KIGALI INDEPENDENT UNIVERSITY ULK

SCHOOL OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE

P. O. Box: 2280 KIGALI

ONLINE PRENATAL MONITORING SYSTEM

CASE STUDY: MULENGE DRC

Done by:

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Declaration

I, AHISHAKIYE MUHUMURE , hereby declare that this work, entitled "Online Prenatal Monitoring System," is my own project. It was submitted in partial fulfillment of the requirements for the award of a Bachelor's degree in computer science.

Name of the student: AHISHAKIYE MUHUMURE

Date

Signature

APPROVAL

Under my direction, the dissertation "ONLINE PRENATAL MONITORING SYSTEM" was completed, and with my permission, it was submitted for review.

The supervisor's name are RUTARINDWA J PIERRE

Date: ____/_____.

The signature ...

Dedication

I dedicate this research Project

To my beloved Mother UWIMANA NYIRANZANINKA and my uncle BONFILS JEAN DE DIEU and my siblings.

Other family members my relative's brothers, sisters, my friends (CHOL NAI, AIME, ISMAEL, RICHARD)

To all my lecturers and ULK staff.

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AHISHAKIYE MUHUMURE

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ABBREVIATION AND ACCRONYMS

CSS : Cascading Style Sheet

DBMS : Database Management System

DFD : Data Flow Diagram

DRC : Democratic Republic of Congo

ERD : Entity-Relationship Diagram

FD : Flow Diagram

HTML :Hyper Text Markup Language

JS : JavaScript

OPMS : Online Prenatal monitoring System

PDF : Portable Document Format

SQL : Structured Query Language

SSSADM : Structured Systems Analysis and Design Method

ULK : Kigali Independent University

UML : Unified Modeling Language

Abstract

Prenatal care is crucial for the health and well-being of expectant mothers and their unborn babies. However, many women face challenges in accessing timely and convenient prenatal services, leading to missed appointments, inadequate monitoring, and potential complications during pregnancy. This project proposes the development of an online prenatal maternity monitoring system, a digital platform designed to address these challenges and improve the accessibility and quality of prenatal care.

The proposed system aims to provide expectant mothers with a comprehensive and user-friendly online platform, enabling them to conveniently schedule appointments, track vaccinations, monitor consultations, access information about pregnancy growth, and communicate with healthcare providers. By leveraging modern technology and digital tools, the system facilitates efficient data management, streamlines communication channels, and empowers expectant mothers to actively participate in their prenatal care journey.

Through the online platform, expectant mothers can easily access their medical records, receive personalized reminders for appointments and vaccinations, and engage in secure communication with healthcare professionals, facilitating timely feedback and guidance. Additionally, the system incorporates educational resources and informative materials Customized to each stage of pregnancy, ensuring that expectant mothers have access to reliable and up-to-date information.

By integrating this online prenatal maternity monitoring system into existing healthcare infrastructure, the project aims to enhance the overall quality of prenatal care services, promote better maternal and fetal health outcomes, and contribute to a more efficient and accessible healthcare system for expectant mothers.

CHAPTER I: GENERAL INTRODUCTION

1.1. Introduction to the study

A prenatal maternity platform offers a digital solution for expectant mothers to seamlessly engage with prenatal care services. It facilitates convenient appointment scheduling, vaccination and consultation tracking, monitoring pregnancy progression, and enabling remote communication with healthcare professionals. Additionally, the platform provides educational resources to empower mothers throughout their prenatal journey. In this chapter researcher defined the background, the objectives of project, the problem statement, scope of study, research questions, project methodology, significance of the project.

1.2. Background

The idea of prenatal care is often attributed to John W. Ballantyne around the turn of the twentieth century. Ballantyne proposed that to prevent fetal abnormalities and reduce maternal, fetal, and neonatal deaths, medical supervision of pregnant women should be provided throughout pregnancy rather than only in labor. (Ballantyne, 1901)

Prenatal care in the United States started as a preventive measure against preeclampsia, which included program visits during which medical professionals conducted physical, history, and risk evaluations. Over the last century, prenatal care has shifted focus to low birth weight and other preventive conditions in order to decrease the rate of infant mortality. Increased use of prenatal care was found to decrease the rates of birth-weight-related mortality and other preventable medical ailments such as post-partum depression and infant injuries. In the 19th century, prenatal care in the United States was largely unstructured and informal. Medical advice for pregnant women often came from popular texts or family members, with little professional involvement. By the mid-1800s, European physicians made important discoveries about preeclampsia, including its association with proteinuria and hypertension, which laid the groundwork for future prenatal interventions.

The early 1900s saw a shift towards more organized prenatal care. Physicians began advocating for routine prenatal care to reduce maternal and infant mortality.

The first prenatal care guidelines were published in 1913, encouraging women to consult doctors from the beginning of pregnancy.

By 1930, a specific schedule of 12-14 prenatal visits was recommended, which remained largely unchanged for decades. The mid-20th century brought technological advancements like ultrasound, electronic fetal heart monitoring, and genetic screening, further medicalizing prenatal care.

Despite attempts to revise prenatal care in the late 20th century, including recommendations for fewer visits for low-risk women, the traditional 12-14 visit schedule persisted in the United States. This remained the norm until the COVID-19 pandemic in 2020, which forced a rapid adoption of reduced visit schedules and telemedicine.

For the first time since 1930, major organizations endorsed reducing the number of in-person prenatal visits, potentially marking a significant shift in prenatal care delivery

Prior to 1960 in the MULENGE region of DRC's South Kivu province, the prenatal care for pregnant women relied solely on traditional practices. They utilized herbal medicines and received guidance from elder women in the community who assisted with monitoring pregnancy stages. Cultural beliefs and ethnic traditions surrounding pregnancy were firmly entrenched. After 1960, some women began making long treks on foot, traveling over 49-56 kilometers, to access limited hospital facilities in distant towns like Fizi and Baraka for prenata9l consultations.

A significant shift occurred in the 1976 with the establishment of CENTRE DE CENTE ILUNDU in MULENGE. This allowed pregnant women to receive advice from nurses and give birth at the hospital rather than relying on home births assisted by elder women. Into the 2000s, the local government and hospital staff launched campaigns to educate families on the advantages of prenatal consultations, vaccinations, and hospital births under nurse supervision versus home deliveries (MINEMBWE, mulenge, 2016).

1.3. Problem statement

The current system of prenatal care in MULENGE is inefficiencies: Firstly, the reliance on traditional methods of storing data in books leads to the loss or misplacement of crucial information, resulting in incomplete records and potentially compromising the quality of care provided to pregnant women , particularly those residing in remote or underserved areas, face accessibility challenges due to inadequate infrastructure, making it difficult to reach healthcare facilities for regular check-ups ; vaccinations and appointments missed because of forgetfulness; the experience for pregnant women visiting hospitals is often marred by long wait times and overcrowded facilities, where they may struggle to obtain the necessary services promptly.

This not only causes frustration but also poses risks to both maternal and fetal health. For healthcare providers, the absence of comprehensive data due to outdated recording methods hampers their ability to deliver personalized and timely treatments, as they may lack essential information regarding pre-existing conditions or allergies. Moreover, the inefficiencies resulting from unnecessary hospital visits for issues that could be resolved remotely contribute to wasted time and resources for both patients and healthcare professionals. Additionally, concerns surrounding the privacy and security of electronic health records further compound the challenges. In order to overcome these obstacles, an online prenatal monitoring system must be created that prioritizes patient data security and privacy, facilitates easy access to comprehensive care, improves patient-provider communication, and ensures timely interventions.

1.4. Objectives

1.4.1 General objective

The general objective is to design an online prenatal monitoring system that allows healthcare providers to monitor the health of unborn child and well-being of pregnant women, enabling early detection of potential complications and timely interventions.

1.4.2 Specific objectives

- To create a database to store patient records, protecting them from unauthorized access.
- To develop a scheduling system that allows patients to schedule an appointment reducing wait times and long queues.
- To implement a chat bot feature to enable direct communication between patients and healthcare providers.
- To develop an alert system that notifies all healthcare providers of emergency situations involving patients.
- To implement a report management system for efficient generation, storage, and retrieval of medical reports.

1.5. Research questions

- How can transitioning from a paper-based system to a centralized digital database improve data accessibility and management in healthcare?
- How does an online appointment scheduling system impact patient wait times and long queue?
- How does system integration affect the quality of patient-provider communication?
- What technologies are most effective for detecting and alerting health providers to patient emergencies?
- How can a report management system be designed to optimize the efficiency of generating, storing, and retrieving medical reports while ensuring data security and compliance with healthcare regulations?

1.6. Scope

6. 1. Content scope

The online prenatal monitoring system encompass a comprehensive set of features to address the various aspects of prenatal care. It facilitate appointment scheduling for consultations check-ups, and vaccinations, notifications for upcoming appointments, vaccinations and consultations. The system should maintain records of vaccinations received, consultations conducted, treatments prescribed, and Foods and medication recommendations, including approved and restricted ones.

6. 2. Geographic scope

MULENGE is a district located in the eastern part of the Democratic Republic of Congo (DRC), within the province of South Kivu. Geographically, MULENGE spans three distinct territories: a portion lies within the territory of Fizi, another segment is situated in the territory of ITOMBWE, and yet another part extends into the territory of UVIRA.

This means that MULENGE is not confined to a single administrative territory but instead involves sections of all three territories. This geographical distribution highlights MULENGE's unique positioning within South Kivu, encompassing parts of FIZI, ITOMBWE, and UVIRA.

6. 3. Time scope

The online prenatal monitoring system research focuses on a 10-year timeframe, beginning when pregnant women in MULENGE started to shift towards utilizing hospital services more frequently. This period marks a significant change in maternal health practices within the community, as women began to prioritize professional medical care over traditional methods.

During this decade, there was a noticeable increase in pregnant women attending hospitals for various services, including prenatal consultations, vaccinations, and other medical check-ups. This shift represented a departure from previous norms, where many women relied on home births or sought guidance from elder women and traditional practitioners. The research aims to analyze the impact and effectiveness of this transition to modern healthcare practices on maternal and infant health outcomes in MULENGE.

1.7. Significance

An online prenatal monitoring system holds significant importance in modern healthcare for several reasons. Firstly, it enhances accessibility to prenatal care, especially for individuals in remote or underserved areas who may face challenges accessing traditional healthcare facilities such as notification of upcoming vaccinations, consultations. By providing convenient scheduling and remote monitoring capabilities, it increases the likelihood that expecting mothers will receive timely and consistent care throughout their pregnancy. Additionally, the system promotes proactive health management by tracking appointments, vaccinations, consultations, and treatment history, reducing the risk of missed or overlooked aspects of prenatal care. This proactive approach can lead to better health outcomes for both mothers and babies, as potential issues can be identified and addressed early. Furthermore, the system's provision of guidance on recommended foods and medicines ensures expecting mothers make informed decisions about their health and well-being. Overall, an online prenatal monitoring system plays a crucial role in improving maternal and child health by facilitating access to comprehensive, timely, and personalized prenatal care.

1.8. Project Methodology

8.1. Data Collection Method

In this research project Online prenatal monitoring system, researcher used both observation and documentation as data collection methods.

8.1.1. Observation

Observations involved watching and recording behaviors and events as they occurred naturally without any interference. This method allowed researcher to gain direct insights into the subjects' actions and interactions in their natural environments. By employing both structured observations, with predetermined checklists, and unstructured observations, where research captured detailed notes without predefined criteria, researcher was able to gather comprehensive data on the subjects' behaviors and contexts.

8.1.2. Documentation

Documentation involved collecting and analyzing existing records and documents relevant to the research. This method included reviewing medical records, health reports, and other written materials that provided valuable information on prenatal care practices and outcomes. By systematically examining these documents, Researcher was able to gather historical and contextual data, which complemented the observations and provided a more comprehensive understanding of the prenatal monitoring system and its impact on maternal health in MULENGE.

8.2. Software Development Methodology

The Agile methodology for the prenatal monitoring system project involves an iterative and incremental approach, with the project being divided into manageable sprints or iterations. Each sprint follows a cycle of planning, development, testing, review. The project begins with initiation and planning, followed by iterative development sprints where user stories or features are implemented, tested, and reviewed with stakeholders. Continuous integration and deployment pipelines automate the build, testing, and release processes. Regular monitoring, feedback incorporation, and adaptation to changing requirements are crucial. The project concludes with final testing, user acceptance, and deployment, ensuring all requirements are met and a high-quality platform is delivered**.**

1.8.3. Software Development Structure

In this research project, Researcher focused on developing an online prenatal monitoring system using the Structured Systems Analysis and Design Method (SSADM). This structured approach helped ensure a thorough analysis and design of the system, from the feasibility study to requirements analysis and system design. SSADM's detailed process and tools, such as data flow diagrams (DFDs), entity-relationship diagrams (ERDs), and a data dictionary, were instrumental in mapping out the system's processes and data structure.

The Data Flow Diagram (DFD) provided a visual representation of the online prenatal monitoring system's processes and data flow at various levels. At Level 0, or the Context DFD, the entire system was depicted as a single process interacting with external entities like patients and healthcare providers. Level 1 DFD broke this process into sub-processes, showing more detail about the system's functionality, such as patient registration, prenatal data collection, and monitoring. Level 2 DFD further detailed specific sub-processes. The Entity Relationship Diagram (ERD) detailed all entities within the proposed database, such as patients, healthcare providers, prenatal records, and appointments, including their relationships and attributes. The data dictionary complemented the ERD by listing all attributes found in every table created in the database, specifying names, data types, and any constraints. This comprehensive approach ensured a clear, structured, and detailed design of the online prenatal monitoring system .

Ethical considerations were paramount in the design process, particularly regarding patient privacy and data security. The system incorporated strict access controls and encryption measures to protect sensitive prenatal information.

1.9. Limitation of project

Online prenatal monitoring system has several limitations: absence of devices to facilitate remote monitoring of pregnancy stages and the health of expecting mothers. Absence of devices to allow health provides to make a remote consultation.

CHAPTER 2: LITERATURE REVIEW

2.0. Introduction

This chapter provides a comprehensive review of literature related to online prenatal monitoring systems. It begins with defining key concepts and terms central to understanding prenatal care and the technologies involved in remote monitoring. The theoretical review then traces the evolution of online prenatal monitoring systems. Finally, the review of related literature section analyzes similar research projects that have previously implemented online prenatal monitoring capabilities. By synthesizing definitions, theoretical foundations, and prior work in this space, this chapter establishes a solid framework for contextualizing and evaluating the development of new online prenatal monitoring platforms.

2.1. Definitions of key term

2.1.1. Prenatal

Prenatal is the period during pregnancy before the birth of a baby. It encompasses the development and health care of the fetus and the expectant mother during or relating to pregnancy.

2.1.2. Online

Online is a state of connectivity to the internet or a computer network, allowing access to digital information, services, and communication. It describes anything that is accessible or occurring via the internet, from websites and social media platforms to streaming services. Means that your computer or hand-held device is connected to a network, usually the internet.

2.1.3. Pregnancy

Pregnancy is the period during which a fertilized egg develops into a fetus and grows inside a woman's womb, typically lasting about 40 weeks from the first day of the last menstrual period to birth. It involves three trimesters, each marked by significant developmental milestones for the baby and physiological changes for the mother. Pregnancy is the term used to describe the period in which a fetus develops inside a woman's womb or uterus**.**

2.1.4. System

A system is an organized collection of interconnected and interdependent components that work together to achieve a specific goal or function.

These components can be physical entities, processes, or abstract elements, and their interactions and relationships define the system's behavior and purpose. A system is a group of interacting or interrelated elements that act according to a set of rules to form a unified whole.

2.1.5. Monitoring

Monitoring is the systematic observation, measurement, and evaluation of processes, activities, or phenomena to track their progress, performance, or changes over time. It involves gathering data and information through various methods such as surveillance, sensors, or reporting systems to assess whether operations or conditions are meeting desired standards, goals, or requirements. Monitoring plays a crucial role in ensuring transparency, accountability, and efficiency in various contexts, including environmental management, healthcare, technology infrastructure, and organizational performance. Monitoring is a process of observing and tracking activities and progress. (evalcommunity, 2015)

2.1.6. Prenatal monitoring

Prenatal monitoring is the process of observing and assessing the health and development of a fetus during pregnancy. It involves various medical and diagnostic techniques aimed at ensuring the well-being of both the mother and the unborn child. Prenatal monitoring typically includes regular check-ups with healthcare providers, where factors such as maternal health, fetal growth, and development are monitored through physical examinations, ultrasound scans, and sometimes additional tests like blood tests or genetic screenings. The goal of prenatal monitoring is to detect any potential risks or abnormalities early on, allowing for timely intervention or medical management to optimize the health outcomes for both the mother and the baby throughout pregnancy and childbirth. Refers to the process of observing and assessing the health and development of a pregnant woman and her unborn child throughout the duration of pregnancy.

2.1.7. Monitoring system

A monitoring system is a structured framework or set of tools that systematically collects, processes, and analyzes data to observe and assess the performance, status, or behavior of a specific process, activity, or environment. It involves the continuous or periodic gathering of information through sensors, instruments, or manual inputs, followed by the interpretation of this data to derive insights or detect anomalies.

2.1.8. Prenatal care

Prenatal care is the health care you get while you are pregnant. It includes your checkups and prenatal testing. Prenatal care can help keep you and your baby healthy. It lets your health care provider spot health problems early. Early treatment can cure many problems and prevent others.

2.1.9. Online prenatal monitoring system

An online prenatal monitoring system is a digital platform designed to support pregnant women and monitor the well-being of their unborn child throughout pregnancy.

2.2. Review of related literature

2.2.1. Database

A database is a collection of data that is organized, which is also called structured data. It can be accessed or stored in a computer system. It can be managed through a Database Management System (DBMS), a software used to manage data. Database refers to related data in a structured form.

2.2.1.1. Evolution of Database

The concept of a database can be traced back to the early 1960s, when computer scientists began working on ways to store and organize large amounts of data in a structured manner. One of the first examples of a database was created by IBM in the 1960s for the U.S. Census Bureau, and it was used to store and process data from the 1960 U.S. Census.

In the 1970s, the relational database model was introduced, which organized data into tables that could be related to one another through the use of keys. This model became the basis for many of the database management systems (DBMS) that are in use today.

In the 1980s and 1990s, the rise of personal computers and the development of client-server architectures led to the widespread use of databases in businesses and other organizations. In the 2000s, the growth of the internet and the proliferation of web-based applications led to the development of new types of databases, such as NoSQL databases, which are designed to support the storage and management of large amounts of unstructured data. Today, databases are an integral part of many modern systems, and they play a vital role in a wide range of applications, including financial systems, customer relationship management, inventory management, and more (Simplilearn, 2023)

2.2.1.2. Types of Databases

Databases can be primarily divided into two main types:

- Single-file: Used for representing a single piece of information or data, they use individual files and simple structures.

  Example: SQLite: SQLite is a self-contained, serverless, zero-configuration, transactional SQL database engine. It is often used in applications that need a local data store without requiring a separate database server.
- Multi-file relational: These databases are relatively a lot more complicated, and they make use of tables in order to display the relationship between different sets of data.

  Example: MySQL: MySQL is a popular open-source relational database management system. It uses tables to organize and store data and supports complex queries to manage relationships between different data sets. It is widely used in web applications and other environments where relational databases are beneficial for structuring and querying data efficiently.

2.2.1.3. Others types of Databases

2.2.1.3.1. Hierarchical Databases

A hierarchical database is a type of database that uses a hierarchical model to organize data. In a hierarchical database, data is organized into a tree-like structure, with each record represented as a node in the tree. Each node is connected to one or more child nodes, and each child node can have its own set of child nodes, creating a hierarchy of nodes.

In a hierarchical database, each node in the hierarchy can have only one parent node, and the relationship between nodes is one-to-many. This means that a parent node can have multiple child nodes, but a child node can only have one parent node.

Example: IBM Information Management System (IMS): IMS is a hierarchical database management system developed by IBM. It organizes data into a tree-like structure where each record (node) is connected to one or more child records. IMS was widely used in mainframe environments for managing large volumes of data with a clear parent-child relationship.

2.2.1.3.2. Network Database

A network database uses a network model to organize data. In a network database, data is organized into a series of interconnected records, with each record representing an entity and the relationships between the entities represented as lines connecting the records.

Each record in this type of database can have multiple parent and child records, creating a complex web of relationships between the data. This allows for a more flexible and expressive data model than hierarchical databases, which have a more rigid one-to-many relationship between parent and child nodes.

Example: Integrated Data Store (IDS): IDS is an example of a network database management system. It uses a network model where each record (entity) can have multiple parent and child records. Relationships between records are established through pointers, allowing for more complex and interconnected data structures than hierarchical databases.

2.2.1.3.3. Object-Oriented Databases

In an object-oriented database, data is organized into objects, which are self-contained entities that contain both data and the methods that operate on that data.

Object-oriented databases are designed to support the creation and management of complex data structures, and they are often used in applications that require the manipulation of large amounts of structured and semi-structured data.

Example: db4o is an open-source object-oriented database management system. It stores data in the form of objects, which encapsulate both data and behavior (methods). Object-oriented databases are designed to handle complex data structures more naturally than relational databases, making them suitable for applications that deal with object-oriented programming paradigms.

2.2.1.3.4. NoSQL Databases

These databases are designed to handle large amounts of unstructured or semi-structured data, and they do not use the traditional table-based relational database model. Instead, they use a variety of data models, such as key-value pairs, documents, and graphs, to store data. Examples of NoSQL databases include MongoDB, Cassandra, and Couchbase.

Example: MongoDB: MongoDB is a popular NoSQL database that uses a document-oriented data model. It stores data in flexible, JSON-like documents, allowing for dynamic schemas and making it suitable for handling semi-structured data. MongoDB is known for its scalability and performance, often used in modern web applications and big data environments.

2.2.1.3.5. Cloud Database

A cloud database is stored and managed on a cloud computing platform, rather than on a local server or device. Cloud databases are accessed over the internet and can be used by multiple users or applications, providing a flexible and scalable way to store and manage data. Cloud databases can be used for a wide range of applications, including web and mobile applications, data warehousing, and more.

Example: Amazon DynamoDB: DynamoDB is a fully managed NoSQL database service provided by Amazon Web Services (AWS). It is designed to handle high-scale applications and offers low-latency access to data. DynamoDB is a key-value and document database that automatically scales based on demand, making it well-suited for cloud-based applications that require flexible and scalable data storage solutions.

2.2.1.4. Advantages and Disadvantages of Database

2.2.1.4.1. Advantages of Database

There are several advantages to using database architecture:

- A database allows data to be organized in a structured and consistent manner, making it easy to access and manipulate.
- It ensures the integrity of the data by enforcing rules on data input and storage, and by tracking changes to the data.
- It provides robust security features to protect the data from unauthorized access or changes.
- It allows applications to be developed and maintained independently of the data, making it easier to make changes to the data or the applications without affecting each other.
- It allows multiple users to access and update the data simultaneously, making it easier to share information and collaborate.

2.2.1.4.2 Disadvantages of Database

There are also some disadvantages to using database architecture:

- Setting up and maintaining a database can be complex, requiring specialized skills and resources.
- The purchase and maintenance of database software and hardware can be expensive.
- Large databases can be resource-intensive, and the performance of the system may suffer as the amount of data grows.
- A database may need to be redesigned or reconfigured as the amount of data grows or the number of users increases, which can be a time-consuming and complex process.

Sabbir Hossain's Employee Management System (EMS), developed in September 2023, utilizes a robust database structure to efficiently manage workforce data. The database design incorporates tables for employee personal information, job details, attendance records, leave requests, and performance evaluations. It employs relational database principles to establish connections between various data entities, ensuring data integrity and minimizing redundancy (Hossain, 2023).

2.2.2. Scheduling Appointment

Appointment scheduling allows you to set your appointment schedule and give patients the ability to book slots on their own. This gives you more control over your time and makes you more productive.

2.2.2.1. Advantages of Appointment Scheduling Software

2.2.2.1.1. Benefits of an online appointment booking system for patients

- Available and accessible 24/7: customers can book an appointment anytime and anywhere.
- Reduced no-shows: automatic reminders help customers remember their appointments.
- Reduced waiting time: pre-booked appointments eliminate long queues and wait times.
- Improve customer experience: with more flexibility to book suitable appointment times, customers gain control over their visits and enhance their experience (Tharmin, 2020)

2.2.2.1.2. Benefits of an appointment scheduling system for service providers

- Control over customer flow and visitor footfall on premises
- Matching clients' service requests to the right staff member with relevant expertise
- Improved operational and staff efficiency
- Efficient resource allocation based on market demand
- Enable efficient time management for staff with balanced customer flows

2.2.2.2 Which industries can benefit from an appointment booking system?

Appointment management can be used in any kind of industry, for various types of businesses, organizations, and services. In the ultimate guide to appointment scheduling systems, the benefits of an appointment scheduling system are highlighted for different industries. Some of the benefits have been compiled below:

2.2.2.2.1. Patient scheduling software for healthcare

As healthcare workers are experiencing an increase in their workload, a patient scheduling system can be a way to relieve some of the stress and administrative tasks. With patient appointments scheduled in advance, healthcare facilities can plan resource allocation in advance, increasing efficiency and reducing staff's stress levels. Moreover, they can regulate the patient flow better with appointment booking solutions and enhance the overall patient experience (Dixie, 2020)

- Appointment booking system for government offices

Public departments like tax, driving license, immigration, and pension offices have always been busy and commonly attend to different citizen services in the same office locations. Appointment booking systems can help manage the visitor flow and organize multiple types of appointments at the same facility. As a service provider, you can decide on the number of appointment slots to be opened at any given time based on your staff availability, giving you full control of the number of people on-premise (Tharmin, 2020)

- Appointment scheduling system for retail.

With new customer behaviors of easy and fast assistance, multiple delivery options, and online shopping, it can be hard to attend to all customers using traditional methods. An appointment scheduling system can help you organize the different types of customer behaviors and demands by:

Providing you with the tools to divide visitors based on department, so your customers are spread out to get the needed help at the right location to avoid large crowds in one store section.
Apply online booking for your services so your customers can arrive when it's their turn to attain a service, for example, a consultation, instead of waiting in long lines at the store hoping there's a timeslot available (Dixie, 2020)
Offer click-and-collect service, enabling your customers to order your products online and collect them when it's a convenient time for them, e.g., on their way home from work.

- Client booking system for banks and other finance institutions

For banks or any other finance service providers, you can avoid unscheduled visits and minimize the crowd in the waiting room by implementing an appointment-only policy.
With advanced appointment booking systems, you can allow your customers to book the type of service they want or select the type of financial assistance they need to match them up with staff members who have the right expertise (Tharmin, 2020)
Md Foysal Miah from the National Defense University of Malaysia developed the Hospital Management System (HMS) in April 2019.

The objectives of this system include providing an online appointment system to allow patients to easily schedule visits, implementing a centralized and systematic way of storing comprehensive patient data and medical records, and enabling efficient retrieval of patient information by authorized hospital staff. By transitioning to an integrated digital platform, HMS seeks to enhance access to care, improve data management practices, and ensure healthcare providers have the necessary patient details readily available to provide high-quality, coordinated medical services. (Miah, 2019)

2.2.3. Communication between health providers and patients

2.2.3.1. Why Is Communication Important in Health Care?

- Healthcare leaders understand that effective communication in organizations starts with recognizing the importance of listening to one another. Often, those in healthcare administration careers can help improve institutional communication by helping shape policy and promoting effective communication behaviors.
- Collectively, medical professionals have a wealth of knowledge and expertise. That wellspring goes untapped when providers rush from one appointment to the next without allowing themselves time to listen and communicate effectively with patients, when patients feel unsafe, when care teams store medical information improperly, or when health organizations fail to employ interpreters for cross-cultural communications.
- Clear, honest communication between patient and provider paves the way for accurate diagnoses and treatment decisions. Similarly, clear, confidential communication between members of a care team, which often includes patients and multiple providers, results in swiftly and ethically delivered care without breaching confidentiality.
- Providers can help patients feel heard, ease their fears, and encourage them to disclose relevant information. For example, a patient who feels embarrassed about a pubic rash will likely feel more safe mentioning this to a provider who they know will treat them with compassion and a professional demeanor.
- In addition, every person deserves to understand the medical care they receive. That means that healthcare organizations may need to train and hire interpreters so that patients can give their informed consent to treatment (Univasity, 2021)

2.2.3.2. Communication Strategies in Health Care

Overcoming communication obstacles does not have to be difficult. Simple changes in behavior can help foster a better relationship between patient and provider, as well as help increase the quality of care. Consider the recommended strategies for communication in health care and how they can help overcome barriers (Tulane, 2021)

2.2.3.2.1. Sit Down and Be Humble

Studies show that when a patient and their provider are seated during office visits and hospital check-ins, the two parties can build trust more easily. When a provider sits down to talk with a patient, the patient will more likely perceive the visit to be longer and more intimate; this can help quell anxiety regarding discussions about symptoms and possible treatments for diagnoses (Tulane, 2021)

2.2.3.2.2. Ask Open-Ended Questions

Patients often feel uncomfortable voicing their concerns, even after a few minutes of empathetic conversation. Doctors and other care providers should ask whether patients have more to say. For example, asking patients some variation of "Is there something else you'd like to talk about today?" can help create space for patients to reflect and voice concerns they might not have mentioned otherwise (Tulaneunivesity, 2021)

Mohammed Alotaibi, Maram Albalawi, and Layan Alwakeel from the University of Tabuk in Saudi Arabia designed a Smart Mobile Pregnancy Management and Awareness System in 2018. This system aims to facilitate communication between pregnant women and their healthcare providers, increase interactions and community building amongst expecting mothers, as well as motivate pregnant women to increase participation in beneficial physical activities. A key feature is remote monitoring capabilities to allow tracking of fetal development and maternal health indicators.

By leveraging mobile technology, the system provides an integrated platform for improving pre- and post-natal care through enhanced provider communication, patient education, activity promotion, and remote monitoring (Mohammed Alotaibi, 2018).

2.2.4. Alert for Emergency

An emergency is an urgent, unexpected, and usually dangerous situation that poses an immediate risk to health, life, property, or environment and requires immediate action.

2.2.4.1. Types of Emergency

2.2.4.1.1. Dangers to life

Many emergencies cause an immediate danger to the life of people involved. This can range from emergencies affecting a single person, such as the entire range of medical emergencies including heart attacks, strokes, cardiac arrest and trauma, to incidents that affect large numbers of people such as natural disasters including tornadoes, hurricanes, floods, earthquakes, mudslides and outbreaks of diseases such as coronavirus, cholera, Ebola, and malaria.

Most agencies consider these the highest priority emergency, which follows the general school of thought that nothing is more important than human life (UKGOV, 2007)

2.2.4.1.2. Dangers to health

Some emergencies are not necessarily immediately threatening to life, but might have serious implications for the continued health and well-being of a person or persons (though a health emergency can subsequently escalate to life-threatening).

The causes of a health emergency are often very similar to the causes of an emergency threatening to life, which includes medical emergencies and natural disasters, although the range of incidents that can be categorized here is far greater than those that cause a danger to life (such as broken limbs, which do not usually cause death, but immediate intervention is required if the person is to recover properly). Many life emergencies, such as cardiac arrest, are also health emergencies (Uk, 2007)

2.2.4.1.3. Dangers to the environment

Some emergencies do not immediately endanger life, health or property, but do affect the natural environment and creatures living within it. Not all agencies consider this a genuine emergency, but it can have far-reaching effects on animals and the long term condition of the land. Examples would include forest fires and marine oil spills (GovUK, 2007)

2.2.4.2. Agencies involved in dealing with emergencies

Most developed countries have a number of emergency services operating within them, whose purpose is to provide assistance in dealing with any emergency.

They are often government operated, paid for from tax revenue as a public service, but in some cases, they may be private companies, responding to emergencies in return for payment, or they may be voluntary organizations, providing the assistance from funds raised from donations.
Most developed countries operate three core emergency services.

- Police – handle mainly crime-related emergencies.
- Fire – handle fire-related emergencies and usually possess secondary rescue duties.
- Medical – handle medical-related emergencies.

There may also be a number of specialized emergency services, which may be a part of one of the core agencies, or may be separate entities who assist the main agencies. This can include services, such as bomb disposal, search and rescue, and hazardous material operations (UK, 2007)
In December 2022, Oretnom designed the Dynamic Web Notification (DWN) system using JavaScript and PHP. This system aims to provide real-time notifications to users through a dynamic web interface. It facilitates instant communication and ensures users are promptly informed about important updates and alerts. By leveraging web technologies, DWN offers an integrated platform for enhancing user engagement and ensuring timely dissemination of information (Oretnom, 2022)

2.2.5. Manage Report

A management reporting system provides information- in the shape of reports or statements. This system helps management by providing them with real-time and relevant information. Moreover, management reporting systems assist in capturing data required by managers to run a successful business (Folio3, 2022)

2.2.5.1. Types of management reports

2.2.5.1.1. Internal reports

Internal reports are developed for reporting on any managerial task. These reports follow some legal format standards and are used for top-level, middle-level, and lower-level management.

2.2.5.1.2. External reports

External reports are developed to report performance to external stakeholders such as creditors, investors, bankers, suppliers, etc. These reports may provide context into something that impacts business performance, such as industry trends.

2.2.5.1.3. Operational reports

Operational reports aim to track all facets related to the performance or operation of different metrics. These reports are created daily, weekly, or monthly. They are used for optimizing business processes, spotting trends, lowering costs, and improving all of the day-to-day operations of a company.

2.2.5.1.4. Analytical reports

This type of management report uses qualitative and quantitative data for analysis, evaluation, and filtration of the performance of a company's strategies. Analytical reports can deliver trends and predictions for business innovation and better decision-making.

2.2.5.2. Best Practices

Below are 4 best practices of management reporting:

2.2.5.2.1. Setting goals and objectives

To create the perfect management reporting, you need to keep the goals and objectives in mind. Thus, a few questions you need to ask yourself before you begin writing reports are:

- Are you familiar with important aspects of your business?
- Define what success is in your business?
- Purpose of reporting in your organization?
- How can you tell your estimation is appropriate?

Furthermore, ask yourself data analytics questions to address the requirements of the report. Moreover, set KPIs and move forward to take the way to achieve your goals.

2.2.5.2.2. Making reports clear

Making clear reports is a fundamental objective in management reporting. For creating a visually clear and attractive report, you must make sure to use white space, carefully choose colors, make your colors stand out, keep a date range next to data, and finally keep your metrics simple so that everyone understands your reports quickly.

Organizing data and sharing it with your stakeholders is now easy with the help of the management reporting system. This system provides you with a considerable amount of data to analyze different aspects of your business. Thus, making the required data available for your team to make strategic business decisions. Furthermore, by developing management reports, members of your management will have easy access to comprehensive data to track the overall management efforts of your company. In turn, it helps you analyze how particular departments are performing within the company. So, you can take the proper measures to improve the way your company is operating (Folio3, 2022)

CHAPTER THREE: SYSTEM ANALYSIS AND DESIGN

3.0. Introduction

Online prenatal monitoring systems are innovative digital platforms designed to track and manage the health of expectant mothers throughout pregnancy. These systems leverage technology to enable healthcare providers to remotely monitor important health indicators, facilitating timely interventions and personalized care. By digitalizing prenatal care, these solutions aim to enhance accessibility, improve the quality of care, and ultimately lead to better health outcomes for both mothers and their unborn babies.

This chapter provides a comprehensive examination of the development process for an online prenatal monitoring system. We begin by analyzing the current prenatal care landscape, identifying existing challenges such as limited access to care in remote areas, inconsistent monitoring, and delayed interventions. The chapter then proposes a new system to address these issues, outlining both functional requirements and non-functional requirements. We explore data flow visualization techniques to illustrate how information moves through the system, and discuss methodological approaches for effective system development. The chapter also delves into various data collection techniques and examines the chosen system development methodology to ensure an efficient implementation process. Through this analysis, we aim to demonstrate how digital technology can be harnessed to revolutionize prenatal care, offering a more responsive, accessible, and effective monitoring solution for expectant mothers.

3.1.Analysis of the current system

3.1.1.Problem of the current system

The current prenatal care system in MULENGE faces several critical challenges that compromise the quality of care for expectant mothers. Traditional paper-based record-keeping leads to information loss and incomplete patient histories, while limited accessibility in remote areas hinders regular check-ups. Pregnant women often miss crucial appointments and vaccinations due to a lack of effective reminder systems. Healthcare facilities are frequently overcrowded, resulting in long wait times and frustration for patients. Healthcare providers struggle to deliver personalized care due to incomplete or inaccessible patient data.

Unnecessary hospital visits for minor issues waste resources and time for both patients and medical staff.

Additionally, the transition to electronic health records raises concerns about data privacy and security. These combined issues underscore the urgent need for an efficient, accessible, and secure online prenatal monitoring system that can address these shortcomings and improve the overall quality of prenatal care.

3.2.Analysis of the new system

3.2.1.Introduction

The new online prenatal monitoring system is designed to revolutionize prenatal care by offering a comprehensive platform for tracking and managing prenatal health. It enables expectant mothers to monitor their health information, including vaccinations, consultations, and scheduled appointments, and provides access to crucial information on recommended and non-recommended medications and foods during pregnancy. The system also predicts the estimated due date based on the conception week, displays schedules for public meetings related to prenatal care, and offers emergency alert services for quick assistance. Additionally, healthcare providers can update patient data, send private notices, and utilize two-factor authentication to enhance security and prevent unauthorized access, ensuring a seamless and secure experience for both patients and providers.

3.2.2.System requirements

The detailed investigation of the proposed online prenatal monitoring system involves analyzing the operations and interactions within and outside the system. Data collection methods such as questionnaires and on-site observations help gather information on current system transactions and decision points.

3.2.2.1.Functional Requirements

3.2.2.1.1.Patients

- Request an appointment: Allows patients to schedule new medical appointments
- View appointments: See approved, denied, and pending appointment requests
- View vaccinations: Access personal vaccination records
- View consultations: Check past, current, and future consultation details
- View medicines and food: See lists of allowed and prohibited medicines and foods
- View public notices: Access general health announcements for all patients

- Chatbot with providers: Communicate with healthcare providers via messaging system
- View treatment history: Access personal medical treatment records
- Emergency alert: Send urgent notifications to healthcare providers
- Predict birth date: Calculate estimated due date based on conception date

3.2.2.1.2. Doctor

- Manage appointments: Schedule, reschedule, or cancel patient appointments
- Manage consultations: Record and update patient consultation details
- Manage vaccinations: Update patient vaccination records and schedules
- Communicate with patients: Send and receive messages from patients
- Manage allowed items: Update lists of allowed and prohibited medicines and foods
- View patient history: Access comprehensive patient treatment records

3.2.2.1.3.Administrator

- Confirm patient registration: Verify and approve new patient accounts
- Confirm doctor registration: Verify and approve new doctor accounts
- Insert new admin: Add new administrative users to the system
- Insert new hospital data: Add or update information about healthcare facilities
- Notify public notices: Create and publish general health announcements
- Reset user passwords: Assist users in resetting their account passwords
- Manage data: Perform general data management and maintenance tasks

3.2.2.2.Non-Functional Requirements

- Two-factor authentication: Enhances login security for health providers via email verification
- Password reset via email: Allows patients to securely reset passwords using emailed verification codes
- Admin-assisted password reset: Enables admins to help users reset passwords through security questions
- Account suspension: Permits admins to deactivate patient or doctor accounts for rule violations
- 24/7 availability: Ensures the system is accessible and operational at all times

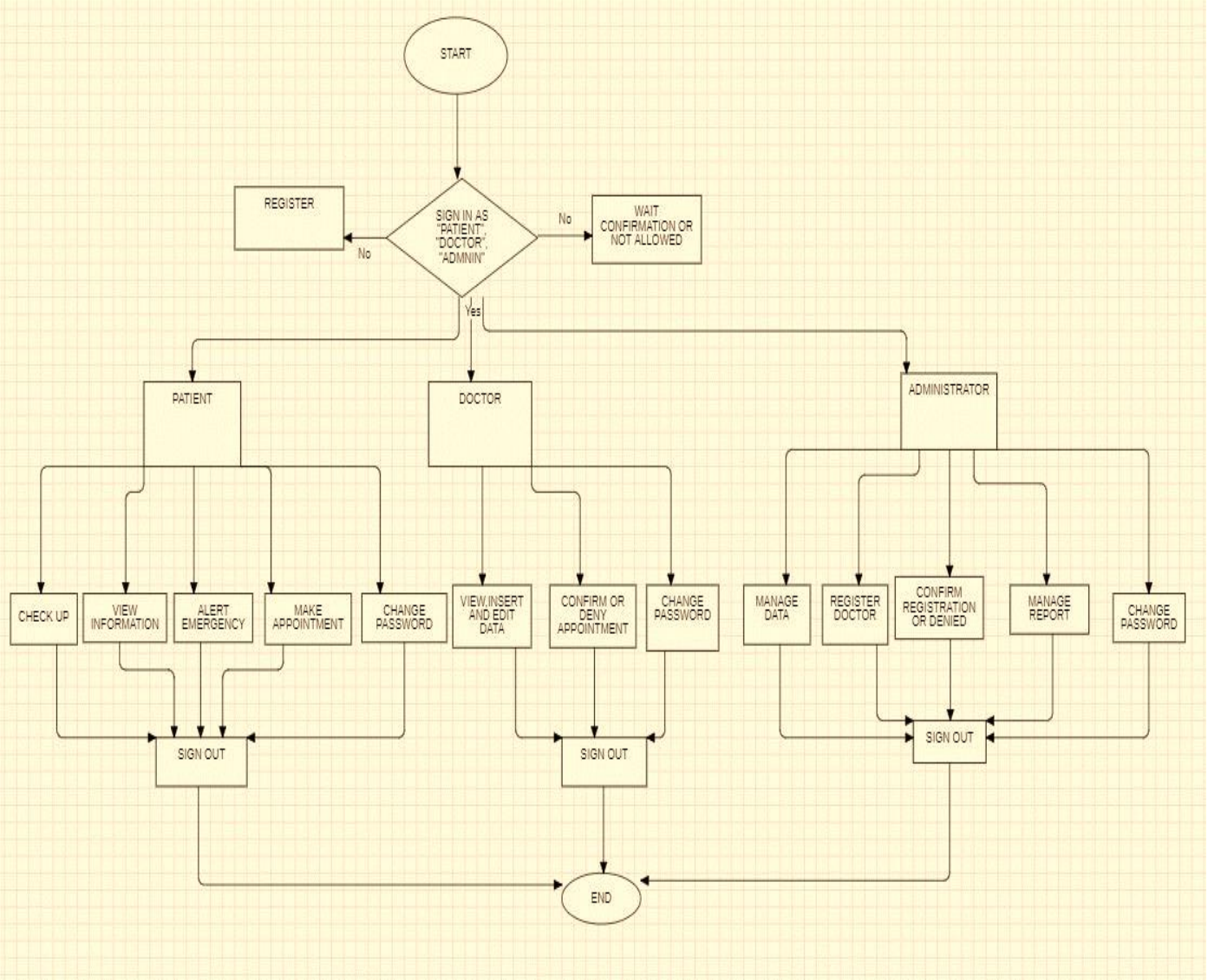
- User-friendly interface: Provides an intuitive, easily navigable design for all user types
- Healthcare system integration: Allows interoperability with existing healthcare systems
- Action logging: Records all user activities for transparency and accountability purposes.

3.3.3.Functional diagram

This functional diagram outlines an online prenatal monitoring system with three user roles: Patient, Doctor, and Administrator. The process begins with a login check, directing users to register if unrecognized. Each role has specific functionalities: Patients can check up, view information, set alerts, make appointments, and change passwords; Doctors can manage data, handle appointments, and update their passwords; Administrators can oversee data, register doctors, manage registrations, and modify their passwords.

The diagram illustrates a streamlined workflow for each user type, emphasizing the system's ability to cater to different healthcare stakeholders. It showcases the interconnected nature of patient care, medical practice management, and administrative oversight within a single platform. The system ensures appropriate access levels and functionalities for each role, culminating in a sign-out option that leads to the process end.

Figure 1


START
REGISTER
SIGN IN AS "PATIENT", "DOCTOR", "ADMNIN"
No
No
WAIT CONFIRMATION OR NOT ALLOWED
Yes
PATIENT
DOCTOR
ADMINISTRATOR
CHECK UP
VIEW INFORMATION
ALERT EMERGENCY
MAKE APPOINTMENT
CHANGE PASSWORD
VIEW,INSERT AND EDIT DATA
CONFIRM OR DENY APPOINTMENT
CHANGE PASSWORD
MANAGE DATA
REGISTER DOCTOR
CONFIRM REGISTRATION OR DENIED
MANAGE REPORT
CHANGE PASSWORD
SIGN OUT
SIGN OUT
SIGN OUT
END

3.3.4.Methodological Approach

3.3.4.1.Data collection techniques

3.3.4.1.1.Observation

In this research online prenatal monitoring system, the researcher employed observation as a primary data collection technique to directly assess the operational practices at hospitals such as Minembwe, CS Kakenge, CS Ilundu, Mikenge Hospital, and Madegu Hospital. Through observation, the researcher noted that these facilities rely on traditional paper-based methods for recording patient data. This method was observed to be time-consuming, as healthcare providers manually documented information in books, which also introduced the risk of errors and data loss. Additionally, the observations revealed long queues of patients awaiting services, highlighting significant inefficiencies in the current system that contribute to extended waiting times and potentially compromise the quality of care delivered.

3.3.4.1.2.Documentation

To complement these observations, the researcher conducted a comprehensive documentation review. This involved analyzing existing records, reports, and patient files to gather further insights into the challenges faced with the current system. The documentation review focused on issues related to data management, waiting times, and overall patient care experience. It also examined any previous attempts at system improvements or recommendations for enhancing prenatal care delivery. By combining these data collection methods—observation for direct assessment of practices and documentation review for historical context and detailed analysis—the researcher gained a holistic understanding of the limitations of the existing prenatal care systems and identified specific user needs. These insights were pivotal in guiding the design and development of a more effective and user-friendly online prenatal monitoring system tailored to address identified challenges and enhance overall healthcare delivery.

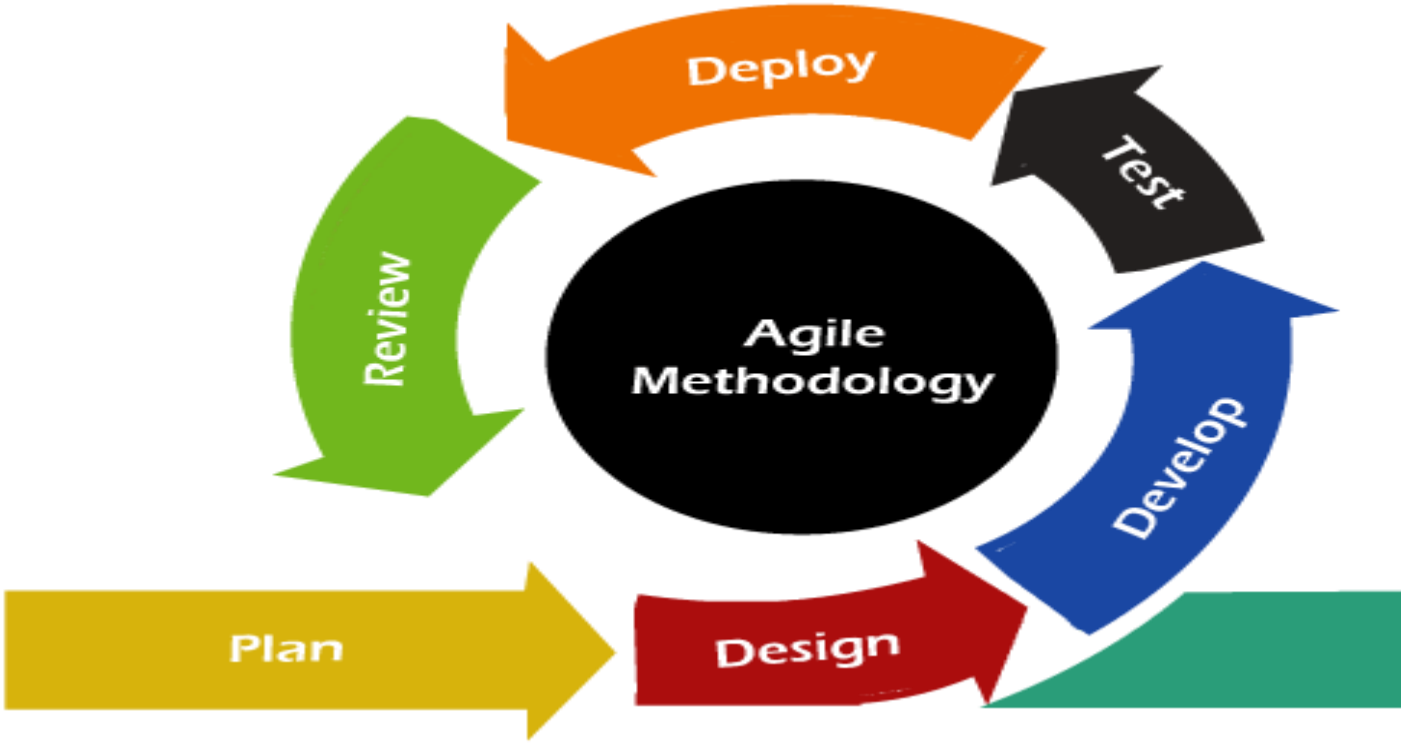
3.3.4.2.Software development methodology

Researcher used the Agile software development technique to create the online prenatal monitoring system in order to guarantee an agile and iterative approach to project execution. The method was led by the fundamental ideas of agile, including iterative development, close collaboration, and flexible planning.

Research started by involving stakeholders in order to specify project objectives and create a product backlog that ranked features and functionality. Every development cycle was divided into sprints, which lasted a few weeks on average and involved cross-functional teams working on particular projects from the backlog. Regular stand-up meetings allowed for quick changes and problem solving by maintaining open lines of communication.

Continuous integration and automated testing were given top priority to ensure the functionality and quality of the code throughout each sprint. Sprint reviews were held with stakeholders at the conclusion of each cycle to present finished work .

Figure1



3.3.4.3.System design and methodology

System Design is the process of defining the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements. It involves breaking down the system into smaller parts and determining how these parts interact and work together to achieve the desired functionality and performance.

Methodology refers to the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge. In practical terms, methodology is the framework within which system design is carried out, including techniques, tools, and processes used for analysis, design, implementation, and testing.

System Design focuses on creating the blueprint for how a system will work.

Methodology provides the approach and guidelines for developing and evaluating the system design.

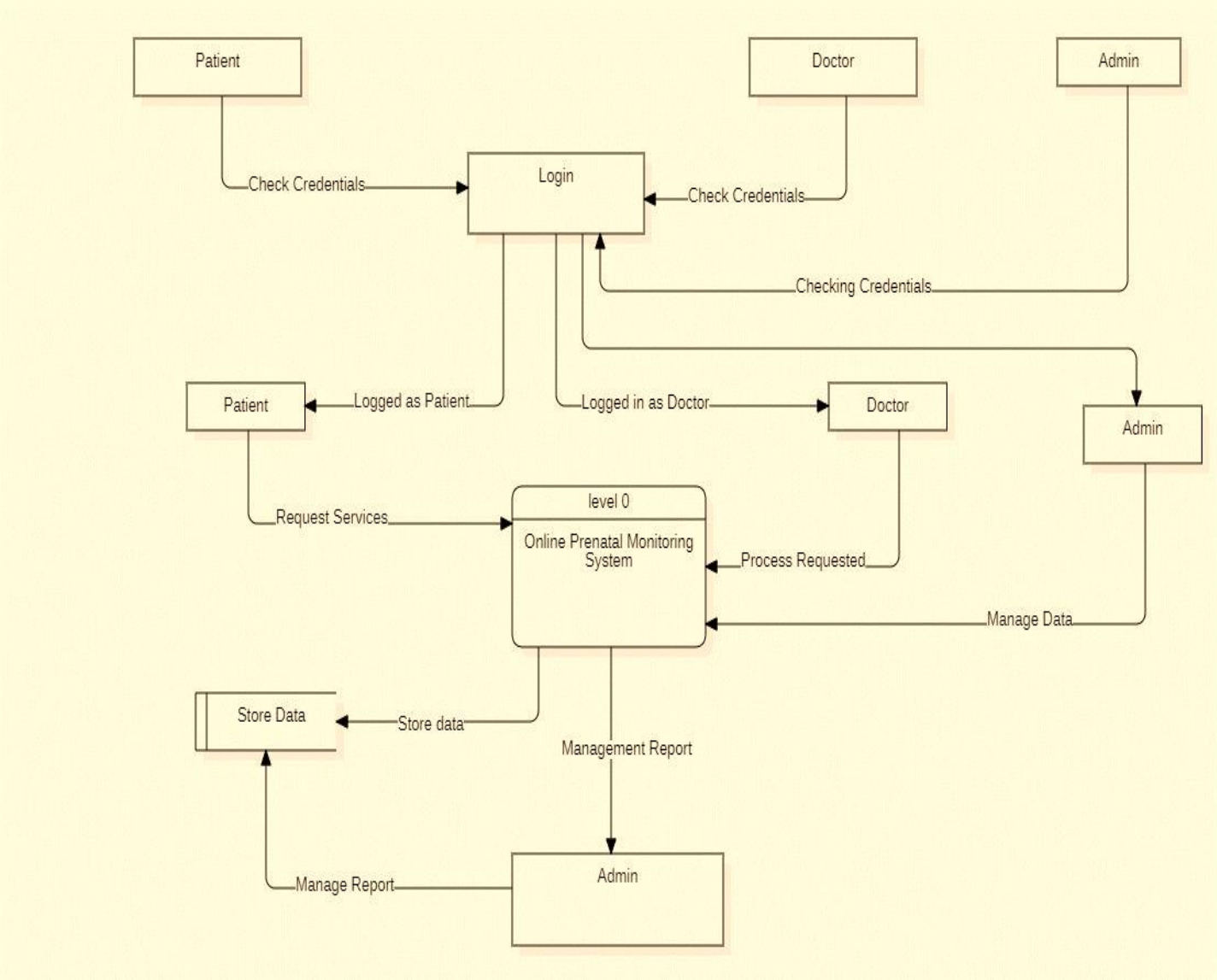
3.3.4.3.1.Data flow diagram (DFD)

A DFD is a graphical representation of how data moves through an information system. It shows the processes, data stores, external entities, and the flow of data between them. DFDs help visualize the system's functions, identify data inputs and outputs, and understand the system's logical structure without detailing its physical implementation.

3.3.4.3.1.1.Level 0

A DFD Level 0, or context diagram, is the highest-level view of an information system. It shows the entire system as a single process, surrounded by external entities that interact with it. It uses simple symbols to depict the system's boundaries, external entities, and the basic data flows between them, without detailing internal processes or data stores.

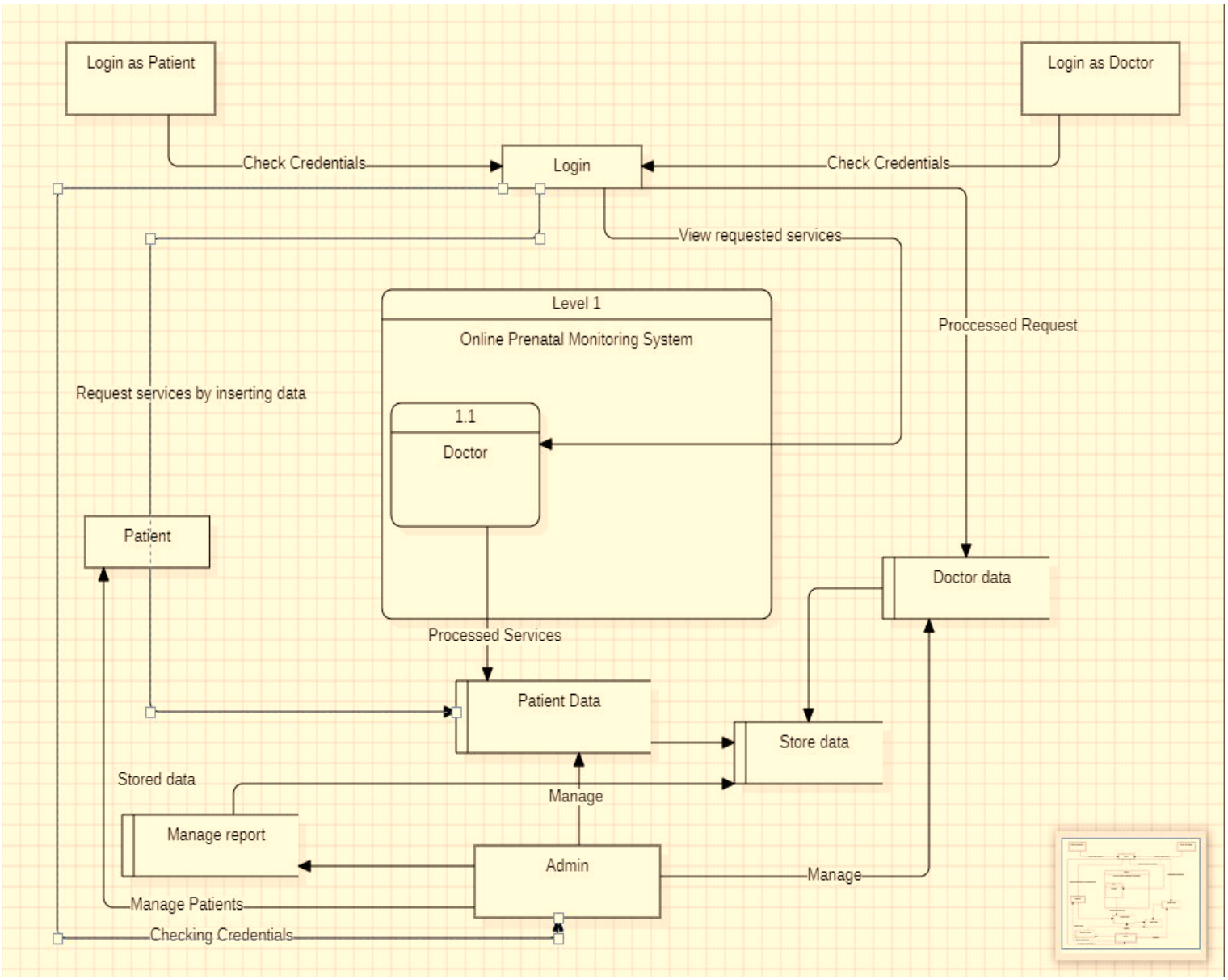
Figure 3



3.3.4.3.1.2. Level 1

A DFD Level 1 expands on Level 0 by breaking down the main system into major processes. It shows how data moves between these main processes, external entities, and data stores. Level 1 provides more detail than Level 0 but is still a high-level view of the system's functionality.

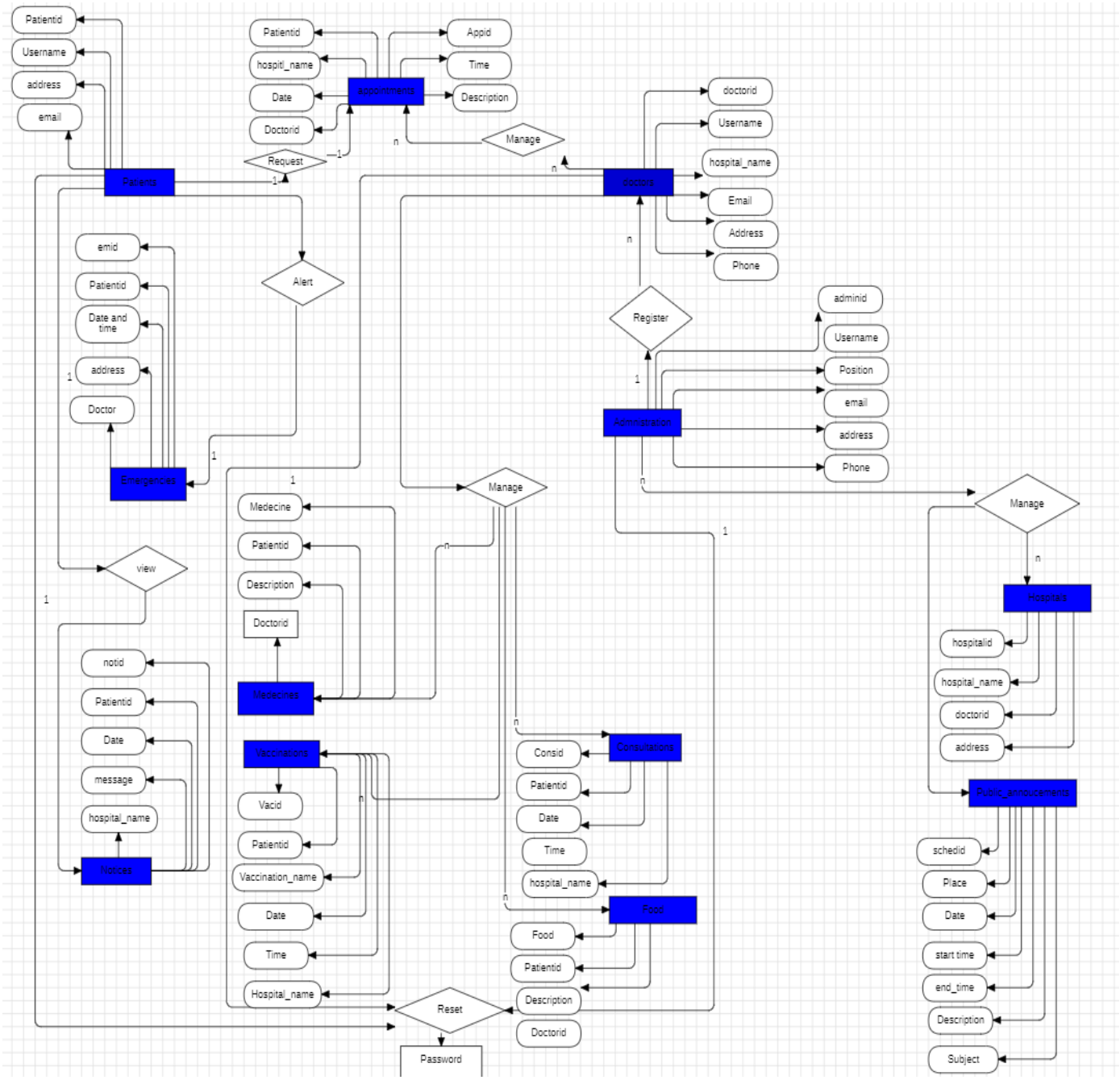
Figure 4



3.3.4.3.1.3.Entity Relationship Diagram (ERD)

An ERD is a visual model representing the structure of a database. It shows entities (objects or concepts), their attributes (properties), and the relationships between entities. ERDs illustrate how data is organized and connected within a system, helping to design efficient databases and communicate data structures to stakeholders.

Figure 5


Patientid
Username
address
email
Patients
Patientid
hospitl_name
Date
Doctorid
appointments
Appid
Time
Description
Request
Manage
doctorid
Username
hospital_name
Email
Address
Phone
doctors
emid
Patientid
Date and time
address
Doctor
Emergencies
Alert
Register
adminid
Username
Position
email
address
Phone
Admnistration
Medecine
Patientid
Description
Doctorid
Medecines
Manage
view
notid
Patientid
Date
message
hospital_name
Notices
Vaccinations
Vacid
Patientid
Vaccination_name
Date
Time
Hospital_name
Consid
Patientid
Date
Time
hospital_name
Consultations
Food
Food
Patientid
Description
Doctorid
Reset
Password
Manage
Hospitals
hospitalid
hospital_name
doctorid
address
Public_annoucements
schedid
Place
Date
start time
end_time
Description
Subject

3.3.4.3.1.4.Data Dictionary

A Data Dictionary is a centralized repository of information about data elements in a database or information system. It defines and describes each data item, including its name, type, format, length, and relationships. The dictionary also includes details on data usage, ownership, and any constraints. It serves as a reference for system developers, database administrators, and users, ensuring consistency in data definitions and facilitating system maintenance and documentation.

1. Administration

2. Name	Type	Extra
Adminid	Varchar(15)	Primary Key
username	Varchar(50)	
name	Varchar(50)	
phone	Varchar(15)	
Email	Varchar(50)	
Password	Varchar(20)	
Address	Varchar(50)	
Position	Varchar(30)	
national_id	Varchar(30)	
national_card	Varchar(50)	
Image	Varchar(50)	
gender	Varchar(20)	
Civil_status	Varchar(20)	
Status	Varchar(20)	
amount	Varchar(10)	
degree	Varchar(30)	
eset_code	Varchar(10)	
Verification_code	Varchar(10)	

2. Appointments

Name	Type	Extra
Appid	Varchar(20)	Primary Key
Hospital_name	Varchar(30)	
Doctorid	Varchar(10)	Foreign Key
holder	Varchar(20)	
Patientid	Varchar(15)	Foreign key
Username	Varchar(30)	
Subject	Varchar(50)	
Date	Date	
Time	Time	
Message	Varchar(200)	
status	Varchar(20)	

3. Consultations

Name	Type	Extra
Consid	Varchar(15)	Primary Key
Patientid	Varchar(15)	Foreign Key
Date	Date	
Time	Varchar(10)	
Consultation	Varchar(50)	
Status	Varchar(20)	
Doctorid	Varchar(15)	Foreign Key
Holder	Varchar(20)	
Hospital_name	Varchar(20)	
Comment	Varchar(100)	
Birth_week_A	Date	
Birth_week_B	Date	
request	Varchar(20)	

3. Contact

Name	Type	Extra
Contid	Varchar(10)	Primary Key
Email	Varchar(50)	
Subject	Varchar(50)	
message	Varchar(100)	
date	date	

4. Emergencies

Name	Type	Extra
EmID	Varchar(15)	Primary Key
Patientid	Varchar(15)	Foreign Key
Hospital_name	Varchar(30)	
date	datetime	
Doctorid	Varchar(10)	Foreign Key
Adminid	Varchar(15)	
username	Varchar(30)	
Status	Varchar(20)	

5. Foods

Name	Type	Extra
Food	Varchar(30)	Primary Key
Patientid	Varchar(15)	Foreign Key
Recommandation	Varchar(20)	
Description	Varchar(100)	
doctorid	Varchar(20)	Foreign Key
Username	Varchar(30)	

6. Medecines

Name	Type	Extra
Medicine	Varchar(20)	Primary Key
Patientid	Varchar(15)	Foreign Key
Regulation	Varchar(20)	
Description	Varchar(50)	
Doctorid	Varchar(20)	Foreign Key
Username	Varchar(30)	

7. Hospitals

Name	Type	Extra
Hospital_id	Varchar(10)	Primary Key
Hospital_name	Varchar(30)	
Holder	Varchar(20)	
Address	Varchar(30)	
Date	date	
Doctorid	Varchar(20)	Foreign Key

8. Login History

Name	Type	Extra
Id	Varchar(10)	Primary Key
Session_id	Varchar(10)	
Patientid	Varchar(15)	
Doctorid	Varchar(20)	
Adminid	Varchar(15)	
Login_time	Date	
Logout_time	date	

9. Notices

Name	Type	Extra
Notid	Varchar(15)	Primary Key
Patientid	Varchar(15)	
Hospital_name	Varchar(30)	
Message	Varchar(200)	
Date	Date	
Holder	Varchar(30)	
Holderid	Varchar(20)	
Reply	Text	

10. Password Recovery

Name	Type	Extra
Id	Varchar(10)	Primary Key
Email	Varchar(50)	
Expiry_time	Datetime	
Reset_code	Varchar(10)	
Status	Varchar(20)	

11. Schedule

Name	Type	Extra
Schedid	Varchar(10)	Primary Key
Description	Varchar(50)	
Date	Date	
Start_time	Time	
End_time	Time	
Place	Varchar(50)	
Message	Varchar(100)	

12. User Info

Name	Type	Extra
Comid	Varchar(10)	Primary Key
Patientid	Varchar(15)	
Subject	Varchar(50)	
Message	Text	
Note	Varchar(30)	
Doctorid	Varchar(20)	Foreign Key
Hospital_name	Varchar(30)	

13. Vaccinations

Name	Type	Extra
Vacid	Varchar(10)	Primary Key
Hospital_name	Varchar(30)	
Doctorid	Varchar(20)	Foreign Key
Holder	Varchar(20)	
Patientid	Varchar(15)	Foreign Key
Vaccination_name	Varchar(50)	
Date	Date	
Time	Time	
Status	Varchar(20)	

14. Doctors

Name	Type	Extra
Doctorid	Varchar(20)	Primary Key
Username	Varchar(30)	
Name	Varchar(30)	
Phone	Varchar(15)	

Email	Varchar(50)	
Password	Varchar(20)	
Hospital_name	Varchar(30)	
Hospital_id	Varchar(10)	Foreign Key
Address	Varchar(30)	
National_id	Varchar(30)	
Image	Varchar(50)	
Age	Int(3)	
Degree	Varchar(50)	
Status	Varchar(20)	
Civil_status	Varchar(20)	
Country	Varchar(30)	
Registration_date	Datetime	
Amount	Int(10)	
Reset_code	Varchar(10)	
Verification_code	Varchar(10)	

15. Users

Name	Type	Extra
Patientid	Varchar(15)	Primary Key
Username	Varchar(30)	
Name	Varchar(30)	
Phone	Varchar(20)	
Husband	Varchar(20)	
Husband_phone	Varchar(20)	
Email	Varchar(50)	
Password	Varchar(20)	
Age	Int(3)	
Address	Varchar(50)	
Hospital_name	Varchar(30)	
Hospital_id	Varchar(10)	Foreign Key
National_id	Varchar(30)	
Bloood_group	Varchar(10)	
National_id_no	Varchar(20)	
Image	Varchar(30)	
Status	Varchar(20)	
Registration_date	Datetime	
Reset_code	Varchar(10)	
Civil_status	Varchar(20)	
Amount	Int(10)	
Adminid	Varchar(15)	Foreign Key
Birth_pred	Date	
Sec_ver_st	Int(10)	

Ver_sta	Varchar(20)	

CHAP FOUR : SYSTEM IMPLEMENTATION

4.1. Implementation and coding

4.1.1. Introduction

The Online Prenatal Monitoring System is a comprehensive digital platform designed to support expectant mothers throughout their pregnancy. It incorporates various modules including patient management, consultations, vaccinations, appointment scheduling, and emergency alerts. The system aims to provide a holistic approach to prenatal care by integrating these features with predictive analytics and secure access controls.

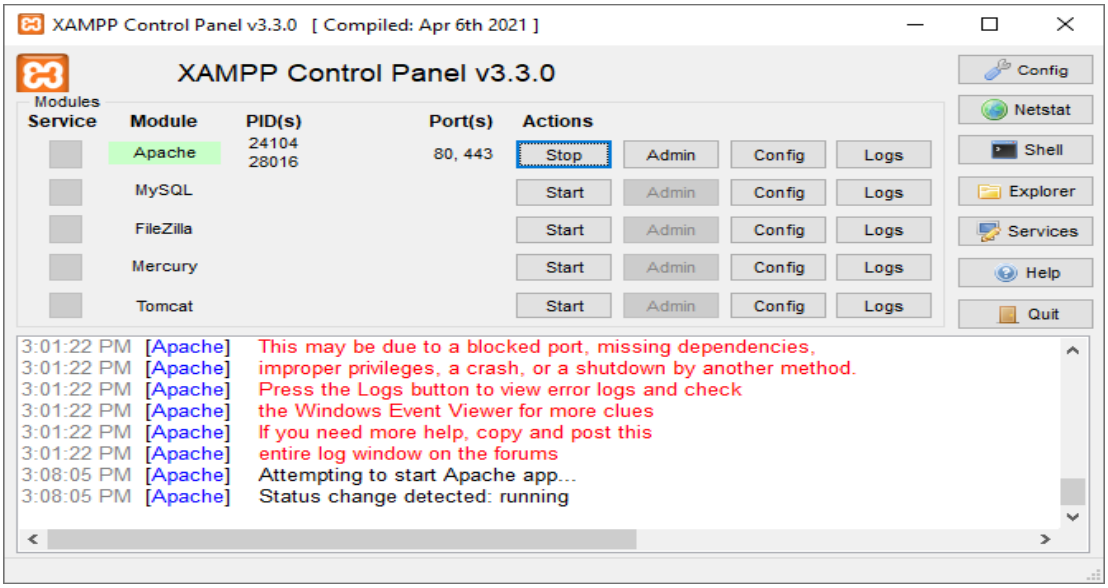
The implementation of this system involved choosing appropriate technologies, designing the database structure, and coding the various modules using HTML, CSS, JavaScript, and PHP. The development process typically included selecting these programming languages, setting up a database, creating user interfaces, and implementing the logic for each module. Testing was crucial to ensure the system's reliability, security, and user-friendliness

4.1.2. Description of Implementation tools and Technologies used

The Online Prenatal Monitoring System is implemented using a combination of common web development tools and technologies:

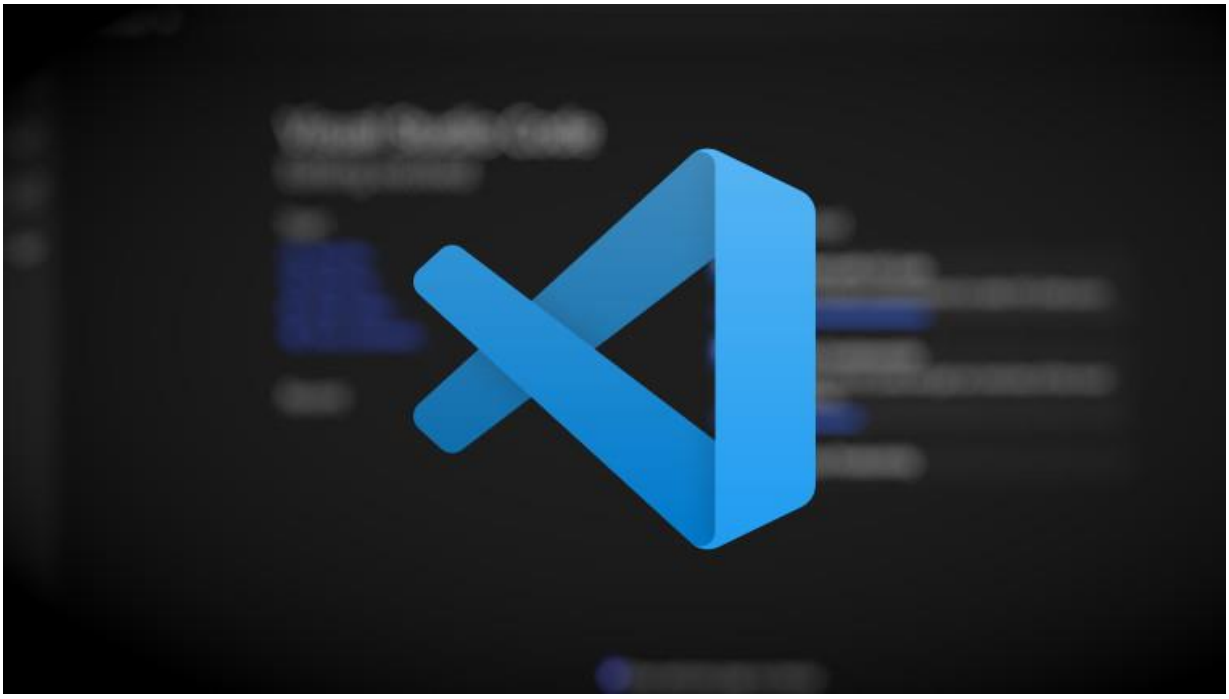
- Xampp: This software stack is used as the local development environment. It provides Apache as the web server, MySQL for the database, and PHP for server-side scripting. XAMPP allows developers to test and run the application locally before deployment.

Figure 6



- SQL Database: MySQL, included in XAMPP, serves as the relational database management system. It stores and manages all patient data, appointments, medical records, and system information in structured tables, allowing for efficient data retrieval and manipulation.
- Visual Studio: This integrated development environment (IDE) is used for coding and debugging. Its features like IntelliSense, code refactoring, and version control integration enhance developer productivity.

Figure 7



Programming Languages:

- HTML**(**Hypertext Markup Language**)**: Used for structuring the web pages and content.
  It uses a system of tags and attributes to define various elements such as headings, paragraphs, links, images, and more. These elements form the skeleton of a web page, organizing content in a meaningful and accessible way. By nesting and combining tags, HTML provides the basic layout and structure that is interpreted by web browsers to display web pages.

- CSS(Cascading Style Sheets): Employed for styling and layout of the user interface.
  used to control the presentation and layout of HTML elements on a web page. It allows developers to apply styles such as colors, fonts, spacing, and positioning to HTML elements, enhancing the visual appeal of a website. CSS works by associating style rules with HTML elements, which can be applied consistently across multiple pages.
  By separating content (HTML) from presentation (CSS), it enables easier maintenance and updates to the site's design.

- JavaScript: Implements client-side interactivity and dynamic content updates.

  JavaScript is a versatile client-side scripting language that enables dynamic and interactive content on web pages. Running directly in the web browser, it can manipulate HTML and CSS to update content, respond to user actions, and create engaging user experiences without needing to reload the page. JavaScript handles tasks such as form validation, event handling, animations, and asynchronous communication with servers (AJAX), making it essential for modern web development.
- PHP(Hypertext Preprocessor): Handles server-side logic, database interactions, and generates dynamic web pages.

  used for web development to create dynamic and interactive web pages. When a PHP script is executed, it processes data on the server, often interacting with databases, and generates HTML to be sent to the client's browser. This allows for functionalities like user authentication, form processing, and content management.

PHP is embedded within HTML code, making it versatile and widely used for developing robust web applications.

This technology stack provides a robust foundation for developing a responsive, secure, and scalable prenatal monitoring system. The combination of these tools allows for efficient development, easy maintenance, and the ability to handle complex medical data and user interactions.

4.1.3. Screen shorts and source codes

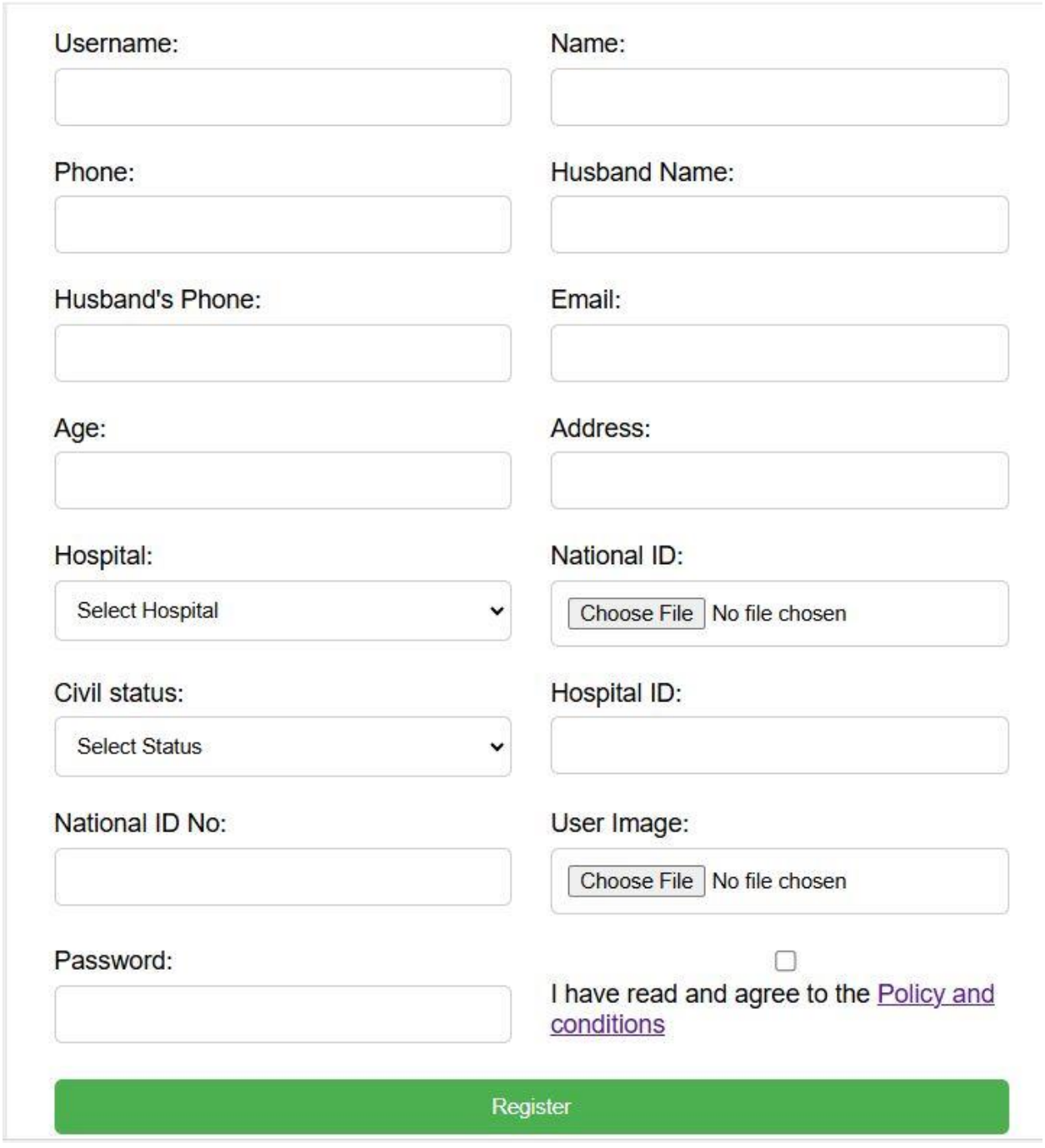
4.1.3.1. Screen shorts

Landing page Figure 8

This is where the users of the system can log in and patient can also do registration

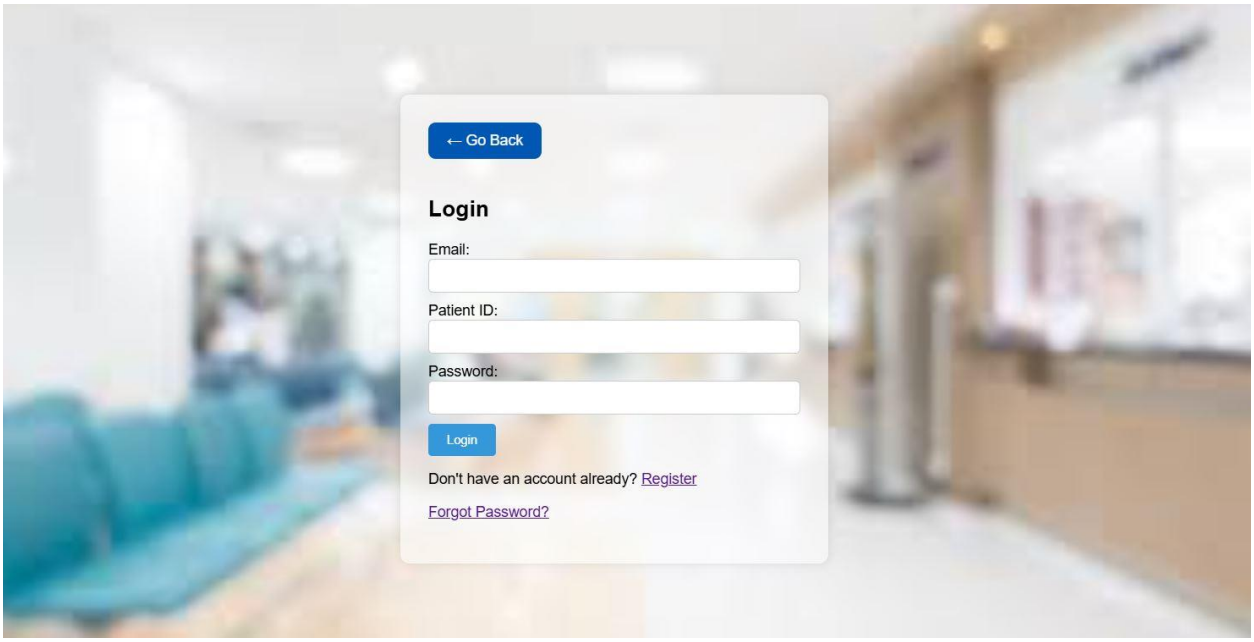
Register Patient **Figure 9**

This is the patient registration form to allow the process of registration



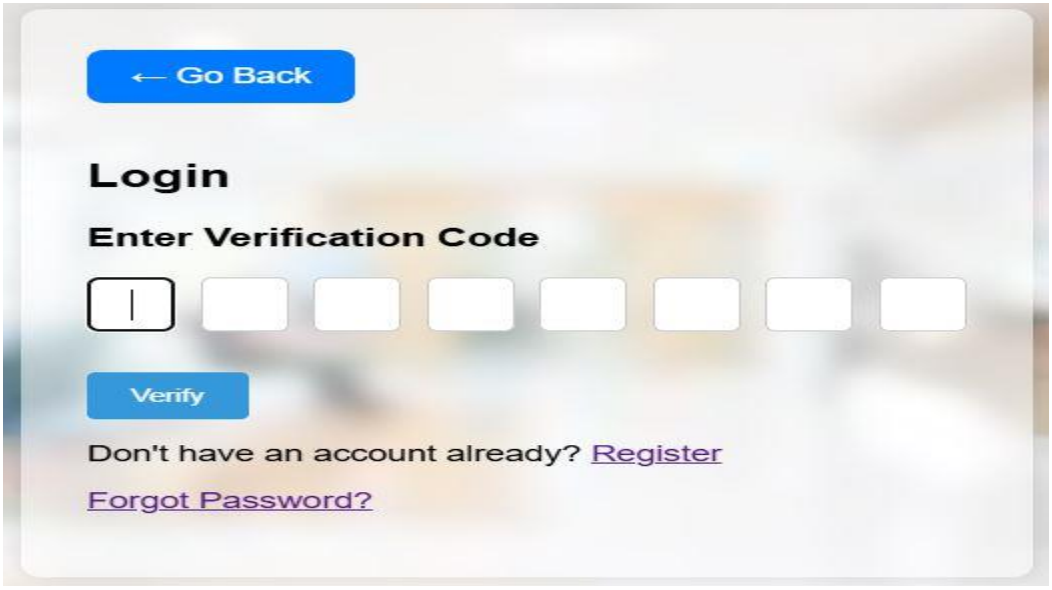
Patient Login **Figure 10**

This is where the patient login to their dashboard to access the services



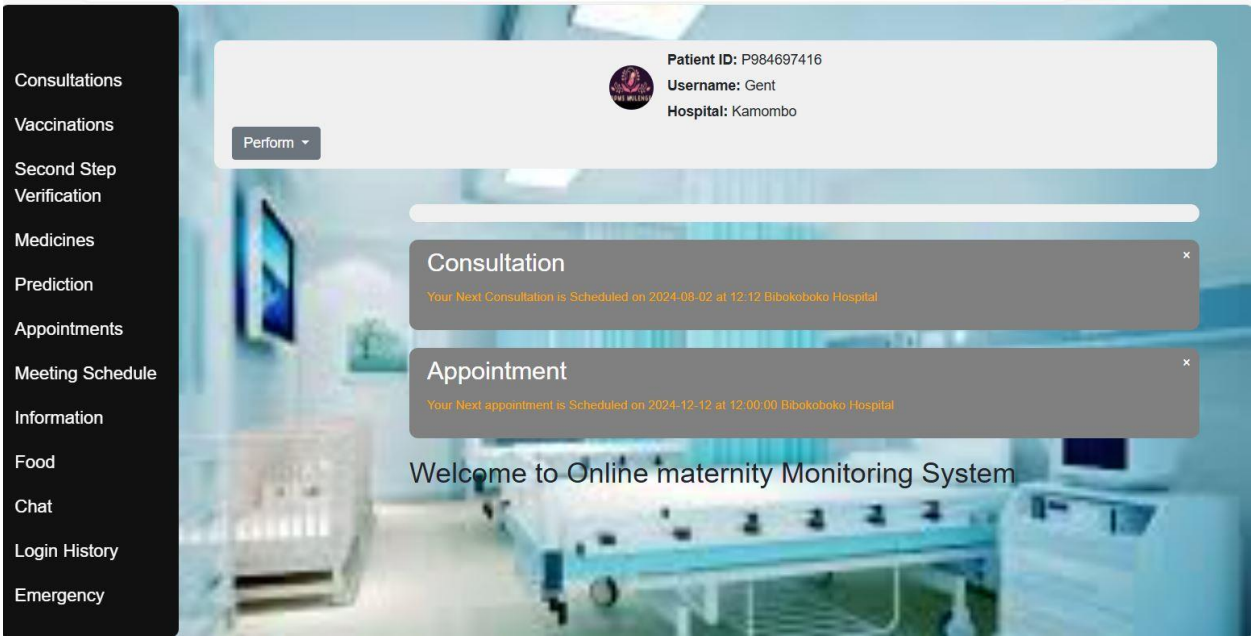
Patient Verification Code **Figure 11**

the Patient must enter the verification code before accessing their dashboard.



Patient dashboard **Figure 12**

This is the dashboard of the patient where he can access their Services.

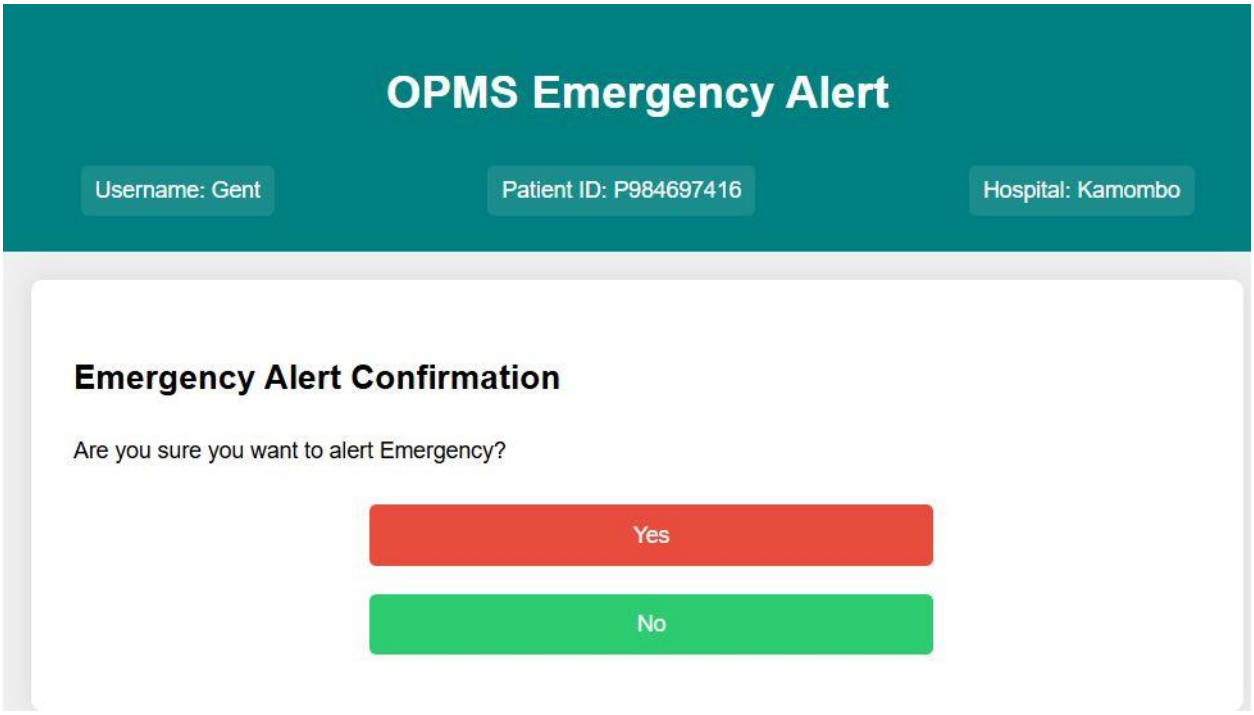


Second Step Verification **Figure 13**

This is to authenticate the credibility of the system

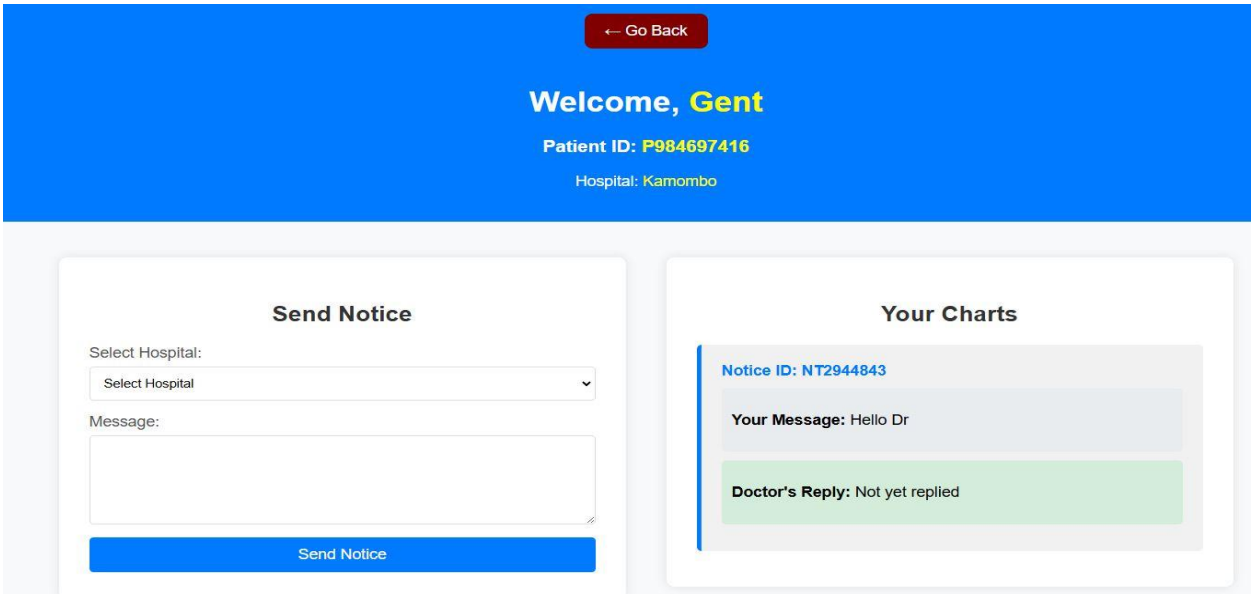
Alert Emergency **Figure 14**

This is where the patient can alert an emergency to the doctor for any quick response.



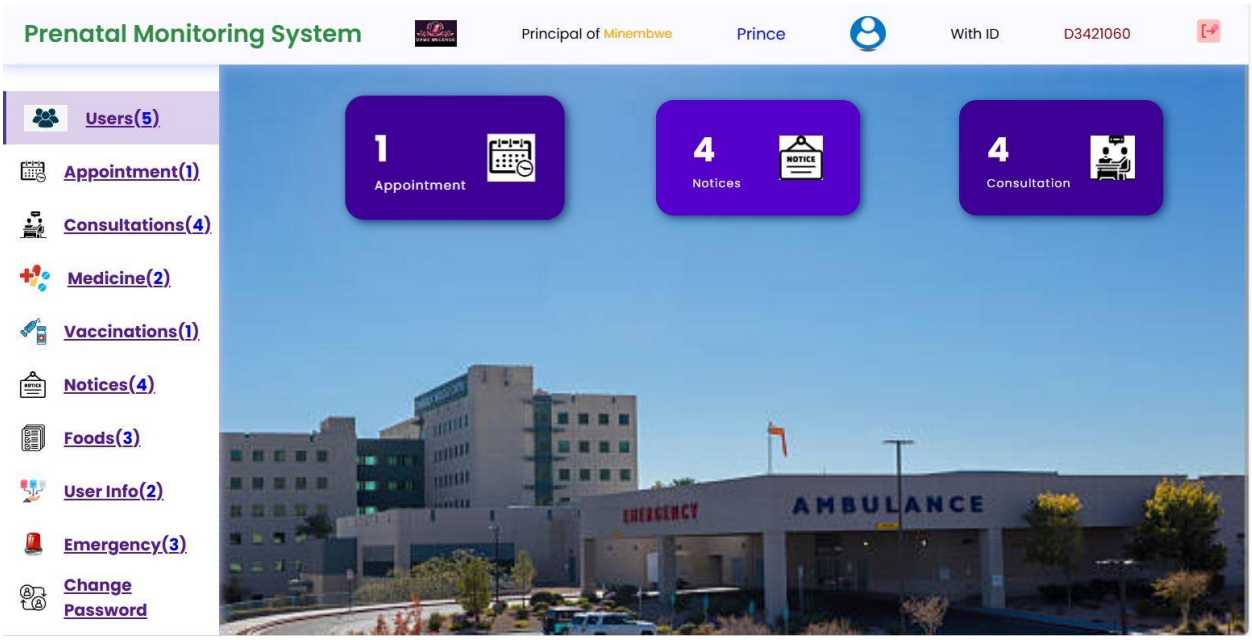
Communications Chart **Figure 15**

This is the where the doctor and the patient can communicate with each other.



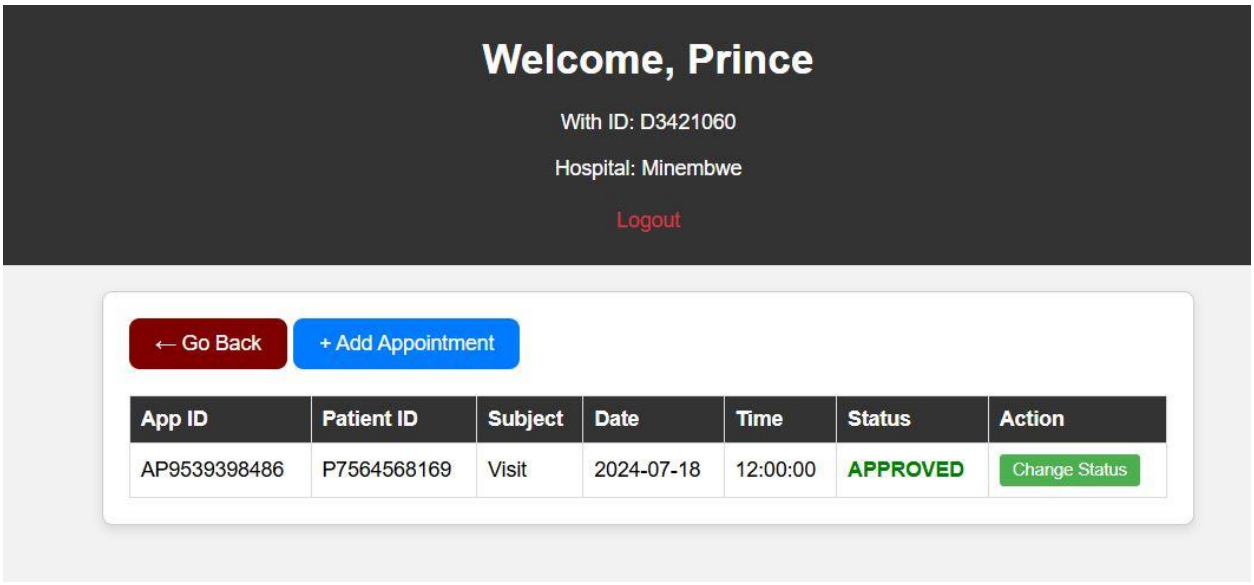
Doctor Dashboard **Figure 16**

This is where the doctor can provide the services and perform his duties.



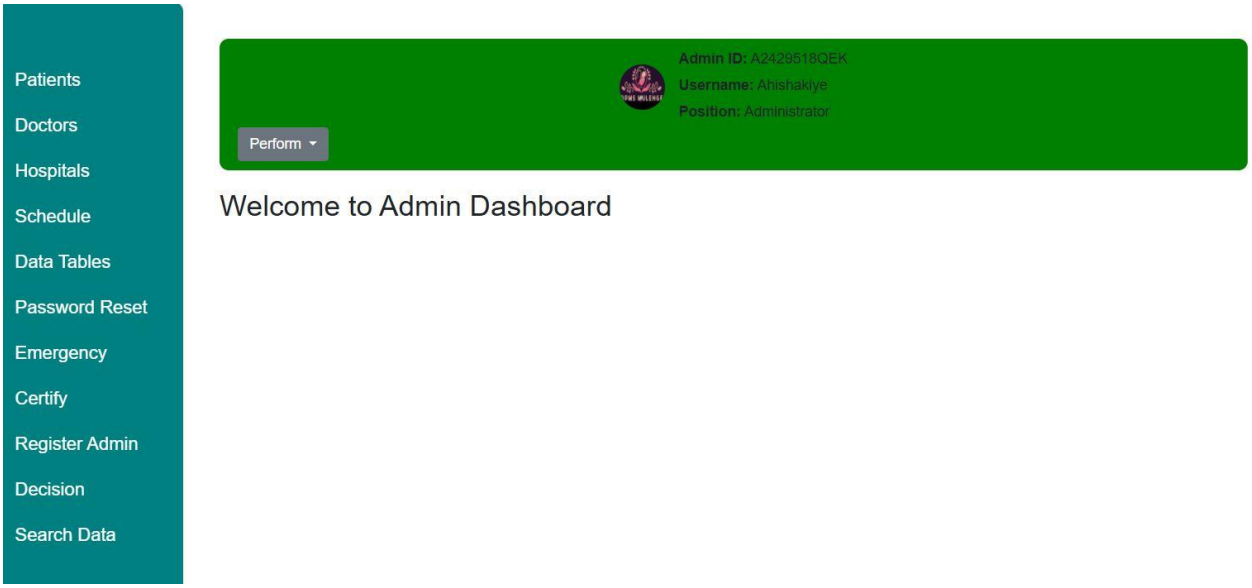
Doctor Manage Appointments **Figure 17**

This is where the doctor manages the appointments and approve thems.



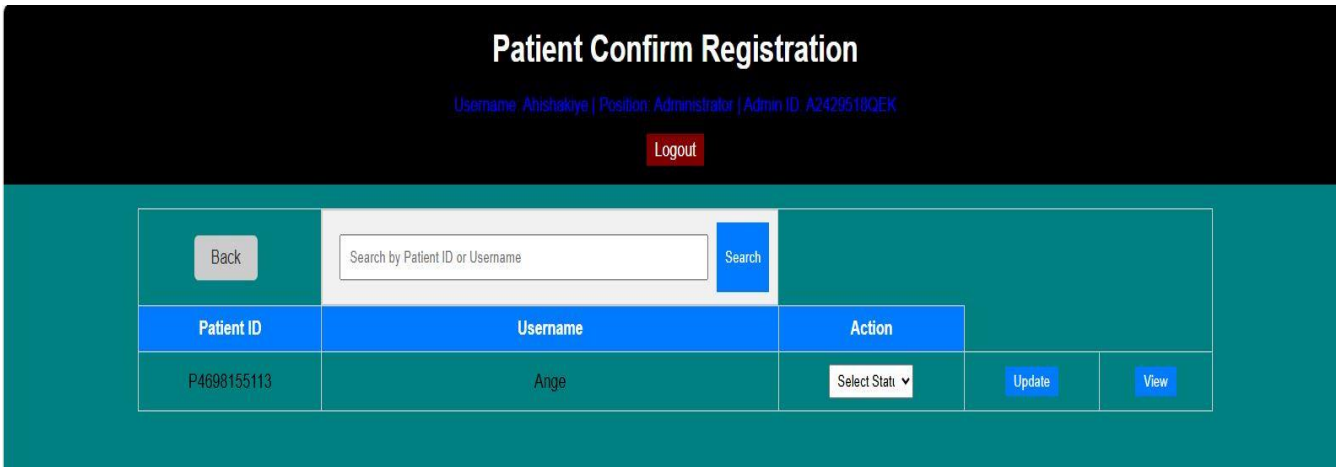
Admin Dashboard **Figure** 18

This is where the admin can access and perform his duties to manage the system.



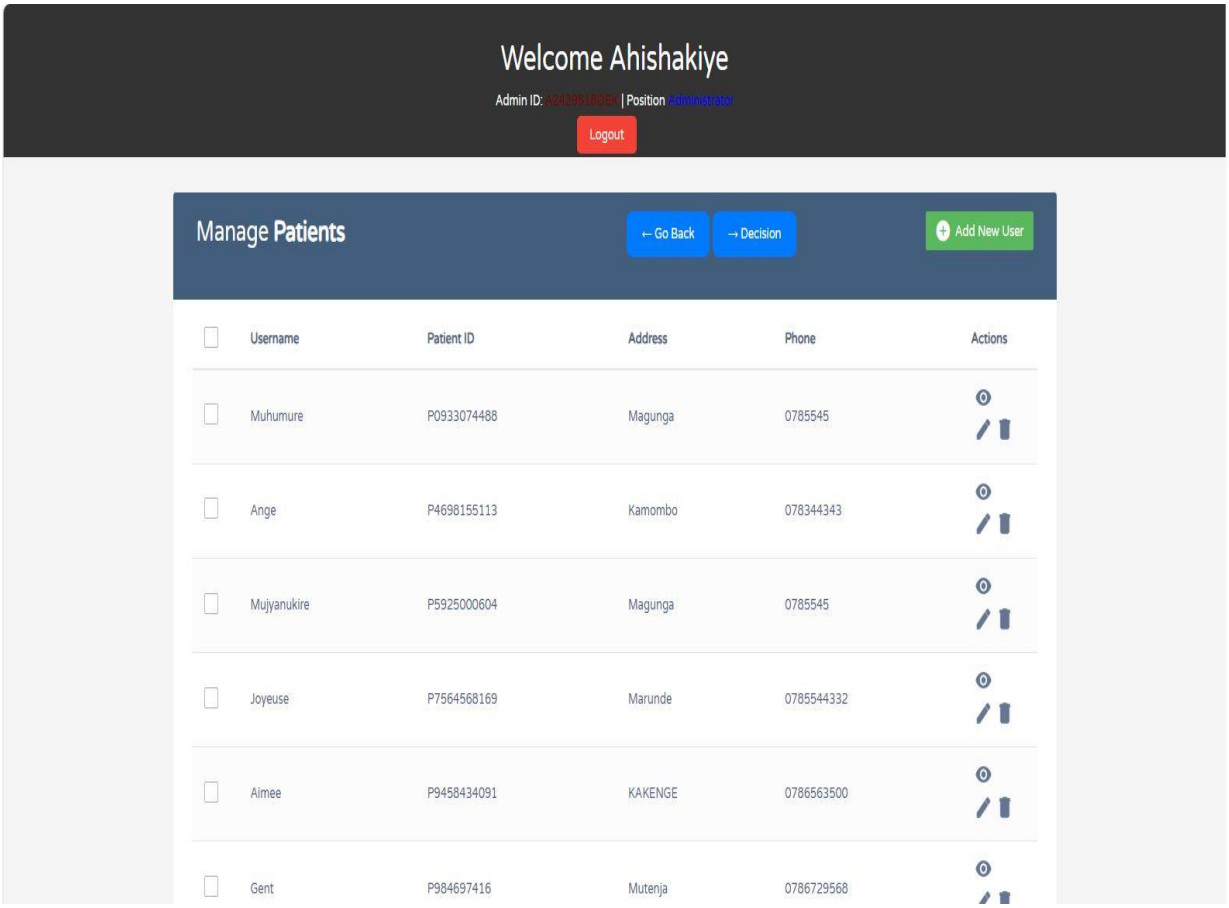
Administrator Managing Registration **Figure** 19

This is where the admin confirm the registration request for the patient .



Admin Patients **Figure** 20

This is where the admin can manage the patient and take necessary action.



Emergency **Figure** 21

This is where the emergencies are managed by the system administration.

4.1.3.2. SOURCE CODES

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Online Prenatal Monitoring System</title>
    <style>
        @import url('https://fonts.googleapis.com/css2?family=Poppins:wght@300;400;600;700&display=swap');

        * {
            margin: 0;
            padding: 0;
            box-sizing: border-box;
            font-family: 'Poppins', sans-serif;
        }

        body {
            background-color: #f0f8ff;
            color: #333;
            line-height: 1.6;
            display: flex;
            flex-direction: column;
            min-height: 100vh;
        }

        .top-banner {
            background: linear-gradient(135deg, #4a90e2, #5ca1e1);
            color: white;
            text-align: center;
            padding: 1rem;
            font-size: 2rem;
            font-weight: 600;
            text-shadow: 2px 2px 4px rgba(0,0,0,0.1);
        }

        header {
            background-color: #ffffff;
            box-shadow: 0 4px 6px rgba(0,0,0,0.1);
            position: sticky;
            top: 0;
            z-index: 1000;
        }

        .header-container {
            max-width: 1200px;
            margin: 0 auto;
            display: flex;
            justify-content: space-between;
            align-items: center;
            padding: 1rem 2rem;
        }

        nav ul {
            list-style-type: none;
            display: flex;
        }
```

```
    <main>
        <h1>Welcome to Our Prenatal Care System</h1>
        <div class="login-options">
            <div class="login-option">
                <h2>Patient Login</h2>
                <a href="users/userlogin/login.php" class="btn">Login as Patient</a>
            </div>
            <div class="login-option">
                <h2>Doctor Login</h2>
                <a href="doctor/login.php" class="btn">Login as Doctor</a>
            </div>
            <div class="login-option">
                <h2>Admin Login</h2>
                <a href="administration/login.php" class="btn">Login as Admin</a>
            </div>
        </div>
        <div class="register-container">
            <a href="users/userlogin/registration.php" class="btn register-btn">Register Now</a>
        </div>
    </main>

    <footer>
        <div class="footer-content">
            <div class="copyright">© 2024 OPMS MULENGE. All rights reserved.</div>
            <div class="footer-logo">OPMS</div>
        </div>
    </footer>
</body>
</html>
```

```
                    <button type="submit" name="verify_identity" class="btn">Verify Identity</button>
                </form>
            <?php elseif (!isset($_SESSION['password_verified'])): ?>
                <form method="POST">
                    <div class="form-group">
                        <label for="password">Enter Password:</label>
                        <input type="password" id="password" name="password" required>
                    </div>
                    <button type="submit" name="verify_password" class="btn">Verify Password</button>
                </form>
            <?php else: ?>
                <form method="POST">
                    <div class="form-group">
                        <label>Enter Verification Code:</label>
                        <div class="code-input">
                            <?php for ($i = 1; $i <= 8; $i++): ?>
                                <input type="text" name="code[]" maxlength="1" required>
                            <?php endfor; ?>
                        </div>
                    </div>
                    <button type="submit" name="verify_code" class="btn">Verify Code</button>
                </form>
            <?php endif; ?>
        <?php endif; ?>
    </div>
</div>

<script>
    // JavaScript to auto-focus next input in verification code
    const codeInputs = document.querySelectorAll('.code-input input');
    codeInputs.forEach((input, index) => {
        input.addEventListener('input', (e) => {
            if (e.target.value && index < codeInputs.length - 1) {
                codeInputs[index + 1].focus();
            }
        });
        input.addEventListener('keydown', (e) => {
            if (e.key === 'Backspace' && !e.target.value && index > 0) {
                codeInputs[index - 1].focus();
            }
        });
    });
</script>
</body>
</html>
```

```php
<?php
session_start();
include 'db_connection.php';
use PHPMailer\PHPMailer\PHPMailer;
use PHPMailer\PHPMailer\Exception;

require 'PHPMailer/Exception.php';
require 'PHPMailer/PHPMailer.php';
require 'PHPMailer/SMTP.php';

if (!isset($_SESSION['patientid'])) {
    header("Location: login.php");
    exit();
}

$patientid = $_SESSION['patientid'];

$stmt = $conn->prepare("SELECT username, patientid, hospital_name, address FROM users WHERE patientid = ?");
$stmt->bind_param("s", $patientid);
$stmt->execute();
$result = $stmt->get_result();
$user = $result->fetch_assoc();

function sendEmergencyEmails($conn, $emID, $patientid, $hospital_name, $username) {
    $stmt = $conn->prepare("SELECT phone, husband_phone, address FROM users WHERE patientid = ?");
    $stmt->bind_param("s", $patientid);
    $stmt->execute();
    $result = $stmt->get_result();
    $userData = $result->fetch_assoc();

    $doctorEmails = [];
    $adminEmails = [];

    $result = $conn->query("SELECT email FROM doctors");
    while ($row = $result->fetch_assoc()) {
        $doctorEmails[] = $row['email'];
    }

    $result = $conn->query("SELECT email FROM administration");
    while ($row = $result->fetch_assoc()) {
        $adminEmails[] = $row['email'];
    }

    $allEmails = array_merge($doctorEmails, $adminEmails);

    $mail = new PHPMailer(true);

    try {
        $mail->isSMTP();
        $mail->Host       = 'smtp.gmail.com';
        $mail->SMTPAuth   = true;
        $mail->Username   = 'muhgroup73@gmail.com';
        $mail->Password   = 'tfdqlscxohzoskzw';
        $mail->SMTPSecure = PHPMailer::ENCRYPTION_STARTTLS;
        $mail->Port       = 587;

        $mail->setFrom('muhgroup73@gmail.com', 'OPMS Emergency Alert');

        foreach ($allEmails as $email) {
            $mail->addAddress($email);
        }

        $mail->isHTML(true);
        $mail->Subject = 'URGENT: Emergency Alert - OPMS';
        $mail->Body    = "
            <!DOCTYPE html>
            <html lang='en'>
            <head>
                <meta charset='UTF-8'>
```

```
        } else {
            header("Location: userlogin/patient_dashboard.php");
            exit();
        }
    } elseif (isset($_POST['verify_password'])) {
        $password = $_POST['password'];

        $stmt = $conn->prepare("SELECT * FROM users WHERE patientid = ? AND password = ?");
        $stmt->bind_param("ss", $patientid, $password);
        $stmt->execute();
        $result = $stmt->get_result();

        if ($result->num_rows > 0) {
            $emID = date('YmdHis') . str_pad(rand(0, 99999), 5, '0', STR_PAD_LEFT);
            $currentDateTime = date('Y-m-d H:i:s');

            $stmt = $conn->prepare("INSERT INTO emergencies (patientid, hospital_name, username, emID, date) VALUES (?, ?, ?, ?, ?)");
            $stmt->bind_param("sssss", $patientid, $user['hospital_name'], $user['username'], $emID, $currentDateTime);

            if ($stmt->execute() && sendEmergencyEmails($conn, $emID, $patientid, $user['hospital_name'], $user['username'])) {
                $message = "<div class='message-box success'>
                                <p>Emergency alert sent successfully! Please wait whil our health providers are coming</p>
                                <div class='emid-container'>
                                    <div class='emid-label'>Emergency ID:</div>
                                    <div class='emid-box'>$emID</div>
                                </div>
                                <p class='address'>Address: {$user['address']}</p>
                                <p class='emergency-note'>For other needs, call OPMS <span class='emergency-number'>0781057525</span></p>
                            </div>";
            } else {
                $message = "<div class='message-box error'>Failed to send emergency alert. Please try again or contact support.</div>";
            }
            $_SESSION['password_attempts'] = 0;
        } else {
            $password_attempts++;
            $_SESSION['password_attempts'] = $password_attempts;
            if ($password_attempts >= 2) {
                $_SESSION['password_attempts'] = 0;
                header("Refresh:0");
                exit();
            } else {
                $message = "<div class='message-box error'>
                                <p>Wrong Password. Please try again. Attempts left: " . (2 - $password_attempts) . "</p>
                                <form method='post'>
                                    <label for='password'>Please enter your password to confirm:</label>
                                    <input type='password' name='password' required>
                                    <button type='submit' name='verify_password'>Verify</button>
                                </form>
                            </div>";
            }
        }
    }
}
?>

<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Emergency Alert - OPMS</title>
    <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/5.15.3/css/all.min.css">
    <style>
```

```php
<?php
include 'db_connection.php';

session_start();

if (!isset($_SESSION['doctorid'])) {
    echo '<script>alert("Please login first."); window.location = "login.php";</script>';
    exit();
}

$doctorid = $_SESSION['doctorid'];

// Fetch username, hospital, and image path from the users table
$query = "SELECT username, hospital_name FROM doctors WHERE doctorid = ?";
$stmt = mysqli_prepare($conn, $query);
mysqli_stmt_bind_param($stmt, "s", $doctorid);
mysqli_stmt_execute($stmt);
$result = mysqli_stmt_get_result($stmt);

if ($result) {
    $row = mysqli_fetch_assoc($result);

    // Check if the doctor exists
    if ($row) {
        $username = $row['username'];
        $hospital = $row['hospital_name'];

        // Fetch counts from respective tables based on doctor ID
        $user_count_query = "SELECT COUNT(*) AS user_count FROM users";
        $notice_count_query = "SELECT COUNT(*) AS notice_count FROM notices WHERE hospital_name = ?";
        $appointment_count_query = "SELECT COUNT(*) AS appointment_count FROM appointments WHERE hospital_name = ?";
        $consultations_count_query = "SELECT COUNT(*) AS consultations_count FROM consultations WHERE hospital_name = ?";
        $emergency_count_query = "SELECT COUNT(*) AS emergency_count FROM emergencies";
        $validation_count_query = "SELECT COUNT(*) AS validation_count FROM user_info";
        $food_count_query = "SELECT COUNT(*) AS food_count FROM foods";
        $medicine_count_query = "SELECT COUNT(*) AS medicine_count FROM medicines";
        $vaccinations_count_query = "SELECT COUNT(*) AS vaccinations_count FROM vaccinations WHERE hospital_name = ?";

        // Prepare and execute queries
        $stmt = mysqli_prepare($conn, $user_count_query);
        mysqli_stmt_execute($stmt);
        $user_count_result = mysqli_stmt_get_result($stmt);

        $stmt = mysqli_prepare($conn, $notice_count_query);
        mysqli_stmt_bind_param($stmt, "s", $hospital);
        mysqli_stmt_execute($stmt);
        $notice_count_result = mysqli_stmt_get_result($stmt);

        $stmt = mysqli_prepare($conn, $appointment_count_query);
        mysqli_stmt_bind_param($stmt, "s", $hospital);
        mysqli_stmt_execute($stmt);
        $appointment_count_result = mysqli_stmt_get_result($stmt);

        $stmt = mysqli_prepare($conn, $consultations_count_query);
        mysqli_stmt_bind_param($stmt, "s", $hospital);
        mysqli_stmt_execute($stmt);
        $consultations_count_result = mysqli_stmt_get_result($stmt);

        $stmt = mysqli_prepare($conn, $emergency_count_query);
        mysqli_stmt_execute($stmt);
        $emergency_count_result = mysqli_stmt_get_result($stmt);

        $stmt = mysqli_prepare($conn, $validation_count_query);
        mysqli_stmt_execute($stmt);
        $validation_count_result = mysqli_stmt_get_result($stmt);

        $stmt = mysqli_prepare($conn, $food_count_query);
        mysqli_stmt_execute($stmt);
        $food_count_result = mysqli_stmt_get_result($stmt);
```

```
        $stmt = mysqli_prepare($conn, $medicine_count_query);
        mysqli_stmt_execute($stmt);
        $medicine_count_result = mysqli_stmt_get_result($stmt);

        $stmt = mysqli_prepare($conn, $vaccinations_count_query);
        mysqli_stmt_bind_param($stmt, "s", $hospital);
        mysqli_stmt_execute($stmt);
        $vaccinations_count_result = mysqli_stmt_get_result($stmt);

        // Fetch counts from query results
        $user_count = mysqli_fetch_assoc($user_count_result)['user_count'];
        $notice_count = mysqli_fetch_assoc($notice_count_result)['notice_count'];
        $appointment_count = mysqli_fetch_assoc($appointment_count_result)['appointment_count'];
        $consultations_count = mysqli_fetch_assoc($consultations_count_result)['consultations_count'];
        $emergency_count = mysqli_fetch_assoc($emergency_count_result)['emergency_count'];
        $validation_count = mysqli_fetch_assoc($validation_count_result)['validation_count'];
        $food_count = mysqli_fetch_assoc($food_count_result)['food_count'];
        $medicine_count = mysqli_fetch_assoc($medicine_count_result)['medicine_count'];
        $vaccinations_count = mysqli_fetch_assoc($vaccinations_count_result)['vaccinations_count'];

    } else {
        // Handle the case where the doctor does not exist
        echo '<script>alert("Doctor not found in the database.");</script>';
        exit();
    }
} else {
    // Handle database query error
    echo '<script>alert("Database error.");</script>';
    exit();
}
?>
<!DOCTYPE html>
<html lang="en">

<head>
    <meta charset="UTF-8">
    <meta http-equiv="X-UA-Compatible" content="IE=edge">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Prenatal Monitoring System</title>
    <link rel="stylesheet" href="style.css">
    <link rel="stylesheet" href="responsive.css">
</head>

<body>
    <!-- for header part -->
    <header>
        <div class="logosec">
            <div class="logo">Prenatal Monitoring System</div>
            <img src="images/mul.jpg" class="icn menuicn" id="menuicn" alt="menu-icon">
        </div>

        <div class="searchbar">
            <span>Principal of</span>   <span style="color: orange; font-size: 14px;"><?php echo $hospital; ?></span>
        </div>
        <span style="color: blue; font-size: 18px;"><?php echo $username; ?></span>
        <div class="dp">
            <a href="doctor_profile.php">
                <img src="images/userh.png" class="dpicn" alt="dp">
            </a>
        </div>
        <span>With ID</span><span style="color: maroon; font-size: 16px;"><?php echo $doctorid; ?></span>
        <div class="message">
            <div class="circle"></div>
            <a href="logout.php">
                <img src="images/logout.png" class="icn" alt="bell">
            </a>
        </div>
```

```
            <label for="message">Message:</label>
            <textarea name="message" required></textarea>
            <label for="hospital_name">Hospital Name:</label>
            <select name="hospital_name" required>
                <?php foreach ($hospitals as $hospital): ?>
                    <option value="<?php echo $hospital; ?>"><?php echo $hospital; ?></option>
                <?php endforeach; ?>
            </select>
            <button type="submit" class="save-btn" name="save">Save</button>
        </form>
    </div>

    <?php if (empty($appointments)): ?>
        <div class="no-appointments">
            <p style="background-color: #ccc; color: red; padding: 10px; border: 1px solid #999; border-radius: 5px;">
                No Requested Appointment
            </p>
        </div>
    <?php else: ?>
        <table>
            <tr>
                <th>App ID</th>
                <th>Patient ID</th>
                <th>Subject</th>
                <th>Date</th>
                <th>Time</th>
                <th>Status</th>
                <th>Action</th>
            </tr>
            <?php foreach ($appointments as $appointment): ?>
            <tr <?php echo ($appointment['status'] === 'Denied') ? 'class="denied"' : ''; ?>>
                <td><?php echo $appointment['appid']; ?></td>
                <td><?php echo $appointment['patientid']; ?></td>
                <td><?php echo $appointment['subject']; ?></td>
                <td><?php echo $appointment['date']; ?></td>
                <td><?php echo $appointment['time']; ?></td>
                <td class="status-cell status-<?php echo $appointment['status']; ?>"><?php echo $appointment['status']; ?></td>
                <td>
                    <form method="post" onsubmit="showLoading()">
                        <input type="hidden" name="appid" value="<?php echo $appointment['appid']; ?>">
                        <?php if (empty($appointment['status'])): ?>
                            <select name="action">
                                <option value="" disabled selected>Select status</option>
                                <option value="Approved">Approved</option>
                                <option value="Denied">Absent</option>
                            </select>
                            <input type="submit" class="update-btn" name="update" value="Update">
                        <?php else: ?>
                            <button type="submit" class="change-btn" data-status="<?php echo $appointment['status']; ?>" name="change">
                                Change Status
                            </button>
                        <?php endif; ?>
                    </form>
                </td>
            </tr>
            <?php endforeach; ?>
        </table>
    <?php endif; ?>
</div>

</body>
</html>
```

```php
    exit();
}

// Fetch user data from the database
include '../db_connection.php';

$adminid = $_SESSION['adminid'];

$query = "SELECT username, position FROM administration WHERE adminid = '$adminid'";
$result = mysqli_query($conn, $query);

if ($row = mysqli_fetch_assoc($result)) {
    $username = $row['username'];
    $position = $row['position'];
} else {
    // Handle the case when the user's data is not found in the database
    $username = 'Unknown';
    $position = 'Unknown';
}

// Fetch student data with empty or null status from the studonts table
$query = "SELECT patientid, username FROM users WHERE status IS NULL OR status = ''";
$result = mysqli_query($conn, $query);
?>

<header>
    <h1>Doctor Confirm Registration</h1>
    <div class="user-info">
        <span>Username: <?php echo $username; ?></span> |
        <span>Position: <?php echo $position; ?></span> |
        <span>Admin ID: <?php echo $adminid; ?></span>
    </div>
    <a class="logout-btn" href="logout.php">Logout</a>
</header>

<?php
if (mysqli_num_rows($result) == 0) {
    echo "<div class='message-box'>No Patient Found</div>";
} else {
?>
<table>
    <tr>
        <td>
            <a href="users.php" class="back-button">Back</a>
        </td>
        <td colspan="2" class="search-container">
            <input class="search-field" type="text" id="searchInput" placeholder="Search by Patient ID or Username">
            <button class="search-btn" onclick="filterTable()">Search</button>
        </td>
    </tr>
    <tr>
        <th>Patient ID</th>
        <th>Username</th>
        <th>Action</th>
    </tr>
    <?php
    while ($row = mysqli_fetch_assoc($result)) {
        echo "<tr>";
        echo "<td>{$row['patientid']}</td>";
        echo "<td>{$row['username']}</td>";
        echo "<td>";
        echo "<select class='status-select' name='status' required>";
        echo " <option value='' disabled selected>Select Status</option>";
        echo "<option value='Approved'>Approved</option>";
        echo "<option value='Denied'>Denied</option>";
        echo "</select>";
        echo "</td>";
```

4.2. Testing

4.2.1. Introduction

The testing phase for the Online Prenatal Monitoring System was designed to ensure the platform's reliability, security, and effectiveness in supporting expectant mothers throughout their pregnancy. Our comprehensive testing strategy covered all aspects of the system, including functional testing of all modules (patient management, consultations, vaccinations, food and medication tracking, appointment scheduling, and emergency alerts), database testing, user interface evaluation, integration testing, and security assessments. We also conducted performance testing, compatibility checks, and user acceptance testing to guarantee a robust and user-friendly experience.

Our testing process employed both manual and automated techniques, utilizing industry-standard tools and methodologies. The primary goal was to identify and resolve any issues before the system went live, ensuring that the Online Prenatal Monitoring System provided dependable support for expectant mothers and healthcare providers. By thoroughly testing each component and their interactions, we aimed to deliver a secure, efficient, and intuitive platform that enhanced the prenatal care experience.

4.2.1. Units testing Outputs

Unit testing is a critical phase in the development of the Online Prenatal Monitoring System, ensuring each module functions as intended. The outputs of unit testing include verification of individual components such as patient management, consultations, and vaccination tracking. This process identifies and resolves issues within specific modules, confirming that each part performs correctly in isolation. The results of unit testing provide detailed insights into the performance of individual functionalities, ensuring that each module meets its design specifications and operates reliably before integration into the system.

Registration

Minimum required Age is 14 years old

Username:
Joyeuse

Name:
Muhumure

Phone:
0785545

Husband Name:
Muhumure

Husband's Phone:
0785545

Email:
muhadn@gmail.com

Birth Date:
08/21/2024

Address:
Magunga

Hospital:
Mikenge

National ID:
Choose File database.JPG

Civil status:
Married

Hospital ID:
H063319

National ID No:
5465

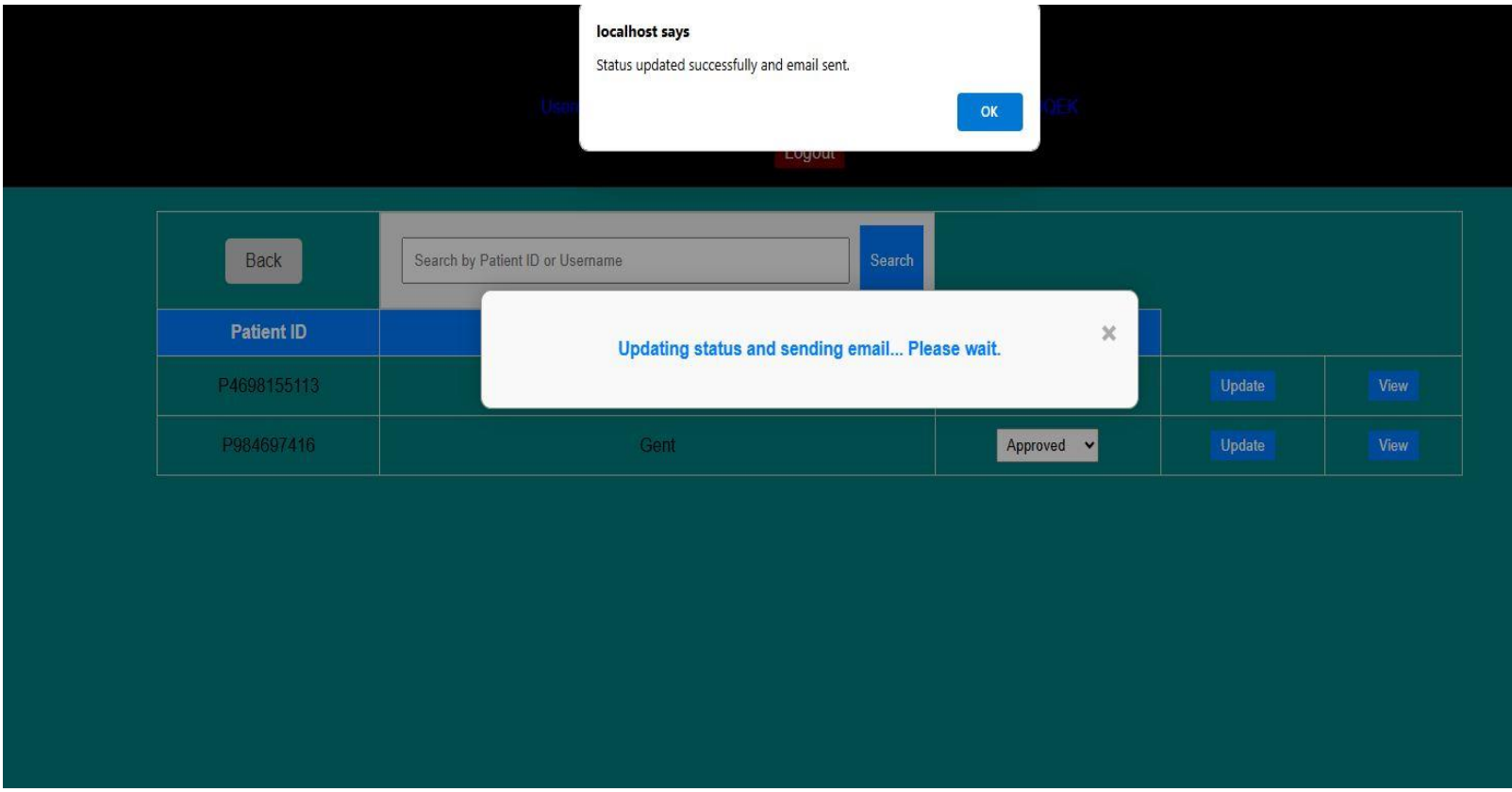
Patient Image:
Choose File database.JPG

Password:
••••

I have read and agree to the Policy and conditions

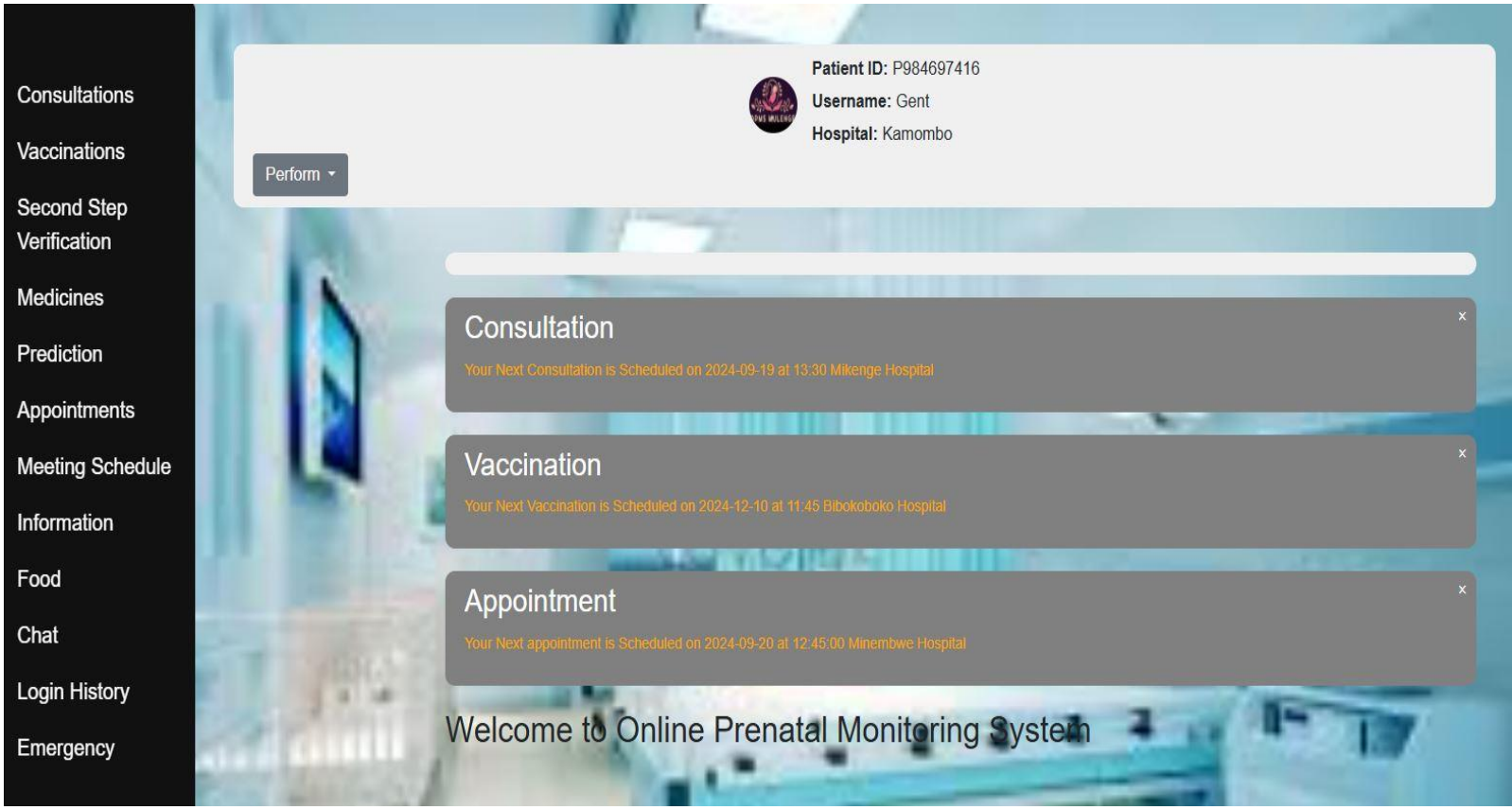
4.2.2. Validation Testing outputs

Validation testing is essential for ensuring that the Online Prenatal Monitoring System meets the specified requirements and performs as expected in real-world scenarios. The outputs of validation testing include comprehensive reports detailing the system's adherence to functional and non-functional requirements, such as usability, performance, and security. These reports highlight any discrepancies or defects discovered during testing, providing actionable insights for addressing these issues. Additionally, validation testing outputs confirm that the system accurately supports workflows like patient management, consultations, vaccination tracking, and emergency alerts, ensuring that the system is ready for deployment and capable of delivering reliable and effective prenatal care.



4.2.3. Integration testing outputs

Integration testing is vital for ensuring that the various modules of the Online Prenatal Monitoring System work seamlessly together. The outputs of integration testing include detailed reports on the interactions between modules such as patient management, consultations, vaccination tracking, appointment scheduling, and emergency alerts. These reports identify any issues arising from module interactions, such as data flow errors or interface mismatches, and provide specific information for resolving these issues. Successful integration testing confirms that all modules function together as intended, ensuring that the system operates smoothly as a cohesive whole and supports the end-to-end workflows essential for effective prenatal care.

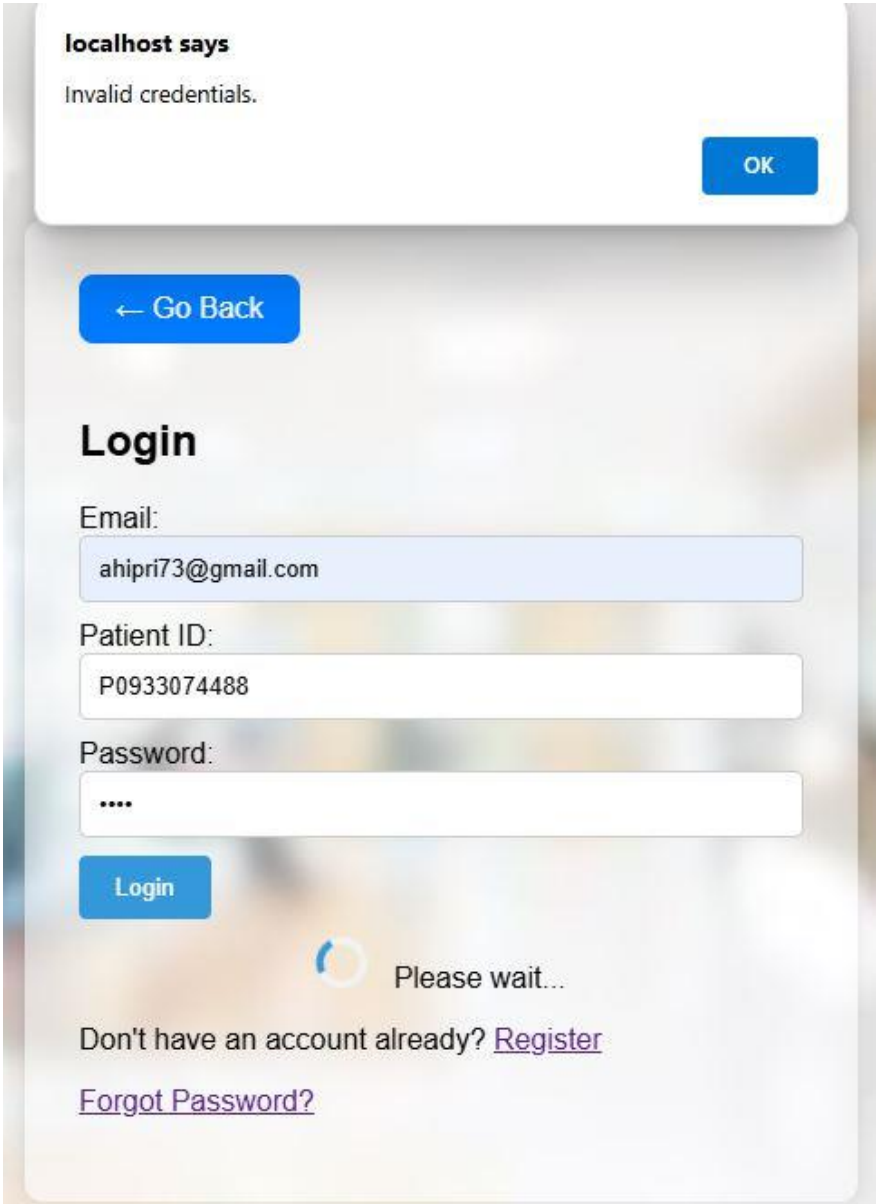


4.2.4. Functional and System Testing

Functional and system testing are crucial steps in ensuring the Online Prenatal Monitoring System operates effectively and meets all specified requirements.

- Functional Testing Outputs

Functional testing focuses on verifying that each feature of the system works according to the defined specifications. The outputs include detailed test case reports that assess functionalities like patient management, consultations, vaccination tracking, appointment scheduling, and emergency alerts. These reports document the success or failure of each test case, highlight any defects or deviations from expected behavior, and provide a basis for correcting issues. Successful functional testing confirms that each feature performs its intended function correctly and reliably.



System Testing Outputs

System testing evaluates the entire system's performance as a whole. The outputs of system testing include comprehensive reports that assess the system's overall functionality, performance, security, and user experience. These reports document the results of end-to-end testing scenarios, ensuring that all modules and features work together seamlessly. They also identify any system-wide issues or bottlenecks that need addressing. Successful system testing validates that the Online Prenatal Monitoring System is ready for deployment, providing a robust, secure, and user-friendly platform for expectant mothers and healthcare providers.

4.2.6. Acceptance Testing report

Acceptance testing was conducted for the Online Prenatal Monitoring System to ensure it meets end-user requirements and is ready for deployment. The testing involved healthcare professionals and expectant mothers using the system in a simulated real-world environment. The results showed that all major functionalities, including patient management, consultations, vaccination tracking, appointment scheduling, emergency alerts, food and medication tracking, and predictive analytics, worked as expected. Users found the system intuitive and responsive, with minor issues quickly resolved and suggestions for future enhancements noted. The system is deemed ready for deployment, with positive feedback on its usability and performance.

CONCLUSION

The implementation of an online prenatal monitoring system in MULENGE, DRC has demonstrated significant improvements in data accessibility and management within the healthcare sector. By transitioning from a paper-based system to a centralized digital database, healthcare providers have gained access to more comprehensive and accurate patient information, reducing the risk of lost or misplaced records. This shift has enabled more personalized and timely treatments, as providers can now readily access essential information about pre-existing conditions and allergies. The digital system has also addressed the challenge of incomplete records, thereby enhancing the overall quality of care provided to pregnant women.

The introduction of an online appointment scheduling system has shown a marked positive impact on patient wait times and queue management. This technological solution has effectively reduced overcrowding in healthcare facilities and minimized the frustration experienced by pregnant women seeking prenatal care. By allowing patients to schedule appointments remotely, the system has improved accessibility, particularly for those in remote or underserved areas. Furthermore, the integration of reminder systems has significantly decreased the number of missed vaccinations and appointments due to forgetfulness, ensuring more consistent prenatal care.

The online prenatal monitoring system has greatly enhanced patient-provider communication and emergency response capabilities. Through system integration, healthcare providers can now more efficiently share and access patient information, leading to improved coordination of care. This has resulted in more effective management of high-risk pregnancies and timely interventions when complications arise. Additionally, the implementation of technologies for detecting and alerting health providers to patient emergencies has proven crucial in improving maternal and fetal health outcomes. While concerns about the privacy and security of electronic health records persist, the benefits of the system in terms of improved access to care, reduced unnecessary hospital visits, and enhanced overall efficiency have been substantial.

RECOMMENDATIONS

The Researcher recommend Enhanced Telemedicine and AI Integration for Prenatal Monitoring

- Implement secure video conferencing for remote consultations
- Create a user-friendly mobile app for iOS and Android
- Integrate with pregnancy-related wearable devices
- Develop early warning systems for pregnancy complications
- Generate personalized care plans using AI
- Establish a continuous feedback and improvement system

In conclusion, these recommendations aim to revolutionize prenatal care in MULENGE, DRC by leveraging advanced technology. The integration of telemedicine capabilities, including video consultations and online check-ups, addresses the challenge of accessibility for remote patients. A comprehensive mobile application enhances patient engagement and facilitates easier access to prenatal care services. The implementation of AI-powered predictive models, coupled with data from wearable devices, enables early identification of high-risk pregnancies and potential complications. This technology-driven approach has the potential to significantly improve maternal and fetal health outcomes by providing timely, personalized care while overcoming geographical and resource constraints. However, success will depend on careful implementation, ongoing evaluation, and adaptation to the specific needs and challenges of the MULENGE healthcare system.

SUMMARY

In summary, the chapter highlights the transformative impact of implementing an online prenatal monitoring system to address the inefficiencies of traditional paper-based methods in MULENGE, DRC. Key points discussed include the improved data accessibility and management enabled by transitioning to a centralized digital database, which enhances the precision of care for pregnant women. The chapter also covers how an online appointment scheduling system reduces patient wait times and mitigates overcrowding in healthcare facilities. Additionally, it underscores the role of advanced technologies in improving patient-provider communication and ensuring timely emergency responses. The chapter concludes by recommending the adoption of such a system to enhance overall prenatal care delivery.

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