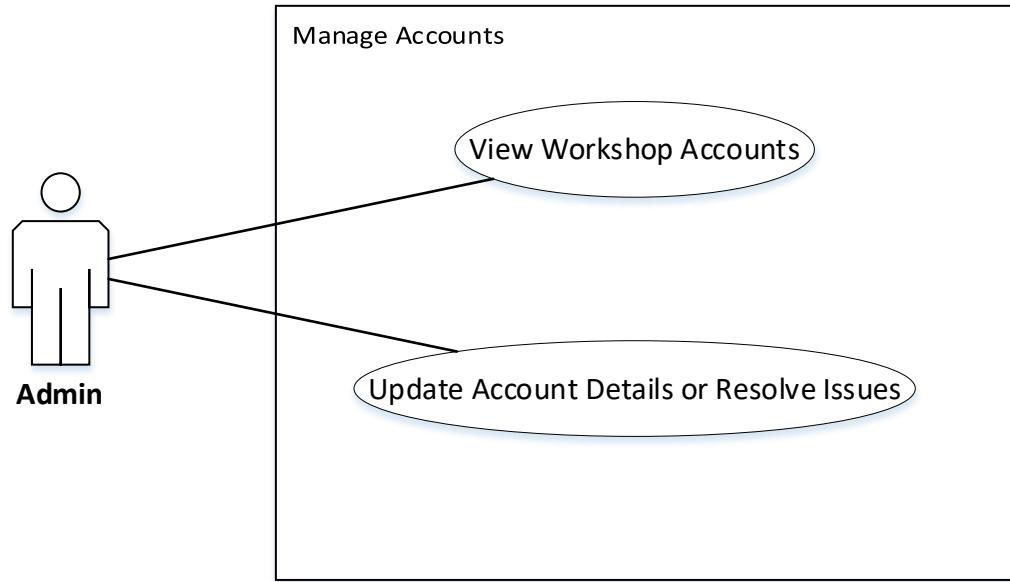


Figure 3. 10. Use case for Manage Accounts

This Use case enables admin to maintain system integrity by managing workshop accounts. Admin can update account details, resolve disputes, and ensure compliance with platform rules. The system's structured approach helps admin resolve issues efficiently while maintaining data accuracy. Exceptions ensure that escalated issues are managed effectively, minimizing disruption.

Table 3. 10. Use case for Manage Accounts

<b>Use Case ID</b>	06
<b>Use Case Name</b>	Manage Accounts
<b>Actors</b>	Admin
<b>Description</b>	Admin manages workshop accounts and ensures data accuracy.
<b>Pre-condition</b>	The admin has logged into the system.
<b>Post-condition</b>	Account details are updated or resolved successfully.
<b>Flow of Activities</b>	<p><b>Actor:</b> Admin views workshop account.</p> <p><b>System:</b> Update account details as needed.</p>
<b>Exception Condition</b>	If an account issue cannot be resolved, the admin will escalate it to higher authorities.

### 3.5. Activity Diagrams

Activity diagrams are behavioral UML diagrams used to visualize the flow of activities within a system. They are particularly useful and essential for modeling dynamic aspects of a system, such as business processes, workflows, and sequences of actions that occur in response to various events. These diagrams clearly show how control flows from one activity to another, helping developers and stakeholders understand the operating logic of the system. In a system like Hi-Tech Garage, activity diagrams can show processes such as user registration, booking services, or order management, supporting better communication, process optimization, and accuracy in system design [15].

### 3.5.1. Activity Diagram for View Nearby Workshop

Figure 5.4 represents the workflow for View Nearby Workshop.

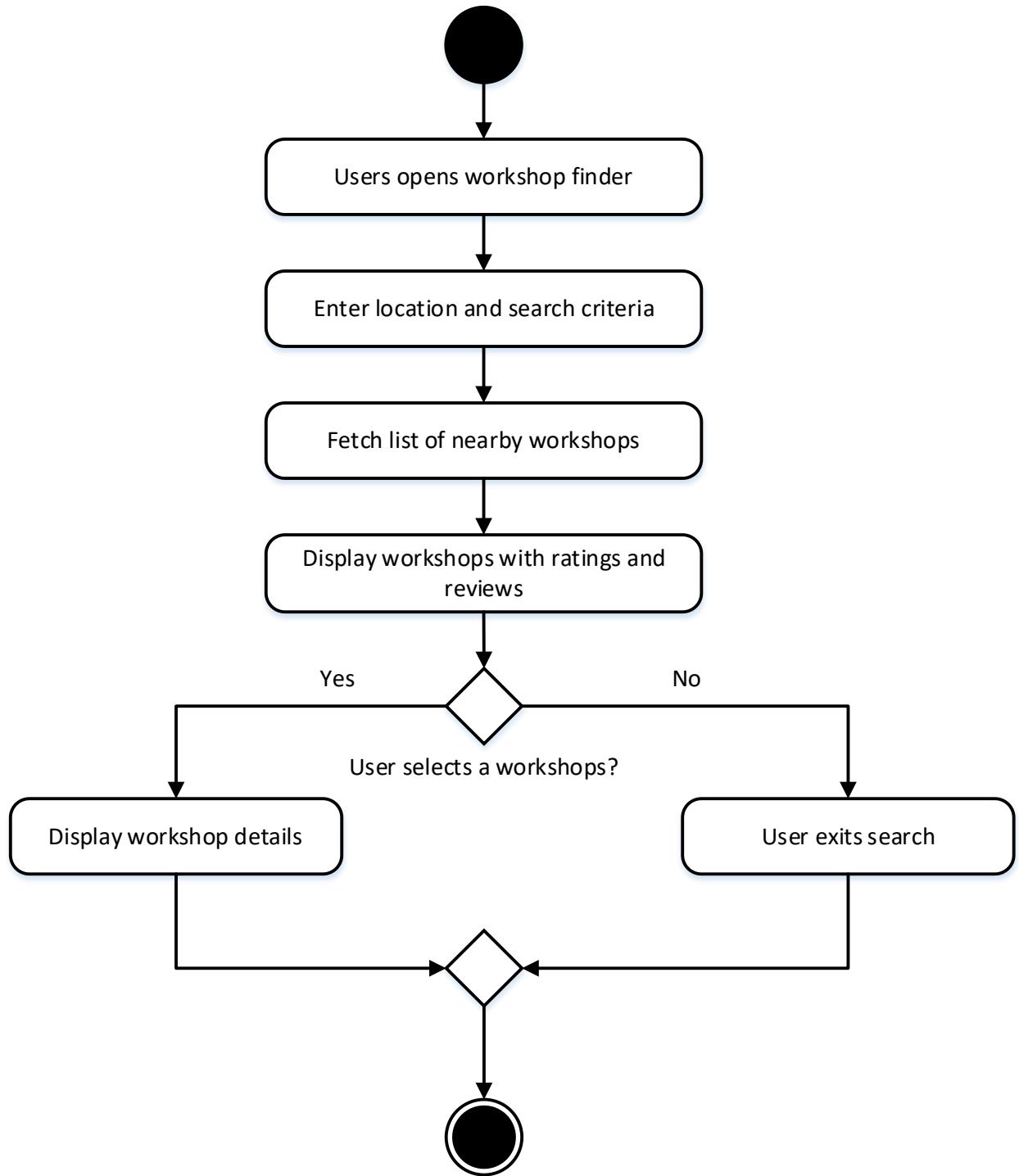


Figure 3. 11. Activity Diagram for View Nearby Workshop

The **workshop finder process** begins when a user opens the workshop finder and enters their location and search criteria to refine the results. The system then fetches a list of nearby workshops that match the details provided and displays them along with ratings and reviews. At this stage, the user needs to decide whether to choose the workshop or exit the search. If the user selects a workshop, its details are displayed for further exploration. However, if the user decides not to continue, they will exit the search. No matter which choice you make, the process concludes, ensuring a streamlined and user-friendly experience when finding workshops efficiently.

### 3.5.2. Activity Diagram for Selecting a Workshop

Figure 5.5 illustrates the workflow of Selecting a Workshop.

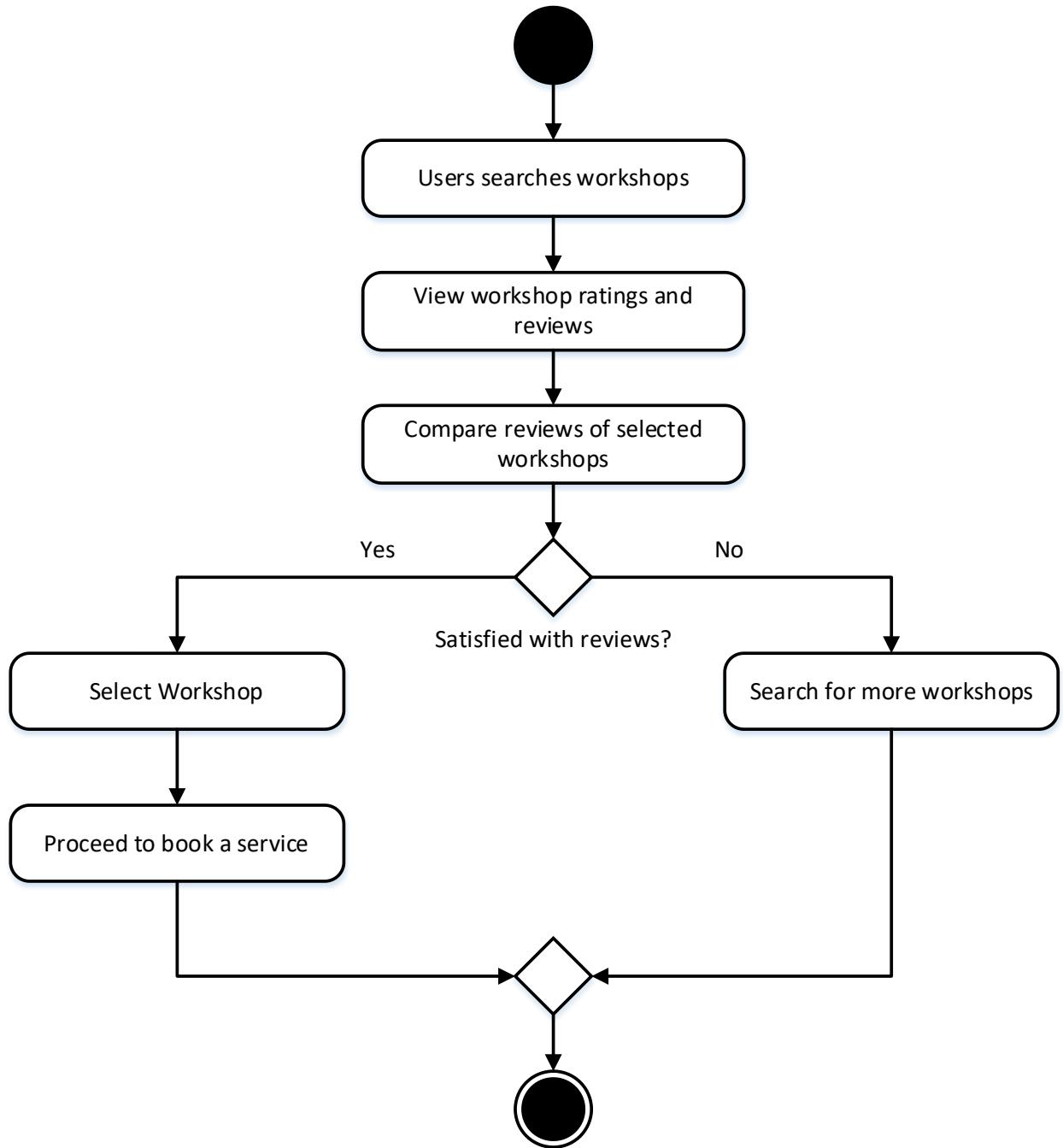


Figure 3. 12. Activity Diagram for Selecting a Workshop

This flowchart represents the **workshop selection and booking process**. It starts when users search for workshops and view ratings and reviews to assess the quality of service. Users then compare reviews of selected workshops to determine their satisfaction. If they are satisfied with the reviews, they will go ahead and choose the workshop and book the service. However,

if they are not satisfied, they will keep looking for more workshops until they find the right option. This process ensures users can make informed decisions based on workshop ratings and reviews, resulting in a seamless service booking experience.

### 3.5.3. Activity Diagram for Roadside Assistance

Figure 5.6 represents the process of Roadside Assistance.

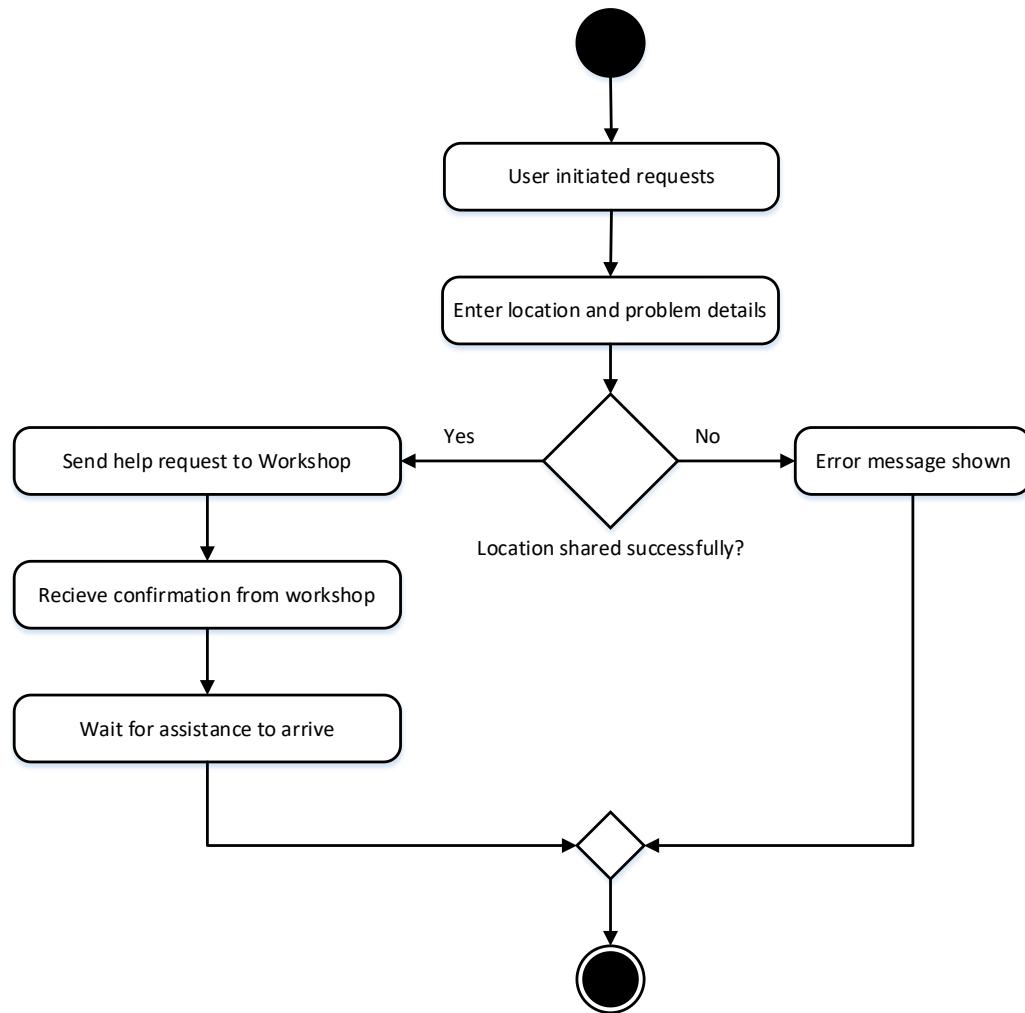


Figure 3. 13. Activity Diagram for Roadside Assistance

This flowchart illustrates the workflow for managing **emergency roadside assistance** requests in the **Hi-Tech Garage** system. The process begins when a user initiates a request and enters their location and problem details. The system then verifies that the location was successfully shared. If location sharing is successful, the system sends a request for help to a nearby workshop. If not, an error message will appear prompting the user to re-enter their location details. After the workshop receives the request, it sends a confirmation message to the user.

indicating that assistance is on the way. The user then waits for shop personnel to arrive and resolve the issue, marking the completion of the process. This workflow ensures efficient communication and prompt assistance to users who need it.

### 3.5.4. Activity Diagram for User Interacting with AI Chatbot

Figure 5.7 represents the process of user interacting with AI Chatbot.

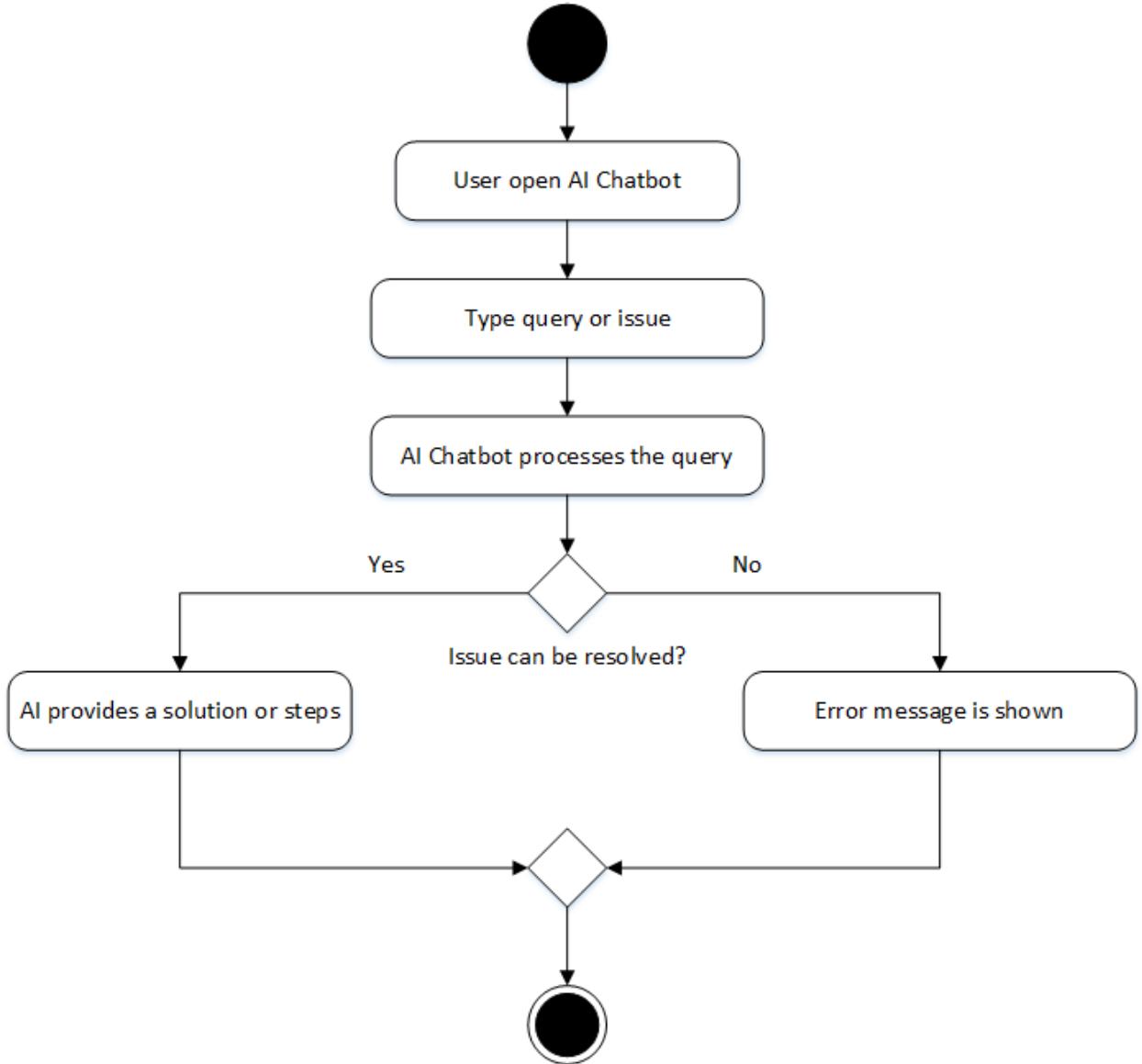


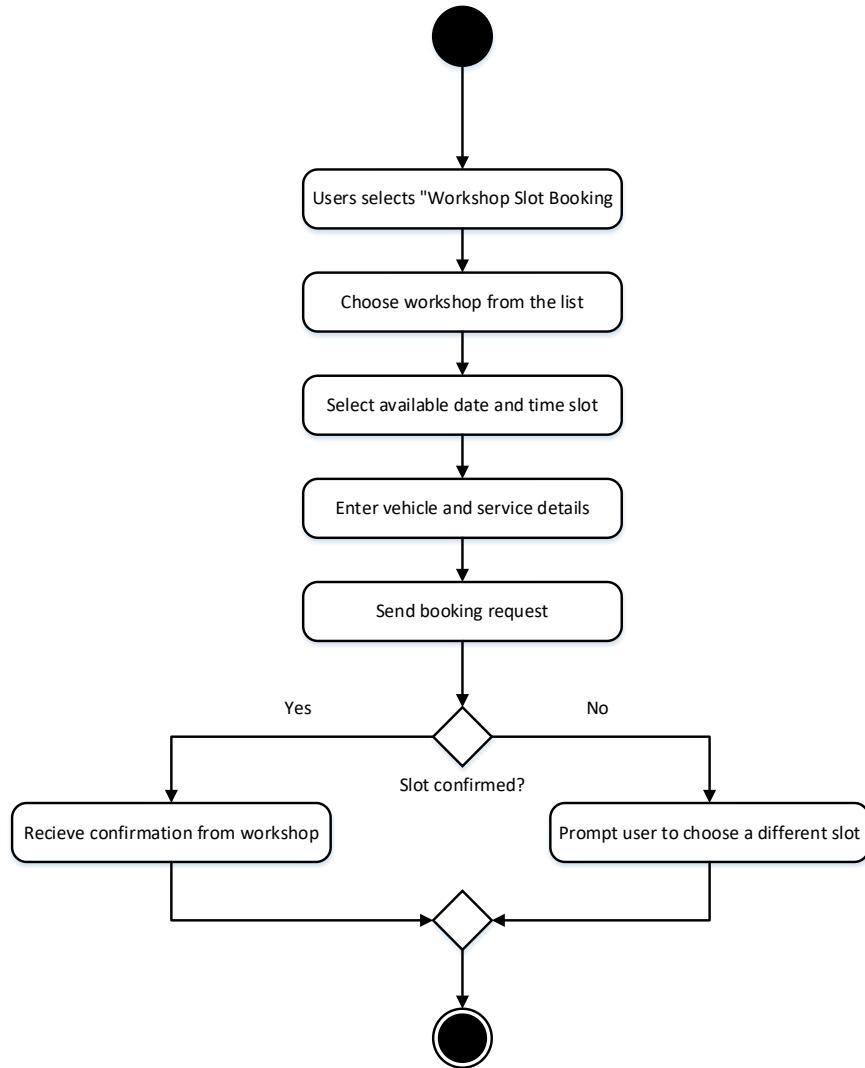
Figure 3. 14. Activity Diagram for User Interacting with AI Chatbot

This flowchart illustrates the **AI chatbot support process**. The process begins when a user opens the **AI chatbot** and enters a query or question. The AI chatbot then processes the query and determines whether the issue can be resolved automatically. If the problem can be solved, the chatbot will provide a solution or step-by-step guidance [16]. However, if the chatbot

cannot resolve the issue, it will show an error message to notify user about inconvenience. This structured approach ensures effective problem resolution by leveraging AI for common queries, while complex issues are escalated to human agents when necessary.

### 3.5.5. Activity Diagram for Booking a Workshop Slot

Figure 5.8 represents the process of scheduling a workshop visit, including selecting services and confirming appointments.



*Figure 3. 15. Activity Diagram for Booking a Workshop Slot*

This flowchart illustrates the **workshop slot booking process** and guides users through the steps to schedule a service appointment. First, the user selects the booking option and then selects the workshop from the list. The user then selects available dates and time slots before entering vehicle and service details. After submitting a booking request, availability will be

checked. If the slot is confirmed, the user will receive a confirmation message from the Workshop. If not, the user will be prompted to select a different slot. This process ensures that workshop appointments are scheduled in a streamlined and efficient manner.

### 3.5.6. Activity Diagram for Booking At-Home Maintenance

Figure 5.9 represents the process of scheduling a workshop visit, including selecting services and confirming appointments.

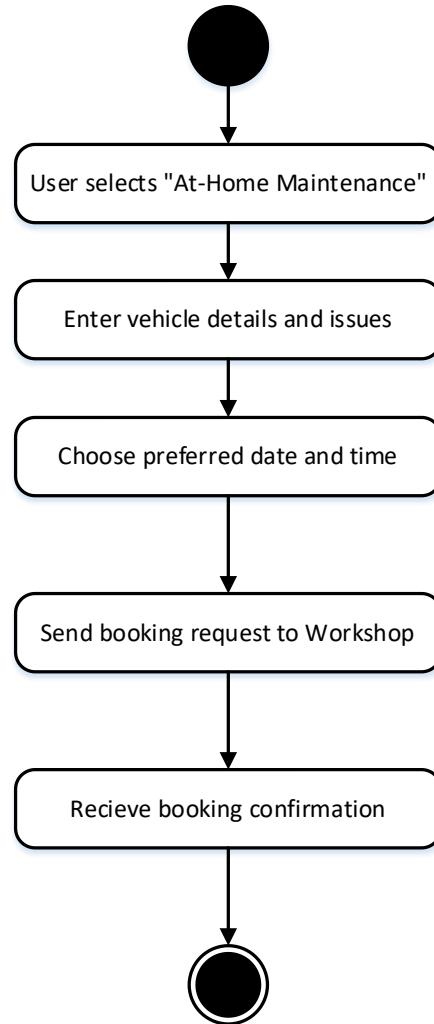


Figure 3. 16. Activity Diagram for Booking At-home Maintenance

This flowchart represents **the home maintenance booking process** and outlines the steps a user follows to schedule maintenance services at their location. The process starts with the user selecting the "**Maintenance at Home**" option. Next, they enter vehicle details and describe any issues that need attention. Users then select their preferred service date and time before submitting a booking request to the workshops. Finally, the system provides booking

confirmation to ensure that the appointment is successfully arranged. This process simplifies maintenance by allowing users to receive service at their convenience.

### 3.5.7. Activity Diagram for Receiving Help Requests

Figure 5.10 represents the process of Receiving help requests.

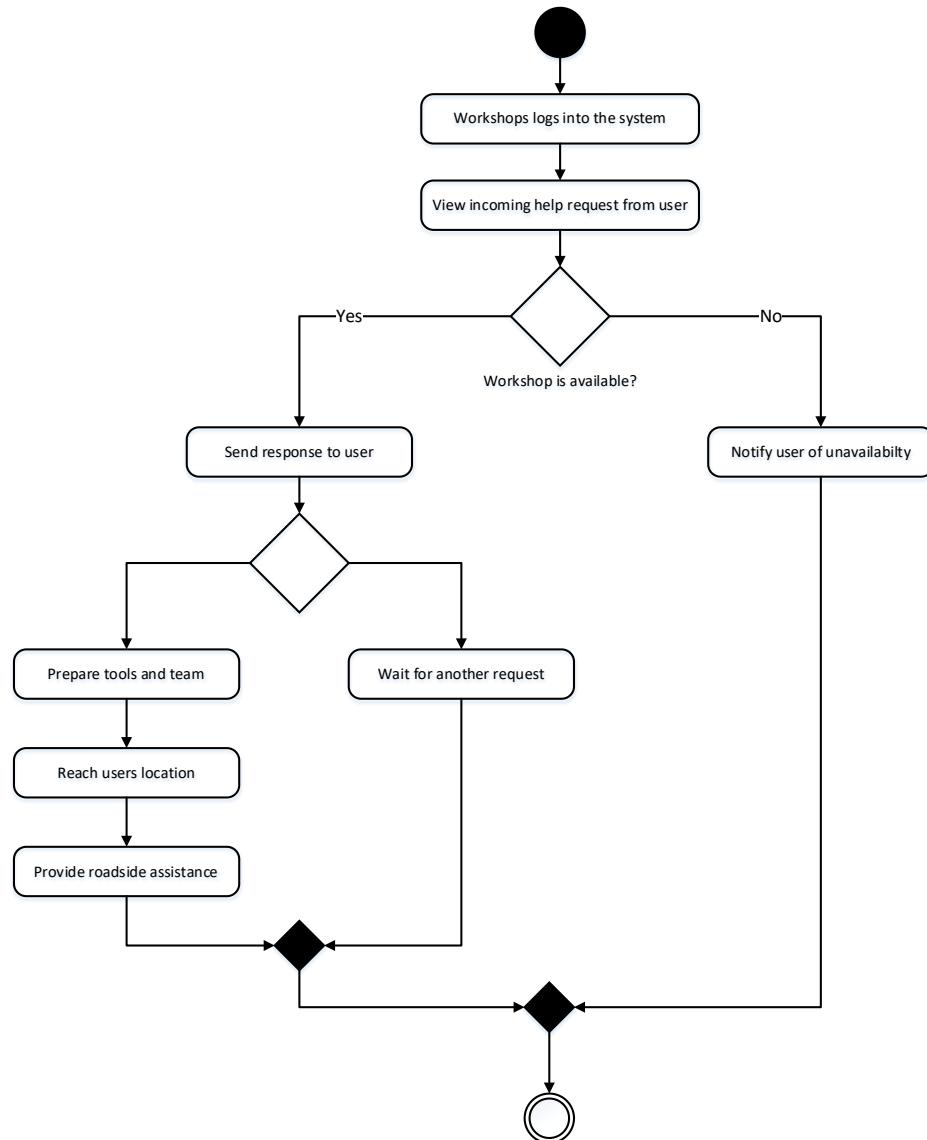


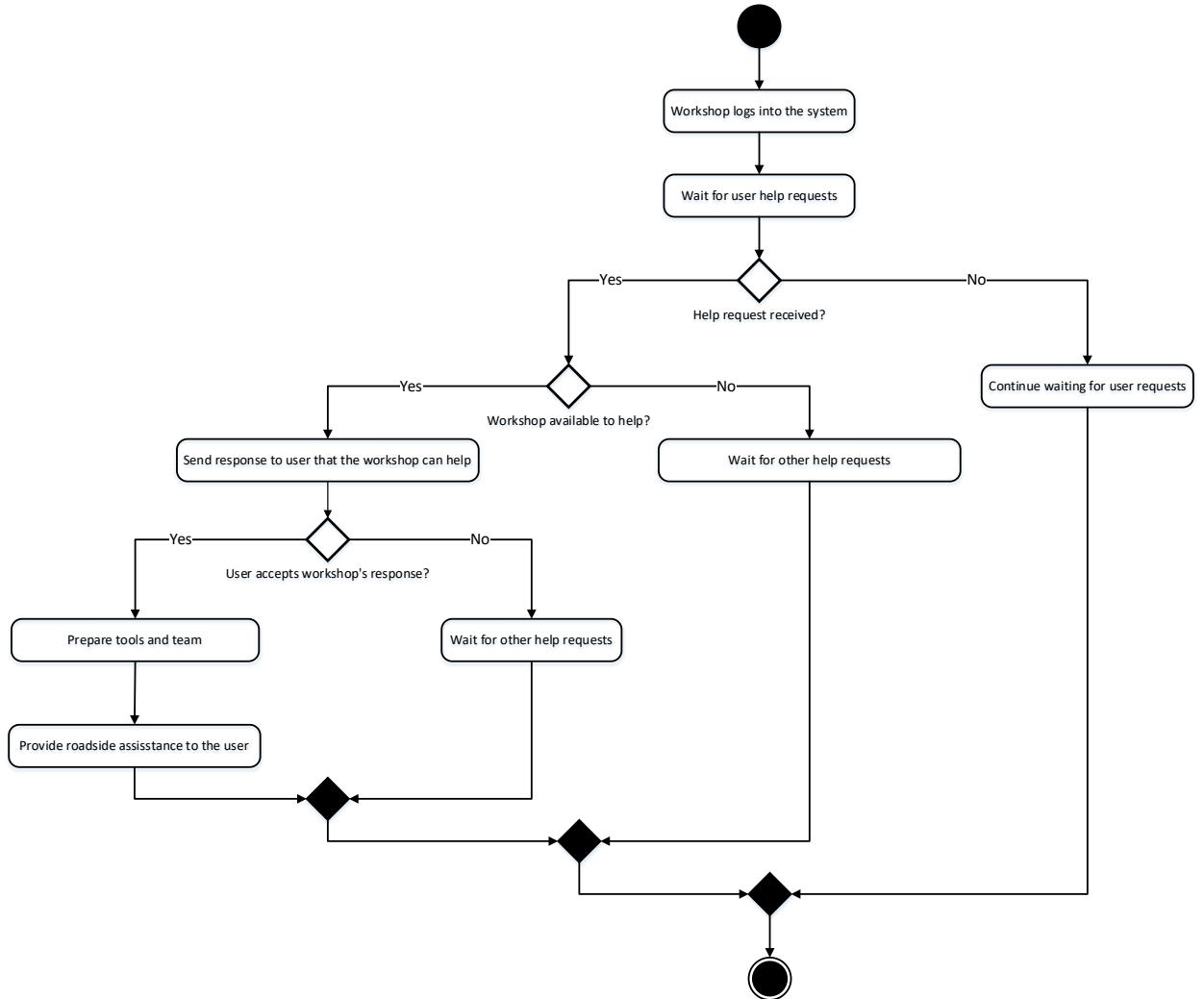
Figure 3. 17. Activity Diagram for Receiving Help requests

This flowchart outlines the workshop's process for handling **incoming roadside assistance requests** in a "Hi-Tech garage" system. The process begins when the workshop logs into the system and views incoming user requests. If the Workshop can handle the request, it will send a response to the user and continue preparing the tool and team. The team then travels to the user's location to provide roadside assistance and complete the service request. If a workshop

is unavailable, it notifies the user about the unavailability. After responding to a request or notifying the user, the Workshop waits for the next incoming request. This process ensures that the workshop manages user requests efficiently and allocates resources efficiently.

### 3.5.8. Activity Diagram for Respond to request

Figure 5.11 represents the process of Responding to request.



*Figure 3. 18. Activity Diagram for Respond to request*

This flowchart represents the process followed by the workshop to **manage user assistance requests** in the **Hi-Tech Garage** system. The workflow starts with the shop floor logging into the system and waiting for a user request for help. After receiving the request, the system checks whether the workshop can help. If available, Workshop sends a response to the user indicating its ability to help. The user then decides whether to accept the workshop's response. If the user accepts, the workshop prepares the tools and team to travel to the user's location and provide roadside assistance to complete the process.

If the workshop is unavailable or the user refuses to respond, the workshop will continue to wait for additional help requests. This iterative process ensures that workshops can manage requests efficiently while prioritizing user confirmation and usability. If a request for help is not initially received, the workshop remains on hold, ready to respond if needed.

### 3.5.9. Activity Diagram to Accept/Manage Bookings

Figure 5.12 represents the process of Accepting/Managing bookings.

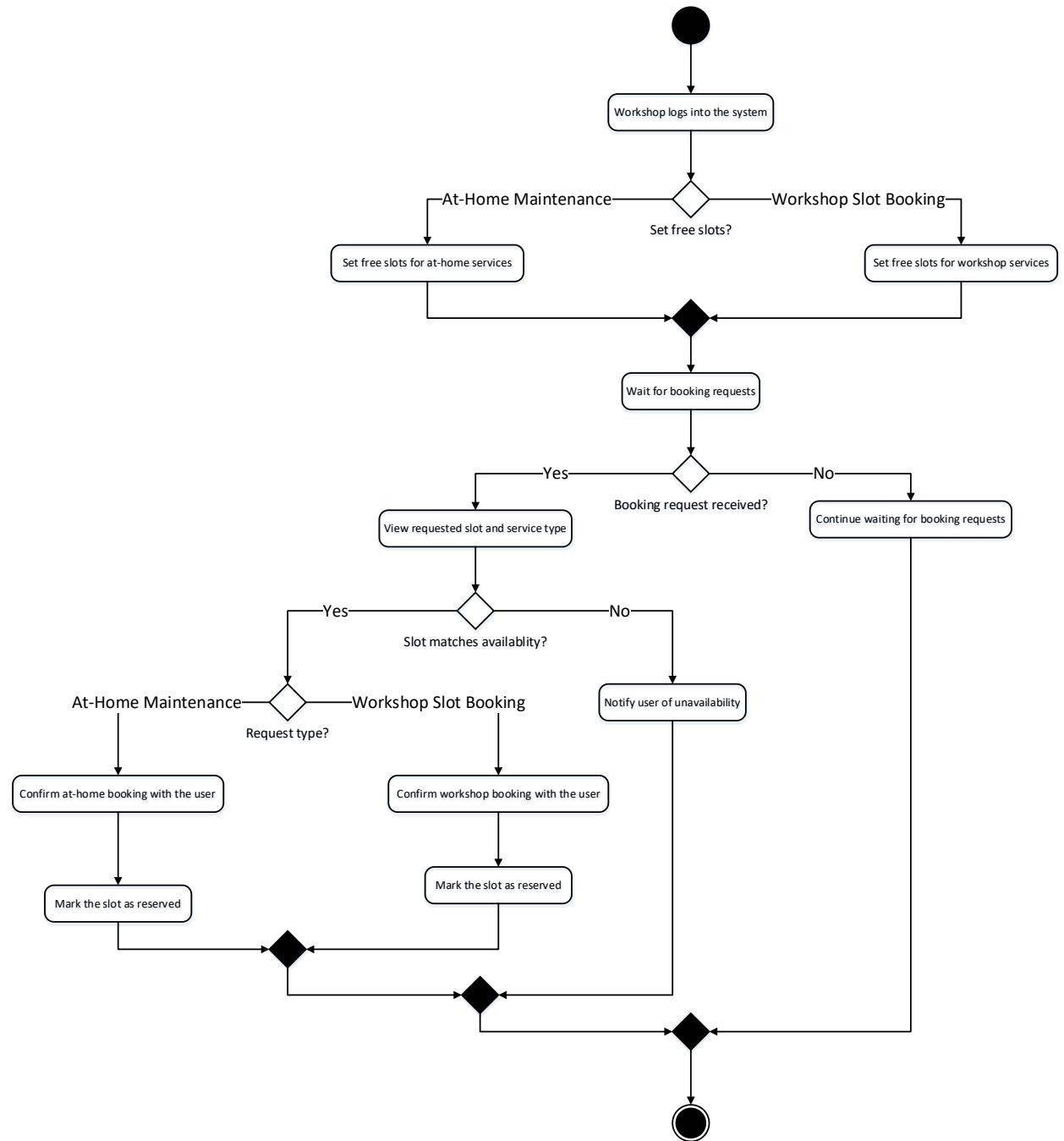


Figure 3. 19. Activity Diagram for Accept/Manage Bookings

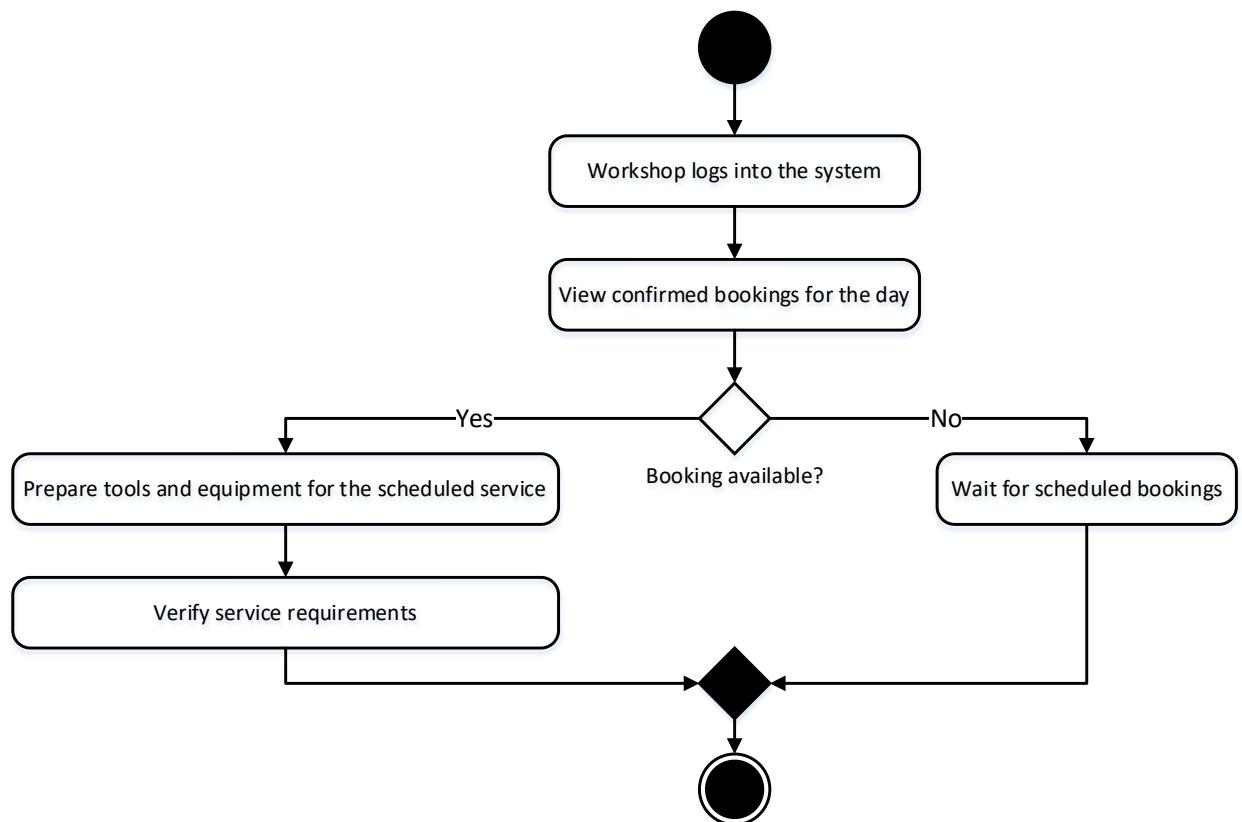
This flowchart outlines the process to **manage workshop bookings** in the **Hi-Tech Garage** system, focusing on two services: **Onsite Maintenance and Workshop Slot Booking**. After logging into the system, the workshop will set up vacant time for on-site maintenance or workshop visits. The system then waits for the booking request.

Once a request is received, the workshop will review the requested dates and type of service. If the slot matches availability, the system determines the type of request. For on-site maintenance, the booking needs to be confirmed with the user and the task marked as assigned. For workshop slot bookings, the system confirms the booking with the user and marks the slot as booked. If no slot is available, the user is notified that it is unavailable.

If no booking request is received, the workshop will be in a state of waiting for new requests. This structured process ensures efficient management of both service types while prioritizing user satisfaction and time slot availability.

### 3.5.10. *Activity Diagram for Prepare for Schedule Booking*

Figure 5.13 represents the process of Preparing for scheduled bookings.



*Figure 3. 20. Activity Diagram for Prepare for Schedule Booking*

This flowchart outlines the workshop's process for **managing confirmed bookings** in the **Hi-Tech Garage** system. First, the shop floor staff logs into the system and views all confirmed bookings for the day. If booking is available, staff will prepare the tools and equipment needed to book the service and verify service requirements to ensure readiness. If no bookings are

available, the workshop will wait for an upcoming scheduled booking. This process ensures smooth and efficient handling of daily operations.

### 3.5.11. Activity Diagram for Workshop Interact with AI chatbot

Figure 5.14 represents the process of workshop interacting with AI Chatbot.

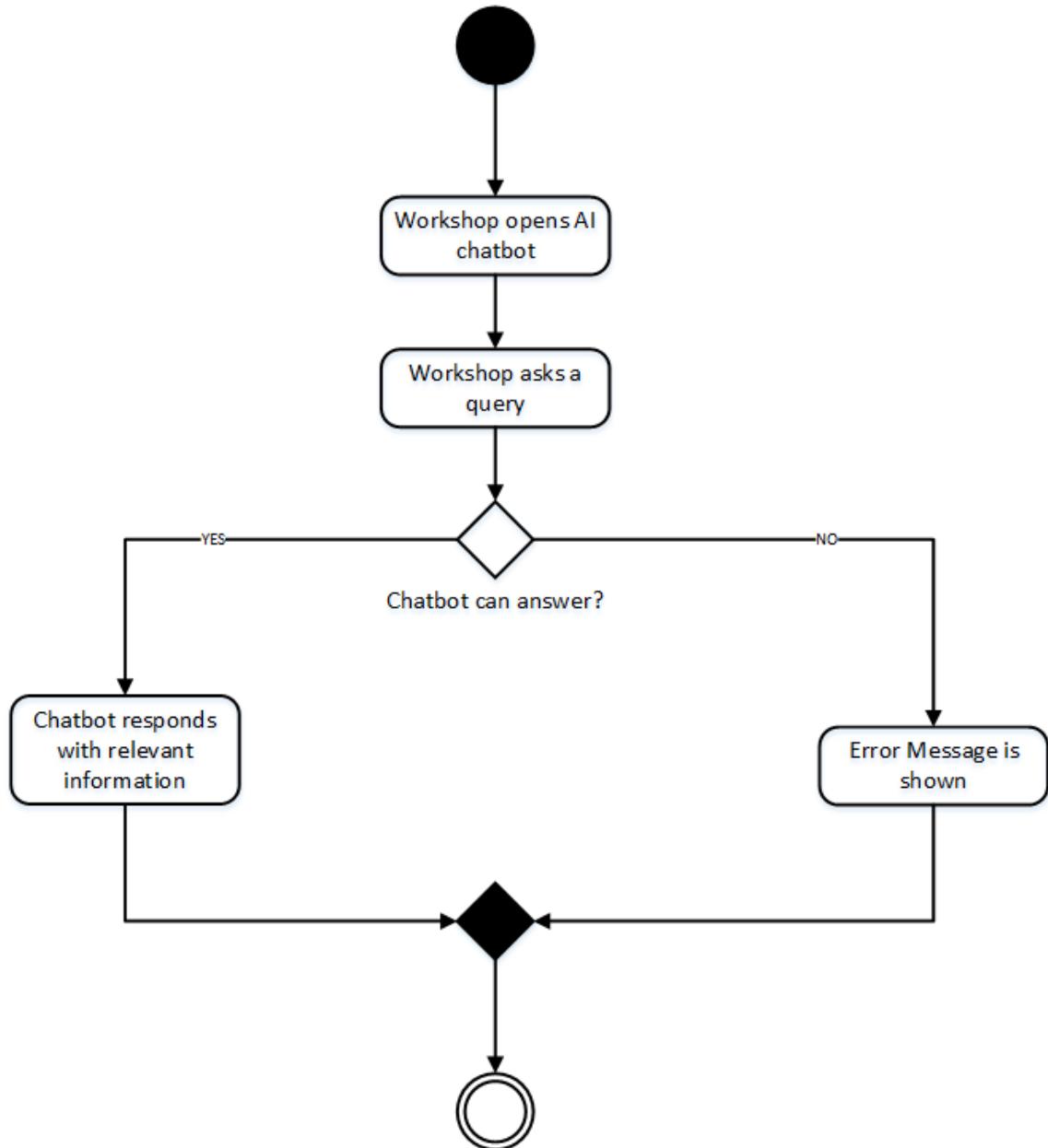


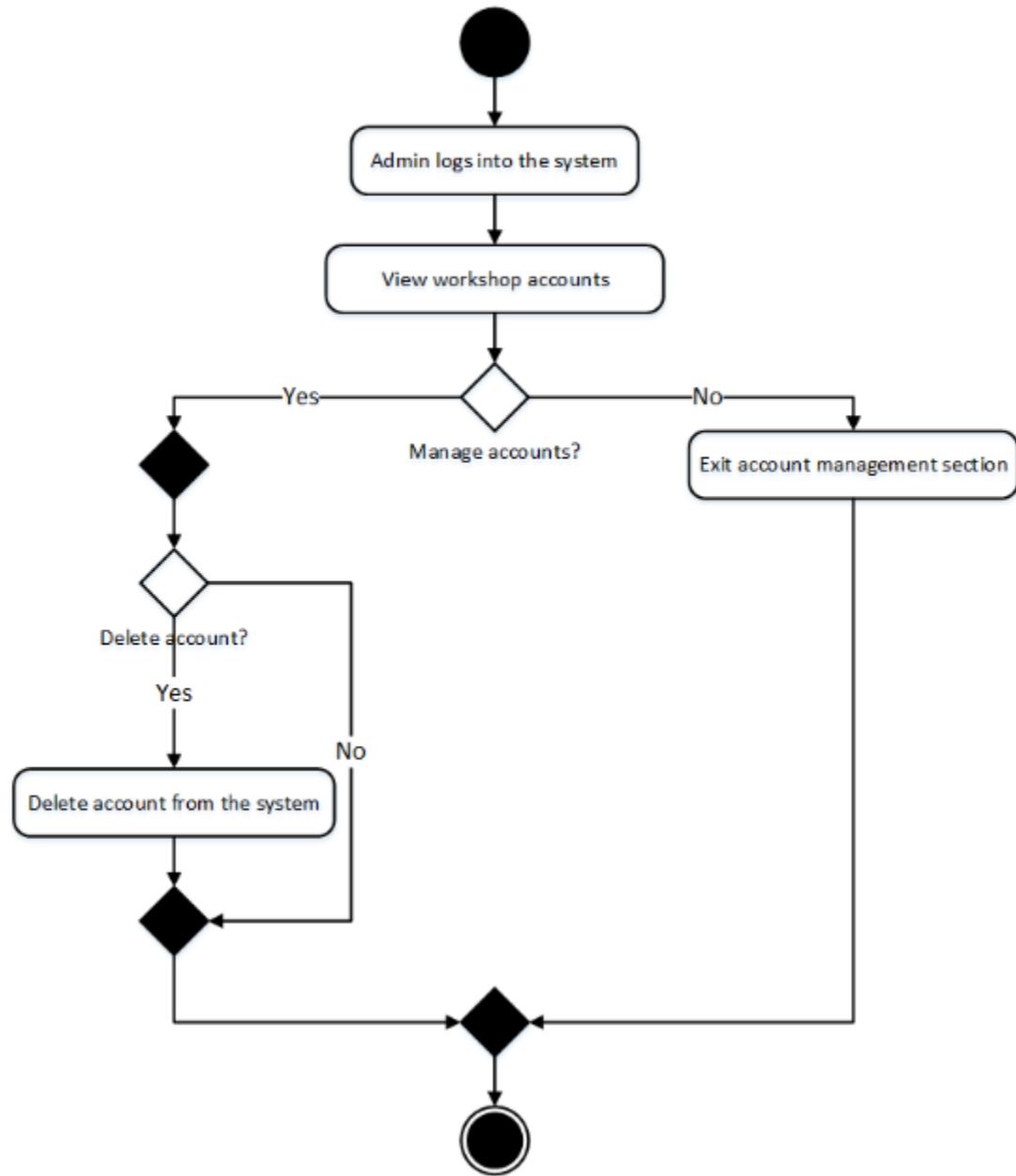
Figure 3. 21. Activity Diagram for Workshop interacts with AI Chatbot

This flowchart shows the interaction process between the workshop and **the AI chatbot** in the "Hi-Tech Garage" system. First, the workshop opens the chatbot and asks a question. If the chatbot can provide relevant answers, it will respond directly to the workshop. If the chatbot

is unable to resolve the query, an error message will be shown. The system ensures seamless communication and efficient resolution of shop floor inquiries.

### 3.5.12. Activity Diagram for Managing Workshop Accounts

Figure 5.15 represents the process of Manage workshop accounts.



*Figure 3. 22. Activity Diagram for Manage workshop accounts*

This flowchart shows the admin's process for workshop account management in the Hi-Tech Garage system. The admin logs into the system and views the workshop account. If account management is required, they will choose to update their account. If deletion is required, the

admin will delete the account from the system. If no action is required, the admin will exit the account management section. This process ensures proper control and management of workshop accounts.

### **3.6. Summary**

This chapter provides a detailed analysis and design of the system. It covers functional and non-functional requirements, detailed use case descriptions, and system use case diagrams. This structured approach ensures that the needs of all stakeholders are met and serves as the basis for system implementation. It includes detailed activity diagrams to illustrate the system's workflow and data flow. This chapter ensures a clear understanding of how various parts of the system integrate and work together to provide a seamless user experience.

# Chapter 4

## Methodology

We laid the foundation for the development journey of the **Online Workshop** project by thoroughly describing the use cases and defining functional and non-functional requirements. This chapter provides an overview of the entire application lifecycle, focusing on time, usefulness, and efficiency. The development approach we adopt plays a crucial role in the success of our application. Here, we conceptualize the challenges and define the methodology to guide project development. Additionally, we tie this approach to the application's timeline, ensuring a well-structured and flexible approach to efficiently deliver the required functionality.

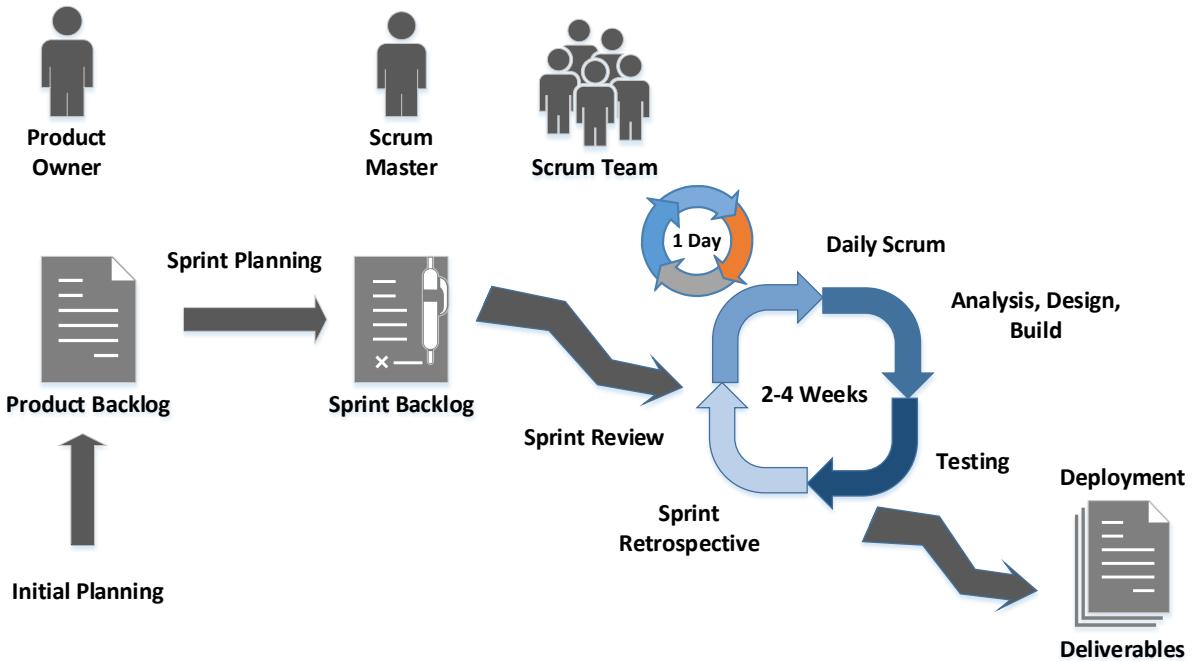
### **4.1. Methodology for Software Development**

To develop the online workshop project, we adopted a software development process that emphasized collaboration, iterative progress, and responsiveness to user needs. Given the complexity and dynamic nature of the platform, which includes features such as instant workshop assistance, online booking and time slot management, a flexible yet structured approach is crucial.

After evaluating multiple approaches, we adopted a hybrid approach that combined Agile and Scrum principles with the iterative nature of the iterative waterfall model. This allows us to meet changing needs while maintaining the system's development framework. This approach ensures continuous delivery of functional components and regular feedback loops, allowing us to create applications that are user-friendly, efficient, and reliable.

### **4.2. Selected Methodology**

For the Online Workshop project, we chose the **Agile-Scrum** approach as the main development method. This approach emphasizes adaptability, collaboration, and iterative progress, making it ideal for platforms with dynamic requirements and user-driven functionality. Unlike traditional iterative waterfall models, Agile Scrum allows for incremental delivery of features, regular feedback integration, and improved stakeholder engagement [17].



*Figure 4. 1. Agile-Scrum Methodology*

The following sections outline the phases of this methodology as applied to the project:

#### *4.2.1. Phases of Agile-Scrum Methodology*

##### **1. Sprint Planning:**

- This phase involves the development team collaborating to set clear goals and deliverables for the upcoming sprint (usually lasting 2-4 weeks).
- The team prioritizes tasks based on their relevance to user needs and business goals. Detailed discussions ensure alignment with the project's overall roadmap.
- The sprint planning process includes estimating the effort and resource allocation for each task to ensure a balanced workload.

##### **2. Requirement Gathering and Backlog Creation:**

- Functional requirements are captured as user stories, which clearly define the expectations of the system. Examples include:
  - Real-time assistance requests from nearby workshops.
  - Book online for home service or in-store maintenance.
  - Time slot management reduces waiting times and streamlines shop operations.
- The Product Backlog is created and maintained as a dynamic document, allowing for iterative refinement and reprioritization based on feedback and emerging needs.

### **3. Design and Prototyping:**

- a. The Design team collaborate to develop wireframes, mockups, and prototypes to ensure visual and functional aspects meet user expectations.
- b. Create prototypes of key features such as:
  - i. A user-friendly interface for displaying and navigating nearby workshops.
  - ii. User-friendly booking form with date, time and service preferences.
  - iii. Real-time notification system for updates between users and workshops.
- c. User feedback on the prototype can guide further improvements and final design.

### **4. Development and Sprint Execution:**

- a. The development team divides user stories into smaller, actionable tasks to be executed in sprints.
- b. Coding follows best practices to ensure code is modular, reusable, and efficient.
- c. Conduct daily Scrum meetings to track progress, resolve impediments, and ensure alignment among team members.

### **5. Testing and Quality Assurance:**

- a. The testing team adopts rigorous testing methodology to validate the features developed during the sprint. Test activities include:
  - i. Functional testing to validate booking, notification and search functionality.
  - ii. Usability testing to ensure intuitive navigation and interaction for users.
  - iii. Performance testing to evaluate scalability and responsiveness during peak usage.
- b. Integrate automated testing tools into pipelines for continuous testing and faster validation cycles.

### **6. Sprint Review and Feedback:**

- a. At the end of each sprint, the team presents the completed functionality to stakeholders and end users for review.
- b. Feedback is carefully documented, and actionable insights are incorporated into the backlog for future iterations.
- c. Sprint Retrospectives are conducted to evaluate team performance and identify improvement opportunities for the next cycle.

## **7. Deployment and Maintenance:**

- a. Features that pass quality checks are deployed in a controlled production environment.
- b. Post-deployment monitoring ensures functionality is functioning as expected and identifies any potential issues early.
- c. Establish user feedback mechanisms, such as website surveys and support channels, to gather ongoing input.
- d. Schedule regular update and maintenance cycles to resolve bugs, implement enhancements, and ensure the platform remains aligned with changing user needs and market trends.

### **4.3. Advantages of Agile-Scrum for the Online Workshop Project**

The **Agile-Scrum methodology** offers several benefits tailored to the unique needs of the online workshop platform [18]. Many of its benefits include:

#### **1. Flexibility and Adaptability:**

- o Agile-Scrum supports iterative development, allowing teams to dynamically respond to new workshop features, changing user preferences, or feedback-driven improvements.

#### **2. User-Centered Development:**

- o By integrating regular feedback loops, the platform evolves in line with user expectations, offering intuitive workshop search, efficient booking and powerful notification capabilities.

#### **3. Continuous Delivery:**

- o Incremental delivery ensures critical features such as real-time notifications and booking mechanisms are deployed early, delivering tangible benefits to users throughout the development process.

#### **4. Risk Mitigation:**

- o Frequent stakeholder reviews and rigorous testing cycles minimize the risk of delivering inconsistent or incomplete functionality, ensuring product quality and relevance.

## **5. Enhanced Collaboration:**

- Collaborative practices like daily stand-ups, sprint reviews, and retrospectives can enhance team cohesion, enable seamless progress, and align with project goals.

## **6. Improved Efficiency:**

- By breaking down complex tasks into smaller, prioritized deliverables, teams can ensure efficient use of resources while adhering to project timelines.

## **4.4. Summary**

This chapter delves into methods that guide the development of an online workshop platform. By choosing **Agile-Scrum** as the base methodology, the team ensured a balance between flexibility, responsiveness and user-centered development. Iterative sprints, collaborative efforts, and feedback-driven adjustments enable teams to effectively meet dynamic requirements and deliver high-quality applications.

A focus on real-time assistance requests, online booking and slot management drove the development process, ensuring a robust, user-friendly platform. **Agile-Scrum** empowers teams to tackle challenges with confidence, allowing the platform to remain relevant and competitive in the fast-paced automotive service industry.

# Chapter 5

## System Architecture

### 5.1. Architecture Diagram

**Hi-Tech Garage** is built using a layered architecture approach to ensure separation of concerns, scalability and maintainability. This design facilitates a clear division of system functions, making it easier to maintain and expand.

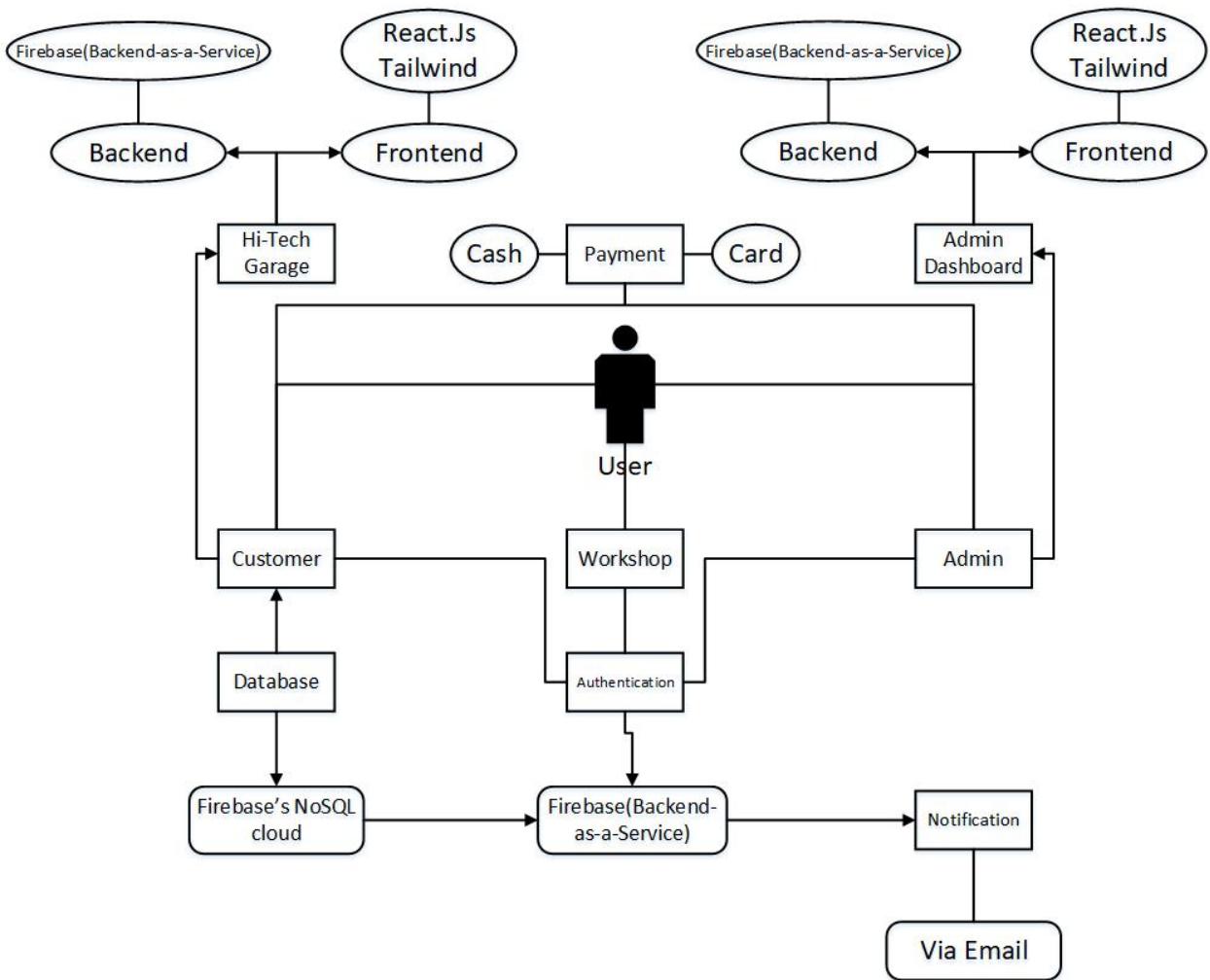


Figure 5. 1. Architecture Diagram

The architecture diagram of the Hi-Tech Garage represents the interaction between users, workshops, admin and the system backend. The front-end of the system is built using React.js and Tailwind CSS, while the back end is powered by Firebase.

The Workshop and Admin sections are managed separately, with authentication handled via Firebase. Workshops interact with Customers and manage services, while Admin oversee operations via the Admin Dashboard. The database used is Cloud Firestore, which stores customers, workshop and management data. Additionally, the system includes email notification for updates and confirmations. The architecture ensures seamless service booking, efficient management and real-time interaction between users, workshops and admin.

The following are the key components of the system architecture:

### **Presentation Layer (Client-Side)**

This layer is developed using Tailwind and React.js and is responsible for rendering the user interface of the web application. It provides a responsive, interactive experience tailored to different user roles, including customers, workshops, and admin. The front-end updates dynamically based on user interactions and data changes.

### **Business Logic Layer (Server-Side)**

This layer is implemented using **Firebase** and coordinates the processing of business rules, user requests, and overall system behavior. Key functions managed by this layer include workshop management, service booking, roadside assistance processing and data processing. It acts as a middleware that connects front-end and back-end data services.

### **Data Access Layer**

This layer provides abstract access to data stored in **Cloud Firestore**, allowing other components of the application to interact with the database through a unified API. It handles all data retrieval, manipulation and storage operations, ensuring data integrity and consistency.

### **Database**

is used to store all application data including workshop details, service bookings, customer requests and comments. Firebase was chosen for its high performance, flexibility in handling different data types, and scalability, which was critical to handling the dynamic data needs of the **Hi-Tech Garage**.

## **Emergency Assistance Module**

This module is integrated into the business logic layer and handles real-time roadside assistance requests. When a user needs help, the system will send a request to all nearby workshops based on geographical location, and the available workshops can provide service responses. Users can then select a workshop to get help.

## **Service Booking Module**

The module enables customers to schedule home vehicle maintenance by selecting the time slot, date and required services. Available workshops offering the selected service are listed for the user to choose from. The system ensures efficient scheduling and coordination between users and workshops.

## **Workshop Visit Booking Module**

This module helps to book a time slot for in-person workshop visits in advance. Users specify required maintenance services, allowing the shop to prepare necessary tools and parts in advance, minimizing waiting times.

## **Security Layer**

This critical component ensures the overall safety and integrity of your Hi-Tech garage system. It includes the following security measures:

- **HTTPS:** All communications between client devices and servers are encrypted using HTTPS to prevent data interception and tampering.
- **Data Encryption:** Sensitive data such as user and workshop details are encrypted using strong encryption algorithms before being stored in the database.
- **Role-Based Access Control (RBAC):** Restrict access to system functionality based on role (user, shop floor, and admin) to prevent unauthorized access.
- **Regular Security Audits:** The system undergoes regular security audits to identify and correct vulnerabilities and ensure protection from cyber threats.

## **5.2. Sequence Diagram**

Sequence diagrams belong to the category of interaction diagrams in UML. It illustrates how processes or objects within a system interact with each other over time, depicting the dynamic behavior of the system by showing sequences of interactions between different elements.

### 5.2.1. Sequence Diagram for User

The Sequence Diagram of the User is displayed in Figure 5.2.

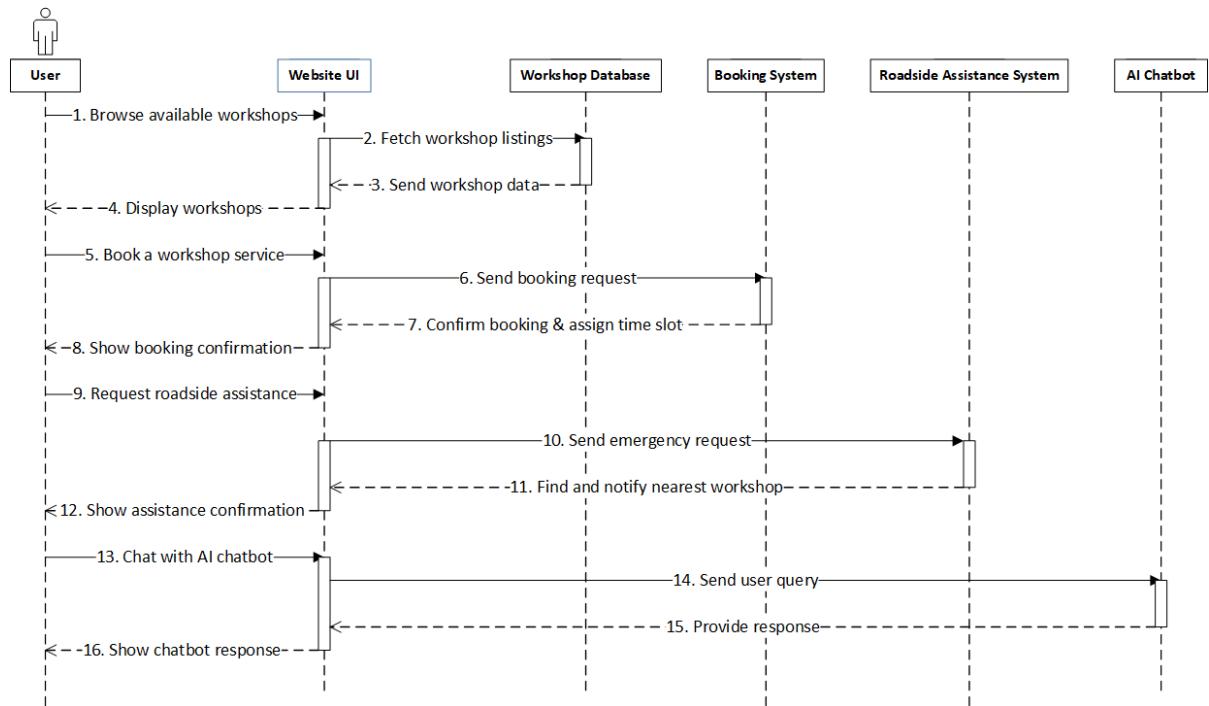


Figure 5. 2. Sequence Diagram for User

#### 1. Browse the workshop

- The user browses the home page.
- The website UI fetches featured workshops and technicians from the workshop database.
- The website UI displays a list of workshops to the user.

#### 2. Search for workshops

- User Search Workshop.
- The website UI sends the search query to the workshop database.
- Workshop Database Get search results.
- The website UI displays the search results to the user.

#### 3. Book a workshop

- User selects a workshop to view details.
- Users can book a workshop by selecting a time slot.
- The website UI checks for available slots by querying the Workshop database.
- Available slots are displayed to the user.
- The user selects a time slot and confirms the booking.

- The booking system stores booking details in the workshop database.
- The appointment is confirmed and displayed to the user.

#### 4. Request roadside assistance

- User requests roadside assistance.
- The roadside assistance system retrieves the user's location and matches it with nearby workshops using a workshop database.
- The roadside assistance system sends the request to the nearest workshop.
- Matching workshops have been notified.
- The system confirms roadside assistance to the user.

#### 5. Chat with an AI chatbot

- Users choose chatbots to ask for help.
- Users submit queries through the chatbot.
- AI chatbot handles queries and gets relevant responses.
- The website UI displays the chatbot's responses to the user.

##### 5.2.2. Sequence Diagram for Workshop

The Sequence Diagram of the User is displayed in Figure 5.3.

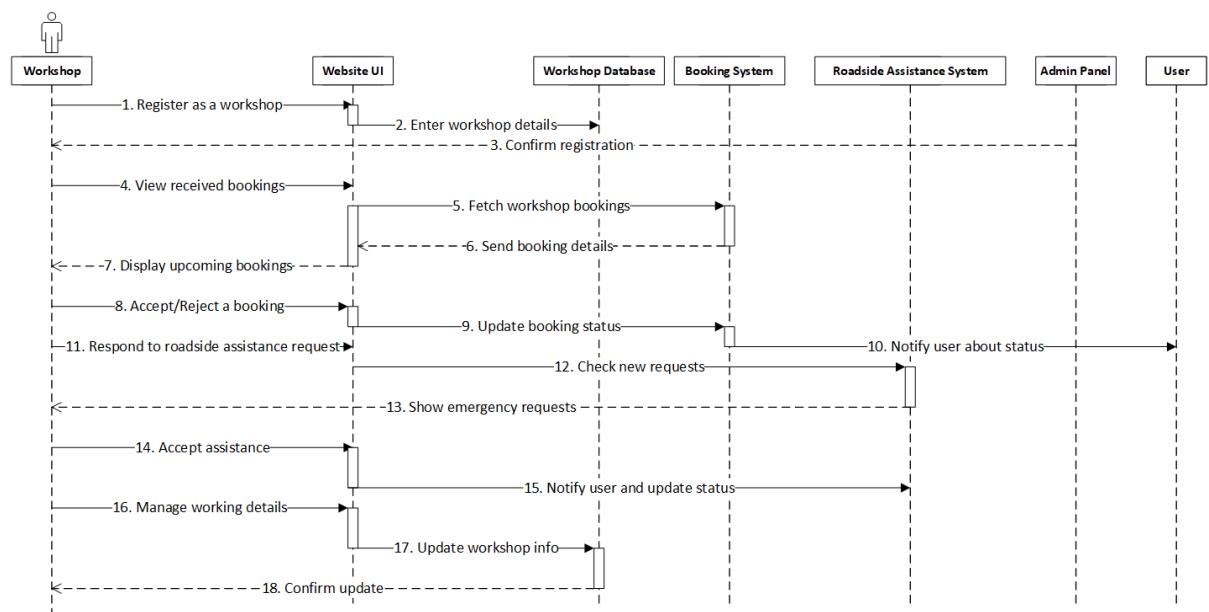


Figure 5. 3. Sequence Diagram for Workshop

## **1. Register for a workshop**

- Workshops are registered as workshops through the website UI.
- The website UI stores the workshop details in the workshop database.
- Admin confirms workshop registration.
- Bookings have been received for the workshop.

## **2. Manage bookings**

- The website UI gets the workshop bookings from the workshop database.
- Booking details will be sent to the website UI.
- Website UI displays upcoming workshop bookings.
- Workshops accept or decline bookings.
- The booking system updates the booking status in the workshop database.
- The system notifies the user of the reservation status.

## **3. Respond to roadside assistance**

- This workshop responds to roadside assistance requests.
- The roadside assistance system checks for assistance requests.
- Urgent requests are presented to the workshop via the website user interface.
- The workshop accepts requests for assistance.
- The roadside assistance system notifies the user and updates the request status.

## **4. Manage workshop details**

- Workshops use the website UI to manage their details.
- The workshop updates its information.
- The system confirms the update.

### 5.2.3. Sequence Diagram for Admin

The Sequence Diagram of the User is displayed in Figure 5.4.

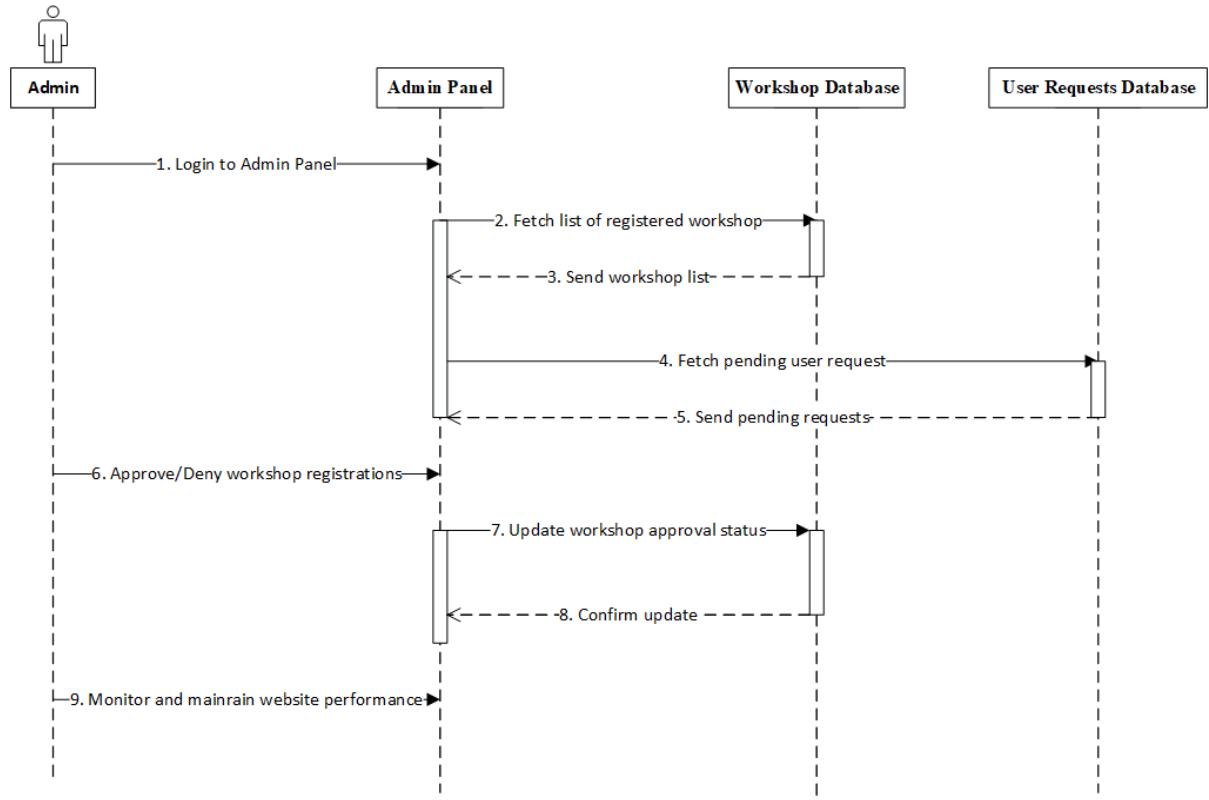


Figure 5. 4. Sequence Diagram for Admin

#### 1. Log in to the management panel

- Admin logs into the admin panel.
- The admin panel gets the list of registered workshops from the workshop database.
- The admin panel gets user requests from the user request database.

#### 2. Approve/deny workshop registration

- The admin approves or denies workshop registrations.
- The admin panel updates the workshop approval status in the workshop database.

#### 3. Monitor website performance

- Admin monitor and maintain website performance.

### 5.3. Class Diagram

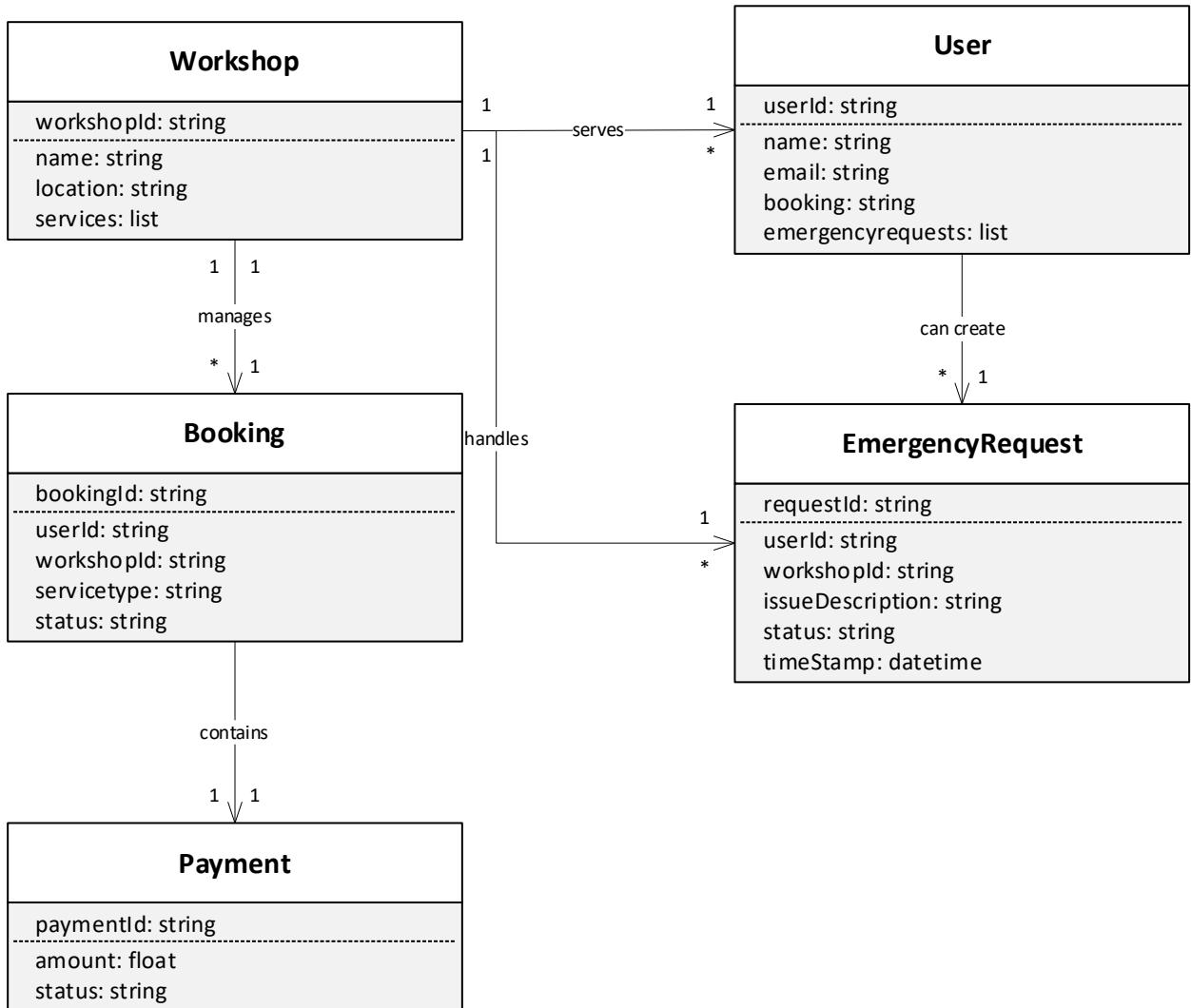


Figure 5. 5. Class Diagram

## 5.4. Database Design (Tree)

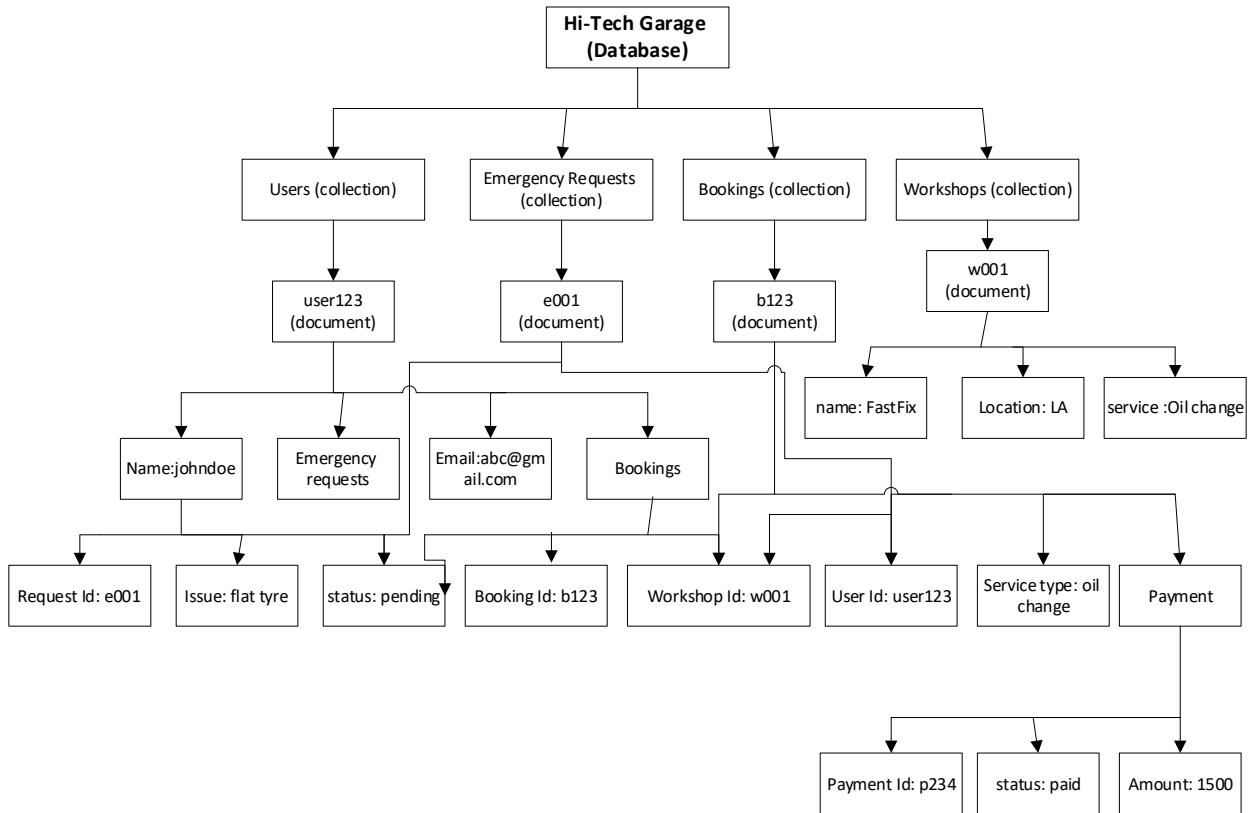


Figure 5. 6. Database Design

## 5.5. Data Flow Diagram

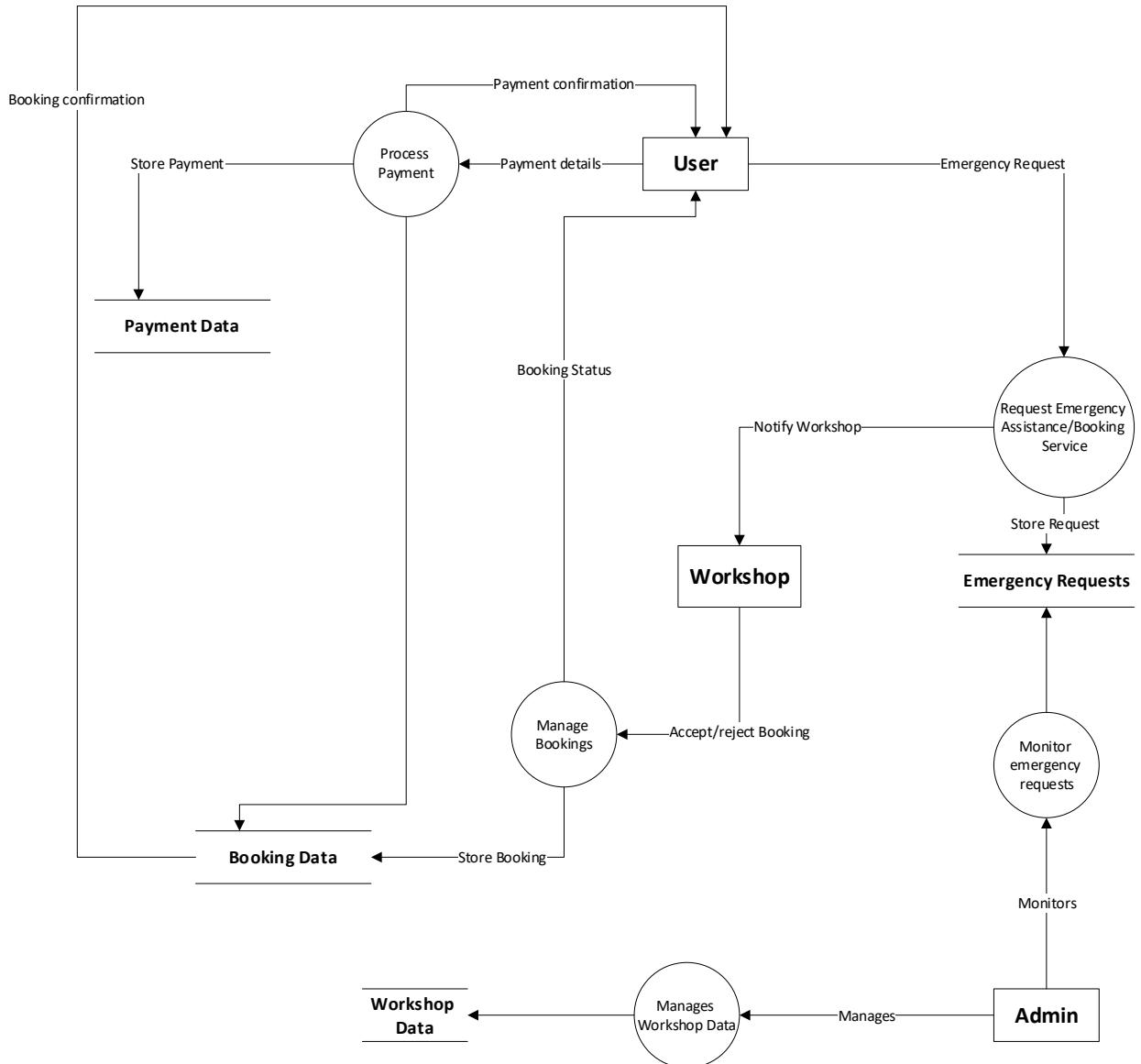


Figure 5. 7. Data Flow Diagram

## 5.6. Summary

The system architecture chapter introduces the overall structure of the **Hi-Tech Garage**, including its components and their interactions. It includes detailed architecture diagrams, class diagrams, and trees to illustrate the system's workflow and data flow. This chapter ensures a clear understanding of how distinct parts of the system integrate and work together to provide a seamless user experience.

# Chapter 6

## System Implementation

### 6.1. Implementation

**System implementation** at Hi-Tech Garage involves several key stages, from setting up the development environment to final deployment and post-launch activities. This section clearly outlines each step in the implementation process, ensuring that the development of the Hi-Tech Garage platform is fully understood and successfully executed.

#### 6.1.1. *Environment setup*

Before starting any coding, it is crucial to set up your development environment. Use the following tools and techniques:

1. **React.js**: used to build the user interface (UI) to ensure a responsive and dynamic platform for car owners and workshops. React.js helps create a smooth and interactive user experience.
2. **Tailwind CSS**: A utility-first CSS framework for front-end styling that provides a flexible and customizable design approach to ensure the platform is visually appealing and easy to use.
3. **Firebase**: The backend is powered by Firebase, which will handle server-side logic, handle user requests, manage bookings, and integrate chatbot functionality [19].
4. **Firebase Cloud Firestore**: Select the database to store application data such as user profiles, workshop details, service bookings, and payment information. Firebase's NoSQL structure ensures flexibility and scalability.
5. **Visual Studio Code**: The premier integrated development environment (IDE) for writing, testing, and debugging code. It enhances the development process with its intuitive interface and wide range of useful extensions.

#### 6.1.2. *Development*

The development phase is divided into front-end and back-end tasks, with the focus on creating a seamless experience for users:

1. **Front-end development:** Using React.js and Tailwind CSS, the front-end team will develop dynamic, interactive and responsive web pages. The focus was on ensuring the platform was user and workshop friendly, with accessible elements such as service booking forms, roadside assistance requests and interactive workshop listings.
2. **Backend development:** The backend is built using Firebase and will handle user authentication, subscription management, and communication between the frontend and the Firebase database. This layer ensures smooth operation by handling user operations and securely storing data.

#### *6.1.3. Integration and Testing*

Once the front-end and back-end components are developed, they need to be integrated and thoroughly tested to ensure everything works together:

1. **Integration:** Connect the front-end and back-end to ensure the correct exchange of data, and all user operations can trigger correct responses from the server.
2. **Testing:** After rigorous testing to ensure system functionality and smooth user experience:
  - **Unit testing:** Test individual components to confirm that they work as expected.
  - **Integration testing:** Verify that all parts of the system work together without problems.
  - **User Acceptance Testing:** Ensures that the system meets user requirements and expectations.

#### *6.1.4. Roadside Assistance and Booking Module Implementation*

Key features of Hi-Tech Garage are the ability to provide roadside assistance and allow users to book maintenance services:

1. **Roadside Assistance:** Implement a feature that allows users to request roadside assistance in the event of vehicle breakdown. Nearby workshops will be notified, and users can select their preferred workshops based on availability and distance.
2. **Service reservation:** Develop a reservation system to allow users to make reservations for vehicle maintenance services at home or in the workshop. Users can select a time, specify required services (e.g. oil change, filter replacement) and select a preferred workshop.

### *6.1.5. Security Implementation*

Given the sensitivity of the data processed by Hi-Tech Garage, strong security measures are required:

1. **HTTPS:** Use HTTPS to protect all communications between clients and servers, ensuring data privacy and security.
2. **Data encryption:** Encrypt sensitive data in the database (such as user passwords and personal information) to ensure protection against unauthorized access.
3. **Authentication:** Use Firebase for secure user authentication, which helps manage secure sessions and ensure that only authorized users can access their accounts and perform actions.

### *6.1.6. Deployment*

After completing the development and testing phases, the system will be deployed:

1. **Server settings:** The application will be hosted on **Vercel** to ensure scalability and high availability, leveraging its serverless architecture for efficient deployment and performance.
2. **Database settings:** Firebase will be deployed locally to ensure that data storage has appropriate configuration and security measures.

### *6.1.7. Maintenance and updates*

After the system goes online, it requires continuous maintenance and updates:

1. **Problem fixing:** Regular system updates will solve any problems encountered by users and ensure that the platform remains stable and operational.
2. **Performance optimization:** The system's performance will be continuously monitored to effectively handle many users and service requests.
3. **Feature updates:** New features and improvements will be implemented over time based on user feedback and technological advancements.

## 6.2. Entity Relationship Diagram

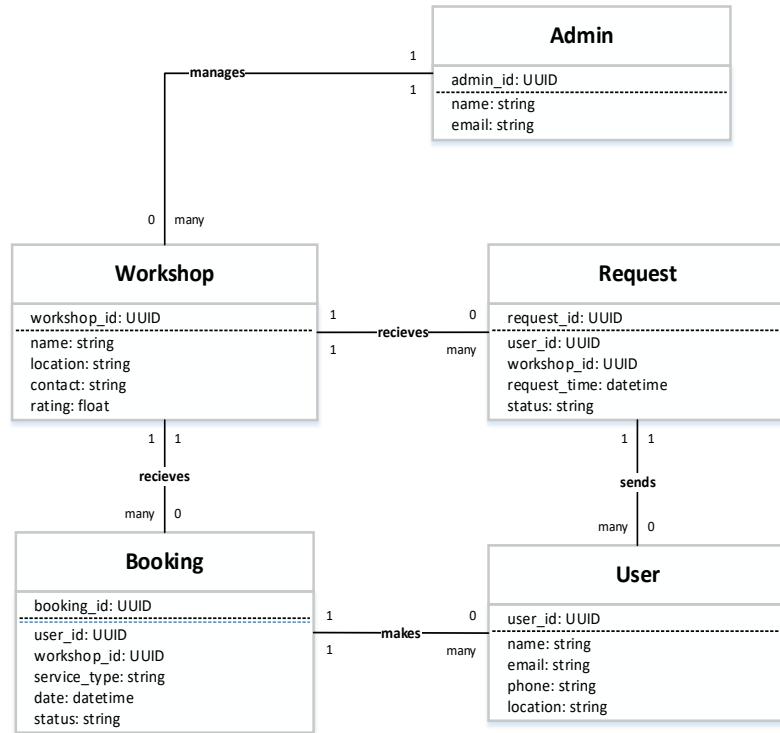


Figure 6. 1. Entity Relationship Diagram

Figure shows, Entity-Relationship Diagram (ERD) for “Hi-Tech Garage”. This ERD highlights the relationships and interactions between five entities: Administrator, Workshop, User, Request, and Booking.

### 6.2.1. Entities

#### 6.2.1.1. Admin

- **Attributes:** `admin_id`, `name`, `email`.
- **Purpose:** Represents the administrative staff responsible for managing the workshops in the system.
- **Relationships:**
  - Manage multiple workshops and build one-to-many relationships.

### **6.2.1.2. Workshop**

- **Attributes:** workshop\_id, name, location, contact, rating.
- **Purpose:** Represents an automobile workshop that provides services.
- **Relationships:**
  - Managed by an administrator.
  - *Receives* multiple requests from users (one-to-many).
  - *Receives* multiple bookings from users (one-to-many).

### **6.2.1.3. User**

- **Attributes:** user\_id, name, email, phone, location.
- **Purpose:** On behalf of an individual using the system to request services or make an appointment.
- **Relationships:**
  - *Sends* multiple requests to workshops (one-to-many).
  - *Makes* multiple bookings for services (one-to-many).

### **6.2.1.4. Request**

- **Attributes:** request\_id, user\_id, workshop\_id, request\_time, status.
- **Purpose:** Represents emergency roadside assistance requests sent by users to nearby workshops.
- **Relationships:**
  - Linked to one user and one workshop, creating 2 many-to-one relationships.

### **6.2.1.5. Booking**

- **Attributes:** booking\_id, user\_id, workshop\_id, service\_type, date, status.
- **Purpose:** Represents scheduled service bookings made by users for home vehicle maintenance or workshop visits.
- **Relationships:**
  - Linked to one user and one workshop, forming 2 many-to-one relationships.

## *6.2.2. Relationships and Cardinality*

### **6.2.2.1. Admin and Workshop**

- One admin can manage multiple workshops.
- Each workshop is managed by exactly one admin.

#### **6.2.2.2. Workshop and Request**

- A workshop can receive multiple requests from users.
- Each request is associated with one workshop.

#### **6.2.2.3. Workshop and Booking**

- A workshop can have multiple bookings from users.
- Each booking is associated with one workshop.

#### **6.2.2.4. User and Request**

- A user can send multiple requests to workshops.
- Each request is sent by one user.

#### **6.2.2.5. User and Booking**

- A user can make multiple bookings.
- Each booking is made by one user.

### *6.2.3. Usage in FYP Document*

This ERD provides a structured blueprint for database design. It ensures seamless management of:

1. Emergency roadside assistance requests.
2. Scheduling and tracking of vehicle maintenance bookings.
3. Workshop administration and user interaction.
4. Accurate assignment and status tracking of services.

## **6.3. Summary**

This chapter thoroughly explains how the Hi-Tech Garage project was implemented, covering key steps like setting up the environment, development, integration and testing. Several key modules, including Roadside Assistance and Booking, are detailed, along with their security protocols, deployment strategies and active maintenance to guarantee system reliability. The chapter also includes an Entity-Relationship Diagram (ERD), showing the system and how its parts interact. This chapter provides an exhaustive account of the project's careful, step-by-step implementation and the result is a flawlessly functional and exceptionally secure system for users, workshops and admin.

# Chapter 7

## System Testing

System testing is a critical stage in the software development life cycle that evaluates the entire website rather than individual components. It ensures that the integrated system meets specified requirements and operates as expected.

During system testing, various aspects of the application are tested, including functionality, performance, reliability, security, and usability. The goal is to identify and resolve any issues that arise when system components interact.

### **7.1. Black Box Testing**

Black box testing is a type of system testing that focuses on evaluating an application from an external perspective without considering its internal structure. Testers cannot access the source code and inspect inputs and outputs to verify functionality.

In the context of an online workshop platform, black-box testing is used to ensure that its core functionality is functioning properly:

1. **Test Scenario Design:** Create test scenarios based on requirements, including:
  - o Request roadside assistance and receive workshop responses.
  - o Book At-Home maintenance services by time.
  - o Schedule workshop appointments and maintenance details.
2. **Equivalence Partitioning:** Input data is classified into equivalence classes to effectively test different scenarios. Examples include:
  - o Various maintenance services and their availability at the workshop.
  - o Slot selection for home and workshop bookings.
3. **Boundary Value Analysis:** Testing was conducted on input ranges such as:
  - o Minimum and maximum distance limits for searching workshops.
  - o The earliest and latest time slots are available for booking.
  - o The maximum number of requests that a workshop can handle at one time.

4. **Decision Table Testing:** A decision table was created to verify all possible combinations of user actions and system responses, ensuring correct outcomes for the scenarios:
  - Accept or reject roadside assistance requests.
  - Selecting various maintenance options during booking.
  - Confirming or canceling workshop appointments.
5. **State Transition Testing:** The system was tested for state changes during different interactions, including:
  - Transition from submission to approval/rejection of roadside assistance requests.
  - Change the reservation status from scheduled to completed.
  - Management of workshop session states from login to logout.

Black box testing ensured that the system functioned as intended without knowledge of the internal code and identified defects and inconsistencies to increase reliability.

## 7.2. White Box Testing

White box testing examines the internal structure, logic, and code implementation of a system. Testers can access the source code to verify system behavior at a detailed level.

For online workshop platforms, white box testing includes:

1. **Unit Testing:**
  - Test individual functions that handle user authentication.
  - Validate the location-based workshop search algorithm.
  - Check the logic for handling various maintenance services.
2. **Code Coverage Testing:**
  - Ensures broad coverage of system functions such as login, reservations, and request processing.
  - Verify coverage of branches and conditions to detect untested execution paths.
3. **Performance Testing:**
  - Measure system response time under various loads.
  - Simulate multiple users requesting road service at the same time.
  - Evaluate the efficiency of the reservation system under high traffic conditions.

#### **4. Security Testing:**

- Evaluation of authentication and authorization mechanisms.
- Check user data protection and communication encryption vulnerabilities.
- Ensure secure handling of location and payment information.

#### **5. Error Handling Testing:**

- Verify appropriate error messages for failed reservations.
- Ensure system recovery from unexpected failures and network interruptions.
- Ensures database integrity when multiple users interact simultaneously.

#### **6. Integration Testing:**

- Validate seamless interaction between modules such as reservation systems, and location-based services.
- Test API communication between frontend and backend for data synchronization.

By applying white box testing techniques, we gained deeper insight into the system's functionality and potential vulnerabilities. From Tables 7.1 to 7.6, the test cases outline the testing of various features of the online workshop platform.

Table 7. 1. Test case for Roadside Assistance Request

<b>Component Name</b>	<b>Roadside Assistance Request</b>
Module Name	Emergency Services
Condition Being Tested	User requests roadside assistance and after that selects a nearby workshop by viewing location.
Expected Result	All the user requests are successfully processed, and the user receives confirmation.
Success Scenarios	A user fills out the needed information and submits his request. Then, it shows all relevant workshops that the user selects from. Upon selecting, the user's request is sent to the workshop, and the user receives a confirmation message.
Failure Scenario	User tries to submit a booking without entering location details. The workshop is not available in the specified area. The workshop does not respond to the request.
Test Result (Pass/Fail)	Pass

Table 7. 2. Test case for Workshop Appointment Booking

<b>Component Name</b>	<b>Workshop Booking</b>
Module Name	Appointment Management
Condition Being Tested	Users book a slot of workshops successfully.
Expected Result	Appointment is scheduled, and the user receives confirmation.
Success Scenarios	User selects a workshop and available time slot. Confirmation is sent along with saving the appointment.
Failure Scenario	User tries to book without selecting a slot. The selected time slot is already booked. The workshop cancels the booking before confirmation.
Test Result (Pass/Fail)	Pass

Table 7. 3. Test case for At-Home Service Booking

<b>Component Name</b>	<b>At-Home Service</b>
Service Booking	Service Booking
Condition Being Tested	User schedules at-home vehicle maintenance booking.
Expected Result	The user sends the service request, and confirmation is provided.
Success Scenarios	The user enters location, selects a workshop, time slot, and confirms booking. Workshop accepts the request, and the system updates its status.
Failure Scenario	User enters an invalid address or slot time. The workshop does not offer at-home service in the user's selected area. A message is sent to the user that no slots are available for the requested time or location.
Test Result (Pass/Fail)	Pass

Table 7. 4. Test case for AI Chatbot Assistance

<b>Component Name</b>	<b>AI Chatbot Assistance</b>
Module Name	User Support
Condition Being Tested	User interacts with the AI chatbot for quick assistance and help.
Expected Result	Chatbot provides relevant assistance based on the user's query.
Success Scenarios	Users ask about any car maintenance, and the chatbot provides instructions.
Failure Scenario	Chatbot does not recognize the query and provides incorrect or irrelevant information.
Test Result (Pass/Fail)	Pass

Table 7. 5. Test case for Workshop Registration

<b>Component Name</b>	<b>Workshop Registration</b>
Module Name	Workshop Management
Condition Being Tested	A workshop registers on the website successfully.
Expected Result	Workshop profile is created, and admin's approval is pending.
Success Scenarios	The workshop's account is created successfully. Admin reviews and approves the registration. The workshop receives confirmation and gets access to the dashboard.
Failure Scenario	Workshop submits an incomplete registration form or admin check that the workshop is not authentic, and admin rejects the registration request.
Test Result (Pass/Fail)	Pass

Table 7.6. Test case for System Security (Unauthorized Access Attempt)

<b>Component Name</b>	<b>Security Module</b>
Module Name	User Authentication & Data Protection
Condition Being Tested	Preventing unauthorized people from accessing an admin panel.
Expected Result	Blocks the access of unauthorized users from admin panel.
Success Scenarios	Only authorized admins can log in. Invalid login attempts notify the admin immediately.
Failure Scenario	System allows unauthorized access and brute force attempts do not trigger security measures.
Test Result (Pass/Fail)	Pass

### 7.3. Summary

This chapter discusses in detail various methods of online workshop platform testing, including black box testing and white box testing. Black-box testing tested system functionality from an external perspective, using various testing techniques for features such as roadside assistance, workshop booking, and at-home service, such as equivalence partitioning, boundary value analysis, and state transition testing. White box testing involves unit testing, code coverage, performance, security, and integration testing to test the internal structure and logic of the platform in detail. In addition, seven key test cases were also set up for various functionalities, including roadside assistance, workshop appointment, AI chatbot, and security module testing. All these testing steps were taken to ensure that the system is accurate, secure and able to improve the user experience.

# Chapter 8

## Prototype

Figures 8.1 to 8.29 show full screenshots of our web application platform, Hi-Tech Garage, illustrating its core functionality and user-centric design. The diagrams show the complete user journey—from authentication to booking and service management. The system supports three major functions: At-Home maintenance, workshop maintenance, and emergency requests, each with a streamlined and intuitive workflow. The screenshots highlight key interactions such as service selection, time slot booking, shopping cart review and final confirmation, ensuring transparency and ease of use. In emergency situations, real-time location sharing and real-time request processing between users and workshops are also effectively presented. The interface design is clear and convenient, providing users and workshop owners with reliable and efficient car service management tools.

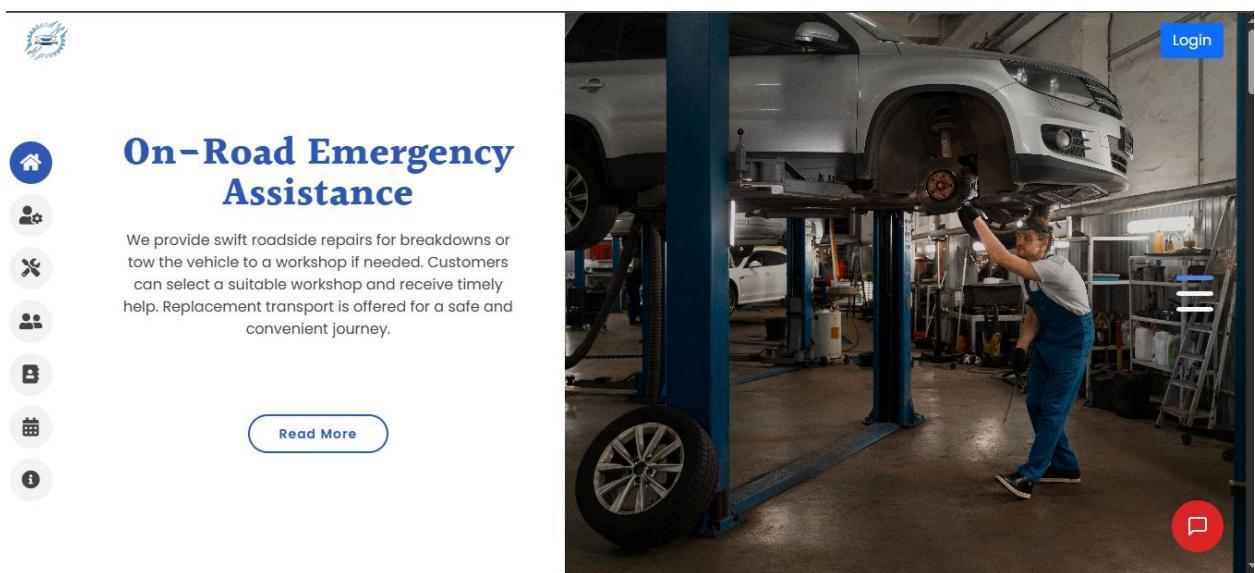


Figure 8. 1 Main Website

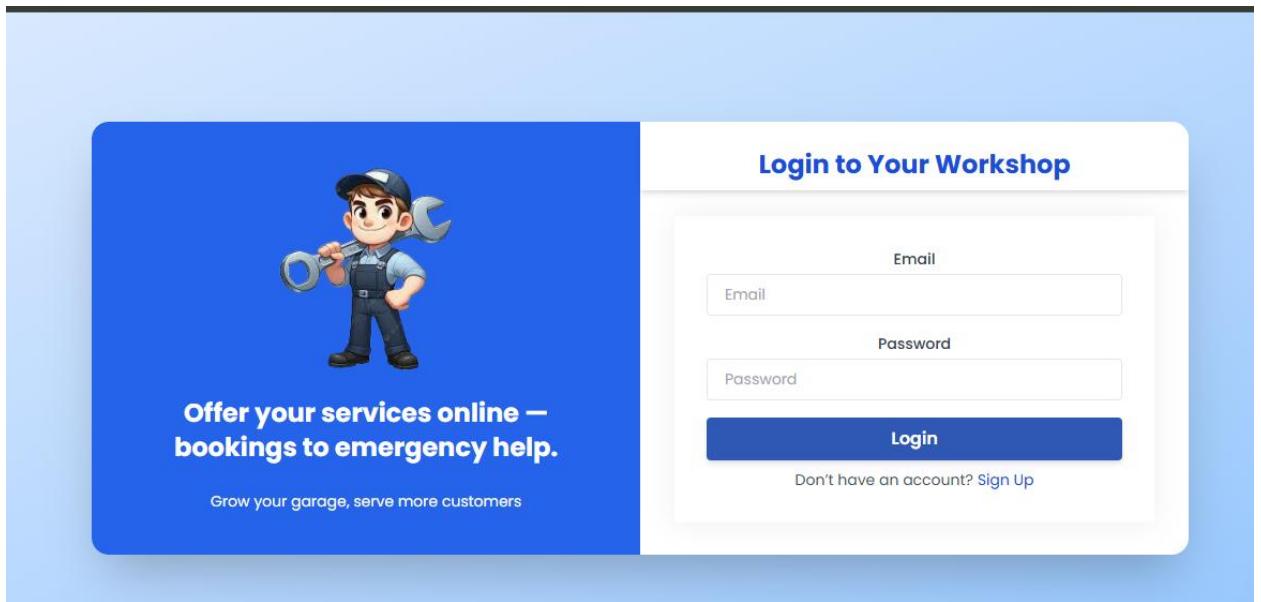


Figure 8. 2 Workshop-Login Page

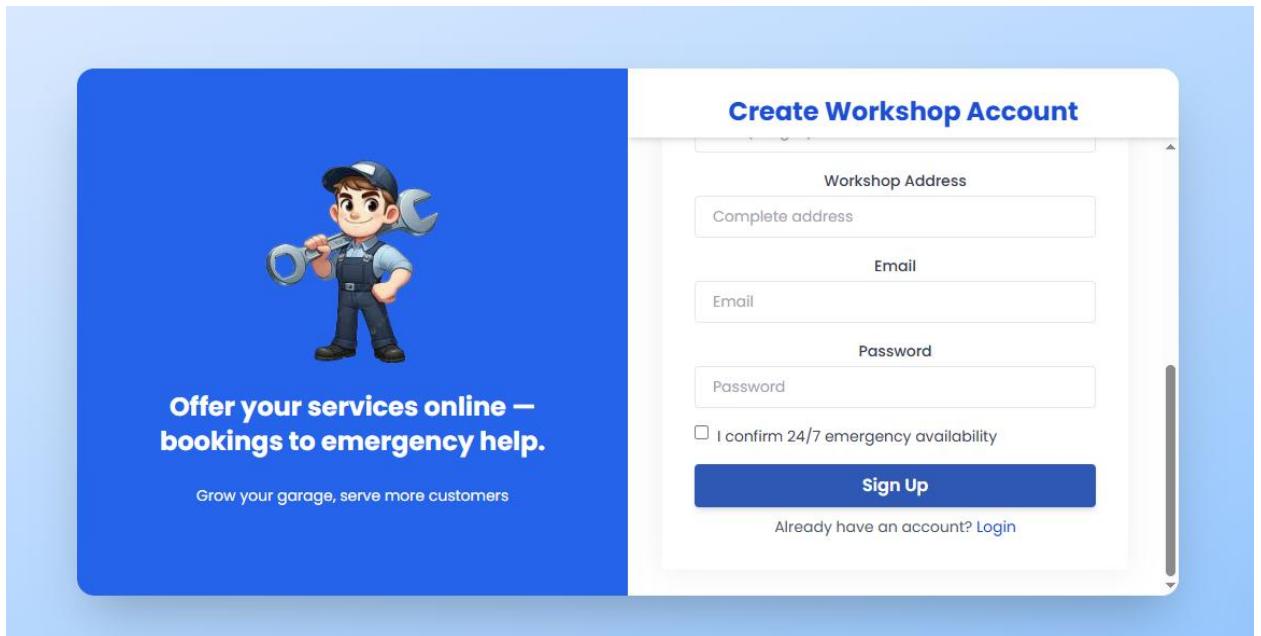


Figure 8. 3 Workshop-Signup Page

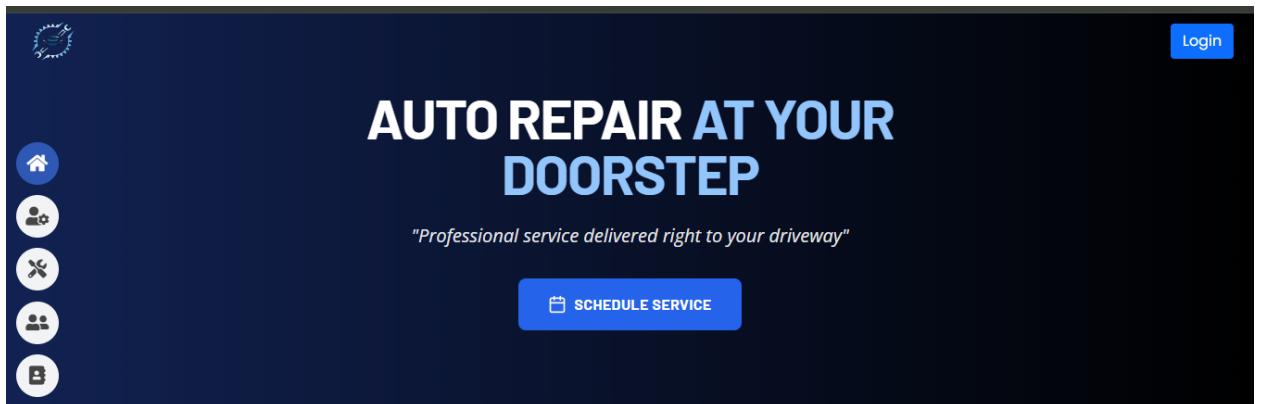


Figure 8. 4 Services Provided

The screenshot shows a mobile application's contact page. At the top, there is a blue header bar with the title 'Get in Touch' in white. Below the header, a sub-header reads '24/7 Emergency Roadside Assistance & Professional Auto Care Services'. There are two prominent buttons: a blue rounded rectangle labeled 'Emergency Assistance' and a white rounded rectangle labeled 'Schedule Service'. The main content area contains three contact methods: 'Phone Support' (with a phone icon, '24/7 Emergency Hotline +1 (234) 567-890'), 'Email Us' (with an envelope icon, 'Quick Response Time support@hitechgarage.com'), and 'Working Hours' (with a clock icon, '24/7 Emergency Services Timing: 24/7'). At the bottom, there are four summary boxes: '50+' Expert Technicians, '25+' Partner Workshops, '10000+' Happy Customers, and '24/7' Hour Support. Each box has a small decorative icon on the left.

Figure 8. 5 Contact-us page

Welcome to Honda Workshop

Please login to access full features or continue as guest

Login

View Page

Honda

4.7 (256 Reviews)

Main Street, City Center

+92 300 1234567

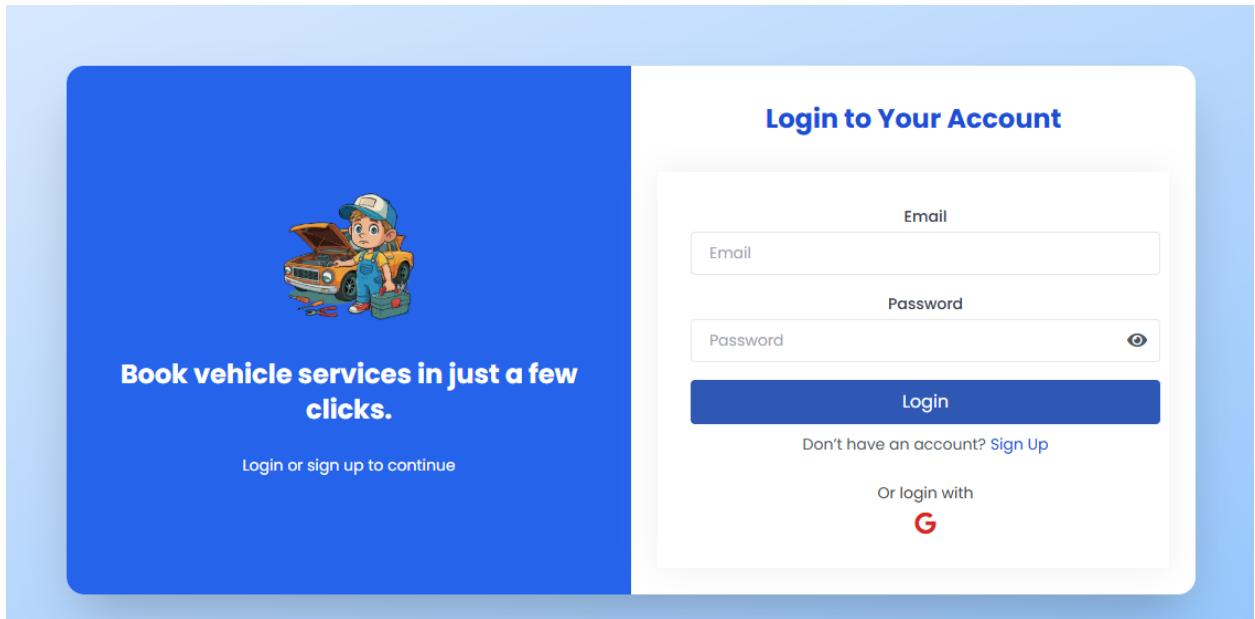
8:00 AM - 8:00 PM

Roadside Assistance

Home Maintenance Service

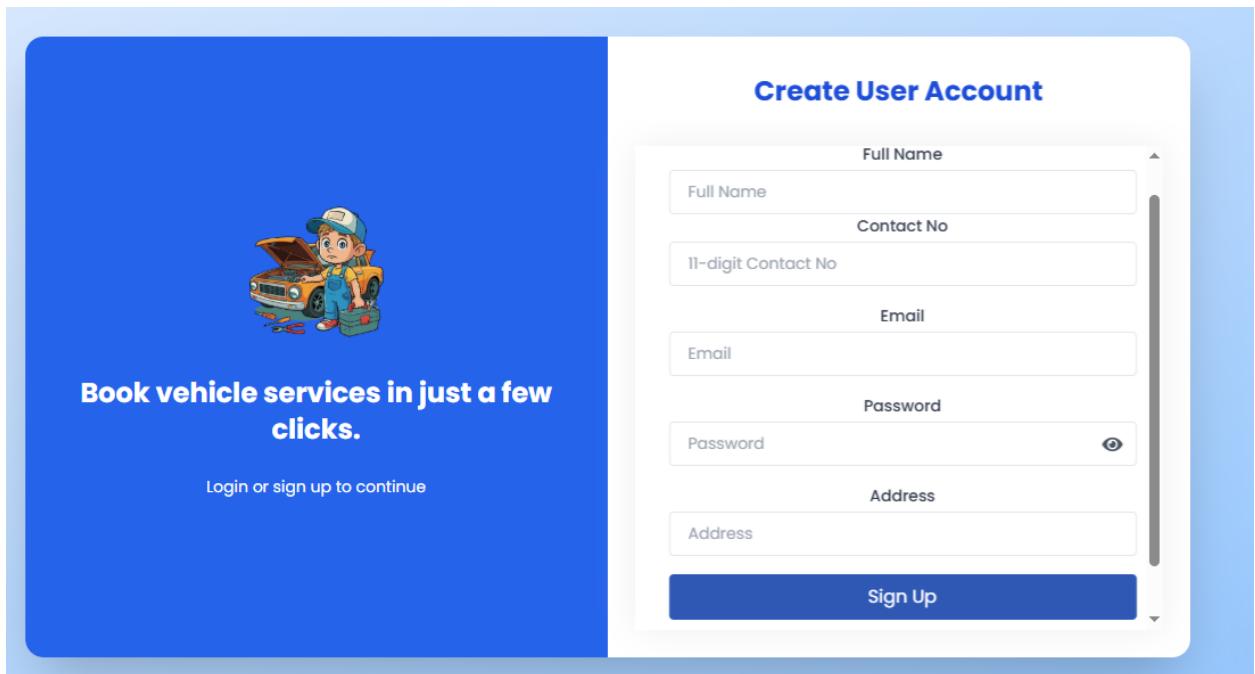
Periodic Servicing

Figure 8. 6 Workshop Page to view



The image shows a user login form. On the left, there is a blue sidebar with a cartoon mechanic character and the text "Book vehicle services in just a few clicks." Below this is a link "Login or sign up to continue". On the right, the main area has a title "Login to Your Account". It contains fields for "Email" and "Password", both with "Forgot Password?" links. A "Login" button is at the bottom of the form. Below the form, there is a link "Don't have an account? Sign Up" and a "Or login with" section featuring a "G" logo.

Figure 8. 7 User login form



The image shows a user sign-up form. On the left, there is a blue sidebar with a cartoon mechanic character and the text "Book vehicle services in just a few clicks." Below this is a link "Login or sign up to continue". On the right, the main area has a title "Create User Account". It contains fields for "Full Name", "Contact No", "11-digit Contact No", "Email", "Password", "Address", and a "Sign Up" button. There is also a vertical scroll bar on the right side of the form.

Figure 8. 8 User Signup form

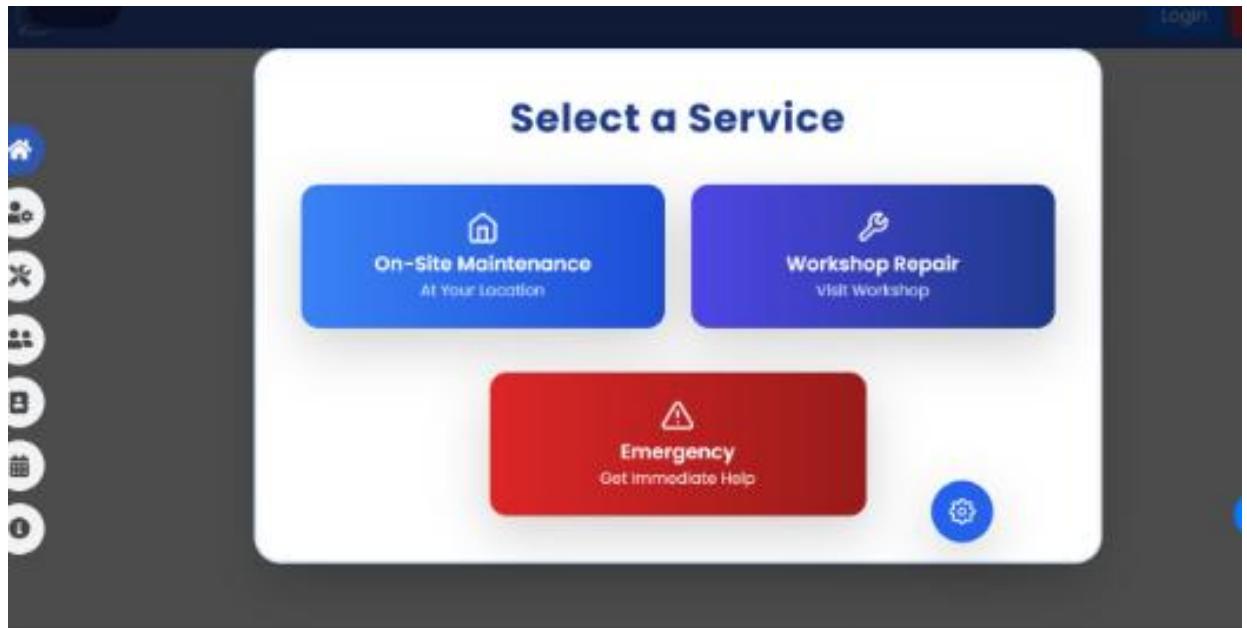


Figure 8. 9 Select a Feature

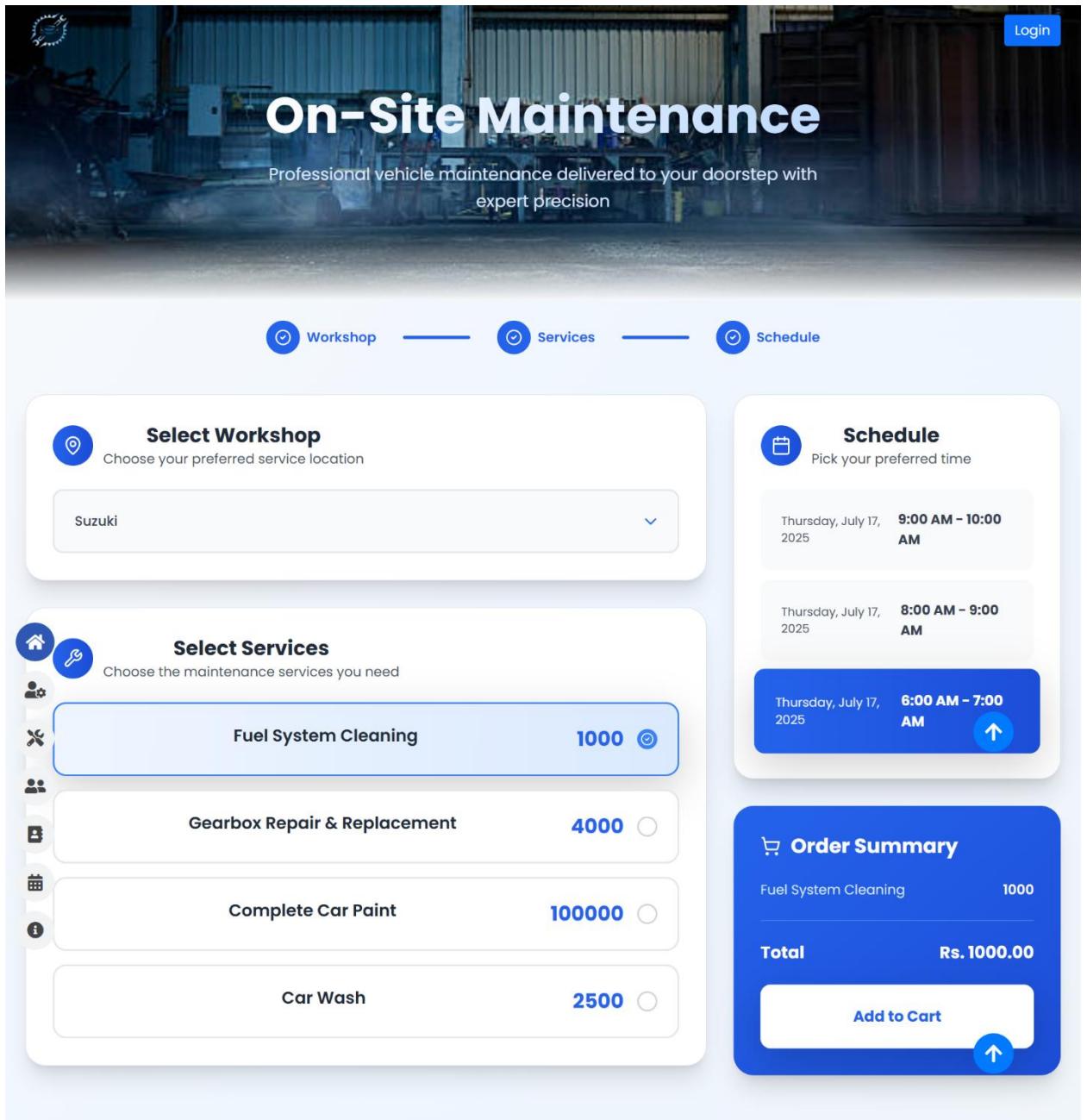


Figure 8. 10 On-site Maintenance

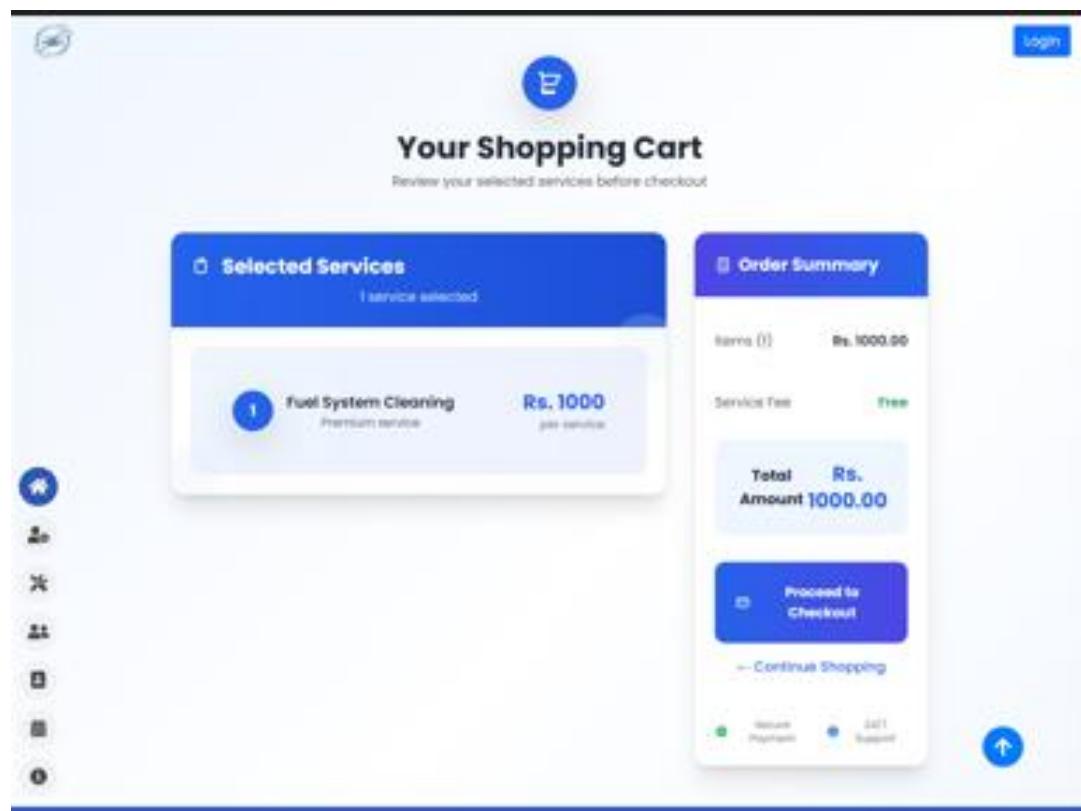


Figure 8. 11 On-site Maintenance- Cart

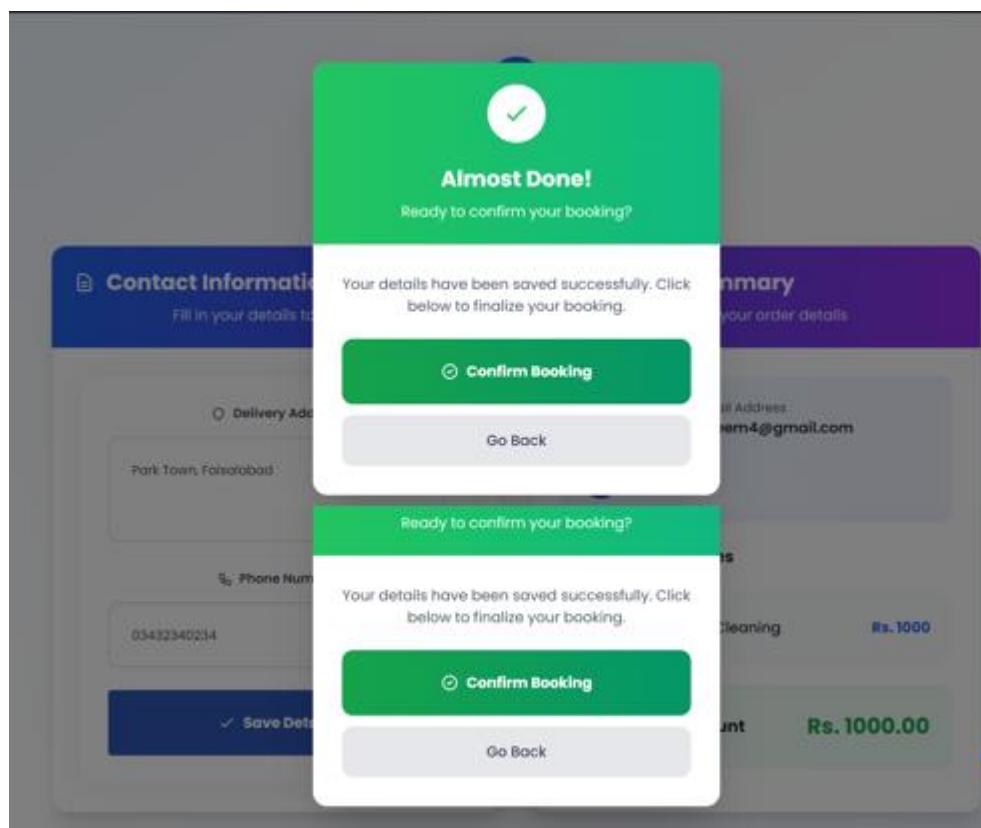


Figure 8. 12 On-site Maintenance- Booking Summary

The screenshot displays a mobile application interface for 'Workshop Maintenance'. At the top, there is a banner with the text 'Workshop Maintenance' and a subtext 'Drive in for dependable auto care – professionally handled at your chosen workshop'. A 'Login' button is located in the top right corner.

Below the banner, there are three navigation tabs: 'Workshop' (selected), 'Services', and 'Schedule'.

**Select Workshop:** This section allows users to choose their preferred service location. A dropdown menu shows 'Honda' as the selected option.

**Select Services:** This section lists maintenance services with their respective costs. Each service has a circular icon with a dot and a downward arrow.

- Engine Oil Change: 1500
- Oil Filter Replacement: 500
- Air Filter Replacement: 600
- Brake Service (Pads Replacement): 4000

**Schedule:** This section shows available time slots for booking. The first slot is highlighted in blue.

Date	Time
Friday, August 1, 2025	12:00 PM – 1:00 PM
Friday, August 1, 2025	4:00 AM – 5:00 AM
Friday, August 1, 2025	11:00 AM – 12:00 PM
Friday, August 1, 2025	2:00 AM – 3:00 AM

**Order Summary:** This section provides a summary of the selected services and their total cost.

Service	Cost
Engine Oil Change	1500
<b>Total</b>	<b>Rs. 1' 00</b>

**Add to Cart** button is present at the bottom of the summary.

**HI-TECH\_GARAGE**

**Address:** Faisalabad, Punjab, Pakistan

**Phone:** +92 302 7169070

**Email:** muneebshahid7169@gmail.com

**Useful Links:**

- Home
- About
- Services
- Workshops
- Book Appointment
- Contact

**Our Services:**

- Roadside Assistance
- At-Home Repair
- Periodic Servicing
- Oil Change
- Tire Services
- Coolant Change

**Our Workshops:**

- Honda
- Asian Autos
- Toyota
- Suzuki
- Ibrahim Autos & Parts
- First-Stop Garage

**Our Socials:**

- f
- in

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Figure 8. 13 At-Home Maintenance Selected services

The screenshot displays the booking summary page for 'At Home Maintenance' on a mobile application. At the top right is a 'Login' button. The main header reads 'Your Shopping Cart' with a sub-instruction 'Review your selected services before checkout'. Below this, there are two main sections: 'Selected Services' and 'Order Summary'.

**Selected Services:** Shows one service selected: 'Engine Oil Change' (Premium service) at 'Rs. 1500' per service. A blue circular icon indicates the quantity '1'.

**Order Summary:** Details the total cost. It shows 'Items (1)' at 'Rs. 1500.00', 'Service Fee' at 'Free', and a bolded 'Total Amount' of 'Rs. 1500.00'. A large blue button labeled 'Proceed to Checkout' is prominent. Below it are links for 'Continue Shopping' and icons for 'Secure Payment' and '24/7 Support'.

On the left side of the screen, a vertical sidebar contains icons for navigation: Home, Profile, Services, Bookings, Calendar, and Help. On the right side, there are social media links for Facebook and LinkedIn, along with a blue circular icon containing an upward arrow and another with a speech bubble.

**HI-TECH\_GARAGE**

- Address:** Faisalabad, Punjab, Pakistan
- Phone:** +92 302 7169070
- Email:** muneebshahid7169@gmail.com

**Useful Links**

- Home
- About
- Services
- WorkShops
- Book Appointment
- Contact

**Our Services**

- Roadside Assistance
- At-Home Repair
- Periodic Servicing
- Oil Change
- Tire Services
- Coolant Change

**Our Workshops**

- Honda
- Aslam Autos
- Toyota
- Suzuki
- Ibrahim Autos & Parts
- First-Stop Garage

**Our Socials**

- f in

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Figure 8. 14 Booking Summary - At Home Maintenance

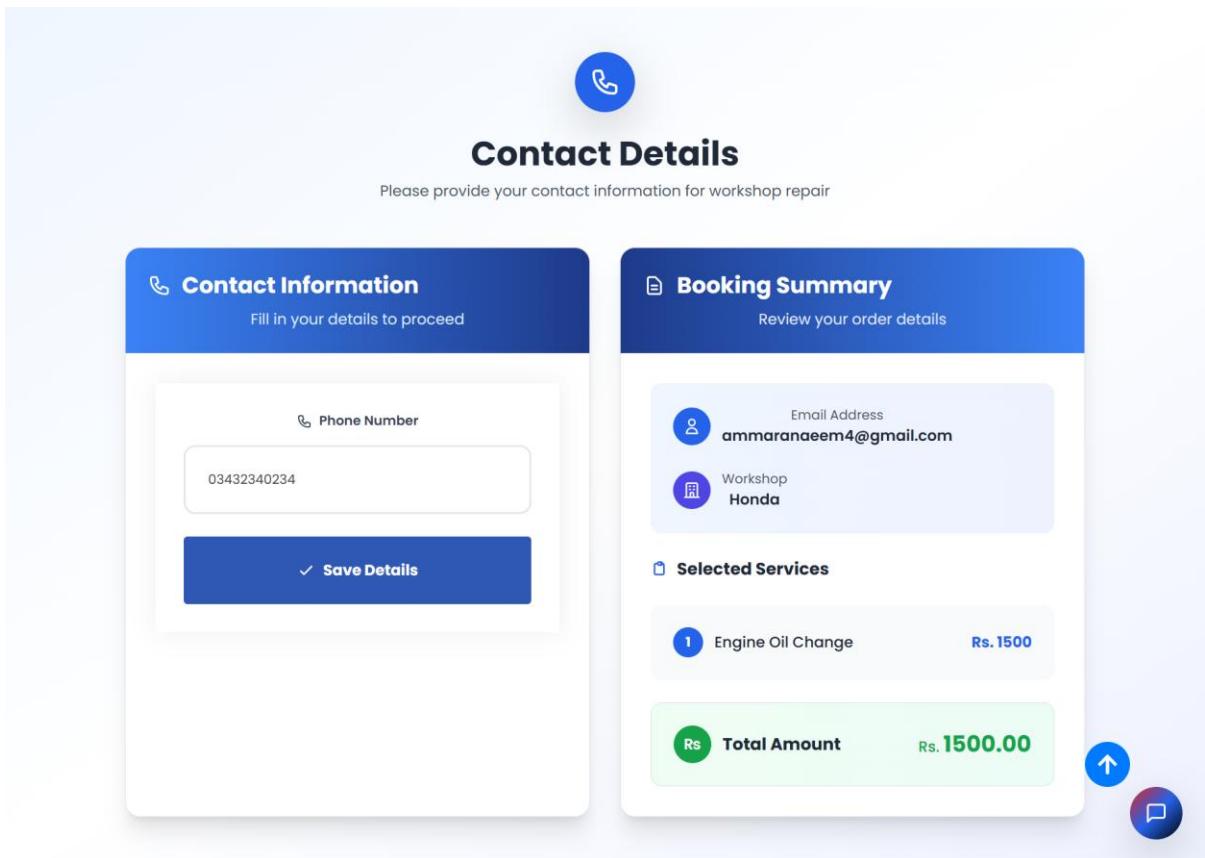
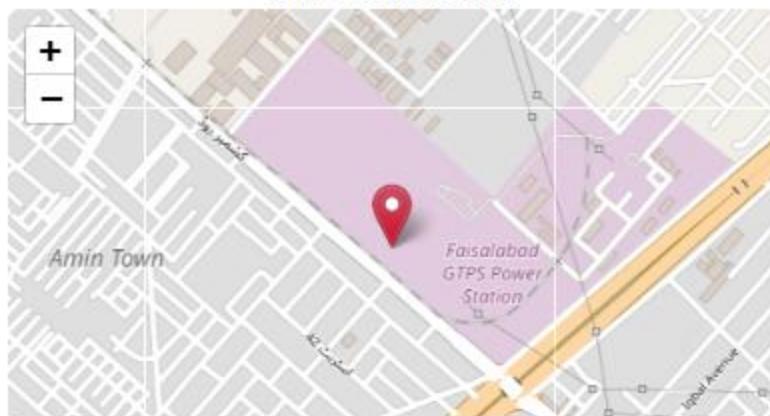


Figure 8. 15 Booking Summary - At Home Maintenance

## Emergency Help

Your Current Location



Kashmir Road, Faisalabad GTPS Power Station, Malkapur, Faisalabad City Tehsil, Faisalabad District, Faisalabad Division, Punjab, 38700, Pakistan

Lat: 31.4441728, Lng: 73.1316224

Describe Your Problem

Explain your emergency situation...

**Send Help Request**

Figure 8. 16 Emergency Help Page

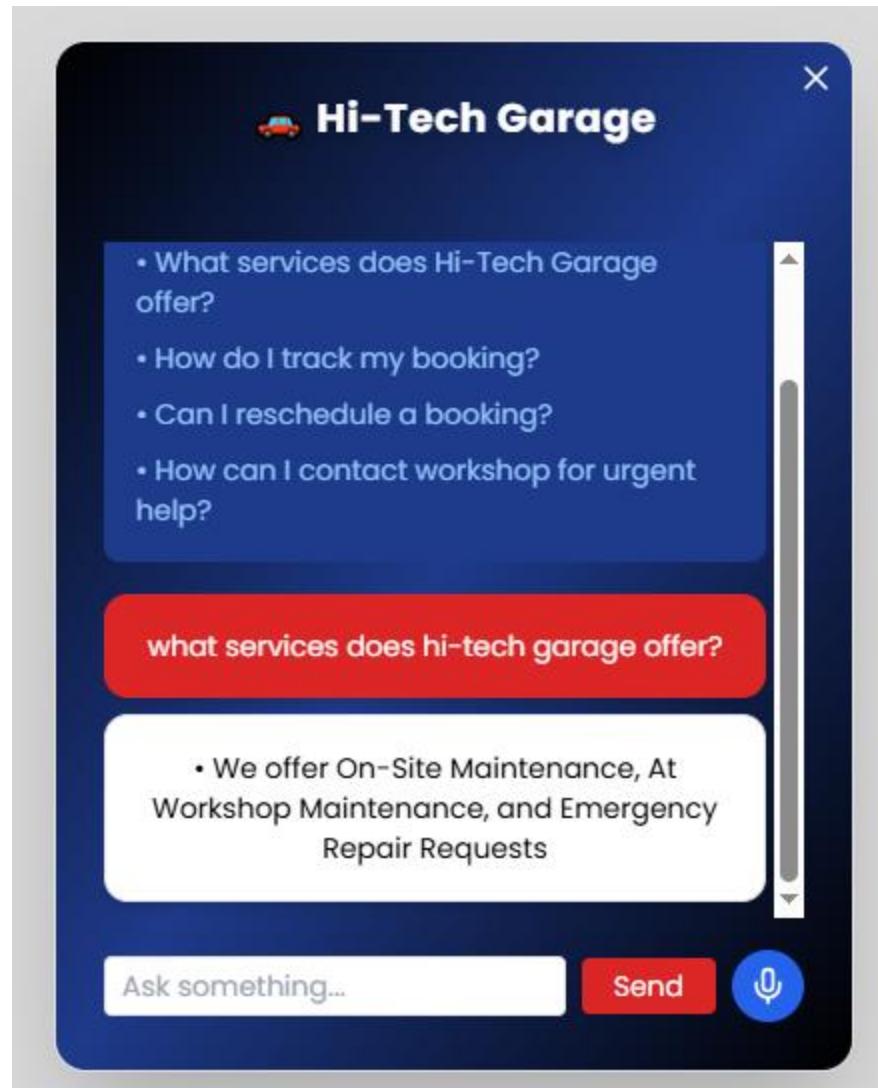


Figure 8. 17 Chatbot for instant support

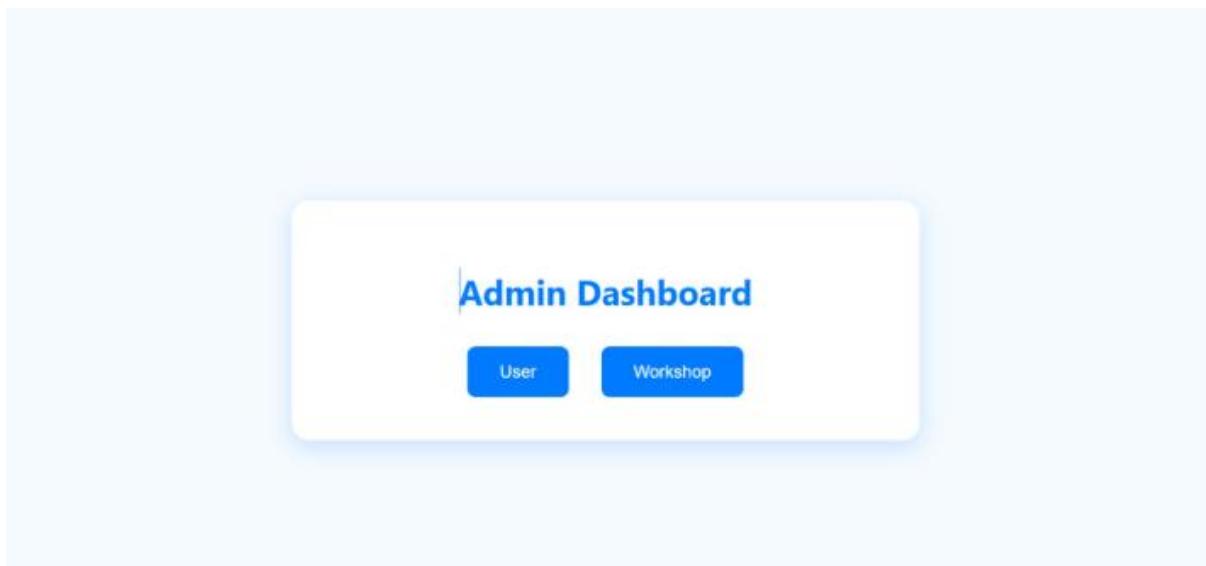


Figure 8. 18 Admin Dashboard

## User Details

**User ID:** hk4RvLkxqIVcsItAyi8Bn91PphQ2

**Full Name:** Silli

**Address:** ghar

**Contact No:** 03247382465

**Email:** salihah.naeem17@gmail.com

 Delete Account

**User ID:** mlAKQiVApEdIFB7UcQFPVEurybt1

**Full Name:** Ammara Naeem

**Address:** Park Town, Faisalabad

**Contact No:** 03432340234

**Email:** ammaranaeem4@gmail.com

 Delete Account

**User ID:** yCckaXV0gRghXx27WuiBduTXAWi1

**Full Name:** Kia

**Address:** House # 3

**Contact No:** 03843698548

**Email:** ammaraafzal234@gmail.com

 Delete Account

Figure 8. 19 User details

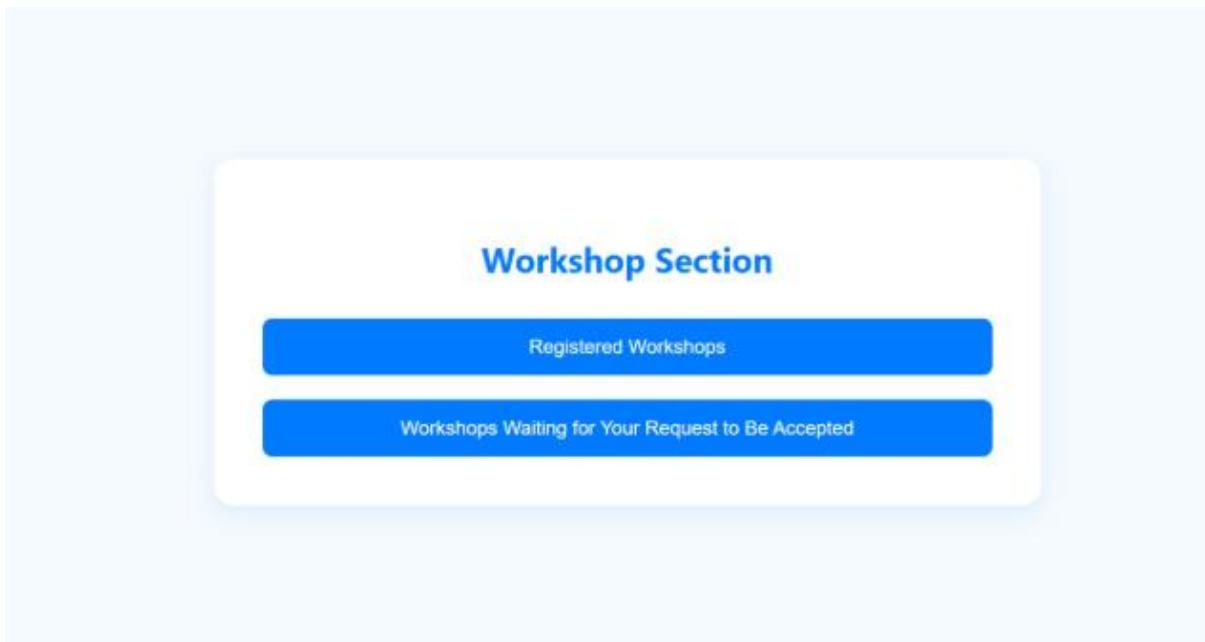


Figure 8. 20 Admin – Workshop Section

A screenshot of the "Registered Workshops" section. It displays three workshop entries, each in its own card. Each card contains the following information:

**UID:** followed by a unique identifier (e.g., 7q5IpEoj2QTFYMH5hs3upr66x672, U6YGwF4LCGhijgjx9AnNfyoTAw1, vfQ4RuGJlhSgJZxlvEV41PXliNb2).

**Full Name:** Salihah Sadiq, Sara Sadiq, Seher Sadiq.

**Email:** salihahsadiq4@gmail.com, sarasadiq424@gmail.com, sehersadiq162@gmail.com.

**Created At:** 03/07/2025, 21:21:45, 03/07/2025, 20:47:54, 03/07/2025, 20:48:38.

A red "Delete Account" button is located at the bottom of each card.

Figure 8. 21 Admin – Registered Workshops



Figure 8. 22 Admin – Accept Workshop Register Request

This dashboard interface includes a top navigation bar with a bell icon showing 2 notifications and the text 'Honda Motors'. On the left, a sidebar lists 'Overview', 'Bookings', 'Customers', 'Services', 'Analytics', and 'Settings', with 'Overview' currently selected. The main area features four cards: 'Pending Requests' (0, orange exclamation mark), 'Active Bookings' (0, blue circle), 'Completed' (0, green checkmark), and 'Earnings' (0 PKR, green dollar sign). Below these is a section titled 'Recent Bookings' with a table header row containing columns for ID, Customer, Service, Type, Status, and Actions.

Figure 8. 23 Workshop Dashboard

This dashboard interface includes a top navigation bar with a bell icon showing 2 notifications and the text 'Honda Motors'. On the left, a sidebar lists 'Overview', 'Bookings' (selected), 'Customers', 'Services', 'Analytics', and 'Settings'. The main area has three sections: 'All Bookings' (No pending emergency bookings found), 'Your Booked Emergency Users' (No confirmed bookings yet), and 'Time Slots'. The 'Time Slots' section contains a form for setting a time range: 'Set Time Range for Slots' with fields for 'Select Date' (Click to select a date), 'Start Time' (6:00 AM), 'End Time' (8:00 PM), and a 'Generate Slots' button.

Figure 8. 24 Workshop Dashboard – Bookings

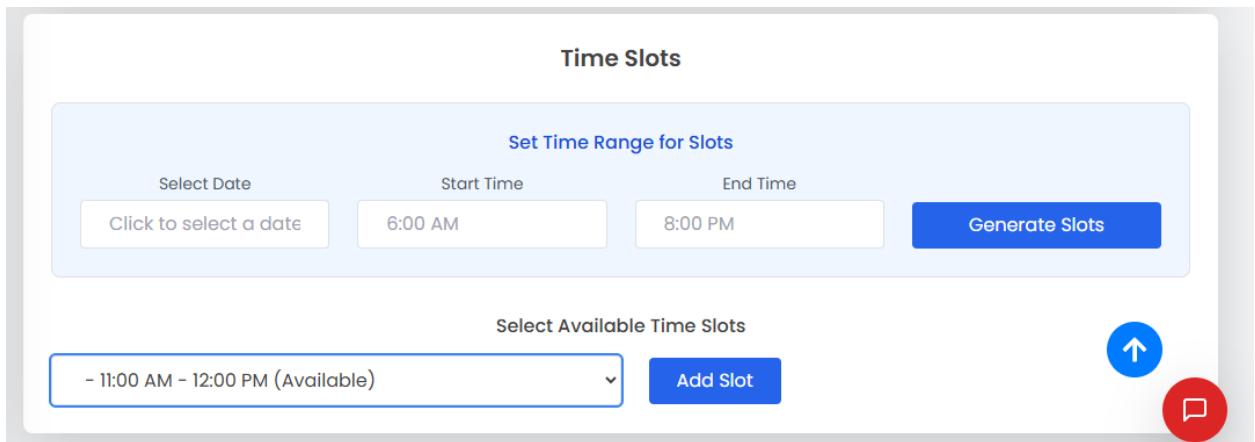


Figure 8. 25 Workshop Dashboard – Generate Time slots

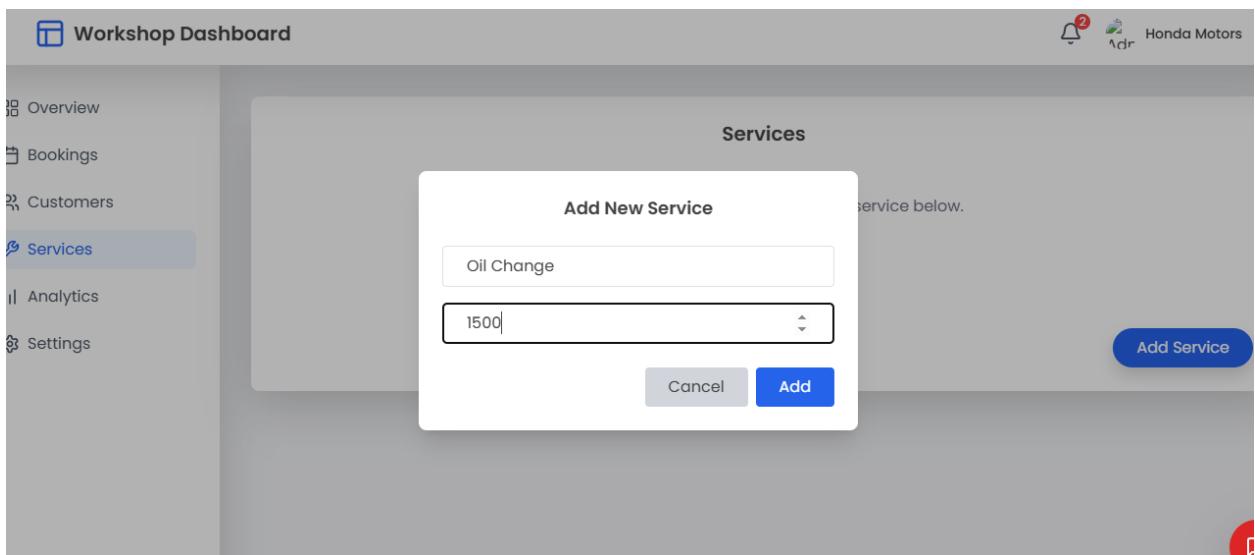
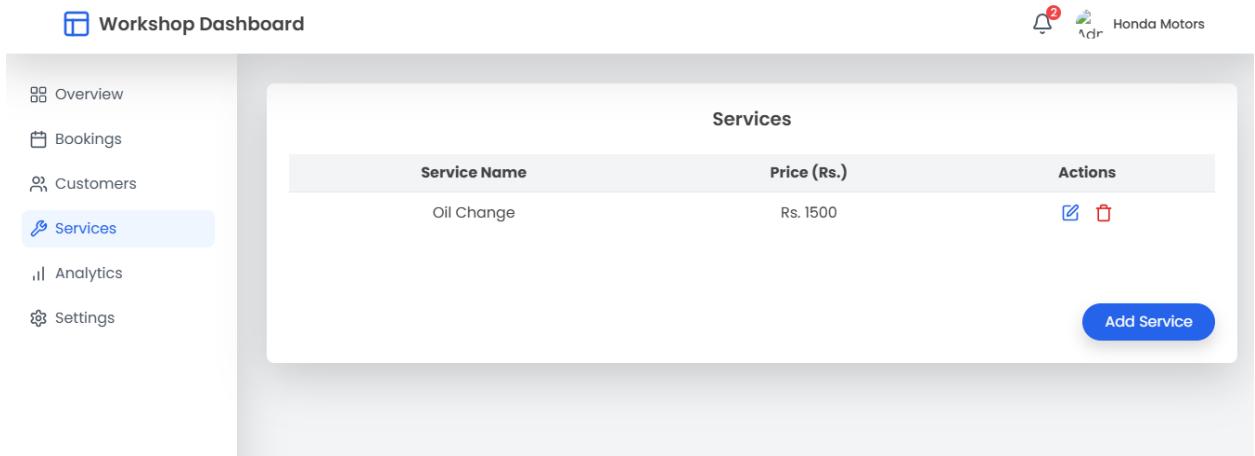
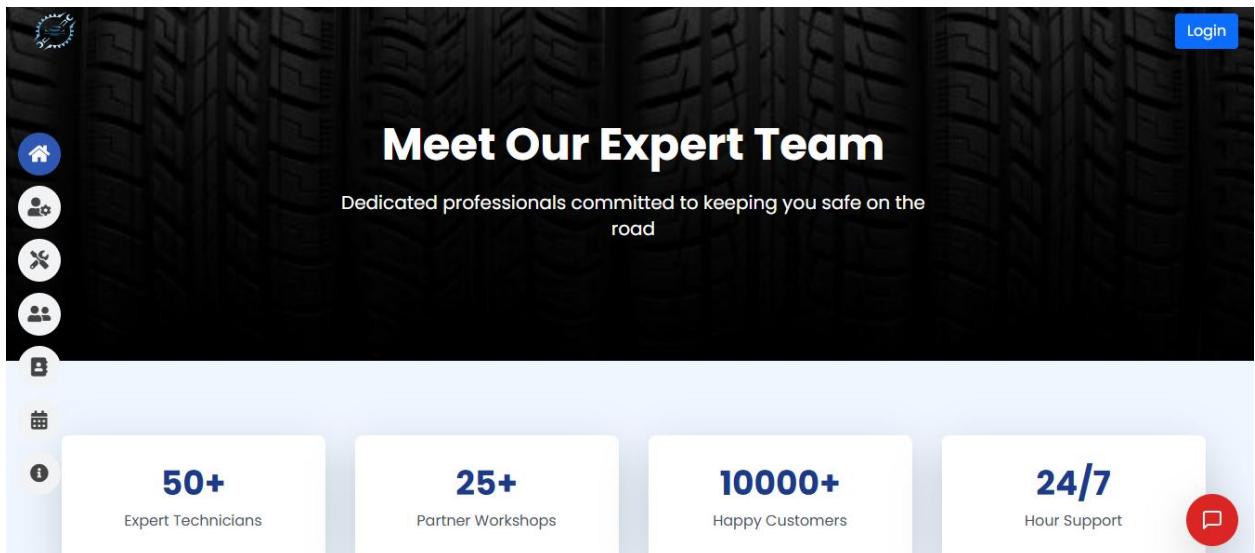


Figure 8. 26 Workshop Dashboard – Add new service



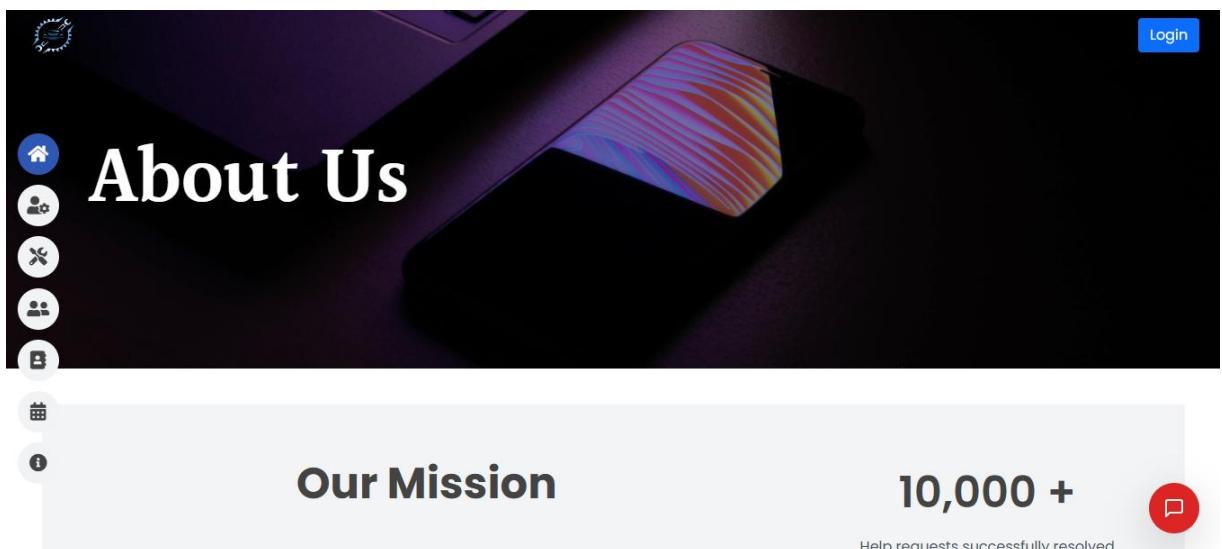
The screenshot shows the 'Workshop Dashboard' interface. On the left, a sidebar menu includes 'Overview', 'Bookings', 'Customers', 'Services' (which is selected and highlighted in blue), 'Analytics', and 'Settings'. The main content area is titled 'Services' and displays a table with one row: 'Oil Change' at 'Rs. 1500'. There are edit and delete icons in the 'Actions' column. A blue 'Add Service' button is located at the bottom right of the table.

Figure 8. 27 Workshop Dashboard – Services



The screenshot shows the 'Our Team' page. It features a dark background with a tire tread pattern. On the left, there is a vertical sidebar with circular icons for Home, Settings, Tools, People, Books, and Information. The main title is 'Meet Our Expert Team' with the subtitle 'Dedicated professionals committed to keeping you safe on the road'. Below this, four statistics are displayed in boxes: '50+' Expert Technicians, '25+' Partner Workshops, '10000+' Happy Customers, and '24/7' Hour Support. A red speech bubble icon is in the bottom right corner.

Figure 8. 28 Our Team Page



The screenshot shows the 'About Us' page. It has a dark background with a blurred image of a car's front end. On the left, there is a vertical sidebar with circular icons for Home, Settings, Tools, People, Books, and Information. The main title is 'About Us'. Below it, the 'Our Mission' section is shown with the text '10,000 +' and a red speech bubble icon. At the bottom, a message says 'Help requests successfully resolved'.

Figure 8. 29 About-us page

## 8.1 Summary

This chapter discusses in detail various methods of how online workshop and automobile owners communicate with each other, including black box testing and white box testing. The platform offers three core features: **Emergency Roadside Assistance**, where users can request help from nearby workshops in real time; **At-Home Vehicle Repair Appointments**, where users can schedule service at their preferred time and location; and On-site Visit Appointments, where users can book slots in advance to avoid delays. The application also includes a chatbot for instant support and was developed using agile **Scrum** methodology throughout its development process. It aims to streamline automotive service, reduce response times, and modernize workshop operations.

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