WEB BASED HOSPITAL APPOINTMENT MANAGEMENT SYSTEM

BY

ARUYA OMUAH DEBBIE

PSC2105312

DEPARTMENT OF COMPUTER SCIENCE,

FACULTY OF COMPUTING,

UNIVERSITY OF BENIN, BENIN CITY.

NOVEMBER, 2025

WEB BASED HOSPITAL APPOINTMENT MANAGEMENT SYSTEM

BY

ARUYA OMUAH DEBBIE

PSC2105312

SUBMITTED TO:

DEPARTMENT OF COMPUTER SCIENCE,
FACULTY OF COMPUTING,
UNIVERSITY OF BENIN, BENIN CITY.

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF SCIENCE (B.Sc.) DEGREE IN COMPUTER SCIENCE

NOVEMBER, 2025

CERTIFICATION

This is to certify that this project titled **"WEB BASED HOSPITAL APPOINTMENT MANAGEMENT SYSTEM"** was carried out by **ARUYA OMUAH DEBBIE** with Matriculation number: **PSC2105312** and submitted to the Department of Computer Science, Faculty of Computing, University of Benin, Benin City, under the supervision of **PROF. F. AMADIN**.

_____ _____

PROF. F. AMADIN **Date**
Supervisor

APPROVAL PAGE

This project titled **"WEB BASED HOSPITAL APPOINTMENT MANAGEMENT SYSTEM"** by **ARUYA OMUAH DEBBIE** with Matriculation number: **PSC2105312** has been approved as meeting the requirements for the award of Bachelor of Science Degree in the Department of Computer Science, Faculty of Computing, University of Benin, Benin city.

_____ _____

DR. MAXWELL OSAGIE **Date**
Project Coordinator

_____ _____

DR. ROSEMARY USIOBAIFO **Date**
Head of Department

_____ _____

EXTERNAL EXAMINER **Date**

DEDICATION

This work is dedicated to the Almighty God, the source of life and giver of grace and strength, who, by his mercies and grace, saw to the finishing of this project work, and this milestone in this academic journey.

ACKNOWLEDGEMENTS

My utmost acknowledgement goes to God Almighty for giving me the strength, wisdom and direction throughout my academic journey. I would like to express my gratitude to my project supervisor PROF. F. AMADIN for his consistent guidance towards ensuring the successful completion of this project.

I sincerely appreciate The Dean, Faculty of Computing, Dr. (Mrs.) R. A. Usiobaifo (Head of Department), and the distinguished academic staff: Prof. (Mrs.) F. A. Egbokhare, Prof. A. A. Imianvan, Prof. G. O. Ekuobase, Prof. (Mrs.) A. O. Egwali, Prof. F. A. U. Imouokhome, Prof. (Mrs.) S. Konyeha, Prof. (Mrs.) V. I. Osubor, Prof. F. O. Chete, Dr. E. Nwelih, Dr. (Mrs.) G. O. Aziken, Mr. E. E. Obasohan, Dr. F. O. Oliha, Dr. (Mrs.) R. O. Osaseri, Dr. C. E. Igodan, Dr. M. Osagie, Mr. K. O. Otokiti, Mr. I. E. Obayagbona, Miss L. O. Usiosefe, Mr. J. O. Okhuoya, Mr. G. I. Evbuomwan, and all non-teaching staff for their immense contributions, mentorship, and support.

Finally, I also want to appreciate those who contributed to the success of this project: Jubilee Abiodun Uhunoma, Fortune Okoha, Courage Ewarami-Yesin, Ojeh Ellis. I would also like to thank my family and friends for their support, words of encouragement, and consistent guidance throughout this project.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This project addresses the inefficiencies inherent in the manual appointment scheduling system at the University of Benin Health Centre, characterized by long waiting times, overcrowding, and poor data management. The study aimed to develop a centralized, web-based hospital appointment management system to enhance operational efficiency and patient access. The solution was designed using a three-tier client-server architecture and UML modeling (Use Case, Class, Activity, and Sequence diagrams) to define the clear interactions between Patients, Doctors, and Administrators. Implementation utilized PHP, MySQL, and Bootstrap to deliver a secure, responsive platform. Key functionalities include real-time appointment booking, doctor profile management, administrator approval/cancellation. Testing and evaluation confirmed the system's robustness and its successful fulfillment of all functional requirements. In conclusion, the developed system successfully digitizes the entire appointment workflow, significantly reducing administrative burdens and patient waiting times, thereby improving the overall quality of healthcare service delivery. Future recommendations include integration with external hospital systems, SMS reminders and advanced security features.

CHAPTER ONE

INTRODUCTION

1.1 Background of Study

Efficient appointment scheduling is a vital component of healthcare delivery, as it determines how well patients can access medical care and how effectively healthcare providers manage their time and resources. In many hospitals and clinics, especially in developing regions, the process of booking appointments remains largely manual. This leads to long wait times, overcrowding, scheduling conflicts, and administrative strain, all of which negatively impact the quality of care (Balaraman & Kosalram, 2013).

Appointment systems are not merely tools for time management; they are critical for ensuring smooth patient flow, optimizing resource utilization, and enhancing overall experience for both patients and hospital staff. Factors influencing system efficiency include patient arrival patterns, variability in consultation times, doctor preferences, availability of digital tools, and administrative competence (Balaraman & Kosalram, 2013).

More advanced web-based systems have been developed to address these inefficiencies. Idowu, Adeosun, and Williams (2017) presented an NHIS online outpatient booking platform, allowing patients to view doctors' schedules, book consultations, and generate reports. This ensured greater transparency and reduced missed appointments. Similarly, Okeke and Musa (2016) designed a Patient Management Information System (PMIS) at General Hospital, Ijebu-Ode, replacing repetitive paper-based processes with a digital framework that collected personal data once and updated medical records automatically. These systems improved efficiency but faced challenges in scalability and broader institutional integration.

At the university level, specialized solutions have been explored. Eyakndue (2018) developed an agent-based appointment management system for the University of Calabar Medical Centre, demonstrating that digital scheduling could reduce outpatient waiting time by up to 44%. More recently, Elochukwu, Njoku, Okpalla, and Odii (2021) proposed a progressive web application (PWA) for the FUTO Medical Centre, offering offline support, push notifications, and cross-platform functionality to overcome technological barriers. These studies highlight the transformative potential of digital systems while revealing ongoing limitations, such as cost, user adoption, and adaptability across different hospital environments.

At the University of Benin Health Centre, appointments are still largely managed through conventional processes, contributing to overcrowding, long patient waiting times, and administrative strain. Building on lessons from previous systems, this study proposes a web-based hospital appointment management system tailored to UNIBEN, with a focus on a user-friendly interface, improved communication, and efficient record management. The goal is to reduce waiting times, minimize administrative bottlenecks, and enhance patient satisfaction and the overall relationship between patients and healthcare providers.

1.2 Statement of Problem

Appointment scheduling at the University of Benin Health Centre continues to pose significant challenges for both patients and hospital staff. The reliance on manual or poorly integrated systems often results in long waiting times, overcrowded outpatient departments, and coordination difficulties, especially during peak periods (Balaraman & Kosalram, 2013). These problems reduce the quality of service delivery, diminish patient satisfaction, and place additional strain on administrative staff who must manage appointments by hand. Although some web-based appointment systems have been introduced in Nigeria, they often face limitations in usability,

adaptability, and support for effective doctor–patient communication (Idowu, Adeosun, & Williams, 2015; Eyakndue, 2018). As a result, patients frequently encounter delays in booking consultations, while staff struggle to manage schedules and keep accurate records. These recurring inefficiencies highlight the urgent need for a centralized and user-friendly web-based hospital appointment management system that can improve appointment coordination, enhance communication, and support more efficient healthcare delivery at the University of Benin Health Centr**e.**

1.3 Aim and Objectives of the Study

Aim:

To develop a web-based hospital appointment management system that improves patient access to healthcare and enhances operational efficiency at the University of Benin Health Centre.

Objectives:

To achieve the stated aim of the study, the following objectives are outlined:

1. To review existing hospital appointment management systems towards establishing a gap which will be filled by this work
2. To design a system that makes appointment management convenient for both administrators and patients
3. To develop the designed system using a web-based platform
4. To test and validate the functionalities of the system

1.4 Significance of the Study

This study addresses persistent challenges in hospital appointment management at the University of Benin Health Centre, where high patient volumes and manual scheduling often lead to delays

and inefficiencies. The proposed system automates appointment tracking, sends timely reminders, and centralizes patient records, ensuring smoother coordination between patients and staff. By streamlining the scheduling process, it helps reduce waiting times, prevent missed appointments, and allows hospital staff to focus more on delivering quality healthcare rather than administrative tasks.

Furthermore, the system facilitates data-driven decision-making, enabling hospital administrators to analyze patient flow, optimize resource allocation, and generate accurate reports for improved operational planning. Beyond immediate benefits for patients and staff, this study demonstrates how technology can enhance service delivery in Nigerian hospitals, improve patient satisfaction, and promote more efficient management practices. In essence, it highlights the potential of digital systems to transform healthcare operations, making them more reliable, organized, and responsive.

1.5 Scope and Limitation of the Study

Scope:

This project focuses on the development of a web-based hospital appointment management system for the University of Benin Health Centre. It will provide patients with an easy-to-use platform to book, modify, or cancel appointments, and allow hospital staff to track and manage schedules efficiently. The system will include features such as automated reminders via email, appointment reporting, and centralized patient information, aimed at improving patient flow and communication between staff and patients. The study focuses on the software itself covering both front-end and back-end implementation for the case study hospital and does not cover integration with national health databases or third-party systems.

Limitations:

The system's performance depends on reliable internet access, which may be a challenge in areas with connectivity issues. Advanced features such as biometric authentication or integration with external hospital systems are not included in this version. The system is designed specifically for the University of Benin Health Centre which implies that modifications may be required for deployment in other hospitals. Additionally, staff and patients need basic digital literacy to fully utilize the platform.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview of A Web Based Hospital Management System

A Web-Based Hospital Appointment Management System (WHAMS) is designed to improve healthcare delivery by enabling patients to conveniently schedule, modify, or cancel medical appointments using online platforms. Unlike manual or semi-automated systems, WHAMS provide real-time synchronization of patient data, integrates seamlessly with electronic medical records (EMRs), and supports enhanced security protocols through encryption and role-based access. This integration ensures that healthcare providers have instant access to updated information, reducing delays in patient care and administrative bottlenecks (Mouttham et al., 2021).

Globally, WHAMS adoption has been driven by government incentives and health reforms. For instance, in the United States, the Centers for Medicare and Medicaid Services (CMS) have introduced reimbursement models to encourage hospitals to digitize appointment systems, while in the UK, the National Health Service (NHS) has made digital booking the default option for most outpatient care (Harrison & Wood, 2020). These policies demonstrate how structured government frameworks can accelerate adoption and ensure standardization.

In contrast, adoption in Nigeria remains slower. While some tertiary hospitals and teaching hospitals in urban centers have piloted web-based appointment platforms, the majority of healthcare facilities, particularly in rural areas, still depend on manual booking methods. This gap is partly due to infrastructural challenges such as inconsistent electricity supply, limited broadband coverage, and high setup costs (Okeke & Musa, 2021). Moreover, while policies like the Federal Ministry of Health's National eHealth Strategy (2015) highlight the importance of digital health transformation, implementation has been fragmented and underfunded.The University of Benin

Health Centre reflects these broader challenges, as it continues to rely primarily on manual scheduling, exposing patients and staff to delays and inefficiencies.

Although WHAMS offer clear benefits efficiency, improved patient satisfaction, and reduced administrative burden the uneven pace of adoption between Nigeria and developed countries highlights a critical gap. This makes Nigeria as a whole and University of Benin health centre relevant cases for studying the challenges and opportunities in implementing WHAMS in low- and middle-income contexts.

2.2 Types of Hospital Appointment Management Systems

2.2.1 Manual Appointment Systems (Okeke & Musa, 2021)

Manual appointment systems use paper registers where staff record patient details and allocate slots by hand. They remain common in Nigeria, especially in rural areas with poor digital infrastructure (Okeke & Musa, 2021). Their strengths lie in being cheap, easy to use, and independent of electricity or internet (WHO, 2018). However, as patient numbers grow, problems such as misplaced records, double bookings, long queues, and overcrowding arise (Adebayo & Omotosho, 2020). These inefficiencies frustrate patients and overburden staff, weakening trust and straining staff–patient relationships. Such issues are evident at the University of Benin Health Centre, where patients still queue physically to secure appointments, reflecting the continued dominance of manual booking methods in Nigerian public hospitals.

Despite national policies like the Health ICT Strategic Framework (Federal Ministry of Health, 2016) promoting e-health, most public hospitals remain tied to paper-based methods. This gap between policy and practice widens inequality, as some urban hospitals adopt digital systems while rural centers lag behind.

Weaknesses:

1. High risk of record loss or damage.
2. Time-consuming, leading to long patient queues.
3. Prone to double bookings and human error.
4. Limited accessibility, since patients must book in person.

2.2.2 Semi-Automated Appointment Systems (Adebayo & Omotosho, 2020)

Semi-automated systems represent a middle ground between manual and fully web-based approaches. Here, hospitals use tools such as Microsoft Excel spreadsheets or locally installed scheduling software to manage bookings. While this reduces some manual workload and errors, staff are still required to enter data manually and oversee the scheduling process. Such systems often lack remote access, meaning patients still depend heavily on hospital staff to book or reschedule appointments. In Nigeria, some private hospitals in urban areas have adopted semi-automated systems as a transitional step, but their limited scalability and inability to integrate with other healthcare services remain significant drawbacks. This highlights a gap between the availability of digital tools and the capacity to use them efficiently at scale.

Weaknesses:

1. Still prone to double bookings without proper controls.
2. Limited remote access since most are not web-enabled.
3. Dependence on staff availability for booking operations.

2.2.3. Fully Appointment Web-Based Appointment Systems

Fully web-based systems automate the entire appointment process through online platforms that allow patients to register, select available slots, and book appointments in real time. These systems can send reminders via SMS or email, generate appointment reports, and often integrate with

electronic medical records, billing systems, and laboratory management platforms. By reducing staff intervention, they minimize errors, enhance transparency, and improve communication between patients and providers.

Eyakndue (2018) and Elochukwu et al. 2021) reported that web-based systems significantly reduce waiting times and missed appointments while increasing patient satisfaction. Beyond convenience, they support patient-centered care by allowing individuals to choose appointment times that suit their schedules and participate actively in healthcare decision-making. For example, studies in Nigeria have reported improvements in patient flow and reduced administrative strain where such systems were piloted (Okeke & Musa, 2021). However, challenges such as the high cost of deployment, dependence on stable internet connectivity, and reluctance from some patients,particularly the elderly or digitally inexperienced to adopt online scheduling still persist. These issues reflect broader barriers to e-health adoption in Nigeria, despite government strategies to promote digital health under the National Health ICT Strategic Framework (Federal Ministry of Health, 2016).

Strengths:

1. Real-time appointment booking and updates.
2. Reduced administrative workload.
3. Improved patient satisfaction through convenience.

2.3 Related Technologies in Web-Based Appointment Management

Web-Based Hospital Appointment Management Systems (WHAMS)(Shaip, 2023; Okeke & Musa, 2021) rely on various supporting technologies that enhance their functionality, reliability, and user

experience. These technologies work together to ensure real-time booking, efficient communication between patients and healthcare providers, and secure storage of appointment data.

2.3.1 Online Booking Platforms

Online booking platforms form the foundation of most web-based appointment management systems, providing patients with a digital interface to select, confirm, or reschedule appointments without visiting the hospital. Studies such as Adesina (2020) and WHO (2018) highlight that these platforms improve transparency in time-slot allocation and reduce overcrowding in waiting halls by minimizing walk-in traffic. Unlike manual or semi-automated methods, they offer patients autonomy and flexibility in choosing suitable consultation times.

However, the effectiveness of online booking platforms is context-dependent. In countries with stable internet access and high digital literacy, they have led to measurable reductions in waiting times and administrative workload. In Nigeria, adoption remains uneven. Many urban hospitals have experimented with online booking, but rural facilities struggle due to poor broadband coverage and patients' limited familiarity with digital tools (Federal Ministry of Health, 2016). This reveals a gap between availability and usability: while the platforms exist, their impact is limited by infrastructural and socio-economic barriers.

Compared to mobile-based systems, online booking portals are less portable, as they typically require a computer or strong internet connection. They remain a critical first step in digital transformation, often serving as the foundation upon which more advanced solutions like mobile apps or telemedicine platforms are built.

Key Features:

1. Calendar integration showing doctor availability.

2. Automatic booking confirmation via email/SMS.
3. Multiple payment gateway integration for prepaid consultations.

Advantages:

1. Eliminates the need for physical visits to make bookings.
2. Enables 24/7 appointment scheduling.
3. Reduces administrative burden on hospital reception staff.

Limitations:

1. Requires patients to have internet access.
2. May cause confusion for elderly patients unfamiliar with online tools.

2.3.2 Mobile Integration (Ojo & Popoola, 2020)

Mobile integration extends appointment management systems to smartphones, making healthcare more accessible through apps or SMS reminders. Ojo & Adebayo (2019) show that mobile platforms significantly reduce missed appointments by sending automated reminders, while WHO (2021) emphasizes their role in promoting patient-centered care, particularly in resource-limited settings. Mobile tools allow patients not only to book appointments but also to receive lab results, medication updates, or follow-up schedules. Mobile-based systems are more portable and adaptable than online booking portals to local realities but their reliance on mobile literacy and network stability still limits universal adoption.

In Nigeria, mobile integration is especially relevant due to high mobile phone penetration, even in rural areas. Unlike fully web-based systems that depend on stable broadband and computer access, mobile platforms leverage the widespread use of GSM networks (Federal Ministry of Health, 2016). For example, SMS-based reminders have been piloted in Lagos and Abuja to improve immunization adherence and antenatal care attendance, with promising results (Eze & Okon, 2020).

Yet, the University of Benin Health Centre has not fully leveraged mobile-based appointment tools, limiting patient engagement and perpetuating long queues.

Key Features:

1. Real-time push notifications for reminders.
2. Access to medical records and appointment history.
3. Mobile payment and telemedicine video call integration.

Advantages:

1. Increases user engagement and reduces missed appointments.
2. Supports on-the-go booking for busy patients.
3. Allows direct communication through in-app messaging.

Limitations:

1. Requires mobile app updates to fix bugs or add new features.
2. High development costs compared to web-only solutions.

2.3.3 Cloud-Based (Nwankwo & Adebisi, 2021) Systems

Cloud-based appointment management systems store patient records, schedules, and medical histories on secure servers accessible online. This method allows healthcare providers to update and retrieve data in real time, promoting collaboration between doctors, nurses, and administrative staff. According to Alhassan et al. (2018), cloud adoption in healthcare improves efficiency by reducing paperwork and enabling data sharing across multiple facilities. Similarly, WHO (2021) highlights that cloud platforms support interoperability—an essential factor for integrated health delivery systems.

In Nigeria, cloud-based solutions are gradually gaining attention, particularly within tertiary hospitals and private healthcare organizations. However, challenges exist around poor internet infrastructure, concerns about cybersecurity, and the affordability of hosting services. A study by Chukwu & Adeoye (2019) found that many Nigerian hospitals express interest in cloud adoption but lack adequate funding and skilled personnel to manage the transition. Government initiatives, such as the National Health ICT Strategic Framework (2015–2020), stress the importance of cloud technologies in digitizing healthcare records, but implementation has been slow. This slow pace is evident at the University of Benin Health Centre, where cloud solutions are absent, forcing staff to depend on physical records and manual processes.

Unlike manual and mobile-based systems, cloud-based solutions offer scalability and a centralized record system and they face more resistance in low-resource settings where internet penetration and trust in data security remain low.

Key Features:

1. Centralized storage of patient appointment data.
2. Real-time synchronization across devices and locations.
3. Automatic data backup and recovery.

Advantages:

1. Accessible from anywhere with internet connectivity.
2. Scalable to handle increasing patient volumes.
3. Reduces local hardware costs.

Limitations:

1. Requires reliable internet connectivity.
2. Data security concerns if hosted on third-party servers.

2.3.4 Artificial Intelligence (Shaip, 2023) (AI)-Based Scheduling

AI-driven appointment systems use predictive analytics to forecast demand, allocate slots efficiently, and reduce no-shows (WHO, 2022). For example, AI can learn from patient history and peak attendance times to optimize scheduling. In Nigeria, however, AI adoption in healthcare remains minimal due to cost, limited expertise, and lack of large datasets for model training (Okeke & Musa, 2021). While AI offers the promise of reducing inefficiencies, its high setup cost makes it impractical for most local hospitals.

Key Features:

1. Predictive analytics for no-show rates.
2. Automated allocation based on urgency and doctor specialty.
3. Adaptive scheduling that adjusts to real-time changes.

Advantages:

1. Improves appointment efficiency and reduces idle doctor time
2. Enhances patient satisfaction by offering faster booking options.
3. Can integrate with triage systems for emergency prioritization.

Limitations:

1. High initial development and implementation costs.
2. Requires large datasets for accurate predictions.

2.3.5 Telemedicine (Eze et al., 2019) Integration

Telemedicine has gained traction as part of appointment management, especially during the COVID-19 pandemic. Eze et al. (2019) note that integrating telemedicine with appointment booking allows virtual consultations, prescription delivery, and remote follow-ups. In Nigeria, telemedicine initiatives have been piloted under the FMoH's eHealth policy, though challenges

such as unstable electricity supply, weak internet coverage, and low trust in digital consultations persist (Adesina, 2020). Despite these barriers, telemedicine remains a critical complement to appointment systems, especially for rural communities with limited physical access to hospitals.

Key Features:

1. Secure video conferencing.
2. Digital prescription delivery.
3. Remote monitoring of patient vitals (in advanced setups).

Advantages:

1. Expands healthcare access to remote or rural areas.
2. Reduces hospital crowding.
3. Saves time for both patients and doctors.

Limitations:

1. Requires strong internet connectivity for video calls.
2. Some medical conditions still require in-person visits.

2.3.6 SMS Notification Systems

SMS reminders continue to play a vital role in healthcare delivery in Nigeria, where internet penetration is still inconsistent, and data costs are high. According to Ojo and Popoola (2020), SMS alerts significantly reduce missed appointments by reminding patients of upcoming visits, cancellations, or reschedules. Unlike mobile apps, SMS reaches even basic mobile phone users in rural areas. However, it requires accurate patient records and incurs additional costs for bulk messaging. Despite these challenges, SMS remains one of the most cost-effective tools for ensuring patient compliance with hospital schedules.

Key Features:

1. Automated appointment reminders via SMS.
2. Notifications for rescheduling, cancellations, and follow-ups.
3. Two-way messaging allowing patients to confirm or cancel directly via text.

Advantages:

1. Reduces missed appointments (no-shows).
2. Accessible to patients without internet or smartphones.
3. Enhances patient engagement, especially in rural areas.

Limitations:

1. Requires accurate patient phone number records.
2. May incur SMS charges for hospitals or patients.
3. Limited compared to mobile apps in terms of functionality.

2.4 Existing Models and Frameworks for Appointment Scheduling

Appointment scheduling models define the method by which hospitals organize, allocate, and manage patient appointment slots. The choice of a scheduling framework directly affects patient waiting times, doctor workload, and the overall efficiency of healthcare delivery. In the Nigerian healthcare context, the right model can mean the difference between overcrowded waiting rooms and a smooth patient flow.

2.4.1 Queue Management Model (Okeke & Musa, 2021)

The queue management model arranges patients in the order of arrival or booking, typically following the First-Come, First-Served (FCFS) principle. In web-based systems, virtual queues allow patients to log in, register, and monitor their position in real time through a portal or mobile

platform (Okeke & Musa, 2021). Such systems are increasingly being applied in Nigerian hospitals to reduce overcrowding in waiting areas, though their adoption remains limited in rural facilities.

Key Components:

1. Queue Registration: Patient logs in or checks in online to join the virtual line.
2. Queue Monitoring: The system updates positions in real time as patients are attended to.
3. Notification System: Alerts patients when it's their turn or when they should start heading to the hospital.

Benefits:

1. Reduces physical congestion in hospital waiting areas.
2. Ensures fairness in order of service.
3. Provides patients with real-time updates on waiting position.

Weaknesses:

1. May not account for emergency or high-priority cases without manual intervention.
2. Requires patients to have some level of digital literacy to join and track queues online.

2.4.2 Patient-Centered Scheduling (Adebayo & Omotosho, 2020) Model

The patient-centered scheduling model prioritizes patient convenience by allowing individuals to choose appointment times that best suit their availability, including evenings, weekends, or virtual consultations. Patients can also reschedule or cancel appointments with minimal restrictions, thereby encouraging flexibility and active participation in healthcare decisions (Adebayo & Omotosho, 2020). In Nigeria, this model is increasingly relevant in urban hospitals where patients demand shorter waiting times and more autonomy, although its adoption is limited in rural areas.

Key Components:

1. Flexible Time Slots: Multiple options per day to suit different patient needs.
2. Self-Service Booking: Patients choose their own slots through a web interface.
3. Feedback Mechanism: Patients can rate their scheduling experience to improve services.

Benefits:

1. Increases patient satisfaction and trust in the hospital.
2. Reduces missed appointments by aligning times with patient availability.
3. Encourages patient loyalty and return visits.

Weaknesses:

1. Requires advanced scheduling algorithms to prevent overlapping bookings.
2. May increase idle time for doctors if patient preferences do not align with optimal workload distribution.

2.4.3 Priority-Based Scheduling (Eze et al., 2019) Model

The priority-based scheduling model allocates appointment slots based on the urgency of a patient's medical condition, ensuring that emergency or urgent cases are attended to before routine check-ups (Eze et al., 2019). This model relies on an initial triage assessment, where patients are categorized as Emergency, Urgent, or Routine, and their appointments are scheduled accordingly. In Nigerian hospitals, particularly tertiary institutions, this model is critical in managing overcrowded outpatient departments and reducing preventable complications. However, its success depends heavily on accurate triage and the availability of skilled staff.

Key Components:

1. Triage Assessment: System or staff assesses urgency based on reported symptoms.
2. Categorization: Patients are classified as Emergency, Urgent, or Routine.

3. Slot Allocation: Emergency and urgent cases override standard appointment times.

Benefits:

1. Ensures timely treatment for life-threatening conditions.
2. Optimizes use of hospital resources in emergency scenarios.
3. Reduces mortality and complication risks.

Weaknesses:

1. Non-urgent patients may face longer waiting times.
2. Requires accurate triage to avoid misclassification.

2.4.4 Hybrid Scheduling (Ojo & Popoola, 2020) Model

The hybrid scheduling model combines elements of queue management, patient-centered, and priority-based scheduling to balance fairness, efficiency, and flexibility. It allows hospitals to serve walk-in patients (queue-based), prioritize emergencies (priority-based), and offer online bookings (patient-centered). This approach maximizes resource use while catering to diverse patient needs. In Nigeria, hybrid models are gradually being considered in tertiary hospitals where patient volumes are high and diverse. For example, emergency cases can be prioritized, routine check-ups scheduled online, and unscheduled walk-ins accommodated through virtual queues.

Benefits:

1. Balances fairness, urgency, and patient preferences.
2. Minimizes wasted slots through dynamic adjustment.
3. Flexible enough to adapt to varying patient volumes and needs.

Weaknesses:

1. Requires more complex software to manage multiple allocation rules.
2. Staff may need extra training to manage and override system decisions when needed.

2.5 Summary of Reviewed Systems

The review of related literature shows that several hospital appointment management systems have been developed to improve healthcare scheduling and reduce patient waiting times. While these systems have demonstrated positive impacts, they also exhibit notable limitations. Some systems are constrained in terms of scalability, functioning effectively only within small healthcare settings but struggling in larger institutions with higher patient volumes (Okeke & Musa, 2016). Others lack user-friendliness and adaptability, making them difficult for patients with limited digital literacy to navigate (Eyakndue, 2018). Cost of deployment and maintenance also poses a barrier, particularly in resource-constrained environments (Idowu, Adeosun, & Williams, 2015). Furthermore, many systems fail to provide adequate real-time communication between patients and doctors, which is essential for reducing missed appointments and improving service coordination (Elochukwu, Njoku, Okpalla, & Odii, 2021). Limitations such as poor integration with existing hospital record systems, inadequate offline support in regions with unstable internet connectivity, and resistance to adoption due to low awareness or lack of trust in digital tools remain significant challenges (Balaraman & Kosalram, 2013).

2.6 Research Gap

Despite these advancements, there is still a clear gap in the development of a centralized, user-friendly, and adaptable hospital appointment management system tailored to institutional contexts such as the University of Benin Health Centre. Existing solutions have not fully addressed issues of scalability, ease of use for diverse patient populations, real-time communication, and efficient record management. Moreover, many reviewed systems were designed for general hospital environments without consideration for the peculiarities of specific healthcare institutions, resulting in reduced effectiveness in practice. This study seeks to fill this gap by developing a web-

based hospital appointment management system that emphasizes convenience, real-time coordination, and improved doctor–patient communication, while also ensuring efficiency and reliability in the scheduling process at the University of Benin Health Centre.

CHAPTER THREE

SYSTEM ANALYSIS AND DESIGN

3.0 Introduction

This chapter provides a comprehensive analysis and design of the *Web-Based Hospital Appointment Management System* developed for the University of Benin Health Centre. It discusses the limitations of the existing manual system, the benefits of the proposed digital solution, and the conceptual and logical design of the new system using Unified Modelling Language (UML) tools.

The chapter also presents the architectural structure, database design, data flow, and interface layout that collectively define the operational backbone of the proposed system. The purpose of this design is to ensure that the system achieves efficiency, usability, scalability, and accuracy in appointment management.

3.1 Analysis of the Existing System

3.1.1 Overview of the Current Workflow

The existing appointment scheduling process at the University of Benin Health Centre is primarily manual and paper-based. Patients seeking medical attention are required to physically visit the centre to book appointments. The administrative staff record patient information in logbooks or paper files and manually communicate available time slots to doctors.

3.1.2 Challenges Observed

The manual nature of this process introduces several inefficiencies:

1. Cumbersome record handling – searching or retrieving patient data takes a lot of time.
2. Frequent loss of data due to torn, misplaced, or outdated records.

3. Long queues and waiting times, especially during peak periods.
4. Communication delays between patients and hospital staff.
5. Difficulty in updating appointment schedules without rewriting entire pages.
6. Poor accessibility – patients cannot view or manage appointments remotely.

3.1.3 Example Scenario

A patient intending to see a doctor must arrive at the clinic early, fill out a paper form, and wait for the records clerk to manually check available doctors. If the doctor's schedule changes, the patient may need to rebook or return another day. This causes frustration and reduces hospital efficiency.

3.2 Disadvantages of the Existing System

The disadvantages of the manual appointment scheduling system can be grouped into technical, operational, and user-related problems.

3.2.1 Technical Disadvantages

- Lack of a centralized database results in fragmented and unstructured information.
- Manual filing increases the risk of data redundancy and inconsistency.
- No data backup, hence vulnerability to permanent record loss.

3.2.2 Operational Disadvantages

- Appointment scheduling and verification are slow, leading to low productivity.
- Difficult to track the number of patients seen per doctor daily.
- Staff workload increases because of repetitive manual entries.

3.2.3 User Disadvantages

- Patients must be physically present to book or check appointment status.
- Inconvenience for patients with mobility issues or those living far away.
- Dissatisfaction due to repeated rescheduling and unclear communication.

3.3 Benefits of the Proposed System

The proposed web-based system introduces automation, accessibility, and real-time data management into the hospital appointment process.

3.3.1 Operational Benefits

1. Improved Efficiency: Appointments can be created, updated, or cancelled within seconds.
2. Automation: Reduces human errors through system validation and digital record keeping.
3. Reduced Paperwork: Eliminates manual logbooks, saving time and space.
4. Enhanced Record Accuracy: All data is consistently stored and easily retrievable.

3.3.2 Technical Benefits

1. Centralized Database: Uses MySQL to store data securely and ensure data consistency.
2. Scalability: The system can easily be extended to handle more patients and doctors.
3. Security: Password encryption (via PHP's password_hash()) ensures user privacy.

3.3.3 User Benefits

1. 24/7 Accessibility: Patients can access the system from any location.
2. Real-Time Updates: Appointment status changes are visible immediately.
3. User-Friendly Interface: The Bootstrap interface is simple, responsive, and intuitive.

4. Transparency: Patients can clearly see appointment confirmations and approvals.

3.4 Analysis of the Proposed System

The proposed system automates all appointment-related processes through an interactive web platform. It involves three categories of users: Patients, Doctors, and Administrators, each with specific privileges and roles.

3.4.1 Objectives of the Proposed System

- To digitize appointment scheduling and management.
- To provide a centralized and secure database.
- To improve doctor–patient communication.
- To reduce human workload and minimize appointment conflicts.

3.4.2 System Features

- Patient registration and login
- Appointment booking form
- Doctor profile management
- Admin approval/cancellation
- Appointment history and feedback

3.4.3 System Requirements

Functional Requirements:

- Patient can register, log in, and book an appointment.
- Admin can view, approve, or cancel appointments.
- Doctor details can be managed by admin.

- Appointment data must be stored in a relational database.

Non-Functional Requirements:

- Accessibility (web-based, responsive)
- Reliability and security (data encryption, authentication)
- Maintainability (modular PHP code)
- Usability (intuitive design, error validation)

3.5 Design of the Proposed System

3.5.1 System Architecture

The architecture of the Web-Based Hospital Appointment Management System is based on a **three-tier client–server model**, which separates the system into three logical layers: the **presentation layer**, the **application layer**, and the **database layer**.

This design ensures scalability, maintainability, and efficient communication between system components. The presentation layer serves as the user interface where patients, doctors, and administrators interact with the system through a web browser. The application layer contains the PHP scripts that handle business logic such as registration, authentication, booking, and approval of appointments. The database layer, implemented using MySQL, manages persistent data storage, including user details, doctor records, and appointment information.

The three layers communicate through standard web protocols. User requests are initiated from the browser interface and transmitted to the PHP server via HTTP. The server processes the requests, performs necessary operations on the database using SQL queries, and returns

appropriate responses to the user interface. This structured communication flow promotes modular development, improves security, and simplifies debugging and future upgrades.

The overall architectural design of the proposed system is illustrated in **Figure 3.1**.

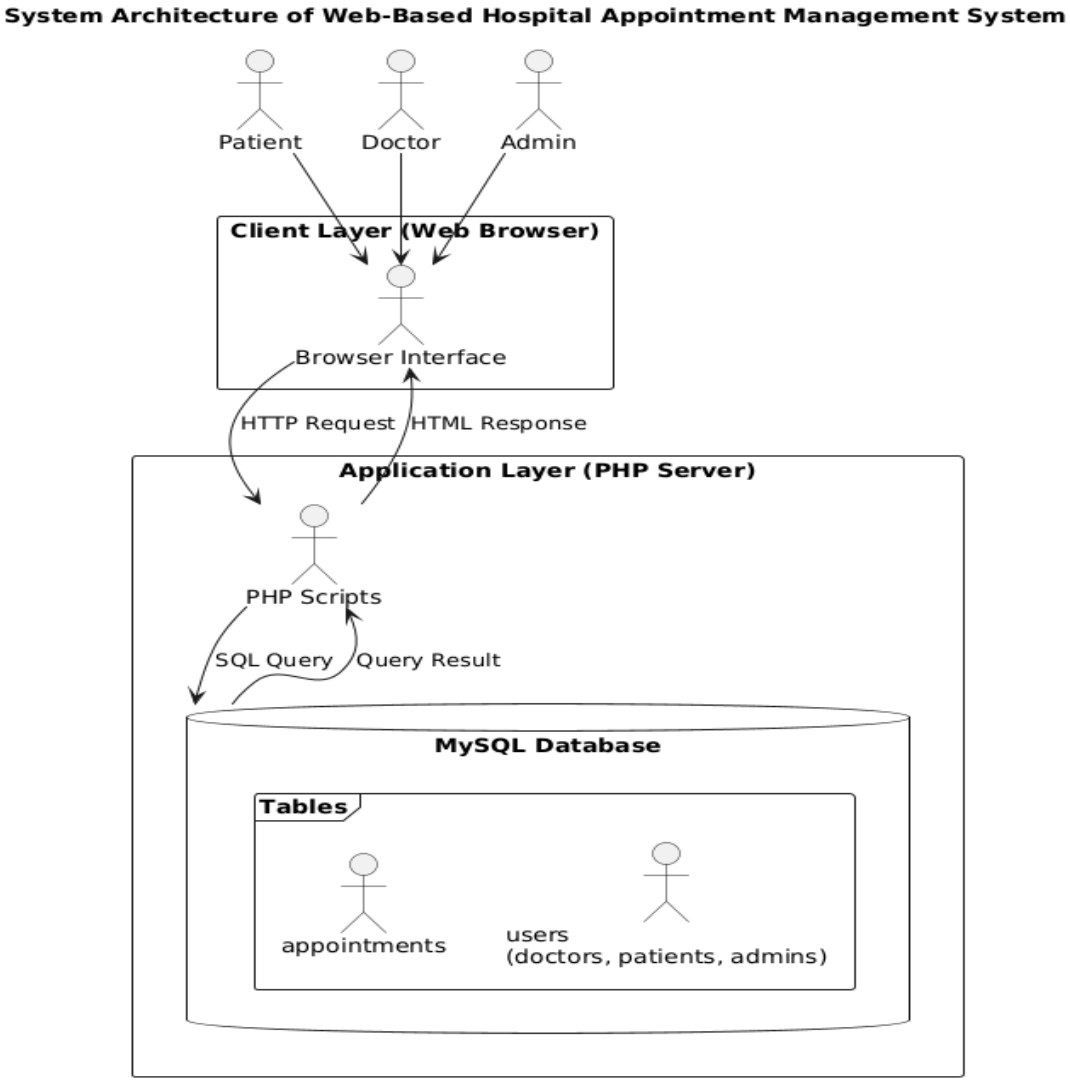


Figure 3.1: System Architecture Diagram of the Proposed System

3.5.2 UML Diagrams

To document the system conceptually, the following UML diagrams are used:

A. Use Case Diagram

The Use Case Diagram illustrates the major interactions between users and the Web-Based Hospital Appointment Management System. The three primary actors are the Patient, Doctor, and Administrator.

Each actor performs specific functions within the system:

- Patients register, log in, and book appointments with available doctors.
- Doctors view appointments assigned to them and schedule date and time.
- Administrators manage user accounts and view appointment reports and feedback.

Figure 3.2 shows the complete Use Case Diagram of the proposed system.

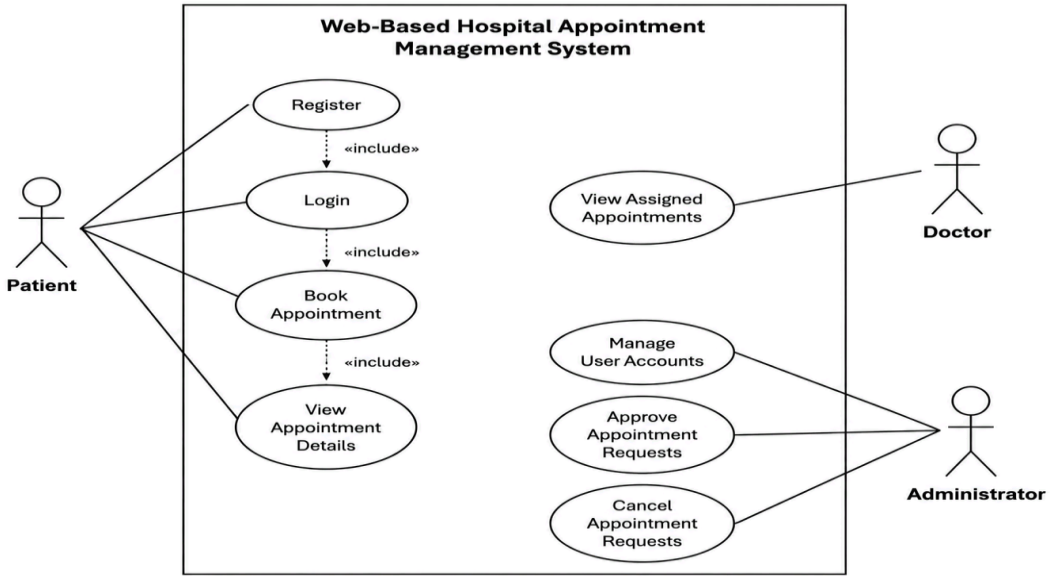


Figure 3.2: Use Case Diagram of the Proposed Web-Based Hospital Appointment Management System

In Figure 3.2, the Patient interacts with the system to perform basic appointment-related operations such as registration, login, booking, and viewing appointment status. The Doctor interacts

primarily to schedule appointments, while the Administrator oversees system activities, including managing doctor records and patient feedbacks. This design ensures clear separation of roles, simplifies communication, and improves workflow within the hospital environment.

B. Class Diagram

The Class Diagram describes the logical structure of the proposed system. It outlines the key entities, their properties, and the relationships that exist between them. In the Web-Based Hospital Appointment Management System, the major classes include *User*, *Doctor*, and *Appointment*. Each class corresponds to a major database table, and their interconnections reflect the relationships among the system's functional components. The Class Diagram shown in Figure 3.3 illustrates these associations.

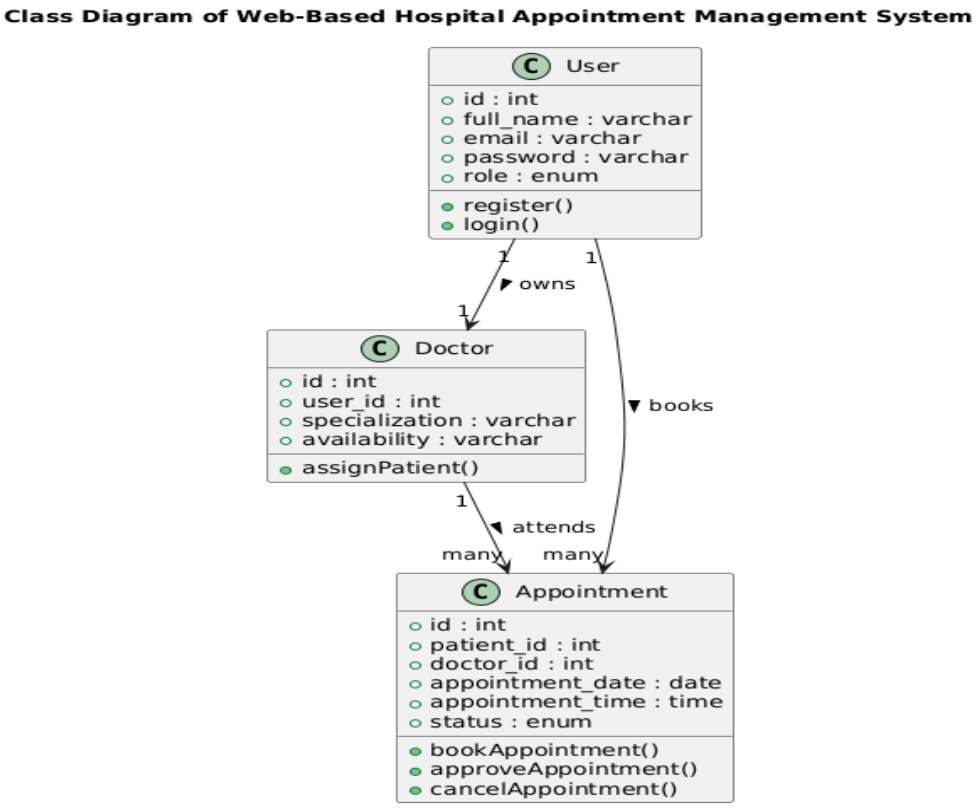


Figure 3.3: Class Diagram of the Proposed Web-Based Hospital Appointment Management System.

The Class Diagram in Figure 3.3 models the core entities of the proposed system. The User class serves as a parent entity for patients, doctors, and administrators. Each doctor record is linked to a user account through the user_id attribute, while each appointment is associated with both a patient and a doctor through patient_id and doctor_id. These relationships ensure data consistency and enforce referential integrity in the MySQL database. The inclusion of methods such as bookAppointment() and approveAppointment() represents the functional operations that correspond to the PHP scripts implemented during the system's development.

C. Activity Diagram

The Activity Diagram models the dynamic behavior of the Web-Based Hospital Appointment Management System. It captures the sequence of actions and decision points involved in the appointment scheduling process. The diagram outlines how a patient initiates a booking request, how the administrator processes the request, and how the system updates the appointment status accordingly. This visualization helps ensure that all workflows are logically connected and consistent with the system's objectives.

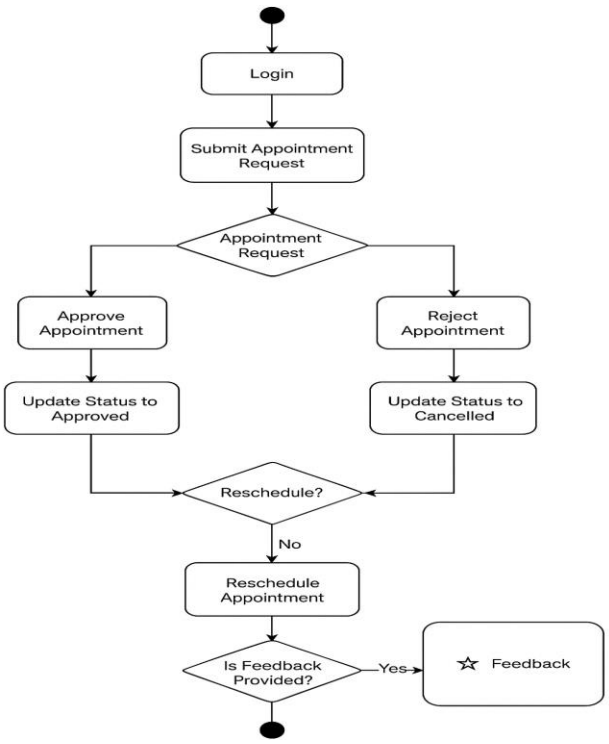


Figure 3.4: Activity Diagram of the Appointment Booking Process in the Proposed System

Figure 3.4 illustrates the workflow of the appointment booking and approval process. The patient logs in, selects a doctor, and submits an appointment request. The system temporarily stores the request as "Pending" until the administrator reviews it. If approved, the system updates the status to "Approved" and notifies the patient. If rejected, the status changes to "Cancelled." This logical flow ensures transparency, real-time updates, and smooth coordination between patients and administrators.

D. Sequence Diagram

The Sequence Diagram represents the **dynamic behavior** of the Web-Based Hospital Appointment Management System by illustrating how system components interact with one another over time. It focuses on the **message flow** between the actors (patients, doctors,

administrators) and the internal components of the system (web interface, PHP server, and MySQL database).

In this system, sequence diagrams are essential for modeling how user requests are processed and how responses are returned across different layers of the architecture. Each vertical lifeline in the diagram represents a participant in the communication process, while the horizontal arrows indicate the direction of messages exchanged during system operations.

Two major sequence interactions are presented in this section. The first sequence diagram (Figure 3.5) shows the **appointment booking process**, which involves a patient submitting a request and the system processing it successfully. The second sequence diagram (Figure 3.6) models the **appointment approval process**, which depicts how the administrator interacts with the system to approve or cancel an existing appointment. These diagrams together demonstrate how synchronization occurs between the client, server, and database layers to ensure accurate and efficient handling of hospital appointments.

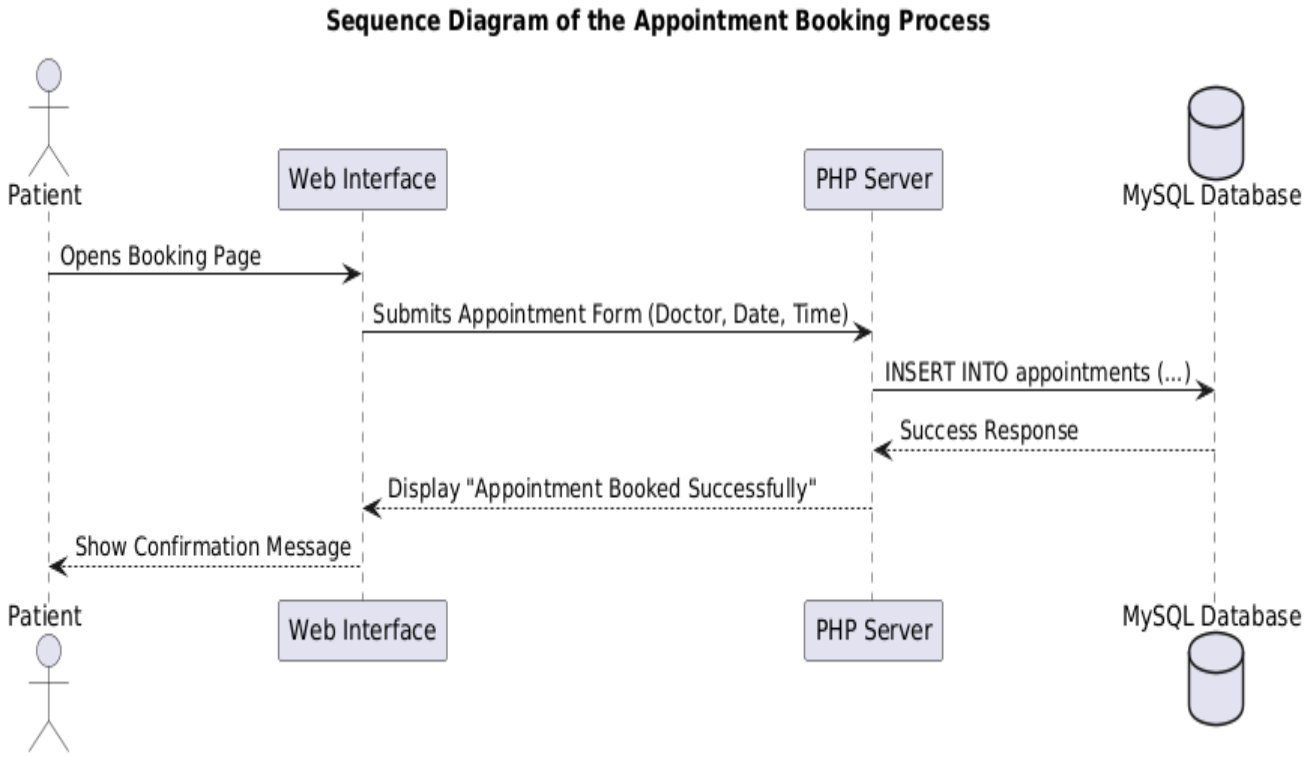


Figure 3.5: Sequence Diagram of the Appointment Booking Process

As shown in Figure 3.5, the Patient initiates a booking by submitting an appointment request via the web interface. The form data is transmitted to the PHP server, which validates and inserts the record into the MySQL database. The database responds with a confirmation message, which the server then forwards back to the interface. The interface displays a success message to the patient, completing the booking cycle. This sequence ensures synchronized communication between all layers of the system and guarantees that appointment data is stored accurately in real time.

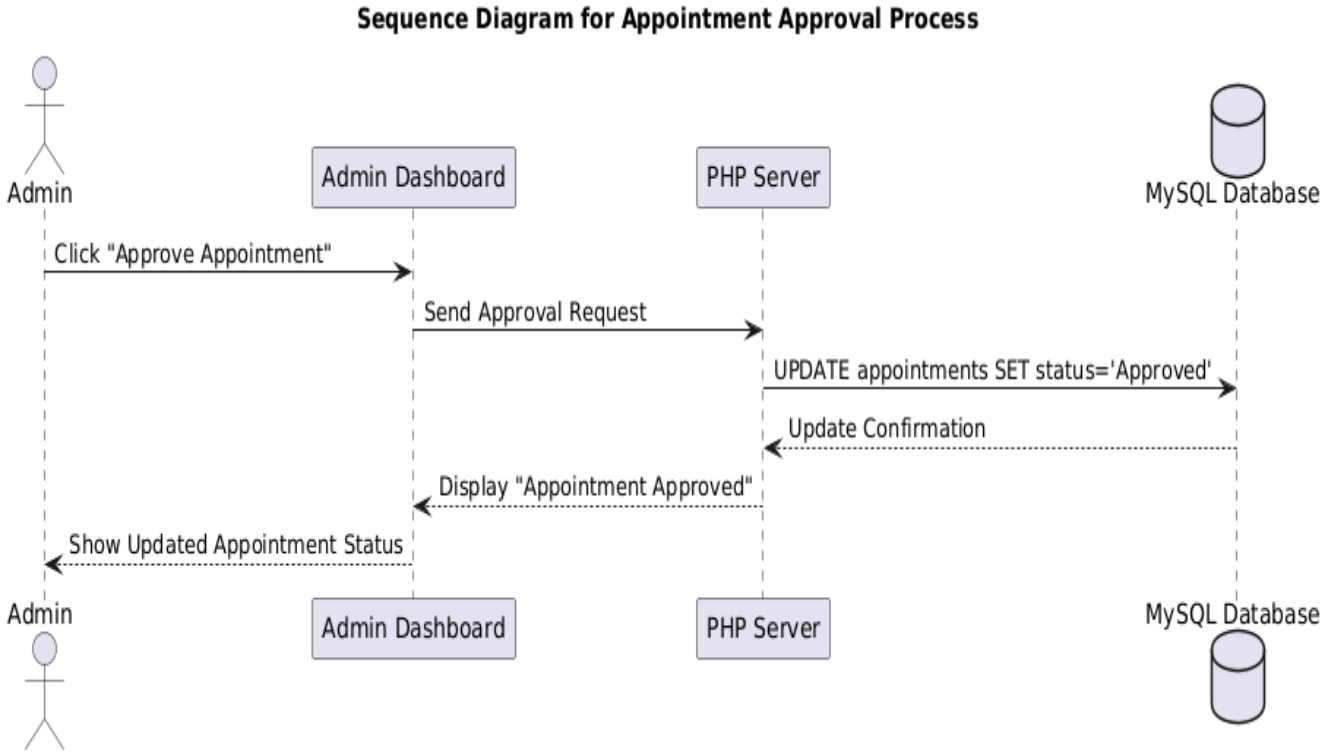


Figure 3.6: Sequence Diagram for the Appointment Approval Process

Figure 3.6 illustrates the interaction between the Administrator, the Admin Dashboard, the PHP Server, and the MySQL Database during the appointment approval process. When the administrator decides to approve an appointment request, the action is initiated from the **Admin Dashboard**, which sends an approval request to the **PHP Server.** The server then executes an SQL UPDATE command on the **MySQL Database**, changing the appointment status from "Pending" to "Approved." Once the database confirms the update, the server sends a success message back to the dashboard interface. The updated status is immediately displayed to the administrator, confirming that the approval was successfully processed.

This process demonstrates the **real-time synchronization** between the user interface, application logic, and database layer. It ensures that all users (patients and administrators) have access to the

most current appointment information, thereby enhancing transparency, accountability, and operational efficiency within the hospital environment.

The UML diagrams collectively describe the structural and behavioral design of the proposed Web-Based Hospital Appointment Management System. Each diagram offers a distinct perspective — from system architecture and actor interactions to dynamic workflows and message sequences. Together, these models form a comprehensive blueprint for the system's implementation, which is discussed in Chapter Four.

CHAPTER FOUR

SYSTEM IMPLEMENTATION, TESTING AND EVALUATION

4.0 Introduction

This chapter discusses the implementation, testing, and evaluation of the Web-Based Hospital Appointment Management System developed for the University of Benin Health Centre. The chapter presents the practical realization of the design models described in Chapter Three, detailing how each component was implemented using appropriate tools and technologies. It outlines the system environment, including both hardware and software configurations, and explains how the system modules were developed and integrated to achieve the intended functionality.

Furthermore, the chapter describes the testing process used to validate the system's reliability, accuracy, and performance. Each module of the system—ranging from user registration to appointment booking and approval—was thoroughly tested to ensure that it meets the specified functional requirements. The results of these tests are presented and evaluated against the project's objectives to confirm that the developed system effectively addresses the problems identified in the existing manual appointment management process at the University of Benin Health Centre.

4.1 System Implementation Environment

The implementation of the Web-Based Hospital Appointment Management System was carried out within a structured development environment consisting of both hardware and software resources. This environment provided the necessary tools, configurations, and support needed to design, code, test, and deploy the system locally using XAMPP. The section below outlines the

specific hardware and software specifications that facilitated the development and implementation of the system.

4.1.1 Hardware Requirements

The hardware resources used in the development of this system were selected to ensure efficient processing, fast execution, and smooth testing. The minimum configuration requirements are presented in Table 4.1.

Component	Specification
Processor	Intel Core i5 / Apple M1 (2.3GHz or higher)
RAM	8 GB minimum
Hard Disk	256 GB SSD
Display	14-inch HD screen
Input Devices	Keyboard, Mouse
Network	Internet access (for browser testing)

These hardware configurations were sufficient to run the web server (XAMPP) and the MySQL database simultaneously while performing various development tasks.

4.1.2 Software Requirements

The development of the proposed system was carried out using a set of software tools and programming technologies that ensured seamless implementation and testing. The selected software environment is summarized in Table 4.2.

Software Component	Description / Version
Operating System	Windows 10 / macOS Monterey
Web Server	XAMPP (Apache, MySQL, PHP, phpMyAdmin)
Backend Language	PHP (Procedural)
Database System	MySQL
Frontend Tools	HTML5, CSS3, JavaScript, Bootstrap 5
IDE / Text Editor	Visual Studio Code
UML Modelling Tool	PlantUML / Draw.io
Browser for Testing	Google Chrome / Mozilla Firefox

These tools were chosen due to their open-source nature, wide community support, and compatibility with each other. The integration of PHP with MySQL in the XAMPP environment made it easy to test the application locally before potential deployment on a live web server.

4.1.3 Development Environment Setup

The development process began with the installation and configuration of XAMPP, which provided the Apache web server and MySQL database management system. The system's source files were created inside the *htdocs* directory of the XAMPP installation, under the folder name **"hospital_appointment_system."**

A database named **hospital_appointment_db** was created using phpMyAdmin, containing three major tables—**users**, **doctors**, and **appointments**—each designed based on the relationships defined in the Class Diagram (Figure 3.3). PHP scripts were developed to connect to the database

using the db_connect.php configuration file, enabling smooth interaction between the web interface and the database.

The implementation was tested locally by running the Apache and MySQL services in XAMPP and accessing the system via the URL: **http://localhost/hospital_appointment_system**

This setup allowed for iterative testing and debugging during the development cycle to ensure that all functionalities operated as expected.

4.2 System Modules Implementation

This section presents the practical realization of each major module of the Web-Based Hospital Appointment Management System. Each module was implemented using PHP for the backend logic, MySQL for database management, and Bootstrap for the frontend interface. The system consists of interdependent modules that collectively automate the process of appointment booking, management, and record-keeping at the University of Benin Health Centre.

4.2.1 User Registration and Login Module

The registration and login module forms the entry point to the system. It allows patients, doctors, and administrators to create accounts and gain authorized access. During registration, user details such as full name, email address, and password are collected and stored securely in the database. Passwords are hashed using PHP's password_hash() function to ensure data security.

Upon login, credentials are verified against stored records in the database. Successful authentication redirects the user to their respective dashboard — patients to the booking page,

doctors to their appointment list, and administrators to the management panel. Invalid credentials trigger an error message prompting the user to retry.

The login and registration forms were designed using HTML and Bootstrap to provide a responsive and user-friendly interface.

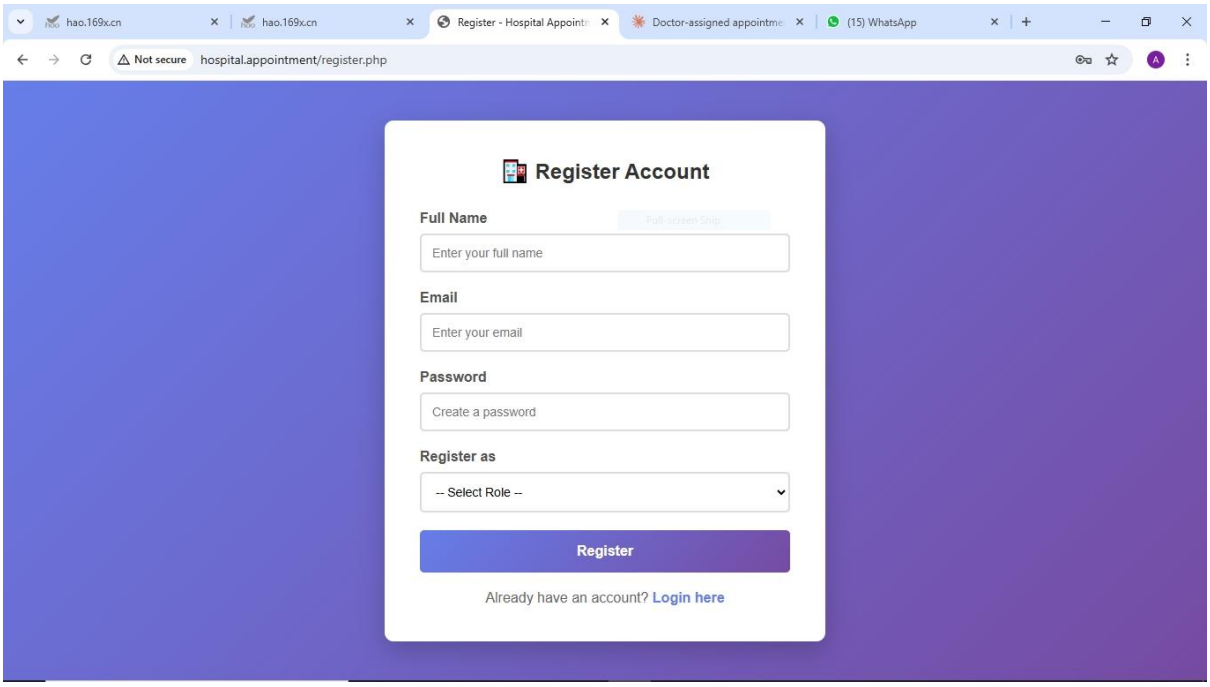


Figure 4.1: User Registration Interface of the Hospital Appointment Management System

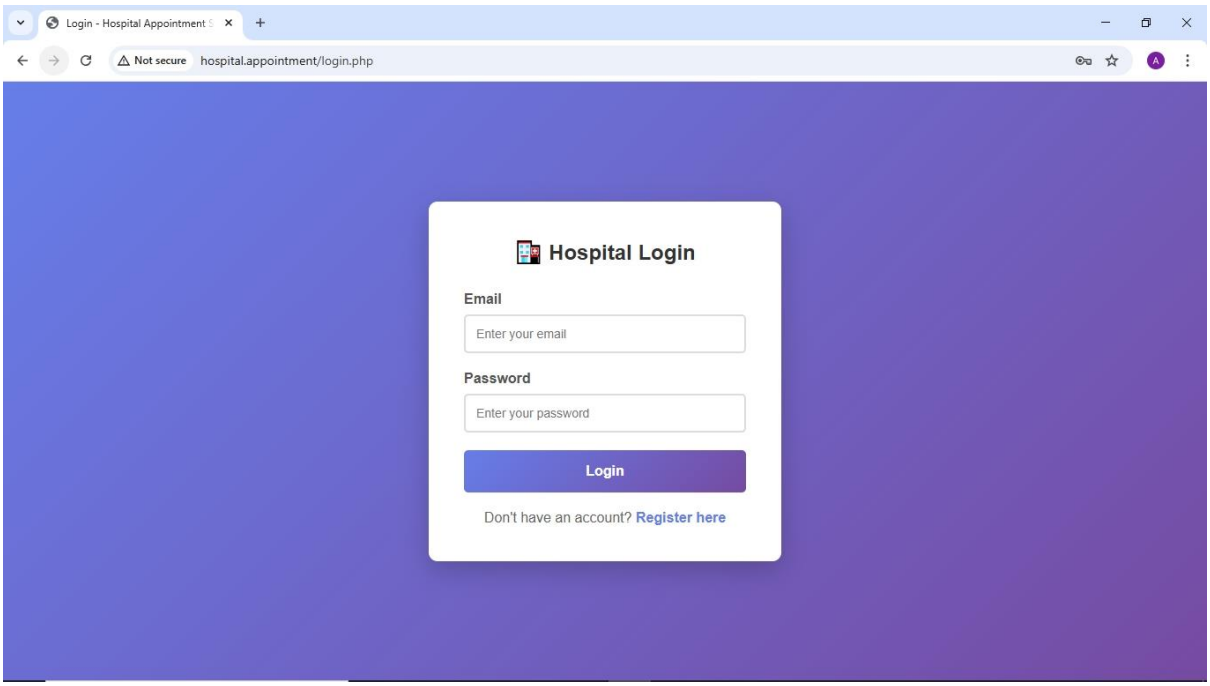


Figure 4.2: Login Page for Patients, Doctors, and Administrators

Figures 4.1 and 4.2 show the registration and login interfaces respectively. These modules ensure that only authorized users can interact with the system, thereby enhancing privacy and access control.

4.2.2 Patient Appointment Booking Module

After successful login, a patient can access the **appointment booking page**, where available doctors are displayed dynamically from the database. The patient selects a doctor, books an appointment and waits for the doctor to choose a time and date. The patient either accepts,cancels or request for a reschedule. After each service,a star rating is given to each doctor as feedback which is accessible by only the administrator.

The backend PHP script validates the inputs and stores the appointment details in the appointments table with a default status of *Pending*. The system then notifies the user of successful submission

and awaits administrative approval. This module simplifies the scheduling process, eliminating the need for physical booking at the hospital.

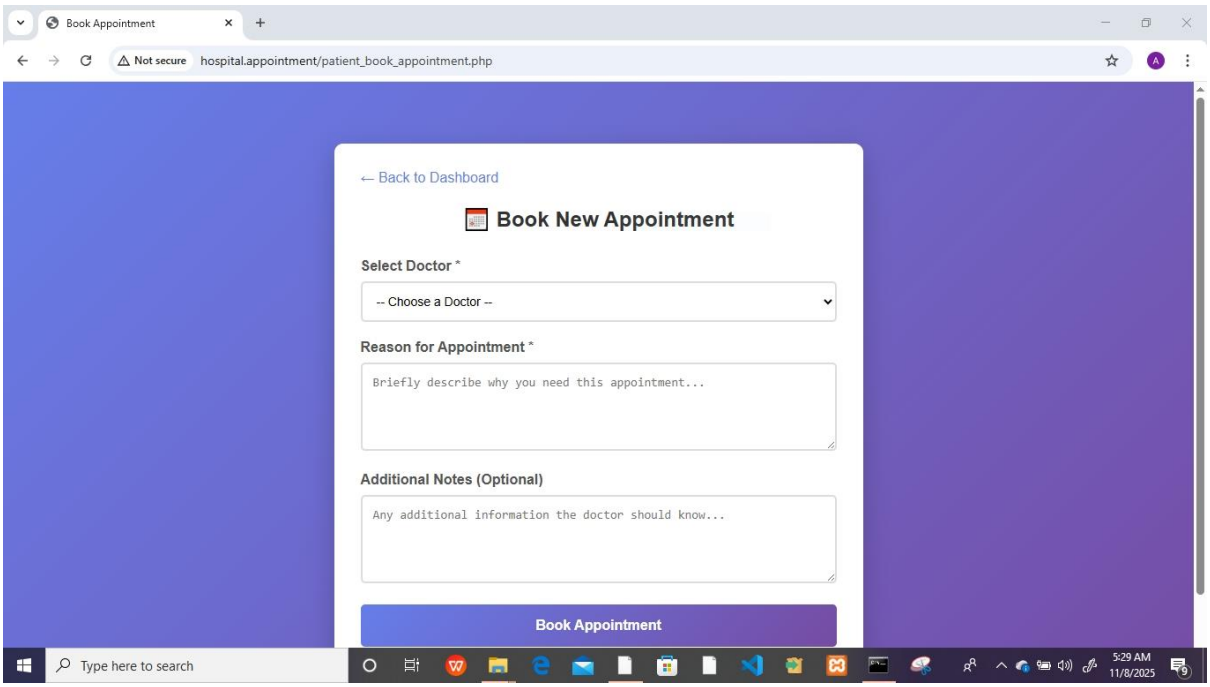


Figure 4.3: Appointment Booking Interface Displaying Available Doctors

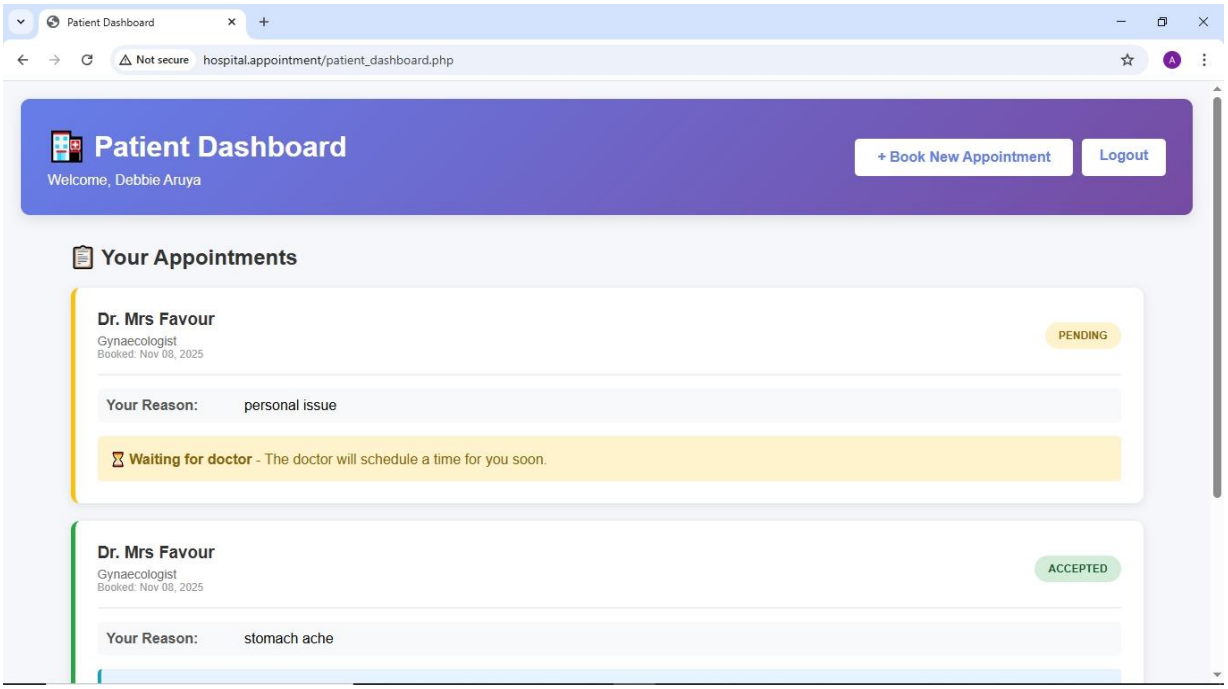
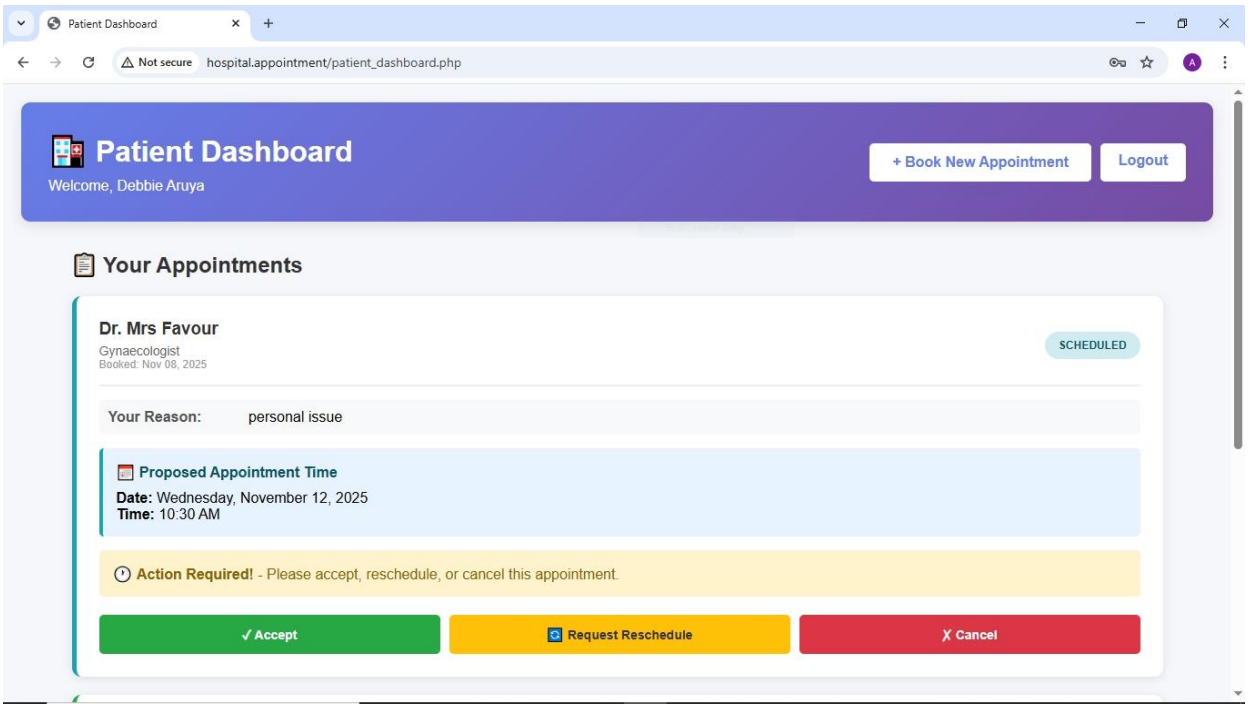


Figure 4.4: Confirmation Message Displayed After Successful Appointment Booking



Figures 4.3 and 4.4 illustrate the patient appointment booking process. The interface is intuitive, and the database ensures that all appointment records are securely stored and retrievable.

4.2.3 Administrator Management Module

The **administrator module** is responsible for managing user accounts, monitoring appointment requests, and updating appointment statuses. Administrators log in through the same authentication system but are redirected to a dashboard that displays all pending, approved, and cancelled appointments.

From the dashboard, the administrator can access reports of bookings from past years and view feedbacks from patients.

nt status.

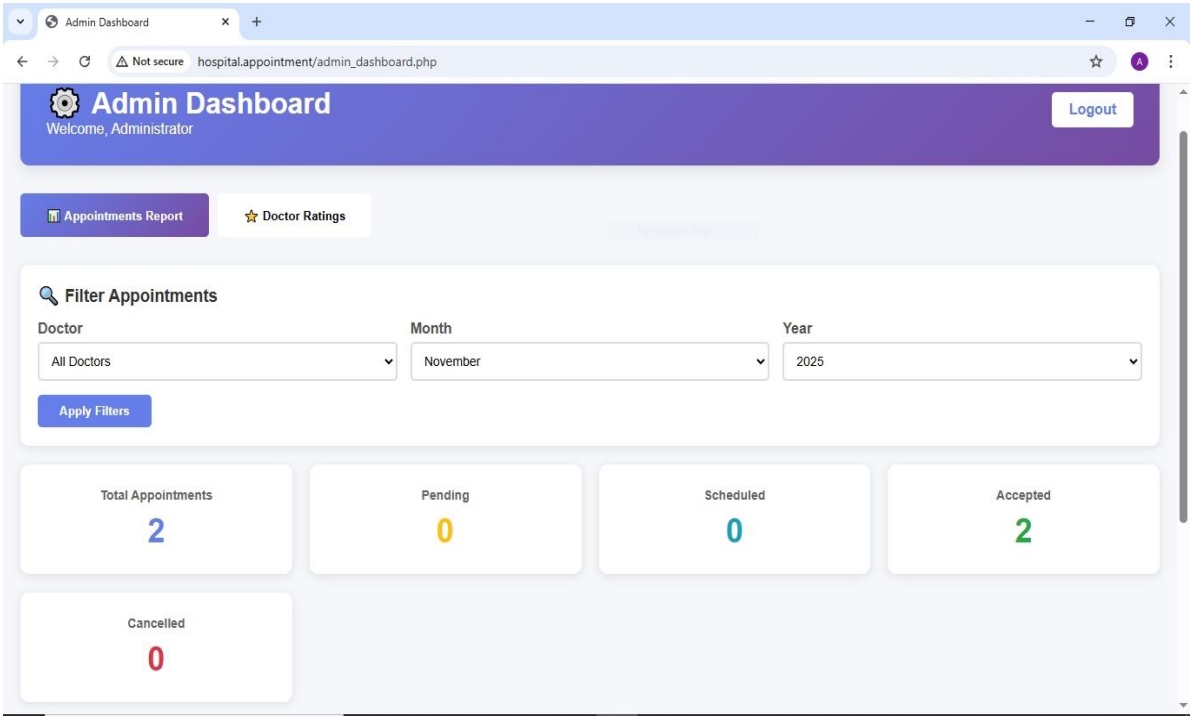


Figure 4.5: Administrator Dashboard Showing Pending,approved, rescheduled and cancelled Appointment Requests

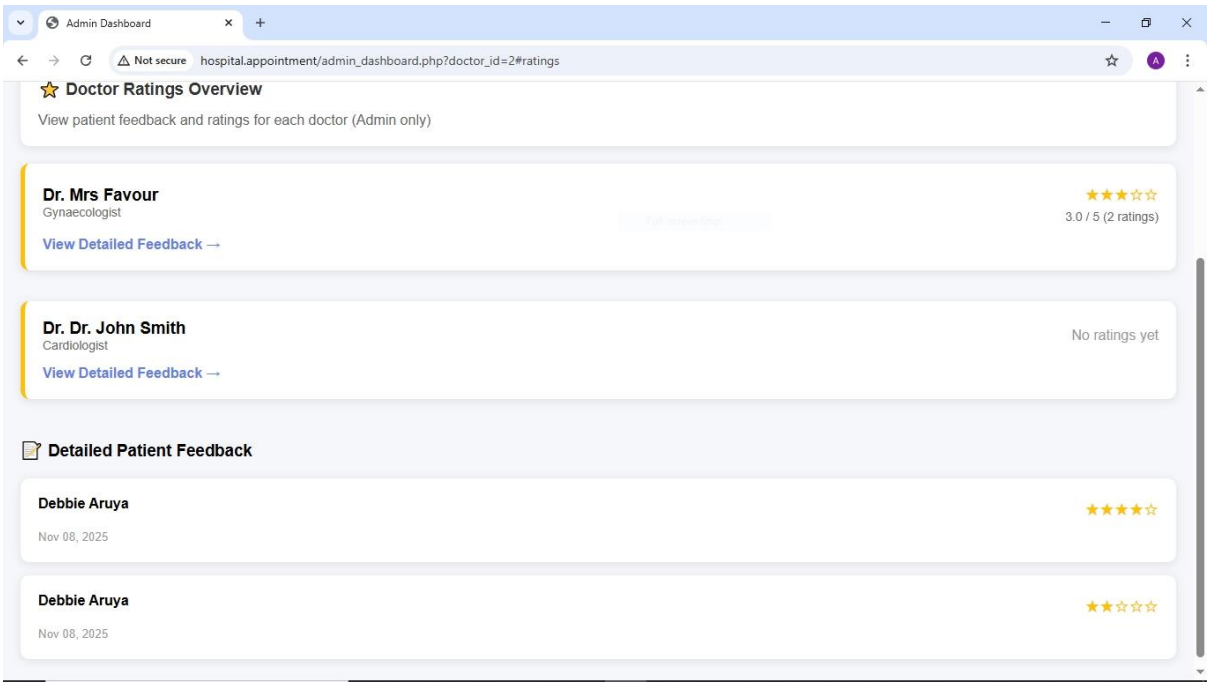


Figure 4.6: Administrator Dashboard showing feedbacks or ratings from patients

4.2.4 Doctor Management and Appointment Viewing Module

The **doctor module** allows each doctor to view appointments assigned to them. When a patient books an appointment with a specific doctor, the system automatically associates that doctor's id with the appointment record in the database.

Doctors can log in to their accounts and view a list of all upcoming appointments, including patient details. The doctor sets a date or time of availability and sends to the patient.This module helps doctors prepare for consultations and manage their daily schedules effectively.

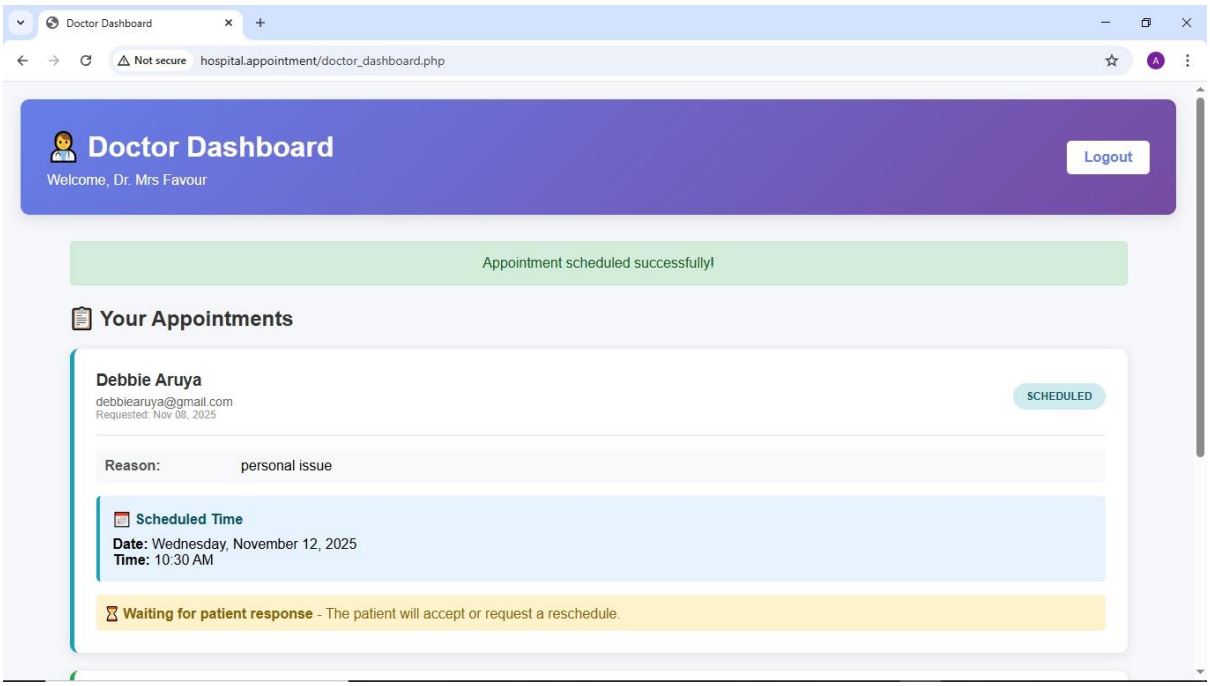


Figure 4.7: Doctor's Appointment Dashboard Displaying Scheduled Appointments

Figure 4.7 illustrates the doctor's dashboard interface. The design focuses on clarity, making it easy for doctors to manage appointments efficiently.

4.2.5 Database Implementation Module

The database was implemented using MySQL within the XAMPP environment. It consists of three main tables — users, doctors, feedback and appointments — all related through foreign keys to maintain referential integrity.

The users table stores information for all types of users, while the doctors table extends the user data to include specializations. The appointments table records the link between patients and doctors, including the appointment date, time, and current status.

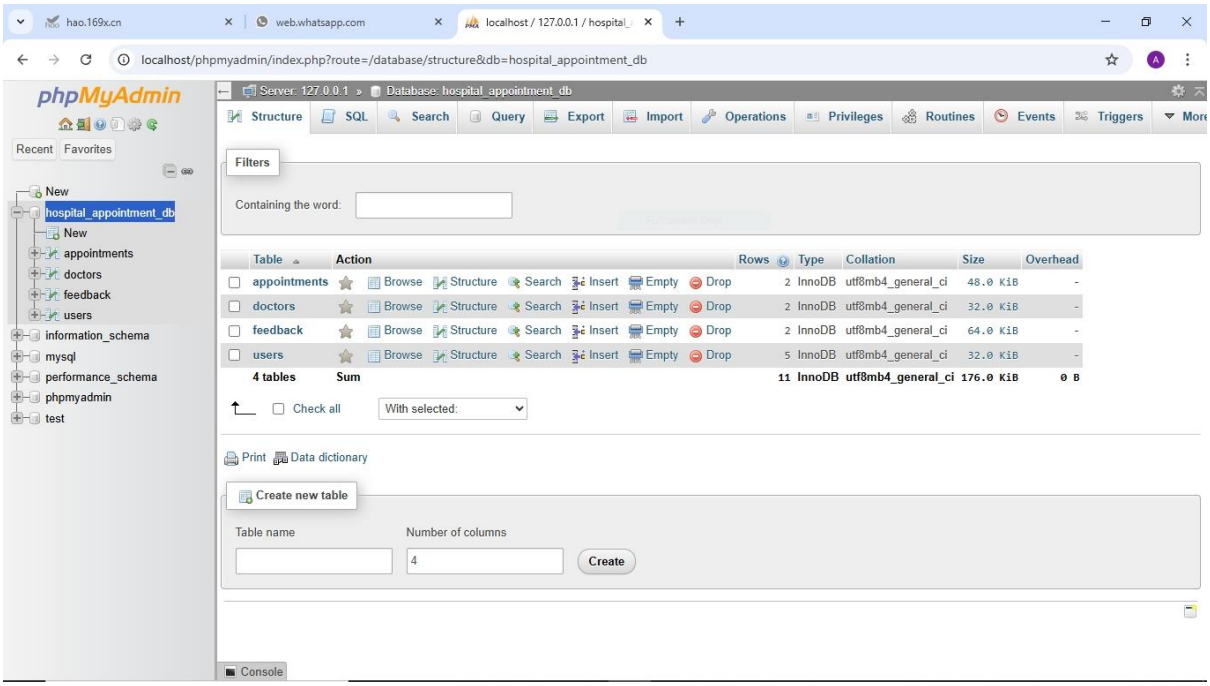


Figure 4.8: Database Structure of the Hospital Appointment Management System in phpMyAdmin

Figure 4.8 presents the relational structure of the system's database. Each table is uniquely identified by a primary key, and foreign key constraints ensure consistent relationships between patients, doctors, and appointments.

4.2.6 Dashboard Integration and Navigation

The system was designed with a **role-based navigation structure**, ensuring that users only access features relevant to their roles. Patients are restricted to booking and viewing appointments, doctors can only schedule, and administrators manage the entire system.

The dashboards were built using Bootstrap cards and table elements to ensure responsiveness and readability on both desktop and mobile devices.

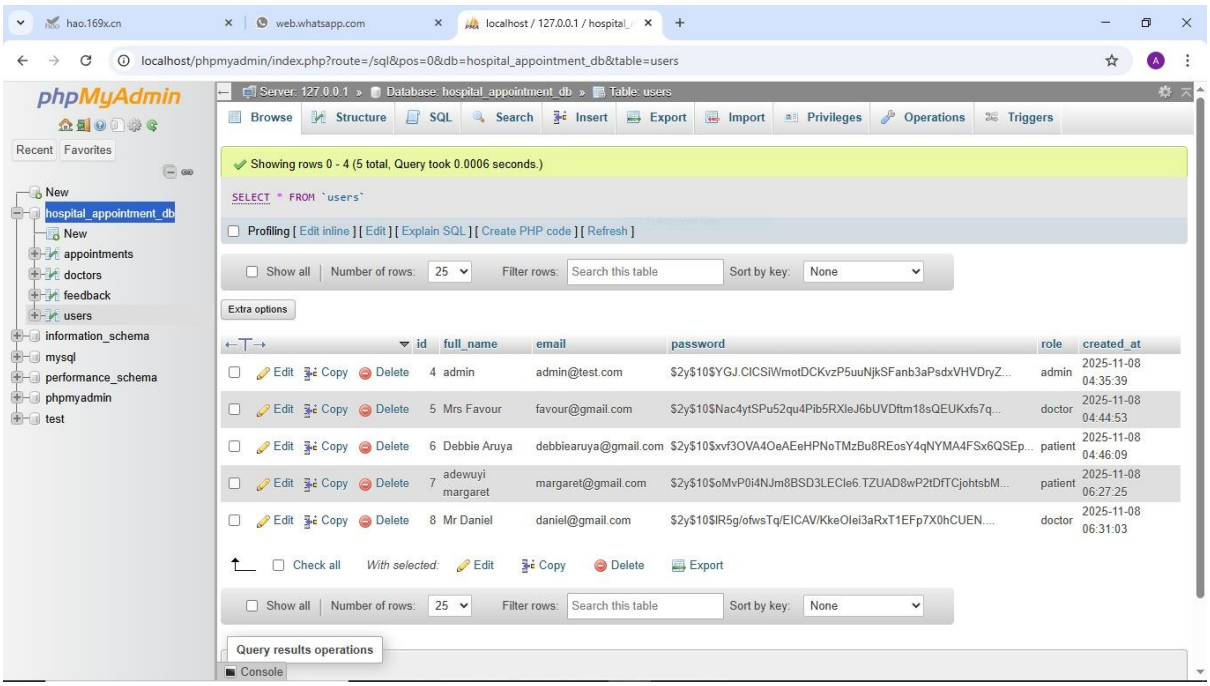


Figure 4.9: Role-Based Dashboard Navigation Interface

Figure 4.9 shows the integration of all system modules within their respective dashboards, providing a seamless and intuitive experience for all user roles.

4.2.7 Security Features

Security was a major consideration during implementation. Sensitive user data, such as passwords, are stored in hashed form using the PHP password_hash() function. Input validation and SQL parameter binding were also implemented to prevent common vulnerabilities such as SQL Injection and Cross-Site Scripting (XSS).

Session variables were used to manage user logins, ensuring that users can only access authorized pages. Logout functions were also implemented to securely terminate user sessions.

4.2.8 Summary

The implementation of the various system modules demonstrates how the proposed design in Chapter Three was successfully realized. Each module performs a distinct function that contributes to the automation of appointment scheduling and management at the University of Benin Health Centre. The next section presents the testing phase of the system, where the developed modules were evaluated to verify their functionality and reliability.

4.3 System Testing

After the successful implementation of the Web-Based Hospital Appointment Management System, a series of tests were carried out to ensure that the system performs according to its design specifications and functional requirements. Testing is a crucial phase in software development because it validates the reliability, functionality, and efficiency of the developed system.

The testing phase was aimed at identifying and resolving potential errors, confirming that all modules work together as intended, and verifying that the system meets user expectations. Both **white-box** and **black-box testing** approaches were adopted — focusing on internal logic verification and external user behavior testing, respectively.

4.3.1 Testing Strategy

A structured testing strategy was employed to ensure comprehensive validation of the system. The testing process was divided into four major stages:

4. **Unit Testing:** This involved testing individual modules and PHP scripts, such as user registration, login, and appointment booking, to verify that each function produces the expected output.

5. **Integration Testing:** Once individual modules were confirmed to work correctly, they were combined and tested as a group to ensure proper interaction between components — for example, verifying that appointments booked by patients appear correctly in the admin dashboard.
6. **System Testing:** This stage verified the performance of the entire system under simulated real-world conditions. It ensured that all modules — patient, doctor, and admin — worked harmoniously when integrated.
7. **User Acceptance Testing (UAT):** Selected users (students and staff) at the University of Benin Health Centre were asked to use the system and provide feedback on usability, performance, and accuracy. Their responses confirmed that the system is easy to use, responsive, and meets its intended purpose.

4.3.2 Testing Environment

The testing was performed locally on a development machine using XAMPP as the server environment. The system was accessed through a web browser using the local URL http://localhost/hospital_appointment_system. The MySQL database stored test data such as user records, appointment details, and approval statuses. Testing covered both functional and non-functional aspects, such as responsiveness, navigation, and security.

4.3.3 Test Cases and Results

The following table presents some of the test cases conducted to verify the functionality of the system. Each test was designed to evaluate a particular operation and confirm whether the actual output matched the expected result.

Table 4.1: Test Cases and Results

Test Case ID	Test Description	Input Data / Action	Expected Output	Actual Output	Status
TC01	User Registration	Name, Email, Password	"Registration successful" message	Registration successful	Pass
TC02	Login Authentication	Valid email & password	Redirect to user dashboard	Redirect to dashboard	Pass
TC03	Invalid Login	Wrong password	Display "Invalid login details"	Error message displayed	Pass
TC04	Appointment Booking	Select doctor	"Appointment booked successfully"	Appointment booked successfully	Pass
TC05	Admin Approval	Click Approve button	Appointment status changes to "Approved"	Status updated in database	Pass
TC06	Admin Cancellation	Click Cancel button	Appointment status changes to "Cancelled"	Status updated in database	Pass
TC07	Doctor Dashboard	View assigned appointments	Display list of patient bookings	Appointments displayed correctly	Pass
TC08	Logout Function	Click logout	Redirect to login page	User session terminated	Pass

4.3.4 Analysis of Test Results

The results in Table 4.1 show that all test cases passed successfully, confirming that the developed system operates as intended. The registration and login modules accurately authenticate users and enforce access control. Appointment bookings are correctly saved to the database and appear on the admin dashboard for approval. Admin actions immediately reflect in the system and are visible to both doctors and patients in real time.

The overall test results confirmed that the system is functionally correct, stable, and reliable for use in a real hospital setting. No major functional errors were recorded during testing, and all minor issues discovered in early testing phases were resolved during integration.

4.3.5 User Acceptance Testing Feedback

User acceptance testing was conducted by a small group of staff and students at the University of Benin Health Centre who simulated the roles of patients, doctors, and administrators. Participants reported that the system was user-friendly and greatly reduced the need for physical booking queues. Administrators appreciated the simplicity of managing appointment records through the web interface.

Feedback from the users confirmed that the proposed system successfully addresses the problems identified in the manual appointment scheduling process — particularly issues of long waiting times, record misplacement, and scheduling conflicts.

4.3.6 Summary

The testing phase demonstrated that the Web-Based Hospital Appointment Management System functions correctly across all modules and user roles. The results validate the reliability and usability of the system. The next section presents the evaluation of the system in relation to the specific objectives outlined in Chapter One.

4.4 System Evaluation

System evaluation is an essential step in software development as it provides a structured assessment of how well the developed system meets the defined goals and objectives. The Web-Based Hospital Appointment Management System was evaluated against the objectives outlined

in Chapter One to determine its effectiveness, efficiency, and ability to solve the problems associated with the existing manual appointment management process at the University of Benin Health Centre.

The evaluation was based on functionality testing, user feedback, and a comparative review of system performance before and after implementation. The assessment confirmed that the system achieved all its objectives and successfully addressed the limitations of the manual system.

4.4.1 Objective-Based Evaluation

The evaluation process was guided by the four major objectives defined in Chapter One. Each objective was reviewed against the outcomes of the developed system to determine whether it was achieved. The results are summarized in Table 4.2 below.

Table 4.2: Evaluation of Project Objectives

Objective	Expected Outcome	Evaluation Result	Status
1. To review existing hospital appointment management systems towards establishing a gap which will be filled by this work	Identify weaknesses of existing manual and semi-digital systems	A comprehensive literature review revealed major limitations such as inefficiency, long queues, and lack of doctor–patient communication.	Achieved
2. To design a system that makes appointment management convenient for both administrators and patients	Develop an intuitive interface and logical workflow	The system's user interface was designed using Bootstrap for simplicity, and role-based dashboards were implemented for different users.	Achieved

Objective	Expected Outcome	Evaluation Result	Status
3. To develop the designed system using a web-based platform	Implement system using PHP, MySQL, and Bootstrap	The system was fully implemented in PHP (backend), MySQL (database), and Bootstrap (frontend). All functionalities worked as expected.	Achieved
4. To test and validate the functionalities of the system	Conduct functionality and user acceptance testing	System testing confirmed that all modules performed accurately; users reported that the system improved efficiency and usability.	Achieved

4.4.2 Evaluation Summary

From the evaluation presented in Table 4.2, it is evident that the developed system achieved all its stated objectives. The system successfully automated the appointment scheduling process, provided real-time feedback to patients, and simplified administrative workflows.

Feedback from test users indicated that the new system drastically reduced waiting times and eliminated the need for physical queueing, thereby improving patient satisfaction. Administrators reported that appointment management became faster, more accurate, and less stressful.

Overall, the system met the intended aim of improving healthcare accessibility and operational efficiency at the University of Benin Health Centre.

4.4.3 System Performance Review

The performance of the Web-Based Hospital Appointment Management System was evaluated based on the following criteria:

4. **Speed:** Page loading and database response times were fast, with negligible delay during form submissions.
5. **Accuracy:** Appointment data was stored correctly without duplication or conflict.
6. **Reliability:** The system performed consistently under repeated tests without crashes or data loss.
7. **Security:** Password hashing, session validation, and input sanitization were implemented to prevent unauthorized access.
8. **Usability:** Test users found the interface intuitive and easy to navigate, with clear labels and error messages.

These performance indicators demonstrate that the system meets both functional and non-functional requirements, making it suitable for real-world deployment.

4.4.4 Comparison with the Existing System

Compared to the manual appointment scheduling system previously used at the University of Benin Health Centre, the proposed system offers several advantages:

4. **Automation of Processes:** The web-based system eliminates paper-based booking and manual record-keeping.
5. **Real-Time Access:** Appointments can be booked and managed from anywhere with an internet connection.
6. **Improved Accuracy:** The database enforces data consistency and prevents double bookings.
7. **Enhanced Communication:** Patients receive instant feedback on appointment approval or cancellation.

8. **Time Efficiency:** Waiting times are minimized as appointments are pre-scheduled and confirmed digitally.

These improvements clearly demonstrate that the developed system solves the problems highlighted in the Statement of Problem and supports more efficient healthcare delivery.

4.4.5 Summary

The evaluation phase confirmed that the Web-Based Hospital Appointment Management System fully satisfies the requirements and objectives of this project. It effectively addresses the inefficiencies of the existing system by providing an automated, centralized, and user-friendly solution. The system enhances productivity, improves communication, and contributes to better healthcare service delivery at the University of Benin Health Centre. The next section presents a detailed discussion of the results obtained and the challenges encountered during implementation.

4.5 Discussion of Results

The results obtained from the implementation and testing phases of the Web-Based Hospital Appointment Management System demonstrate that the system achieved all its functional and performance expectations. Each module performed accurately during testing, and user feedback confirmed that the system is both efficient and user-friendly. The testing results presented in Table 4.1 (Section 4.3) validated that all core features — including registration, login, appointment booking and feedbacks executed without error.

During the evaluation, the system proved capable of automating appointment scheduling, thereby eliminating the inefficiencies and long waiting times previously experienced at the University of Benin Health Centre. The integration between the **patient module**, **administrator module**, and

doctor module worked seamlessly, ensuring real-time synchronization of data across the entire platform. When a patient books an appointment, it instantly appears on the doctor's dashboard for scheduling time and date,any actions taken will be reviewed in the patient's dashboard immediately.

Additionally, the **system's security features** performed effectively. Password hashing prevented unauthorized access to user accounts, while PHP session management ensured that only authenticated users could access restricted areas. The use of Bootstrap improved the **user experience (UX)** by providing a clean and responsive interface that adapts well to both desktop and mobile screens.

From the performance standpoint, system response time was optimal, and the database handled multiple simulated requests without lag. The successful completion of all test cases confirmed that the developed system is stable, reliable, and ready for deployment in a real hospital environment.

The analysis further shows that the system directly addresses the problems identified in the manual appointment process. It reduces administrative workload, prevents record duplication, enhances communication, and ensures that appointments are scheduled efficiently and transparently. These improvements align with the project's aim of improving operational efficiency and patient satisfaction at the University of Benin Health Centre.

4.6 Challenges Encountered

Despite the successful development and deployment of the Web-Based Hospital Appointment Management System, several challenges were encountered during the implementation and testing

phases. These challenges were primarily technical, environmental, and procedural in nature, and each provided valuable learning experiences for system improvement.

1. **Database Constraints and Foreign Key Errors:**

   During early database implementation, foreign key constraint errors occurred when linking the appointments table with the doctors and users' tables. This issue was resolved by ensuring that doctor records were created and assigned valid user IDs before any appointment could be made.

2. **Session Management Bugs:**

   At the initial stage of user authentication, some session variables failed to initialize correctly, resulting in users being redirected to the login page unexpectedly. The issue was traced to inconsistent variable names and was corrected by standardizing session declarations across all PHP pages.

3. **Interface Alignment Issues:**

   Minor UI inconsistencies were observed when testing the application on different browsers and screen resolutions. This was corrected by applying Bootstrap grid layouts and ensuring all CSS styles were responsive.

4. **Time Zone Differences:**

   During booking, there were inconsistencies in appointment times due to local and server time differences. This was resolved by setting a consistent time zone (date_default_timezone_set("Africa/Lagos");) in the PHP configuration file.

5. **System Testing Environment Limitations:**

   Testing was performed on a local machine using XAMPP, which limited concurrent user testing and server load simulation. A live deployment environment with multiple users would provide more realistic stress testing conditions.

6. **Limited End-User Training:**

   Some test users initially struggled to navigate the system due to unfamiliarity with web-based systems. This was addressed by providing a brief demonstration of how to log in, book appointments, and view status updates.

These challenges, although significant, contributed to a deeper understanding of the technical and practical aspects of system design and deployment. Each problem was resolved systematically, resulting in a more robust and user-friendly final system.

4.7 Summary

This chapter discussed the implementation, testing, and evaluation of the Web-Based Hospital Appointment Management System. The various modules of the system were implemented successfully using PHP, MySQL, and Bootstrap. Testing confirmed that all modules performed according to specifications and that the system met all project objectives. The evaluation and result discussions demonstrated the system's efficiency, reliability, and ability to solve the identified problems of manual appointment scheduling at the University of Benin Health Centre.

The next chapter presents the summary of findings, conclusion, and recommendations for future improvements and deployment of the system.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the summary, conclusion, and recommendations derived from the design, development, and evaluation of the Web-Based Hospital Appointment Management System for the University of Benin Health Centre. It highlights the major findings of the study, the system's achievements, and areas for future improvement. The chapter also reflects on how the developed system met the stated objectives and effectively solved the identified problems in the existing manual appointment management process.

5.1 Summary of the Study

The primary aim of this study was to design and develop a **Web-Based Hospital Appointment Management System** to improve healthcare accessibility and administrative efficiency at the University of Benin Health Centre. The study began by identifying the challenges of the existing manual system, which included long waiting times, overcrowded outpatient units, poor communication between patients and doctors, and frequent record mismanagement.

To address these challenges, the project followed a systematic approach involving system analysis, design, implementation, and testing. The system was developed using **PHP** for backend logic, **MySQL** for data storage, and **HTML/CSS/Bootstrap** for the user interface. UML diagrams such as the Use Case, Class, Activity, and Sequence Diagrams were used to model system behavior and relationships between components.

The implementation produced a functional web application that automates appointment scheduling, approval, and monitoring. The system provides different dashboards for patients, doctors, and

administrators, ensuring that each user accesses only the features relevant to their role. The administrator can access reports and feedbacks in real time, and patients receive immediate feedback through the interface. The database ensures accurate record storage and retrieval, minimizing human error and improving service efficiency.

The system was thoroughly tested using both unit and integration testing, and user acceptance testing was carried out with selected users. Results confirmed that the system is reliable, easy to use, and efficient. It successfully addressed all the objectives defined in Chapter One and demonstrated significant improvement over the existing manual scheduling process.

5.2 Major Findings

Based on the implementation and evaluation of the system, the following key findings were made:

1. The manual appointment management process at the University of Benin Health Centre is inefficient and prone to delays, data loss, and overcrowding.
2. The developed system automates the entire appointment scheduling process, reducing waiting times and administrative workload.
3. The system provides role-based dashboards that improve communication and streamline workflow between patients, doctors, and administrators.
4. Testing and user feedback confirmed that the system is accurate, user-friendly, and suitable for real-world deployment.
5. The integration of PHP and MySQL proved effective for developing lightweight, secure, and maintainable web applications.
6. Security measures such as password hashing and session validation ensure that user data is protected and unauthorized access is prevented.

5.3 Conclusion

The development of the Web-Based Hospital Appointment Management System successfully achieved its aim of improving patient access to healthcare and enhancing operational efficiency at the University of Benin Health Centre. The system provides a centralized platform where patients can conveniently book appointments, doctors can manage schedules, and administrators can monitor bookings.

By addressing the limitations of the manual system, the developed web-based solution contributes significantly to better healthcare management and service delivery. It ensures accurate data handling, real-time feedback, and reduced administrative stress. The project demonstrates that the integration of modern web technologies can effectively solve organizational challenges in the healthcare sector.

In conclusion, the system fulfills all the functional and non-functional requirements outlined at the beginning of the study. It stands as a reliable, secure, and efficient solution that can be deployed at the University of Benin Health Centre and adapted for use in other medical facilities facing similar appointment management challenges.

5.4 Recommendations

Although the system performed effectively during testing, certain improvements and extensions can be made to enhance functionality, security, and scalability. The following recommendations are proposed for future work:

1. **Online Notification and SMS Integration:** Implementing SMS or email notifications would allow patients and doctors to receive appointment reminders and updates automatically.

2. **Medical Record Integration:** The system could be extended to include electronic medical records (EMR), allowing doctors to access patient history during appointments.
3. **Mobile Application Version:** Developing an Android or iOS mobile version of the system would make it more accessible to patients and doctors on the go.
4. **Data Analytics and Reporting:** Adding a reporting module could enable administrators to generate statistics on appointments, patient visits, and doctor availability for better decision-making.
5. **Enhanced Security:** Although the system currently uses password hashing, additional security layers such as two-factor authentication (2FA) and SSL encryption should be implemented in future deployments.
6. **Cloud Deployment:** Hosting the system on a cloud server (e.g., AWS or Google Cloud) would enable scalability, reliability, and multi-user access from different locations.

These recommendations, if implemented, would further enhance the system's performance, reliability, and overall impact in healthcare administration.

5.5 Contribution to Knowledge

This study contributes to the growing body of knowledge in the application of web technologies to healthcare management. It demonstrates how open-source tools like PHP, MySQL, and Bootstrap can be combined to solve real-life problems in resource-constrained environments. The project serves as a practical model for implementing similar systems in hospitals and clinics across Nigeria and other developing countries, where efficiency and accessibility remain major challenges in healthcare delivery.

5.6 Summary

This chapter provided a comprehensive summary of the study, discussed the findings and implications of the developed system, and offered recommendations for future enhancement. The

Web-Based Hospital Appointment Management System stands as a robust and reliable solution that automates appointment scheduling, improves communication, and enhances the overall quality of healthcare service delivery.

The successful completion of this project demonstrates that with proper analysis, design, and implementation, technology can be effectively leveraged to improve healthcare management and patient experience. Future research and development can build on this foundation to create even more comprehensive hospital management solutions.

REFERENCES

Adebayo, O., & Olatunji, T. (2022). Challenges of health information system implementation in Nigerian hospitals. *Nigerian Journal of Health Informatics*, 7(1), 23–39.

Akande, A., & Salisu, Y. (2020). Improving patient flow and reducing waiting time using hospital appointment management systems in sub-Saharan Africa. *African Journal of Medical Informatics*, 4(3), 11–24.

Eze, E. C., & Nwankwo, I. U. (2021). Digital transformation in Nigeria's healthcare: Challenges and prospects of e-health adoption. *Journal of Health Informatics in Developing Countries*, 15(2), 45–57.

Federal Ministry of Health, Nigeria. (2015). National eHealth policy framework. *Abuja: Government Press*.

Federal Ministry of Health, Nigeria. (2016). National health information system strategic plan. *Abuja: Government Press*.

Federal Ministry of Health, Nigeria. (2022). National digital health policy framework. *Abuja: Government Press*.

Ojo, S. T., & Adeyemi, B. (2023). Leveraging SMS technology for healthcare communication in Nigeria. *Journal of Mobile Health Technologies*, 6(2), 76–90.

Olamide, R. A., & Yusuf, A. T. (2022). Healthcare challenges and the role of ICT in improving hospital efficiency in Nigeria. *African Journal of Public Administration and ICT*, 10(2), 65–80.

Olatunji, T., & Adebayo, O. (2022). Implementation of web-based appointment management systems in Nigerian hospitals: Opportunities and barriers. *Nigerian Journal of Information Systems*, 8(1), 20–36.

Osei, P., & Ojo, O. (2021). Enhancing healthcare delivery through ICT integration in West Africa. *International Journal of Health Systems and Technology*, 9(4), 55–70.

Patel, R., & Khanna, S. (2022). Web-based hospital management systems and data integration challenges. *International Journal of Computer Applications*, 184(10), 33–42.

Schedule.cc. (n.d.). Patient appointment scheduling system – Simplify healthcare appointments online. *Retrieved November 2025*, from https://schedule.cc/patient-appointment-scheduling-system

Shaip. (2024). Natural language processing for low-resource management. *Shaip Blog*. https://www.shaip.com/blog/nlp-for-low-resource-languages/

World Health Organization. (2018). Global strategy on digital health 2020–2025. *Geneva: WHO*.

World Health Organization. (2021). Digital health interventions: Guideline for health system strengthening. *Geneva: WHO*.

World Health Organization. (2022). World health statistics 2022: Monitoring health for the SDGs. *Geneva: WHO*.

World Health Organization. (2023). Digital health in Africa: Strengthening systems through technology. *WHO Regional Office for Africa*. https://www.afro.who.int/

Mouttham, A., et al. (2021). Development of FHIR based web applications for appointment management in healthcare. Procedia Computer Science, 184, 917–922. https://doi.org/10.1016/j.procs.2021.03.114

```php
\<?php
$host = "localhost";
$user = "root";
$pass = "";
$db   = "hospital_appointment_db";

$conn = new mysqli($host, $user, $pass, $db);
if ($conn->connect_error) {
    die("Connection failed: " . $conn->connect_error);
}
?>
```

ADMIN.DASHBOARD

```php
<?php
session_start();
require_once 'db.php';

// Check if user is admin
if (!isset($_SESSION['user_id']) || $_SESSION['role'] != 'admin') {
    header("Location: login.php");
    exit();
```

```
}
```

```
// Get filter values
$selected_doctor = $_GET['doctor_id'] ?? '';
$selected_month = $_GET['month'] ?? date('m');
$selected_year = $_GET['year'] ?? date('Y');
```

```
// Get all doctors for dropdown
$doctors_query = "SELECT d.id, u.full_name, d.specialization
                  FROM doctors d
                  JOIN users u ON d.user_id = u.id
                  ORDER BY u.full_name";
$doctors_result = $conn->query($doctors_query);
```

```
// Build appointments query with filters
$appointments_query = "SELECT a.*,
                              u1.full_name as patient_name,
                              u2.full_name as doctor_name,
                              d.specialization
                       FROM appointments a
                       JOIN users u1 ON a.patient_id = u1.id
                       JOIN doctors d ON a.doctor_id = d.id
                       JOIN users u2 ON d.user_id = u2.id
                       WHERE 1=1";
```

```
$params = [];
```

```
$types = "";
```

```
if ($selected_doctor) {
    $appointments_query .= " AND a.doctor_id = ?";
    $params[] = $selected_doctor;
    $types .= "i";
}
```

```
if ($selected_month && $selected_year) {
    $appointments_query .= " AND MONTH(a.created_at) = ? AND
YEAR(a.created_at) = ?";
    $params[] = $selected_month;
    $params[] = $selected_year;
    $types .= "ii";
}
```

```
$appointments_query .= " ORDER BY a.created_at DESC";
```

```
$stmt = $conn->prepare($appointments_query);
if (!empty($params)) {
    $stmt->bind_param($types, ...$params);
}
$stmt->execute();
$appointments_result = $stmt->get_result();
```

```
// Get doctor ratings
```

```
$ratings_query = "SELECT d.id, u.full_name as doctor_name,
d.specialization,
                        COUNT(f.id) as total_ratings,
                        AVG(f.rating) as avg_rating
                    FROM doctors d
                    JOIN users u ON d.user_id = u.id
                    LEFT JOIN feedback f ON d.id = f.doctor_id
                    GROUP BY d.id
                    ORDER BY avg_rating DESC";
$ratings_result = $conn->query($ratings_query);
```

```
// Get detailed feedback for selected doctor
$feedback_details = [];
if ($selected_doctor) {
    $feedback_query = "SELECT f.*, u.full_name as patient_name,
f.created_at
                        FROM feedback f
                        JOIN users u ON f.patient_id = u.id
                        WHERE f.doctor_id = ?
                        ORDER BY f.created_at DESC";
    $stmt = $conn->prepare($feedback_query);
    $stmt->bind_param("i", $selected_doctor);
    $stmt->execute();
    $feedback_details = $stmt->get_result();
}
?>
```

DOCTOR DASHBOARD

```php
<?php

session_start();

require_once 'db.php'; // Change to 'db.connect.php' if that's your
filename



// Check if user is logged in and is a doctor

if (!isset($_SESSION['user_id']) || $_SESSION['role'] != 'doctor') {

    header("Location: login.php");

    exit();

}
```

```php
$user_id = $_SESSION['user_id'];
```

```php
// Get doctor's ID from doctors table

$doctor_query = "SELECT id FROM doctors WHERE user_id = ?";

$stmt = $conn->prepare($doctor_query);

$stmt->bind_param("i", $user_id);

$stmt->execute();

$doctor_result = $stmt->get_result();

$doctor = $doctor_result->fetch_assoc();

$doctor_id = $doctor['id'];
```

```php
// Handle scheduling appointment

if ($_SERVER['REQUEST_METHOD'] == 'POST' && isset($_POST['schedule'])) {

    $appointment_id = $_POST['appointment_id'];
```

```
    $appointment_date = $_POST['appointment_date'];
    $appointment_time = $_POST['appointment_time'];
    $doctor_notes = $_POST['doctor_notes'];

    // Update appointment with date, time, and change status to
'scheduled'
    $sql = "UPDATE appointments
            SET appointment_date = ?, appointment_time = ?, doctor_notes
= ?, status = 'scheduled', updated_at = NOW()
            WHERE id = ? AND doctor_id = ?";

    $stmt = $conn->prepare($sql);
    $stmt->bind_param("sssii", $appointment_date, $appointment_time,
$doctor_notes, $appointment_id, $doctor_id);

    if ($stmt->execute()) {
        $success = "Appointment scheduled successfully!";
    } else {
        $error = "Error scheduling appointment.";
    }
}
```

```
// Get all appointments for this doctor
$appointments_query = "SELECT a.*, u.full_name as patient_name, u.email as
patient_email
                       FROM appointments a
                       JOIN users u ON a.patient_id = u.id
                       WHERE a.doctor_id = ?
```

```
                        ORDER BY
                            CASE
                                WHEN a.status = 'pending' THEN 1
                                WHEN a.status = 'rescheduled' THEN 2
                                WHEN a.status = 'scheduled' THEN 3
                                WHEN a.status = 'accepted' THEN 4
                                ELSE 5
                            END,
                            a.created_at DESC";
```

```
$stmt = $conn->prepare($appointments_query);
$stmt->bind_param("i", $doctor_id);
$stmt->execute();
$appointments_result = $stmt->get_result();
?>
```

PATIENT DASHBOARD

```
<?php
session_start();
require_once 'db.php';

// Check if user is logged in and is a patient
if (!isset($_SESSION['user_id']) || $_SESSION['role'] != 'patient') {
    header("Location: login.php");
    exit();
```

```
}
```

```
$patient_id = $_SESSION['user_id'];
```

```
// Handle patient actions (accept, reschedule, cancel)
if ($_SERVER['REQUEST_METHOD'] == 'POST') {
    $appointment_id = $_POST['appointment_id'];

    if (isset($_POST['accept'])) {
        // Patient accepts the appointment
        $sql = "UPDATE appointments SET status = 'accepted', updated_at =
NOW() WHERE id = ? AND patient_id = ?";
        $stmt = $conn->prepare($sql);
        $stmt->bind_param("ii", $appointment_id, $patient_id);

        if ($stmt->execute()) {
            $success = "Appointment accepted successfully!";
        } else {
            $error = "Error accepting appointment.";
        }
    }

    if (isset($_POST['reschedule'])) {
        // Patient requests reschedule
        $sql = "UPDATE appointments SET status = 'rescheduled', updated_at
= NOW() WHERE id = ? AND patient_id = ?";
        $stmt = $conn->prepare($sql);
```

```
        $stmt->bind_param("ii", $appointment_id, $patient_id);

        if ($stmt->execute()) {
            $success = "Reschedule request sent to doctor!";
        } else {
            $error = "Error requesting reschedule.";
        }
    }

    if (isset($_POST['cancel'])) {
        // Patient cancels appointment
        $sql = "UPDATE appointments SET status = 'cancelled', updated_at =
NOW() WHERE id = ? AND patient_id = ?";
        $stmt = $conn->prepare($sql);
        $stmt->bind_param("ii", $appointment_id, $patient_id);

        if ($stmt->execute()) {
            $success = "Appointment cancelled.";
        } else {
            $error = "Error cancelling appointment.";
        }
    }
}
```

```
// Get all appointments for this patient
$appointments_query = "SELECT a.*, u.full_name as doctor_name,
d.specialization
```

```
                        FROM appointments a
                        JOIN doctors d ON a.doctor_id = d.id
                        JOIN users u ON d.user_id = u.id
                        WHERE a.patient_id = ?
                        ORDER BY
                            CASE
                                WHEN a.status = 'scheduled' THEN 1
                                WHEN a.status = 'pending' THEN 2
                                WHEN a.status = 'rescheduled' THEN 3
                                WHEN a.status = 'accepted' THEN 4
                                ELSE 5
                            END,
                            a.created_at DESC";
```

```
$stmt = $conn->prepare($appointments_query);
$stmt->bind_param("i", $patient_id);
$stmt->execute();
$appointments_result = $stmt->get_result();
?>
```

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Patient Dashboard</title>
    <style>
```

```css
* {
    margin: 0;
    padding: 0;
    box-sizing: border-box;
}

body {
    font-family: Arial, sans-serif;
    background: #f5f7fa;
    padding: 20px;
}

.header {
    background: linear-gradient(135deg, #667eea 0%, #764ba2 100%);
    color: white;
    padding: 30px;
    border-radius: 10px;
    margin-bottom: 30px;
    box-shadow: 0 5px 15px rgba(0,0,0,0.1);
}

.header h1 {
    margin-bottom: 10px;
}

.header-actions {
    display: flex;
```

```
        justify-content: space-between;
        align-items: center;
    }

    .btn-new {
        background: white;
        color: #667eea;
        padding: 12px 25px;
        border-radius: 5px;
        text-decoration: none;
        font-weight: bold;
        display: inline-block;
    }

    .btn-new:hover {
        background: #f0f0f0;
    }

    .alert {
        padding: 15px;
        border-radius: 5px;
        margin-bottom: 20px;
        text-align: center;
    }

    .alert-success {
        background-color: #d4edda;
```

```
        color: #155724;
        border: 1px solid #c3e6cb;
    }

    .alert-error {
        background-color: #f8d7da;
        color: #721c24;
        border: 1px solid #f5c6cb;
    }

    .appointments-container {
        max-width: 1200px;
        margin: 0 auto;
    }

    .appointment-card {
        background: white;
        border-radius: 10px;
        padding: 25px;
        margin-bottom: 20px;
        box-shadow: 0 2px 10px rgba(0,0,0,0.1);
        border-left: 5px solid #667eea;
    }

    .appointment-card.pending {
        border-left-color: #ffc107;
    }
```

```
.appointment-card.scheduled {
    border-left-color: #17a2b8;
}

.appointment-card.accepted {
    border-left-color: #28a745;
}

.appointment-card.rescheduled {
    border-left-color: #fd7e14;
}

.appointment-card.cancelled {
    border-left-color: #dc3545;
    opacity: 0.7;
}

.card-header {
    display: flex;
    justify-content: space-between;
    align-items: center;
    margin-bottom: 15px;
    padding-bottom: 15px;
    border-bottom: 2px solid #f0f0f0;
}
```

```
        .doctor-info h3 {
            color: #333;
            margin-bottom: 5px;
        }

        .doctor-info p {
            color: #666;
            font-size: 14px;
        }

        .status-badge {
            padding: 8px 15px;
            border-radius: 20px;
            font-size: 12px;
            font-weight: bold;
            text-transform: uppercase;
        }

        .status-pending {
            background: #fff3cd;
            color: #856404;
        }

        .status-scheduled {
            background: #d1ecf1;
            color: #0c5460;
        }
```

```
.status-accepted {
    background: #d4edda;
    color: #155724;
}

.status-rescheduled {
    background: #ffe5d0;
    color: #8b4513;
}

.status-cancelled {
    background: #f8d7da;
    color: #721c24;
}

.appointment-details {
    margin: 15px 0;
}

.detail-row {
    margin: 10px 0;
    padding: 10px;
    background: #f8f9fa;
    border-radius: 5px;
}
```

```
        .detail-row strong {
            color: #555;
            display: inline-block;
            width: 150px;
        }

        .scheduled-time {
            background: #e7f3ff;
            padding: 15px;
            border-radius: 5px;
            margin: 15px 0;
            border-left: 4px solid #17a2b8;
        }

        .scheduled-time h4 {
            color: #0c5460;
            margin-bottom: 10px;
        }

        .action-buttons {
            display: flex;
            gap: 10px;
            margin-top: 20px;
        }

        .btn {
            padding: 12px 25px;
```

```
            border: none;
            border-radius: 5px;
            font-size: 14px;
            font-weight: bold;
            cursor: pointer;
            transition: transform 0.2s;
        }

        .btn:hover {
            transform: translateY(-2px);
        }

        .btn-accept {
            background: #28a745;
            color: white;
            flex: 1;
        }

        .btn-reschedule {
            background: #ffc107;
            color: #333;
            flex: 1;
        }

        .btn-cancel {
            background: #dc3545;
            color: white;
```

```
        flex: 1;
    }

    .btn-rating {
        display: inline-block;
        padding: 12px 25px;
        background: #ffc107;
        color: #333;
        text-decoration: none;
        border-radius: 5px;
        font-weight: bold;
        text-align: center;
    }

    .btn-rating:hover {
        background: #ffcd39;
    }

    .no-appointments {
        text-align: center;
        padding: 50px;
        color: #999;
    }
```