Swasthya (HMS)

A Project Report

Submitted in partial fulfillment of the requirements for the award

of the degree of

BACHELOR OF SCIENCE

(Computer Science)

By

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Roll number: 515

Under the esteemed guidance of

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NAGINDAS KHANDWALA COLLEGE

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MAHARASHTRA

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DEPARTMENT OF COMPUTER AND INFORMATION SCIENCE

CERTIFICATE

This is to certify that the project titled, **Swasthya**, is Bonafide work of **Vivek Manoj Dubey** bearing Roll No: 515 is submitted in partial fulfillment of the requirements for the award of degree of BACHELOR OF SCIENCE in COMPUTER SCIENCE from University of Mumbai.

Internal Guide **Coordinator** **External Examiner**

Date **College Seal**

DECLARATION

I hereby declare that the project titled "**Swasthya**," carried out at **Nagindas Khandwala College**, is an original work and has not been duplicated, replicated, or submitted to any other university or institution for the award of any degree or academic qualification. To the best of my knowledge and belief, no part of this project, in its current form, has been presented for evaluation or credit at any other academic institution.

This project is undertaken as a part of the final semester curriculum for the **Bachelor of Science (Computer Science) degree**, in partial fulfilment of the requirements for the award of the degree. I affirm that the research, analysis, and documentation presented here are solely the result of my efforts, under the guidance and supervision of my respected mentors at Nagindas Khandwala College.

I fully understand the importance of academic integrity, and I confirm that all sources, data, and materials used in this project have been appropriately acknowledged, with due credit given wherever necessary. I take full responsibility for the authenticity and originality of this work, and I acknowledge that any violation of academic conduct may result in disciplinary action.

Signature

Vivek Manoj Dubey

ACKNOWLEDGEMENT

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Abstract

The "Swasthya" project is a user-friendly Hospital Management System (HMS) designed to simplify and digitalize healthcare operations. It integrates key functionalities such as patient registration, appointment scheduling, medical record management, and billing into a single platform. By automating routine tasks and minimizing manual errors, the system improves operational efficiency and allows healthcare professionals to focus more on patient care. An AI-driven X-ray analysis tool is incorporated to support accurate and quick diagnosis, ensuring timely treatment and better patient outcomes.

The system offers a secure and intuitive interface for doctors, administrators, and patients, making it accessible and easy to use. Patients can interact with a smart chatbot to book appointments, check lab results, and access their medical records anytime. Role-based access controls and data encryption ensure that sensitive patient information remains secure and compliant with healthcare regulations like HIPAA. These features not only protect data but also enhance user trust in the system.

Swasthya is designed with scalability and flexibility in mind, making it adaptable to the growing needs of hospitals and clinics. The system provides real-time reporting and analytics, enabling administrators to make data-driven decisions and optimize resource utilization. By streamlining workflows, the platform reduces waiting times and improves patient satisfaction, while advanced AI capabilities help in enhancing diagnostic accuracy.

Overall, the "Swasthya" project represents a modern and comprehensive approach to healthcare management. It bridges the gap between technology and healthcare, empowering both providers and patients with efficient tools. With its focus on usability, security, and innovation, Swasthya ensures better coordination, improved outcomes, and a seamless healthcare experience for all stakeholders.

Table of context

1. Introduction

1.1 Background of the Project

A Healing Center Administration Framework (HMS) is a cutting-edge software platform designed to streamline and optimize the administrative, clinical, and financial processes of healthcare organizations. By integrating and automating key functions, an HMS enhances hospital operations, improving efficiency, reducing errors, and elevating patient care. Core features typically include patient registration, appointment scheduling, electronic medical records (EMR) management, billing, pharmacy and inventory control, laboratory services, and staff management. These features ensure healthcare providers have real-time access to accurate patient data, allowing for more informed decision-making and improved health outcomes.

The implementation of an HMS significantly reduces the administrative burden on healthcare staff by automating routine tasks, optimizing workflows, and minimizing human error. This increased operational efficiency allows healthcare professionals to devote more time to patient care. Additionally, advanced reporting and data analytics integrated into the system support data-driven decision-making, improving resource allocation and enabling continuous quality improvement.

A well-designed HMS features an intuitive, user-friendly interface that facilitates easy adoption by hospital staff, while robust security protocols protect sensitive patient data and ensure compliance with healthcare regulations. The system also improves communication and collaboration across departments, fostering a more coordinated work environment. Modern HMS platforms often incorporate artificial intelligence (AI) capabilities, such as AI-driven diagnostic tools for X-ray image analysis, which aid in the faster and more accurate detection of fractures and abnormalities. This automation reduces diagnostic errors, accelerates treatment, and allows healthcare providers to focus on critical cases.

Records management, as a crucial component of an HMS, involves the systematic creation, maintenance, and secure transfer of organizational records. Effective records management ensures the preservation of essential information for legal and evidentiary purposes, timely updates, and controlled access by authorized personnel only. Proper records management contributes to overall data integrity, operational transparency, and regulatory compliance. By ensuring accurate record-keeping and seamless retrieval, it enhances both administrative efficiency and patient safety.

The integration of smart chatbots within an HMS enhances patient engagement by providing real-time responses to common queries. These AI-powered virtual assistants facilitate services such as appointment scheduling, lab result retrieval, medication management, and bill downloads, resulting in a more efficient and satisfying patient experience. By automating these interactions, hospitals can significantly reduce administrative overhead, while ensuring that patients receive prompt and accurate assistance.

Furthermore, modern HMS platforms are designed to support scalability, allowing hospitals to expand their services without compromising performance. Cloud-based solutions ensure data accessibility across multiple departments, promoting better collaboration within large

healthcare systems. Features like role-based access controls, audit trails, and encrypted data storage protect patient privacy and ensure compliance with stringent healthcare data regulations.

In addition, an HMS supports resource optimization by providing real-time insights into equipment usage, bed occupancy rates, and staff allocation. Hospitals can use this data to improve capacity planning, ensuring that critical resources are available when needed. This proactive approach helps reduce waiting times, improve patient outcomes, and enhance overall hospital performance.

One of the significant advantages of an HMS is its integration with telemedicine services. By supporting virtual consultations and remote patient monitoring, an HMS enables hospitals to extend access to care, particularly in underserved areas. This not only increases patient convenience but also helps healthcare providers manage a larger patient base without overburdening physical infrastructure.

Moreover, many HMS platforms come with mobile applications that provide real-time access to patient data, appointment scheduling, and test results. These apps allow both patients and healthcare professionals to stay connected and informed, improving engagement and communication.

The use of predictive analytics within an HMS allows hospitals to anticipate patient admission patterns, disease outbreaks, and seasonal surges in demand. This capability improves preparedness, ensuring optimal resource allocation and minimizing disruptions during peak periods.

In summary, a Hospital Management System (HMS) is a transformative solution for modern healthcare institutions. It improves patient care, boosts operational efficiency, and provides valuable insights through advanced data analytics. With AI-powered diagnostics, secure data management, and streamlined processes, an HMS empowers healthcare organizations to deliver superior patient outcomes, optimize resource use, and continuously improve services. As a cornerstone of healthcare modernization, it contributes to the advancement of the healthcare industry, fostering better coordination, enhanced care delivery, and improved patient satisfaction. Moreover, its scalability and adaptability make it a future-proof investment, positioning hospitals for sustained growth in an ever-evolving healthcare landscape.

1.2 Scope of the Project

The Hospital Management System (HMS) project involves creating and integrating a customized software solution to address the wide-ranging requirements of a healthcare facility. The primary objective is to simplify and digitize various administrative, clinical, and financial processes to boost hospital productivity and improve patient care. The project scope includes the following key components:

- **Frontend Development**: The system prioritizes a user-friendly and visually appealing interface. Built using modern web technologies like HTML, CSS, and JavaScript, the frontend ensures smooth navigation across devices. This responsive design caters to users of all technical backgrounds, simplifying how they interact with the system. The result is a seamless experience that improves accessibility for patients, doctors, and administrators alike.

- **Backend Development**: The backend is designed for robustness and efficiency, supporting key operations like managing patient data, scheduling appointments, and handling secure transactions. Built using PHP, it ensures reliability and scalability, enabling the system to process large volumes of data without compromising performance. By maintaining smooth communication between the client-side and the database, the backend forms the backbone of the HMS.

- **Database Management**: A well-structured MySQL database forms the backbone of the system. It securely stores patient records, staff details, and other critical information while offering quick access for authorized users. With features like indexing and normalization, the database reduces redundancy, ensuring accurate and consistent data handling. This organized structure allows hospitals to efficiently retrieve and manage crucial information.

- **Security and Authentication**: Protecting sensitive data is a core priority. The system incorporates secure login methods, including email-password combinations and two-factor authentication (2FA) via OTPs. Role-based access control prevents unauthorized access, ensuring only relevant users access critical features. Regular security updates and encryption further bolster the system's data protection measures.

- **Admin Dashboard**: A centralized admin dashboard provides an all-encompassing view of hospital operations. Administrators can manage patients, staff, and appointments while generating detailed reports to track performance. The dashboard includes real-time analytics, giving hospital managers actionable insights for better decision-making. Its intuitive design minimizes learning curves, enabling quick adoption by staff.

- **Reporting Module**: The system includes a comprehensive reporting feature that provides insights into hospital performance. From patient statistics to financial summaries, administrators can access data-driven visualizations such as charts and graphs, allowing them to identify trends and optimize resources. Advanced tools help identify bottlenecks in workflows, leading to actionable improvements across

departments.

- **AI-Powered X-Ray Analysis**: One standout feature is AI-driven X-ray analysis, which automates the detection of fractures and abnormalities. This not only improves diagnostic accuracy but also speeds up treatment. The AI continuously learns from new data, ensuring more accurate results over time. By reducing diagnostic errors, it contributes to better patient outcomes.

- **Quick Access for Patients**: The system ensures patient engagement by providing easy access to key functionalities. Patients can book appointments, view lab results, download invoices, and access prescriptions—all from the comfort of their homes. The streamlined interface reduces dependency on physical visits and ensures prompt communication. This improves overall patient satisfaction and fosters trust in the healthcare system.

- **Scalability and Adaptability**: Designed to grow with the needs of healthcare facilities, the HMS system is scalable and future-ready. It can handle increasing patient volumes and integrate additional features as required. Modular design ensures updates do not disrupt current operations, making the system a long-term investment. Its adaptability supports evolving healthcare demands, ensuring continued efficiency.

- **Enhanced Communication**: The system includes a secure messaging platform that facilitates seamless communication between patients, doctors, and hospital staff. Whether it's a quick follow-up query or coordination for appointments, the messaging feature improves collaboration and patient satisfaction. Patients feel more connected, and providers can address concerns more efficiently, enhancing the quality of care.

- **Patient Empowerment**: By providing transparent access to medical records, appointment schedules, and personalized notifications, the system empowers patients to take an active role in their healthcare journey. This level of engagement fosters trust and enhances their overall experience. Patients are equipped with tools to track their health better, promoting informed decision-making.

1.3 Objective of the Project

- ✓ **Improve the Quality of Patient Care**: The HMS is designed to significantly enhance the quality of patient care by providing healthcare professionals with real-time, comprehensive access to essential patient information. This includes detailed medical histories, diagnostic test results, and personalized treatment plans, enabling informed and precise clinical decisions. The system minimizes the risk of medical errors by offering features like automated alerts for critical conditions and reminders for follow-up care. By streamlining data accessibility and fostering a holistic approach to patient management, the system ensures better health outcomes and higher patient satisfaction. Real-time data sharing between departments promotes seamless communication, enabling healthcare providers to act swiftly during emergencies and focus on critical cases without delay.

- ✓ **Automate and Streamline Hospital Operations**: The HMS automates and integrates a hospital's administrative, clinical, and financial processes into a unified system, ensuring smoother workflows and better coordination between departments. Routine tasks such as patient admissions, appointment scheduling, billing, inventory management, and discharge procedures are handled efficiently, minimizing manual errors and saving time. The system reduces human reliance, allowing healthcare staff to dedicate more time to patient care. Additionally, real-time monitoring of resource utilization ensures that equipment, beds, and staff are optimally allocated, leading to better productivity. By enhancing operational efficiency, the HMS creates a well-organized environment where tasks are completed faster, improving both the patient experience and hospital performance.

- ✓ **Ensure Strong Data Security and Privacy Compliance**: The system prioritizes robust data protection by implementing advanced encryption protocols, secure data transmission methods, and role-based access controls (RBAC). These measures ensure that sensitive patient information is handled with the utmost confidentiality and security. Compliance with key healthcare regulations such as HIPAA and GDPR is maintained, protecting institutions from potential legal issues. To further enhance security, multi-factor authentication, including email OTPs, is incorporated to prevent unauthorized access. Regular system audits and encrypted data storage ensure the safety of patient records throughout their lifecycle. This comprehensive security approach fosters trust among patients and healthcare providers, ensuring that data remains protected at every level.

- ✓ **Generate Comprehensive Reports and Data-Driven Insights**: The HMS features an advanced reporting module that enables administrators and stakeholders to generate detailed real-time reports on various aspects of hospital performance. Key metrics, such as patient outcomes, staff productivity, appointment trends, and financial performance, are presented through intuitive visual dashboards with graphs and charts. This data empowers decision-makers to identify bottlenecks, optimize resources, and implement strategies for continuous improvement. Predictive analytics further enhances the system by forecasting trends in-patient admissions and resource requirements, enabling hospitals to proactively plan for peak periods. By offering actionable insights, the system transforms data into a powerful tool for improving healthcare delivery and operational efficiency.

- ✓ **Enhance Patient Engagement and Accessibility**: The HMS includes a dedicated patient portal that simplifies access to essential healthcare services. Patients can easily view their medical records, lab reports, prescriptions, and appointment schedules from any device,

promoting transparency and convenience. Personalized notifications and reminders keep patients informed about upcoming appointments or medication schedules, improving compliance and engagement. The portal empowers patients to participate actively in their healthcare journey by allowing them to communicate directly with healthcare providers. This sense of involvement fosters trust and strengthens the patient-provider relationship, ultimately leading to better health outcomes and improved satisfaction with healthcare services.

- ✓ **Improve Interaction and Efficiency with an Intelligent Chatbot**: To enhance interaction and efficiency, the HMS integrates an intelligent chatbot capable of addressing common patient inquiries instantly. Available 24/7, the chatbot allows patients to book appointments, access lab results, retrieve prescriptions, and download invoices without manual assistance. By automating routine tasks, it reduces administrative workloads and waiting times, ensuring a smoother healthcare experience. The chatbot also offers multilingual support to cater to diverse patient demographics and provides health tips and updates, further enriching the user experience. Its availability at all times ensures that patients receive immediate support, improving convenience and reducing stress during critical situations.

- ✓ **Foster Seamless Integration and Collaboration**: The HMS is designed to ensure seamless integration across various hospital departments, creating a unified platform for better collaboration. By connecting administrative, clinical, and financial operations, the system facilitates smooth communication and data sharing between doctors, nurses, technicians, and administrative staff. Integration with external tools, such as diagnostic devices and telemedicine platforms, further enhances the system's capabilities. This interconnected approach reduces redundancies, ensures consistent data across all departments, and eliminates delays caused by manual data transfers. The result is a more cohesive healthcare ecosystem where all stakeholders work in harmony to deliver exceptional patient care.

2. Literature Review

Hospital Management Systems (HMS) are integral to modern healthcare facilities, streamlining operations, and enhancing patient care. With the rise of digital technologies, online HMS solutions are becoming increasingly prevalent. This review explores existing literature on online HMS, focusing on key themes, and existing gaps.

In recent years, numerous studies have been published on the development and implementation of online Hospital Management Systems. Key sources include:

(Devi, Deepica, Dharshini, & Dhivyashree, 2021) The use of technology in healthcare has increased, especially during the pandemic when people preferred staying at home. Many now rely on websites and apps to connect with hospitals. To manage the large amounts of data involved, like patient records and appointments, a special system has been created.

(Devi, Deepica, Dharshini, & Dhivyashree, 2021) This system lets patients book appointments and check their medical history online. Doctors can see their schedules and give online prescriptions, while administrators manage all the medical data and allow labs to upload reports. The system also sends email reminders for upcoming appointments. It's a user-friendly platform for patients, doctors, and administrators to manage healthcare data efficiently.

(Chafekar, Sundas, & Sharma, 2021) The coronavirus, which has affected the world, has caused numerous health problems, especially in regions similar as South Asia and Africa. The deficit of sanatorium outfit similar as ventilators and sanatorium beds in India has stressed the need for better healthcare services. Online sanatorium operation can be developed to break this problem. a This system allows cases to make movables and admit treatment from doctor sever, reducing the need for sanatorium visits and saving plutocrat for those in critical need. The web operation can be penetrated from mobile phones, laptops and desktops, making healthcare easier in delicate times. It may also mate with certified apothecaries to deliver affordable Users to cases' doorsteps. This approach aims to help cases, especially the senior and impaired, admit treatment at home by reducing the burden on healthcare labour force by reducing the number of hospitals.

(C, S.Nithyapriya, & Dr.A.Bhoomadevi, 2024) This research focuses on developing a Medical Records Management system for Android and iOS platforms using Low Code and No Code (LCNC) software development tools. The goal is to create a user-friendly app that allows healthcare professionals, including doctors, nurses, and postgraduate students, to easily access, update, and retrieve patient information. By using LCNC platforms, even non-technical hospital staff can customize and manage the application without complex coding. The system aims to improve communication and data sharing within healthcare teams, leading to better patient outcomes and enhanced quality of care. This approach highlights the feasibility and benefits of using LCNC tools in healthcare, particularly for managing medical records.

(Yamin, 2018) Healthcare operation is witnessing significant changes, driven by advancements in both surgical technology and information technology (IT). While new surgical machines and procedures are transubstantiating how surgeries are performed, the operation side of healthcare is inversely important. IT is playing a pivotal part in perfecting the operation of health movables and medical records. The rise of data processing allows for the collection, mining, and analysis of large quantities of medical data, abetting in diagnostics, medicine administration, and overall

healthcare operation. This composition highlights how IT is reshaping healthcare operation, perfecting decision-timber, and enhancing the effectiveness of hospitals and the healthcare assiduity as a whole.

(Tanbeer & Sykes, 2021) MyHealthPortal is designed to overcome the limitations of current e-Health portals, which typically only support listed practices in healthcare facilities and limit access for family members and caregivers. With the growing demand for outpatient, home and specialty healthcare services, and the increasing need for patients to have additional control over their health record MyHealthPortal delivers a more flexible and comprehensive outcome. It supports non primary care and home care services by providing online scheduling, information sharing, and more. Developed in partnership with Ending the Gap Healthcare, a leading provider of home care services, MyHealthPortal is secure, patient-friendly, and field-tested, achieving a high usability score of 92.5, making it an effective tool for both patients and healthcare providers.

(Singh, et al., 2017) Reducing child mortality is a top priority for the country, but in India, child health and immunization records are still largely paper-based, missing opportunities for early detection of growth disorders. To address this, India's first hospital-linked cloud application, iCHRcloud, has been developed to enable automated immunization and real-time growth monitoring of children. It integrates with hospital HIS/EMR systems via HL7 protocols and provides a web portal for doctors and a mobile app for parents to enhance doctor-parent interaction. The app automates the creation of growth charts using High charts and provides real-time updates via push notifications on iOS and Android. Recognized as an innovative solution to a national challenge, iCHRcloud aims to reduce child mortality by providing secure, sustainable, and seamless access to health data. A preliminary analysis of 16,490 podiatric medical records highlights the need for more effective screening strategies to meet the needs of diverse demographics. This article highlights the potential of iCHRcloud in shaping effective health policy.

(Wadhwa, Saxena, & Wadhwa, 2007) Advances in IT and social change have created a need for innovative knowledge-based healthcare systems that can meet both current and future needs. Hospital Information Management Systems (HIMS) are designed to meet these needs by effectively managing hospital information both inside and outside the hospital, including telehealth and e-health. Developed within a knowledge management (KM) framework, HIMS allows users to share and use knowledge more effectively and allows the system to adapt to future technical, social, administrative and economic requirements. This article presents a functional HIMS designed to meet the changing needs of the global healthcare system.

(Sun, Yu, Lei, Wang, & Hu, 2017) This about centres on creating a portable brilliantly wellbeing data framework for moving forward clinic administration and quiet care by utilizing Web of Things (IoT) innovation. The consider starts with a comprehensive writing survey to investigate the essential theories and current inquire about within the areas of Web of Things, versatile wellbeing frameworks, and savvy healing centres. At that point, a field study is conducted through location visits, overviews, and assessments to get it the healing centre forms counting determination, treatment, charging, and capacities of the existing clinic data system. Based on the comes about, the framework is created employing a computer program improvement technique cantering on necessities investigation and framework plan. The most

recent framework coordinating NFC (Close Field Communication) and indoor route innovation to streamline healing centre commerce forms and make an intuitive user interface. The program and equipment environment required to back the framework is additionally analysed. Eventually, the IoT-based portable shrewdly therapeutic data framework is anticipated to significantly abbreviate understanding treatment time, move forward both understanding treatment and healing centre administration proficiency, and advance the advancement of keen healthcare.

(Karthikraj H, Pavithra M, & M, 2021) Optimizing hospital appointment scheduling through a web application called "Online Doctor Appointment." The system provides separate signup and login processes for both doctors and patients. Doctors can register by providing essential details such as their availability, fees, and specialty. After successful registration, doctors can log in to view patient booking requests. If a doctor accepts a patient's request, the status is updated to "booking confirmed." Patients must also sign up and log in to book appointments. They can search for doctors based on specialty, the nature of their medical issue, and location. The search results display a list of matching doctors, allowing patients to select one and send a booking request. If the doctor is available, they confirm the appointment, and the patient is notified both through the application and via SMS. This system enhances the efficiency of appointment scheduling, making it easier for patients to find and book appointments with doctors who meet their specific needs.

(Nayak, et al., 2015) This emphasizes the urgent requirement for prompt access to vital emergency services that are crucial for preserving lives. Unexpected emergencies can make it difficult to get help quickly. The article emphasizes the significance of services offered by government organizations, such as firefighters, police, medical services, blood banks, and ambulance services, crucial for guaranteeing the safety and welfare of society. Acknowledging the challenges individuals encounter in quickly accessing these services, the article presents a web-based app that offers in-depth details on all emergency services, available around the clock. The app includes options to find nearby blood banks and medical services open 24/7, as well as access details on police and fire departments all in one place. This tool is especially important during the current pandemic, when there may be sudden emergencies. The goal of the web application is to streamline the process of accessing urgent care and support by consolidating information and ensuring it is easily reachable, thus assisting individuals in managing emergency situations with greater efficiency.

(Shiva & Revathi, 2019) This presents the concept of an online resource designed to assist individuals during emergencies by providing quick access to essential information. The proposed solution, a Web-Based Emergency Directory, is a web application aimed at addressing emergency situations by collecting and processing requests from those in need. The application offers vital information, including addresses, phone numbers, and other relevant details for various emergency services, ensuring that help is readily available. The system is built using modern web development tools like Node.js, React.js for a user-friendly interface, and Firebase for efficient backend support. These technologies are chosen for their effectiveness in creating responsive and reliable web applications. The paper also suggests that future research will focus on enhancing the web app by adding features related to emergency response techniques and improving usability, including optimization for mobile devices. This directory serves as a crucial tool for ensuring that people can quickly and easily access emergency services when needed, potentially saving lives.

(LATIF & SOOMRO, 2015) This suggests creating a better system for reporting and intervening to improve communication between citizens and government, particularly in urgent situations like medical emergencies, traffic accidents, fires, and natural disasters. Using the latest developments in telecommunications and mobile technology, the system will sort problems by importance, with pressing matters allowing for instant reporting to ensure a rapid response, crucial for rescuing lives. The research highlights the significance of cooperation among different government reporting systems, with the goal of establishing a cohesive platform that complies with regulations and promotes collaboration between citizens and government entities. This method aims to decrease intervention time, limit harm to human lives, and enhance the overall efficiency of emergency management systems.

(Divya, Deepthi, Aakanksha, Shree, & Abhigjna, 2023) This study explores the development of a mobile application designed to provide quick access to emergency helpline numbers for various medical and related situations. As smartphones become increasingly common, many users rely on mobile apps to simplify their lives, especially in emergencies. The study reviews existing systems that offer features such as monitoring vital statistics, tracking blood glucose levels, providing hospital details, and assisting paralytic patients. Building on these concepts, the proposed application aims to streamline access to emergency services, allowing users to send alert messages or make calls to family members, ambulance services, police, and fire stations, all with a single click. Additionally, the app includes an online pharmacy service, further enhancing its utility in critical situations. This methodology is designed to be accessible and efficient, ensuring that users can quickly get the help they need in emergencies.

(Hameed, Alam, Nuh, & Salim, 2010) This research paper addresses the challenges in Malaysia's medical, healthcare, and emergency systems, which are often fragmented and lack comprehensive computerization and integration. Current issues include difficulties in accessing and managing up-to-date patient, doctor, hospital, and User records, as many are still stored in physical files and not unified in an electronic medical record (EMR) system. This fragmentation hampers communication and data exchange between medical units. To address these issues, the paper proposes a Novel Integrated Medical Emergency Model (IMEM), consisting of three main components: a web-based database, an intelligent agent, and mobility solutions. The focus is on developing an interactive web-based database that allows hospitals, healthcare centres, and emergency services to simultaneously view, exchange, manage, and collaborate on patient records and resources. This integrated approach aims to streamline data access and improve coordination among medical units.

(Rewa, Khushboo, Harshada, Arati, & Bhushan, 2021)
This article addresses the critical issue of timely access to healthcare services in India, where delays are mostly due to lack of awareness about healthcare services. Surveys and reports sho w that most citizens face difficulty in getting healthcare services on time due to limited access to information about doctors, residential healthcare services and services. This article present s a solution to address these issues through a web design to improve emergency medical services. The website provides a complete list of nearby doctors and hospitals, including contact details, bed availability, services and cost estimates. The system also provides a list of nearby doctors and hospitals, including contact details, bed availability, services and cost estimates. The system is designed to improve overall health response by recording all events and interactions and ensure patients receive timely, quality care.

(El-Masri, 1797) This presents the Mobile Comprehensive Emergency System (MCES), which integrates mobile web services into the health sector to address critical communication challenges in emergency situations. The proposed system leverages cellular networks to equip ambulances and doctors with mobile devices capable of accessing the Internet. This setup allows real-time access to patient health records and facilitates efficient communication with hospitals. By utilizing web services from both static and mobile servers, the MCES aims to enhance the reliability, speed, and accuracy of emergency responses, reducing human errors and improving overall system performance. The implementation of this system is expected to make emergency healthcare communication more efficient and dependable.

(SHIHAB A. HAMEED, 2011) This paper addresses the challenges faced by Malaysia's healthcare and medical emergency systems, including issues related to locality, lack of a unified electronic medical record (EMR), and insufficient use of Internet, multimedia, and real-time technologies. Key problems include difficulties in accessing up-to-date patient, doctor, hospital, and User records, as many are still stored in physical files, leading to communication and data exchange issues between medical units. To overcome these challenges, the paper proposes the Novel Integrated Healthcare Medical Emergency Model (IHMEM), which consists of three main components: a web-based database, an intelligent agent, and mobility solutions. The focus is on developing an interactive web-based database with a unified EMR and SMS facilities, allowing hospitals, healthcare centres, and emergency services to8 simultaneously access, exchange, and manage patient records and resources. A prototype of this system is presented, demonstrating its implementation and potential for customization to suit other countries.

(Okereke, et al., 2024) This paper presents the Health Emergency Request APP (HER-APP), a mobile application designed to address communication challenges between patients and healthcare personnel in Nigeria, especially during out-of-hospital emergencies. The app facilitates the immediate assignment of patients to the nearest and most qualified health personnel for prompt attention. By using a location tracking service, HER-APP connects patients with nearby responders and employs a matching algorithm to ensure effective pre-clinical treatment before full medical intervention is available. The application utilizes an optimized service-oriented architecture and Google GPS for tracking patient requests and available responders. It enhances the Hungarian model to improve patient-responder matching, ultimately aiming to reduce mortality rates and improve emergency response efficiency.

(K.Dhayaneshwar, M.Karthik, & B.Sharmila, 2017) The Complete First Aid app offers a comprehensive resource with 75 topics categorized into three classifications for easy retrieval. verified by a doctor. The app also features a hospital search function for users with data or Wi-Fi connectivity. Its design is both attractive and functional, with a gradient UI, clear iconic buttons, and a simple, user-friendly UX that enhances ease of use.

(Ronke, Adigun, Mohammed, & Edwin, 2020) This investigate creates a computer-aided conclusion framework for recognizing and categorizing bone breaks in X-ray pictures employing a combination of K-Nearest Neighbor (KNN) and Back Vector Machine (SVM) calculations. The consider incorporates information collection, preprocessing (grayscale change and picture improvement), division (Entropy and Canny edge strategies), and highlight extraction (Hough Change). Assessment measurements like precision, affectability, specificity, and Kappa Insights were utilized to survey execution. Comes about appeared an

precision of 90%, affectability of 87%, specificity of 100%, and a Kappa coefficient of 83%. The proposed strategy demonstrates successful for categorizing break sorts in bone pictures.

(Ghosh, Mallick, Chakraborty, & Gupta, 2024) This inquire about addresses the deficiency of restorative staff in India by creating an robotized framework for recognizing bone breaks with tall accuracy (97% precision) and an great F1 score of 0.98. The framework employments visual apparatuses like heatmaps and execution charts to survey its adequacy. A user-friendly interface is additionally being made to encourage its selection in clinical settings. Be that as it may, challenges related to information complexity, category representation, and show versatility got to be overcome. The ponder highlights the importance of careful testing to guarantee the system's unwavering quality some time recently far reaching arrangement within the therapeutic field.

(Joshi & Singh, 2020) This article points to help within the programmed location of bone breaks in X-ray pictures, tending to the challenges confronted by radiologists in under-resourced or active clinical settings. The paper is isolated into five parts: 1) information planning for break discovery, 2) image-processing methods utilized, 3) investigation of customary and profound learning strategies for conclusion, 4) comparative investigation of existing strategies, and 5) talk of the issues and challenges in break discovery investigate. The investigate highlights the affect of clinician deficiencies, weakness, and workload on precise break conclusion, supporting for robotized frameworks to move forward discovery and recuperation.

(Liu, et al., 2011) This paper presents a quick advancement demonstrate for creating interfacing and getting to information in therapeutic clinical information administration frameworks, based on XML reports. The demonstrate comprises of two parts: an interface era motor and programmed information get to. It utilizes the unique manufacturing plant design, object-oriented programming highlights, and reflection procedures to empower fast exchanging between distinctive databases and application stages. The strategy has been tried and appeared to decrease plan time by 60% compared to manual strategies, essentially progressing framework advancement proficiency and viability.

(PRIYANKA, NAYAKA, RAKSHITHA, BATTU, & YADAV, 2024) This paper talks about the utilize of chatbots in healthcare, where they associated with clients through content or voice interfacing to supply help. Chatbots are commonly utilized in client benefit, e-commerce, and call centers, and are presently progressively integrated into healthcare websites to assist guests discover specialists, plan arrangements, and get to therapeutic treatment. These frameworks can react reliably, adjust to particular catchphrases, and utilize machine learning to tailor intuitive. In spite of the benefits, concerns emerge over supplanting human staff with robotized frameworks in basic segments like healthcare. The healthcare chatbot works 24/7, replying common and particular healthcare request, producing leads, and sending them to deals groups whereas directing patients to recognize their healthcare needs.

(Paranthaman, Gayathri, Kanishka, & Lavanya, 2022) This venture proposes a restorative chatbot fueled by AI to assist clients counsel specialists remotely, lessening travel costs and improving get to to therapeutic counsel. The chatbot employments machine learning to analyze clutters and give fundamental data some time recently seeing a specialist. It works by analyzing data sets and employing a common approach to resolve inquiries, progressing healthcare openness and comfort.

3. REQUIREMENTS AND ANALYSIS

3.1 Problem Definition

In healthcare institutions, the efficient management and coordination of hospital operations are often hindered by inefficiencies, reliance on manual processes, and a lack of integrated solutions. These challenges affect healthcare facilities of all types, from large public hospitals and specialized medical centers to small private clinics. The absence of streamlined systems not only impacts administrative and clinical workflows but also compromises the quality of care delivered to patients. The main issues faced by these institutions are outlined below:

Ineffective Manual Procedures: Many hospitals still rely heavily on outdated manual methods for critical tasks such as maintaining patient records, scheduling appointments, and managing care delivery. These labor-intensive procedures are time-consuming, prone to human errors, and often result in delays that can directly affect patient treatment and administrative efficiency. For instance, a misplaced medical record or a miscommunication in scheduling can lead to long wait times, missed treatments, or improper care delivery. Automating these processes not only speeds up workflows but also reduces the likelihood of errors, improving the overall patient experience and operational efficiency.

Customization Obstacles: Healthcare facilities often have unique requirements for managing patient information, adhering to specific treatment protocols, and generating reports tailored to their needs. Generic hospital management systems may lack the flexibility to meet these diverse demands, leaving institutions struggling to adapt existing software to their operational workflows. Without a highly customizable solution, hospitals risk inefficiencies and inconsistencies in their processes. An adaptable and scalable hospital management system (HMS) ensures alignment with the distinct operational needs of different healthcare facilities, enabling them to deliver better services tailored to their specific patient populations.

Data Integration Challenges: In hospitals, multiple departments often work in silos, making it difficult to ensure that patient information is updated and accurate across all units. This fragmentation can result in critical errors, such as incorrect medication dosages or incomplete diagnostic records, which compromise patient safety and treatment outcomes. The absence of seamless integration between departments necessitates repetitive manual data entry, which not only wastes time but also increases the risk of discrepancies. A well-integrated HMS ensures real-time data synchronization across all departments, providing healthcare professionals with accurate, up-to-date information when and where they need it.

Security Concerns: The growing volume of sensitive patient data stored digitally has heightened concerns about data security and privacy. Inadequate security measures leave hospitals vulnerable to data breaches, unauthorized access, and potential legal repercussions. Protecting patient information is critical not only for maintaining confidentiality but also for ensuring compliance with global healthcare regulations such as HIPAA and GDPR. Advanced encryption methods, secure data transmission protocols, and role-based access controls are essential for safeguarding patient data and building trust between healthcare providers and their patients.

AI Integration for Enhanced Diagnostics: The incorporation of artificial intelligence (AI) in hospital management systems has opened new possibilities for improving diagnostic accuracy and efficiency. By leveraging AI-driven X-ray image analysis, the HMS can automatically detect fractures and abnormalities, providing instant and reliable diagnostic

results. This feature significantly reduces delays in treatment, allowing healthcare providers to act promptly in critical cases. Furthermore, the AI system continuously learns and adapts, enhancing its diagnostic precision over time. This innovation not only supports overburdened radiology departments but also improves the overall quality of care for patients.

Quick Access Chatbot: To enhance patient interaction and improve accessibility, the HMS will include a quick access chatbot. This intelligent feature will simplify essential tasks for patients, such as booking appointments, accessing lab reports, retrieving prescriptions, and downloading invoices. The chatbot is designed with an intuitive interface, ensuring ease of use for patients across all age groups and technological proficiencies. Available 24/7, it provides instant responses to queries, reducing the need for manual assistance from hospital staff. By streamlining routine processes and offering a user-friendly experience, the chatbot makes healthcare services more responsive and patient-focused.

Benefits of implementing a hospital management system (HMS)

Implementing a modern Hospital Management System (HMS) transforms the way healthcare facilities operate by integrating advanced technologies into administrative, clinical, and operational workflows. By leveraging tools like artificial intelligence (AI) and smart chatbots, the HMS enables hospitals to achieve remarkable efficiency, improve patient care, and streamline processes across departments. Below are the key benefits explained in greater detail:

Simplified Appointment Booking: The HMS simplifies the appointment booking process by allowing patients to schedule their visits online, eliminating the need for long queues or manual handling of schedules. Features such as automated notifications and SMS reminders help reduce missed appointments by informing patients well in advance. The inclusion of an intelligent chatbot further enhances this process, enabling patients to book, reschedule, or cancel appointments quickly and conveniently. The system's 24/7 availability ensures patients can access this functionality anytime, improving user engagement and satisfaction.

Role-Based Access Control (RBAC): To enhance security, the HMS incorporates role-based access control, ensuring that staff members can only access the information relevant to their specific job roles. For example, administrators can manage appointments and billing, while doctors focus on medical records and patient care. This approach minimizes the risk of unauthorized access, upholds data integrity, and ensures patient confidentiality. Additionally, real-time monitoring of access logs adds another layer of security, providing administrators with a transparent view of who accessed sensitive data and when.

Cost Reduction through Automation: The HMS significantly reduces operational costs by digitizing all hospital processes and eliminating the need for paper-based systems. Storing data in secure databases or cloud servers negates the expenses associated with maintaining physical servers and paper records. Automation of routine tasks like billing, appointment scheduling, and inventory management ensures better utilization of resources and reduces the administrative burden on staff. Furthermore, AI-powered resource allocation forecasts can prevent unnecessary expenses by optimizing the use of available assets.

Improved Data Accuracy and Integrity: Manual data entry is often error-prone, leading to inaccuracies in patient records, billing, and other critical processes. The HMS addresses this issue by automating data collection and management, ensuring information remains precise and up-to-date. AI-driven inventory management provides real-time alerts when stock levels are low, ensuring essential items such as medications and medical supplies are always

available. Automated reminders for billing and patient follow-ups further enhance the accuracy and reliability of hospital operations.

Enhanced Data Security: Data protection is a critical requirement in healthcare, and the HMS ensures this by employing advanced encryption protocols and secure data transmission methods. Role-based access control, combined with two-factor authentication (2FA) and email OTPs, safeguards sensitive patient information from unauthorized access. Regular system audits and compliance with global healthcare regulations like HIPAA and GDPR further reinforce data security. By implementing these measures, the system builds trust among patients and healthcare providers while maintaining the highest standards of confidentiality.

Efficient Financial Management: The HMS streamlines financial operations by automating billing, invoicing, and payment tracking. Administrators can access detailed financial reports that provide insights into hospital revenues, patient billing trends, and outstanding payments. By analyzing these metrics, healthcare facilities can make data-driven financial decisions to optimize costs and improve cash flow. Automated alerts for overdue payments further enhance revenue management by minimizing the risk of profit loss.

AI-Driven Diagnostics: One of the standout features of the HMS is its integration of AI-powered diagnostic tools. For example, the system can analyze X-ray images to detect fractures or anomalies with speed and precision, reducing the burden on radiologists and minimizing diagnostic delays. As the AI model learns from new data, its accuracy improves over time, leading to better outcomes for patients. By automating diagnostic processes, healthcare providers can focus more on delivering high-quality care while ensuring prompt and reliable results.

Quick Access Chatbot: The HMS incorporates a smart chatbot to enhance patient engagement and accessibility. This virtual assistant allows users to perform tasks like booking appointments, viewing lab results, retrieving prescriptions, and downloading invoices without requiring manual support. The chatbot operates 24/7 and is multilingual, catering to patients from diverse backgrounds. It also provides personalized health tips, reminders, and updates, creating a seamless and interactive healthcare experience. By reducing the workload on staff, the chatbot improves overall efficiency and patient satisfaction.

Streamlined Workflows and Productivity: By automating routine tasks, the HMS optimizes workflows across departments, enabling staff to focus on critical responsibilities. For instance, appointment scheduling, billing, and record management are handled efficiently by the system, freeing up valuable time for healthcare professionals. This streamlined approach not only reduces errors but also enhances hospital efficiency and transparency. Real-time task tracking ensures accountability and allows administrators to monitor staff performance, leading to higher productivity levels.

Improved Patient Experience: Patients benefit from a seamless experience with features that simplify every aspect of their healthcare journey. From online appointment scheduling to easy access to medical records and timely notifications, the HMS ensures convenience at every step. The AI-powered chatbot further enhances this experience by offering instant assistance around the clock. Transparent access to health data empowers patients to actively participate in their care, fostering trust and satisfaction. The user-friendly patient portal also allows individuals to track their health progress, communicate with providers, and manage their medical needs effortlessly.

3.2 Requirements Specification

Demand dissection is a overcritical process of relating the necessary software, tackle, and active specifications for developing the sanitarium operation system (HMS). It involves gathering stakeholder requirements, defining and validating special conditions, and icing these are played throughout the evolution life circle. The system will integrate improved technologies, involving AI- driven features and an exceptional chatbot, to enhance patient care, streamline workflows, and ameliorate user experience.

Software Requirements:

Operating System: The operating system serves as the interface between user applications and the system kernel. Windows 10 and above. The hospital management system is designed to run optimally on Windows 10 or later versions, utilizing the 64-bit architecture for enhanced performance, security, and support for modern hardware capabilities. This ensures that the system can handle intensive tasks, such as database management and real-time processing, with minimal latency.

Programming Language and Framework:

PHP: PHP excels in handling server-side operations, including data processing, user authentication, and integration with databases, making it ideal for healthcare environments where reliability and security are paramount.

MVC Model: The system utilizes the Model-View-Controller (MVC) architectural pattern to separate business logic, UI, and user input.

Front-End Technologies:

HTML5: HTML5 is used to structure the content of web pages, organizing elements such as headings, paragraphs, forms, and tables.

CSS: CSS is used to style the content of the web pages, controlling the appearance of HTML elements like fonts, colors, and layout.

JavaScript: JavaScript is employed to add interactivity to the web pages, handling events like clicks, form submissions, and dynamic content updates.

Backend Technologies:

PHP: PHP is the core backend technology used for server-side scripting, processing form data, handling sessions, and communicating with the database.

MySQL: MySQL is the relational database management system (RDBMS) used to manage complex data relationships efficiently, storing patient, doctor, appointment, and other healthcare data.

PHPMailer: PHPMailer is used to send emails from the hospital management system, handling email notifications and communication with patients and staff.

TCPDF: TCPDF is used for generating PDF documents, such as reports, invoices, and patient records, directly from the web application.

AI-Driven Diagnostics: AI algorithms integrated with the HMS provide advanced diagnostic capabilities, such as X-ray image analysis, helping doctors identify fractures and abnormalities with speed and accuracy. This reduces the workload on radiologists and ensures timely interventions.

Quick Access Chatbot: An intelligent chatbot is embedded into the system to assist users with common tasks, including appointment booking, retrieving lab reports, accessing prescriptions, and downloading invoices. It operates 24/7, enhancing accessibility, reducing staff workload, and improving overall patient engagement.

Build and Dependency Management:

Composer: Composer is used for managing PHP dependencies, ensuring consistent project configurations and facilitating the integration of third-party libraries.

Hardware Requirements:

Processor: Intel i5 (2.5 GHz up to 3.5 GHz) or an AMD equivalent is recommended to handle multi-threaded operations efficiently. This specification ensures that the HMS can manage concurrent tasks, such as real-time chatbot responses and AI-driven diagnostics, without performance bottlenecks.

Memory: At least 8GB RAM is required to support smooth execution of multiple applications, AI models, and data-intensive operations like processing large patient datasets and generating analytical reports.

Secondary Storage: A minimum of 256GB SSD (or HDD) is recommended for storing the database, application files, and system logs. SSD storage is preferred for faster read/write speeds, ensuring quick access to critical data and improving the system's overall performance.

Network Connectivity: A reliable internet connection with a bandwidth of 5 Mbps to 375 Mbps is essential for seamless data exchange between clients and servers, including real-time chatbot communication and AI-based diagnostic services. This ensures that the system can handle high volumes of data while maintaining low latency and high responsiveness.

3.2 Planning and Scheduling

Effective project planning and scheduling are vital for the successful implementation and timely delivery of a hospital management system (HMS). The planning phase begins with a thorough understanding of the project's scope, which encompasses essential features such as patient registration, appointment scheduling, medical record management, billing, and security protocols. By defining the scope clearly, the development team establishes a foundation for meeting user expectations and ensuring the system aligns with the healthcare facility's unique needs. Clear objectives, such as minimizing administrative burdens, reducing patient wait times, and enhancing data accuracy, act as benchmarks to measure the project's success.

Proper scheduling is equally important, as it ensures that the project progresses smoothly and within the allotted time frame. It involves identifying all key tasks, allocating resources, and setting realistic deadlines to meet project milestones. By coordinating the efforts of stakeholders, including developers, testers, healthcare professionals, and administrators, scheduling helps streamline the execution of complex tasks. It also mitigates risks by identifying dependencies and potential bottlenecks in advance, enabling the team to devise contingency plans where needed.
One of the most effective tools for managing project timelines is the Gantt chart. This visual representation of the project schedule outlines the start and end dates for each task and their dependencies. It allows project managers to track progress at a glance and identify delays that could impact the overall timeline. Gantt charts also facilitate better communication among team members by providing a shared understanding of task sequences and deadlines. For large-scale projects like an HMS, where multiple teams often work simultaneously, Gantt charts help ensure coordination and prevent overlapping efforts.

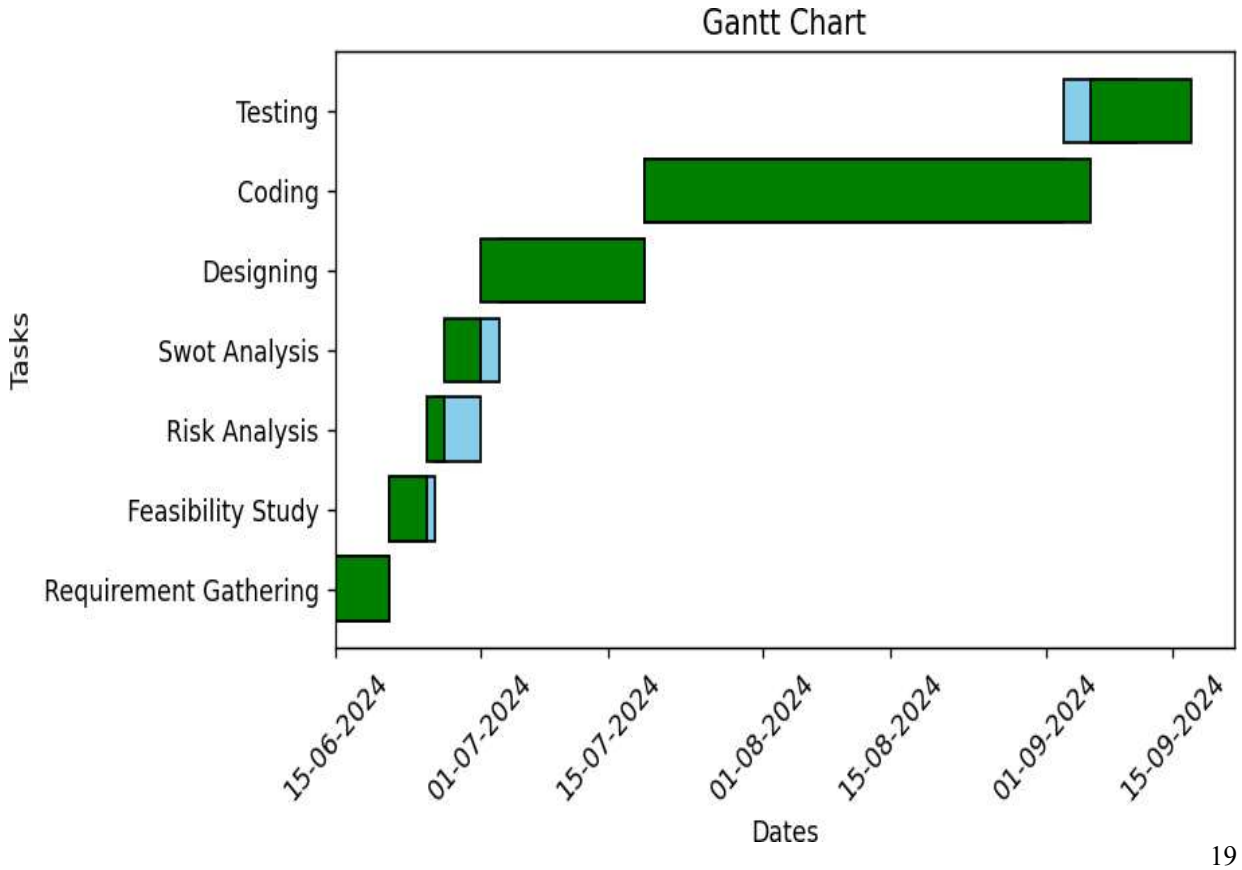
Beyond tracking progress, scheduling serves as a strategic mechanism for allocating resources effectively. By defining priorities, project managers can ensure that critical tasks receive adequate attention and resources without overburdening the team. Regular reviews and updates to the project plan are necessary to adapt to unforeseen challenges, such as technical issues or changes in requirements. Continuous monitoring and adjustments ensure that the project stays aligned with its goals and delivers a robust, user-friendly HMS on time.

Additionally, effective risk management is a crucial aspect of project scheduling. By proactively identifying potential risks, such as delays in data integration, technical challenges, or shifts in regulatory requirements, the team can develop strategies to address them. This includes allocating extra time for critical tasks, establishing backup plans, and ensuring that resources are flexible enough to handle unexpected hurdles. A comprehensive risk management approach minimizes disruptions and ensures that the project remains on track, ultimately contributing to the successful deployment of a hospital management system that meets all functional and operational expectations.

Gantt Chart:

A Gantt chart visually displays the timeline of a project, illustrating when each task begins and ends, and how tasks are connected to one another. It helps project managers monitor progress, spot any delays, and maintain control over the project's timeline. By clearly showing task dependencies, it allows for better coordination and adjustment of schedules as needed. This makes it an essential tool for ensuring that projects are completed on time and within scope.

Sr. No	Task	Plan Date	End Date	Actual Date	End Date	No. of working Days
1	Requirement Gathering	15-06-2024	21-06-2024	15-06-2024	21-06-2024	5
2	Feasibility Study	21-06-2024	26-06-2024	21-06-2024	25-06-2024	2
3	Risk Analysis	26-06-2024	01-07-2024	25-06-2024	27-06-2024	2
4	Swot Analysis	01-07-2024	03-07-2024	27-06-2024	01-07-2024	2
5	Designing	03-07-2024	19-07-2024	01-07-2024	19-07-2024	14
6	Coding	19-07-2024	03-09-2024	19-07-2024	06-09-2024	35
7	Testing	03-09-2024	11-09-2024	06-09-2024	17-09-2024	7



4. System Design

4.1 Data Design (Table Design)

In the Hospital Management System (HMS), the SQL database plays a overcritical part by storing, disposing, and managing essential healthcare data similar as patient information, croaker details, movables, medical commentaries, and broadcasting information. This centralized database structure ensures that all data related to sanitarium missions is efficiently played and can be fluently penetrated when needed.

The data project process includes the coinage of tables, each with rows and lines, to represent nonidentical realities in the system. These tables are precisely structured to insure data delicacy, grease smooth deals, and conserve data veracity. The project also follows stylish practices to misbehave with healthcare regulations and data security ordinances, similar as HIPAA, icing that sensitive patient information is securely stored and penetrated.

The database structure is separated into nonidentical tables, each serving a special purpose.

- Patient Information: A table to store patient details, including personal information, medical history, and contact details.
- Doctor Details: A table to store doctor profiles, including their specialization, contact information, and schedule.
- Appointments: A table to track patient appointments, including date, time, doctor assigned, and appointment status.
- Medical Records: A table dedicated to storing patient medical histories, diagnoses, treatments, and prescriptions.
- Billing: A table to manage financial records, including charges for services, payments, and billing status.
- Inventory Management: A table to track hospital supplies, medications, and medical equipment.

Each table is connected utilizing connections (foreign keys) to conserve thickness and ensure that affiliated data is fluently retrievable. This project allows for effective data reclamation and operation, enhancing the common interpretation and functionality of the system.

The project also prioritizes screen, with encryption for sensitive data similar as patient commentaries, and tools part- grounded access control to ensure that only empowered druggies can pierce special data. also, the database is aimed to manage voluminous volumes of data while maintaining interpretation and scalability, supporting the sanitarium's missions as it grows.

By structuring the database in a well- organized manner, the HMS can efficiently take sanitarium missions, ameliorate patient care, streamline executive tasks, and ensure compliance with data sequestration regulations.

List of Tables with Attributes and Constraints:

The following is the list of tables used in the project of "Hospital Management System"
Database Name: hospital_pro

Table name: users

Name	Type	Null	Key	Default	Foreign Key
id	int (11)	No	PRI		
username	varchar (100)	No	UNI		
email	varchar (100)	No	UNI		
password	varchar (100)	No			
otp	int (6)	Yes			
otp_expiry	datetime	Yes			
role	varchar (100)	No			
created_at	timestamp	No			
reset_token	varchar (100)	Yes			
reset_time	datetime	Yes			
security_question	varchar (100)	No			
security_answer	varchar (100)	No			

Table name: appointments

Name	Type	Null	Key	Default	Foreign Key
id	int (11)	No	PRI		
patient_id	int (11)	No			users(id)
date	date	No			
time	time	No			
doctor_name	varchar (100)	No			

Table name: clinical_documentation

Name	Type	Null	Key	Default	Foreign Key
id	int (11)	No	PRI		
patient_id	int (11)	No			users(id)
document_type	varchar (255)	No			
content	text	No			
date_created	timestamp	No			

Table name: feedback

Name	Type	Null	Key	Default	Foreign Key
id	int (11)	No	PRI		
user_id	int (11)	No			users(id)
comments	text	No			
rating	int (1)	No			
created_at	timestamp	No		current_time	

Table name: invoices

Name	Type	Null	Key	Default	Foreign Key
id	int (11)	No	PRI		
appointment_id	int (11)	No			appointments(id)
amount	decimal (10,2)	No			
date_issued	date	No			

Table name: medical_orders

Name	Type	Null	Key	Default	Foreign Key
id	int (11)	No	PRI		
patient_id	int (11)	No			users(id)
order_details	text	No			
status	varchar (50)	No			
date_ordered	timestamp	No		timestamp	

Table name:messages

Name	Type	Null	Key	Default	Foreign Key
id	int (11)	No	PRI		
sender_id	int (11)	No			users(id)
recipient_id	int (11)	No			users(id)
message	text	No			
sent_at	timestamp	No		timestamp	

Table name: Notifications

Name	Type	Null	Key	Default	Foreign Key
id	int (11)	No	PRI		
user_id	int (11)	No			users(id)
message	text	No			
is_read	tinyint (1)	No		0	
created_at	timestamp	No		timestamp	

Table name:pdf_files

Name	Type	Null	Key	Default	Foreign Key
id	int (11)	No	PRI		
doctor_id	int (11)	No			users(id)
patient_id	int (11)	No			users(id)
file_name	varchar (255)	No			
uploaded_at	timestamp	No		timestamp	
file_path	varchar (255)	No			

Table name: schedules

Name	Type	Null	Key	Default	Foreign Key
id	int (11)	No	PRI		
doctor_id	int (11)	No			users(id)
date	date	No			
start_time	time	No			
end_time	time	No			

4.1.1 Schema Design

Designing a robust and efficient database schema for a hospital management system (HMS) is a multifaceted process that requires careful attention to several key principles. To begin with, understanding the specific needs of the system is paramount. An HMS needs to support various user roles, such as doctors, patients, and administrators, each with different access levels to the data. Visual tools like Entity-Relationship Diagrams (ERDs) are invaluable for mapping out the entities—such as Users, Appointments, and Medical_Orders—and their interrelationships. This step forms the foundation for an effective schema, helping the design team understand how the system will function and how data will flow between tables.

Another essential principle in database design is normalization, which helps in reducing redundancy and enhancing data integrity. Normalization typically extends to the third normal form (3NF), which ensures that data is atomic, eliminating unnecessary repetition. This process also removes partial and transitive dependencies, ensuring that non-key attributes depend solely on the primary key. By adhering to these guidelines, the database can store information more efficiently and avoid inconsistencies, which could lead to errors or confusion when retrieving data.

The integrity of the system also heavily depends on primary keys, which guarantee that each record within a table is unique, and foreign keys, which preserve the relational integrity between different tables. Properly set relationships allow the system to perform complex queries and return accurate data when needed, ensuring seamless interactions between different parts of the hospital management system.

Security is a top priority in healthcare systems, given the sensitive nature of patient data. Role-based access control (RBAC) is an important method for enforcing security, ensuring that users only have access to the data necessary for their roles. This access control prevents unauthorized users from viewing or modifying sensitive information. In addition to access control, encrypting sensitive data both at rest and during transmission is essential to protect it from unauthorized access. Compliance with healthcare regulations, such as HIPAA (Health Insurance Portability and Accountability Act) in the U.S. or GDPR (General Data Protection Regulation) in Europe, is mandatory to safeguard patient privacy and prevent legal issues.

Improving database performance is another critical consideration. Indexing frequently queried columns speeds up data retrieval, reducing the time users spend waiting for information. In cases where tables become large, partitioning them into smaller, more manageable pieces can help enhance performance by making queries more efficient. It's also vital to implement constraints and validation rules to ensure data accuracy and prevent errors from being stored in the database.

Finally, an often-overlooked but crucial aspect of database design is auditing and logging. By setting up mechanisms to track who accessed or modified sensitive data, hospitals can monitor for potential security breaches or errors. These logs provide an important audit trail for compliance purposes and allow administrators to track the history of data changes, making it easier to investigate and resolve issues that may arise. In a healthcare environment, where data accuracy and security are paramount, these measures help ensure the system is both reliable and secure.

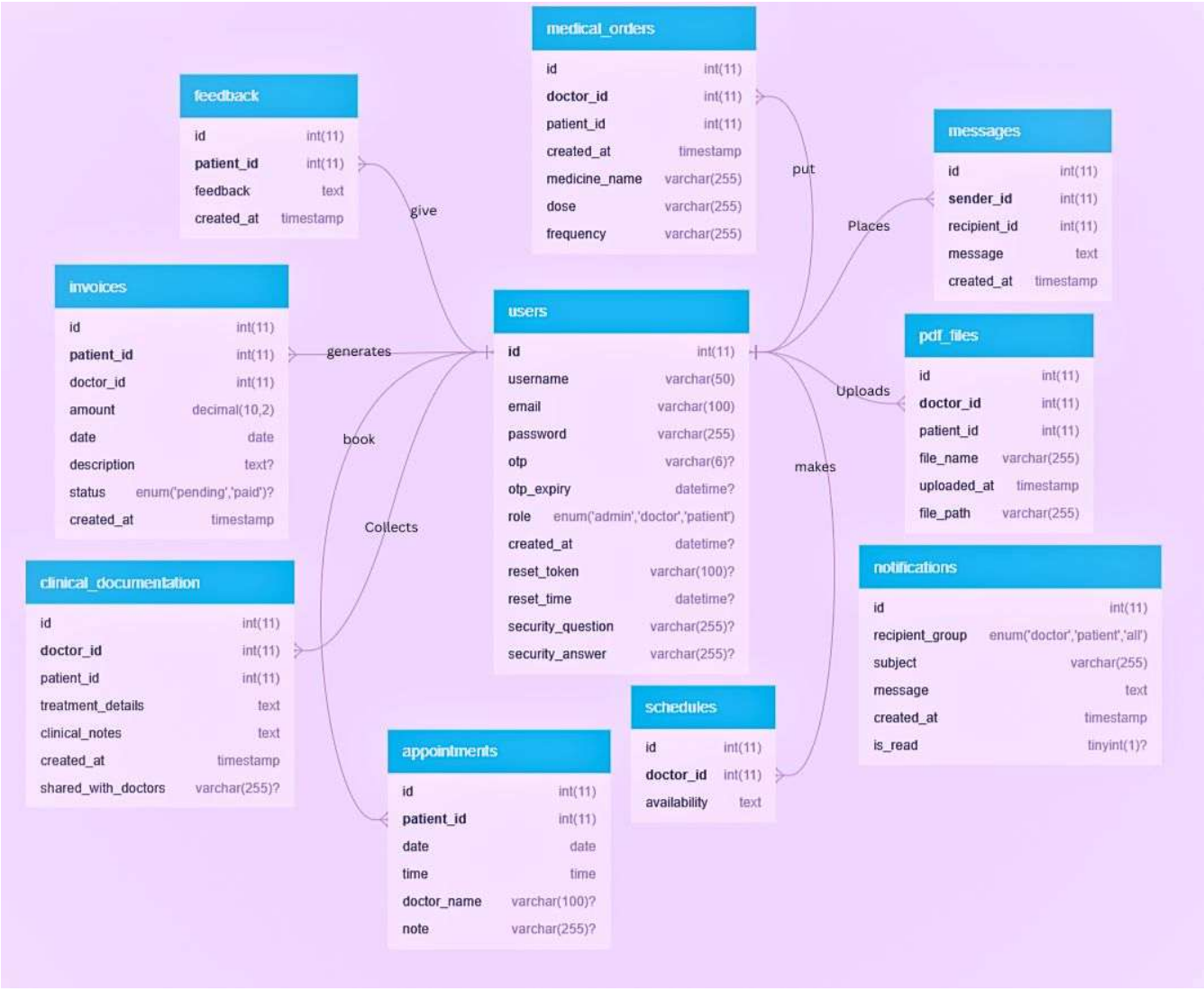

appointments
id int(11)
patient_id int(11)
date date
time time
doctor_name varchar
note varchar
schedules
id int(11)
doctor_id int(11)
availability text
feedback
id int(11)
patient_id int(11)
feedback text
created_at timestamp
messages
id int(11)
sender_id int(11)
recipient_id int(11)
message text
created_at timestamp
users
id int(11)
username varchar
email varchar
password varchar
otp varchar
otp_expiry datetime
role enum
created_at datetime
reset_token varchar
reset_time datetime
security_question varchar
security_answer varchar
notifications
id int(11)
recipient_group enum
subject varchar
message text
created_at timestamp
is_read tinyint(1)
pdf_files
id int(11)
doctor_id int(11)
patient_id int(11)
file_name varchar
uploaded_at timestamp
file_path varchar
medical_orders
id int(11)
doctor_id int(11)
patient_id int(11)
created_at timestamp
medicine_name varchar
dose varchar
frequency varchar
invoices
id int(11)
patient_id int(11)
doctor_id int(11)
amount decimal...
date date
description text
status enum
created_at timestamp
clinical_documentat...
id int(11)
doctor_id int(11)
patient_id int(11)
treatment_details text
clinical_notes text
created_at timestamp
shared_with_doctors varchar

4.2 Diagrams

Design diagrams play a crucial role in visualizing, planning, and implementing a hospital management system by providing clear representations of system structure, processes, and interactions. Here's an overview of the key diagrams and their relevance to your project

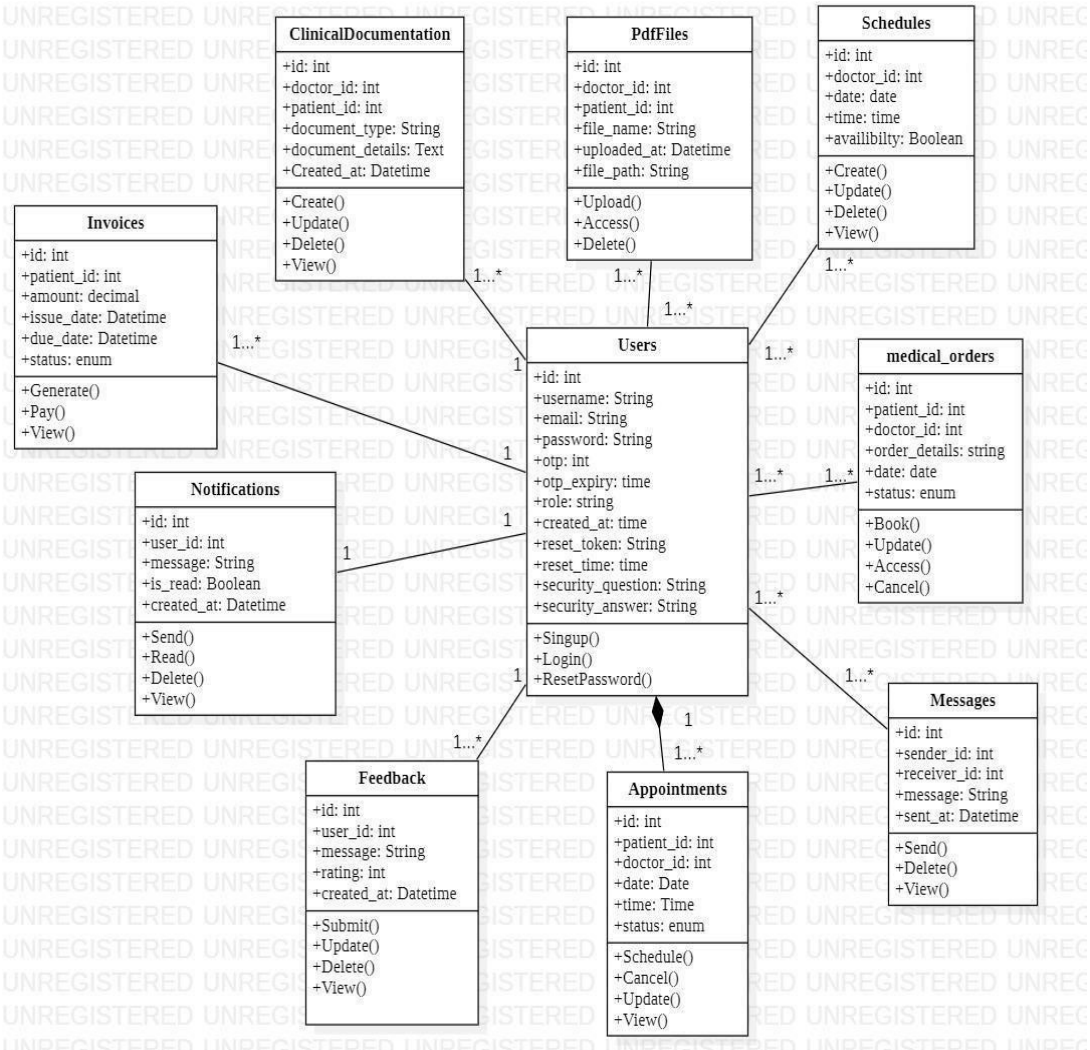
4.2.1 E-R Diagram

Entity-Relationship (ER) Diagram is an essential tool for visualizing the structure of the hospital management system's database. It represents various entities such as patients, doctors, appointments, medical orders, invoices, and users, each with its associated attributes. These entities are connected through relationships, which are key to understanding how data flows and interacts within the system. The ER diagram helps in determining primary keys, which uniquely identify records, and foreign keys, which link related data across different tables. This ensures that the database is well-structured, normalized, and maintains data integrity. By using the ER diagram as a blueprint, we can ensure that the Swasthya HMS is organized efficiently, with all data interconnections clearly defined, ultimately supporting seamless data management throughout the system.



4.2.2 Class Diagram

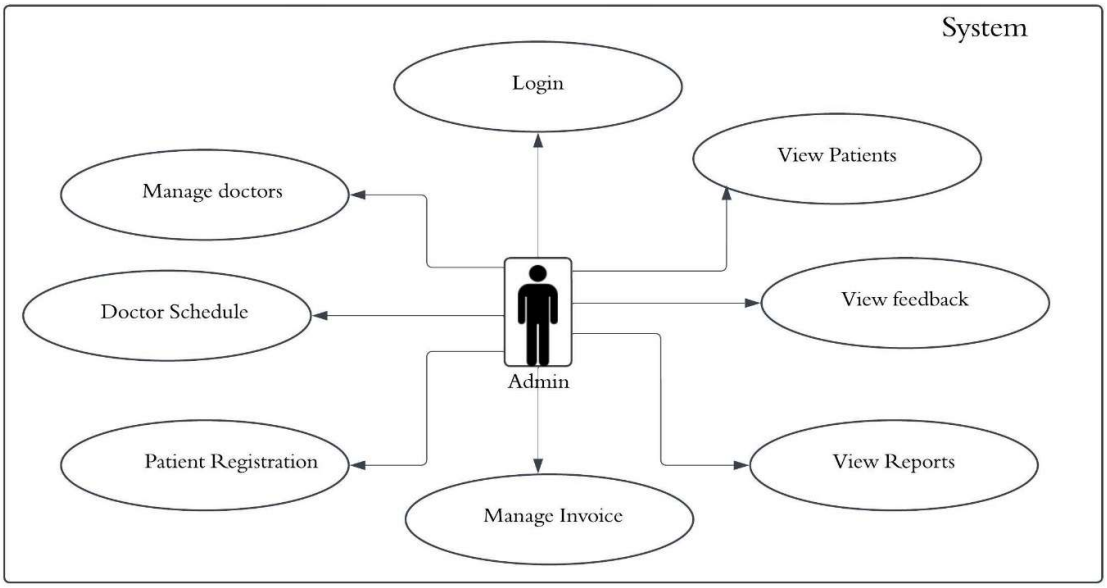
Class Diagram: The class diagram represents the static structure of the system, showing classes, their attributes, methods, and the relationships between them. In the hospital management system, classes could include User, Appointment, Invoice, and Medical_Order, each containing relevant properties and functions. This diagram is crucial for object-oriented design, helping developers understand how different components interact within the system. It also serves as a blueprint for coding, ensuring consistency and alignment with the project's requirements.



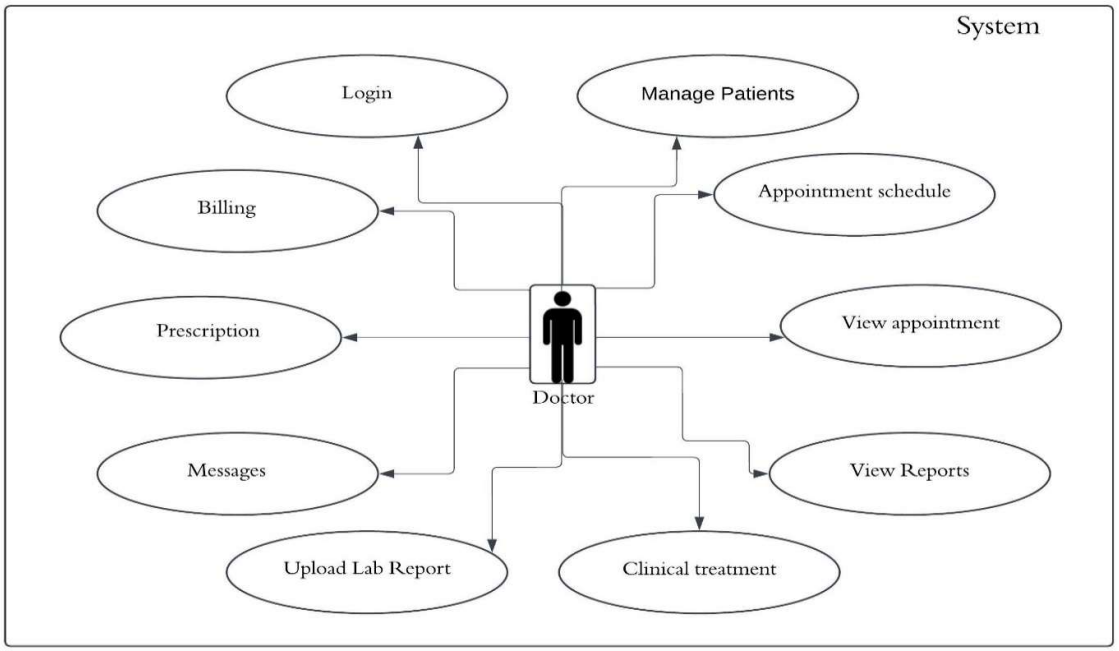
4.2.3 Use Case Diagram

Use Case Diagram: Use case diagrams represent the system's functional requirements by illustrating the interactions between users (actors) and the system. In a hospital management system, key actors might include patients, doctors, administrators, and lab technicians. Use cases depict the functionalities available to each actor, such as scheduling appointments, managing patient records, and processing invoices. This diagram helps in understanding the system's behavior from the user's perspective, defining user roles, and ensuring all necessary functions are addressed.

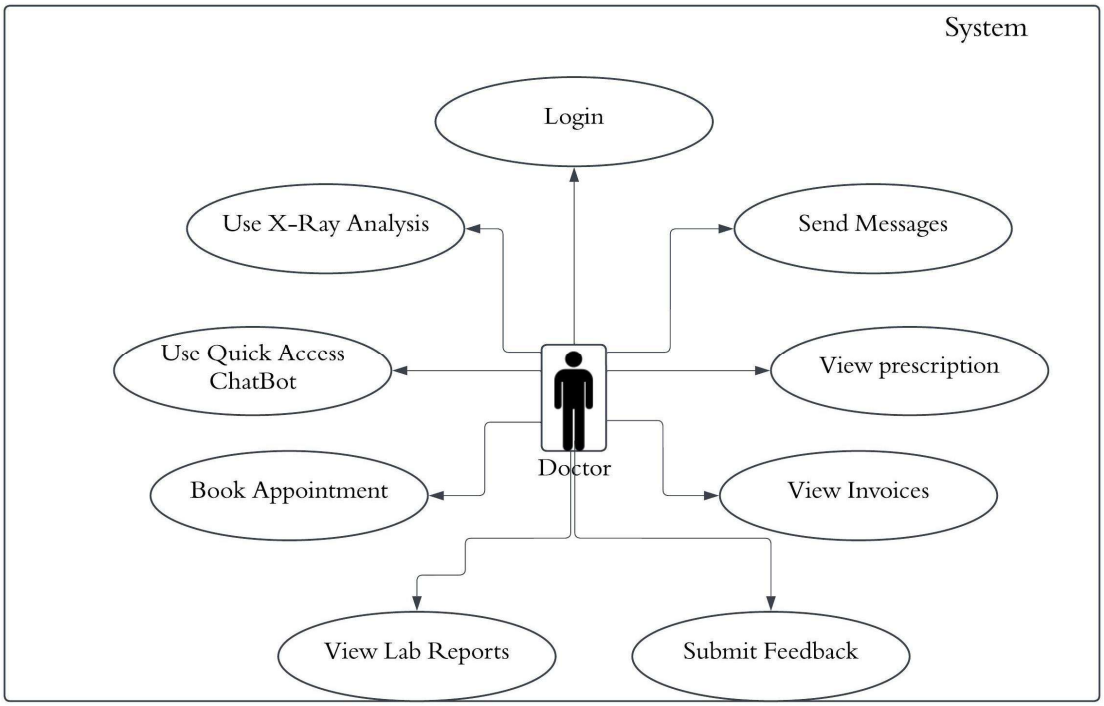
★ Admin use case diagram



★ Doctor use case diagram

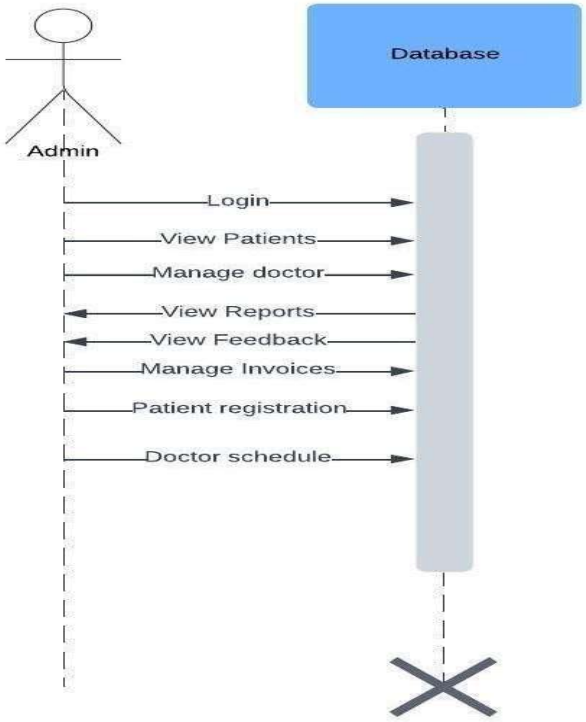


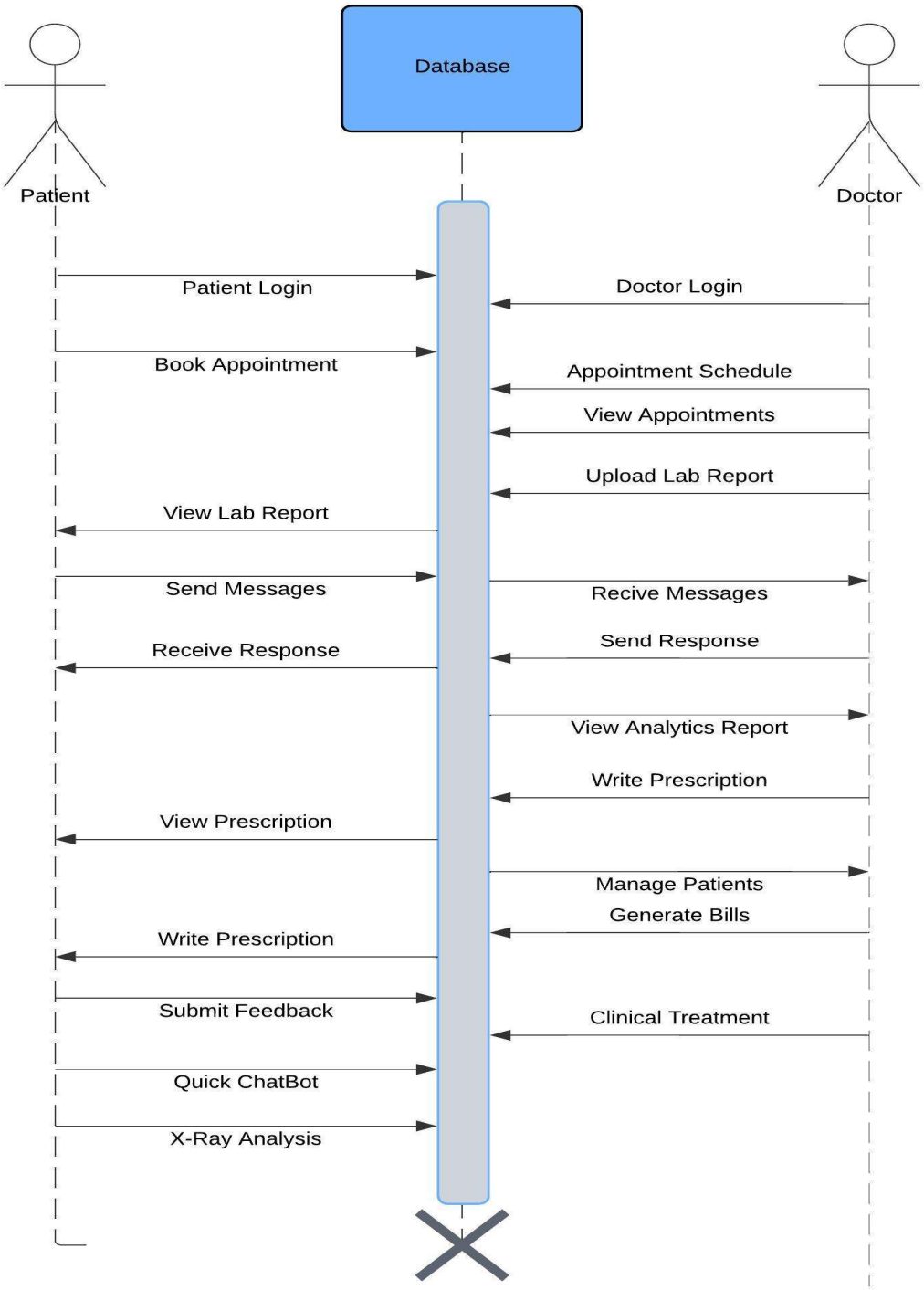
★ Patient use case diagram



4.2.4 Sequence Diagram

Sequence Diagram: The Sequence Diagram depicts the flow of messages between objects over time. It shows how different objects interact with each other to complete a process, such as scheduling an appointment or generating a medical report. This diagram is valuable for understanding the sequence of operations and ensuring that the interactions between objects are correctly implemented.

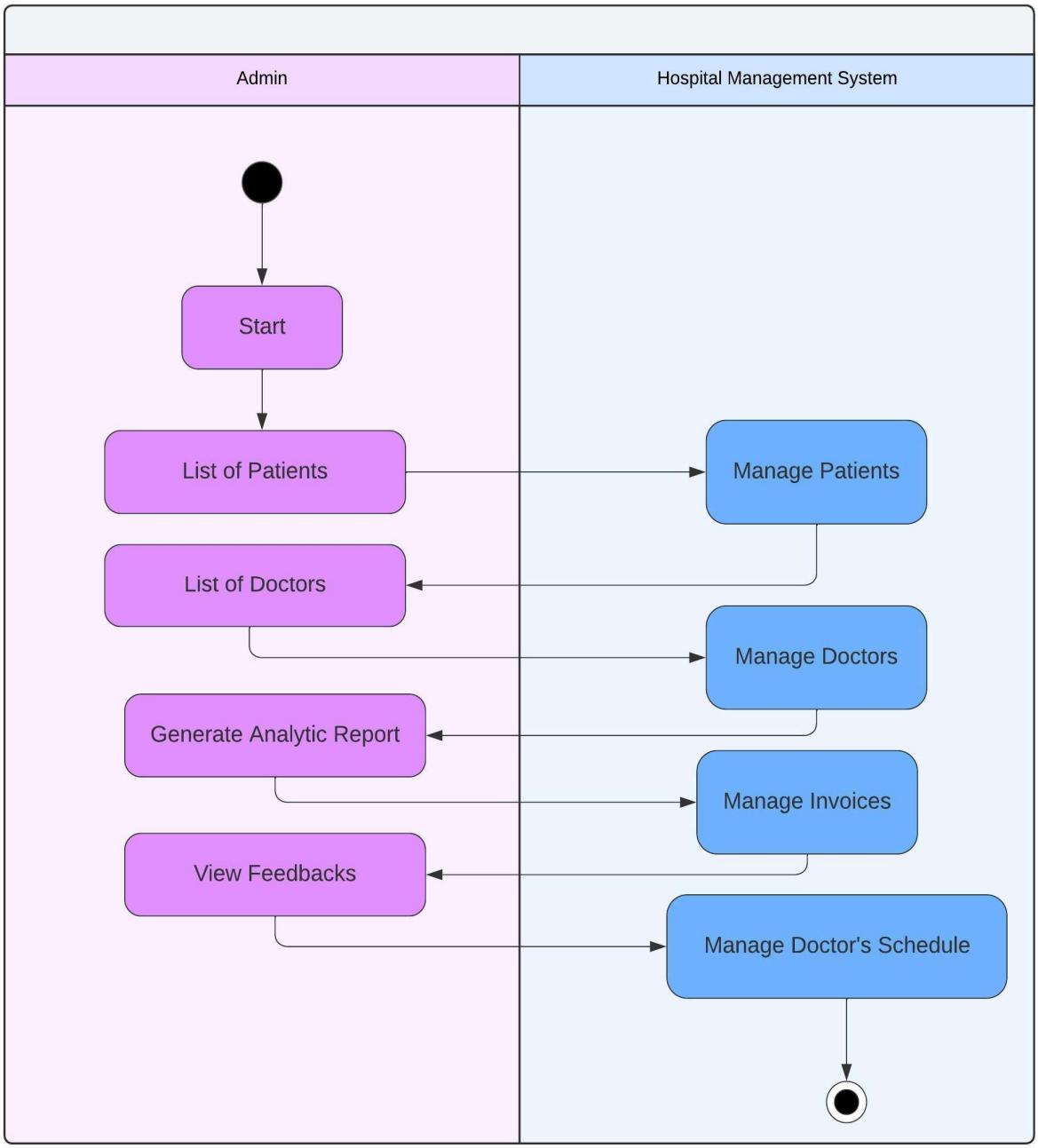



Database
Patient
Doctor
Patient Login
Doctor Login
Book Appointment
Appointment Schedule
View Appointments
Upload Lab Report
View Lab Report
Send Messages
Recive Messages
Receive Response
Send Response
View Analytics Report
Write Prescription
View Prescription
Manage Patients
Generate Bills
Write Prescription
Submit Feedback
Clinical Treatment
Quick ChatBot
X-Ray Analysis

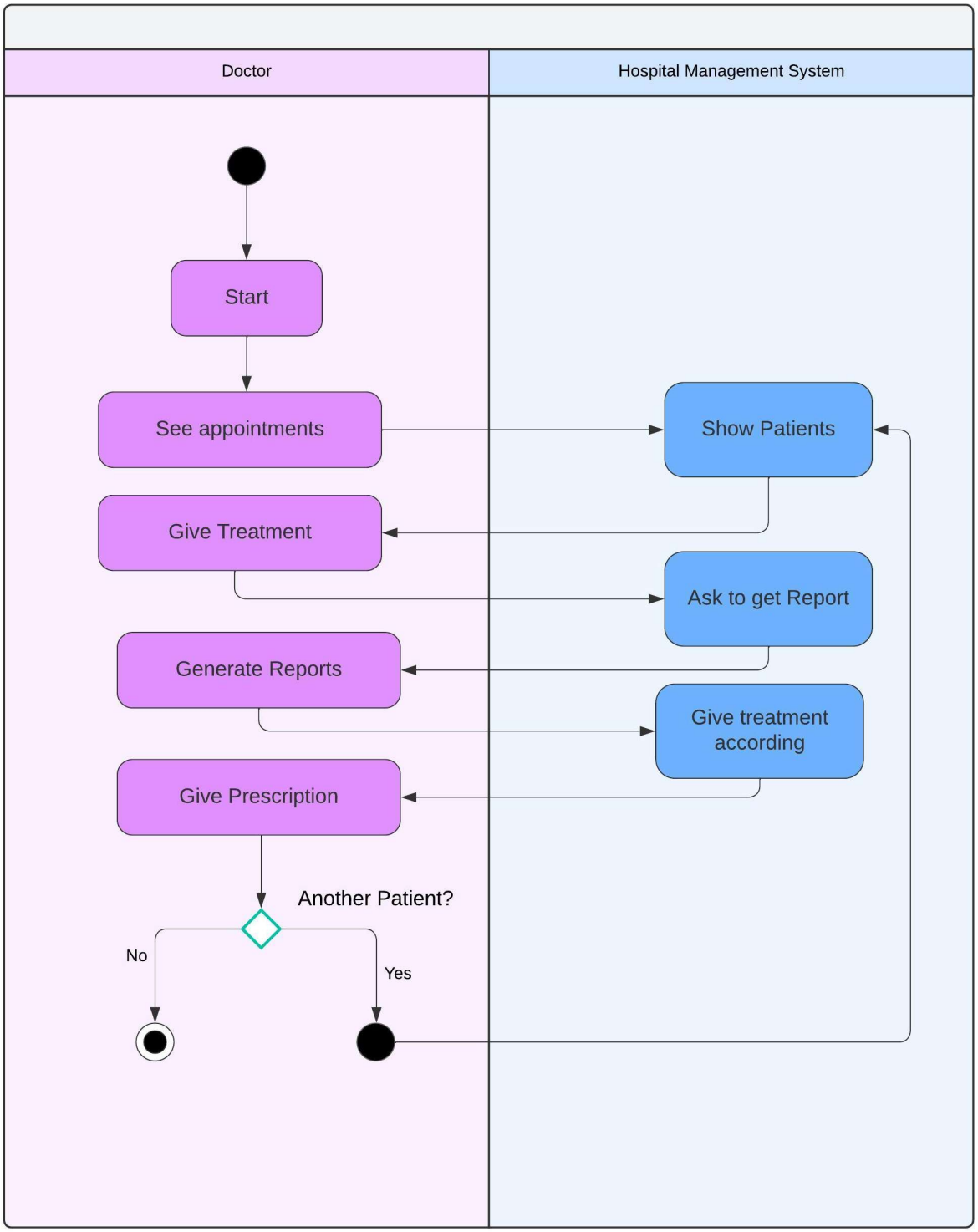
4.2.5 Activity Diagram

Activity Diagram: The Activity Diagram represents the workflow of the system, detailing the sequence of activities and decision points involved in a particular process. For example, it can illustrate the steps involved in patient registration or the process of handling medical orders. This diagram helps in understanding the process flow and identifying potential areas for improvement.

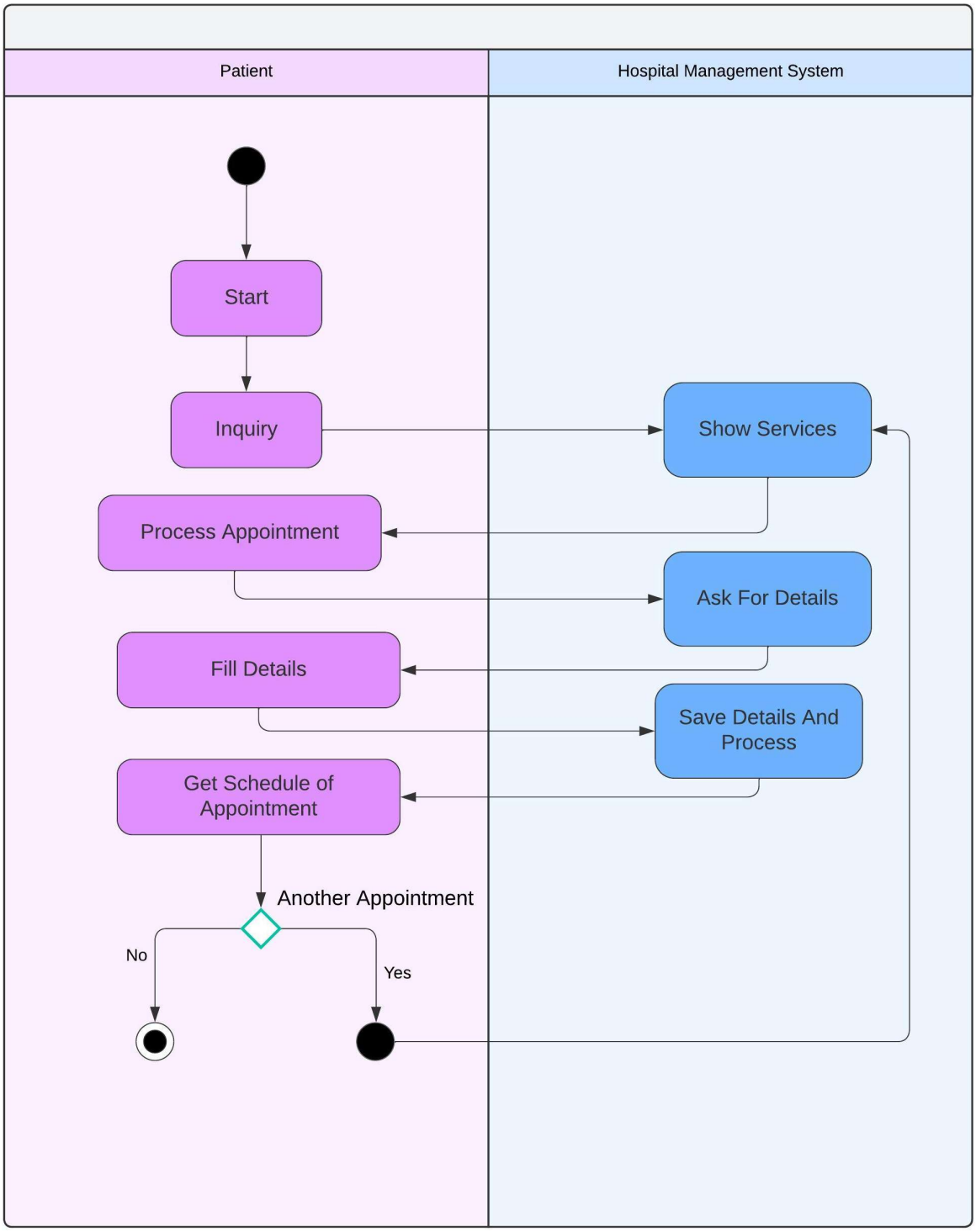
★Admin Activity Diagram



★Doctor Activity Diagram

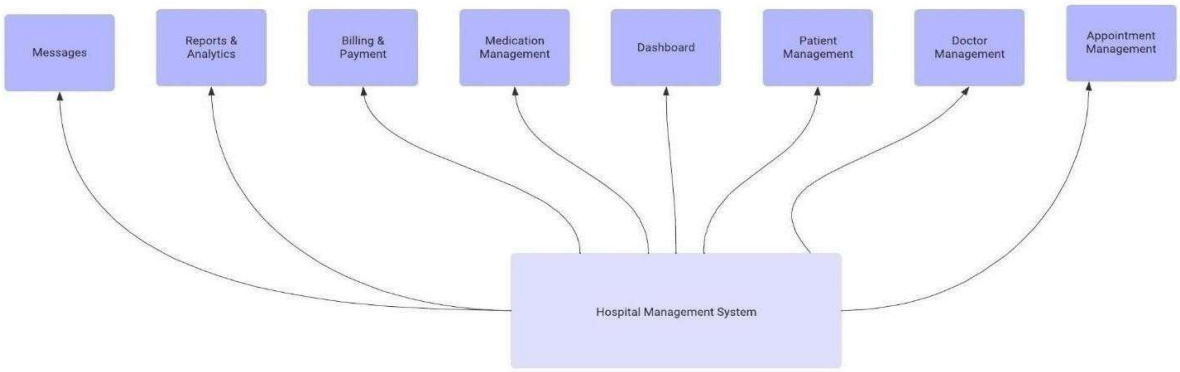


★Patient Activity Diagram



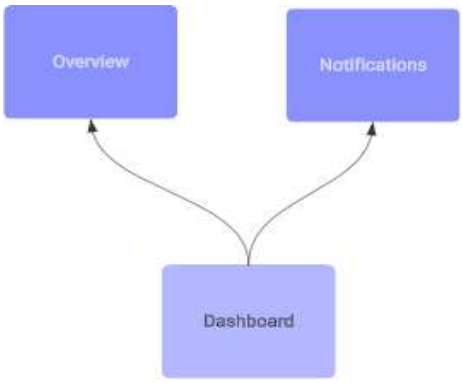
4.2.6 Menu Tree

A menu tree is a hierarchical representation of options available in a software application, organized in a way that allows users to easily navigate through various functions. For a Hospital Management System (HMS), the menu tree is designed to address the diverse needs of the users, including doctors, administrators, patients, and other healthcare staff.

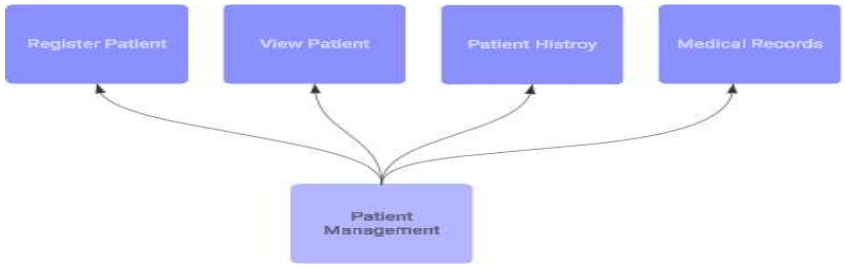


Key Elements of a Hospital Management System Menu Tree

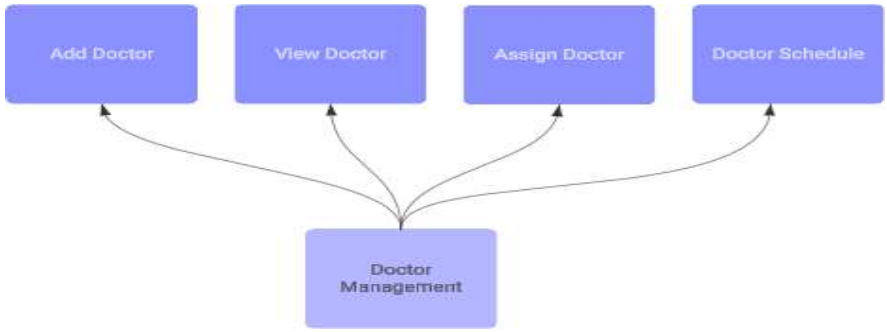
Dashboard: The entry point of the system, providing an overview of key metrics such as the number of active patients, appointments, pending tasks, notifications, and reports. It serves as a quick summary of the hospital's current operational status.



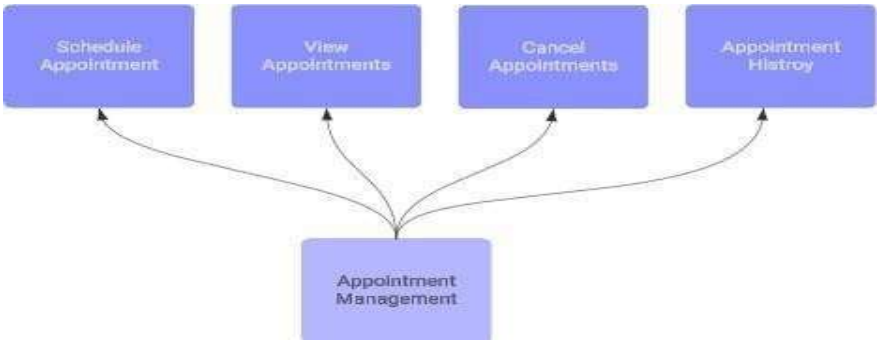
Patient Management: Functions like registering new patients, viewing patient details, accessing patient history, managing appointments, and maintaining medical records. This section is critical for managing all patient-related data and activities, ensuring a streamlined patient flow from admission to discharge.



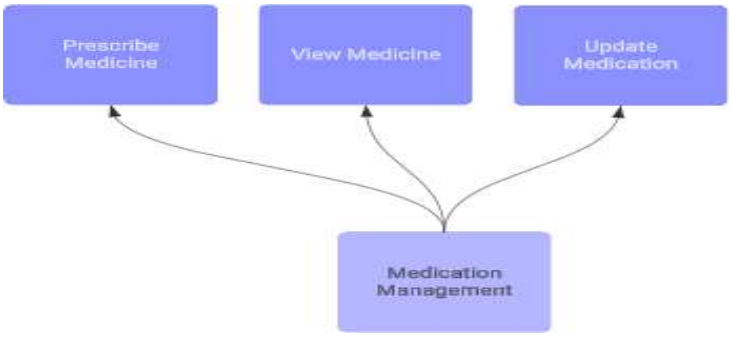
Doctor Management: Manages doctor profiles, schedules, and assignments. It allows administrators to add new doctors, view doctor details, assign them to specific departments or patients, and manage their schedules. This ensures that the hospital can efficiently allocate its medical resources.



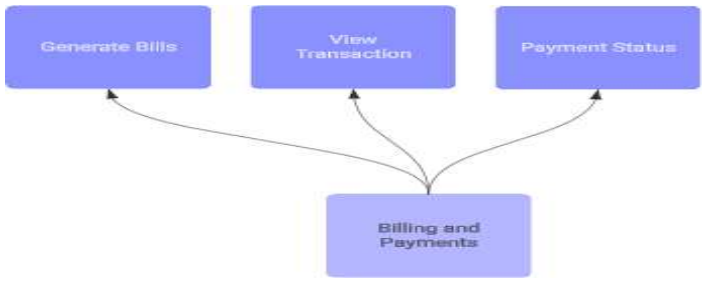
Appointment Management: Involves scheduling, viewing, and cancelling appointments, along with maintaining appointment history. This section is vital for coordinating between patients and doctors, minimizing wait times, and optimizing the use of hospital resources.



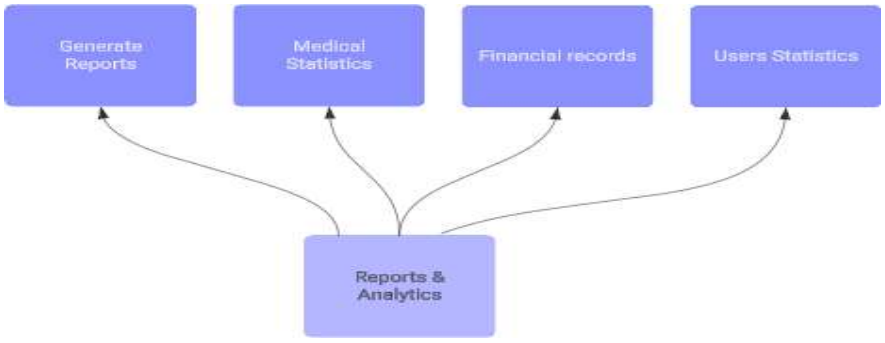
Medication Management: Handles the prescription, viewing, and updating of medications, along with tracking medication stock. This feature ensures proper medication administration, inventory control, and compliance with prescription protocols.



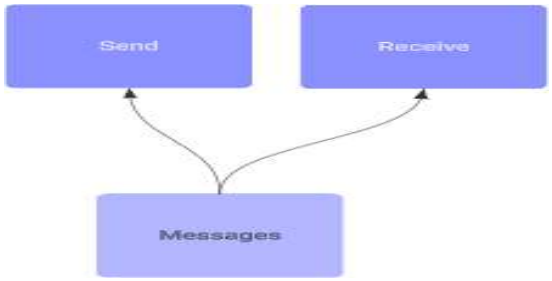
Billing & Payments: Covers all financial transactions including generating bills, viewing transactions, and tracking payment statuses. This section supports the hospital's revenue cycle management by providing clear financial overviews and ensuring accurate billing for services rendered.



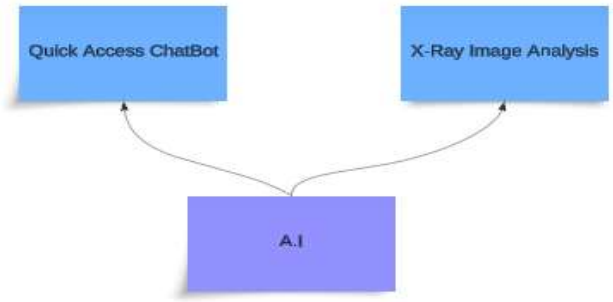
Reports & Analytics: Generates various reports, such as medical statistics, financial reports, and operational analytics. This function helps hospital administrators and stakeholders to make data-driven decisions by providing insights into hospital performance.



Messages: Provides a communication module for sending and receiving messages among doctors, patients, and hospital staff. Effective communication is essential for coordinated patient care and operational efficiency.



AI Module: Provides an AI model for X-Ray image analysis, determining whether a fracture is present. Using a quick access chatbot, users can instantly interact with HMS services like messaging, report generation, and medical insights.

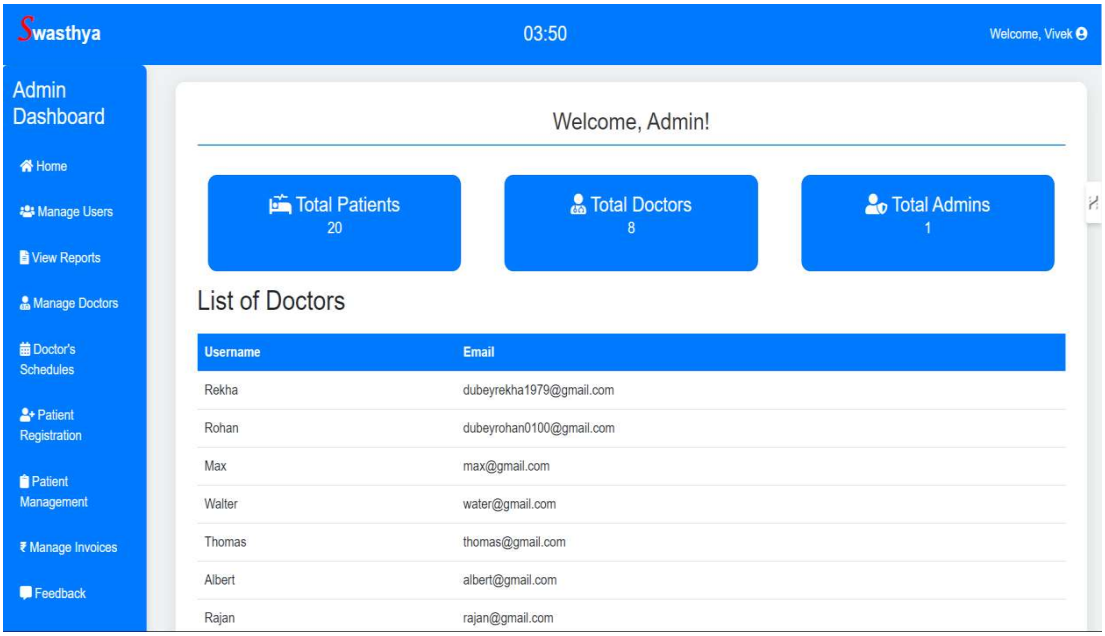


4.3 User interface design

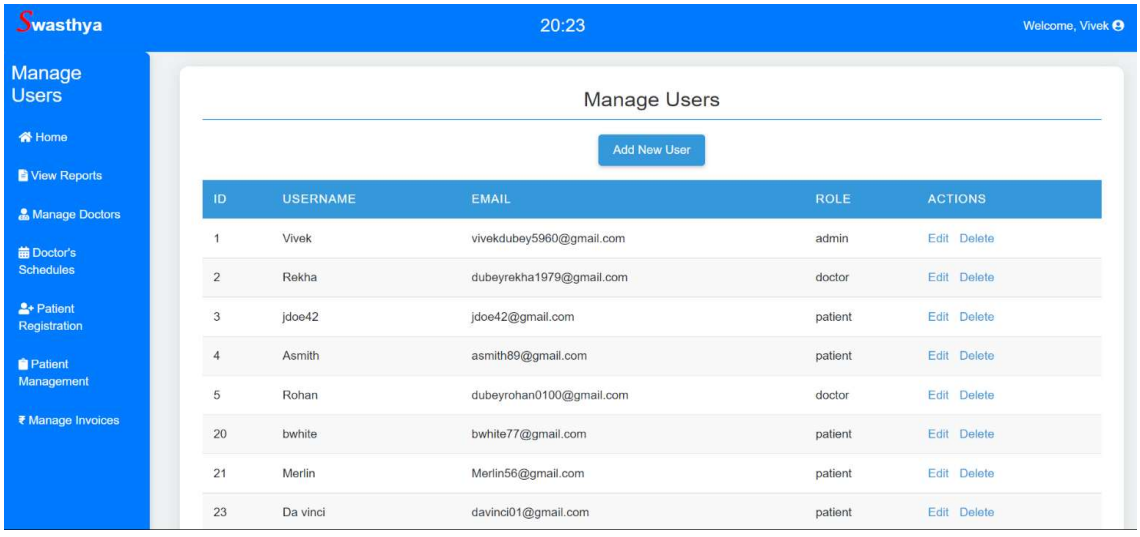
Designing a user interface (UI) for a hospital management system requires a user-centered approach that prioritizes simplicity, accessibility, and security. The UI should be intuitive, allowing users—such as doctors, administrators, and patients—to navigate the system effortlessly. Key elements like clear navigation menus, consistent design patterns, and responsive layouts ensure that users can perform tasks quickly and accurately. Accessibility features, such as adjustable text sizes and high-contrast modes, make the interface usable for people with varying abilities, enhancing inclusivity.

AdminUI

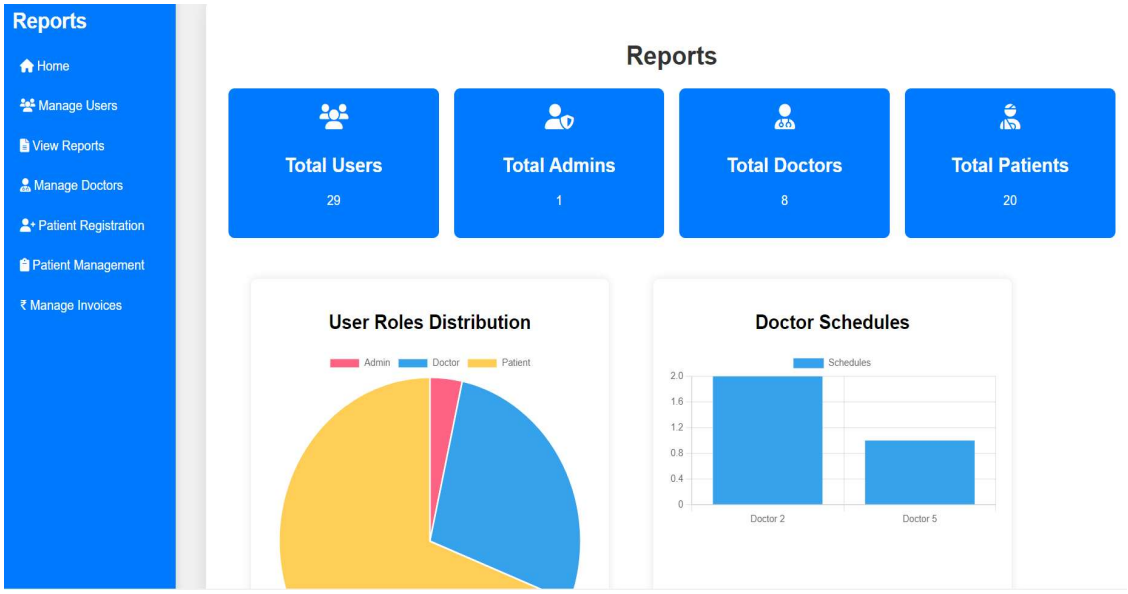
Home



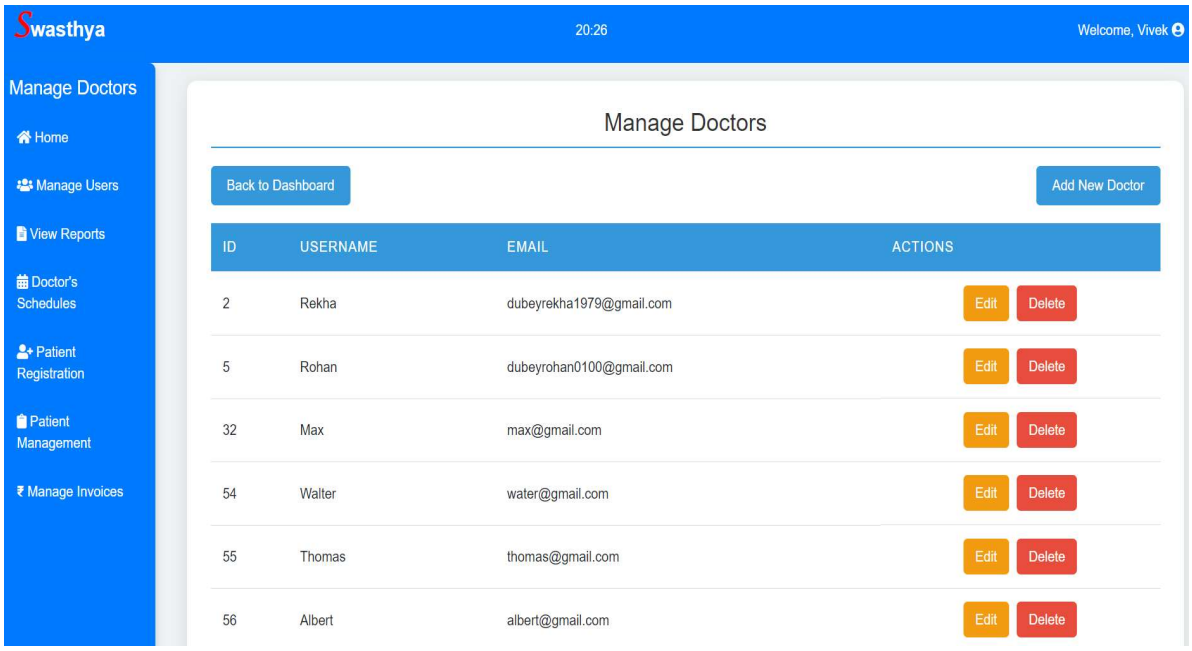
Manage Users



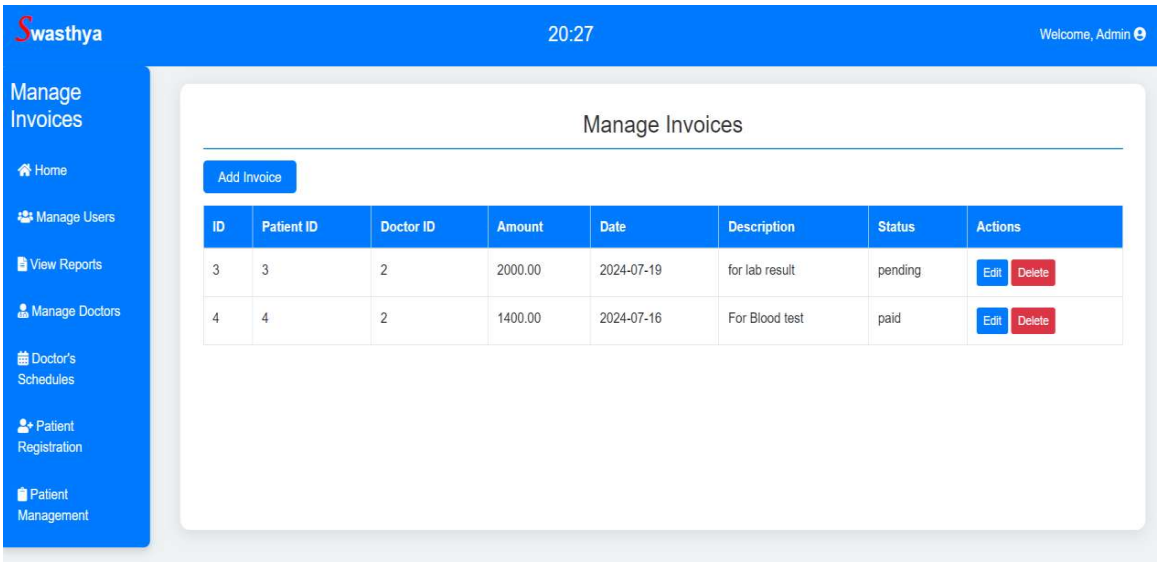
View Reports



Manage Doctors

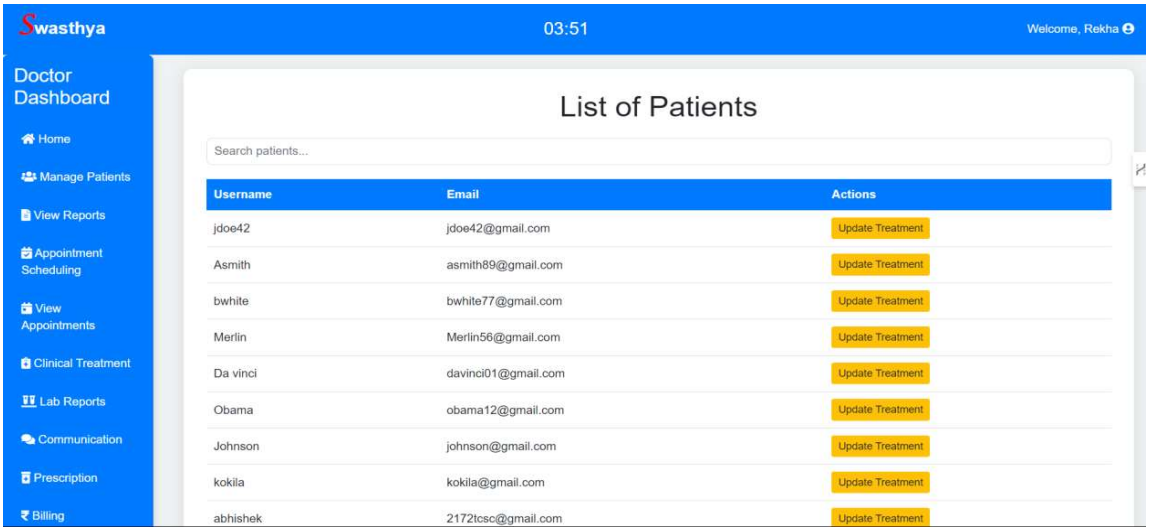


Manage Invoices

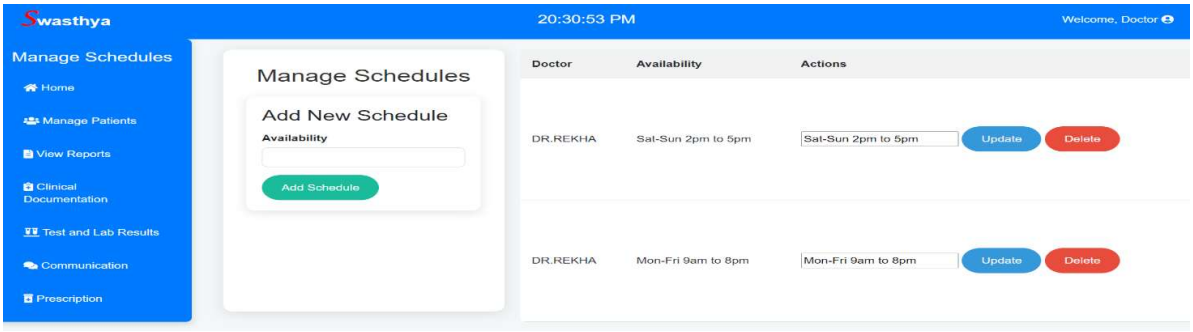


DoctorUI

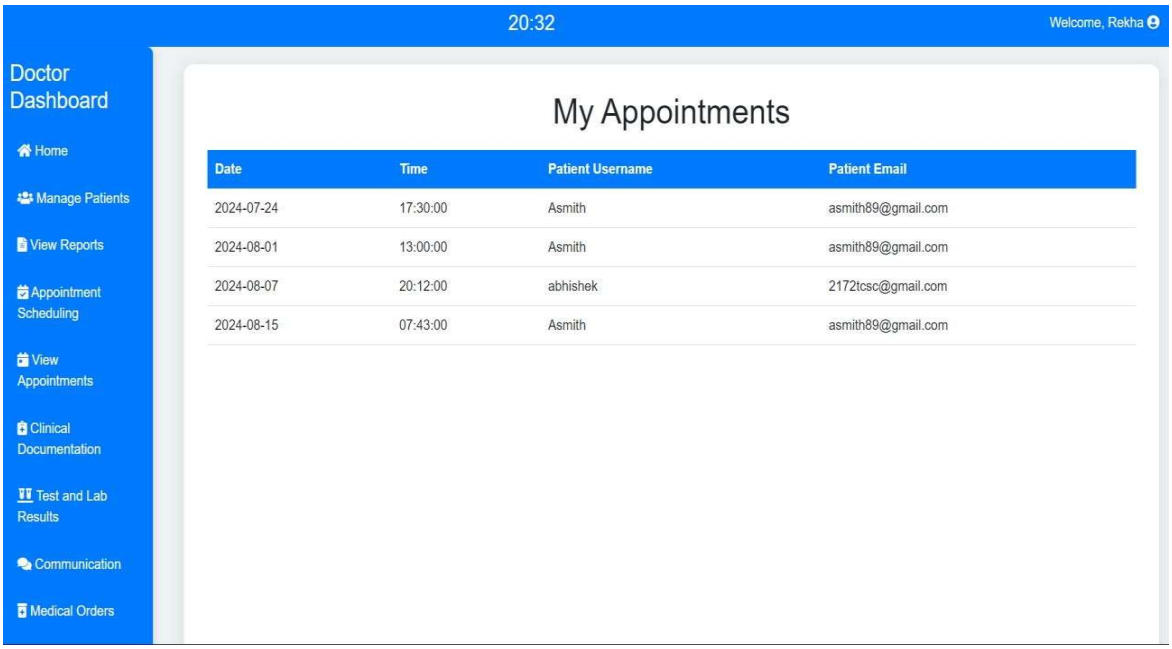
Home



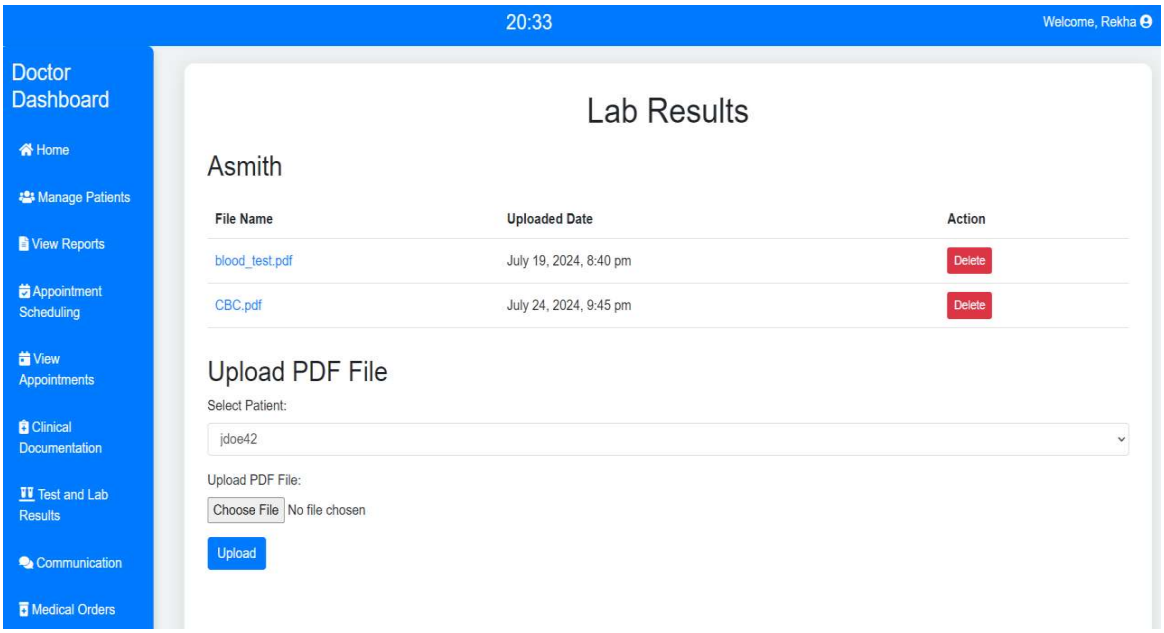
Doctor Schedules



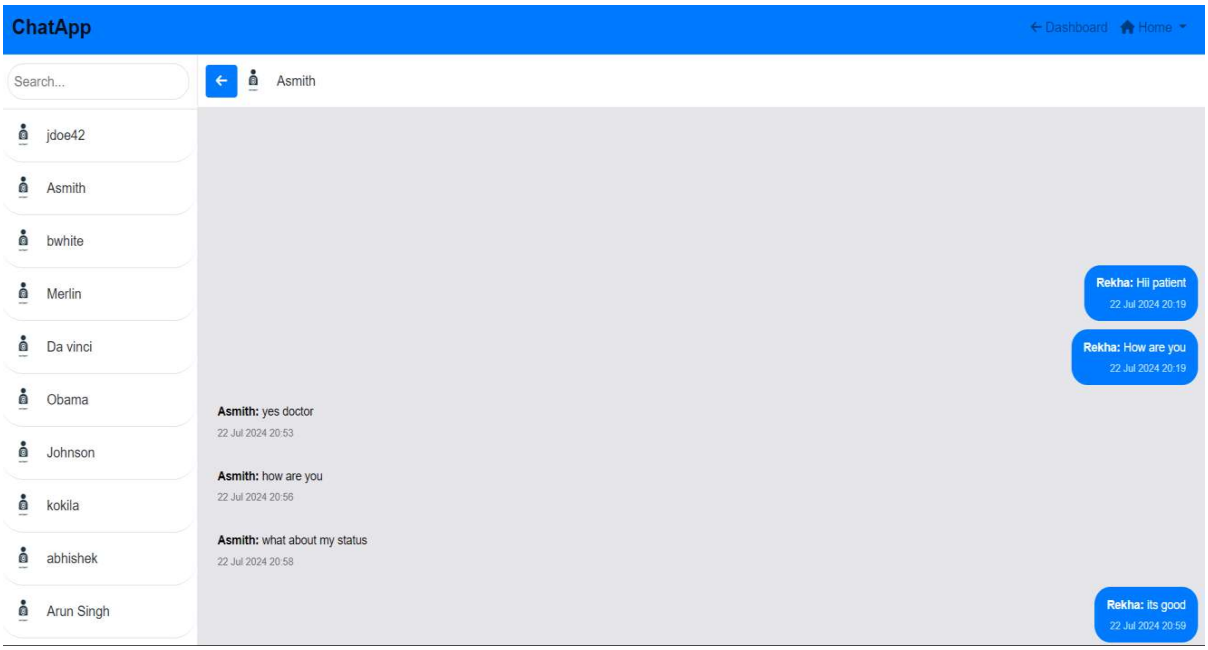
View Appointments



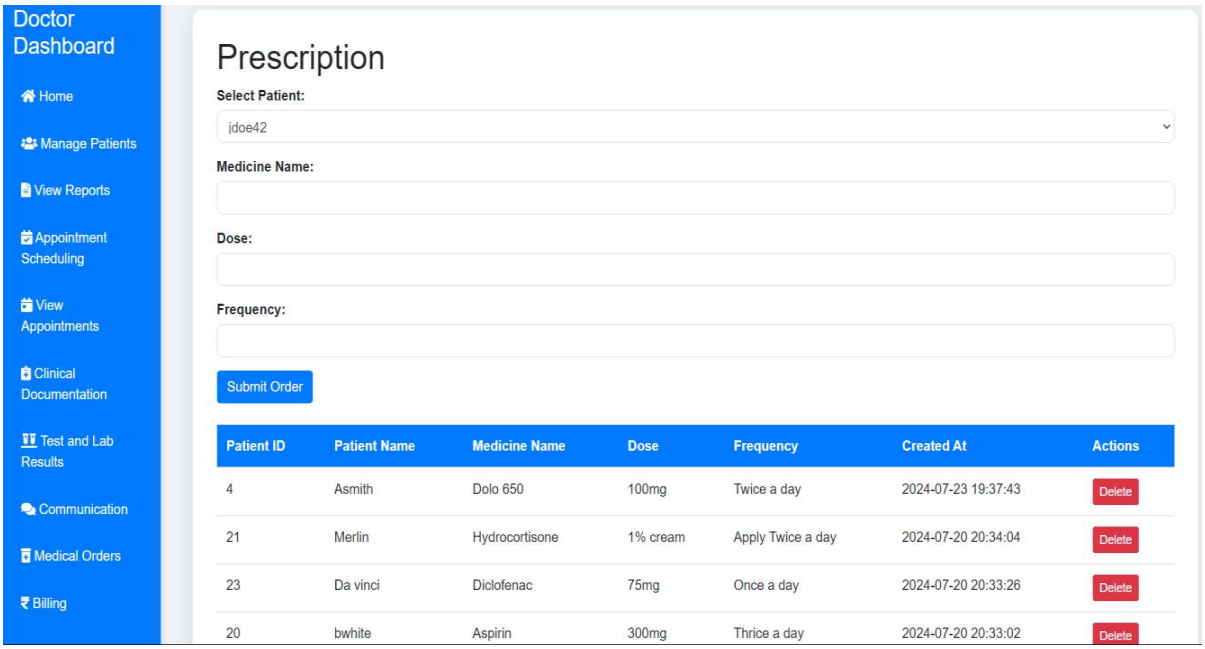
Test and Lab Results



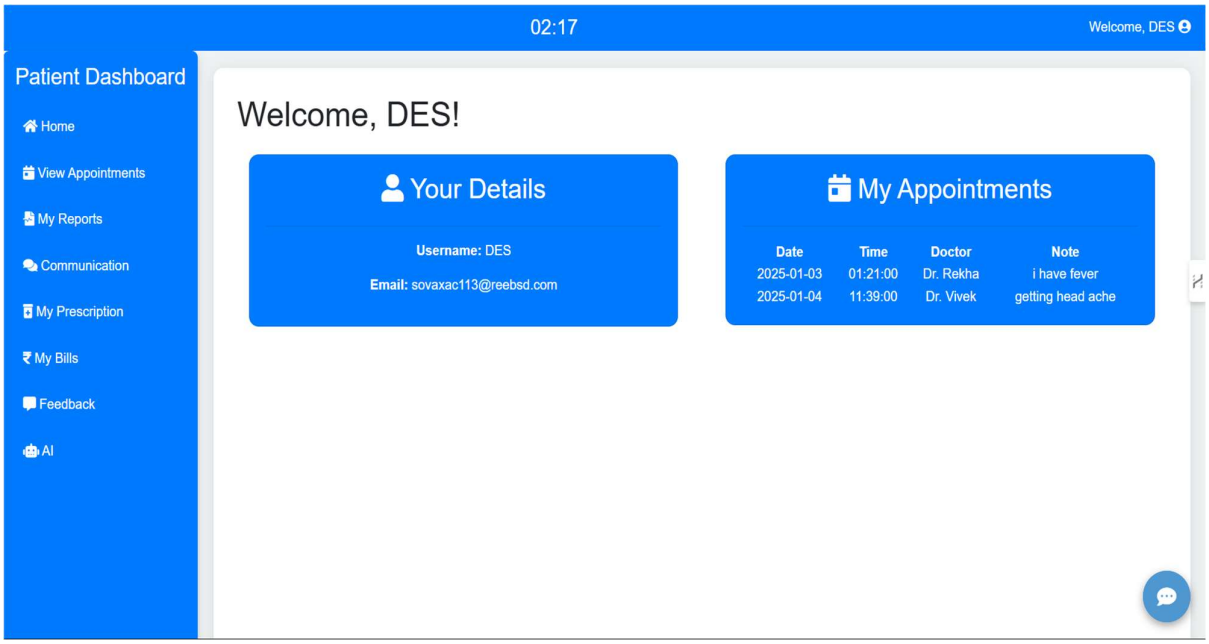
Communication



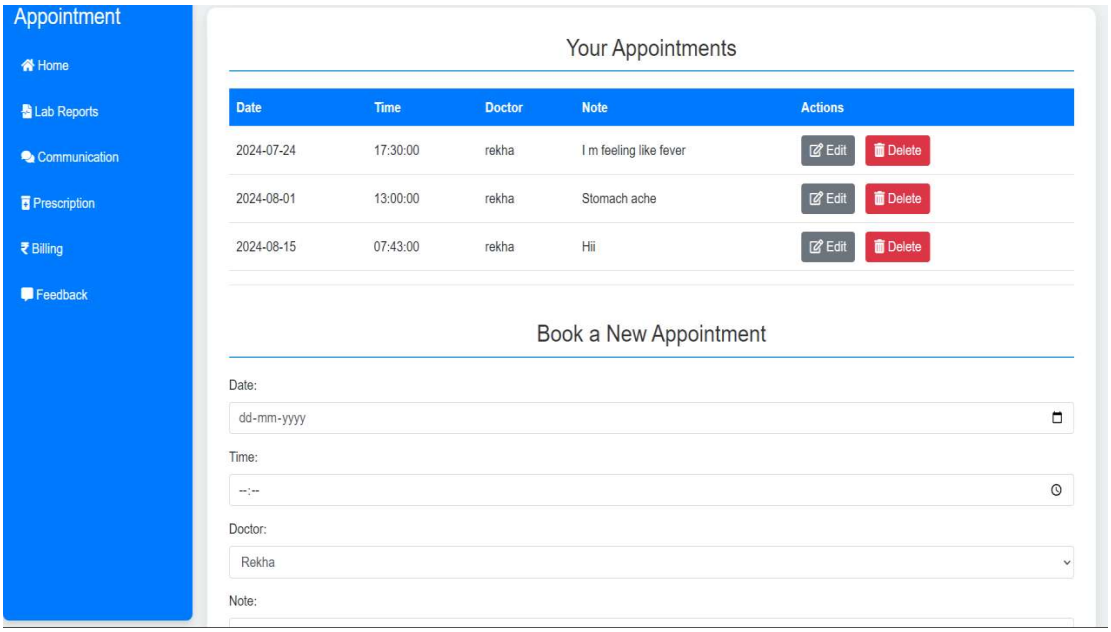
Prescription



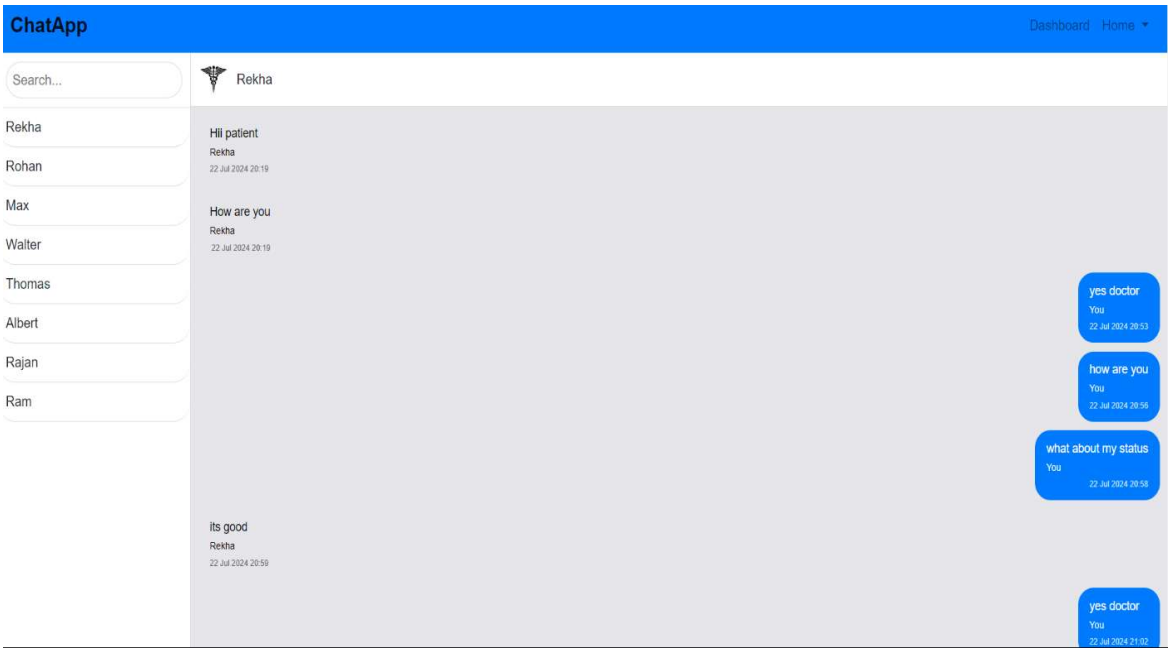
Patient UI



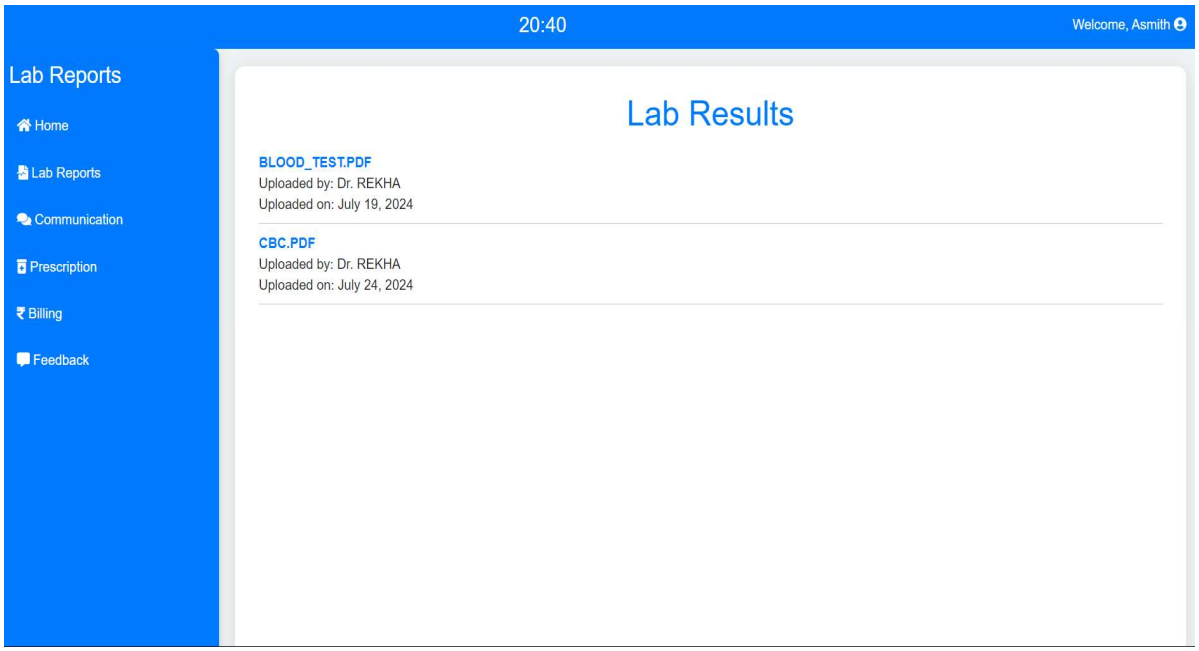
Appointments



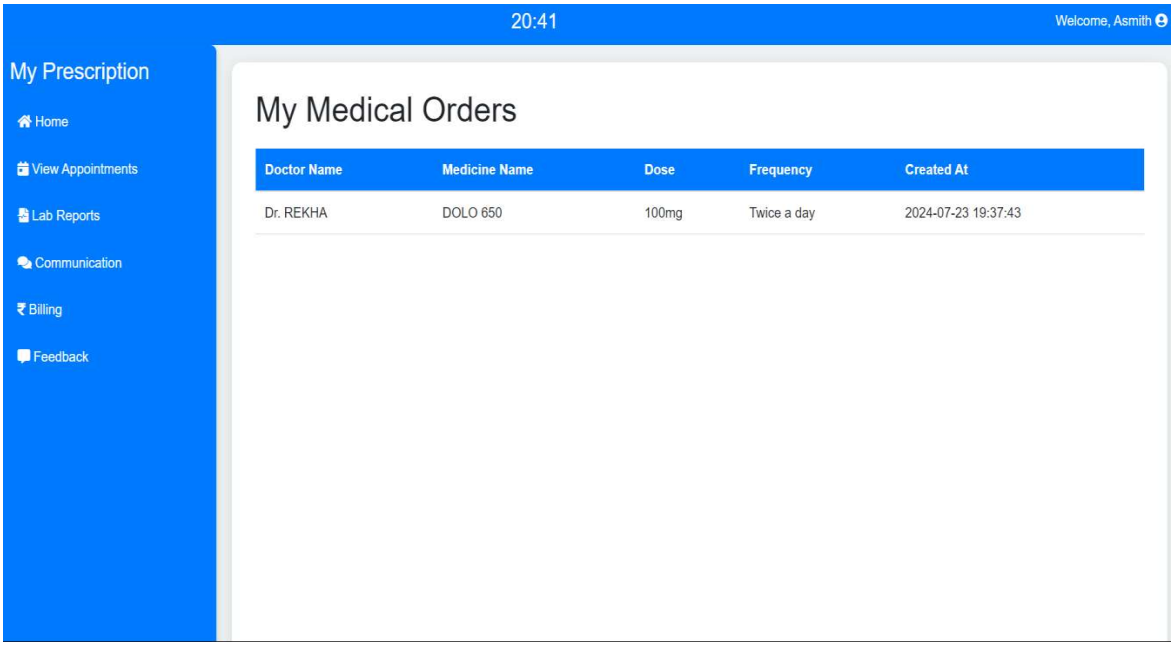
Communication



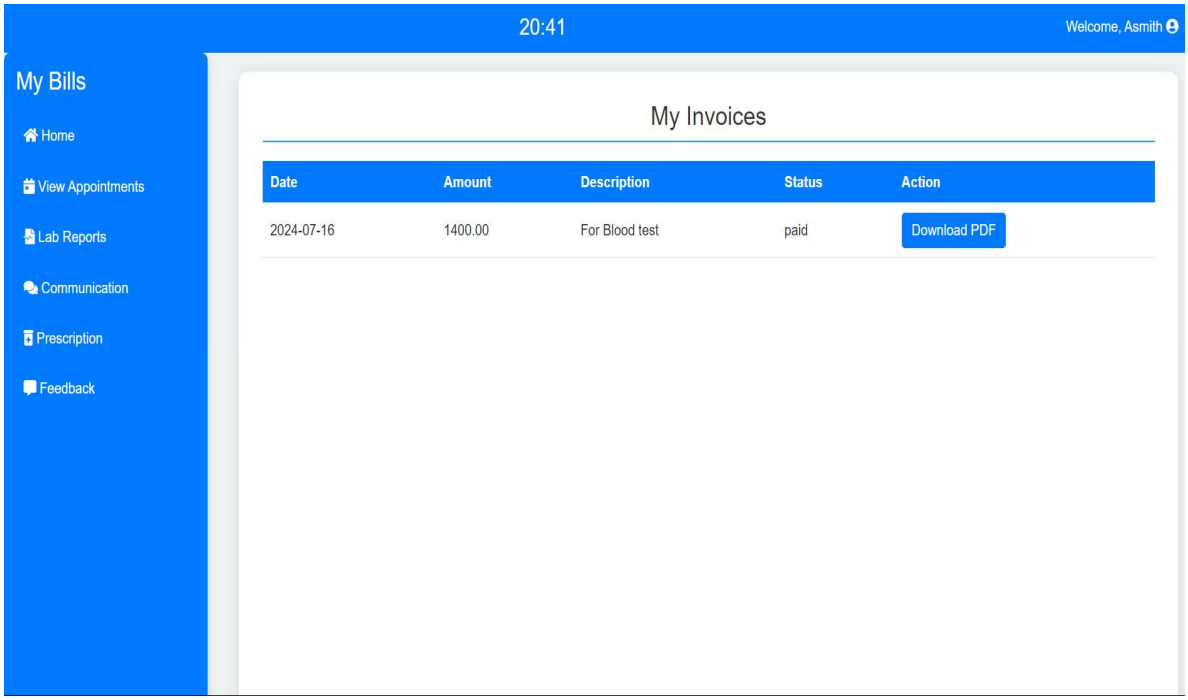
Lab Reports



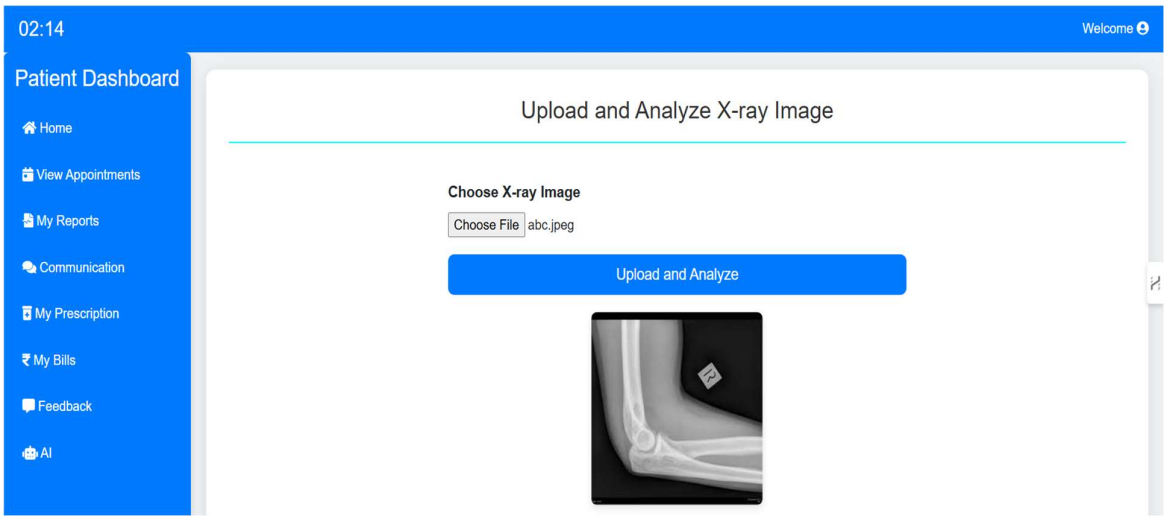
Prescription



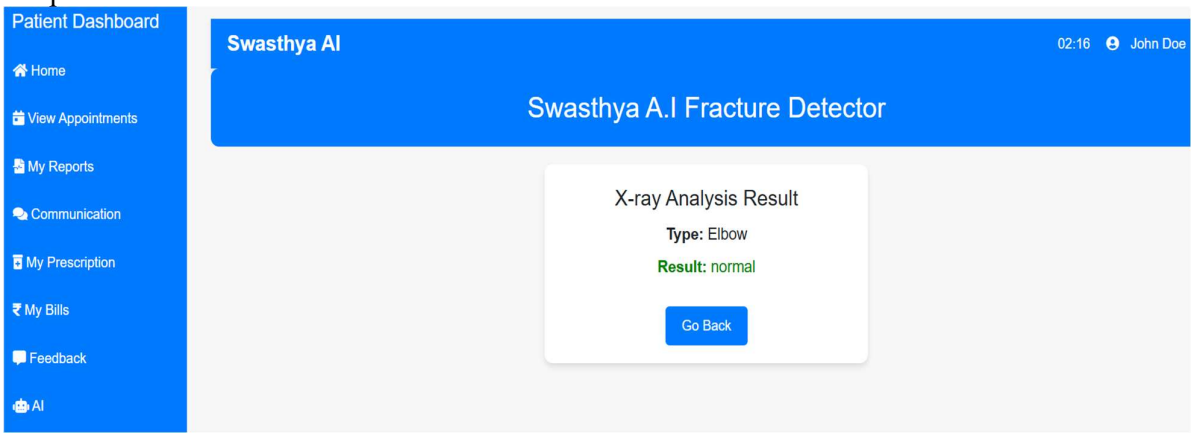
Billing



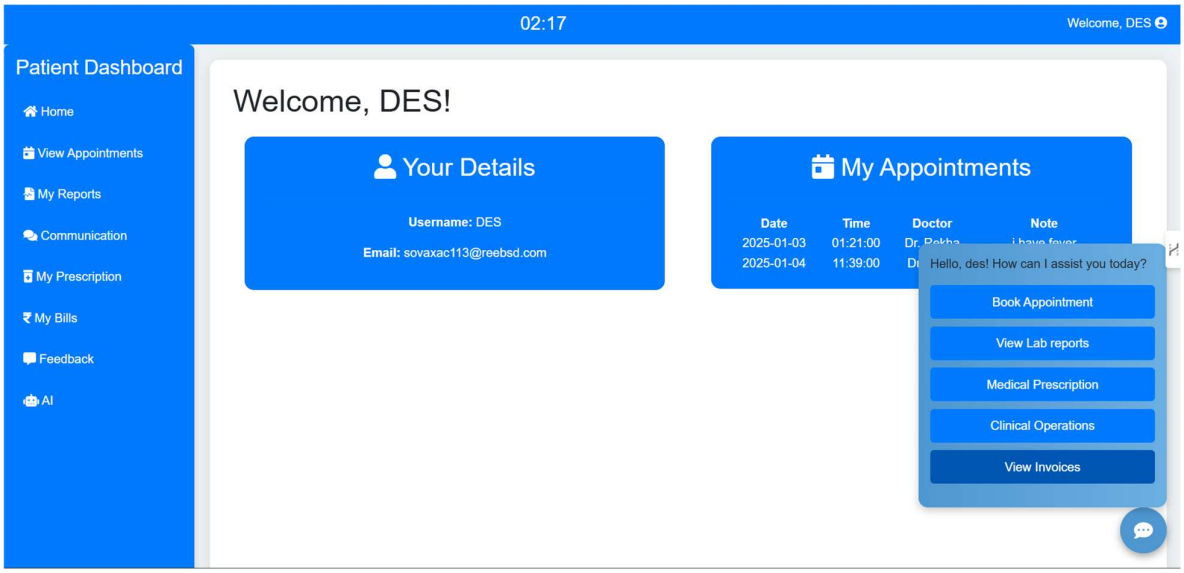
A.I



Response



Quick Access Chatbot


02:17
Welcome, DES
Patient Dashboard
Home
View Appointments
My Reports
Communication
My Prescription
My Bills
Feedback
AI
Welcome, DES!
Your Details
Username: DES
Email: sovaxac113@reebsd.com
My Appointments
Date
Time
Doctor
Note
2025-01-03
01:21:00
2025-01-04
11:39:00
Hello, des! How can I assist you today?
Book Appointment
View Lab reports
Medical Prescription
Clinical Operations
View Invoices

5. IMPLEMENTATION AND TESTING

5.1 Code

System coding involves writing software to implement a system based on its design and requirements. Key considerations include using the right programming language and tools, maintaining clean and modular code, implementing security measures, handling data securely, testing thoroughly, and documenting the code. Collaboration, testing, deployment, and ongoing improvement are essential aspects of successful system development.

The following is the code of Login Form from where User will give input through this html form and it will Record to Database.

HTML Code:

Login.php

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Login</title>
    <style>
        body {
            margin: 0;
            font-family: 'Open Sans', sans-serif;
            background: linear-gradient(120deg, #007bff, #3498db);
            height: 100vh;
            display: flex;
            justify-content: center;
            align-items: center;
        }
        .login-container {
            background: #fff;
            padding: 40px 50px;
            border-radius: 10px;
            box-shadow: 0 10px 15px rgba(0, 0, 0, 0.1);
```

```
    width: 100%;
    max-width: 400px;
}
.login-container h2 {
    margin-bottom: 20px;
    color: #333;
    font-weight: 500;
    font-size: 24px;
    text-align: center;
}
.login-container label {
    font-size: 14px;
    margin-bottom: 5px;
    color: #333;
}
.login-container input[type="email"],
.login-container input[type="password"] {
    width: 100%;
    padding: 10px;
    margin: 10px 0 20px;
    border: 1px solid #ccc;
    border-radius: 5px;
    font-size: 14px;
}
.login-container button {
    width: 100%;
    padding: 10px;
    background: #007bff;
    border: none;
    color: #fff;
    font-size: 16px;
    border-radius: 5px;
```

```
            cursor: pointer;
            transition: background 0.3s ease;
        }
        .login-container button:hover {
            background: #0056b3;
        }
        .login-container a {
            display: block;
            text-align: center;
            margin-top: 10px;
            color: #007bff;
            text-decoration: none;
            font-size: 14px;
            transition: color 0.3s ease;
        }
        .login-container a:hover {
            color: #0056b3;
        }
        .error {
            color: red;
            margin-bottom: 30px;
            text-align: center;
            font-size: 16px;
        }
        .message {
            display: none;
            color: #ff6f61;
            text-align:  center;
            margin-top:  20px;
            font-size: 16px;
        }
</style>
```

```
</head>
<body>
<div class="login-container">
    <h2>Login</h2>
    <?php if ($error): ?>
        <div class="error"><?php echo htmlspecialchars($error); ?></div>
    <?php endif; ?>
    <form method="POST" action="login.php">
        <label for="email">Email:</label>
        <input type="email" id="email" name="email" autocomplete="on" required>
        <label for="password">Password:</label>
        <input type="password" id="password" name="password" required>
        <button type="submit">Login</button>
    </form>
    <a href="register.php">Register</a>
    <a href="forgot_password.php">Forgot Password?</a>
    <div id="redirect-message" class="message">
        If you are using a mobile phone, please open this site in desktop mode.
    </div>
</div>
</body>
</html>
```

PHP: The following is the php code for the above login.php which is used to fetch data from database and validate the user if user is valid, he can proceed to further.

```
<?php
require_once 'config.php';
session_start();
$error = '';
if ($_SERVER['REQUEST_METHOD'] == 'POST') {
    $email = $_POST['email'];
    $password = $_POST['password'];
    $stmt = $conn->prepare("SELECT id, password, role FROM users WHERE email = ?");
    $stmt->bind_param("s", $email);
```

```
    $stmt->execute();
    $stmt->store_result();
    if ($stmt->num_rows > 0) {
        $stmt->bind_result($id, $hashed_password, $role);
        $stmt->fetch();
        if (password_verify($password, $hashed_password)) {
            $_SESSION['user_id'] = $id;
            $_SESSION['role'] = $role;
            switch ($role) {
                case 'admin':
                    header("Location: admin/admin_dashboard.php");
                    break;
                case 'doctor':
                    header("Location: doctor/doctor_dashboard.php");
                    break;
                case 'patient':
                    header("Location: patient/patient_dashboard.php");
                    break;
                default:
                    $error = "Invalid role.";
            }
            exit;
        } else {
            $error = "Invalid password.";
        }
    } else {
        $error = "No user found with that email.";
    }
    $stmt->close();
}
?>
```

PYTHON: The following is the python code for the A.I Model which is used to analysis the X-Ray image and validate that it is fracture or not, then can proceed to further, Flask is python library which is mostly used in web development.

Api.py

```
from flask import Flask, request, jsonify
from predictions import predict
import os
from PIL import Image
```

```
app = Flask(__name__)

@app.route('/upload', methods=['POST'])
def upload_xray():
if 'file' not in request.files:
return jsonify({"error": "No file provided"}), 400

file = request.files['file']
upload_dir = 'uploads'

# Ensure the uploads directory exists
if not os.path.exists(upload_dir):
os.makedirs(upload_dir)

file_path = os.path.join(upload_dir, file.filename)
file.save(file_path)

# Perform prediction
bone_type_result = predict(file_path)
result = predict(file_path, bone_type_result)

return jsonify({"type": bone_type_result, "result": result})

if __name__ == "__main__":
app.run(debug=True, port=5000)

def predict(img, model="Parts"):
        size = 224
        if model == 'Parts':
                chosen_model = model_parts
        else:
                if model == 'Elbow':
                        chosen_model = model_elbow_frac
                elif model == 'Hand':
                        chosen_model = model_hand_frac
                elif model == 'Shoulder':
                        chosen_model = model_shoulder_frac

temp_img = image.load_img(img, target_size=(size, size))
x = image.img_to_array(temp_img)
x = np.expand_dims(x, axis=0)
images = np.vstack([x])
prediction = np.argmax(chosen_model.predict(images), axis=1)
if model == 'Parts':
        prediction_str = categories_parts[prediction.item()]
else:
        prediction_str = categories_fracture[prediction.item()]

return prediction_str
```

5.2 Testing Approach and Test Cases

Test Cases: Test cases are specific scripts designed to corroborate the correct functioning of a software operation. They outline detailed way, inputs, and anticipated issues for a given functionality. A well- written test case includes a unique identifier, a brief description, preconditions, detailed way, test data, and anticipated results. Test cases insure comprehensive content of software conditions and help in totally relating blights. They may include both positive (valid inputs) and negative (invalid inputs) scripts to validate all possible actions of the software.

Test cases help in vindicating colorful aspects of the software, similar as its functionality, performance, and security. They can be created manually or generated automatically using test robotization tools. Well- defined test cases ameliorate test content, reduce nebulosity, and insure thickness in testing. Each test case should have a clear ideal, making it easier to understand and execute. The results of test cases play a vital part in determining the readiness of the software for release.

Testing Approaches: Testing approaches are methodical styles used to corroborate and validate software operations to insure they meet their willed conditions, perform rightly, and are free of blights. These approaches guide the planning and prosecution of testing conditioning throughout the software development lifecycle. There are several testing approaches, each with its specific objects, ways, and focuses.

A well- defined testing approach ensures that blights are linked beforehand in the development process, reducing the overall cost of fixing them. It helps ameliorate software quality by icing that all critical functionalities are tested completely. Different approaches may be applied grounded on the type of software, its complexity, and user conditions. opting the right approach is pivotal for achieving high test content and effectiveness. Effective testing approaches not only validate functionality but also insure performance, trustability, and security of the software.

1. **Manual Testing:** Manual testing involves mortal testers executing test cases and interacting with the software as an end user would. Testers observe, estimate, and report issues grounded on their moxie and experience. It's suitable for relating issues related to user experience and visual interfaces. Homemade testing can be time- consuming but provides precious perceptivity into real- world usability and behavior. It's especially salutary in exploring edge cases that automated tests may miss. also, it helps identify private issues similar as visual aesthetics, availability, and user-friendliness.
2. **Black Box Testing:** Black box testing focuses on testing the functionality of the software without knowledge of its internal law structure. Testers examine inputs and labors to validate if the software behaves rightly. This approach is useful for vindicating that the software meets user conditions. It's generally used during system and acceptance testing phases. Black box testing ensures that the software provides the anticipated results under colorful conditions. It's also effective in testing system behavior, from the user's perspective, icing that features are rightly enforced according to specifications.
3. **White Box Testing:** White box testing examines the internal law structure and sense of the software. Testers use knowledge of the law to design test cases that corroborate specific law paths. It ensures law quality by relating blights in algorithms and sense. This approach is largely effective for perfecting law content and optimizing performance. White box testing

can also help uncover security vulnerabilities, similar as indecorous access control or unhandled exceptions. also, it assists in validating the effectiveness of law by testing the boundaries and performance of algorithms.

4. **Integration Testing:** Integration testing is a software testing approach that checks how different factors or modules of a software operation work together when integrated. It ensures that these factors interact rightly, data flows easily between them, and dependences are managed effectively. It helps in detecting interface mismatches and data flow issues. Integration testing is essential for vindicating end- to- end functionality of a system. This testing helps insure that preliminarily insulated modules work harmoniously within a larger system. It also identifies implicit issues similar as incorrect API calls, data disagreement, and indecorous running of external systems or services.

Manual Testing

Index	Test Case	Test Data	State	Input Values	Results
1.	The values for email and Password should match	Entered wrong email and Password	Invalid	abc@gmail.com & 1234	Show Error Message
2.		Right email and password	Valid	Vivekdubey5960@gmail.com & 12345	Input is accepted and redirected to dashboard
3.	All fields must have values	Username field empty	Invalid	None	Message “please Fill out this field”.
4.		Both fields are given	Valid	Vivekdubey5960@gmail.com & 12345	Input is accepted and redirected to given page
5	Upload Image for Analysis	Image Uploaded	Valid	Image	Response is generate as Fracture or Not.

Blackbox Testing

Index	Test case	Test Data	Input Values	Result
1.	User Registration	Valid user information	User provides valid registration details.	OTP is sent through email for verification
2.	Book appointment	Input Valid Data	Name, Doctor, Time, Date. Etc	Appointment booked
3.	Security Access Control	Unauthorized access attempts	Unauthorized users attempt admin actions.	Unauthorized access is denied.
4.	Error Handling	Invalid inputs and scenarios	Invalid data and scenarios are tested.	System handles errors gracefully.
5.	Analysis	No image	No Image	Asking for image
6.	Quick Access	Invalid Inputs	Not registered email & password	Prompting error Message

Whitebox Testing

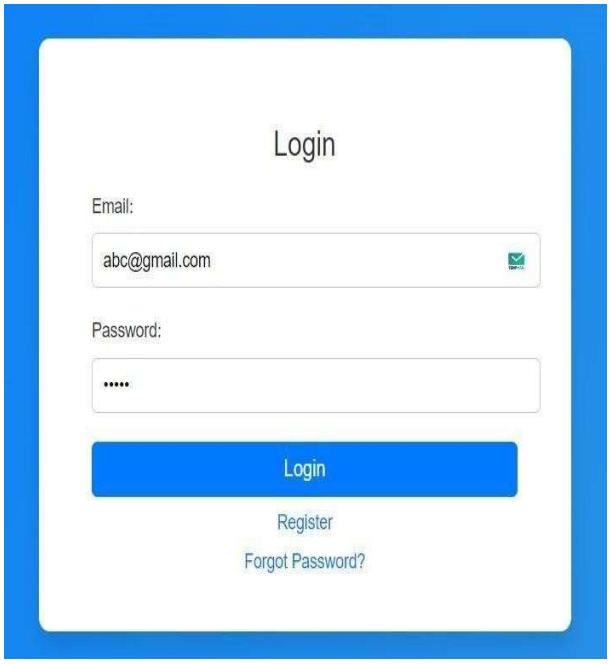
Index	Test Case	Test Data	Input Values	Result
1.	User Registration Validation	Valid and Invalid user inputs.	User provides valid and invalid data.	Validate and handle user input data appropriately.
2.	User input Data Validation	Valid and Invalid User input data	User attempts to book appointment with valid and invalid data	Validate Input data and handle errors effectively.
3.	Security Access Control Logic	Access control scenarios	Attempt unauthorized actions as a user.	Ensure proper access control and security measures..
4.	Error Handling Logic	Trigger error conditions	Introduce errors in different scenarios..	Verify that errors are handled and logged correctly

1. Integrated Box Testing

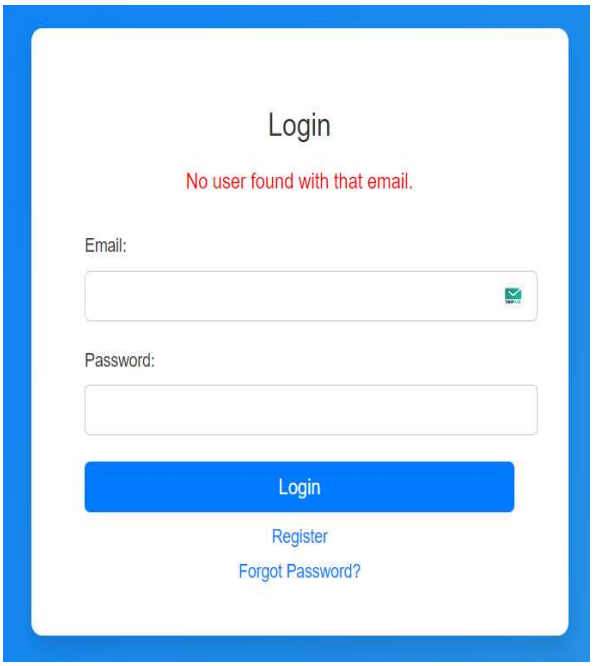
Index	Test Cases	Test Data	Input Values	Result
1.	User Registration and Login	Valid user registration data	User registers and logs in with valid credentials.	User successfully registers and logs in.
2.	User booking appointment	User Input Data	User selects Date, Time	Appointment booked
3.	Security Access Control Logic	User and admin access control scenarios	Unauthorized access attempts by users and admin.	Unauthorized access is denied, and access control works.
4.	Error Handling	Triggering error conditions and handling of exceptions	Introduce errors in different scenarios..	Verify that errors are handled and logged correctly. Errors are handled gracefully, and system logs errors.

5.3 Image of Validations

1st Test case



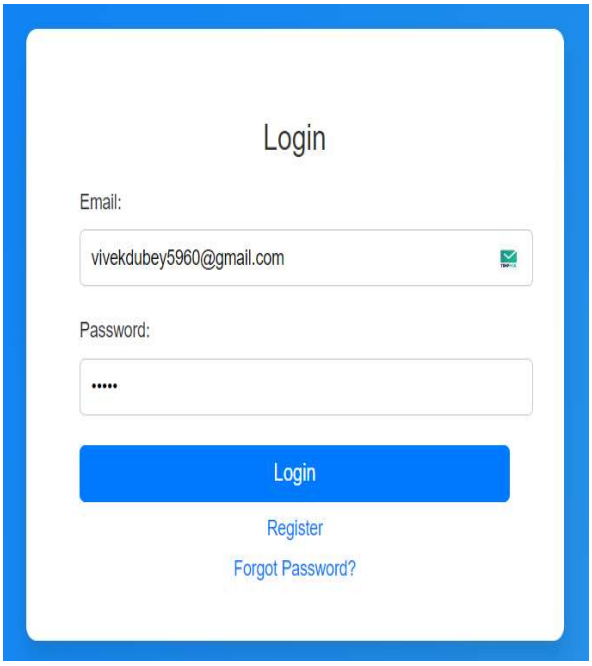
Login page



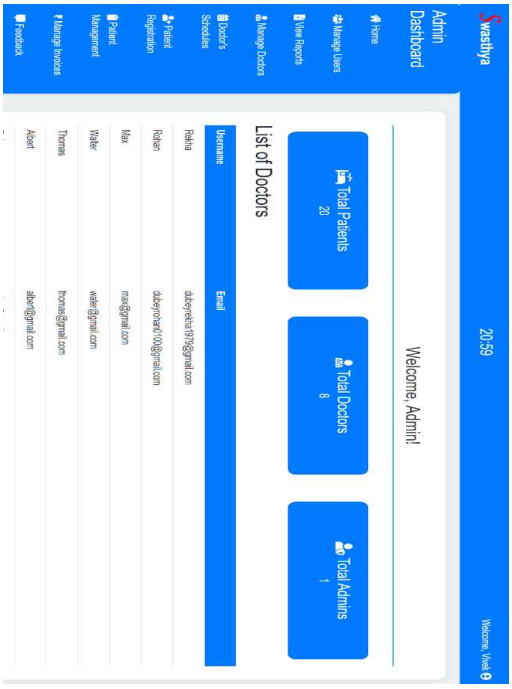
Error Message

2nd Test case

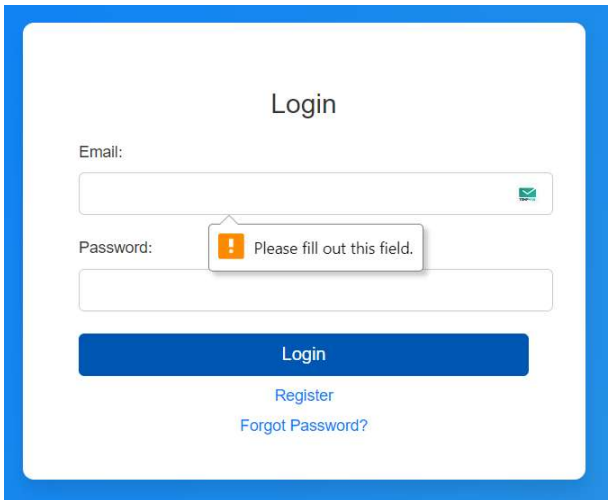
Login page



Redirect to Dashboard

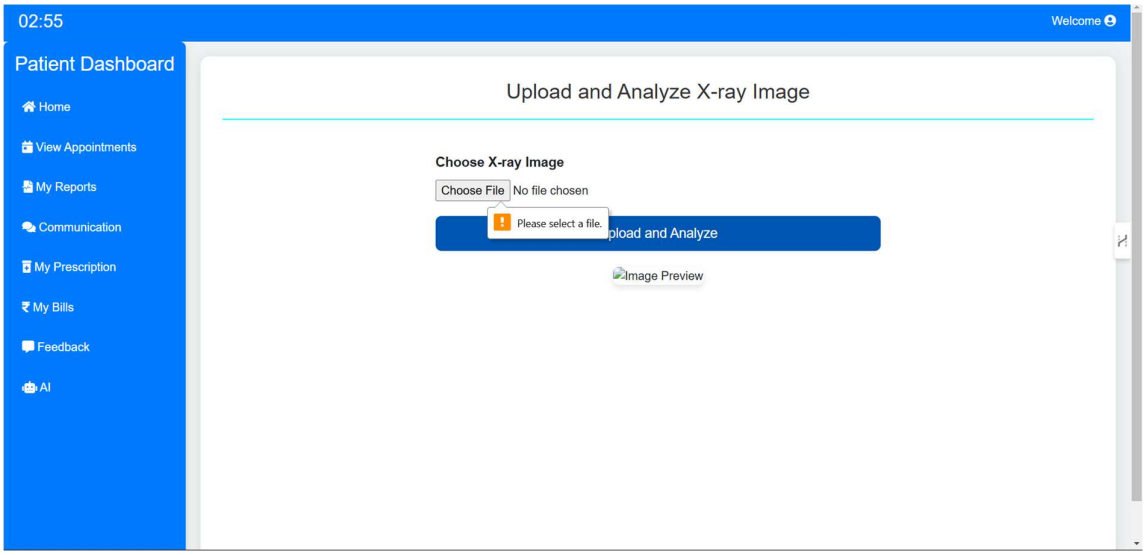


3rd Test case

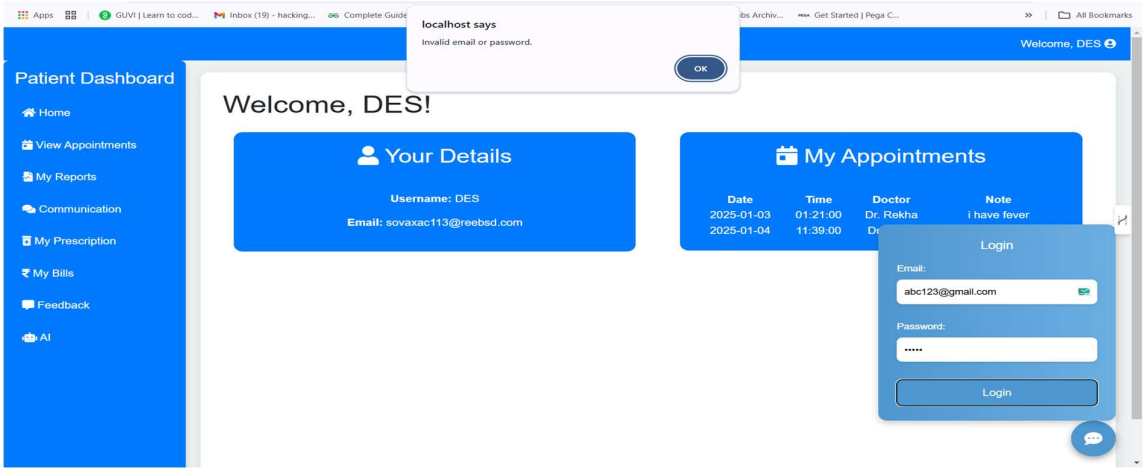


Login page

4th Test case



5th Test case



6. DISCUSSION AND CONCLUSION

6.1 DISCUSSION

The development and successful implementation of the Hospital Management System (HMS), titled Swasthya, required a systematic approach combining in-depth analysis, detailed planning, and robust execution. This system was developed to address specific operational challenges faced by healthcare institutions, including administrative inefficiencies, data management issues, and the need for enhanced patient engagement. This discussion elaborates on the key components, technologies, and methodologies used in developing Swasthya, evaluates its practical outcomes, and outlines areas for enhancement and future scalability.

Key Features and Their Impact

The Swasthya HMS is designed to integrate a range of hospital operations, including patient management, doctor scheduling, billing, and reporting. These features collectively improve hospital workflows and enhance service delivery. Below is a detailed analysis of its most significant features:

1. **AI-Driven Diagnostic Support**
    - A significant feature of Swasthya is its integration of artificial intelligence (AI) for automated X-ray image analysis. By employing machine learning models, the system can identify fractures and other abnormalities in X-ray images with a high degree of accuracy. This reduces the workload on radiologists and speeds up the diagnostic process.
    - The AI model was trained using a dataset of X-ray images to distinguish between normal and abnormal conditions. Its incorporation into the HMS ensures that healthcare providers can rely on quicker, more consistent diagnostic support, leading to timely medical intervention and better patient outcomes.
2. **Comprehensive Patient Portal**
    - The patient portal provides a one-stop interface for users to manage appointments, view medical records, and receive notifications. This feature enhances the patient experience by offering convenience and transparency. Patients can directly interact with healthcare providers, reducing their dependency on hospital visits for routine queries.
    - Additionally, the portal offers personalized health recommendations and reminders for follow-up visits, medication schedules, and upcoming diagnostic tests.
3. **Quick Access Chatbot**
    - The chatbot integrated into the Swasthya HMS acts as a virtual assistant, providing instant responses to common queries such as appointment booking, test result retrieval, and billing information. Its real-time interaction capability helps streamline communication between patients and hospital staff.
    - Unlike traditional systems that require manual input, the chatbot ensures faster response times and reduces the administrative workload. Moreover, its ability to handle routine queries allows hospital staff to focus on more critical tasks

4. **Role-Based Access Control (RBAC) for Security**
    - Given the sensitivity of healthcare data, security was a primary concern during the system's development. Swasthya incorporates a role-based access control (RBAC) mechanism, ensuring that users can only access information relevant to their roles. This minimizes the risk of unauthorized access and ensures compliance with data protection regulations such as HIPAA.
    - The system also supports two-factor authentication (2FA) and secure password policies to further safeguard patient information. Regular audits and access logs are maintained to monitor any unauthorized activity.
5. **Automated Billing and Inventory Management**
    - Billing errors and stock shortages are common issues in healthcare institutions. Swasthya addresses these challenges by automating the billing process and integrating inventory management. The system generates invoices automatically based on services rendered and ensures accurate payment tracking.
    - The inventory module tracks the availability of medical supplies, alerts staff when stock levels are low, and facilitates timely procurement. This reduces the likelihood of stockouts and improves overall resource management.

Technological Advancements Incorporated

1. **Machine Learning and AI Algorithms**
    - The diagnostic module uses machine learning algorithms for image recognition. These algorithms were developed and fine-tuned through multiple iterations to improve their accuracy and reliability. The use of convolutional neural networks (CNNs) allows the system to process complex image data effectively.
2. **Scalable Cloud Infrastructure**
    - Swasthya is deployed on a cloud-based platform to ensure scalability and high availability. This architecture allows the system to handle a large number of concurrent users without performance degradation. Additionally, cloud storage ensures data redundancy and disaster recovery.
3. **Interoperability with Other Systems**
    - The HMS is designed to be interoperable with other healthcare systems, such as electronic health records (EHR) and laboratory information systems (LIS). Standardized protocols such as HL7 and FHIR were used to facilitate seamless data exchange between different platforms.

Societal and Operational Impact

The implementation of Swasthya HMS has far-reaching implications for healthcare providers and patients alike. Below are some of the key impacts observed:

1. **Enhanced Operational Efficiency**

    - By automating routine tasks such as appointment scheduling, billing, and inventory management, the system significantly reduces the administrative burden on hospital staff. This allows them to focus more on patient care, thereby improving overall hospital efficiency.

2. **Improved Patient Satisfaction**

    - The patient-centric features of the HMS, such as the portal and chatbot, enhance the overall patient experience. Patients can access their medical records, book appointments, and receive timely notifications without visiting the hospital in person. This convenience leads to higher patient satisfaction and better adherence to treatment plans.

3. **Data-Driven Decision Making**

    - The reporting and analytics module provides healthcare administrators with real-time insights into hospital operations. These insights help in identifying bottlenecks, optimizing resource allocation, and improving service delivery.

4. **Support for Remote Healthcare**

    - Although the current system primarily supports in-hospital operations, its modular design allows for future expansion into telemedicine. This would enable remote consultations and monitoring, increasing access to healthcare for patients in rural and underserved areas.

Challenges Encountered:
During the development and deployment phases, several challenges were faced:

1. **Data Privacy Concerns**

    - Ensuring compliance with healthcare regulations regarding data privacy was a major challenge. The team had to implement advanced encryption techniques and conduct regular security audits to ensure data safety.

2. **Integration with Existing Systems**

    - Many healthcare institutions already use legacy systems for managing specific operations. Integrating Swasthya with these systems required extensive customization and testing to ensure compatibility.

3. **User Training and Adoption**

- The transition from manual processes to an automated HMS required comprehensive user training. Ensuring that hospital staff could efficiently use the system involved multiple training sessions and the development of user manuals.

4. **AI Model Accuracy**

    - While the AI model for X-ray analysis achieved a high level of accuracy, further improvements were necessary to reduce false positives and negatives. Ongoing training of the model with new datasets is required to maintain its reliability.

6.2 Conclusion

The "Swasthya HMS" project represents a pivotal advancement in the modernization and optimization of healthcare management systems. This innovative platform integrates cutting-edge AI-driven modules designed to enhance both communication and analytics, which in turn fosters a more collaborative, efficient, and data-driven healthcare environment. By streamlining communication channels among doctors, patients, and hospital staff, the system enables real-time interaction, a crucial element for improving patient care, operational efficiency, and overall service quality.

The integrated messaging system within "Swasthya HMS" is designed to reduce communication gaps, allowing healthcare professionals to respond to patient needs and emergencies more quickly. This responsiveness can directly lead to better patient outcomes by reducing the likelihood of medical errors, ensuring that all stakeholders—doctors, nurses, patients, and administrative staff—remain well-informed and aligned. The automation of such interactions, coupled with secure and user-friendly interfaces, offers an added layer of convenience and effectiveness in hospital operations.

A key feature of "Swasthya HMS" is its powerful analytics module, which generates actionable insights into critical areas such as medical statistics, financial performance, and operational efficiency. Hospitals can leverage these insights to make informed decisions, optimize resource allocation, track patient care metrics, and improve overall management. The ability to monitor financial data and track operational performance enables hospital administrators to reduce costs, streamline workflows, and ensure better utilization of available resources. Furthermore, this data-driven approach facilitates proactive decision-making, which is vital in addressing the ever-growing demands of healthcare services.

Despite its numerous advantages, the successful implementation of "Swasthya HMS" necessitates overcoming several challenges. One of the most pressing concerns is data privacy and security, as safeguarding sensitive patient information is paramount. The system must adhere to the highest standards of cybersecurity to prevent breaches and unauthorized access to confidential health records. Ensuring the integrity and confidentiality of patient data through robust encryption protocols, secure authentication methods, and continuous monitoring is essential to maintaining trust with patients and regulatory bodies.

Another challenge lies in the integration of "Swasthya HMS" with existing hospital infrastructure. Legacy systems may pose difficulties in terms of compatibility, which will require careful planning and thoughtful integration strategies. Additionally, the successful adoption of the system depends heavily on the training and adaptation of hospital staff. Comprehensive training programs must be developed to ensure that all users—from administrative personnel to healthcare providers—can efficiently navigate the system and harness its full potential.

Nonetheless, the long-term benefits of "Swasthya HMS" are substantial. By automating routine administrative tasks and optimizing clinical workflows, the system helps hospitals operate more efficiently, reduce overhead costs, and ultimately improve the quality of care provided to patients. The platform's scalability and adaptability ensure that it can evolve alongside the changing needs of healthcare institutions, enabling hospitals to stay at the forefront of the industry in the years to come.

In conclusion, "Swasthya HMS" has the potential to transform the landscape of healthcare management by providing a unified, AI-powered solution that enhances communication, drives operational efficiency, and delivers data-driven insights. Its successful implementation will empower healthcare institutions to not only improve patient care but also streamline operations and reduce costs. As the healthcare sector continues to embrace digital transformation, "Swasthya HMS" promises to be an indispensable tool in shaping the future of healthcare delivery, ensuring that hospitals are better equipped to meet the challenges of an increasingly complex and dynamic healthcare environment.

As healthcare systems around the world continue to face mounting pressure due to rising patient volumes, resource constraints, and the increasing complexity of medical care, technologies like "Swasthya HMS" offer a promising solution to address these challenges. The system's ability to consolidate multiple functions—from patient record management and appointment scheduling to financial analysis and resource optimization—into a single, unified platform enhances both operational efficiency and patient satisfaction. By integrating AI to support decision-making and predict future trends, "Swasthya HMS" helps hospitals stay ahead of the curve, identifying potential issues before they escalate and ensuring timely interventions.

Looking forward, the adaptability of "Swasthya HMS" ensures that it remains relevant even as the healthcare industry evolves. With continuous advancements in AI and healthcare technology, the platform is designed to scale and evolve in tandem with new healthcare demands, including the growing need for personalized medicine, remote patient monitoring, and telemedicine integration. As such, "Swasthya HMS" not only addresses the current needs of healthcare providers but is also positioned to meet future challenges, making it a long-term investment in the quality and efficiency of healthcare services.

7. LIMITATIONS

Limitations of "Swasthya HMS"

While the "Swasthya HMS" offers a multitude of benefits to hospitals and healthcare facilities, there are several limitations and challenges that must be addressed to ensure the successful implementation and long-term sustainability of the system. These limitations can arise from both technical and organizational aspects, and addressing them proactively is critical for achieving the full potential of the system. Below are some of the key limitations:

1. **Internet Connectivity Dependence**

- Since "Swasthya HMS" is designed as a web-based solution, one of its core limitations lies in the reliance on a stable internet connection. This dependency becomes particularly challenging in areas where internet access is either inconsistent or has low bandwidth. Hospitals located in rural or remote areas may face frequent network interruptions, making it difficult for staff to access or update crucial patient data. Such interruptions can delay important decisions, especially in emergencies, and negatively affect the hospital's operational efficiency.
- Possible Solutions: Introducing an offline functionality within the system could allow healthcare workers to continue recording and accessing essential information even when the network is down. Once the internet is restored, the system can automatically synchronize the data.

2. **Browser and Device Compatibility Challenges**

- "Swasthya HMS" needs to be compatible across a wide range of web browsers and devices to ensure a consistent user experience. Each browser interprets web pages slightly differently, which could lead to issues such as layout inconsistencies, broken functionality, or slower performance on certain platforms. Additionally, healthcare staff may use different types of devices, including desktops, laptops, tablets, and smartphones, which can introduce challenges in making sure the system functions optimally on all of them.
- Solution: To address these challenges, it's important to conduct thorough cross-browser testing to ensure the system works across all major browsers, including Chrome, Firefox, Safari, and Edge. Implementing a responsive design will ensure that the system adapts seamlessly to any screen size, whether it's a large desktop monitor or a small mobile device. Ensuring the application supports the latest browser versions, while also considering backward compatibility for older browsers, will enhance usability.

3. **Security Vulnerabilities**

- A major limitation of web applications is the increased vulnerability to cyber threats. "Swasthya HMS" will store highly sensitive patient data, making it an attractive target for hackers. Potential risks include data breaches, SQL injection, and malicious attacks like cross-site scripting (XSS). A successful breach could lead to unauthorized access

to confidential medical records, resulting in significant consequences for both the patients and the healthcare provider's reputation.

- Possible Solutions: To combat these risks, the application should be built with strong data encryption techniques and employ multi-factor authentication (MFA) for secure login procedures. Regular security audits and penetration tests can help identify vulnerabilities, while employing a Web Application Firewall (WAF) can prevent many types of attacks.

4. Reliance on Server Infrastructure

- The performance and accessibility of Swasthya HMS are closely tied to the servers that host the application. If these servers face issues such as downtime or performance slowdowns, the entire system could become unavailable, which would disrupt hospital operations. Since Swasthya HMS is a web application, it depends on centralized server infrastructure. Any problem with these servers—whether technical failures or maintenance issues—could leave users unable to access vital system features, causing delays and inefficiencies in hospital workflows.
- Solution: To mitigate this risk, the system should implement redundant servers and disaster recovery plans to ensure quick recovery in case of failure. Cloud-based services can offer scalability and reliability, providing better uptime and performance during peak usage periods. Additionally, failover mechanisms can ensure the system stays operational even when one server is down.

5. Potential Latency Issues

- Since "Swasthya HMS" is a web-based application, it might face latency problems due to the time it takes for data to travel between the user's device and the server. This latency can cause delays in fetching important information like medical records or lab results. In areas with slower internet speeds, this can result in frustrating delays, which is critical in a healthcare environment where quick access to data is necessary for timely decision-making.
- Possible Solutions: Implementing edge computing can help by processing some data closer to the user's location, reducing the dependency on the central server. Moreover, using data caching strategies can ensure that frequently accessed data is available locally, reducing the need for repeated requests to the server and improving overall response times.

6. Impact of System Downtime

- Healthcare systems are increasingly dependent on technology, which makes downtime a critical concern for applications like Swasthya HMS. If the system experiences a failure—whether due to a software bug, server crash, or external security threat—the consequences can be significant. A temporary loss of access could delay treatments, compromise patient records, and disrupt communication across departments. Given the fast-paced nature of healthcare, such disruptions can affect patient outcomes and overall hospital efficiency.
- Solution: To reduce the likelihood of downtime, hospitals must establish backup systems, failover solutions, and disaster recovery plans. These measures ensure that the

system can continue functioning even if certain components fail. Regular maintenance, updates, and security patches are also essential to minimize vulnerabilities. Hosting the application on a cloud platform can offer higher reliability and a service-level agreement (SLA) guaranteeing uptime.

7. Challenges in Real-Time Data Processing

- Healthcare settings generate vast amounts of data, especially during patient intake, diagnosis, and treatment processes. Swasthya HMS needs to be capable of processing large amounts of data in real-time to provide healthcare professionals with up-to-date information without delay. However, managing this data in real-time—especially during high-traffic periods like emergency room visits or busy hospital shifts—can be a technical challenge. Delays or slow response times in accessing patient data could lead to errors or disruptions in care.
- Solution: To overcome performance bottlenecks, the system should leverage cloud-based infrastructure that can scale resources dynamically according to demand. Data compression and parallel processing techniques can optimize the system's ability to handle large data volumes. Additionally, employing load balancing can ensure the application remains responsive, even during high-demand periods.

8. Training and User Adoption

- For Swasthya HMS to be successful, hospital staff must adopt the system fully. However, user adoption can be challenging in healthcare environments, as staff members have varying levels of technological familiarity. While some may be comfortable with new technology, others may resist the change, especially if they are used to traditional, manual processes. The transition to a comprehensive digital system may be perceived as a burden, particularly in a fast-paced, high-pressure environment like a hospital.
- Solution: Overcoming this resistance requires comprehensive training programs that are tailored to the specific needs of different roles. For example, doctors may require training focused on clinical features, while administrative staff may need to focus on managing patient records and billing. Providing user-friendly interfaces and clear visual guidance within the system can help facilitate the transition. Additionally, ensuring ongoing support and feedback from staff throughout the implementation phase can smooth the adoption process and identify areas for improvement.

8. FUTURE WORK

For the future development of Swasthya (HMS), we can focus on several area to enhance the system's capabilities, user experience, and integration. Here's a potential roadmap of future work.

1. Integrating Advanced AI & Analytics.

- Purpose: Leverage AI to enhance hospital operations and patient care.
- Explanation: Machine learning models can be implemented to predict patient outcomes and identify potential risks early, allowing healthcare providers to take proactive steps. For instance, an AI tool could analyze patterns in patient data and alert doctors to signs of deteriorating health before symptoms are visibly obvious.
- Example: Using AI for predictive analytics, the system could forecast a patient's risk of developing complications like infections or heart failure based on their medical history, lab results, and other data.

2. Improving System Interoperability with External Platforms.

- Purpose: Enable seamless data sharing between hospitals, insurance companies, and other healthcare systems.
- Explanation: Hospitals often use different software for patient records, billing, and insurance. By integrating Swasthya HMS with Electronic Medical Records (EMR), Electronic Health Records (EHR), and insurance claim systems, you can eliminate redundant data entry and reduce the risk of errors. This would allow for easier access to patient history, quicker insurance claims, and more accurate billing.
- Example: When a patient visits, their complete medical history, including previous treatments, lab results, and prescriptions, can automatically be pulled from integrated EMR/EHR systems, streamlining the doctor's workflow and reducing delays.

3. Telemedicine and Remote Monitoring.

- Purpose: Extend the reach of healthcare services and improve patient monitoring.
- Explanation: Telemedicine features allow patients to consult doctors remotely, which is especially beneficial for those in rural or underserved areas. Remote patient monitoring can also keep track of vital signs and chronic conditions without requiring patients to be physically present in the hospital.
- Example: A diabetic patient can monitor their blood sugar levels at home using connected devices, and the system will alert both the patient and the doctor if readings are abnormal, prompting immediate action.

4. Mobile Application for Easy Access.

- Purpose: Enhance patient and staff interaction with the system via mobile devices.
- Explanation: A dedicated mobile app for patients can provide features like appointment booking, accessing medical records, and securely communicating with doctors. Similarly, a staff mobile app can enable doctors and nurses to access patient records, update treatment plans, and receive real-time notifications about critical situations.
- Example: A patient can use the app to book appointments, get reminders for medication, or even consult with a doctor via a secure video call, reducing the need for physical visits.

5. Strengthening Security and Data Privacy.

- Purpose: Ensure that patient and hospital data is protected against unauthorized access.
- Explanation: With increasing digitalization, protecting patient data is paramount. Using technologies like blockchain can enhance data security and ensure records are tamper-proof. Multi-factor authentication (MFA) will ensure that only authorized personnel access sensitive information, providing an added layer of security.
- Example: By implementing blockchain, a patient's medical record can be stored in a way that ensures each update (such as a new diagnosis or treatment) is securely logged and cannot be altered, providing both transparency and security.

6. Multilingual Support for Diverse Patient Base.

- Purpose: Cater to a wider demographic by providing services in multiple languages.
- Explanation: To serve a diverse community, especially in multicultural regions, offering the HMS interface and documents in multiple languages is crucial. This ensures patients and staff from different linguistic backgrounds can easily interact with the system without facing language barriers.
- Example: The patient portal can offer options in English, Hindi, Tamil, and other regional languages, enabling patients to check their reports, book appointments, and communicate with healthcare providers in their preferred language.

7. Customizable Dashboards and Reporting Tools.

- Purpose: Provide hospital administrators with tailored insights into hospital performance.
- Explanation: Hospital management can benefit from dashboards that allow them to track key metrics like patient wait times, bed occupancy, staff performance, and financial health. Customizable reports would let them dive

deeper into specific areas of concern or interest, like resource usage or patient satisfaction.

- Example: An administrator can set up a dashboard to monitor the number of available beds in real-time, the total number of patients admitted, and the length of stay, helping optimize the allocation of hospital resources.

8. Optimized Resource Scheduling and Bed Management.

- Purpose: Improve hospital resource utilization and patient flow.
- Explanation: Scheduling tools that intelligently allocate hospital rooms, medical equipment, and staff based on patient needs can improve efficiency. A bed management system would help hospital staff manage the allocation of beds based on severity and availability, ensuring no patient is left without care.
- Example: If a patient requires an ICU bed, the system can prioritize their needs and instantly provide availability status, making sure critical care beds are allocated promptly and appropriately.

9. Legal Compliance and Audit Trails.

- Purpose: Meet regulatory requirements and maintain accountability.
- Explanation: Keeping track of who accessed sensitive data and what actions they performed is essential for compliance with healthcare regulations. Audit logs can capture every action within the system, providing a detailed record of access and changes made to patient records or financial information.
- Example: If there is a dispute over billing or a medical error, the audit trail can show who made the change, when it was made, and what the exact change was, providing clarity and accountability.

10. Sustainability Initiatives for Hospitals.

- Purpose: Reduce the environmental impact of hospital operations.
- Explanation: Healthcare systems are resource-intensive. By monitoring energy usage and waste management, hospitals can reduce their carbon footprint. A green initiative module could track the hospital's energy consumption and suggest areas for improvement, helping the facility become more sustainable.
- Example: If the system identifies high energy consumption in specific departments, it can automatically suggest energy-saving practices or adjust heating, cooling, or lighting systems in real-time to optimize consumption.

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