Automated Home Service Solutions: Improving Efficiency and Satisfaction through Real-Time Management

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Abstract:

This research introduces an innovative Automated Home Service Management System designed to revolutionize the management and delivery of home services. Traditional systems often suffer from inefficiencies such as scheduling conflicts, lack of real-time updates, and inadequate visibility into technician availability and performance. The proposed system addresses these gaps by integrating real-time scheduling algorithms, technician tracking, and predictive analytics into a unified, user-friendly platform. By leveraging cutting-edge technologies, the system enhances operational efficiency, optimizes resource allocation, and significantly improves customer satisfaction. The platform's modular design ensures scalability and adaptability, offering a robust solution to the growing demands of the home service industry.

Introduction

Due to the fast pace of life, there is a total reliance on technology, including home service solutions. Therefore, traditional methods, which are often manual and disconnected, such as calling each technician individually, lack real-time updates, tracking of technicians, conflicting schedules and inefficiencies. These difficulties may face both service providers and customers. Home services have become an integral part of everyday life. There is a lack of integrated platforms to manage daily repairs such as plumbing, electrical, maintenance and cleaning while ensuring that the full needs of both service providers and customers are met**.** This paper proposes an Automated Home Service Management System, an integrated platform designed to revolutionize the way home services are scheduled, managed, and delivered. The proposed system integrates real-time scheduling, advanced analytics, and a user-friendly interface to address the shortcomings of current solutions.

Problem Statement

Current home service management systems face inefficiencies that cause issues like scheduling conflicts and poor service transparency. These problems often result in overlapping appointments and underused resources, leading to missed services and unhappy customers. On top of that, there’s limited visibility into technician availability and past service records, which makes it harder for customers to make informed decisions and for service providers to manage their work effectively. These challenges show just how important it is to have a more efficient and transparent system to improve both customer satisfaction and operational efficiency.

Objectives

1. Develop a unified platform for managing client reservations and technician schedules.
2. Implement real-time scheduling and technician tracking to reduce conflicts.
3. Enhance client satisfaction by improving service transparency and reliability.

Methodology

The development of the Automated Home Service Management System follows a structured, iterative methodology to ensure efficiency and reliability. The process begins with a thorough requirement analysis to identify key features and user needs. Next, the system is designed using UML diagrams to create a clear and scalable architecture. Implementation involves building the front-end with HTML, CSS, and JavaScript, while the back-end is powered by C# and .Net 8, For database management SQL is used, with Entity Framework employed to establish seamless connectivity. Finally, the system undergoes rigorous testing in real-world scenarios to validate its functionality and performance. Fig 1.1 below illustrates the Methodology phases.

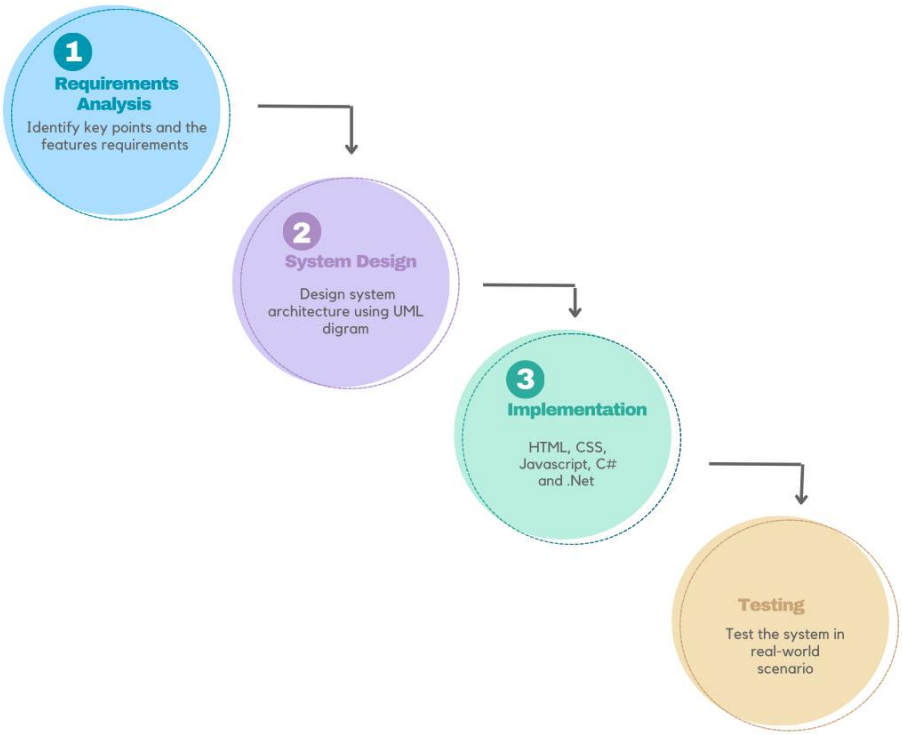

Figure 1.1 Incremantal Methodology

Literature Review

The Current State of Home Service Management Systems have transitioned from manual, inefficient methods to technology-driven platforms that improve accessibility and reliability. Modern systems feature secure payment gateways, real-time technician tracking, and geo-location-based scheduling. However, significant gaps remain, such as the lack of predictive analytics, AI-driven recommendations, and robust data privacy measures. Many systems also struggle with scalability and geographic expansion. These limitations highlight the need for a more advanced, comprehensive solution to optimize service delivery and enhance user experience.

Study 1: An Online System for Household Services

This study focuses on providing a centralized platform for managing household services such as plumbing, cleaning, and repairs through a web and mobile application. The system emphasizes ease of use with features like secure payment gateways, interactive user interfaces, and service confirmation notifications. The inclusion of a mobile-friendly environment broadens its accessibility, allowing users to book services conveniently. The system also standardizes service rates to eliminate price haggling, ensuring a seamless experience for both users and service providers.

Limitations: While the study introduces essential features for service management, its architecture lacks scalability, which could hinder its ability to handle increasing user demands. Moreover, the absence of advanced technologies like real-time tracking or predictive analytics limits its capability to optimize service delivery dynamically. Additionally, its reliance on manual updates by administrators reduces operational efficiency.

Study 2: An Online System for Home Services

This research integrates geo-location-based real-time tracking and a feedback-driven rating system to enhance user experience and service efficiency. By enabling users to locate and book technicians based on proximity, the system significantly improves response times. It also provides a secure platform for transactions and fosters trust through a user-driven feedback mechanism that helps service providers improve over time.

Limitations: Despite these advancements, the system lacks robust privacy protocols, leaving user data potentially vulnerable. Additionally, it does not incorporate advanced scheduling algorithms or AI-driven features to optimize resource allocation. The system's dependency on geo-location alone restricts its adaptability to more complex scenarios, such as predicting service demands based on user patterns.

Study 3: An Android Application for Home Services

This study extends home service accessibility to rural areas through an Android application. It offers a simple, user-friendly interface that allows customers to book a wide range of services, from appliance repair to cleaning. The focus on affordability and reach makes it a valuable solution for underserved markets.

Limitations: The study’s reliance on a single platform (Android) limits its accessibility for users on other devices. Additionally, the system lacks integration with advanced technologies such as predictive analytics or AI to enhance user experience. Its basic architecture restricts scalability, and the absence of robust privacy measures exposes it to potential data breaches.

Study 4: Home Service Management System

This study provides a broad spectrum of services, including garbage disposal, furniture repair, and home cleaning, managed through a simple web-based platform. The use of PHP and MySQL ensures efficient backend operations, while its modular approach facilitates basic customization. The system also includes a 24/7 service model, ensuring user convenience.

Limitations: The system's simple architecture limits its ability to scale with user demands or integrate with modern technologies. It lacks advanced features such as real-time technician tracking or predictive analytics, which are essential for optimizing service delivery. Additionally, the focus on basic functionality compromises user engagement and experience.

Study 5: HOMERESC Home Service System

The HOMERESC system adopts an agile methodology to deliver a user-centric platform for home repair services. It emphasizes transparency and secure transactions, employing strong data protection protocols. The system includes multi-language support and focuses on building trust between users and service providers by providing detailed profiles and verified credentials.

Limitations: Despite its strengths, HOMERESC is geographically constrained, limiting its usability outside specific regions. Furthermore, it does not integrate emerging technologies like IoT or AI to provide dynamic service recommendations. The system also lacks a comprehensive strategy for handling high user volumes, which could affect performance as demand increases. Table 2.1 below illustrate comparison Table of Studies and Proposed Work

Table 2.1 Taxonomy table

Feature	Study 1	Study 2	Study 3	Study 4	Study 5	Proposed system
Platform Support (Web)	✓	✓		✓		✓
Platform Support (Mobile)	✓	✓	✓		✓	✓
Platform Support (IoT)						✓
Real-Time Tracking		✓			✓	✓
Secure Payment	✓	✓			✓	✓
Feedback System		✓			✓	✓
AI-Driven Recommendations						✓
Geo-Intelligent Scheduling		✓				✓
Predictive Analytics						✓
Advanced Privacy Protocols					✓	✓
Comprehensive Service Coverage	✓	✓	✓	✓	✓	✓
Cross-Platform Scalability					✓	✓

Proposed System

The proposed system, Automated Home Service Management System, aims to address inefficiencies in scheduling, technician management, and service delivery by providing a unified platform for clients, technicians, and administrators. The system integrates real-time scheduling algorithms, intuitive user interfaces, and advanced analytics to streamline home service operations and improve user satisfaction. The system architecture is composed of three main modules, the first one is Technician Management which tracks technician availability

dynamically assigns tasks based on workload and location and allows technicians to update their schedules in real-time. It ensures efficient resource utilization and minimizes idle time. The second is Client Reservation which is designed for user convenience, this module allows clients to browse available services, check technician availability, and book appointments. It also provides real-time updates and notifications, ensuring a seamless booking experience. The third one is Visit Scheduling which automates the allocation of service tasks by considering technician availability, location proximity, and client preferences. By optimizing scheduling, it reduces conflicts and ensures timely service delivery. The Fig 3.1 below illustrates the system architecture design.

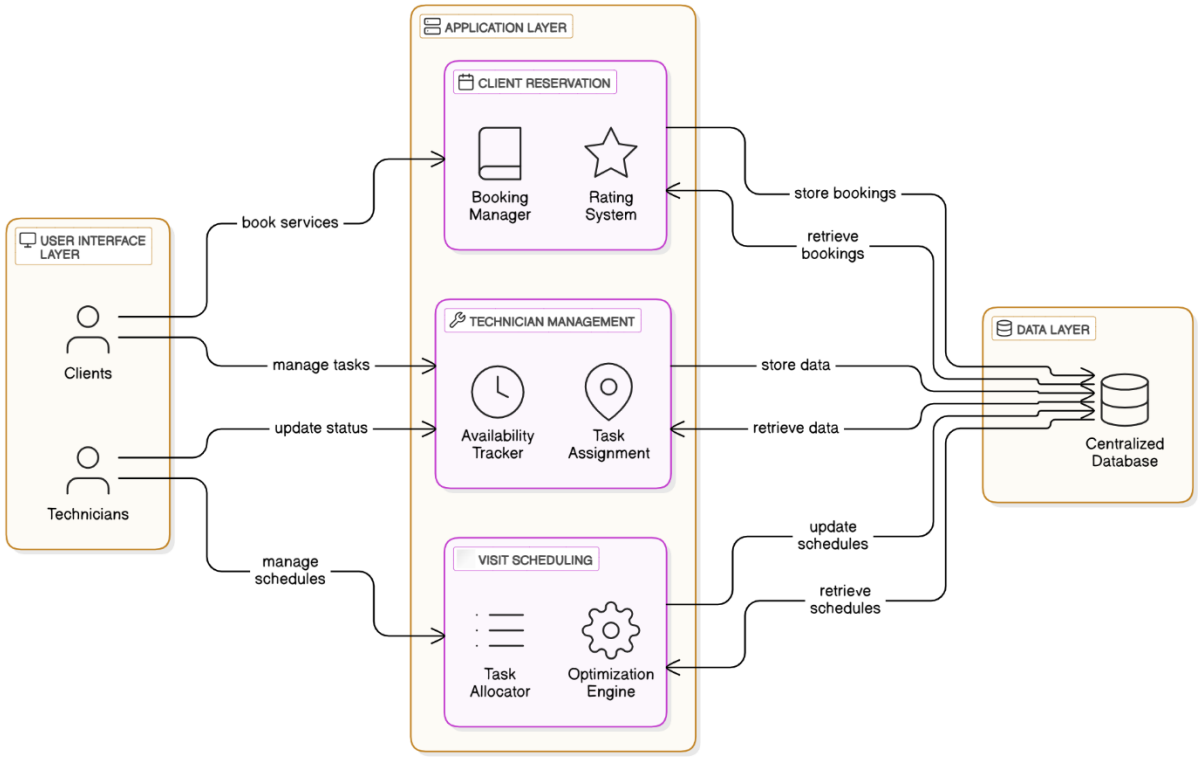

Figure 3.1 System Architecture

Implementation

The primary goal of the implementation is to bring the proposed functionalities to life, including real-time scheduling, technician tracking, and advanced analytics. Each feature was meticulously designed to address the pain points identified in the problem statement, providing a robust and efficient solution for managing home services. The following sections present key screenshots and real data examples from the application, showcasing its functionality and usability.

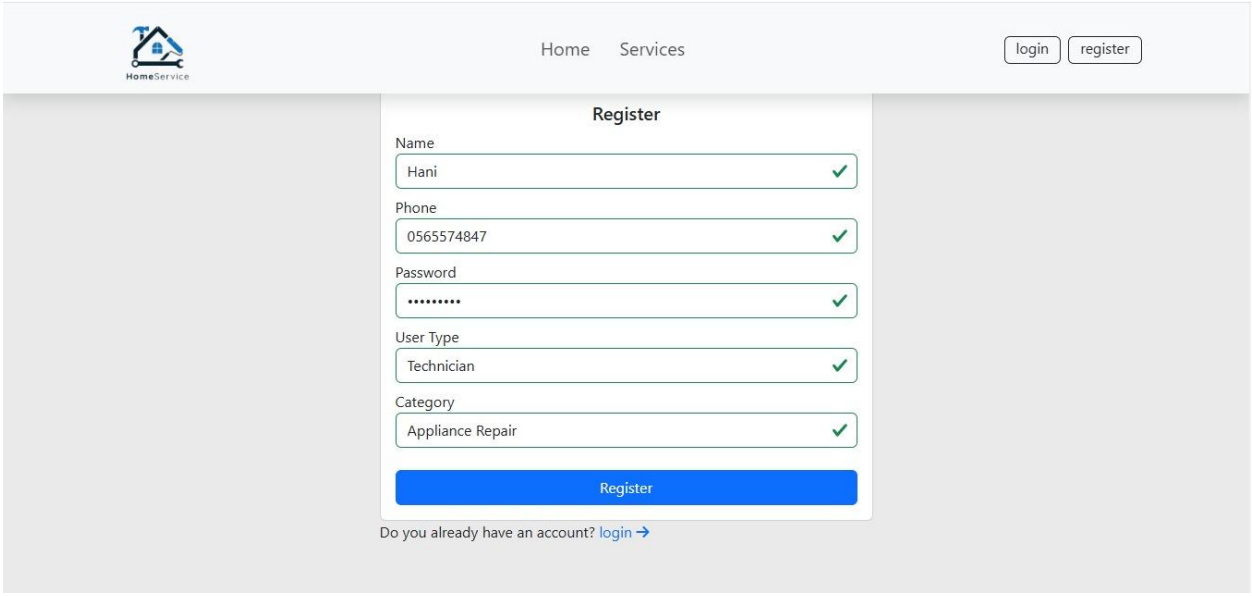

Figure 4.1 Technician Registration Page

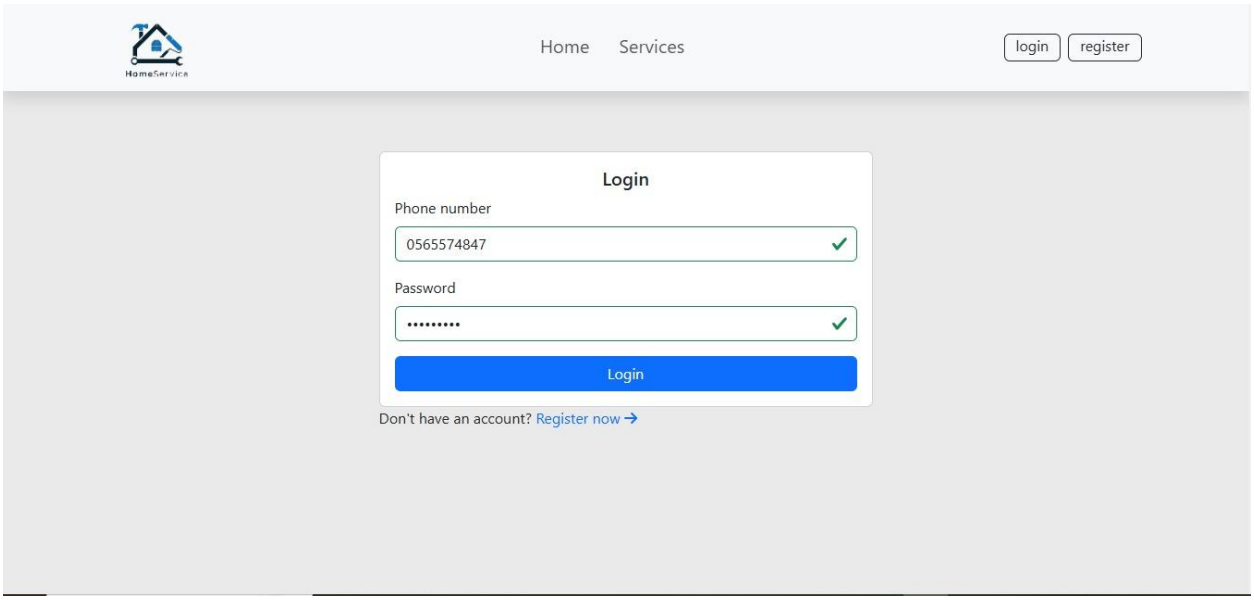

Figure 4.2 Technician Login Page

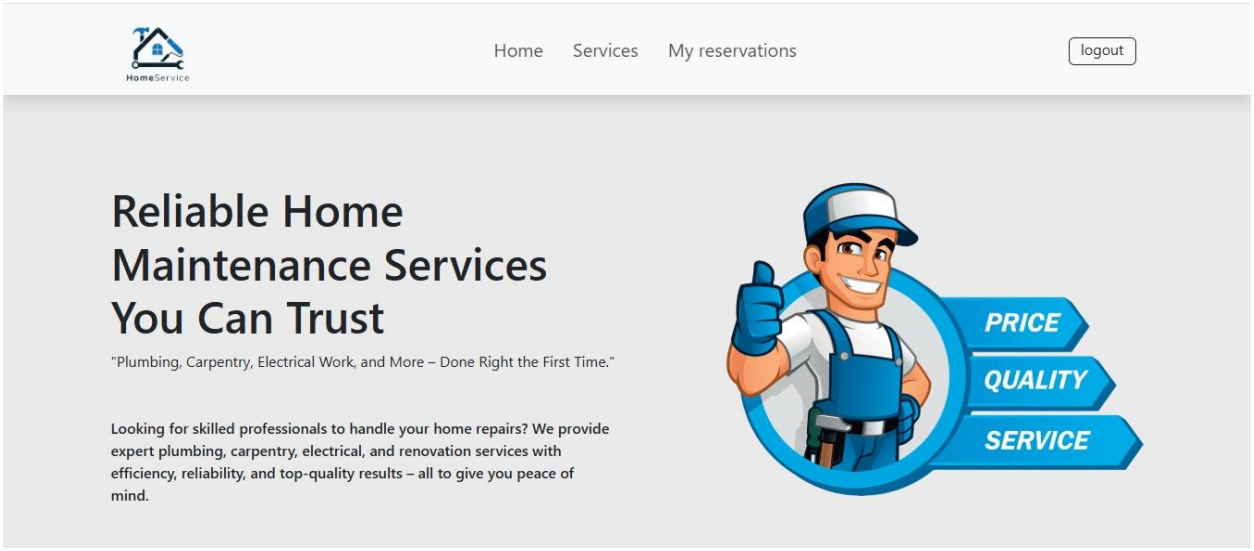

Figure 4.3 Technician's Home Page can view the services.

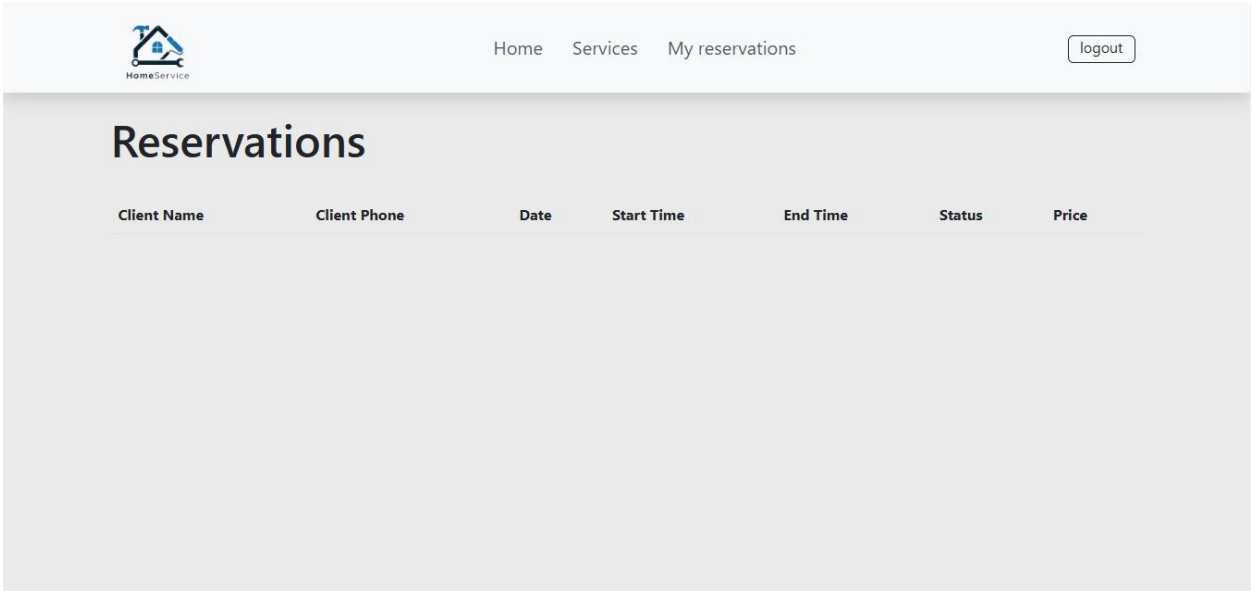

Figure 4.4 Technician tasks pages and there are no tasks yet

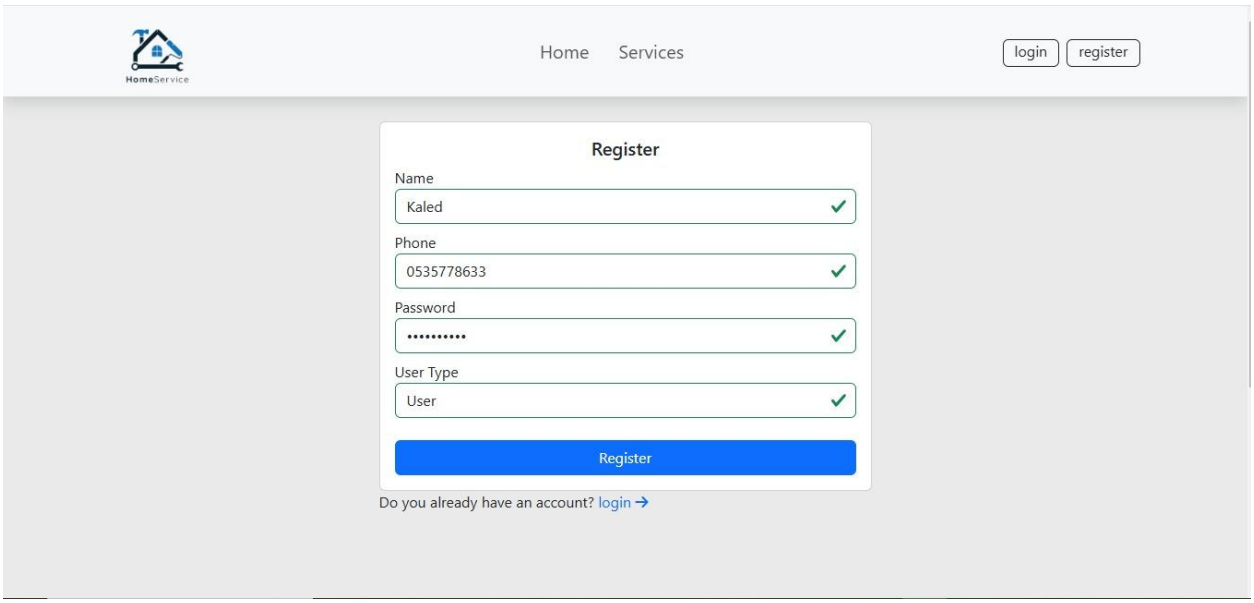

Figure 4.5 User Registration Page

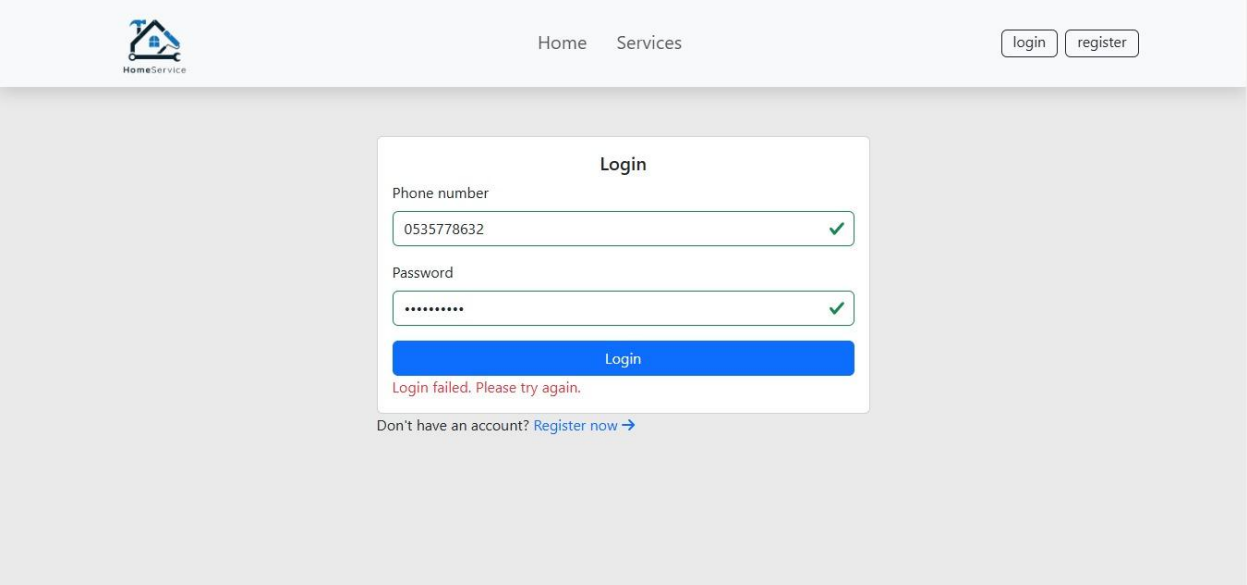

Figure 4.6 Users login page and it shows that they cannot log in because they entered the wrong mobile number

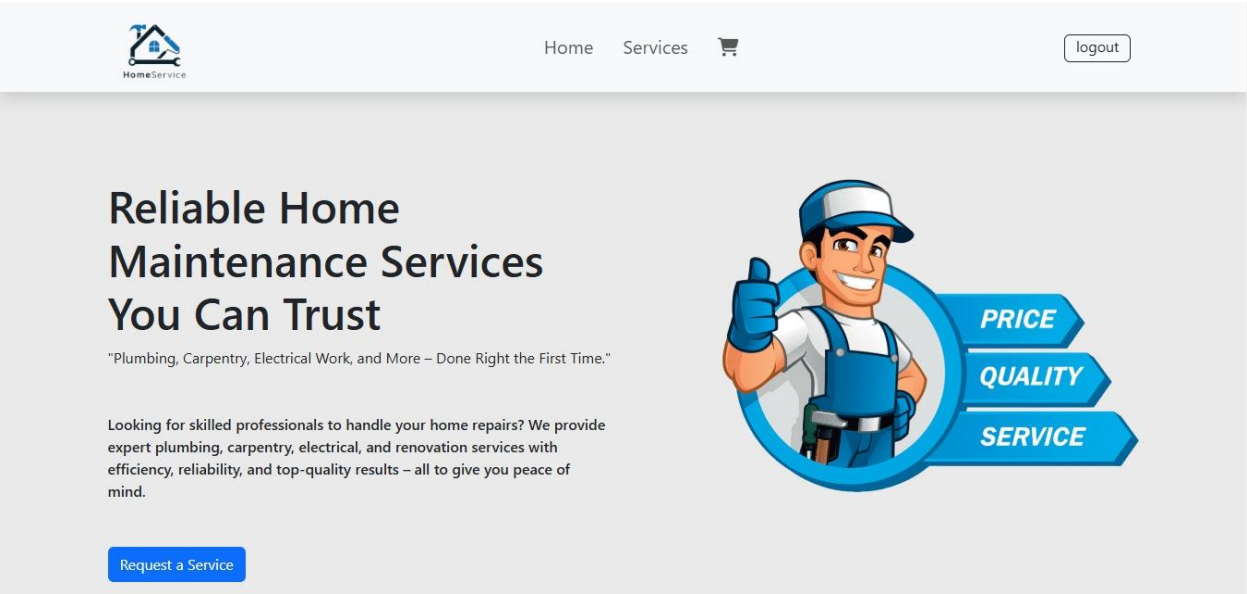

Figure 4.7 User Home Page

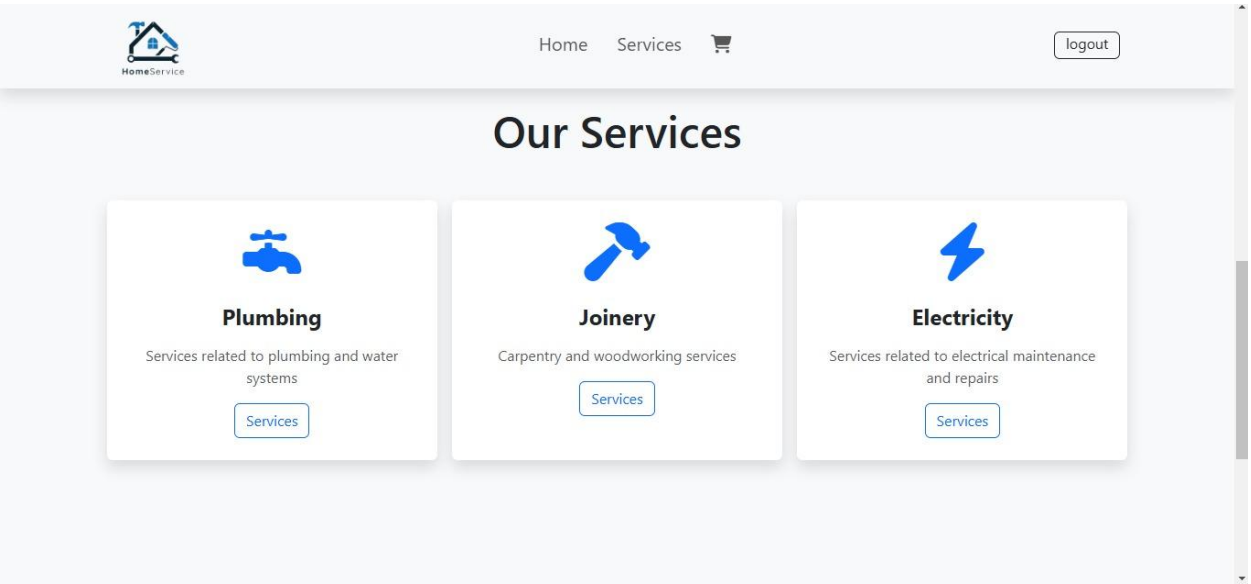

Figure 4.8 Main categories of services

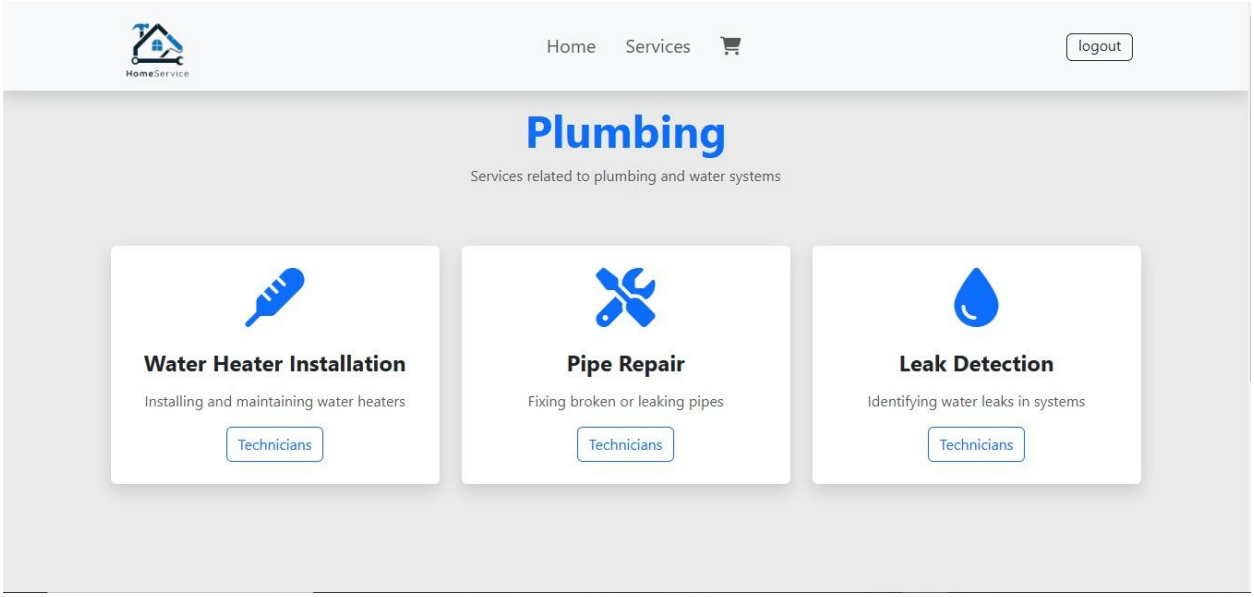

Figure 4.9 Available services in the plumbing section

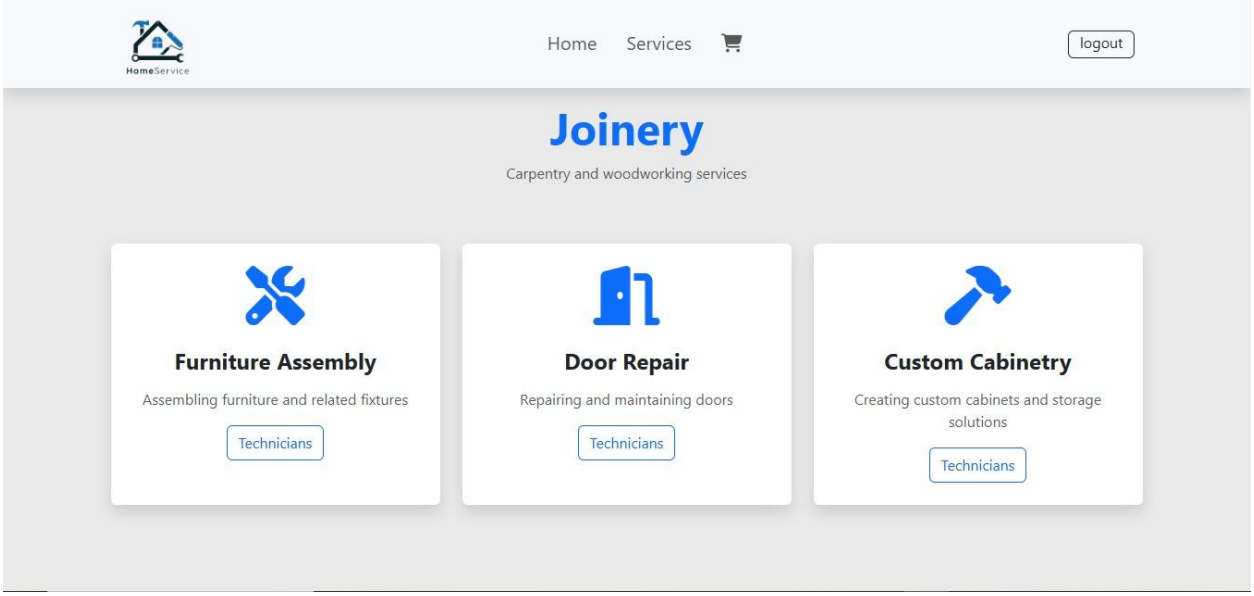

Figure 4.10 Available services in the joinery section

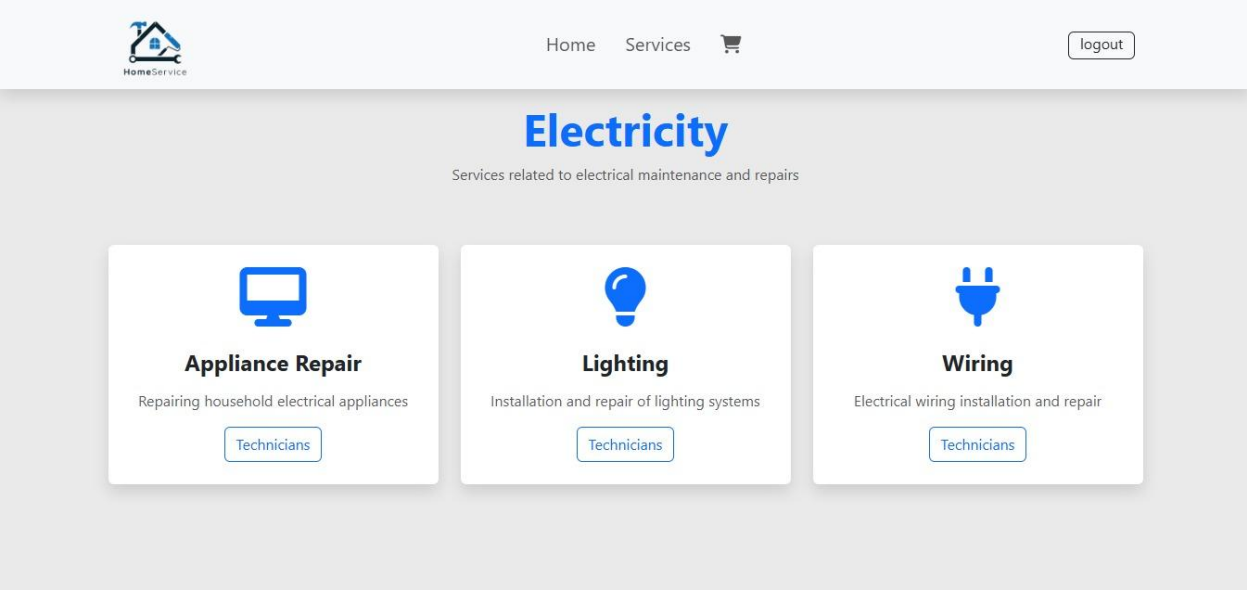

Figure 4.11 Available services in the electricity section

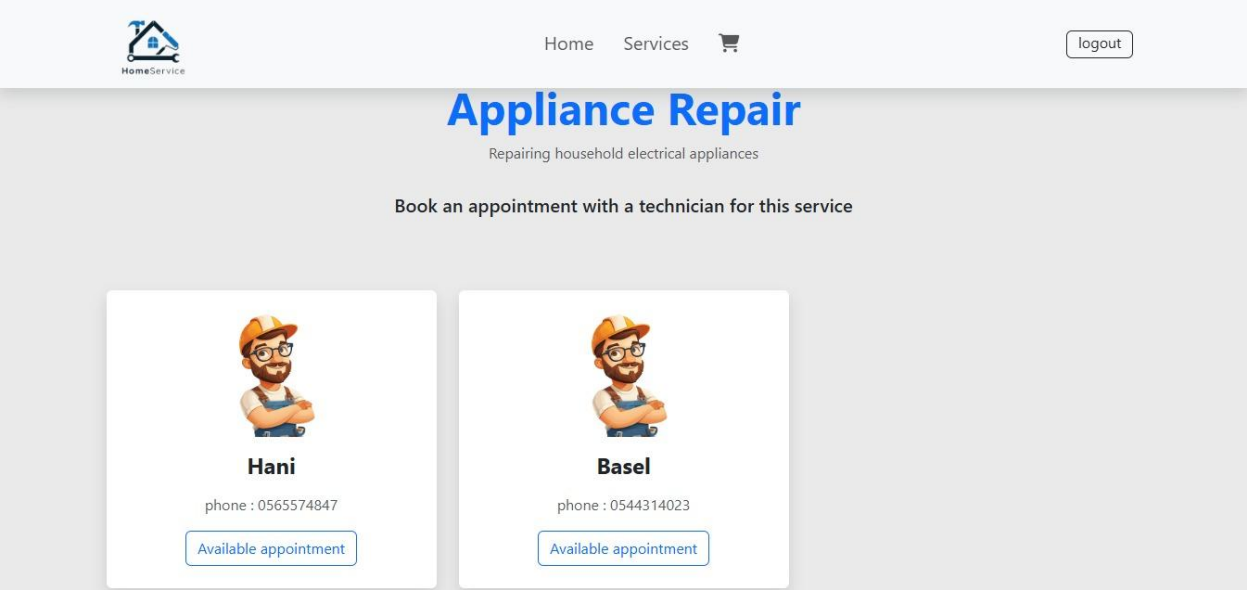

Figure 4.12 Registered technicians in the appliance repair service

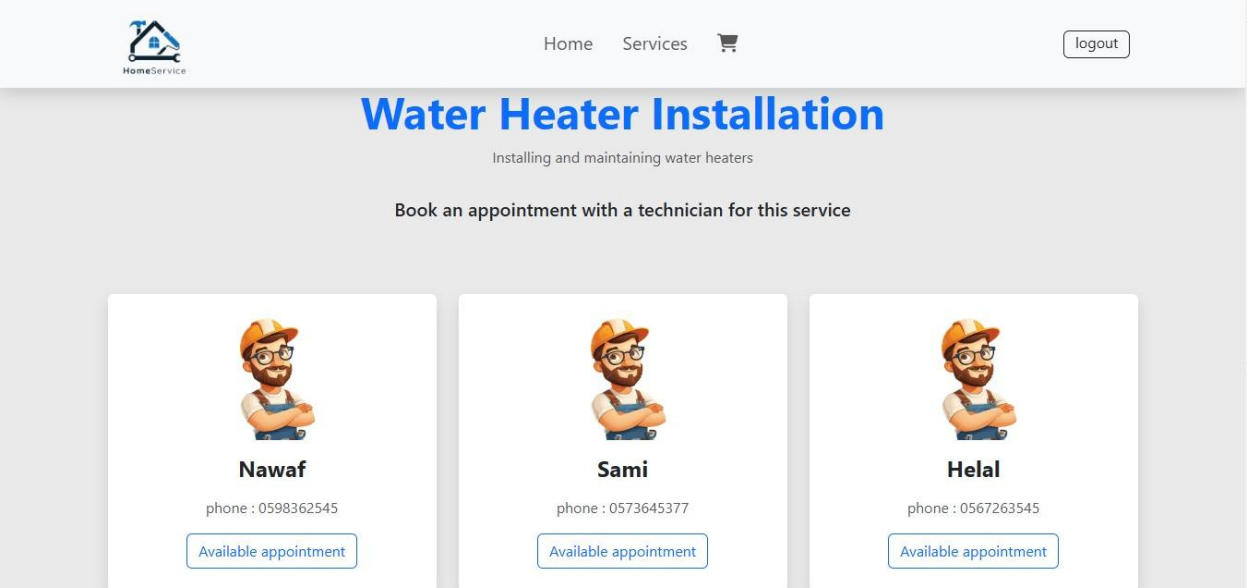

Figure 4.13 Registered technicians in the water heater installation service

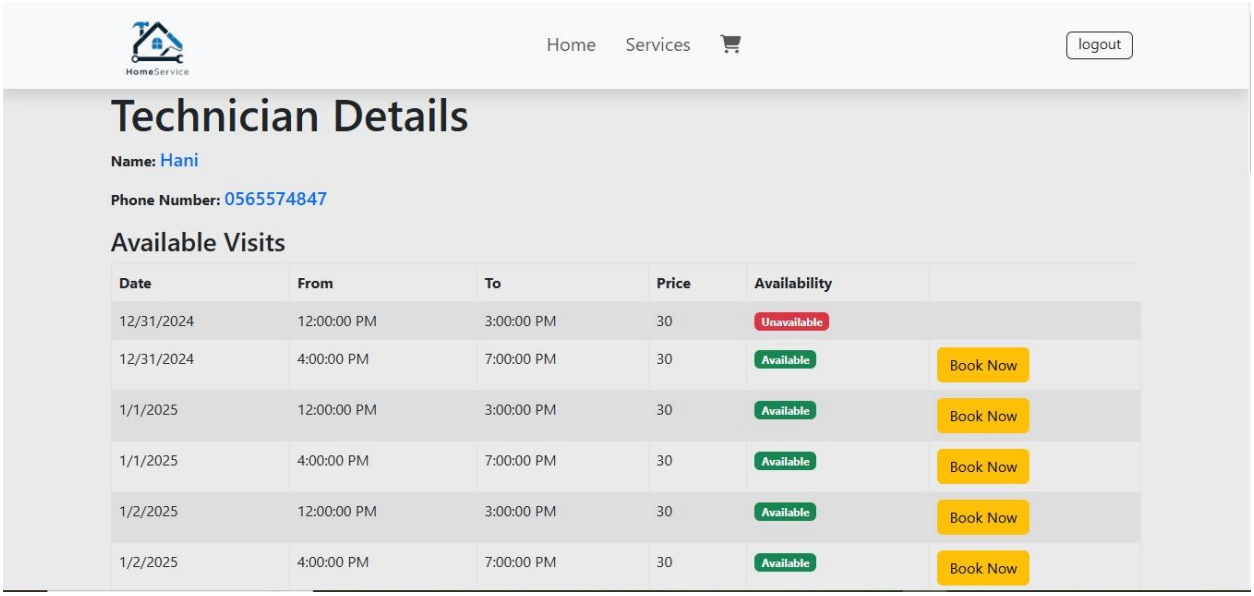

Figure 4.14 Request an appliance repair service from technician Hani

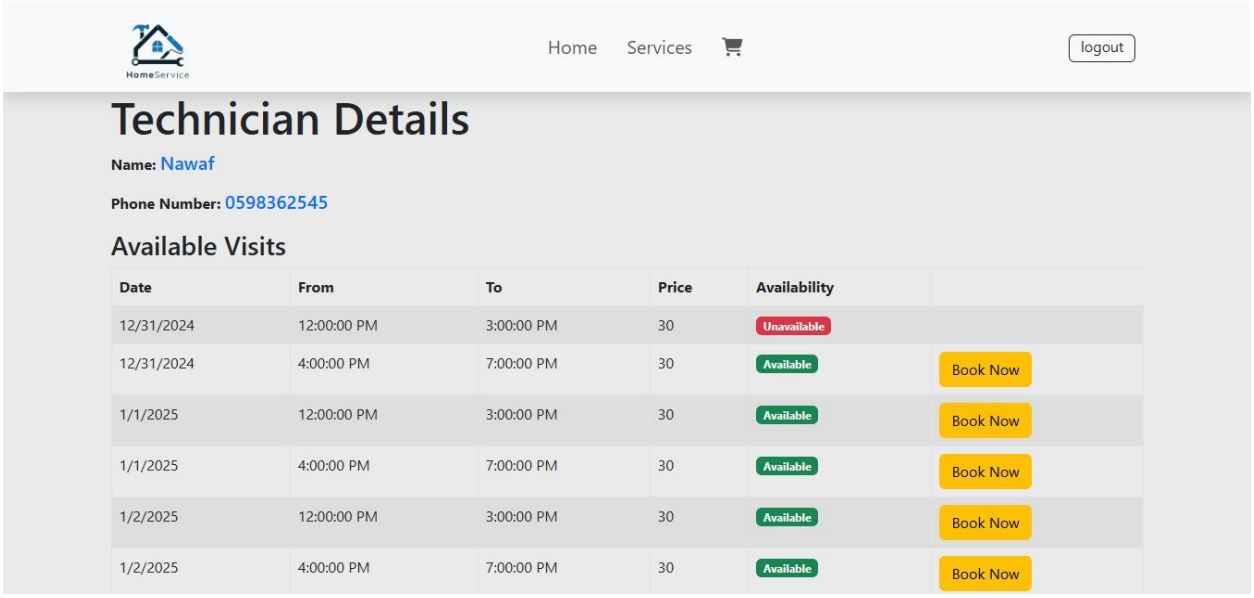

Figure 4.15 Request a water heater installation service from technician Nawaf

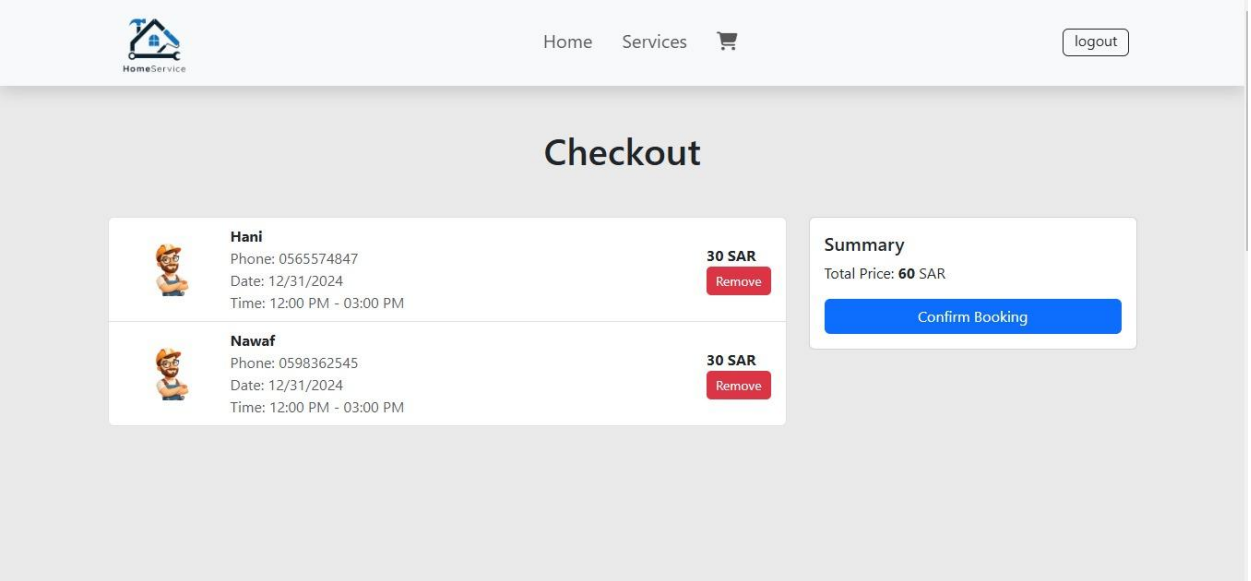

Figure 4.16 Enter the cart to complete the payment process

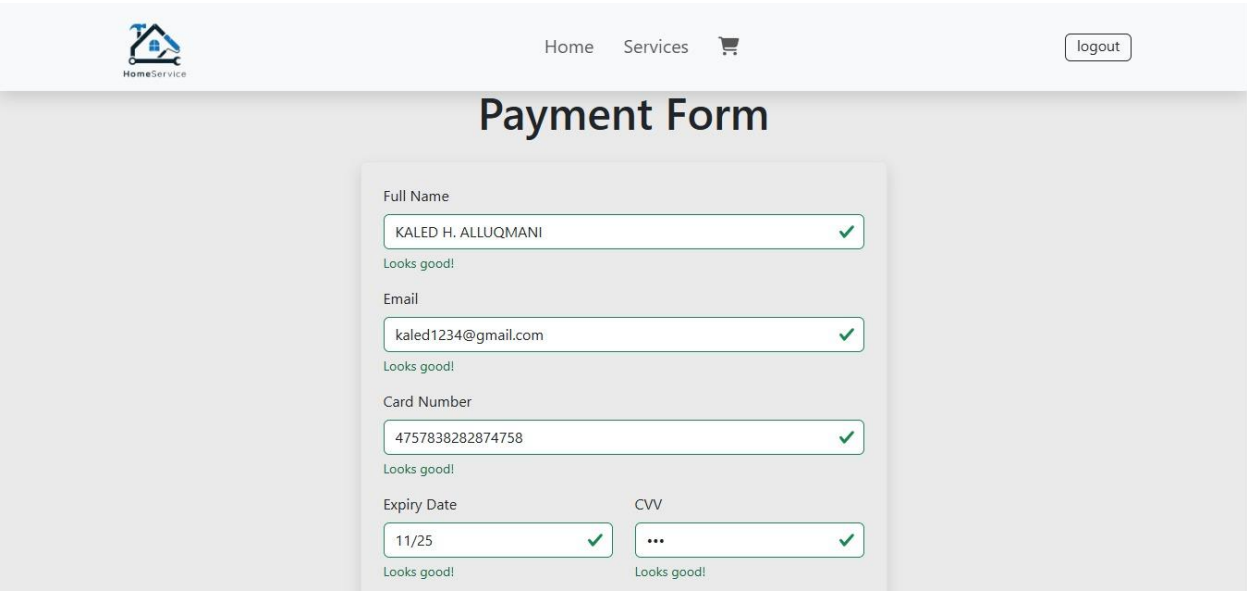

Figure 4.17 Fill in the payment page information

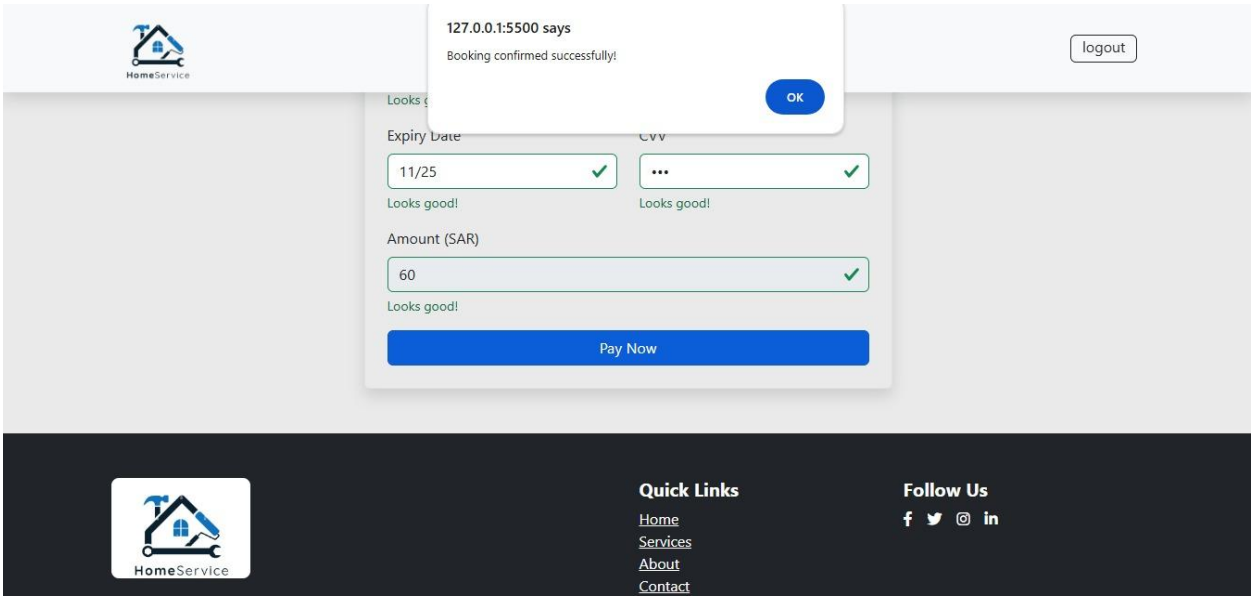

Figure 4.18 After confirming the payment process

Figure 4.19 View the user's upcoming appointments and reservations.

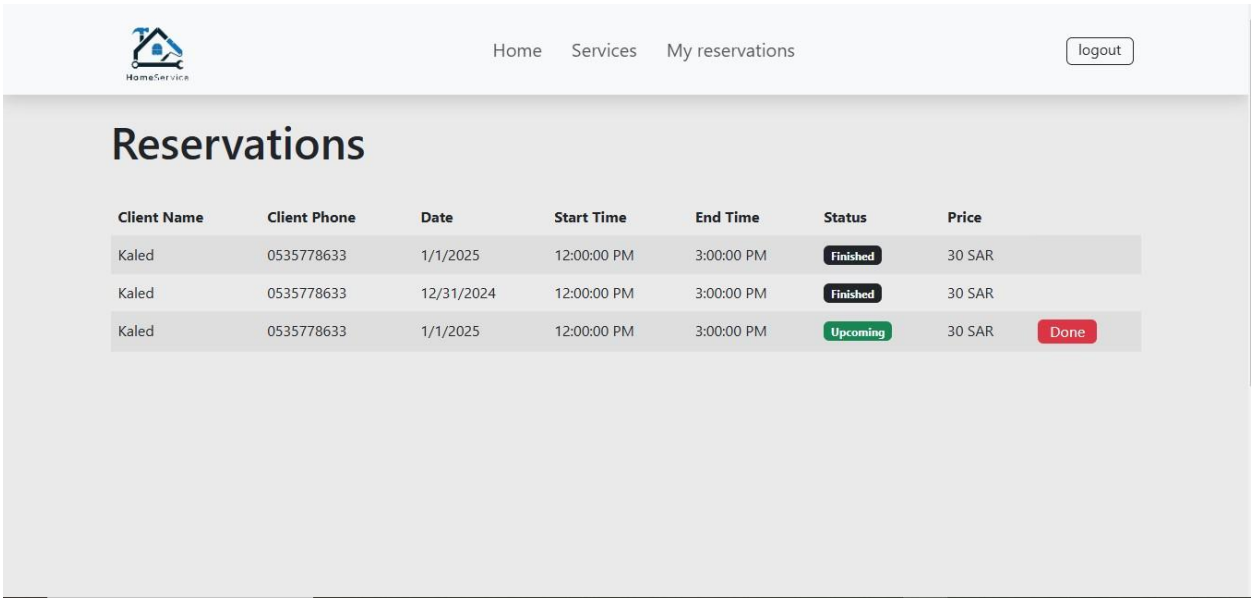

Figure 4.20 Login as technician, view the working hours and click Done, which means that the technician has completed the visit.

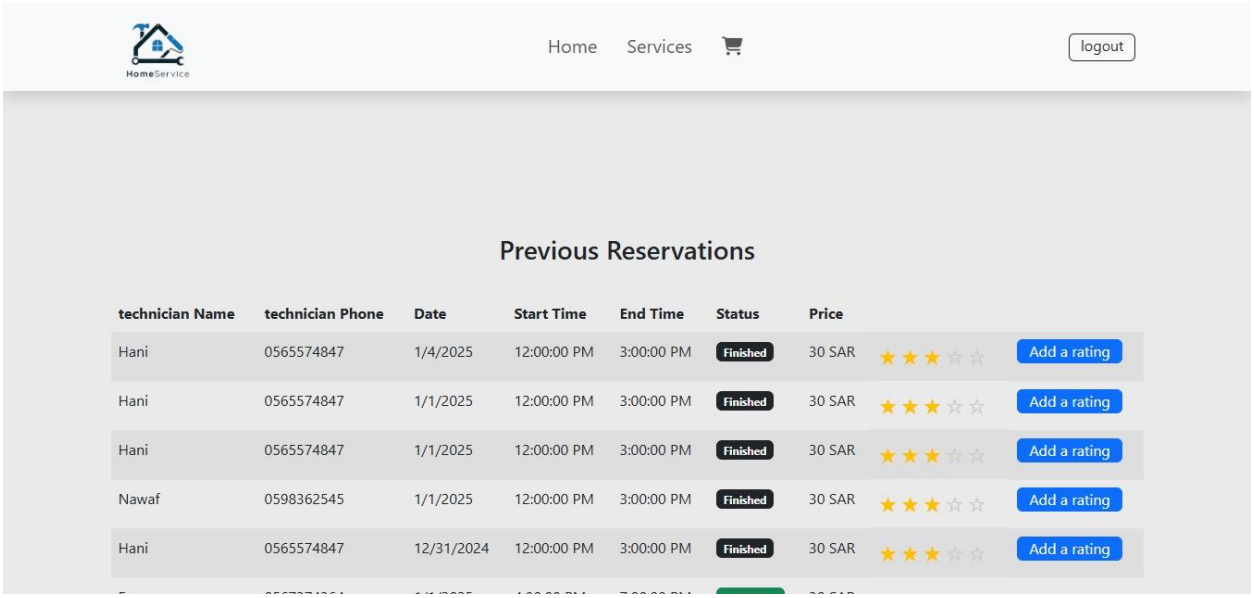

Figure 4.21 Then go back to the user page to evaluate the service.

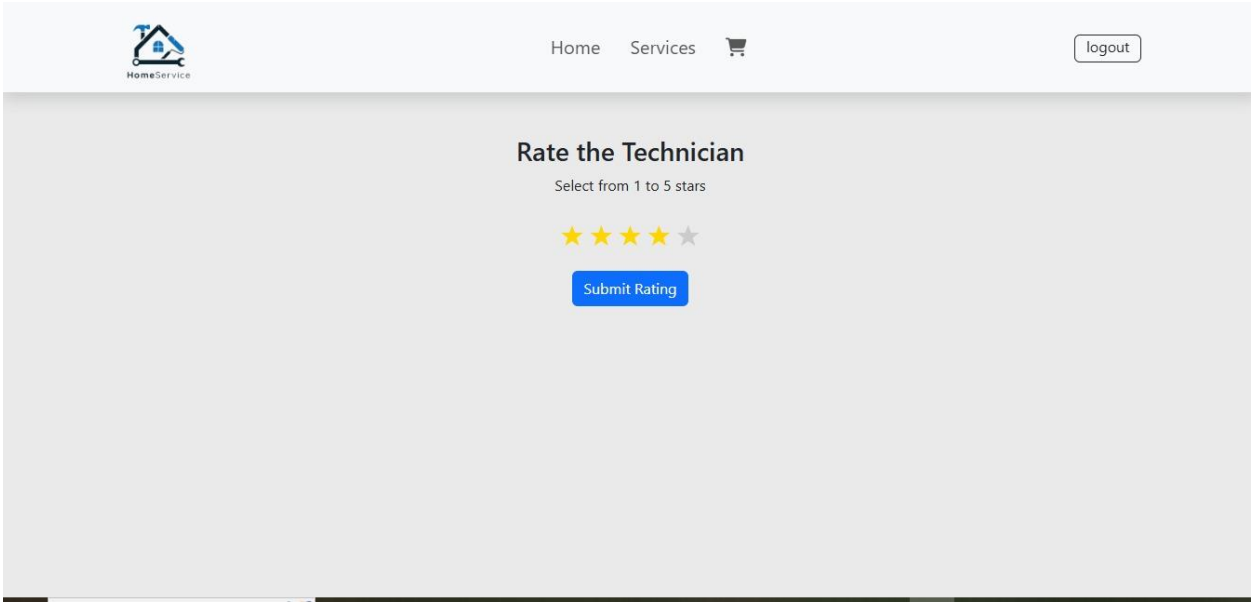

Figure 4.22 Rate the service and then click on Submit

Result and Analysis

The implementation of the Automated Home Service Management System has yielded significant improvements across various operational aspects. Scheduling conflicts, a persistent issue in traditional systems, thanks to the integration of a real-time scheduling algorithm. This enhancement ensured better resource utilization and minimized client inconvenience. Additionally, client satisfaction is attributed to enhanced service transparency and a user-friendly interface that simplified booking and tracking processes. Technician productivity also improved in daily task completion, enabled by optimized task allocation and better schedule management.

Addressed several critical inefficiencies in traditional home service operations. The system successfully eliminated scheduling conflicts by leveraging real-time scheduling algorithms, ensuring seamless resource allocation and improving client satisfaction. The enhanced transparency and intuitive interface provided clients with a streamlined booking and tracking experience, fostering greater trust and convenience. Technicians benefited from optimized task

allocation and better schedule management, enabling them to complete more tasks effectively while maintaining service quality.

When benchmarked against existing systems, the Automated Home Service Management System exhibited superior performance in terms of service delivery, customer retention, and operational reliability. This performance underscores its capability to meet the complex demands of users and service providers more effectively than traditional platforms.

Conclusion

The Automated Home Service Management System provides a transformative approach to addressing the systemic inefficiencies inherent in traditional home service management. By incorporating advanced features such as real-time scheduling, predictive analytics, and dynamic technician tracking, the system ensures a seamless and transparent service delivery process. The implementation and analysis validate its potential to improve operational efficiency and enhance the user experience through intelligent automation and data-driven decision-making. Furthermore, the system’s scalability and modularity position it as a benchmark for future advancements, including the integration of artificial intelligence and IoT to further refine predictive capabilities and operational performance. This research underscores the critical role of technology in modernizing service industries and sets a foundation for continued innovation in this domain.

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