
An-Najah National University

Faculty of Engineering & Information Technology Presented in partial

Fulfillment of the requirements for Bachelor

Degree in Computer Engineering

Graduation Project 1

# Smart Hospital Enhancement System

# (SHES)


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**Supervisor:**

Eng. Muhannad AL-Jabi

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## Acknowledgment:

Praise be to Allah, the Lord of the Worlds, who granted us the strength, patience, and knowledge to complete this graduation project.

We would like to extend our heartfelt gratitude to our families, whose continuous encouragement and unwavering support were a source of strength throughout this journey.

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We are deeply thankful to our supervisor, Eng. Muhannad Al-Jabi, for his valuable guidance, insightful feedback, and continuous motivation that enriched our project and contributed greatly to its success.

We also thank our friends and colleagues who supported us during the development of the Smart Hospital Enhancement System (SHES)**,** whether through collaboration, reviews, or moral support. This achievement is the result of a collective effort, and we are truly grateful to everyone who contributed to it.

## Disclaimer:

This report was written by students Amer Hatem and Sami Haji at the Computer Engineering Department, Faculty of Engineering and Information Technology, An-Najah National University. It has not been altered or corrected beyond basic editorial adjustments, and it may contain language or content errors. The views, results, and recommendations presented in this report are solely those of the authors.

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# Abstract:

Healthcare institutions today face growing operational challenges such as inefficient patient scheduling, delayed decision-making for administrative approvals, and the lack of structured performance evaluation systems for medical staff. These challenges often lead to longer patient wait times, supply shortages, increased hospital costs, and reduced quality of care.

The Smart Hospital Enhancement System (SHES) is a web-based platform designed to modernize hospital operations through AI-powered automation, real-time data tracking, and streamlined workflows. SHES complements existing Hospital Information Systems (HIS) by acting as a modular enhancement layer that focuses on improving five core domains: appointment scheduling, doctor performance tracking, leave management, and patient interaction.

Unlike traditional hospital systems that prioritize administrative users, SHES actively involves patients by providing them with access to their medical history, appointment schedules, AI-based preliminary diagnosis tools, and feedback mechanisms. The system also allows hospital supervisors to monitor doctor workload, manage leave requests, and ensure fair patient-doctor distribution using intelligent algorithms.

This project delivers a robust and scalable hospital management enhancement system that includes:

- Smart appointment scheduling with fallback recommendations when doctors are unavailable.
- A performance scoring system that evaluates doctors based on feedback, efficiency, and punctuality.
- An automated leave request and approval workflow to reduce delays.
- A responsive user interface for patients, doctors, supervisors, and administrators.

By addressing the inefficiencies of traditional hospital management systems, SHES aims to provide a modern, patient-centered, and data-driven solution that enhances overall hospital performance and improves the quality of healthcare delivery.

# Chapter 1:

# Introduction:

## 1.1 General Background

Hospitals in Palestine still operate using traditional or semi-digital systems that struggle to keep up with the growing demands of modern healthcare. Critical areas such as appointment scheduling, doctor availability, leave management, and patient follow-up are often handled manually or inefficiently. These limitations result in scheduling errors, delayed responses, excessive administrative workload, and poor communication between staff and patients.

To address these issues, the Smart Hospital Enhancement System (SHES) was developed as a standalone software solution that integrates seamlessly with existing hospital infrastructures. SHES leverages intelligent algorithms and AI-based features to streamline hospital operations, enhance doctor performance management, and improve patient experience—all without replacing the existing Hospital Information System (HIS)

## 1.2 Objectives

The aim of SHES is to simplify hospital operations by providing intelligent tools that reduce manual intervention and improve workflow efficiency. It seeks to automate appointment scheduling, minimize delays through AI-assisted suggestions, and allow patients to analyze their symptoms before visiting a doctor. The platform also supports tracking doctor performance using structured metrics such as punctuality and patient feedback, and digitizes leave requests through a streamlined approval process. By offering dedicated interfaces and real-time notifications, SHES enhances collaboration between hospital users and improves overall service quality

## 1.3 Organization of the Report

This report begins with a review of the theoretical background and related hospital systems in Chapter 2. Chapter 3 covers the development methodology and the technologies used to build SHES. Chapter 4 details the design aspects, including the database schema, system diagrams, and interface components. Chapter 5 presents the implementation results and discusses key challenges and outcomes. Chapter 6 introduces suggested improvements and possible future extensions. Finally, Chapter 7 provides a conclusion with a summary of what has been learned and achieved throughout the project.

# Chapter 2

# Theoretical Background and Previous Work

## 2.1 Theoretical Background

### 2.1.1 Smart Healthcare Platforms

Modern healthcare platforms are evolving to become more intelligent and responsive. Unlike legacy Hospital Information Systems (HIS) that mainly focus on storing patient data and managing internal documentation, smart platforms like SHES incorporate real-time decision-making tools, AI-based features, and direct interaction with patients and staff. These systems focus on improving hospital flow and empowering users to access relevant data and services without administrative bottlenecks.

### 2.1.2 Digital Systems in Healthcare

The rise of digital transformation in healthcare has enabled institutions to adopt technologies such as web portals, cloud-based databases, AI tools [4], and mobile interfaces to streamline hospital operations. Digital systems have been especially valuable in areas like appointment management, patient feedback collection, and doctor evaluation. SHES is designed to leverage these advancements by providing a responsive, real-time platform that connects all users through structured digital workflows.

### 2.1.3 User-Centered Design in Hospital Interfaces

User Experience (UX) design is a critical factor in the success of healthcare applications. In SHES, the design process focused on usability, accessibility [5], and clarity for all user roles. The system's interface is role-specific—ensuring doctors, patients, supervisors, and administrators each interact with tailored dashboards. The goal is to reduce cognitive load, prevent errors, and improve overall satisfaction through a clean, intuitive design. By prioritizing patient interaction, real-time feedback, and visual simplicity, SHES enhances user engagement across the system.

## 2.2 Previous Work and Literature Review

Numerous studies have been conducted on the digital transformation of healthcare systems, particularly in the areas of smart scheduling, patient engagement, and workflow automation. As hospitals continue to adopt technology-driven solutions, the focus has shifted from simple data management to intelligent systems that actively support clinical and administrative decision-making.

Several academic and industrial projects have explored the integration of AI and automation into hospital workflows. Research highlights the importance of user-centered systems that provide real-time interaction between patients and medical staff. Systems such as Electronic Medical Records (EMRs) and Hospital Information Systems (HIS) primarily focus on record-keeping but often lack features that support intelligent recommendations, patient self-service, and dynamic workflow management. This gap creates opportunities for enhancement platforms like SHES, which are designed to operate alongside traditional systems without replacing them.

The concept of smart scheduling has been a central topic in recent healthcare research. Intelligent scheduling algorithms have been shown to reduce waiting times, balance doctor workload, and improve resource utilization. Studies also emphasize the role of fault-tolerant scheduling systems that suggest alternative times or available staff based on real-time data—an approach integrated into SHES to prevent appointment conflicts and improve patient access.

In addition, literature has highlighted the growing need for structured doctor performance monitoring systems. Previous work supports the use of quantitative and qualitative metrics—such as patient feedback, punctuality, and case load—to assess doctor efficiency. These insights informed the design of SHES's scoring system, which helps supervisors monitor performance trends and make data-driven decisions.

User experience (UX) also plays a critical role in healthcare platforms. Research stresses the importance of clean interfaces, role-specific views, and easy navigation to reduce human error and increase satisfaction. Systems that apply visual hierarchy, accessibility standards, and responsive design principles tend to achieve higher usability scores. SHES was designed with these principles in mind, offering dedicated interfaces for patients, doctors, supervisors, and admins.

Overall, while various hospital systems address data storage or clinical documentation, few have achieved a cohesive solution that includes intelligent scheduling, AI-powered symptom analysis, role-based dashboards, and automated approval workflows—all of which SHES aims to unify in one platform.

Mobile healthcare applications have become an essential component of digital hospital ecosystems. However, many development teams overlook critical accessibility and usability principles, especially for mobile interfaces. In healthcare, ensuring accessibility is even more important due to the diversity of users, including elderly patients and those with disabilities. The SHES platform addresses this by adopting responsive design and role-specific interfaces that are optimized for both desktop and mobile devices, providing a seamless and intuitive experience across screen sizes and user types.

The COVID-19 pandemic accelerated the digital transformation of healthcare, highlighting the need for remote services, virtual appointments, and mobile patient engagement. With smartphones and tablets becoming primary tools for accessing health services, platforms like SHES must ensure high performance, reliability, and accessibility for mobile users. This includes designing with touch interactions, clear visual layouts, and mobile-friendly features such as notifications and simplified scheduling.

Additionally, as digital healthcare platforms handle sensitive personal and medical information, robust data protection is crucial. SHES incorporates secure authentication mechanisms such as JWT tokens,[1] encrypted password storage using Bcrypt, and role-based access controls to prevent unauthorized access. The system follows best practices in web security, including HTTPS enforcement, protection against injection attacks, and regular validation of user input to safeguard against vulnerabilities.

By integrating accessibility principles, mobile responsiveness, and strong security frameworks, SHES aims to deliver a healthcare platform that not only meets the operational needs of hospitals but also complies with modern standards of usability, privacy, and user trust.

# Chapter 3

# Methodology

In this chapter, we provide a comprehensive overview of the development approach followed in building the Smart Hospital Enhancement System (SHES). The system was developed to support multiple user roles, including doctors, patients, supervisors, and administrators, each of whom interacts with the platform in a different context. The solution was designed as a full-stack web and mobile application using modern tools that ensure scalability, maintainability, and security. This chapter outlines the tools, technologies, and design decisions used during implementation, along with the structure of the interfaces developed for both web and mobile platforms.

## 3.1 Standards and Specifications

The SHES platform was developed using modern, reliable technologies to ensure scalability and efficiency. The web interface was built using React, while the mobile app was created with React Native to support both Android and iOS from a single codebase.

For the backend, we used ASP.NET Core (C#) with Entity Framework Core and the Code-First approach, and we followed the principles of Clean Architecture [2] to maintain separation of concerns and improve testability and maintainability. Communication between frontend and backend was implemented via RESTful APIs, and development was carried out using Visual Studio and Visual Studio Code.

## 3.2 Security used in the project

To protect sensitive health data, SHES implements several key security measures. JWT tokens are used for user authentication and secure API access, while Bcrypt encrypts passwords before storing them in the database.

Frontend route protection ensures users only access authorized pages based on their roles. The backend enforces role-based authorization to control access to system features and data.

## 3.3 Diagram

### 3.3.1 ERD Diagram

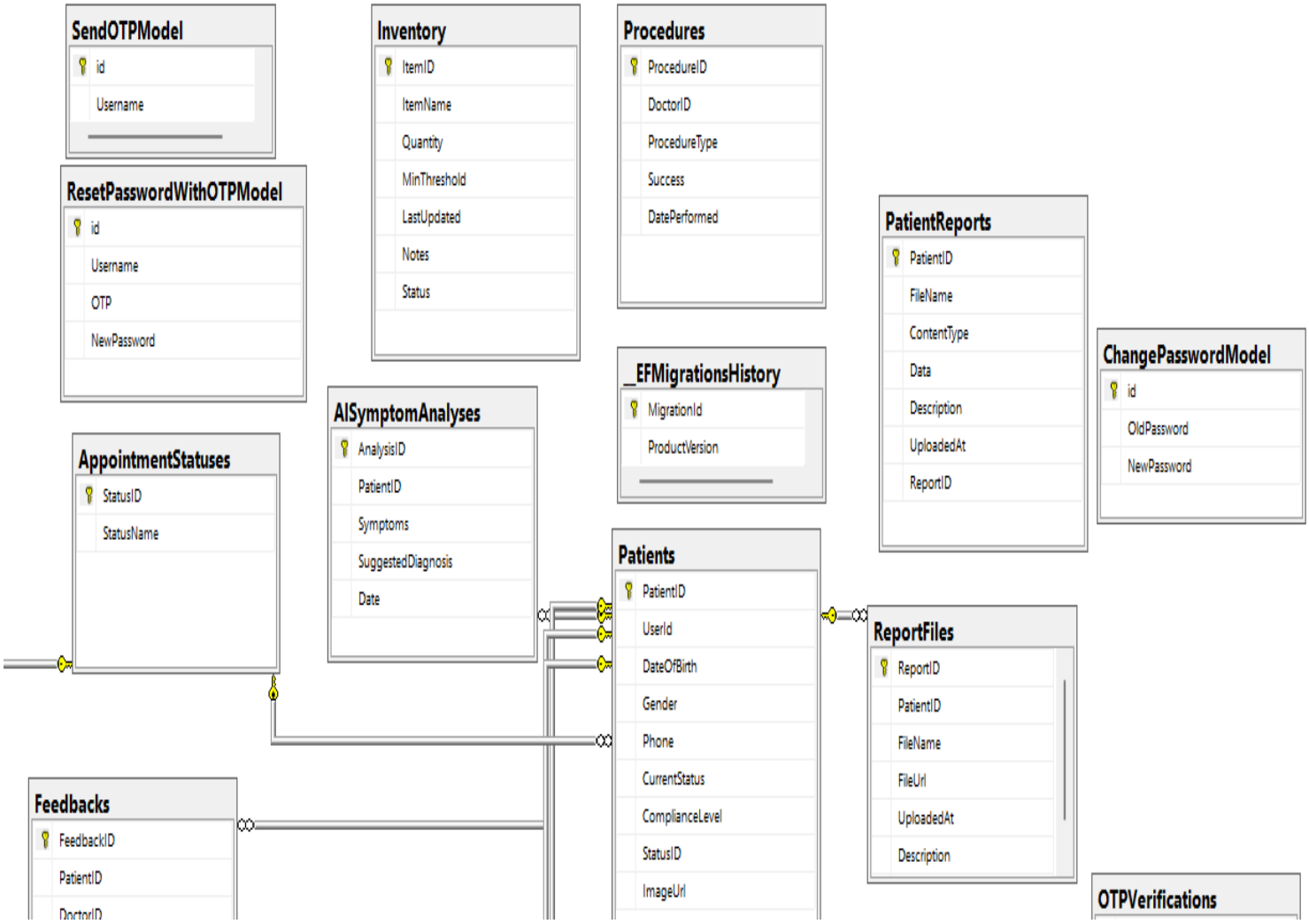


*Figure 3.1: ERD1 Diagram*

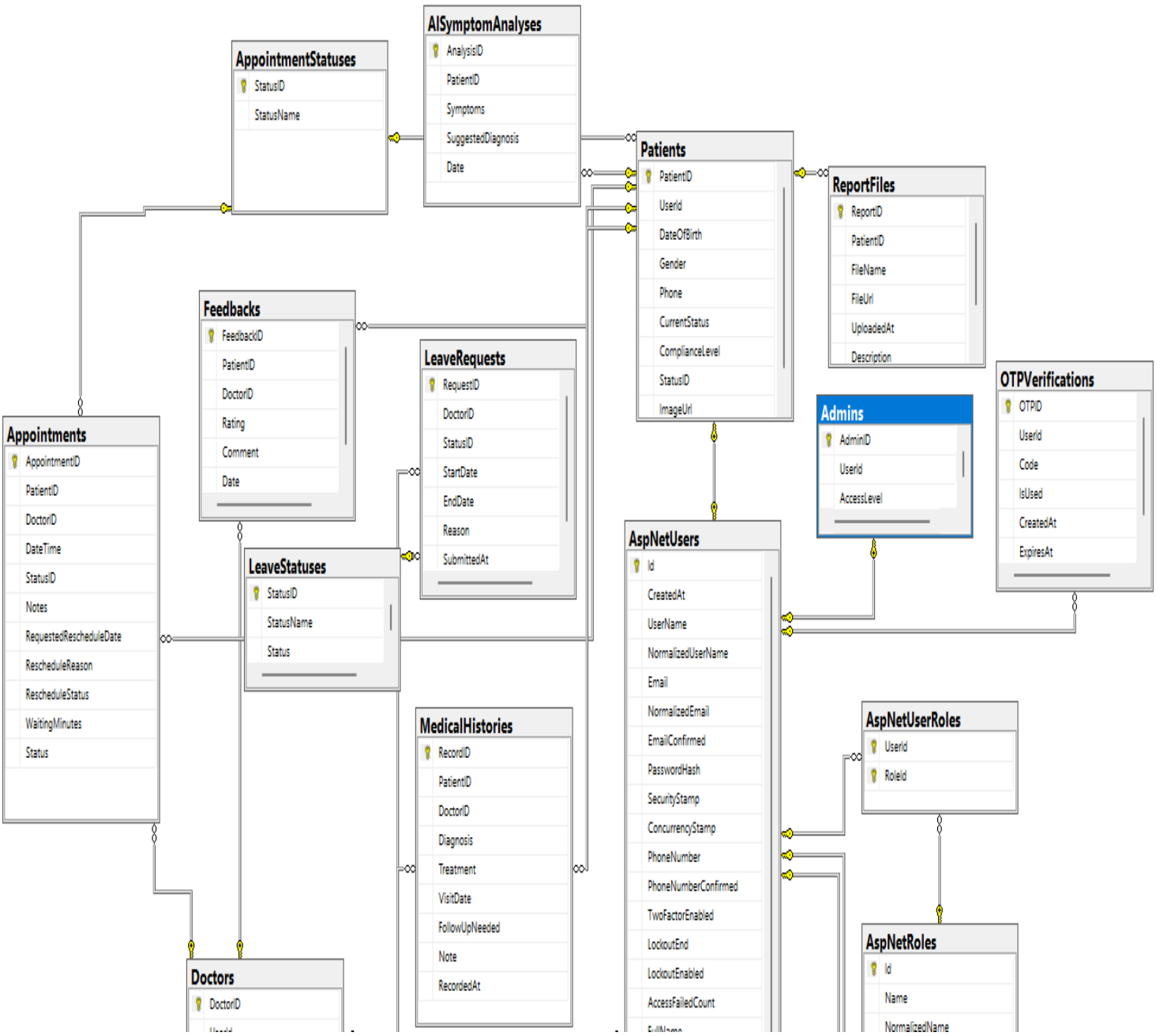


*Figure 3.2: ERD2 diagram*

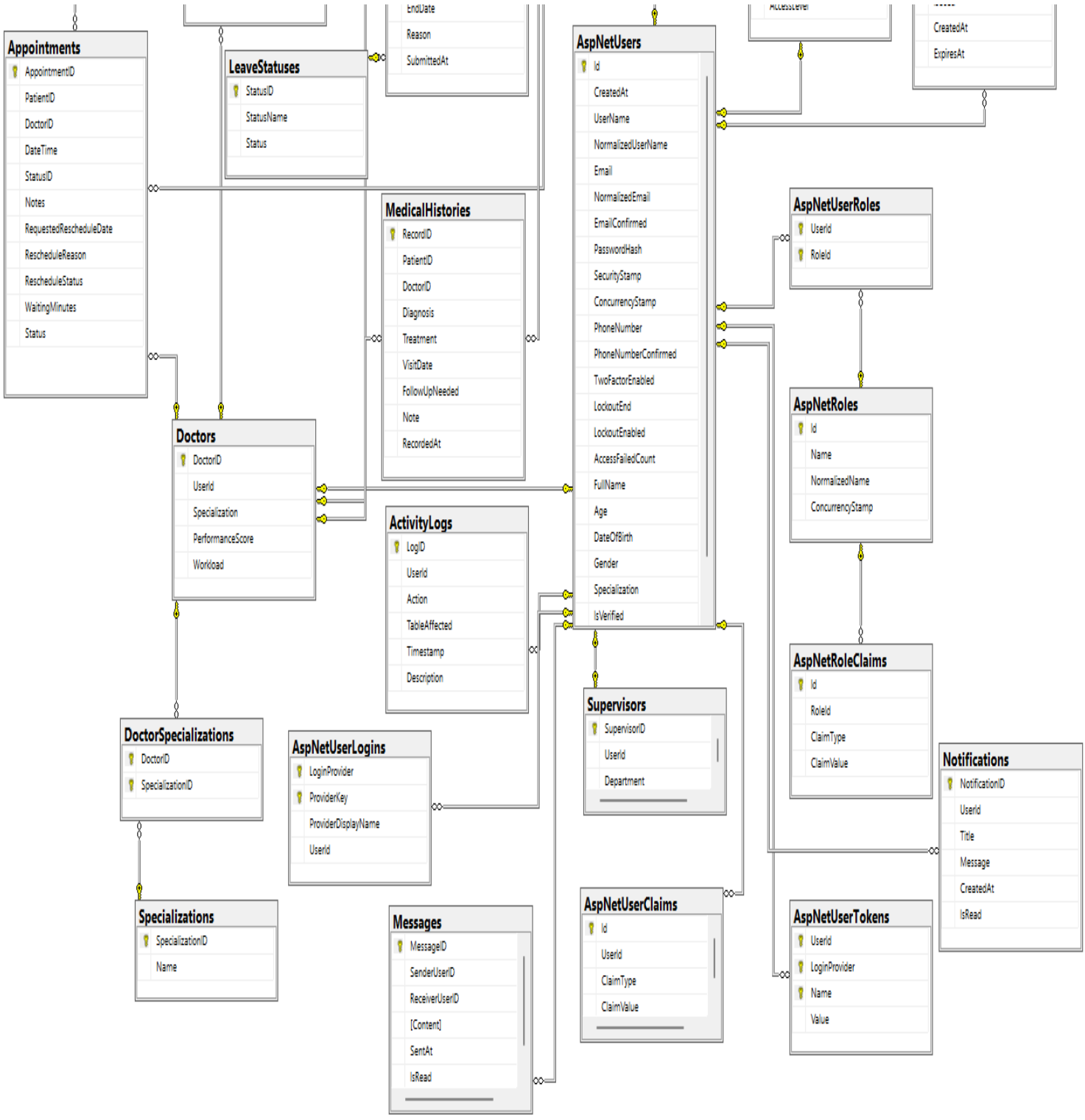


*Figure 3.3: ERD3 diagram*

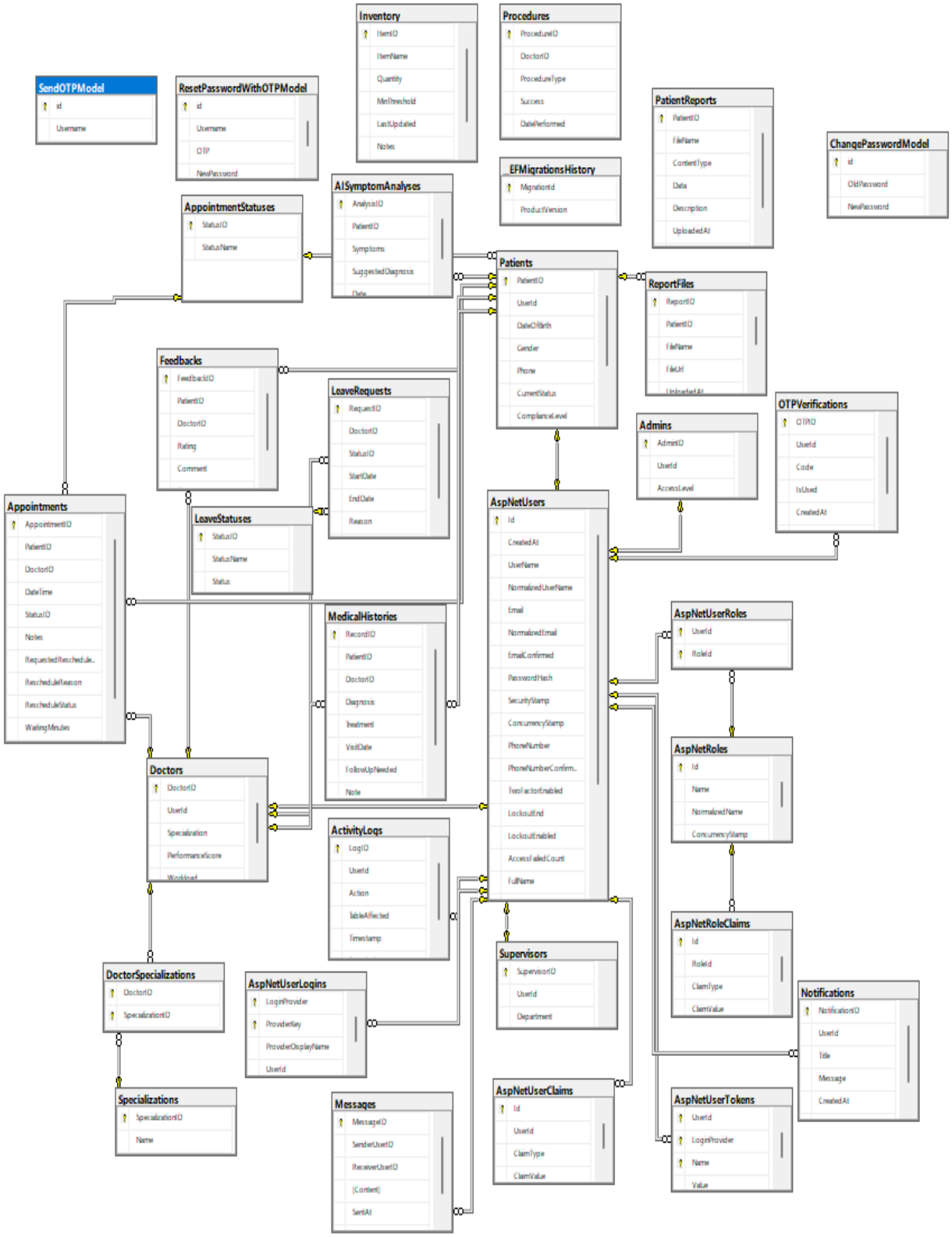


*Figure 3.4: ERD diagram*

## 3.4 User Interface Overview

### 3.4.1 WEB

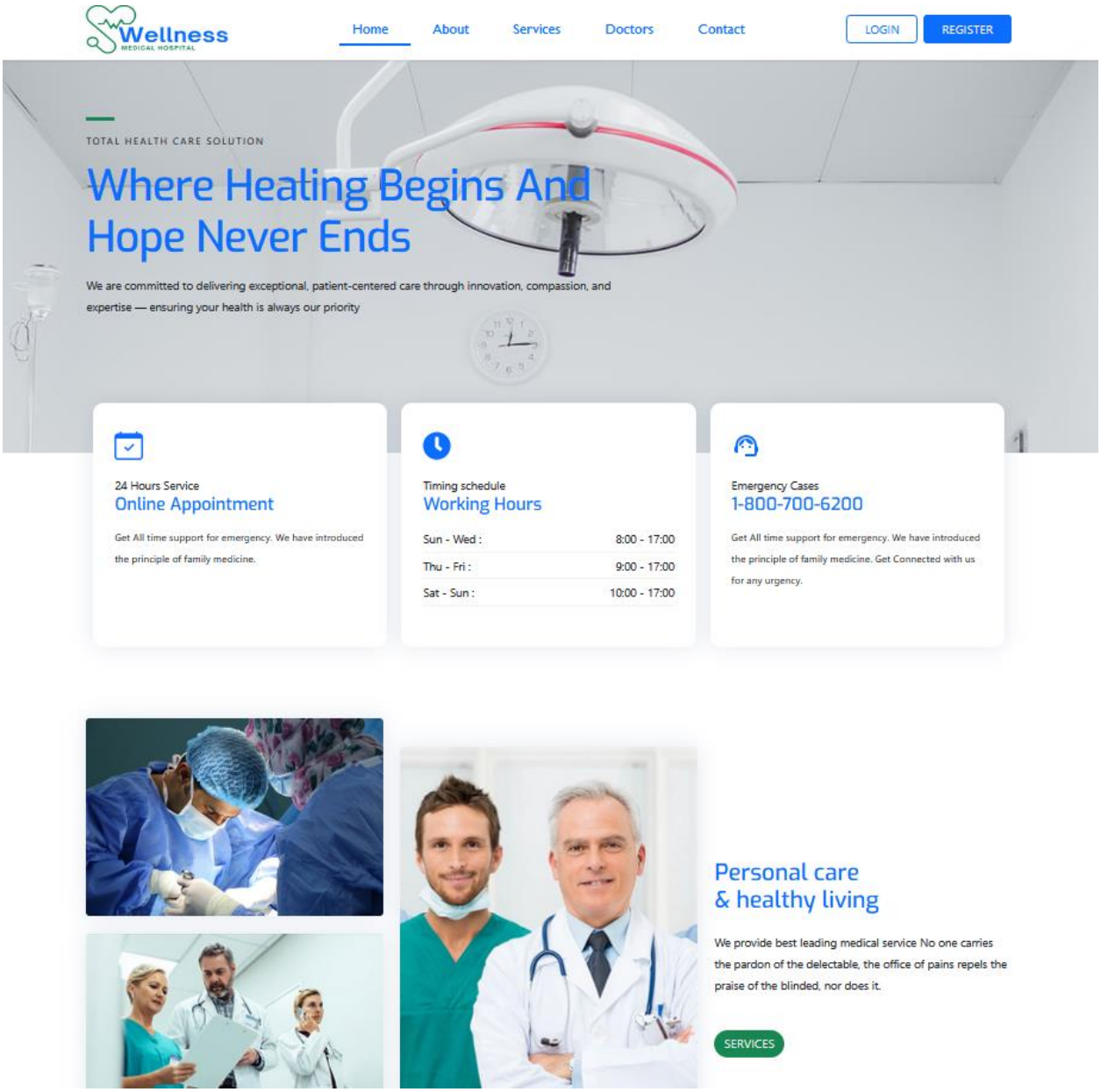


*Figure 3.5.1: Home Page*

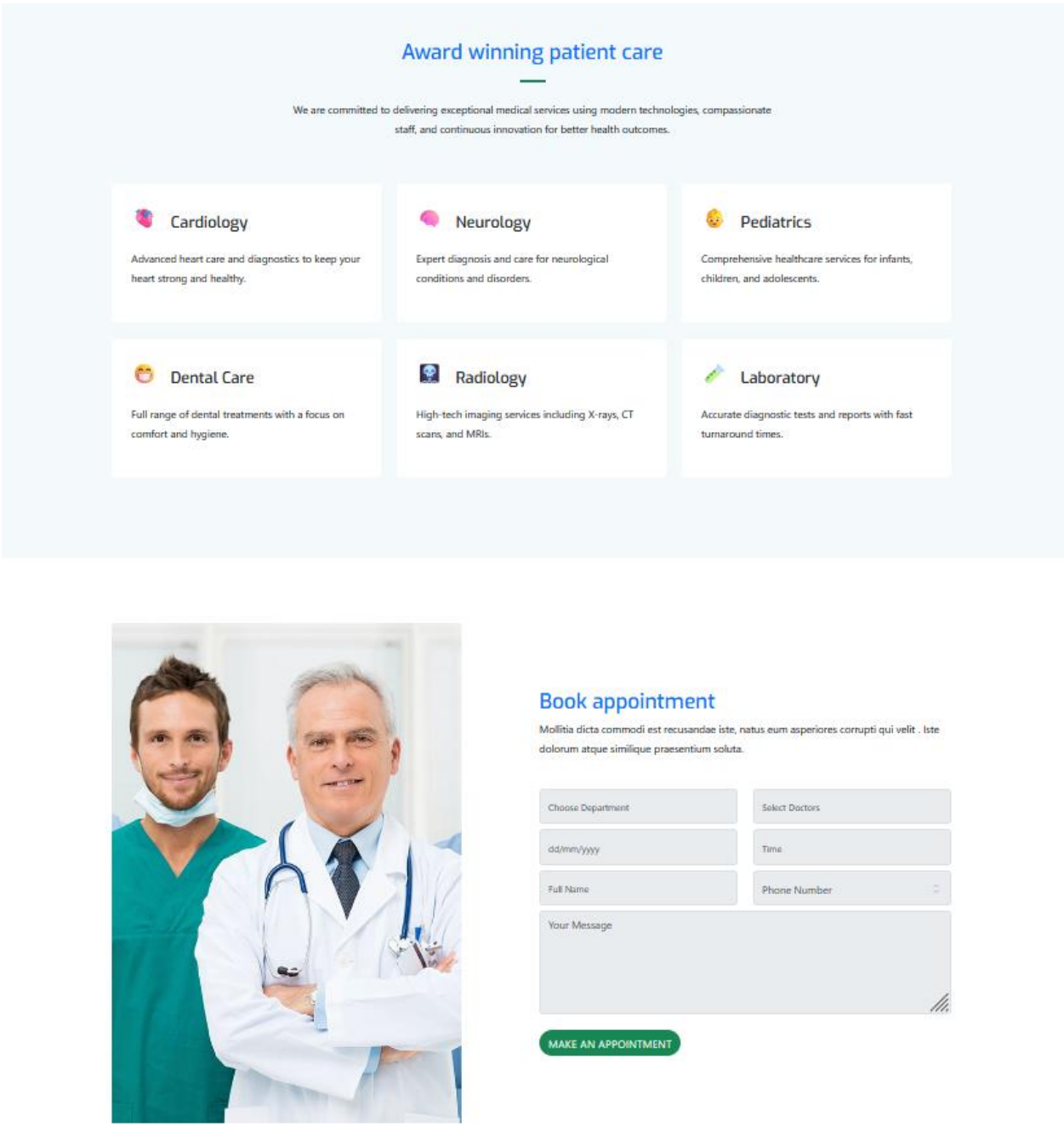


*Figure 3.5.2: Home Page*

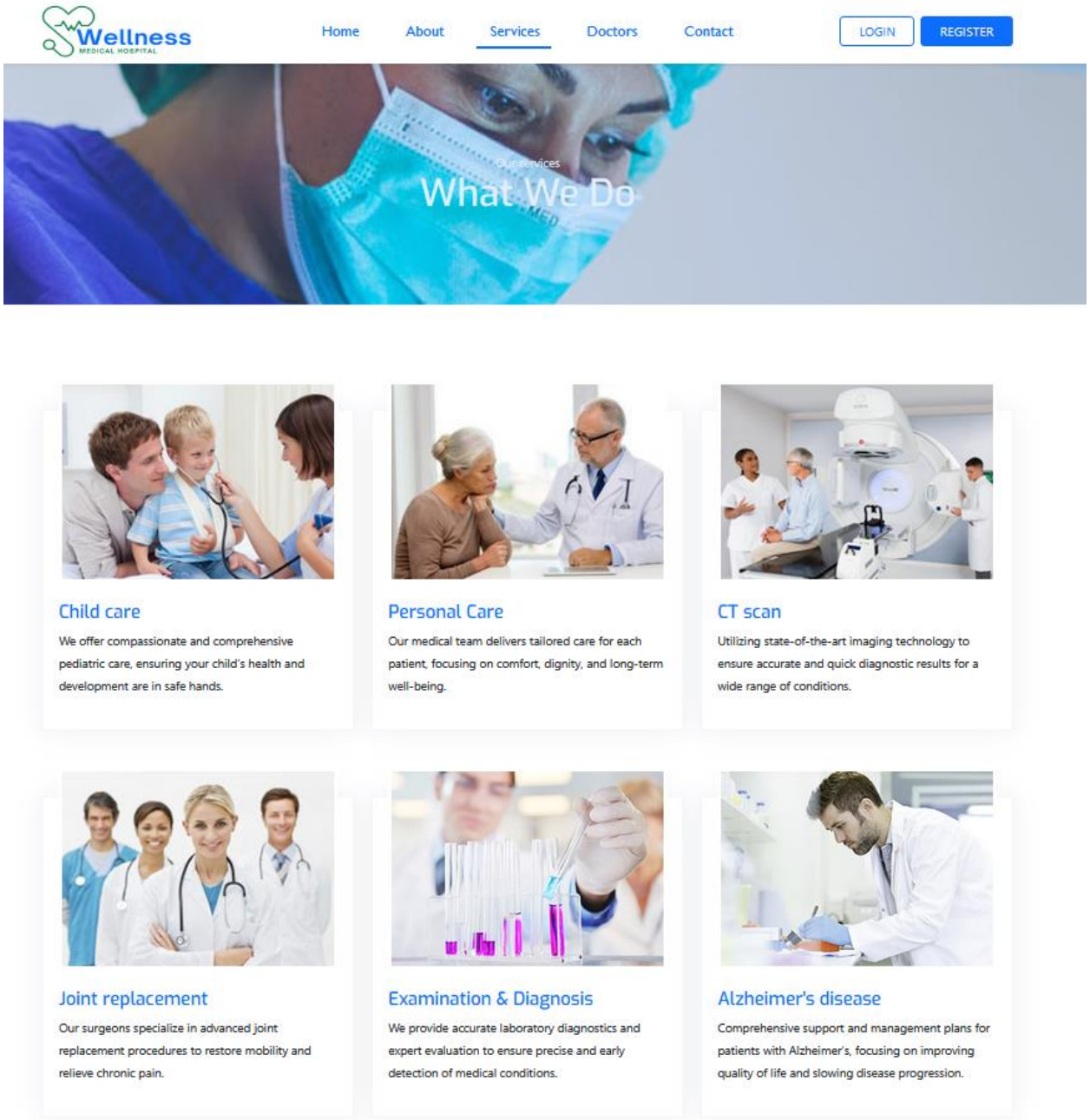


*Figure 3.6: Services Page*

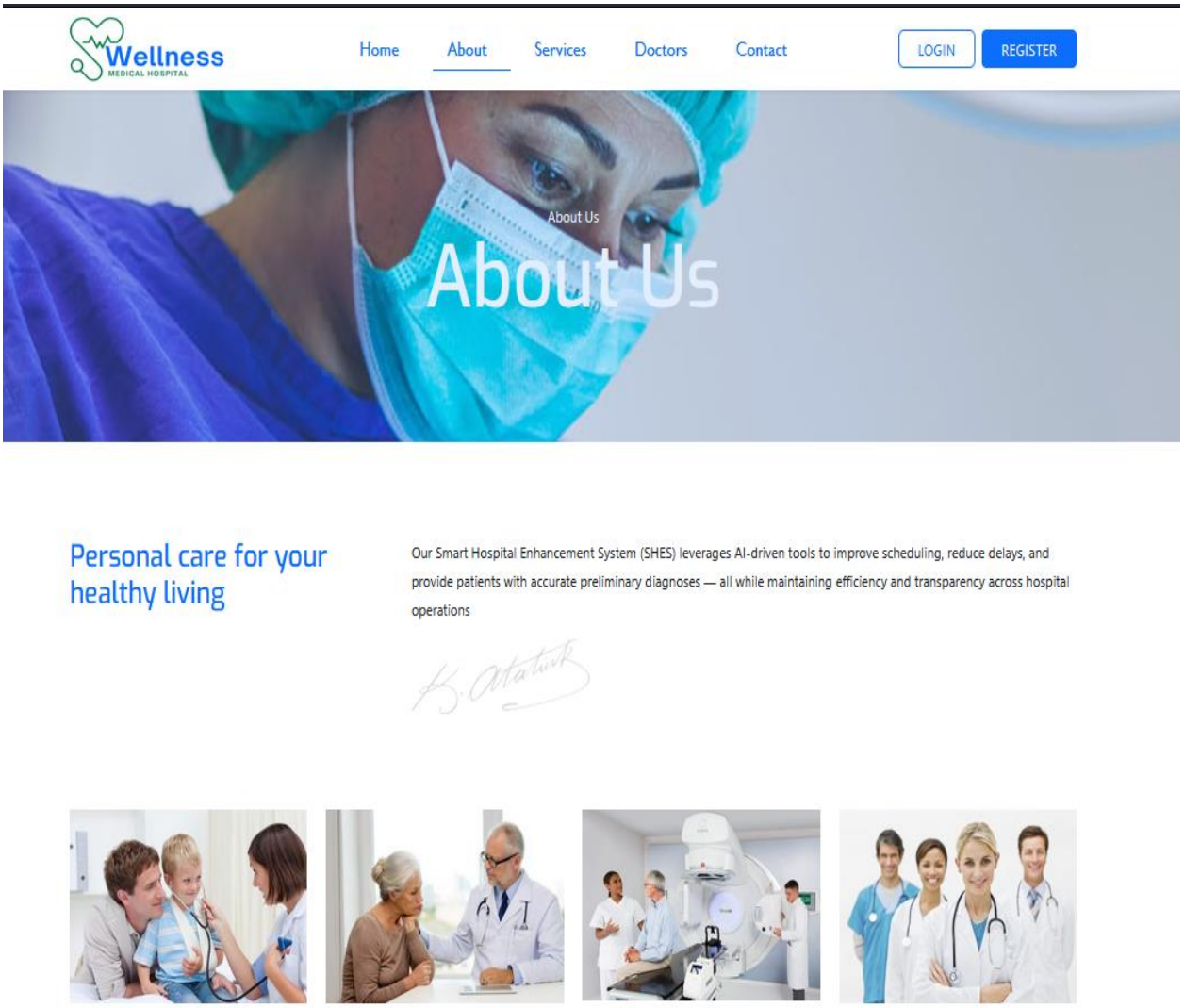


*Figure 3.7:About Page*

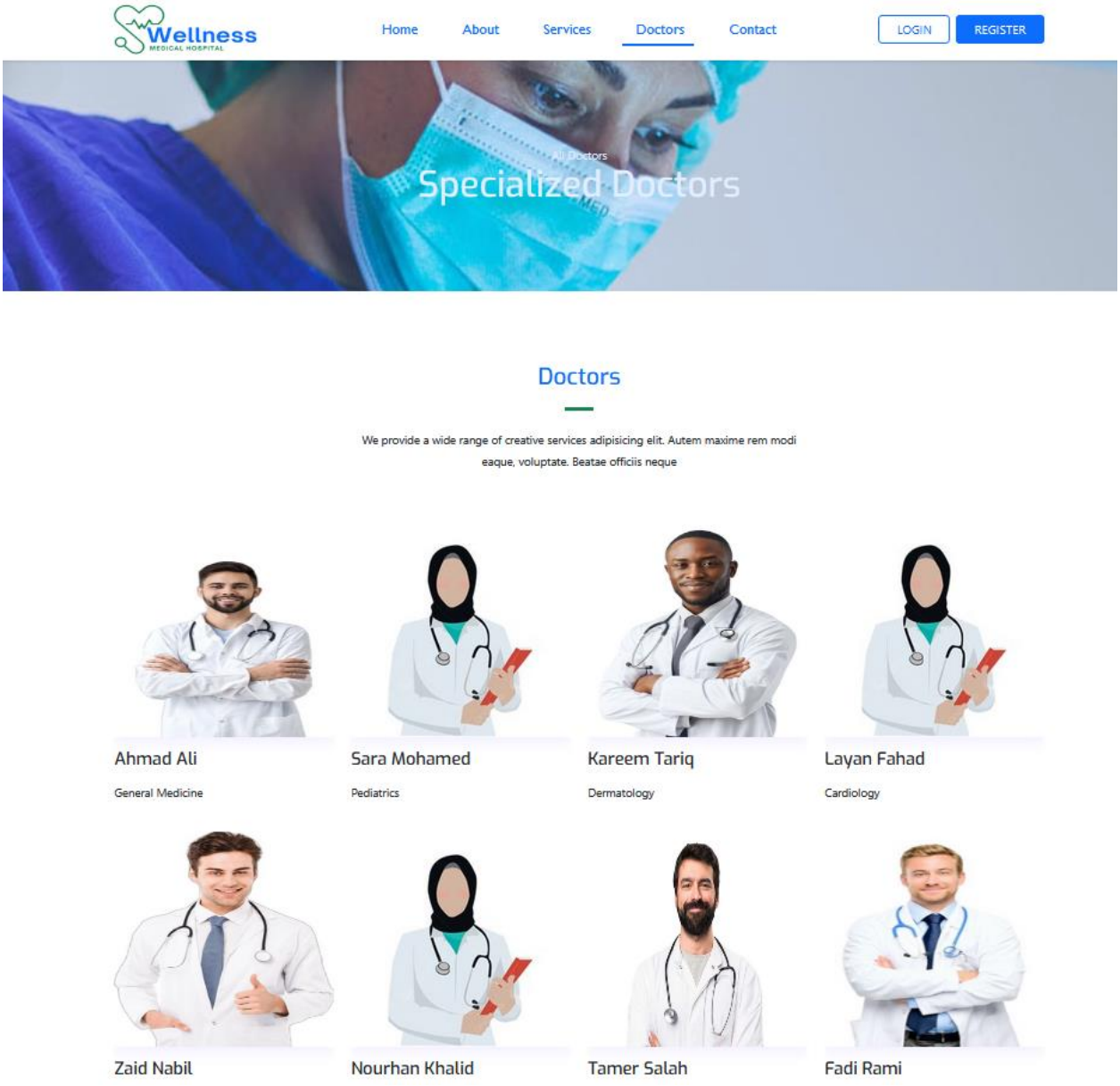


*Figure 3.7.1:Doctors Page*

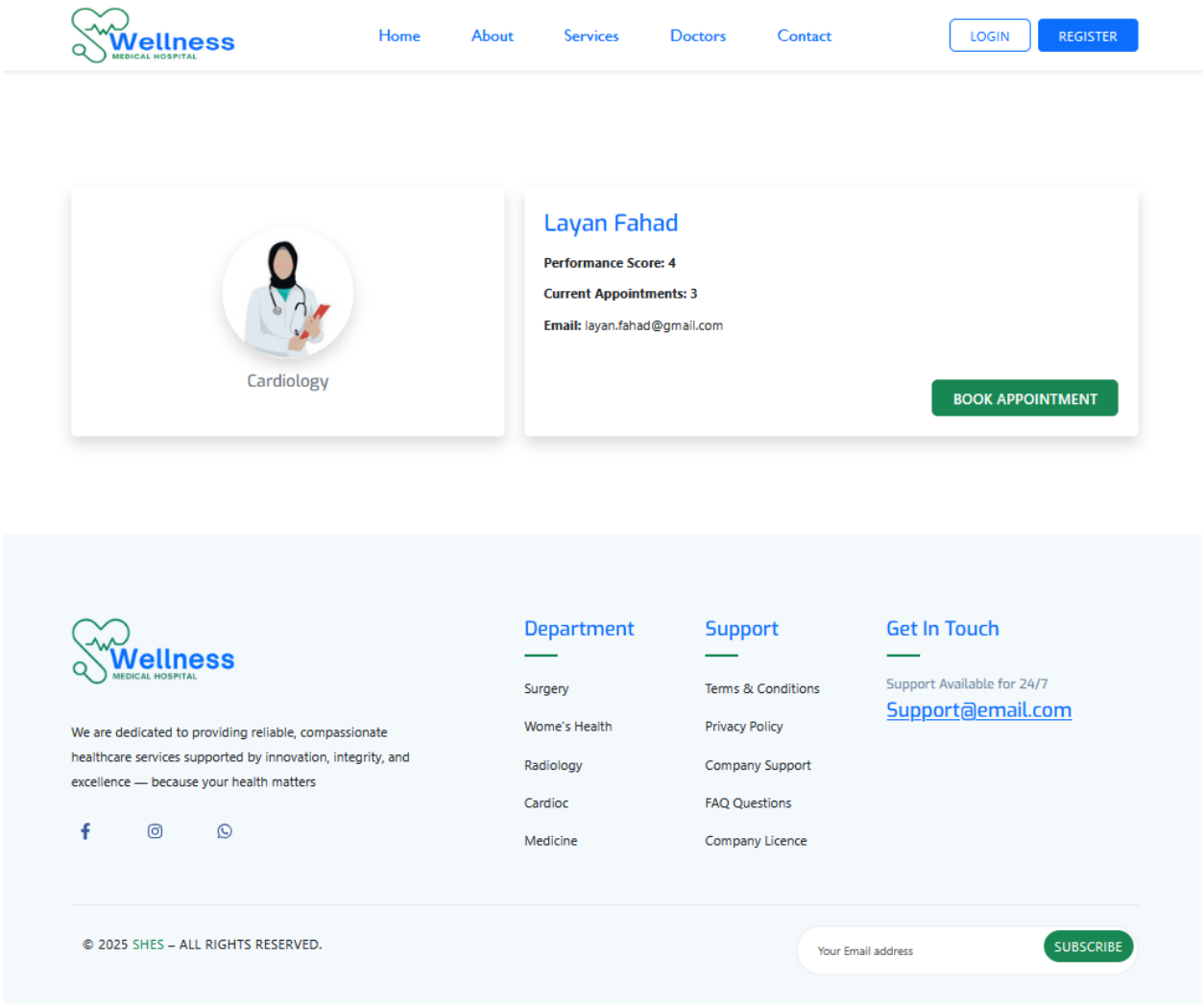


*Figure 3.7.2: Doctors Page*

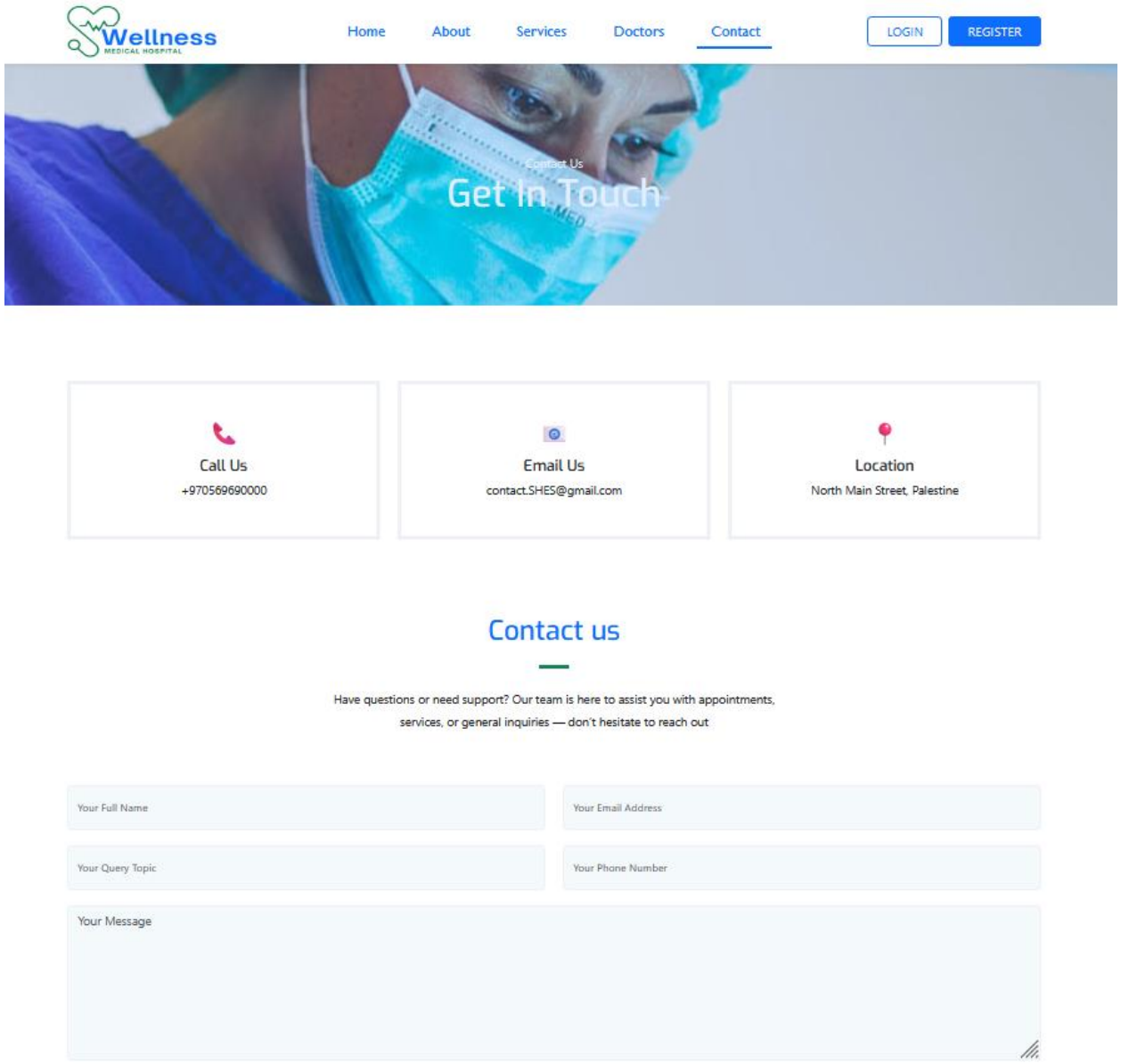


*Figure 3.7.3:Contact Page*

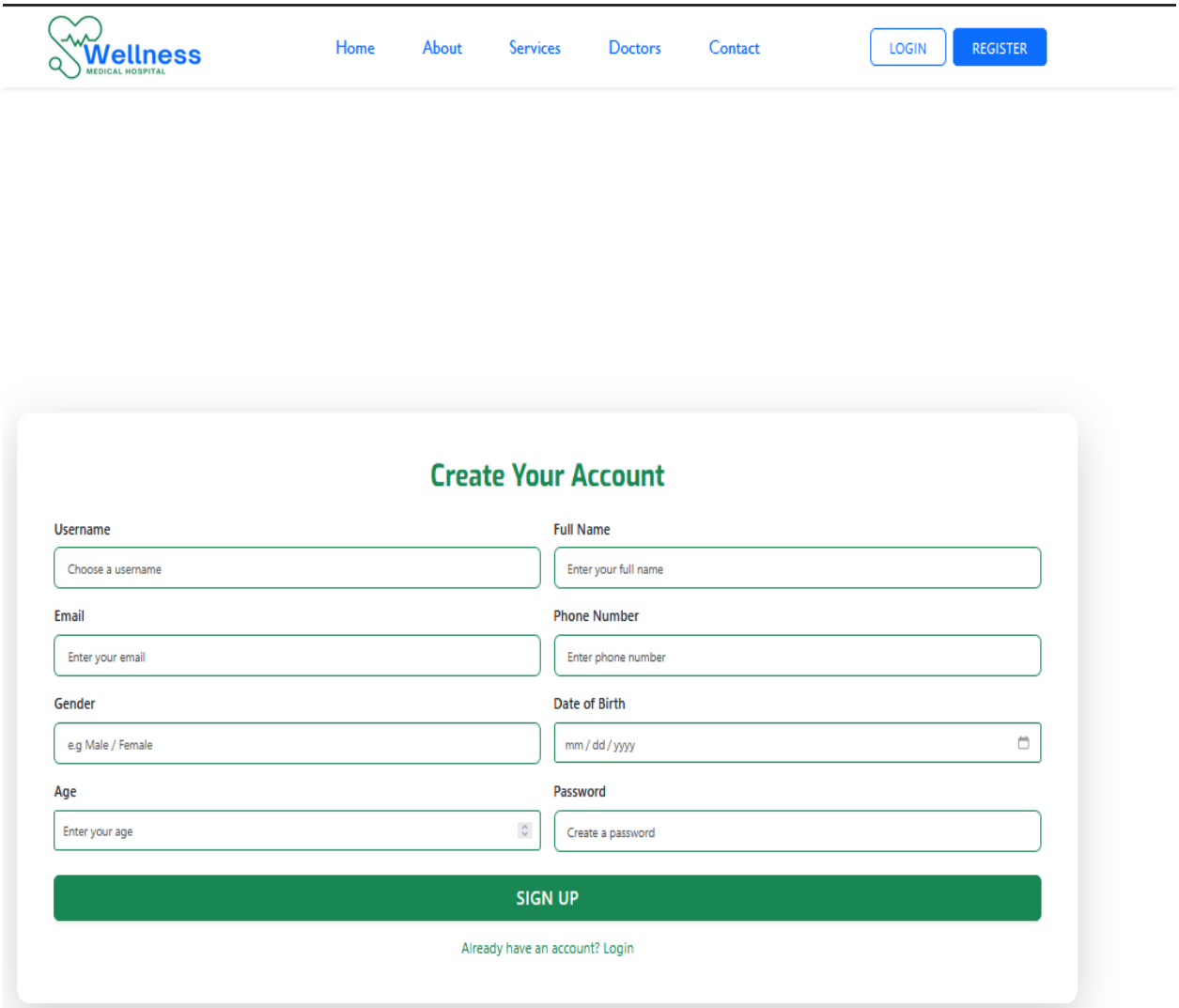


*Figure 3.8: Register Page*

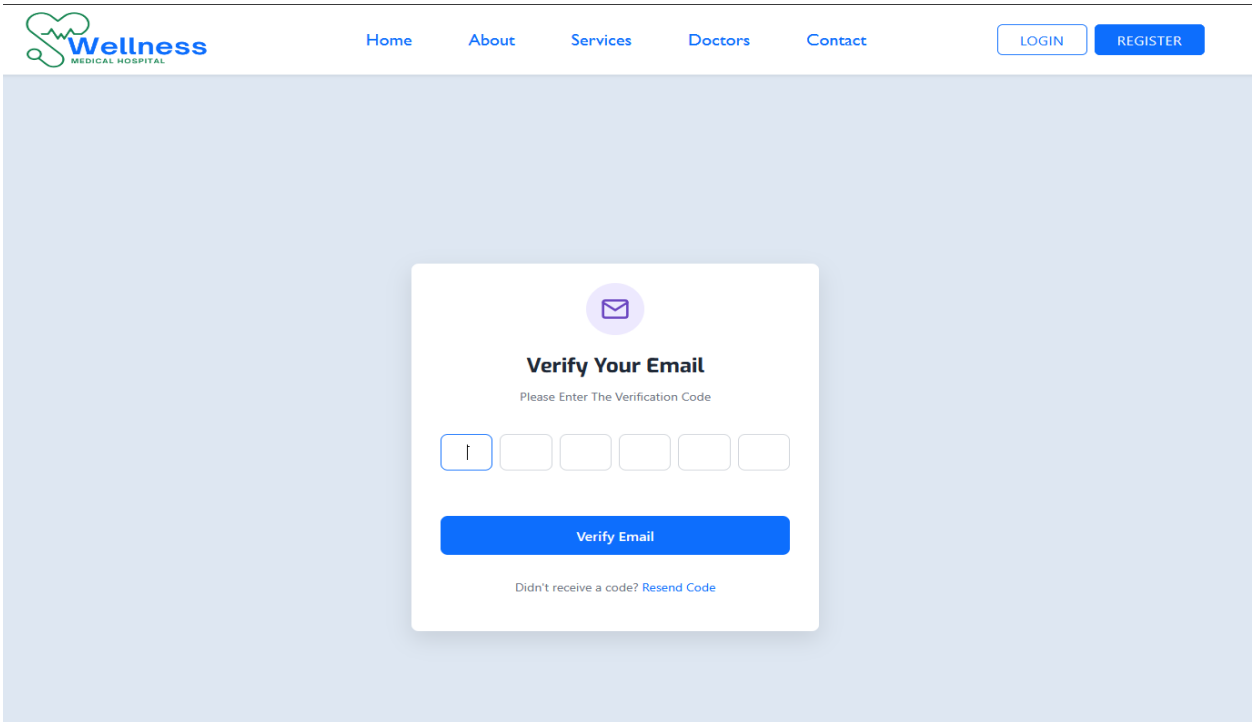


*Figure 3.9: Verify Email Page*

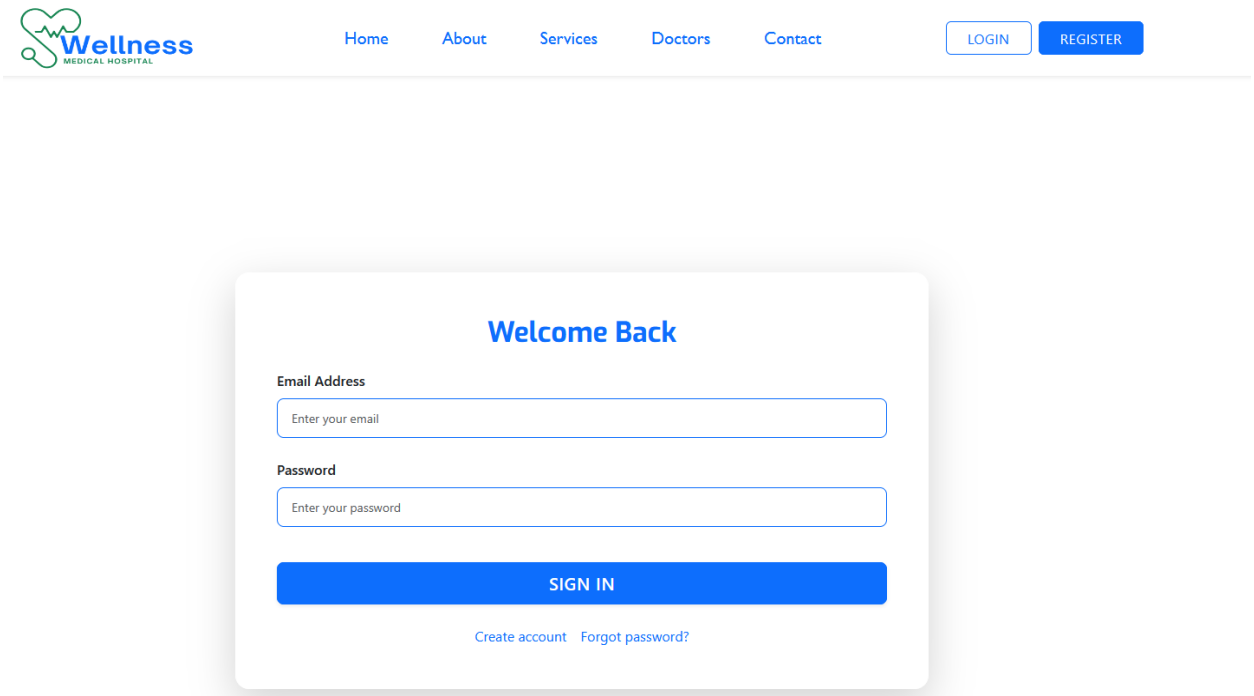


*Figure 3.10: Login Page*

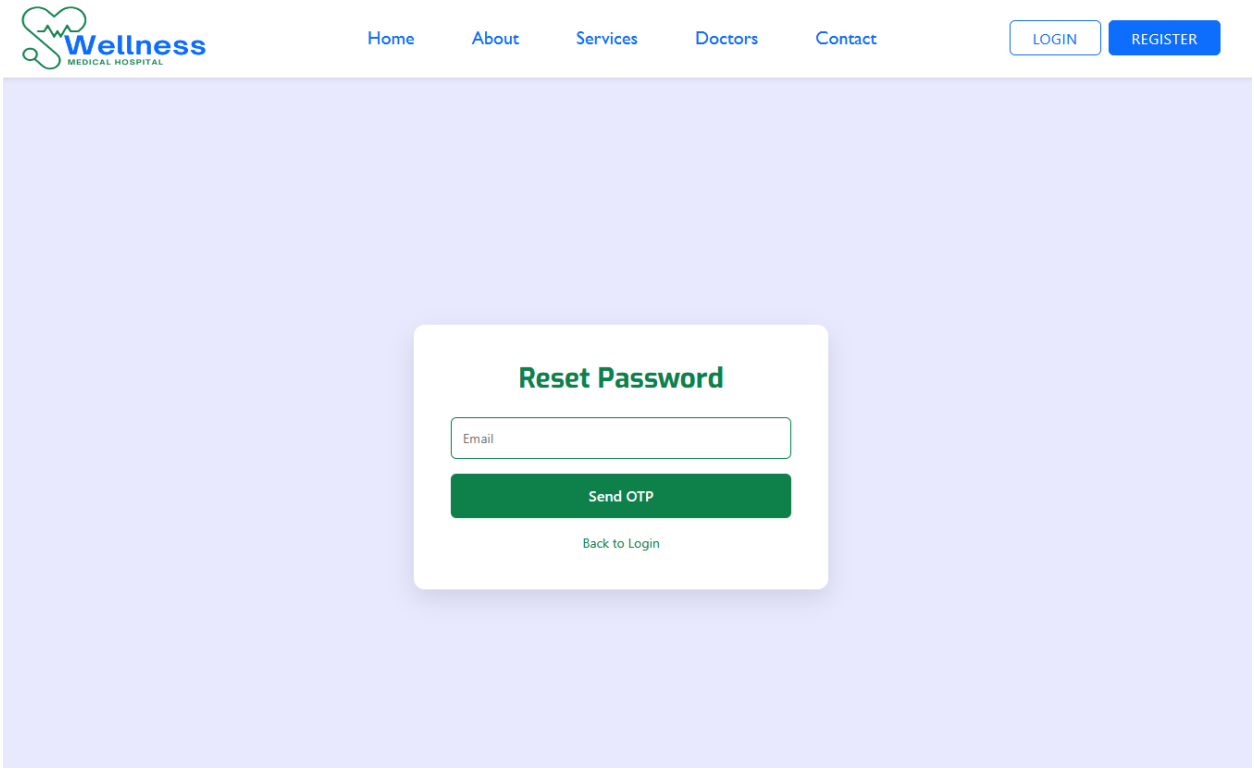


*Figure 3.11: Reset Password Page*

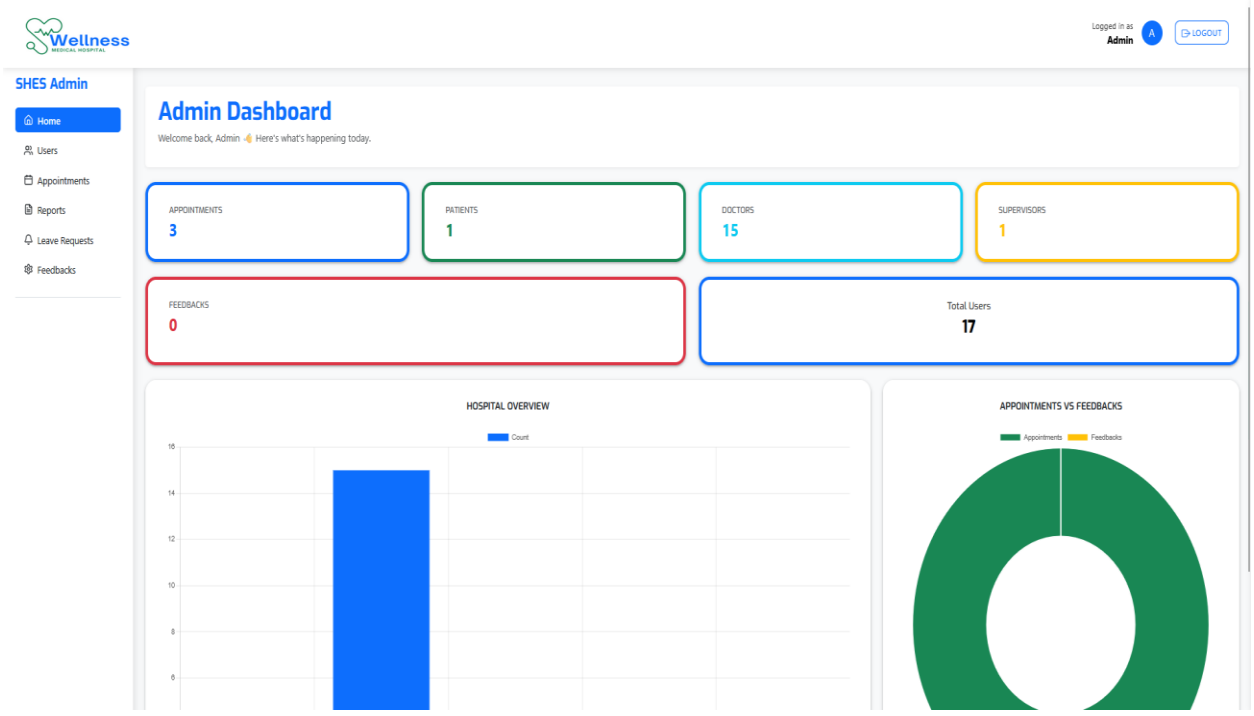


*Figure 3.12: Admin Dashboard Page*

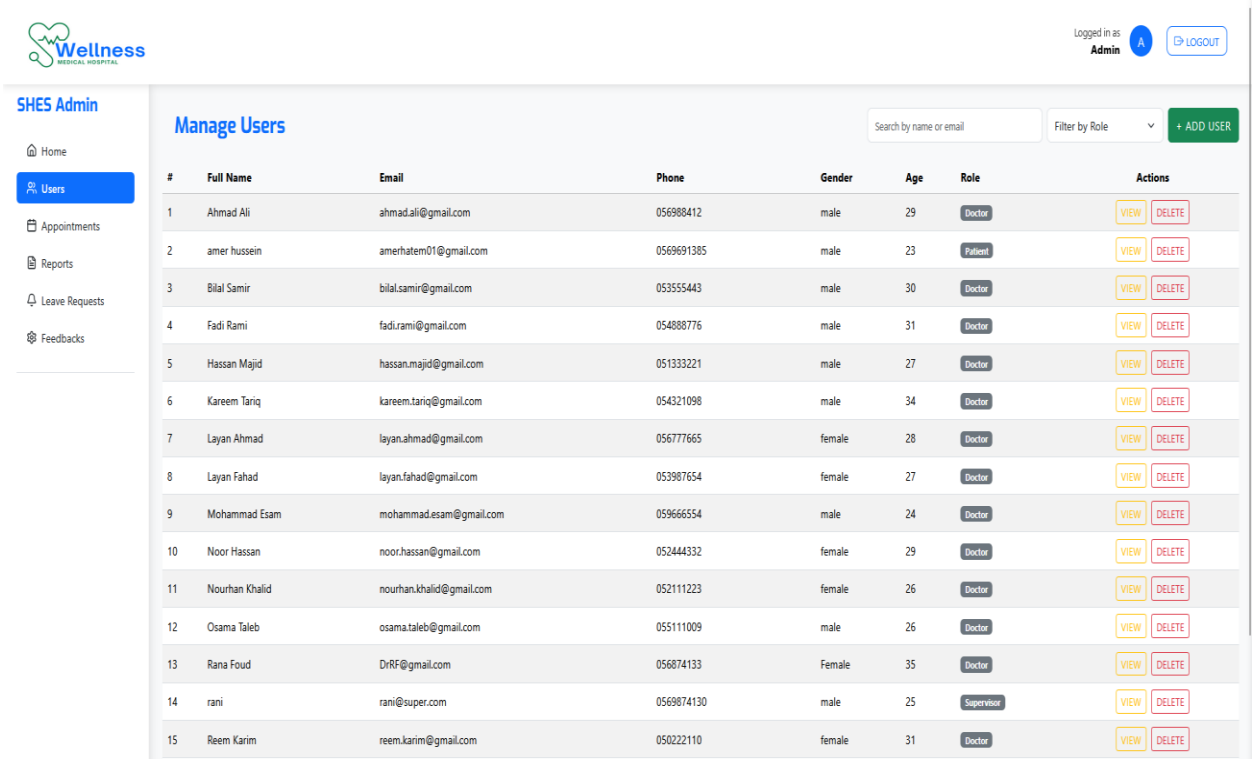


*Figure 3.13: Users Page*

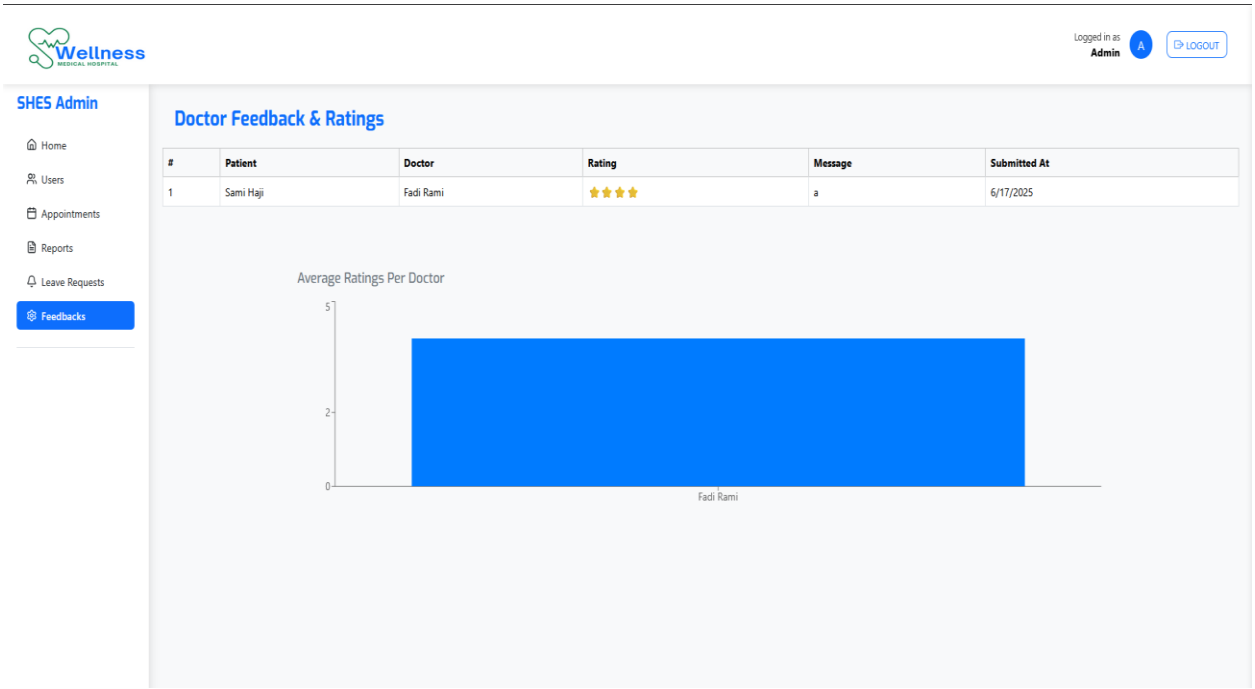


*Figure 3.14: Feedback Page*

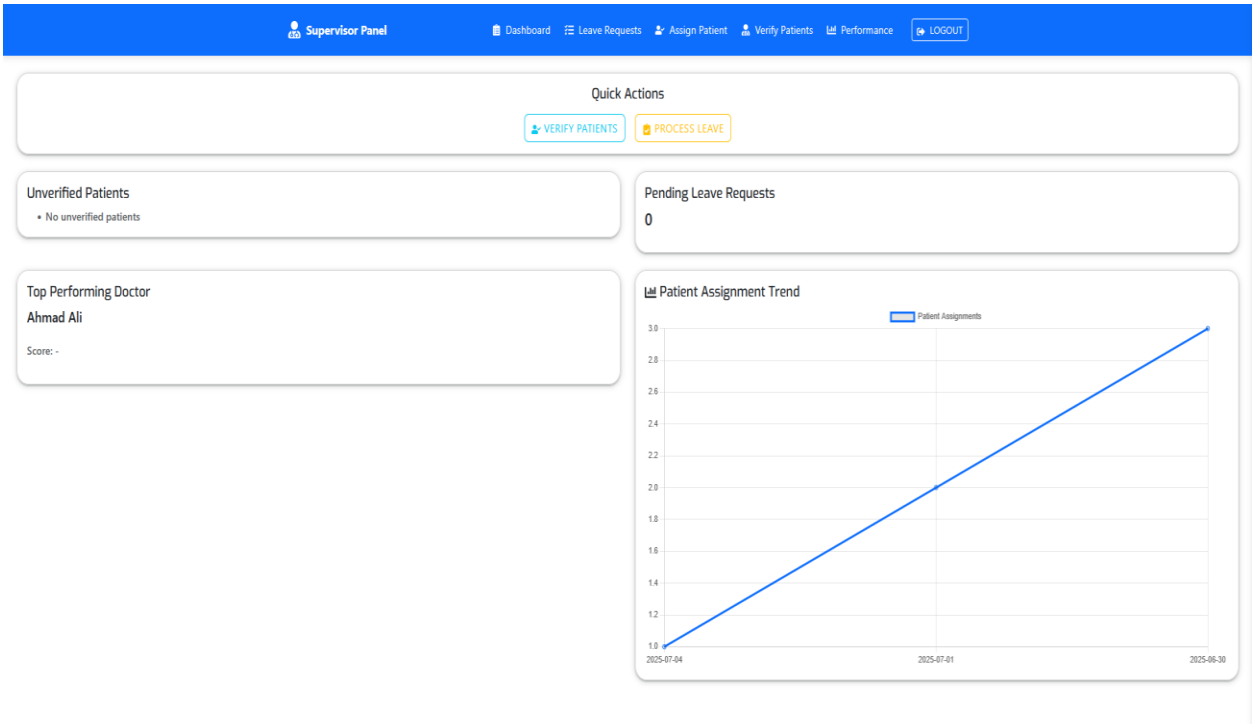


*Figure 3.15: Supervisor  Dashboard Page*

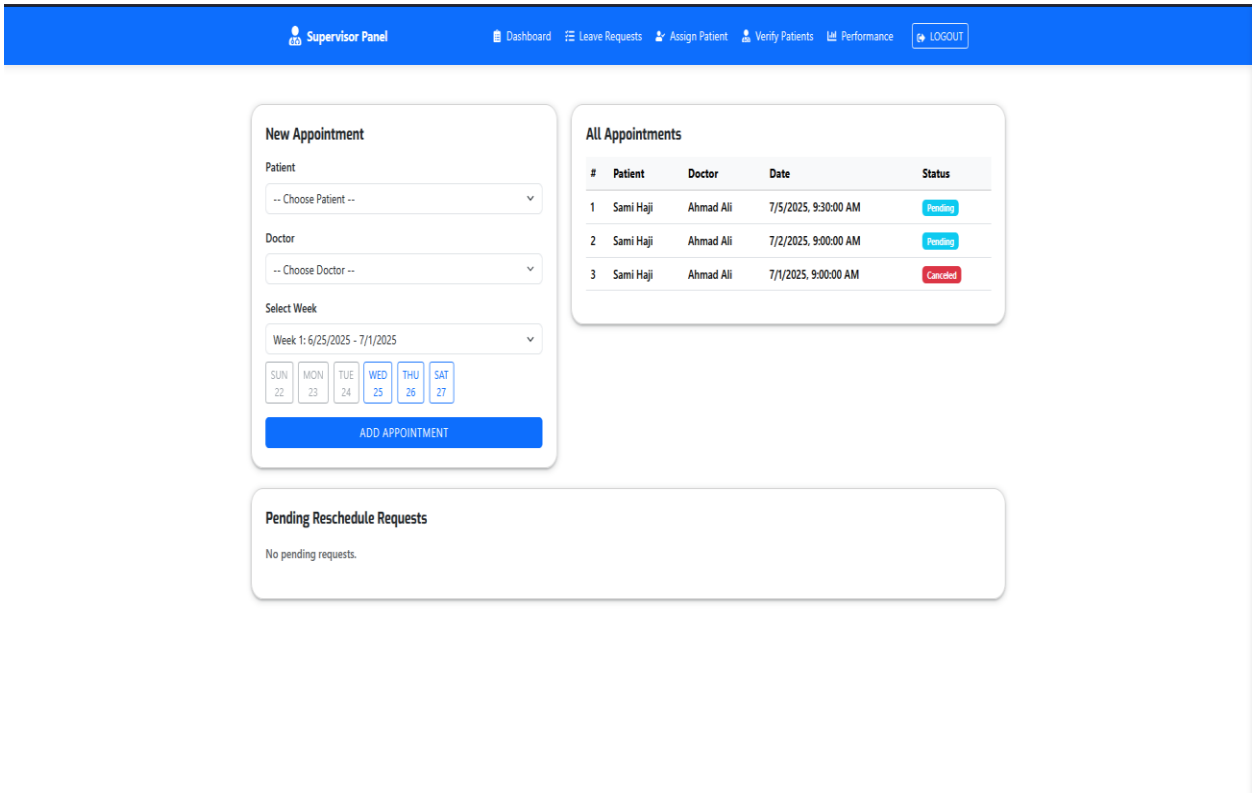


*Figure 3.16: Assign Patient Page*

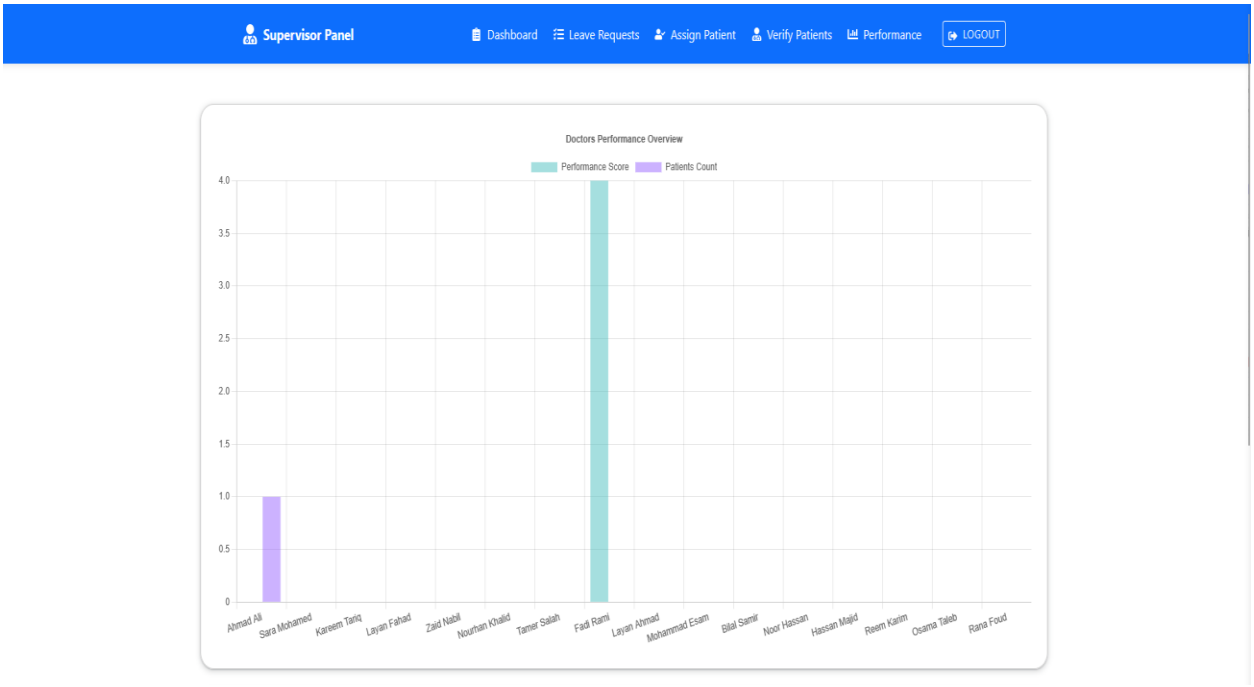


*Figure 3.17: Performance Page*

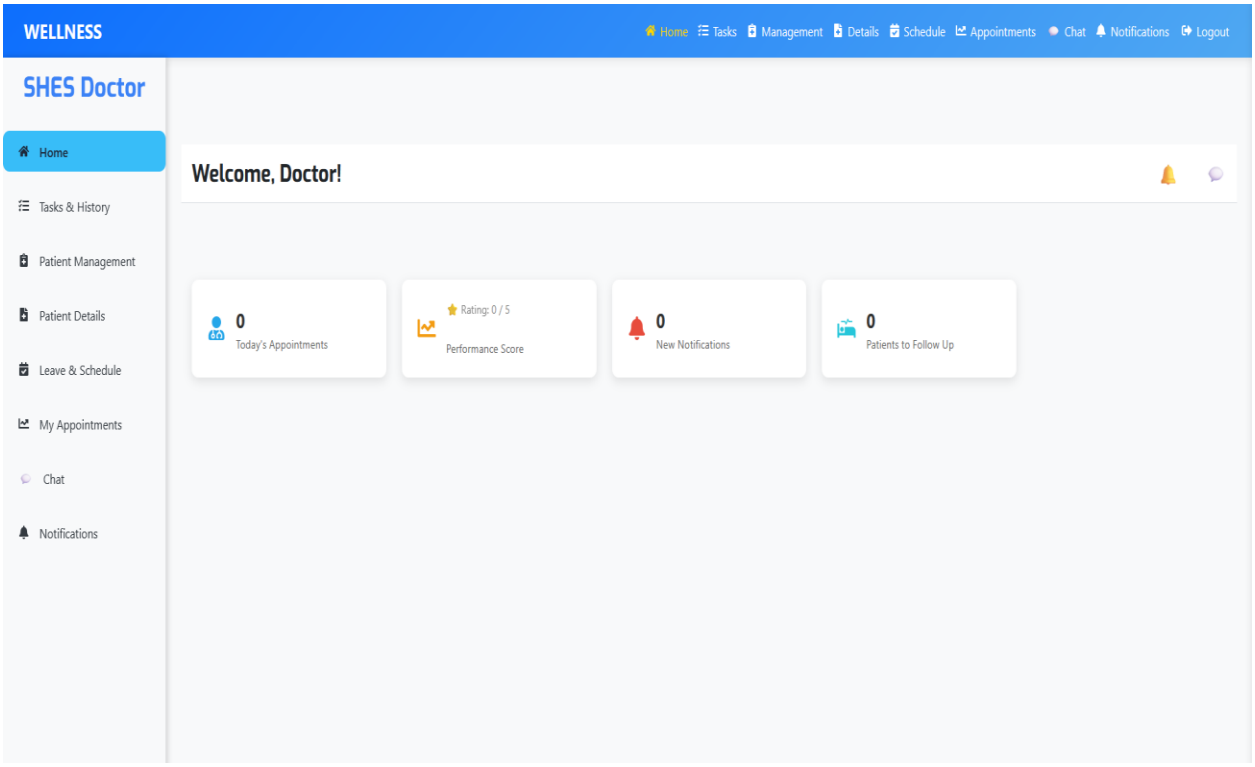


*Figure 3.18: Doctor  Dashboard Page*

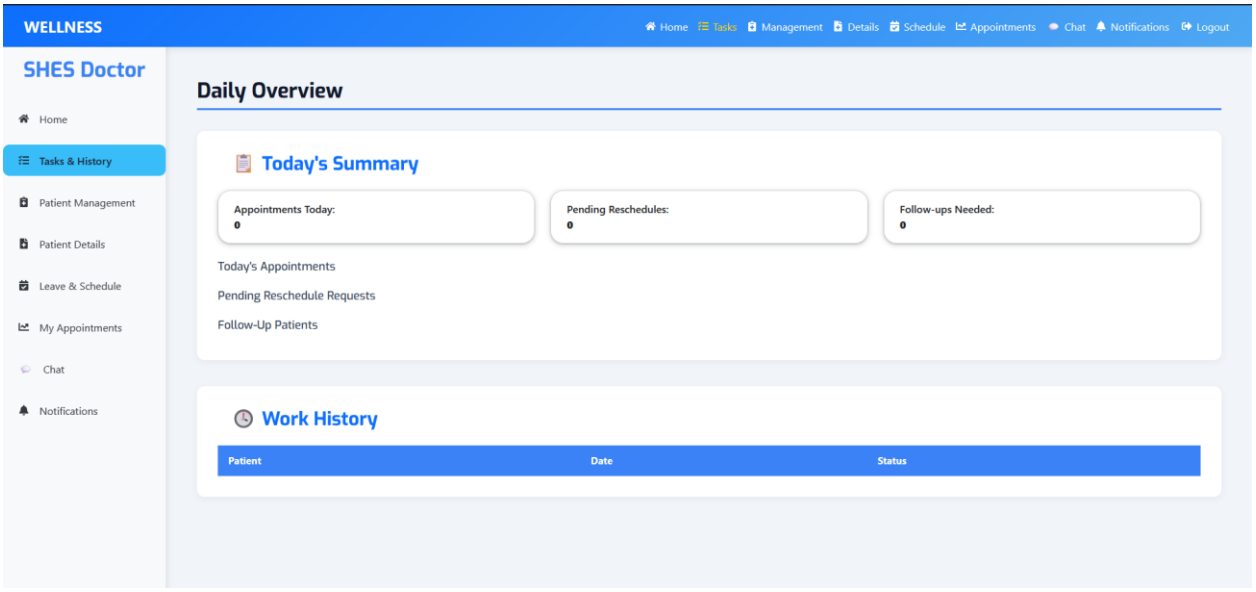


*Figure 3.19:Tasks And History Page*

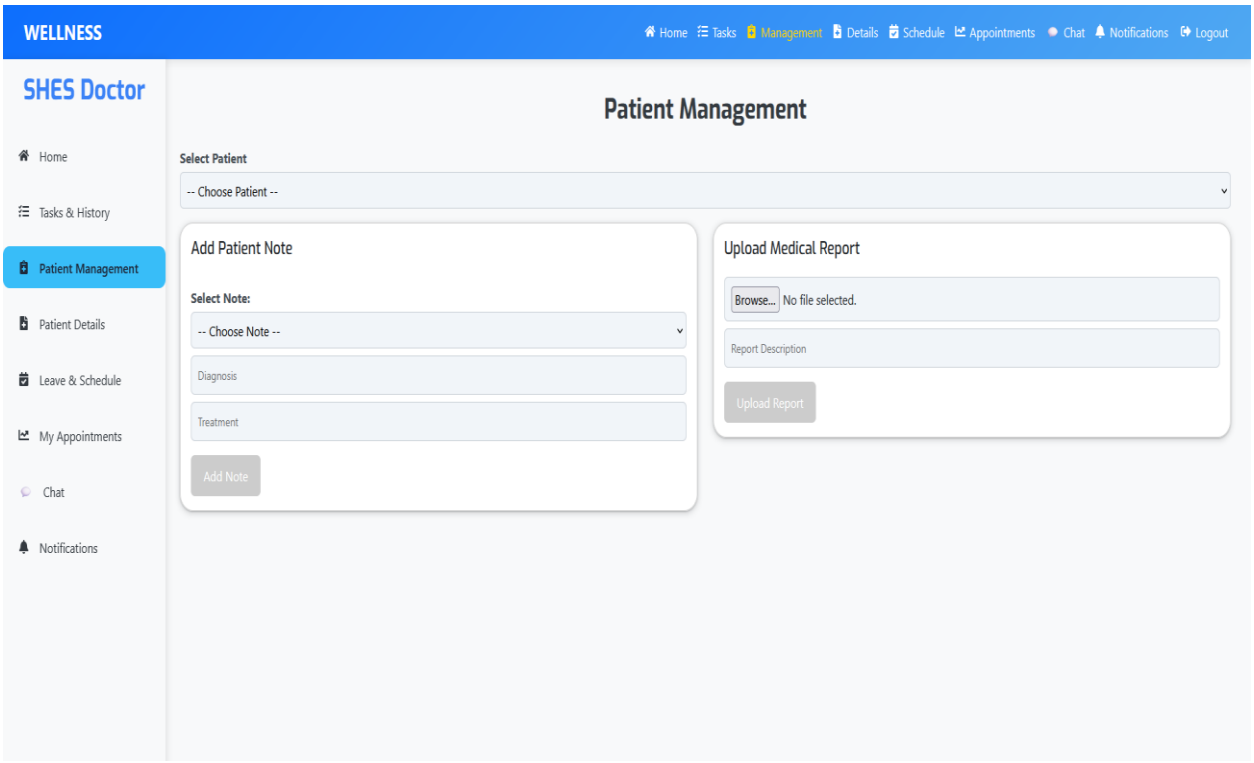


*Figure 3.20: Patient Management Page*

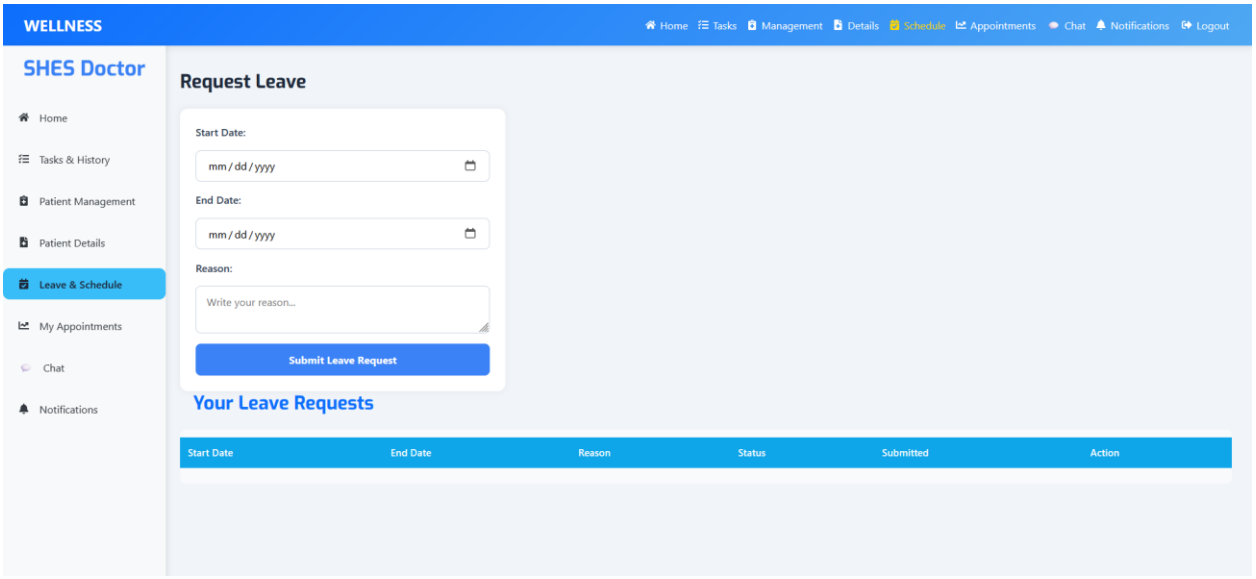


*Figure 3.21: Leave And Schedule Page*

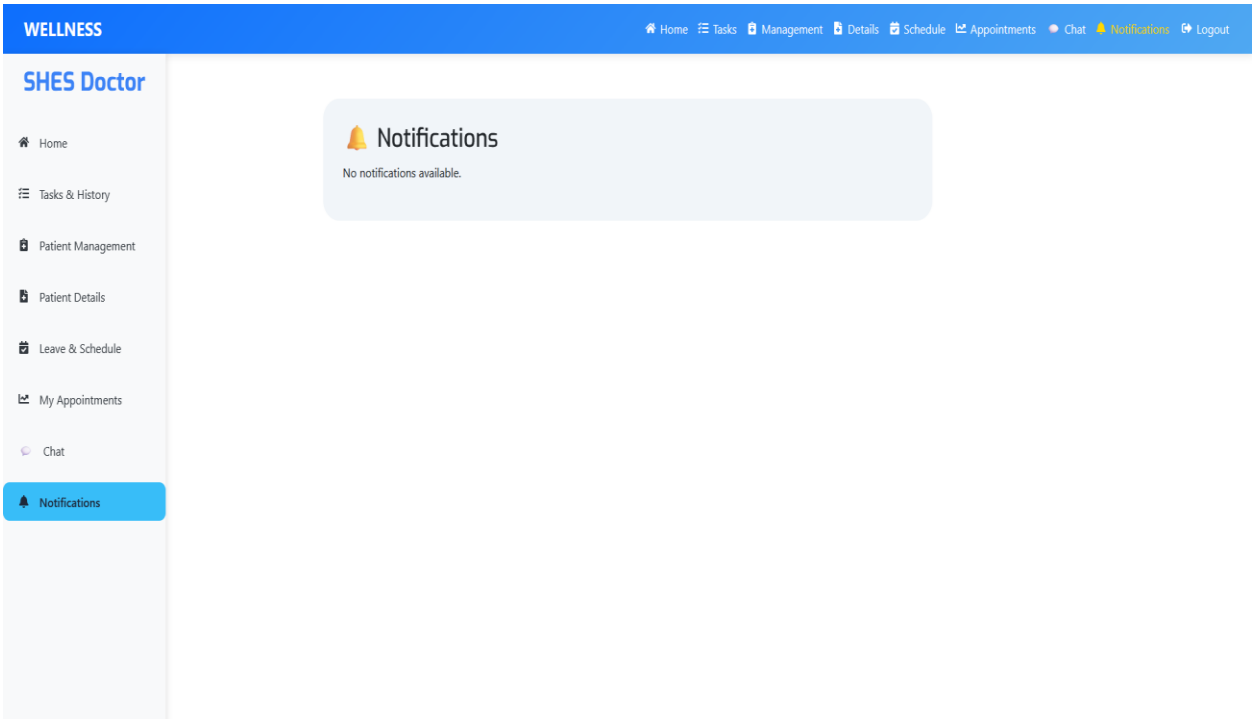


*Figure 3.22: Notifications Page*

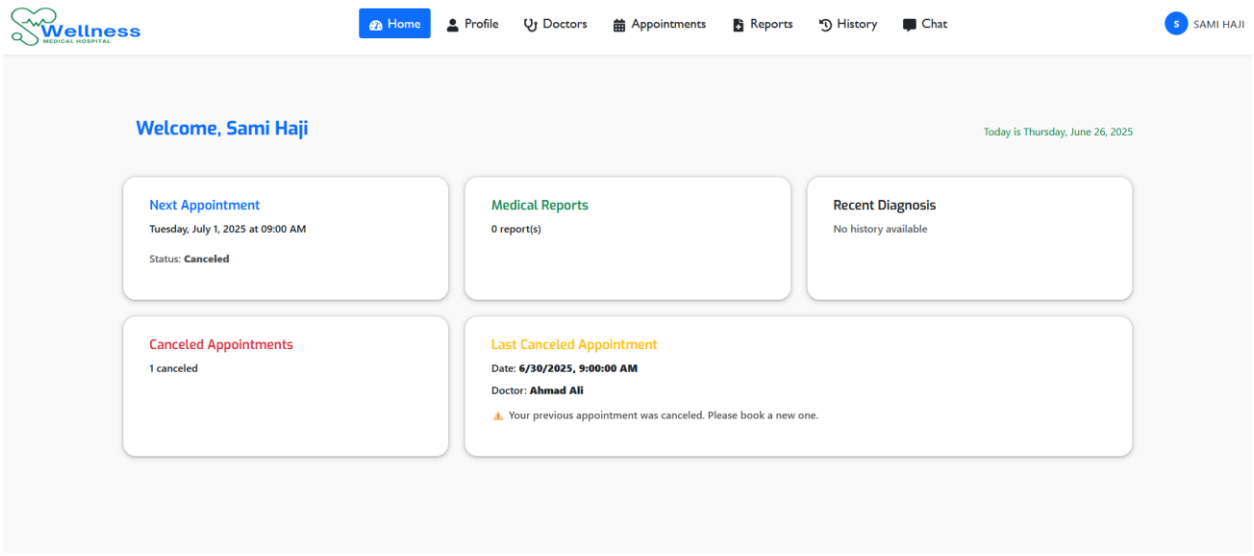


*Figure 3.23: Patient Dashboard Page*

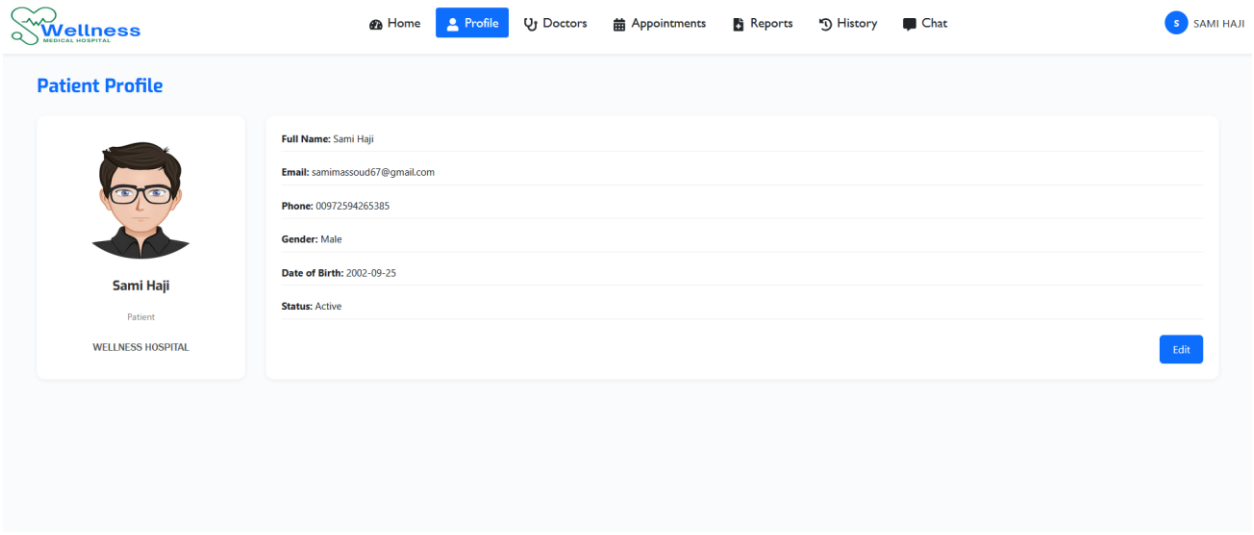


*Figure 3.24: Patient Profile Page*

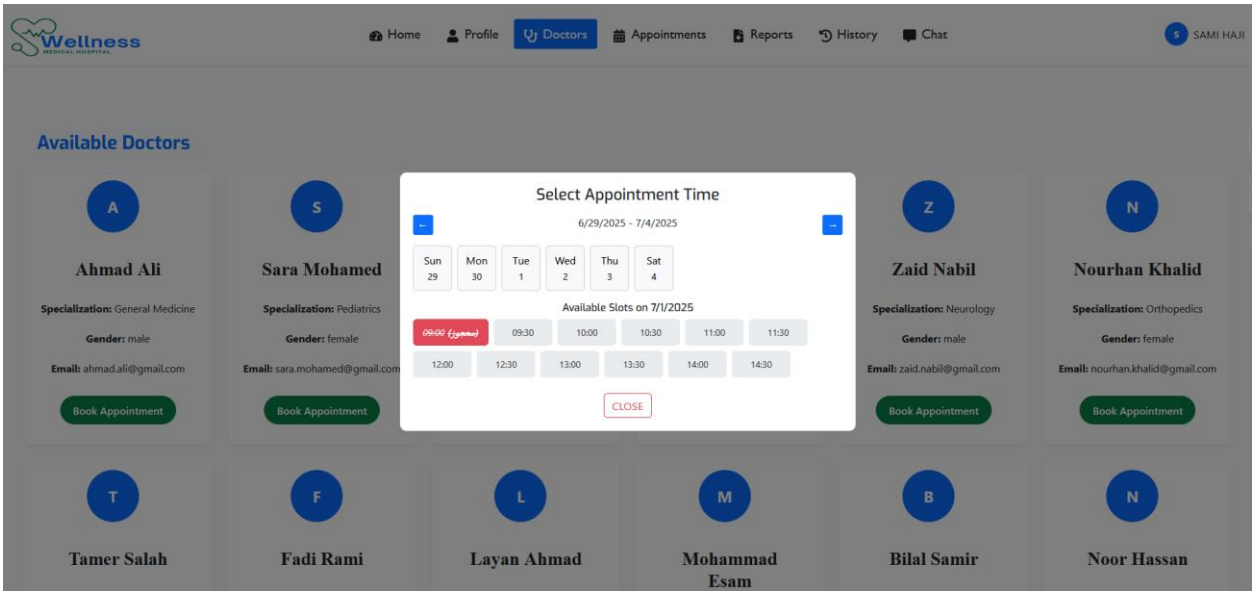


*Figure 3.25: Doctors Page*

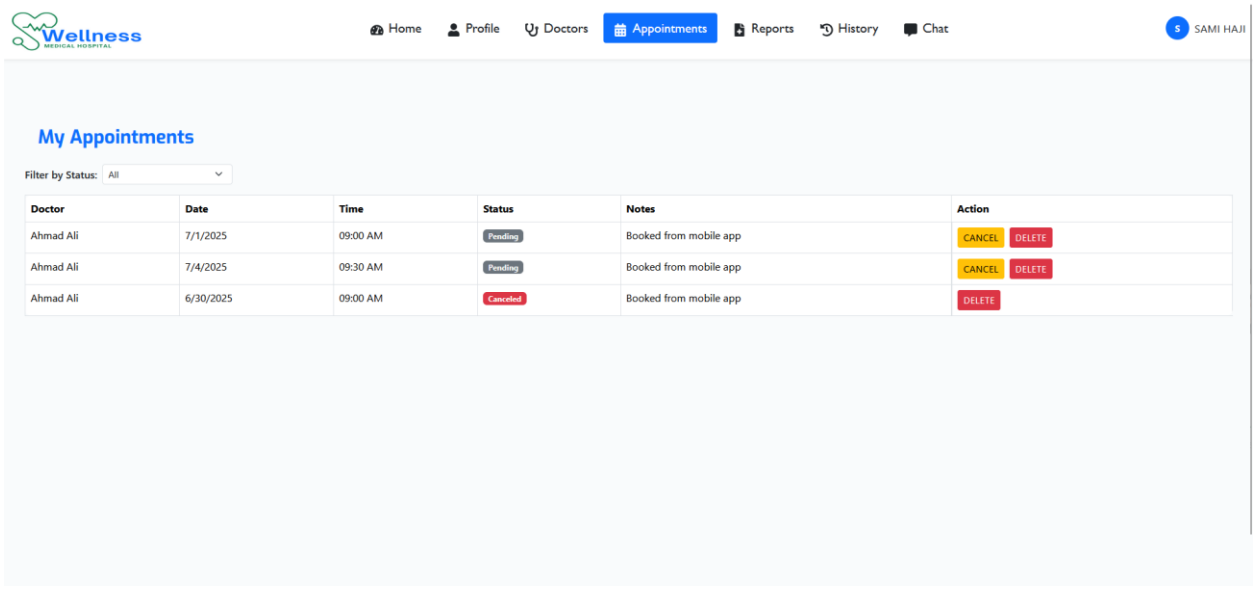


*Figure 3.26: My Appointments Page*

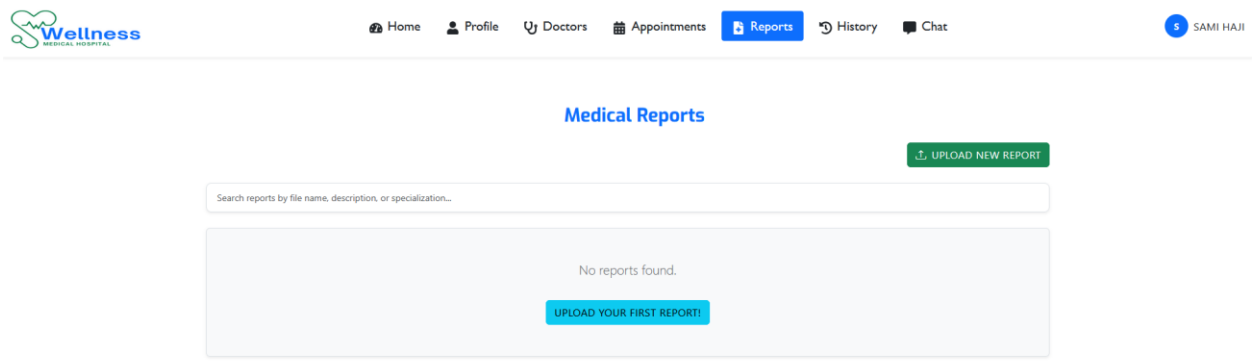


*Figure 3.27: Report Page*

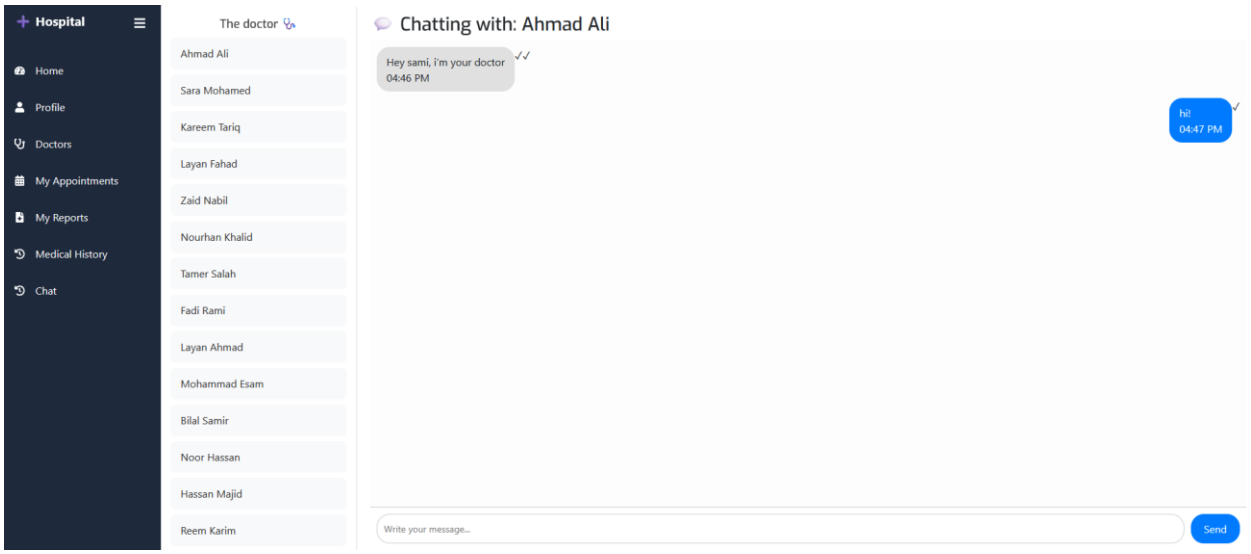


*Figure 3.28: Chat Page*

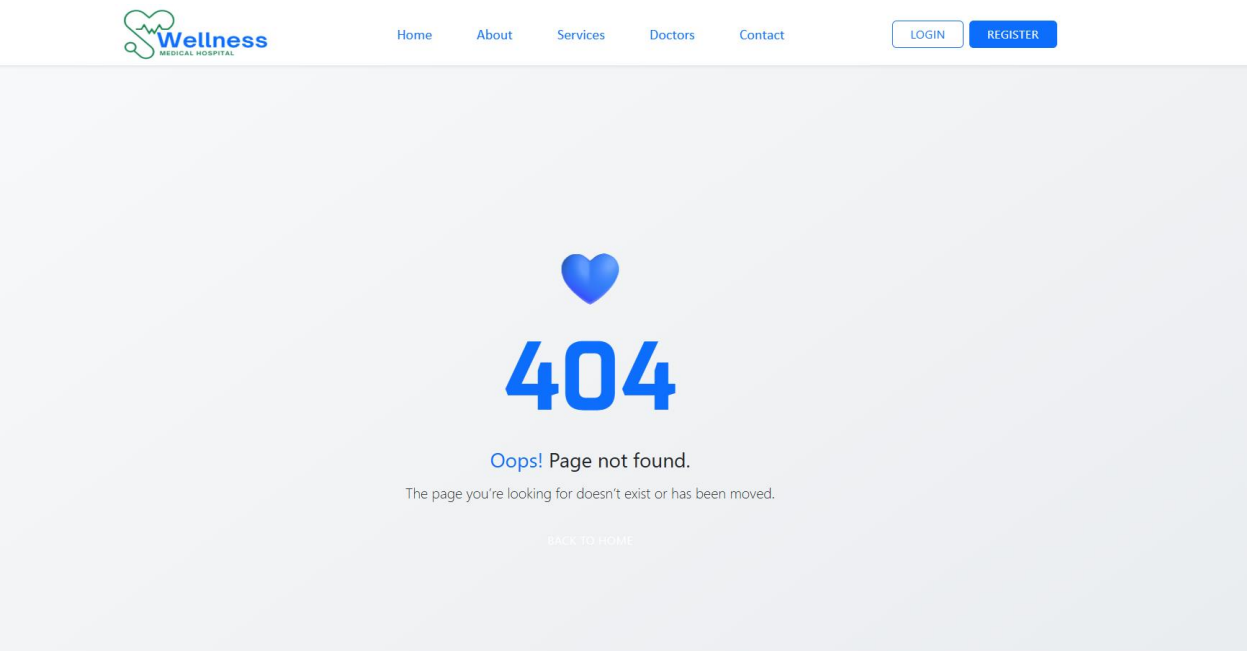


*Figure 3.29: 404 Page*

### 3.4.2 MOBILE APPLICATION

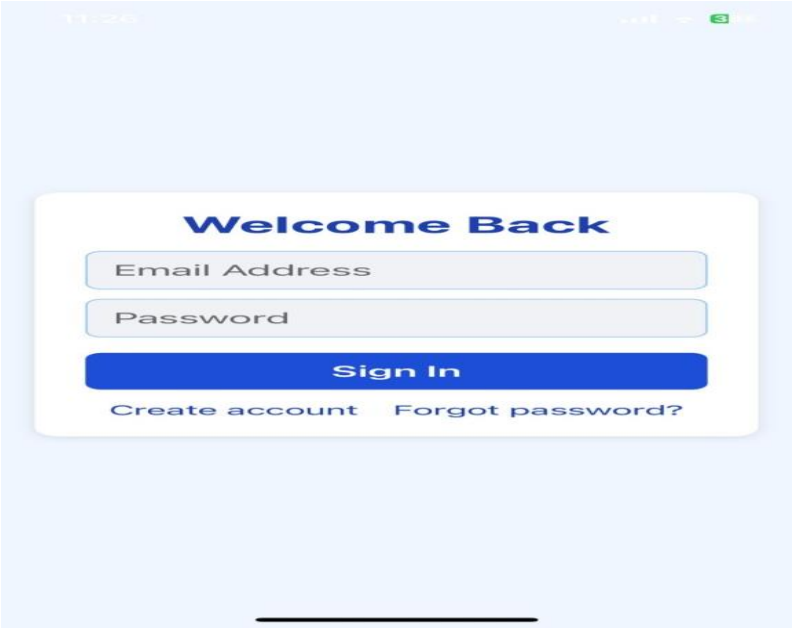


*Figure 3.30: login Page*

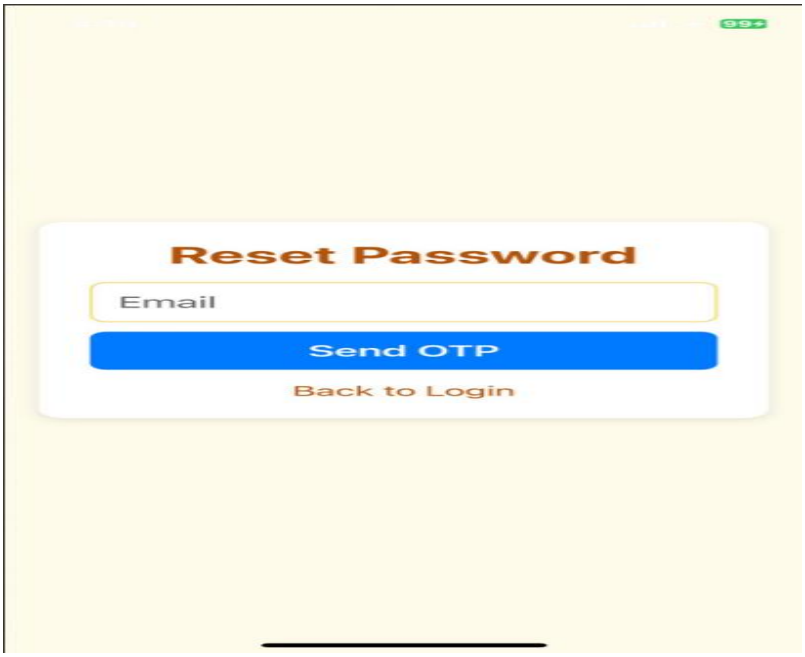


*Figure 3.30.1: Reset Password Page*

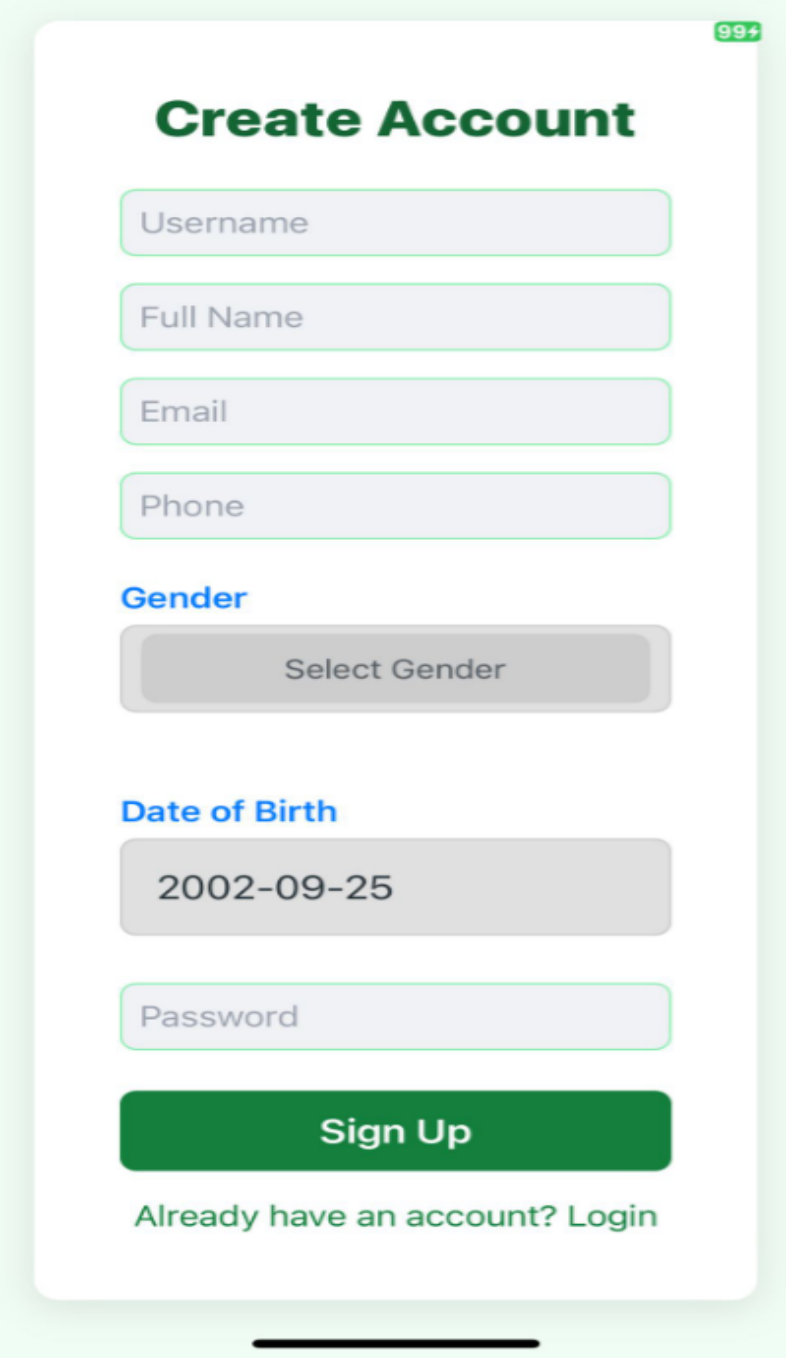


*Figure 3.31: Register  Page*

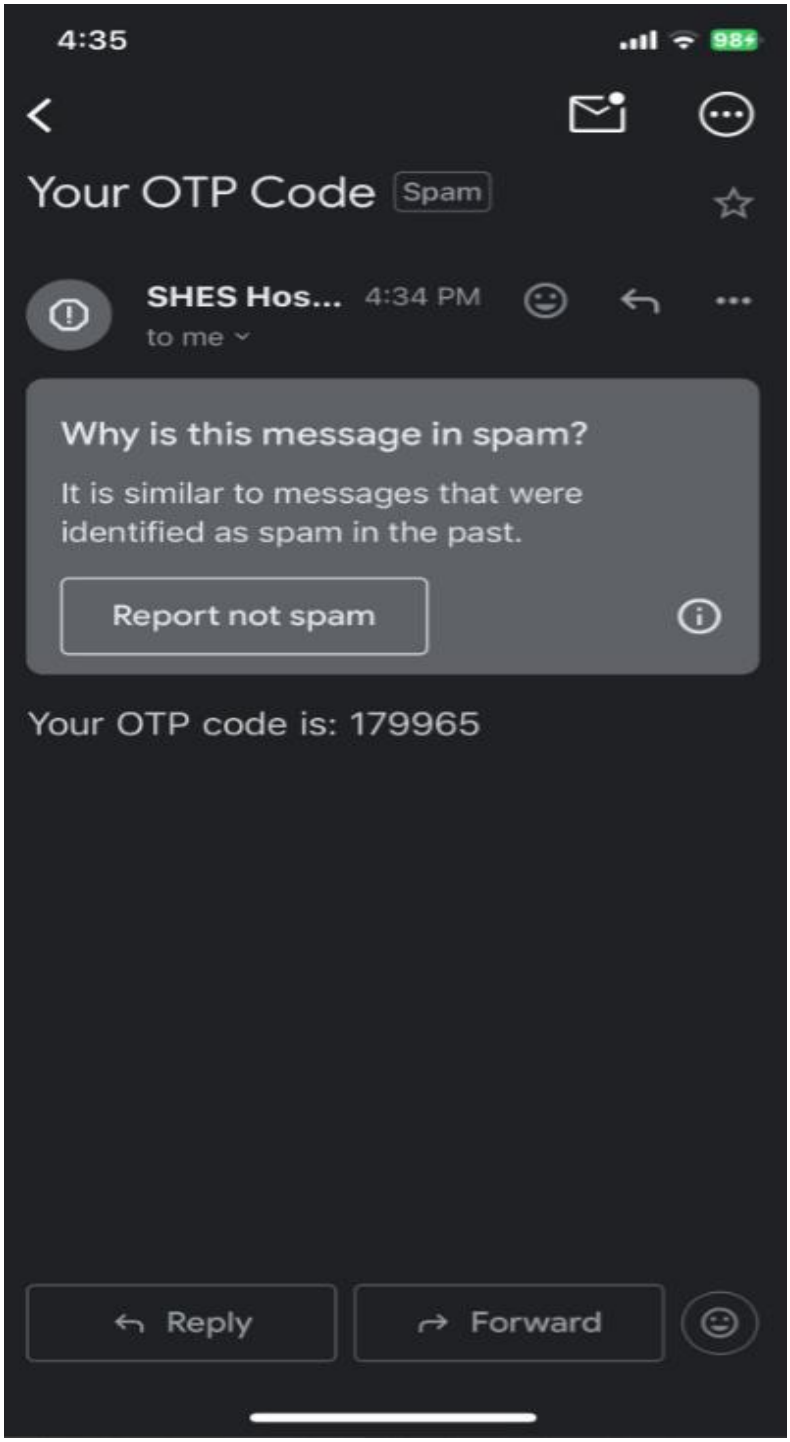


*Figure 3.32: OTP Code*

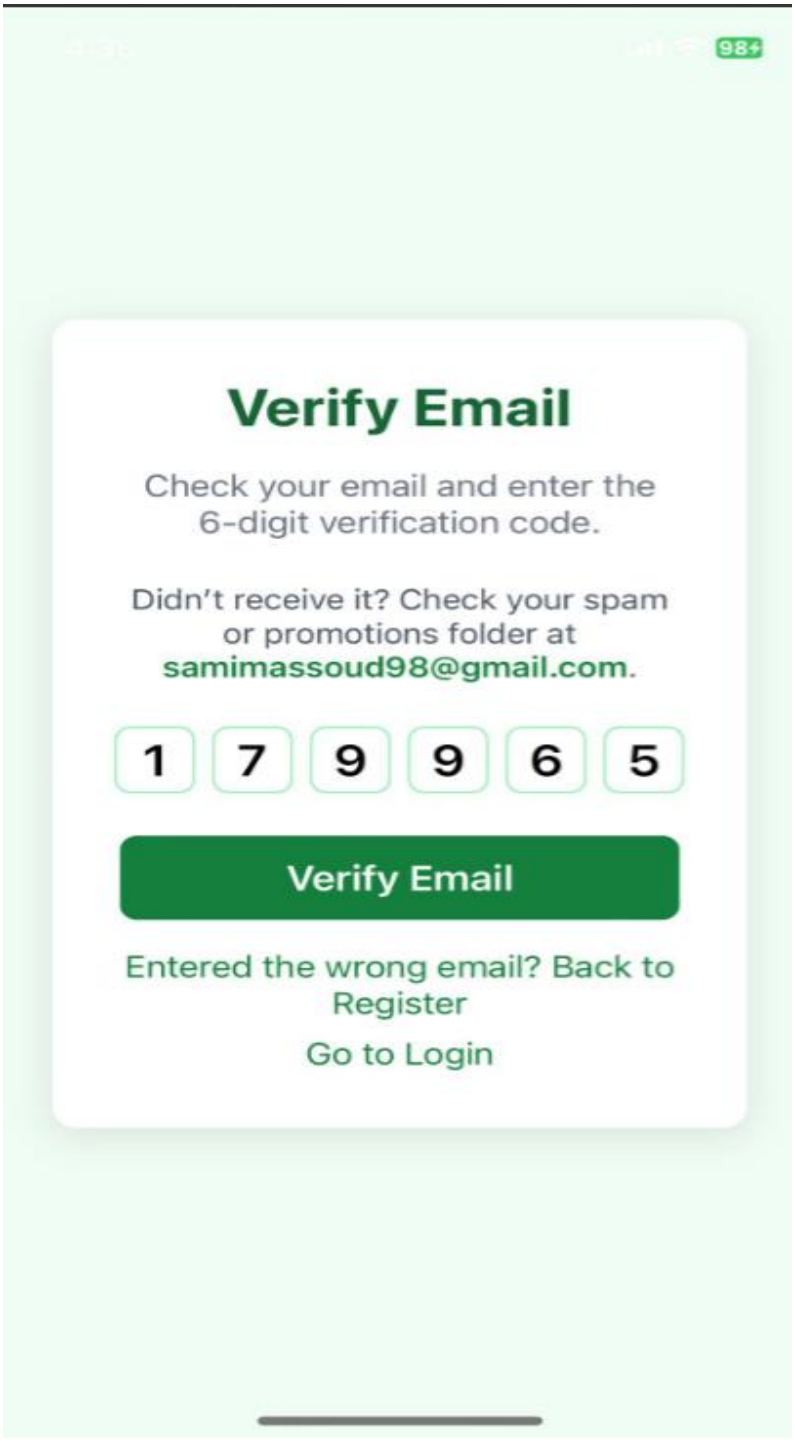


*Figure 3.33: Verify Email  Page*

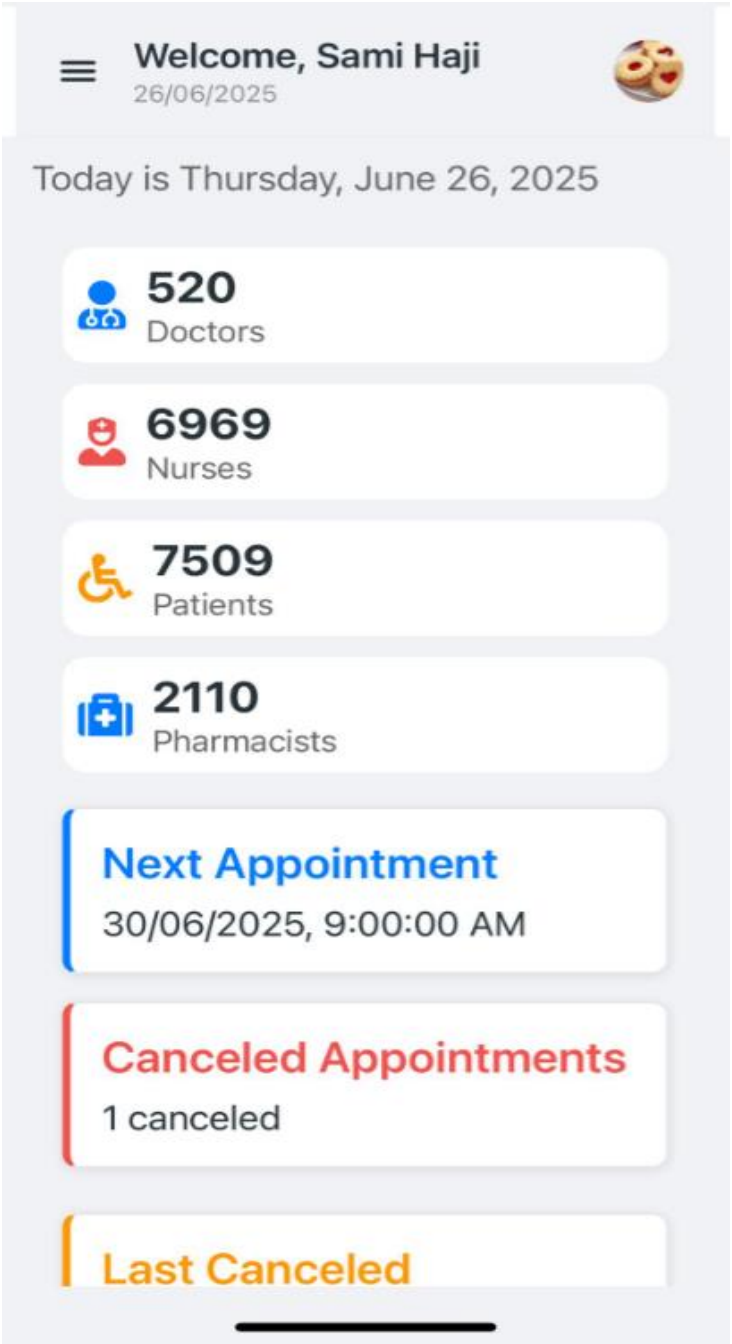


*Figure 3.34: Patient Page*

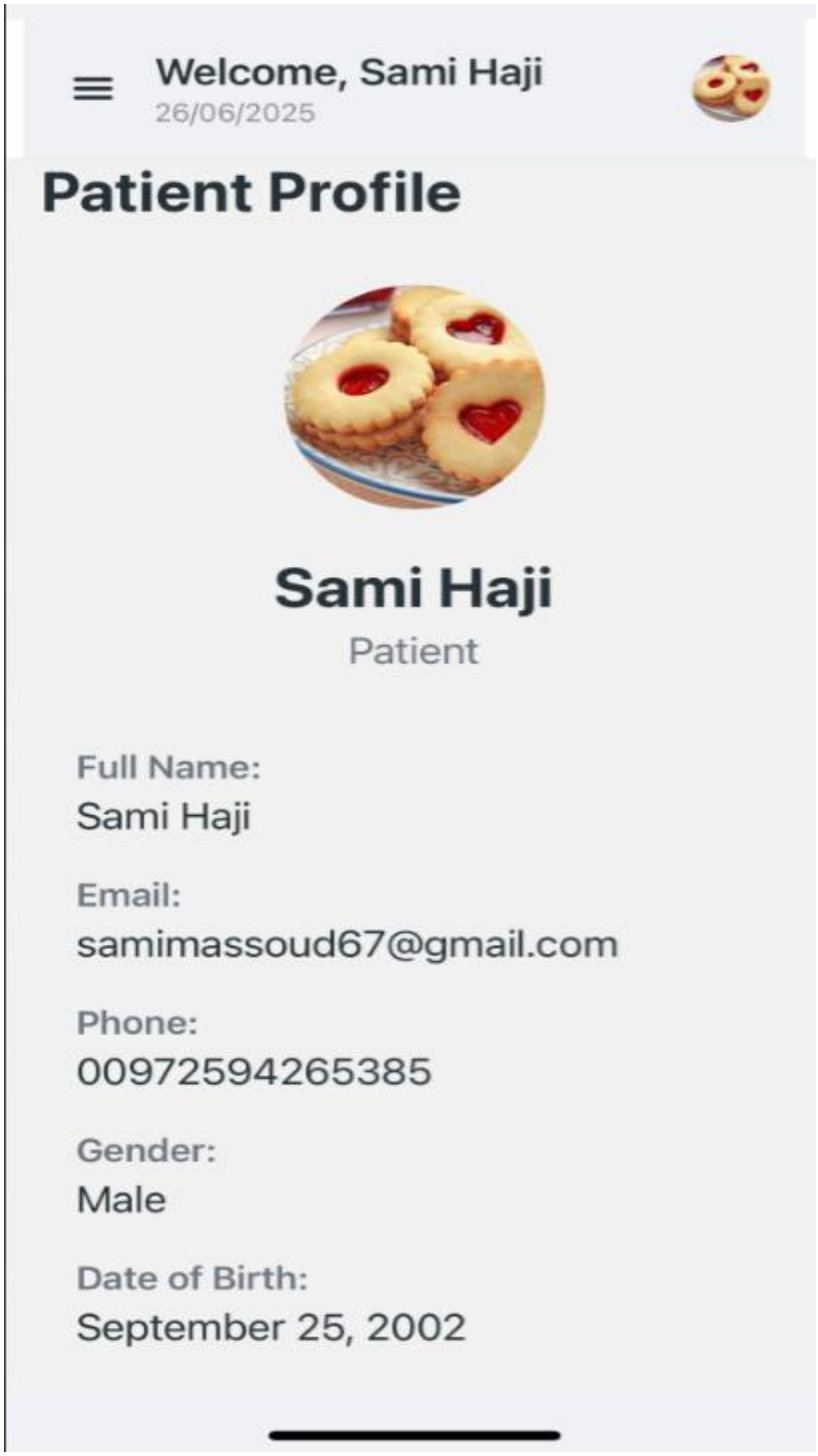


*Figure 3.35: Patient Profile Page*

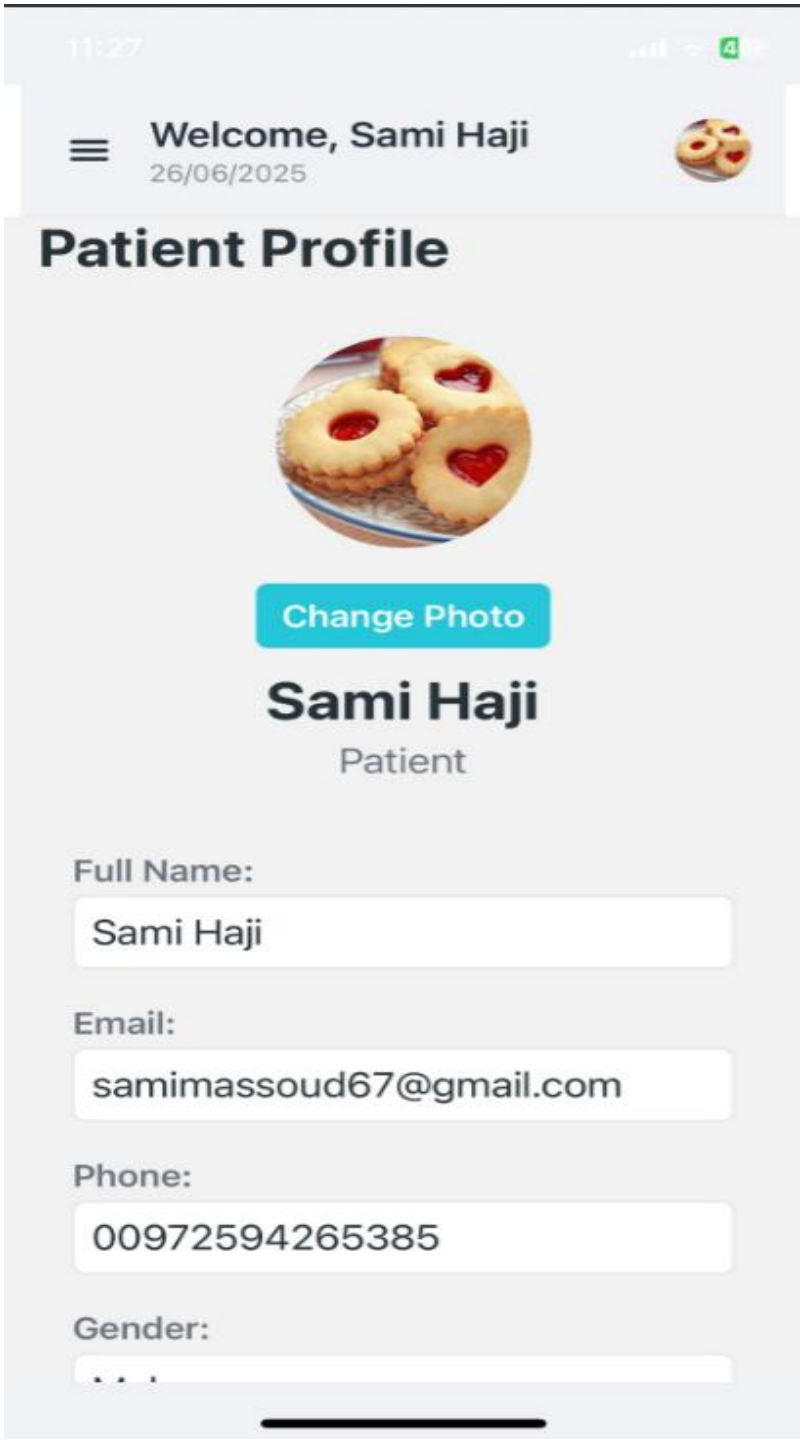


*Figure 3.36: Patient Profile Edit Page*

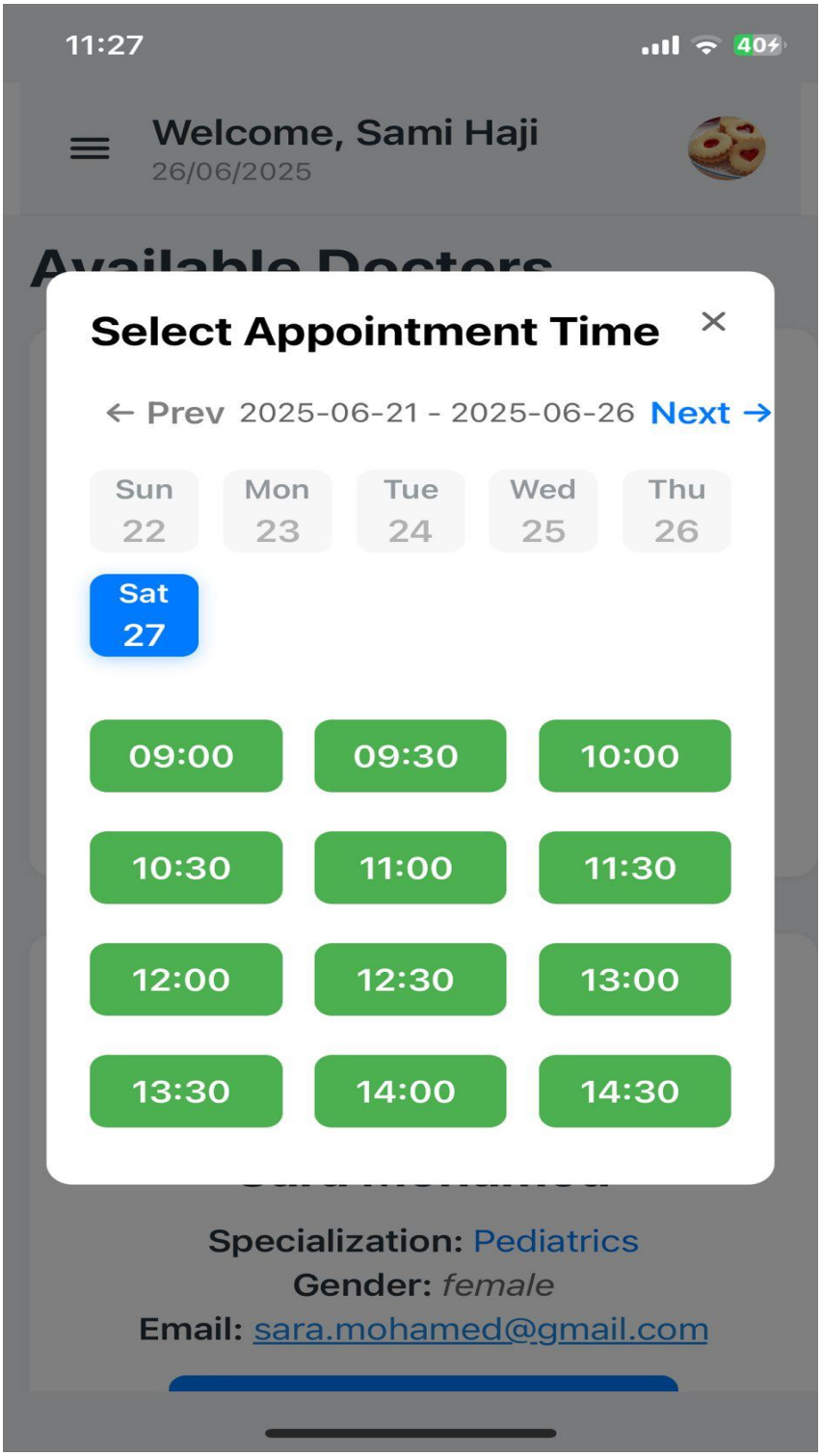


*Figure 3.37: Doctors Page*

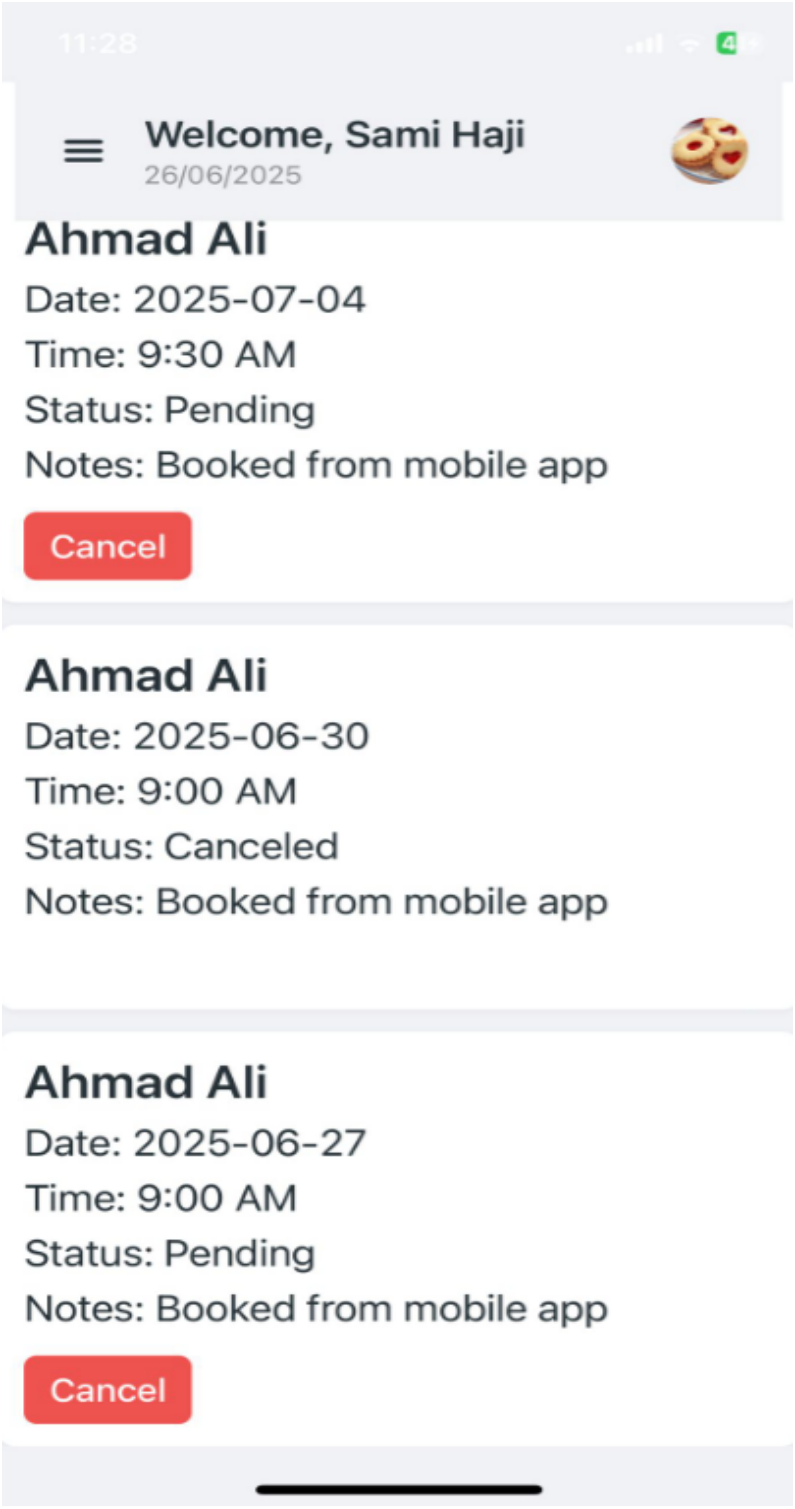


*Figure 3.38: My Appointment  Page*

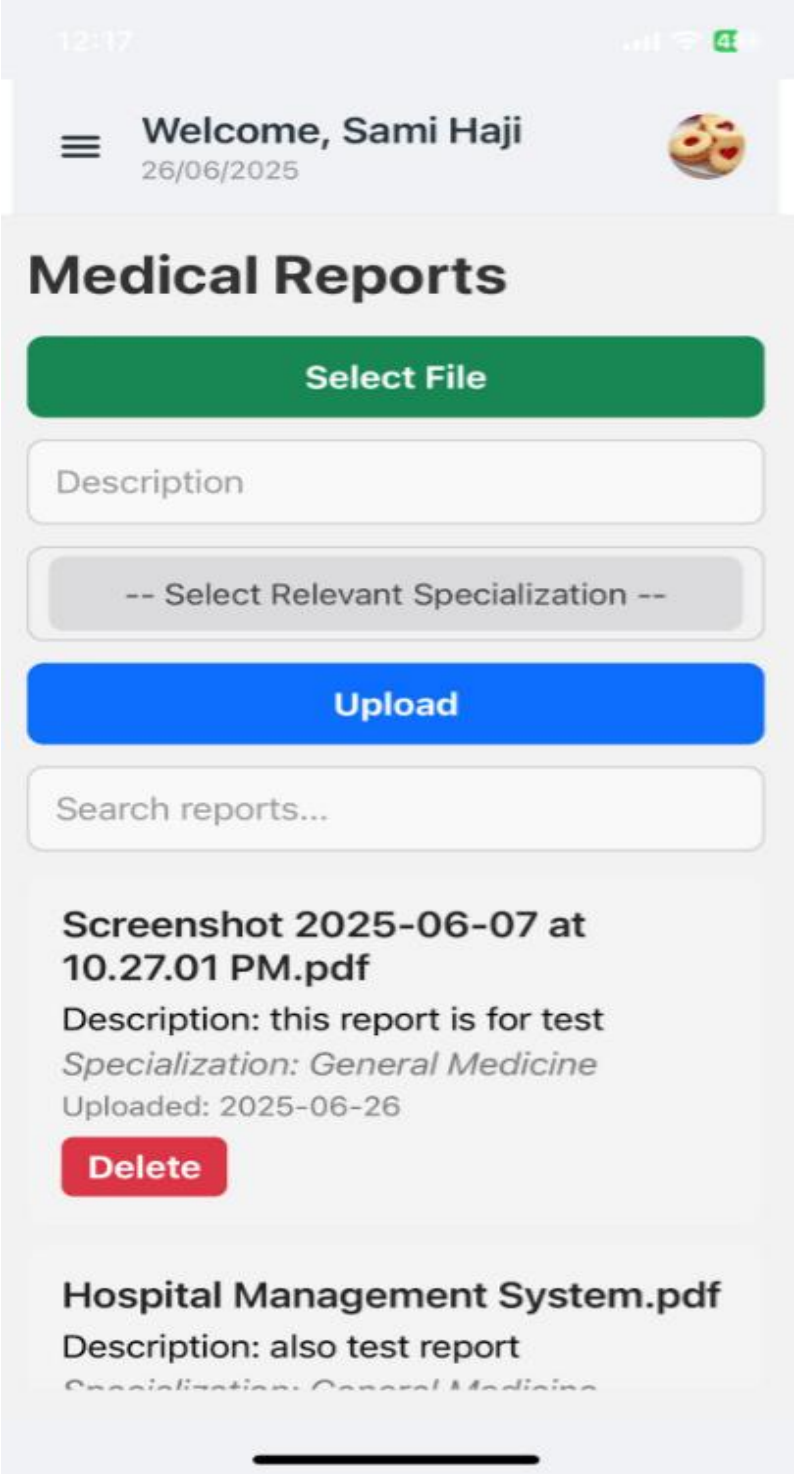


*Figure 3.39: My Reports Page*

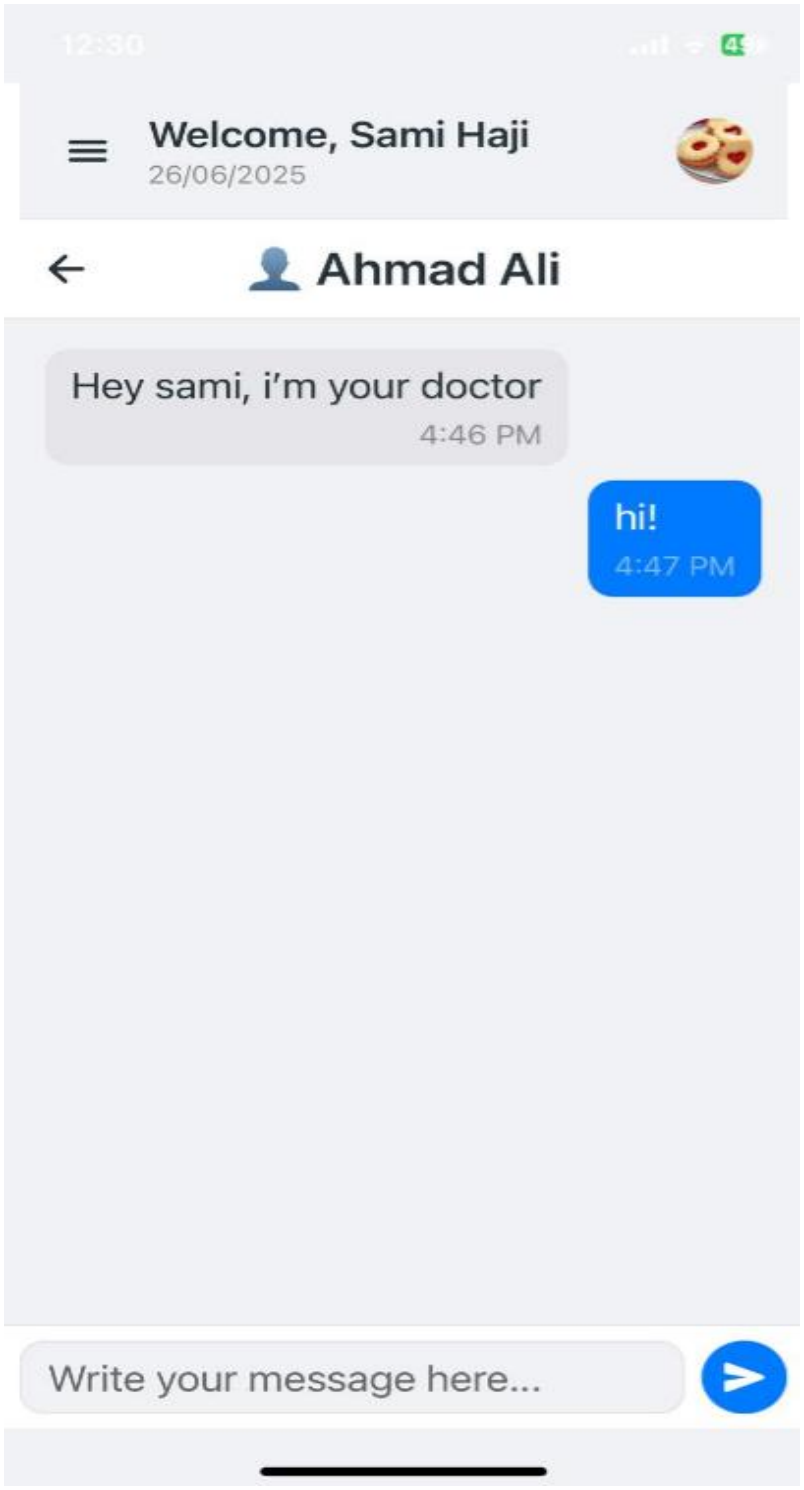


*Figure 3.40: Chat With Doctors Page*

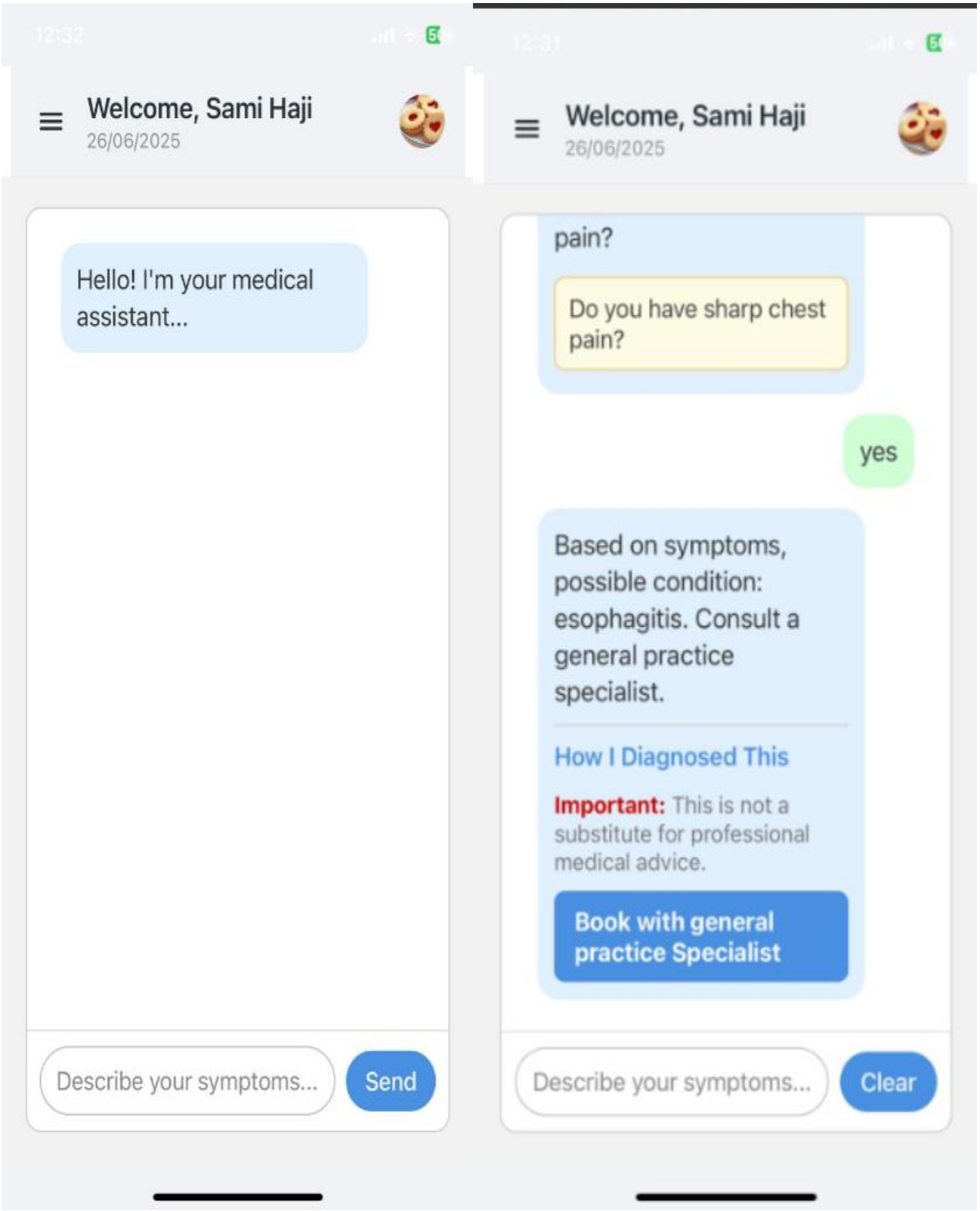


*Figure 3.41: Chat Ai Page*

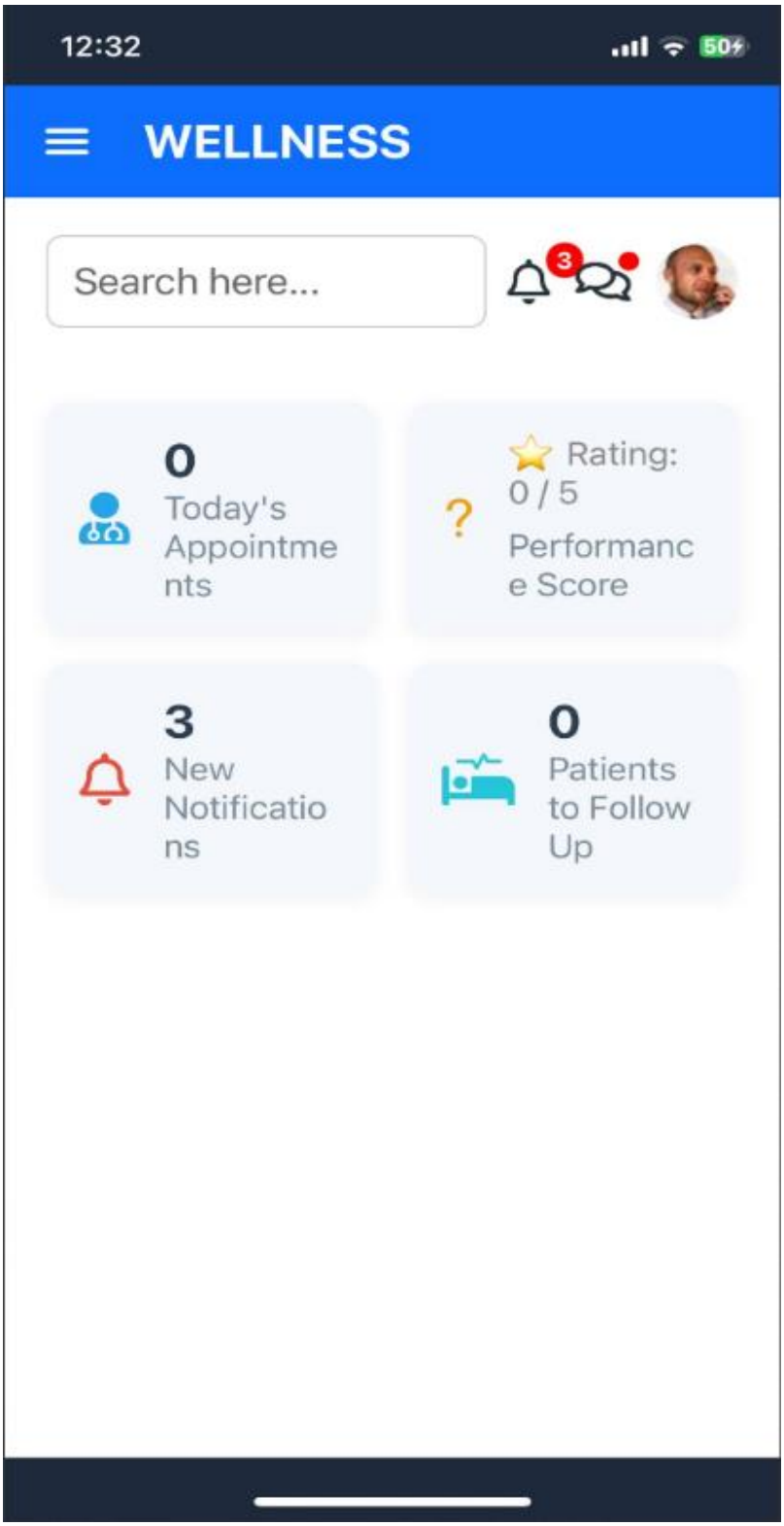


*Figure 3.42: Doctor Dashboard Page*

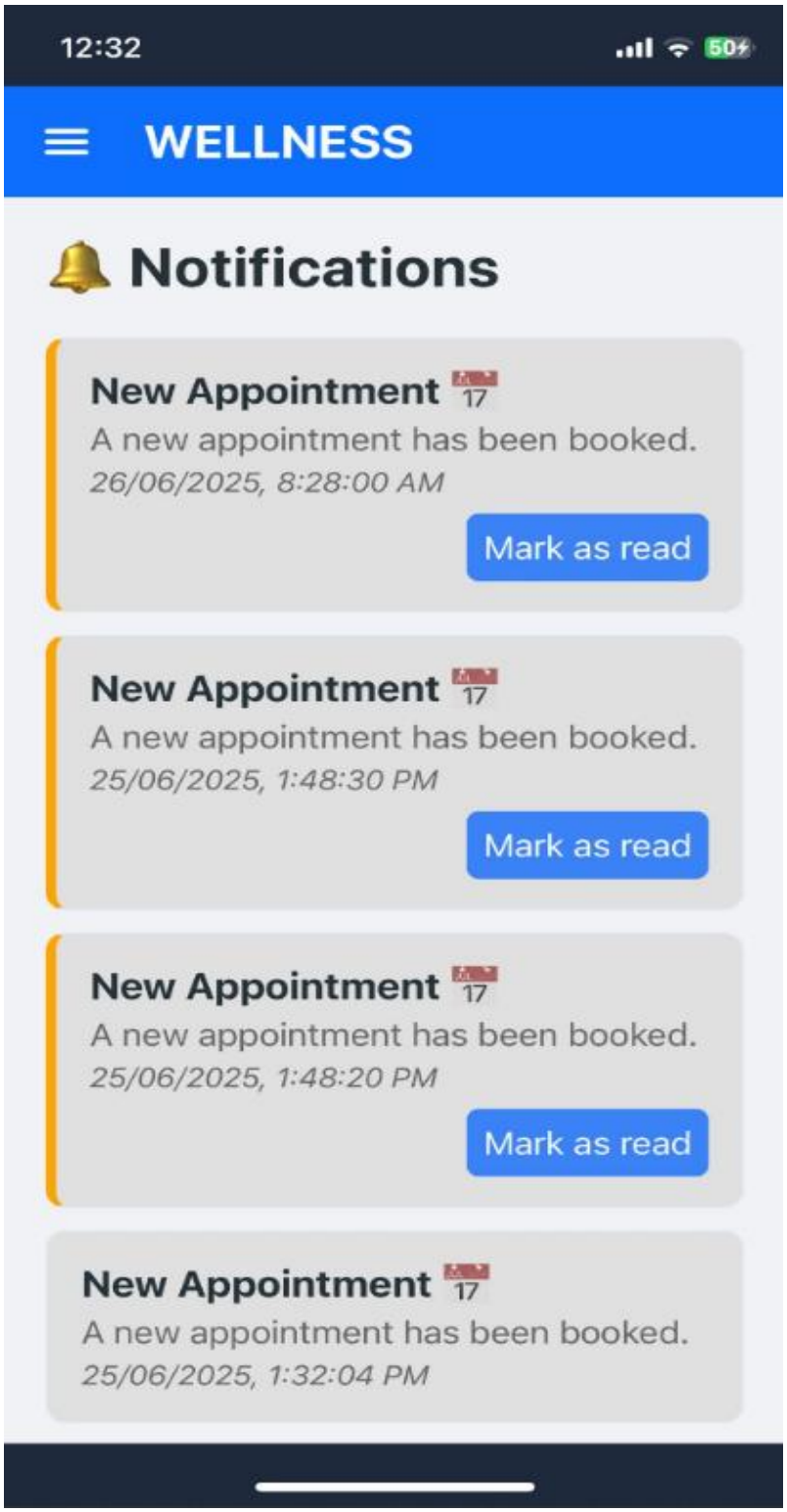


*Figure 3.43: Notifications Page*

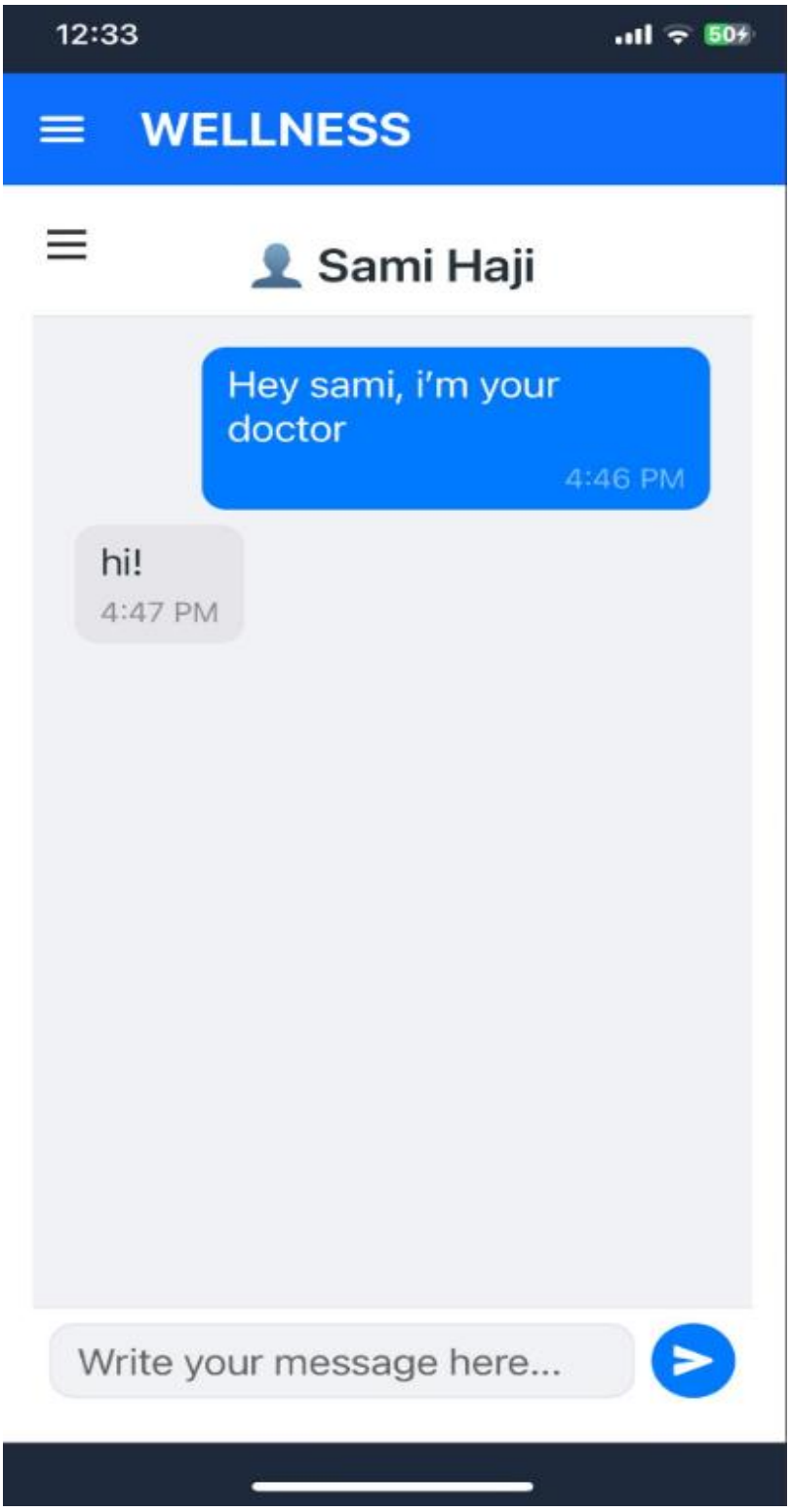


*Figure 3.44: Chat With Patients Page*

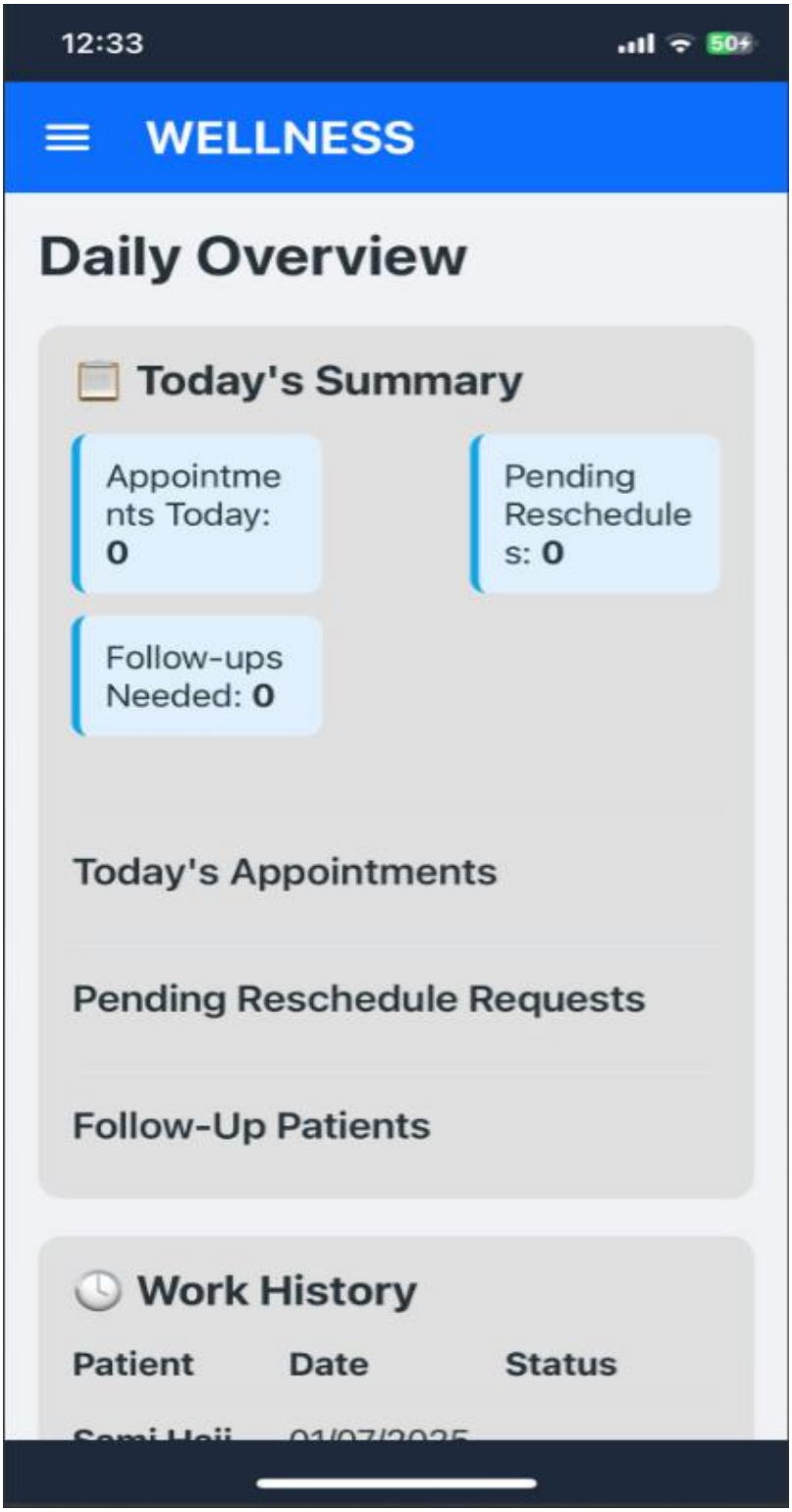


*Figure 3.45: My Tasks Page*

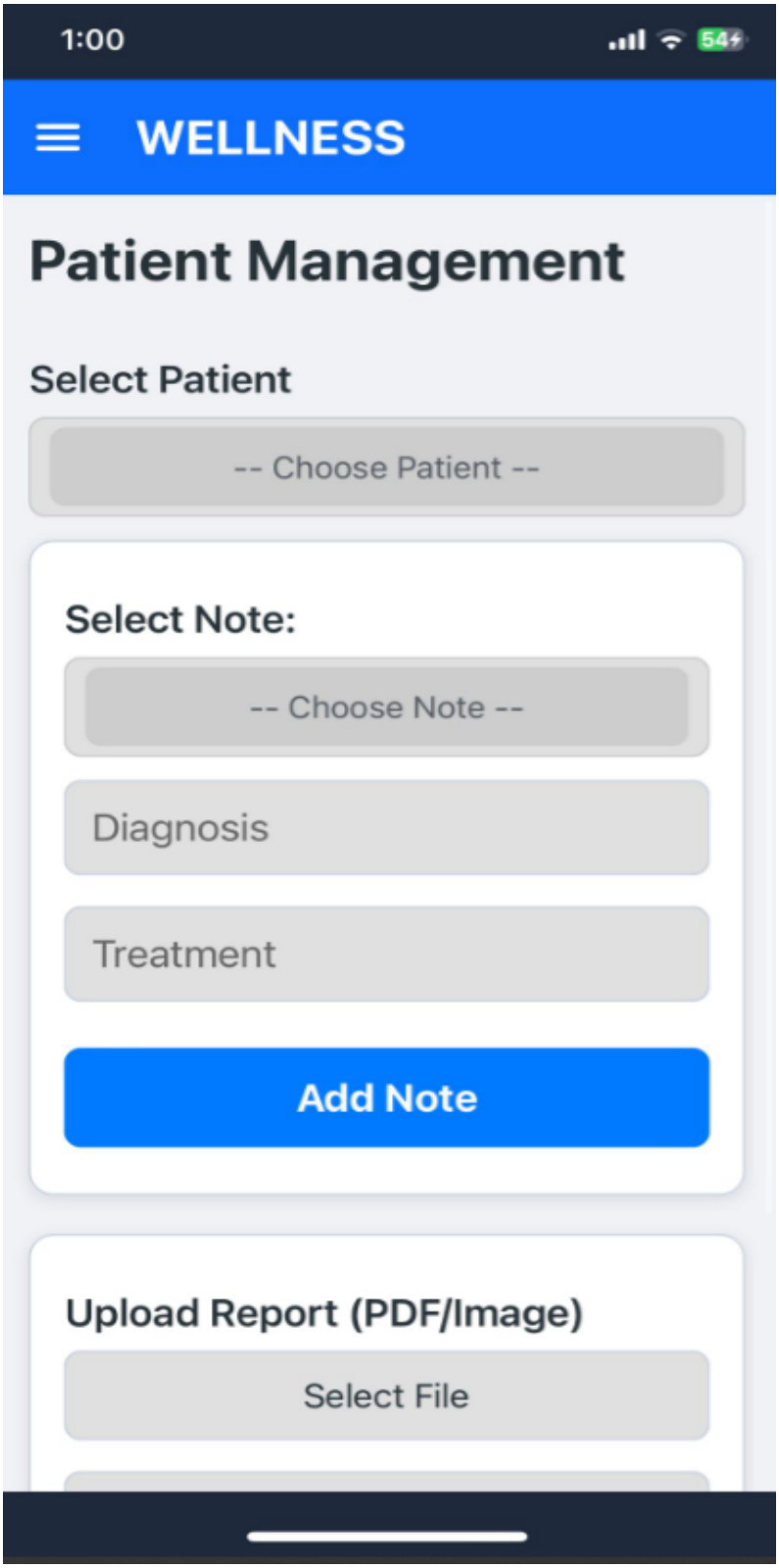


*Figure 3.46: Patient Managements Page*

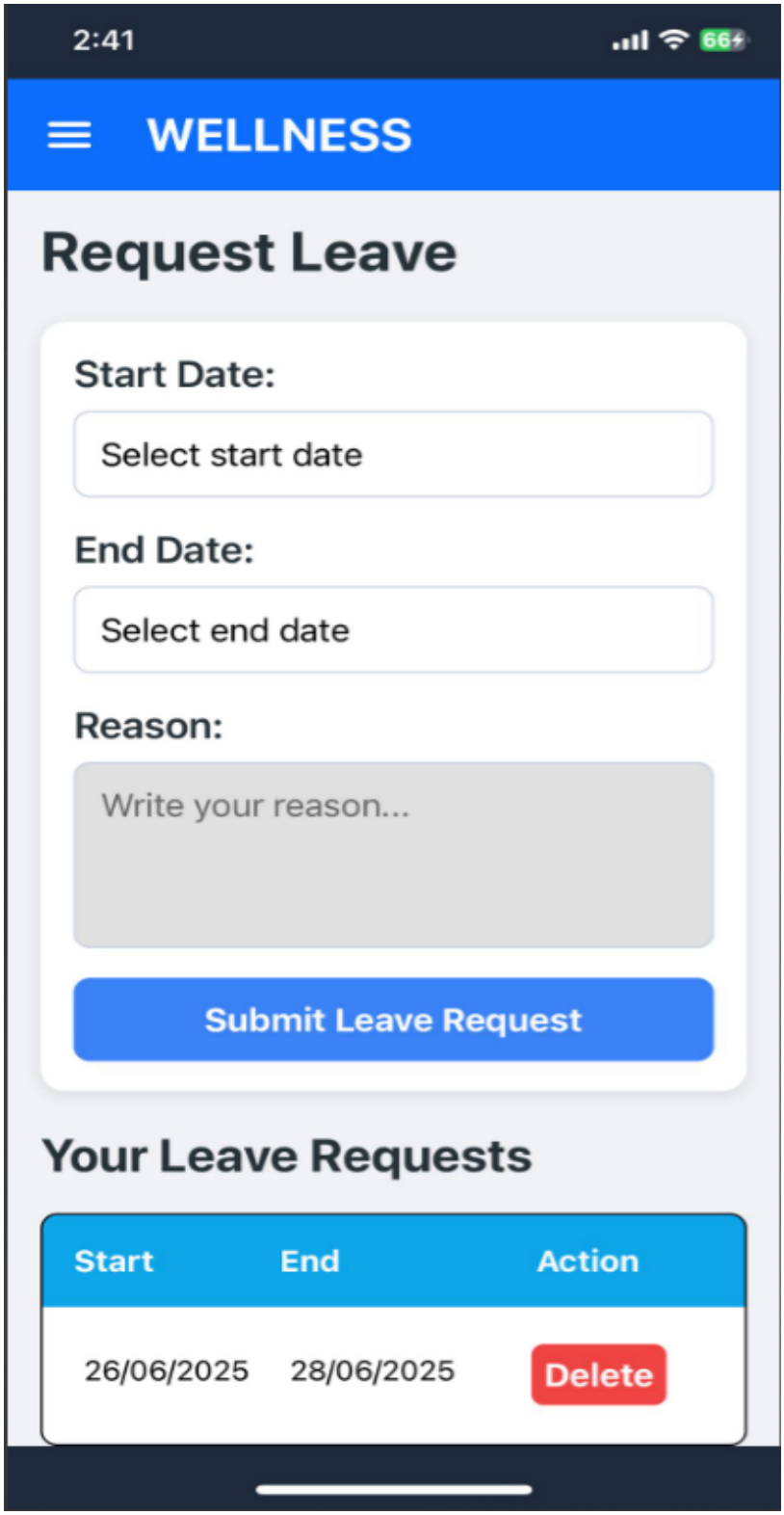


*Figure 3.47: Leave Request  Page*

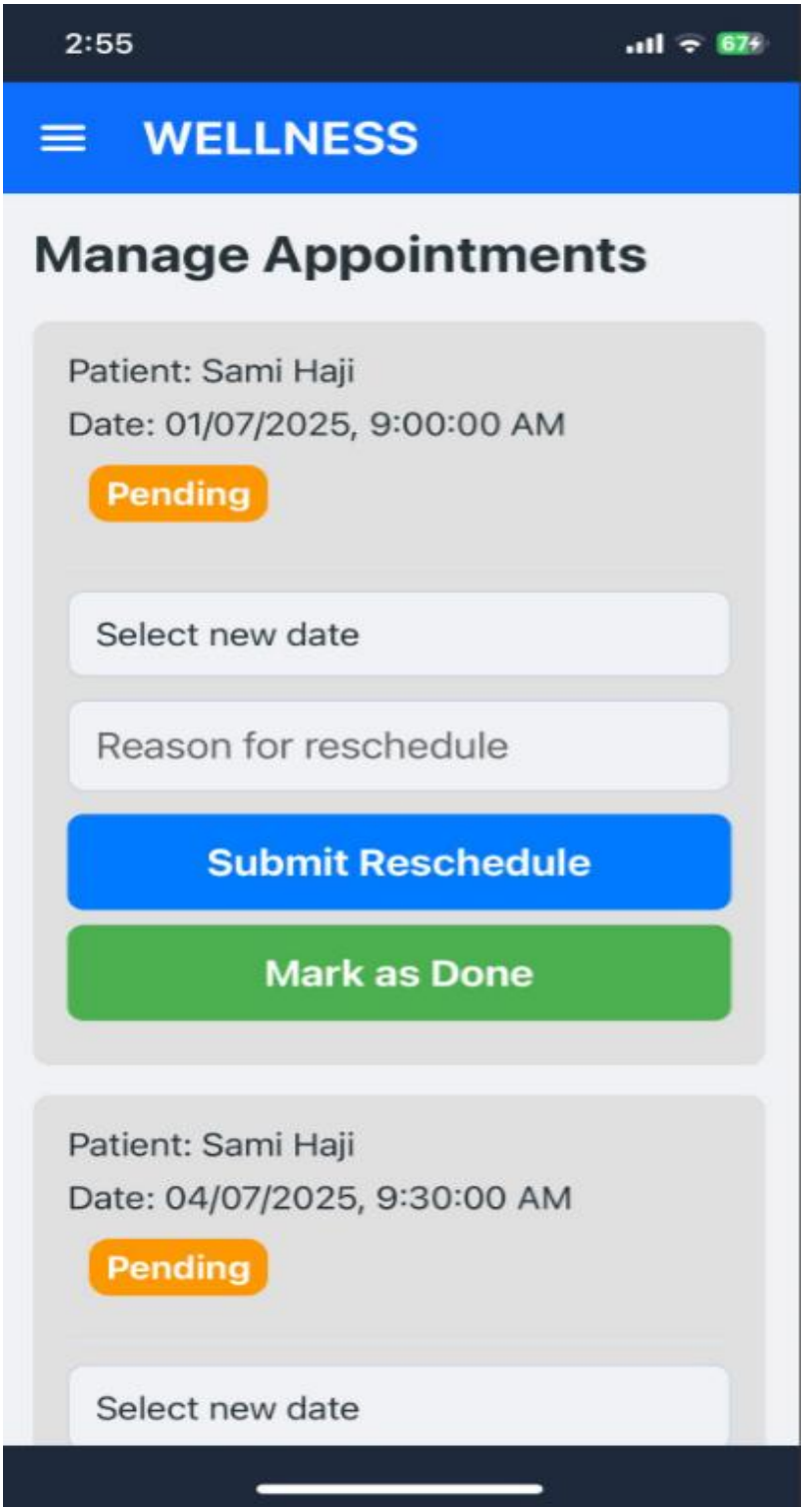


*Figure 3.48: Appointment Management Page*

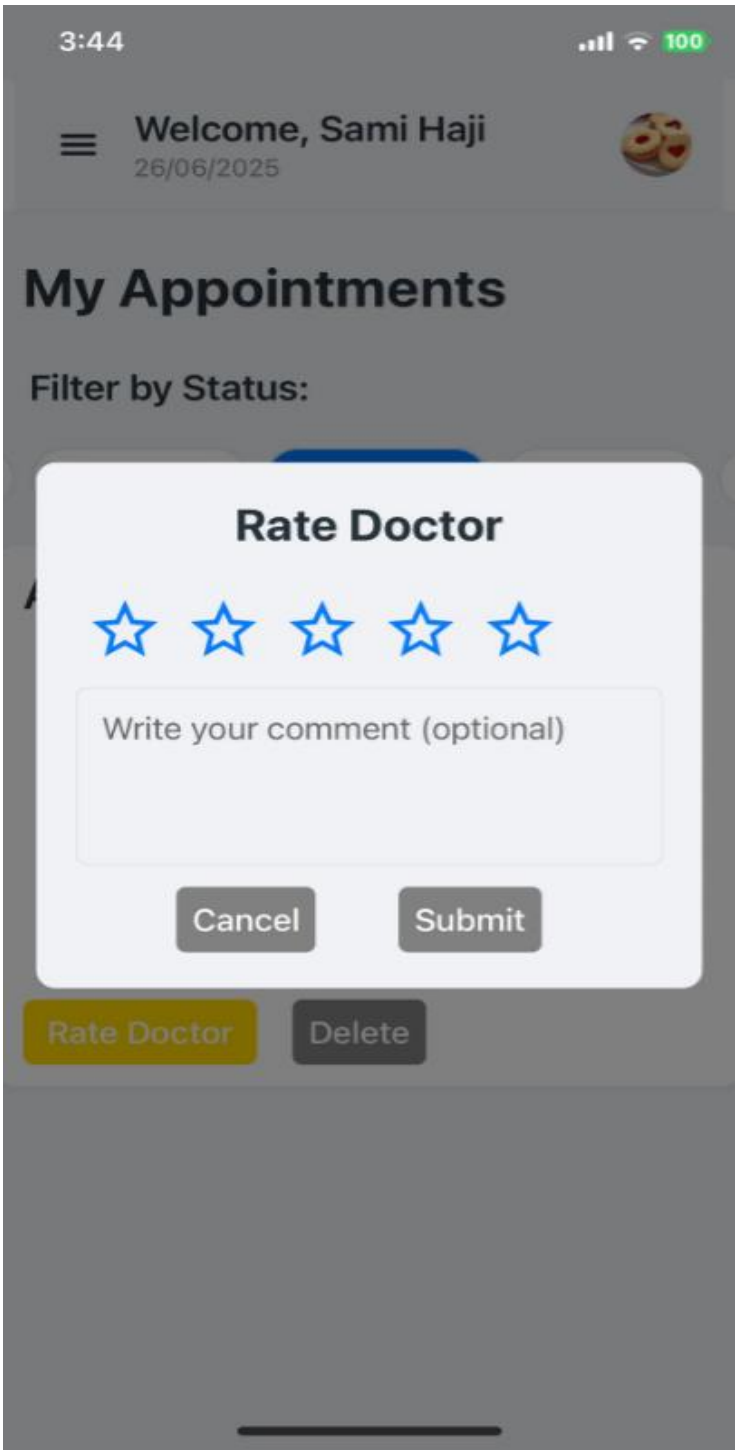


*Figure 3.49: Rate Doctor Page*

# Chapter 4

## Results and Discussion

### 4.1 Functionality and User Experience

The SHES platform was designed to provide a seamless and intuitive experience for all users, including patients, doctors, supervisors, and administrators. The system features role-specific dashboards, responsive interfaces for web and mobile, and clearly organized workflows. Users can easily navigate through appointment scheduling, medical history access, leave request management, and feedback submission. The AI-powered symptom analysis tool adds an extra layer of interactivity, helping patients engage with the system even before their clinical visit.

### 4.2 Anticipated Impact on Hospital Staff

Although SHES has not yet been deployed in a real hospital setting, its features are expected to significantly reduce administrative burden on staff. Doctors can manage schedules and leaves more efficiently, supervisors can monitor performance and approve requests in real-time, and administrators can maintain structured oversight of the entire hospital flow. The smart scheduling system reduces the chance of double bookings or missed appointments, while automated notifications keep everyone updated on changes or approvals.

### 4.3 Anticipated Impact on Patients

Even without live patient feedback, SHES has been developed with a patient-first mindset. Patients are expected to benefit from clearer access to appointment options, medical histories, and symptom assessments. By empowering patients to take an active role in their healthcare journey—through features like feedback submission, chat with doctors, and appointment tracking—SHES fosters a more transparent and interactive hospital experience.

## 4.4 Integrating Features from Existing Systems

SHES builds on the strengths of existing hospital systems but introduces enhancements that are often missing in traditional HIS platforms. It includes intelligent automation, AI-driven interactions, and structured role-based access in a unified, user-friendly environment. The system was designed to operate as an enhancement layer rather than a replacement, making integration with existing infrastructures smoother and more cost-effective.

## 4.5 Discussion

The development of SHES was driven by real challenges observed in healthcare environments, such as poor scheduling, lack of feedback mechanisms, and manual administrative tasks. By focusing on user roles, workflow automation, and mobile access, SHES aims to deliver a balanced system that improves efficiency without increasing complexity. While the current version was developed for demonstration and testing purposes, its architecture and features make it well-suited for future real-world deployment. The success of the platform will depend on continuous iteration, user feedback, and integration with live hospital data systems to maximize its impact.

# Chapter 5

## Conclusion

### 5.1 Summary

The SHES project was developed to enhance hospital workflows by providing an intelligent, user-friendly platform that bridges the gap between traditional hospital management systems and modern digital healthcare needs. The system offers distinct interfaces for patients, doctors, supervisors, and administrators—each tailored to their respective roles—while introducing features like AI-based symptom analysis, smart appointment scheduling, and structured leave request management. The web and mobile applications were designed with usability and scalability in mind, and their successful integration demonstrates the project's ability to improve healthcare efficiency and patient engagement

### 5.2 Recommendations for Improvement

Although the SHES platform meets its current objectives, several enhancements can be considered to increase its impact. Future versions can incorporate machine learning to further personalize the AI [3]symptom analyzer and optimize scheduling recommendations based on historical data. Multilingual support would help broaden accessibility, especially in diverse healthcare environments. Advanced features like video consultation modules, real-time chat between patients and doctors, and integration with wearable health devices could significantly improve interactivity and responsiveness.

### 5.3 Lessons Learned

Throughout the development of SHES, several key lessons were learned. The importance of designing with the end-user in mind was central to creating an effective solution. Building a healthcare platform requires close attention to privacy, security, and ease of use. We also realized that incorporating modular architecture (Clean Architecture) and following best practices in backend and frontend development greatly improved maintainability. Finally, the project highlighted the critical role of secure data handling and role-based access in medical systems where information sensitivity is a top priority.

## 5.4 Future Work and Directions

Future versions of the SHES platform can include several enhancements to extend its capabilities and adaptability in real-world hospital environments. One key improvement would be the addition of multilingual support, making the system more accessible to a broader user base, including patients and staff who speak different languages.

Another important direction is the integration of video consultation functionality, allowing patients to connect remotely with doctors—especially valuable in emergency situations or for follow-up visits. The AI-based symptom analysis module can also be upgraded using machine learning techniques and historical patient data to provide more accurate and personalized diagnostic suggestions.

In terms of communication, SHES could be enhanced with real-time notification systems using SMS or mobile push notifications, ensuring that users are promptly informed about appointment updates, test results, or administrative approvals.

Finally, although not implemented in the current version, the addition of a smart inventory management module remains a valuable future goal. This would allow supervisors and admins to monitor medication and supply levels, receive alerts for low-stock items, and automate restocking processes based on usage trends—thereby improving hospital resource efficiency.

## 5.5 References:

[1] Housley, B. (2020). *Securing Web Applications with JSON Web Tokens (JWT)*. O'Reilly Media.

[2] Martin, R. C. (2017). *Clean Architecture: A Craftsman's Guide to Software Structure and Design*. Prentice Hall.

[3] Topol, E. (2019). *Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again*. Basic Books.

[4] Xu, Z., & Cai, L. (2020). Intelligent appointment scheduling in healthcare using deep reinforcement learning. *Journal of Biomedical Informatics*, 109, 103541.

[5] Johnson, C. M., Johnson, T. R., & Zhang, J. (2005). A user-centered framework for redesigning health care interfaces. *Journal of Biomedical Informatics*, 38(1), 75–87.