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Smart Hospital Management System

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Dedication

This heartfelt dedication is lovingly bestowed upon our parents, whose unwavering support and guidance have shaped us into the strong women we are today. We are grateful for our siblings, friends, and extended family for their constant presence and love. We also express profound appreciation for the invaluable role they have played in our lives.

In the remembrance of the soul of our late Grandfather Moussa Djelloul (may he rest in peace), we hold deep reverence and gratitude for his indelible influence on our lives. His wisdom and love continue to guide us in our endeavors.

A special mention is reserved for our dear friends Zineb Rabie, Meriem Brahmi, Zohra Dakhiya, and Chahra Bensliman, whose remarkable presence has brought immeasurable joy and support to our college lives. Through their unwavering friendship, our experiences have transcended the ordinary, creating memories that will forever hold a special place in our hearts. We are immensely grateful for their companionship and the invaluable moments we have shared together.

May kind words and blessings forever resonate in honor of our loved ones and dear friends, for they have enriched our lives in ways that words cannot adequately express.

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Abstract

In this dissertation, we introduce Mediquora, an innovative Smart Hospital Management System. Mediquora utilizes advanced technologies . The system encompasses a comprehensive range of features aimed at improving efficiency, patient care, and overall management.

Mediquora minimizes waiting times, reduces administrative burdens, and enhances the overall patient experience. The system integrates seamlessly with existing hospital infrastructure and electronic health records, ensuring smooth implementation and compatibility.

Furthermore, Mediquora incorporates real-time monitoring and analytics capabilities, enabling healthcare professionals to access critical patient data, track medical trends, and make informed decisions promptly. The system also facilitates secure communication and collaboration among medical staff, promoting seamless information sharing and interdisciplinary coordination.

The system empowers hospitals to optimize their resources effectively, reduce costs, and enhance overall performance.

Keywords: Smart Hospital Management System, Patient Care, Efficiency.

الملخص

في هذه المذكرة ، نقدم ميديكورا ، وهو نظام مبتكر لإدارة المستشفيات الذكية. تستخدم ميديكورا التقنيات المتقدمة. يشمل النظام مجموعة شاملة من الميزات التي تهدف إلى تحسين الكفاءة ورعاية المرضى والإدارة الشاملة

يقلل ميديكورا من أوقات الانتظار ويقلل من الأعباء الإدارية ويعزز تجربة المريض بشكل عام. يتكامل النظام بسلاسة مع البنية التحتية للمستشفيات الحالية والسجلات الصحية الإلكترونية، مما يضمن التنفيذ السلس و التوافق

علاوة على ذلك، تتضمن ميديكورا قدرات المراقبة والتحليلات في الوقت الفعلي، مما يمكّن المتخصصين في الرعاية الصحية من الوصول إلى بيانات المرضى الحرجة، وتتبع الاتجاهات الطبية، واتخاذ قرارات مستنيرة على الفور. وييسر النظام أيضا الاتصال والتعاون الآمنين فيما بين الموظفين الطبيين، ويعزز تبادل المعلومات السلس والتنسيق المتعدد التخصصات

يعمل النظام على تمكين المستشفيات من تحسين مواردها بشكل فعال، وخفض التكاليف، وتحسين الأداء العام

الكلمات الرئيسية: نظام إدارة المستشفيات الذكية، رعاية المرضى، الكفاءة

Résumé

Dans cette mémoire, nous présentons Mediquora, un système innovant de gestion hospitalière intelligente. Mediquora utilise des technologies avancées . Le système comprend une gamme complète de fonctionnalités visant à améliorer l'efficacité, les soins aux patients et la gestion globale.

Mediquora minimise les temps d'attente, réduit les fardeaux administratifs et améliore l'expérience globale des patients. Le système s'intègre parfaitement à l'infrastructure hospitalière existante et aux dossiers de santé électroniques, assurant une mise en œuvre et une compatibilité en douceur.

En outre, Mediquora intègre des capacités de surveillance et d'analyse en temps réel, permettant aux professionnels de la santé d'accéder aux données critiques des patients, de suivre les tendances médicales et de prendre rapidement des décisions éclairées. Le système facilite également la communication et la collaboration sécurisées entre le personnel médical, en favorisant un partage d'information transparent et une coordination interdisciplinaire.

Le système permet aux hôpitaux d'optimiser efficacement leurs ressources, de réduire leurs coûts et d'améliorer leur rendement global.

Mots-clés : Système Intelligent de Gestion Hospitalière, Soins aux Patients, Efficacité.

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Introduction

In the modern healthcare landscape, hospitals face numerous challenges in effectively managing their operations. These challenges include increasing patient demands, regulatory compliance, information management, resource optimization, and financial management. To address these challenges, hospitals are adopting Hospital Management Systems (HMS).

HMS leverages technology to streamline administrative processes, enhance communication, improve patient care, and optimize resource allocation. By implementing an efficient HMS, hospitals can enhance operational efficiency, improve patient experiences, and achieve sustainable growth in the healthcare industry.

Problem Statement:

The current hospital management system suffers from inefficiencies in appointment management, limited access to patient information, communication gaps among healthcare professionals, reliance on manual processes, and ineffective resource allocation.

This hampers patient care, increases errors, and leads to sub optimal resource utilization. A modern hospital management system aims to address these issues, streamline processes, improve information access and communication, and optimize resource allocation for more efficient healthcare delivery.

Objectives:

The objective of this dissertation is to develop a Smart Hospital Management System that addresses the challenges faced in traditional hospital management. The proposed solution consists of the following components:

Hospital Management Platform: Develop a web-based platform that serves as the central hub for managing hospital operations. This platform will provide functionalities such as appointment scheduling, patient registration, electronic health records management, and resource allocation.

Smart Hospital Mobile Application: Design and develop a user-friendly mobile app for doctors and patients. It enables secure access to healthcare information, appointment management, prescription services, and efficient communication. The app enhances healthcare access and streamlines information management in the Smart Hospital Management System.

This dissertation is organized into four chapters:

- Chapter 1: Internet of things We will discuss the concept of the internet objects, its operation, its architecture and its fields of application, etc.

- Chapter 2: Hospital Management System The second chapter introduces the concept of a smart Hospital management system and discusses the shortcomings of the traditional system. It also presents some related working in the field .

- Chapter 3: Design of the proposed solution This chapter provides a detailed overview of the proposed system and presents its functionalities from various perspectives.

- Chapter 4: Implementation of the system The fourth chapter presents the implementation of the system, starting with a description of the software tools .

Chapter 1

Internet of things

1.1 Introduction

The term IoT was first proposed by Kevin Ashton in 1999. which is considered a network of physical objects-devices, instruments, vehicles, buildings and other items embedded with electronics, circuits, software, sensors and network connectivity that enables these objects to collect and exchange data. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency and accuracy [1].

IoT is able to interact without human intervention. Some preliminary IoT applications have been already developed in the healthcare, transportation, and automotive industries. IoT technologies are at their infant stages; however, many new developments have occurred in the integration of objects with sensors on the Internet. The development of IoT involves many issues such as infrastructure, communications, interfaces, protocols, and standards[2].

So in this chapter, we will give a general concept of IoT, the architecture and layers of IoT, some basic terms associated with it and the services provided

1.2 Definition of Internet of things (IOT)

The Internet of Things is a novel paradigm shift in the IT arena. The phrase "Internet of Things" which is also shortly well-known as IoT is coined from two words i.e. the first word is "Internet" and the second word is "Things", Which is defined as an open and comprehensive network of intelligent objects that have the capacity to auto-organize, share information, data and resources, reacting and acting in face of situations and changes in the environment [3].(Figure1.1)

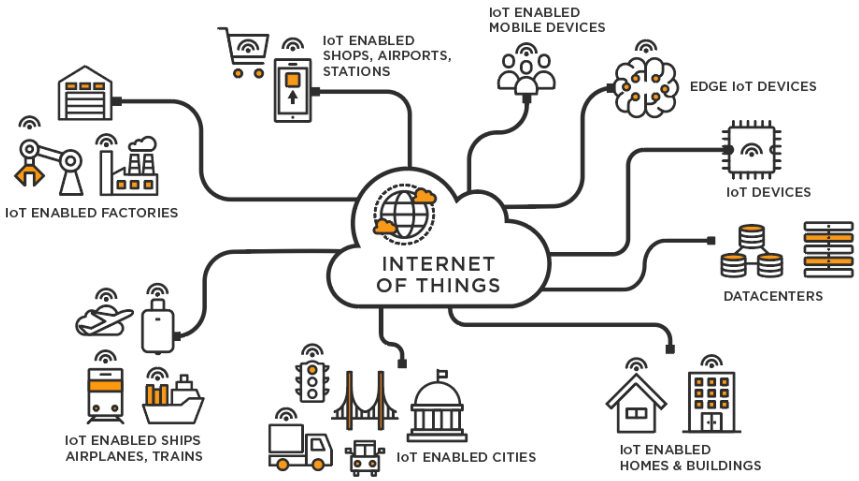

Figure 1.1 – Internet of things[4]

1.3 Characteristics of IoT

A wide range of appliances must be developed and implemented in order to attain a modernized smart grid. These appliances work in a predefined manner, and they are intelligent enough to understand and use the incoming power supply. They are grouped into following key technology areas as listed below [5]

-Interconnectivity : Anything can be linked to the global information and communications infrastructure in IoT.

-Things-related service: The Internet of Things is able to provide services related to things within the constraints of things, such as privacy protection and semantic consistency between physical and virtual objects associated with them.

-Heterogeneity : The devices in the IoT are heterogeneous based on different hardware platforms and networks.

-Dynamic changes : The state of devices changes dynamically,e.g, sleeping and waking up, connected and/or disconnected as well as the context of devices including location and speed.

-Enormous scale : The number of devices that need to be managed and that communicate with each other will be at least an order of magnitude larger than the devices connected to the current Internet.

-Connectivity : Connectivity enables network access compatibility. Accessibility is getting on a network while compatibility provides the common ability to consume and produce data.

1.4 IoT Architecture

The proposed architecture for IoT needs to address many factors like scalability, interoperability, reliability, QoS, etc. Since IoT connects everything and everyone to exchange information among themselves, the traffic and storage in the network will also increase exponentially way. Thus, IoT development depends on the technological progress and design of various new applications and business models.

Generally, the structure of IoT is divided into five layers [6]. (Figure 1.2)

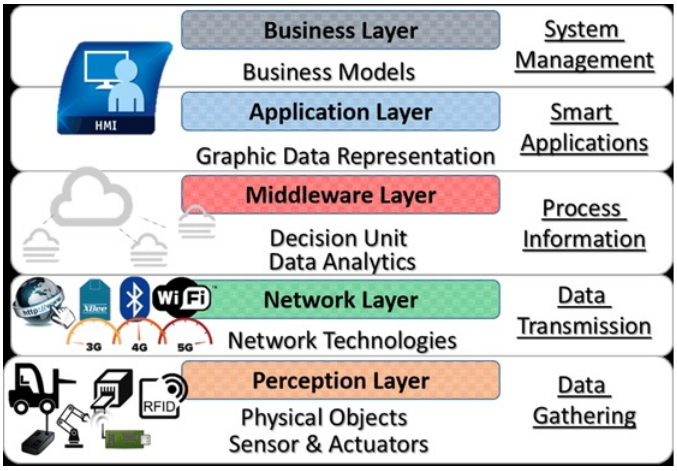

Figure 1.2 – iot layers[7]

1.4.1 Perception layer

It consists of the physical objects and sensor devices, The sensors can be RFID, 2D-barcode, or Infrared sensor depending on the object's identification method. This layer basically deals with the identification and collection of objects specific information by the sensor devices.

The collected information is then passed to the Network layer for its secure transmission to the information processing system.

1.4.2 Network layer

Network layer or transmission layer. This layer securely transfers the information from sensor devices to the information processing system.

The transmission medium can be wired or wireless and technology can be 3G, WIFI, Bluetooth, ZigBee, etc. Depending on sensors .

1.4.3 Middleware Layer

Each device connects and communicates with other devices that perform only the same type of service.

This class is responsible for service management and is relevant to the database. It receives information from the network's layer and stores it in the database. process information and calculation everywhere and make automatic decisions based on results .

1.4.4 Application Layer

Also known as the Business Logic Layer ,This layer provides global application management based on the object information processed in the Middleware layer, it includes components such as controllers, services, and models that handle tasks like user authentication, data processing, and enforcing business rules .

1.4.5 Business Layer

This layer is responsible for the management of overall IoT system including the applications and services. It builds business models, graphs, flowcharts etc. based on the data received from Application layer. The real success of the IoT technology also depends on the good business models. Based on the analysis of results, this layer will help to determine the future actions and business strategies .

1.5 IoT Applications domains

IoT (Internet of Things) applications span across various domains and industries. Here are some common IoT application domains:

1.5.1 Smart city domain:

A smart city uses Internet of Things (IoT) sensors to collect data and automate systems such as traffic, energy use, and waste management (Figure 1.3).

Figure 1.3 – Smart City [8]

1.5.2 Smart home domain

IoT devices in a residential setting to automate and enhance home functions, including smart lighting, security systems, thermostats, appliances, and entertainment systems (Figure 1.4).

Figure 1.4 – Smart home domain [9]

1.5.3 Agriculture domain

Use IoT technology in this domain to simplify its work, for example Drones for watering, sensors for monitoring crops (Figure 1.5).

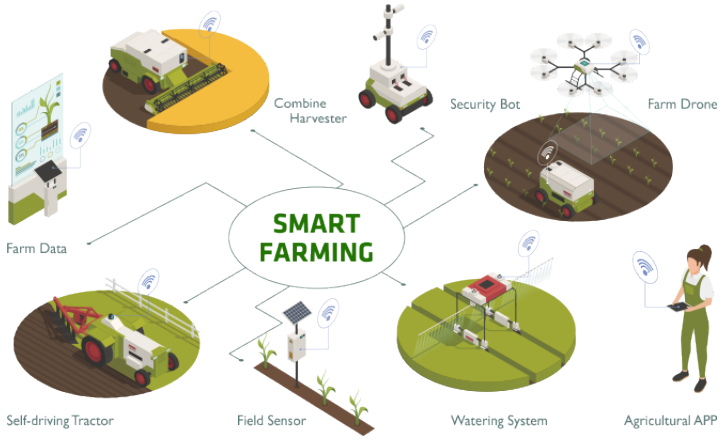

Figure 1.5 – Agriculture domain [10]

1.5.4 Health care domain

IoT devices and systems for remote patient monitoring, wearable health trackers, smart medication management, asset tracking in hospitals, and healthcare facility management (Figure 1.6).

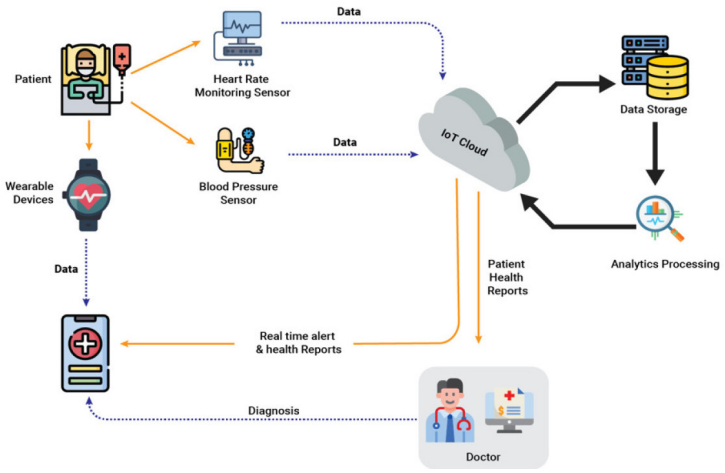

Figure 1.6 – Health care domain [11]

1.5.5 Transportation domain

Use the IoT technology to improve quality of life by decreasing congestion, and hence shortening travel time, as well as reducing fuel/electricity usage (Figure 1.7).

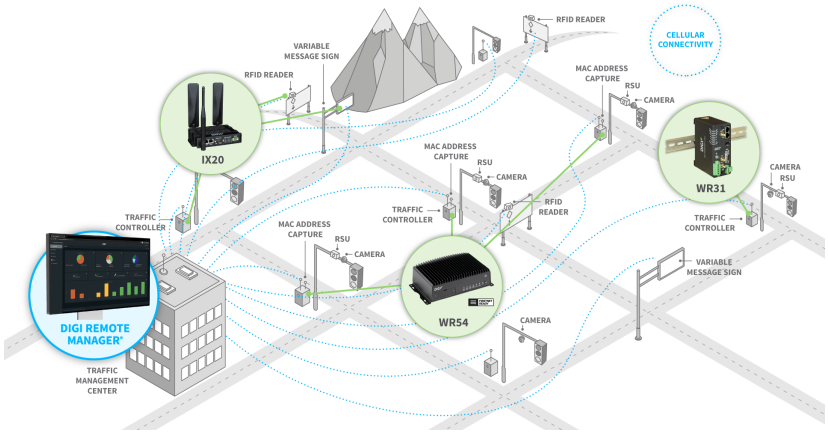

Figure 1.7 – Transportation domain [12]

1.6 Technologies of IoT

The Internet of Things (IoT) is a rapidly growing field that has the potential to transform the way we live, work, and interact with our environment.

At its core, IoT involves connecting everyday physical objects to the internet, allowing them to be monitored, controlled, and optimized in ways that were

previously impossible. To make this possible, a wide range of technologies are used [13] :

- RFID (Radio-Frequency Identification) This technology uses radio waves to identify and track objects with RFID tags.

- Sensor technology This technology involves the use of sensors to detect and measure changes in the physical environment, such as temperature, pressure, and motion.

- Nano technology This technology involves the manipulation of matter on a nanoscale level, which can be used to create smaller and more efficient devices.

- Embedded intelligence technology This technology involves the integration of intelligent software and hardware into everyday objects, making them ”smart” and capable of communicating with other devices.

- Radio Frequency Technology This technology involves the use of radio waves to transmit data between devices, such as Wi-Fi and Bluetooth.

- Remote Communication Technology This technology allows devices to communicate with each other over long distances, such as cellular and satellite networks.

- Remote Information Transmission Technology This technology involves the transmission of data over long distances, such as through the internet or cloud-based services.

- Information Technology This technology involves the collection and analysis of data from IoT devices, which can be used to optimize processes and make informed decisions.

- Control Technology This technology involves the use of software and hardware to control and manage IoT devices, such as through automation and remote monitoring.

1.7 Challenges of IoT

The advent of the Internet of Things (IoT) has ushered in a paradigm shift in technology, offering unparalleled benefits and transformative opportunities. However, along with its promises, IoT presents a host of challenges that demand scholarly attention [14].

1.7.1 Selecting the right wireless module

When adding wireless connectivity to your products there are a number of technologies to choose from, including Wi-Fi, Bluetooth, ZigBee. You may opt to buy a wireless module rather than build your own custom RF design to save time and money. However there are dozens of modules out there, and several factors to consider [15].

1.7.2 Designing and debugging complex mixed signal devices

Traditionally, radio devices for most applications would have been designed by highly experienced RF design engineers. Now there are countless radio "modules" that can be purchased and integrated into your project with reference designs. These modules are helping to fuel the huge boom in IoT devices and can speed along development time. However, when it comes time to system level troubleshooting, design teams struggle to figure out if the problem lies with their module or with their device [15].

1.7.3 Maximizing battery life

Power management is a primary concern in IoT design. The battery life of IoT devices varies greatly, from hours to years, depending on the application and its operating environment. In all cases, however, the ability to accurately describe the device's power consumption is essential. Robust power analysis helps designers identify opportunities to reduce energy consumed and optimize battery life [15].

1.7.4 Passing EMO and EMC certification

The race to add products to the Internet of Things brings a degree of complexity to EMI testing. Not only do product manufacturers need to learn how to properly add a wireless capability to their product, but from an EMI perspective it requires additional intentional radiator testing. EMI regulations are in place throughout the world to provide improved reliability and safety for users of electrical and electronic equipment [15].

1.7.5 Standards certification

Wireless technology standards are needed to ensure that products can interoperate within the ecosystem where they will be deployed. There are a number of technologies to choose from, including Wi-Fi, Bluetooth, ZigBee. However to adhere to the standard, new products will need to meet qualification as defined per the standard selected. Failing qualification can mean design turns that will delay the final product release and draw additional significant development cost [15].

1.7.6 Combatting the interference of things

Over the past decade there has been a dramatic increase in the population of wireless transmitters found in the world. Arguably the spectrum in the 2.4 GHz is the most popular operating area for low-cost, license free applications and there are literally millions of radios operating in this frequency band. Utilizing license exempt spectrum is attractive because of the cost savings, but you get NO protection from all the other people using the same channels [7].

1.8 Conclusion

Throughout this chapter, we delved into the fascinating world of the Internet of Things (IoT). We started by defining what IoT is and exploring its unique characteristics that distinguish it from other technological domains. We then

took a closer look at the architecture of IoT and the various technologies that make it all possible.

Moreover, we explored several application domains of IoT, including healthcare, transportation, and smart homes, among others. These examples illustrated the breadth of potential use cases for IoT and how it can revolutionize various aspects of our daily lives.

However, despite its numerous advantages and possibilities, IoT faces various challenges that must be addressed for its widespread adoption. These challenges include security concerns, interoperability issues, and privacy risks, to name a few. Addressing these challenges requires collaboration and innovation from various stakeholders in the IoT ecosystem.

In conclusion, IoT is a rapidly evolving field that promises to transform the way we interact with technology and the world around us. While there are challenges to overcome, the potential benefits are immense, and it is an exciting time to be a part of this technological revolution.

Chapter 2

Hospital Management System

2.1 Introduction

The healthcare sector is one of the most critical industries in the world, responsible for the well being and safety of millions of patients worldwide. However, as the volume of data and transactions in hospitals increases with the growing number of patients and staff, managing this data manually or through outdated systems becomes increasingly challenging. Therefore, hospitals are turning to digital solutions to streamline their operations, adhere to international standards, and improve patient care.

In this chapter, we focus on the hospital management system and its role in transforming the healthcare sector. We will delve into the key features and functionalities of the system, and how it can help healthcare providers manage patient data, medical records, and inventory efficiently. Additionally, we will explore some of the related works in the same domain and the services they offer to further understand the potential of this technology in the healthcare sector.

2.2 Hospital definition

The word ”hospital” dates back to the old French language ”hospice”, which means ”hospitality.” The first hospital in the Islamic world was established in Baghdad in the 8th century AD. Hospitals are important institutions in the history of medicine and health care. Many hospitals have been established throughout

history throughout the world.

It is an institution built and equipped to diagnose and treat patients and patients medically and surgically, and provides the necessary accommodation for them during the treatment period.

Hospitals matter to people and often mark central points in their lives. They also matter to health systems by being instrumental for care coordination and integration. They often provide a setting for education of doctors, nurses and other health-care professionals and are a critical base for clinical research [16] (Figure 2.1).

Figure 2.1 – Hospital [17]

2.3 Hospital Management

Hospital management is the process of planning, organizing, coordinating, guiding and continuously improving the various processes and activities that take place within the hospital, with the aim of achieving the specific goals and providing high quality health care to patients and meeting their needs and providing a safe and healthy working environment for staff. Hospital management includes many functions and functions, such as managing human, financial, technological, administrative and information resources, facilities and other administrative services.

The Department's work aims to improve the quality of health care, increase the efficiency and effectiveness of medical service delivery, control costs and revenues, and meet the needs and expectations of patients, community members and official health care stakeholders.

Hospital management can be defined as the processes and procedures implemented to achieve hospital management goals, with a view to providing cost-effective health care that meets the needs of patients and the communities they serve. The Department of Hospitals also includes planning, organizing, implementing, monitoring and evaluating health operations within the hospital, as well as managing relationships with patients, their families and various outsiders associated with health care.

2.4 Hospital Management Systems

Hospital Management Systems (HMS) are computer-based systems designed to manage and streamline hospital operations or healthcare facilities. The system deals with all patient data, doctor's information and medical staff. These systems can automate and integrate various hospital departments and functions, a number of different applications and software modules, including patient registration, scheduling, electronic medical records, laboratory and imaging services, pharmacy management, billing and invoice preparation, inventory management, human resources management, accounts management, reports and statistics.

HMS aims to improve the efficiency and effectiveness of hospital operations, reduce medical errors, enhance patient safety, improve their experience and increase their satisfaction, and provide real-time access to patient data for medical staff. It also helps hospital managers monitor and analyse hospital performance, track and increase revenue and reduce costs, and make data-based decisions to improve hospital services.

HMS can be implemented as a stand-alone program or as part of a larger healthcare information system that includes other software modules such as telemedicine, patient portals and healthcare analytics [18].

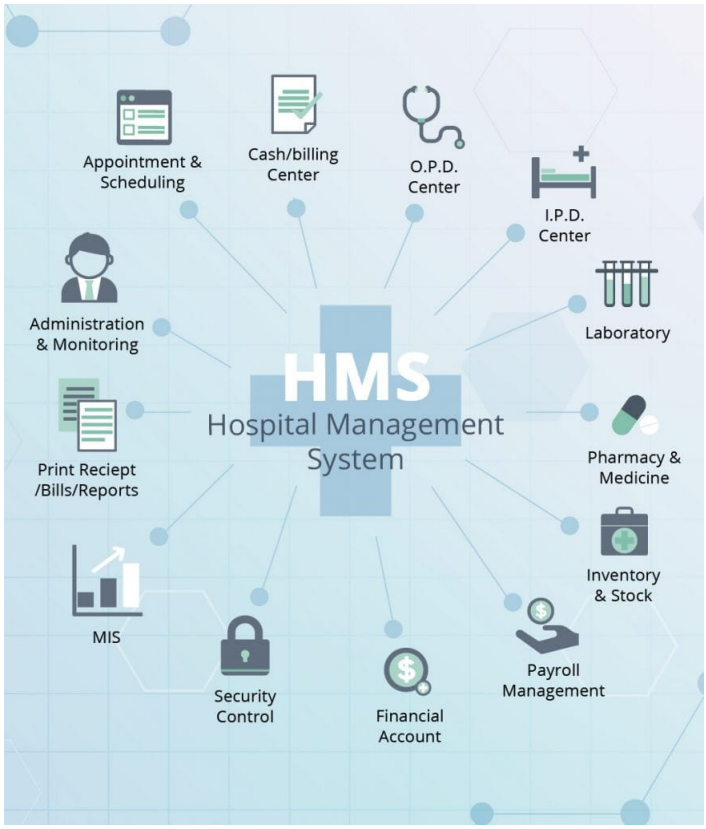

Figure 2.2 – Hospital Management System [**30**]

2.5 The functionalities of Hospital Management System

The main functions of the hospital management system can be included in the following [18]:

- Patient management : includes scheduling appointments, patients' electronic medical records file, issuing and managing invoices.

- Employee management : includes work scheduling, salary and benefits management, health insurance and general employee management.

- Inventory management : includes inventory management and medical supplies, including movement tracking and financial management.

- Managing reservations : Where patients can book their appointments online or by phone, the appointments are allocated and organized in the agenda.

- Statistical reports : the system can create statistical reports on the hospital's performance and operations, including income, expenditure, human resources and others.

- Financial management : includes tracking of income, expenditure, accounts, payments, invoices and other financial matters.

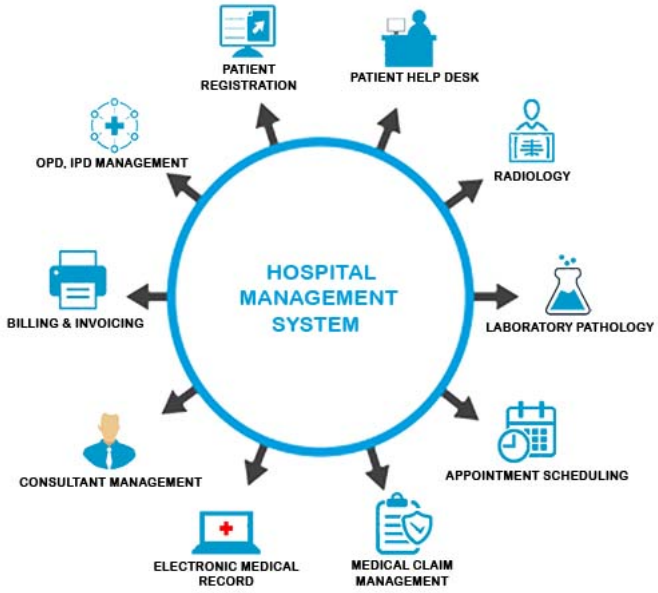

Figure 2.3 – Functions of HMS [19]

2.6 Hospital Management Systems in Algeria

Healthcare workers are increasingly using digital technologies and implementing patient software, which is a reflection of ongoing organizational and cultural change. This change is enabling those involved in healthcare to take full use of the potential offered by digital technologies.

Algeria's healthcare industry is progressively becoming more digital. The management of healthcare facilities is improved, and information and communication technologies are used to their full potential. This has become more clear during the epidemic, when a number of e-health applications and technological tools have appeared, helping to slow the spread of the virus and making it easier for medical personnel to do their jobs.

The introduction and advancement of these technologies within Algeria health-

care institutions still face obstacles and problems, nevertheless. The workforce's lack of knowledge, inadequate training, and limited skills are among the challenges that must be urgently addressed if the change is to go as planned[20].

2.7 Related Works

In this part, we will present and compare related works to our project as follows:

The authors in this paper [21] describes an online job management system designed using the Laravel framework and a MySQL database. The system aims to help the Governing Council in assigning a large number of tasks using the system. The designed system provides a login feature with different access rights. This system can record every development or operation for all units of the Mohammadiah Lamongan hospital and can also assist the Governing Council in seeing employee performance in the project. This system is also capable of making uploaded files available anywhere and at any time.

In this paper [22] , the authors are create a hospital management system , The objective of this project is to develop hospital management web-based application with a front-end and the back end (JavaScript,CSS) with mongo database. This system will help to be more efficient in handling the booking doctors, booking lab test slots, pharmacy services, and getting health programs. This system consists of an admin handling part, which means admin can manage users, pharmacy systems, health program management, and manage booking of doctor's appointments and lab tests. Of their patients, who book appointments , buy medicines and view medical programs . It also explains the user interface, different models that could be used to develop software such as this.

The author in [23] create an efficient and reliable hospital management system at the Mountain Top University Health Center that can do all the manual work with ease. a database was created, and this project was built on Laravel framework with other frontend and backend technologies using Visual Studio .

The Hospital Management System created is useful in helping patients, doctors, nurses, record officers and administrators monitor and manage their respec-

tive operations properly, also can increase the profitability of the organization. Hospital administrators would be able to significantly improve the operational control and thus streamline operations. This would improve the response time to the demands of patient care.

The authors in this research [24] showed that there were no standards for building a smart structure for the healthcare systems. Previous studied frameworks showed that they were established based on specific needs per each application. They were tailored for precise organization or field needs.the proposed methodology in this project targets the basic requirements for the healthcare systems using the IoT technology. Given the importance of dealing with critical cases, it is necessary to send an alert to the healthcare provider in order to assess the seriousness of the situation. Time and security are not only the critical requirements for the medical community, but also, the accuracy of health data . Data being collected are to be saved using the cloud computing technology. Consequently a list of functional and non-functional requirements has been proposed in this methodology, as well as its implementation, to highlight best practices to be followed to optimize the functioning of healthcare systems. The implementation of this structure in the real medical field and its experience is planned by healthcare personnel.

The SHMS proposed by the authors in this paper [25] , provided various aspects of AI, IoT, applications of SHMS, and its limitations. They also presented the structure block diagram which provides a basic idea about the working of the SHMS. They also showed various challenges that are faced by Smart Hospitals and the measures taken to reduce their impact. With the rapid growth in technologies , Like machine learning, big data analytics, cloud services, IoT and AI.

Smart hospitals have come out to be an efficient solution for providing more efficient diagnosis processes and a friendly environment to the patient, also its reduce the expense factor to a great extent making it feasible for the patients to take up their treatments without any further stress.

2.8 Conclusion

In this chapter we showed the problems facing hospital management , we talked about the hospital management system that solved these problems and also the hospital management system in Algeria. at the end of the chapter we introduced some related work and their technologies

Chapter 3

Design of the proposed solution

3.1 Introduction

The construction process for the HMS is described in this chapter. The flowchart, use case diagrams, design details, and software development life cycle are presented at the beginning of this chapter.

The goal of creating a safe online hospital administration system is to raise the standard of hospital services. The process by which automated management systems are created is changing significantly as a result of the better developments in information and technology.

The quality of hospital services has increased as a result of the use of Information and Communication Technology (ICT) in health institutions. The health institution should adapt to the changes in contemporary society in addition to the quick changes brought on by ICT evolution in society. Information technology (IT) utilization has benefited organizations.

3.2 General Architecture

In this section we present the general architecture of the project, it's composed of four main components: Web api server , mobile app for the patient and one for the doctor.

- Web api server : the web-platform used by the hospital supervisor for managing the hospital (patients data, doctors data, hospital data).

- patient user: the mobile application can used by the patient allows him to call the doctor in the hospital, take appointments, medical history.

- doctor user: The mobile application can be used to by doctors to show the patient's call, medical history of patients, doctors blackboard, medicines stocks, and show the patient's data.

- Data Base: where all the vital data necessary for hospital operations is stored and managed, including patient records, personnel information, medical inventory, billing and payment details.

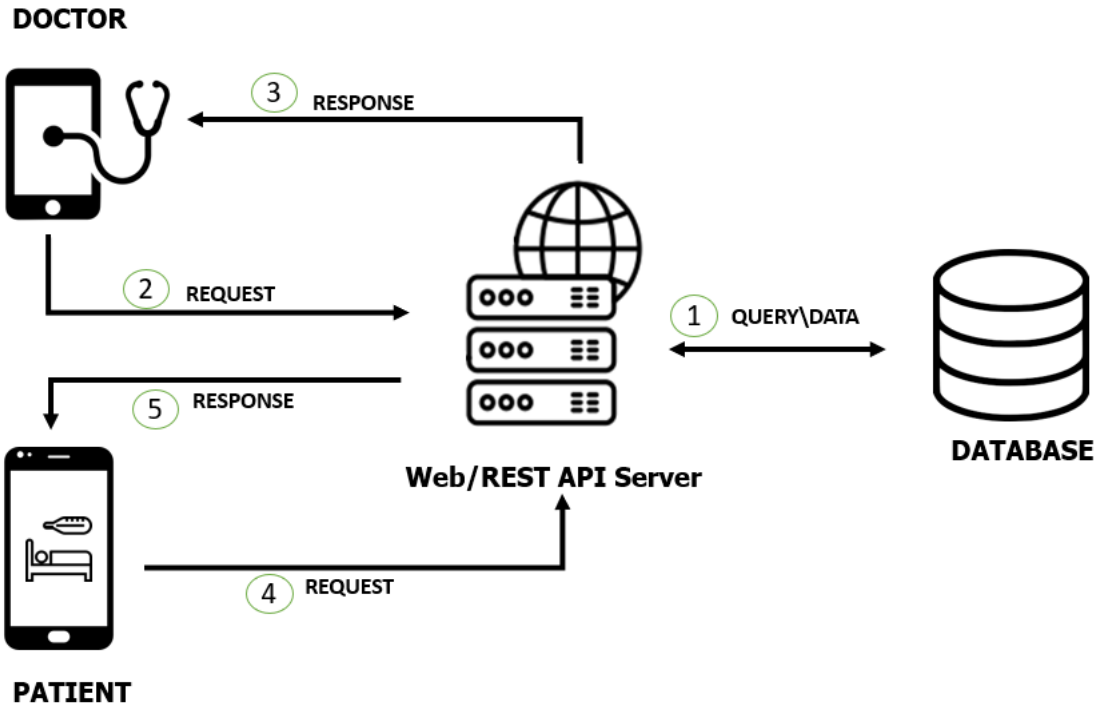

Figure 3.1 – Hospital management system global architecture

3.3 Detailed Architecture of the system

Hospital management is a comprehensive system that integrates several modules to manage hospital operations efficiently. Here is a detailed architecture of the system:

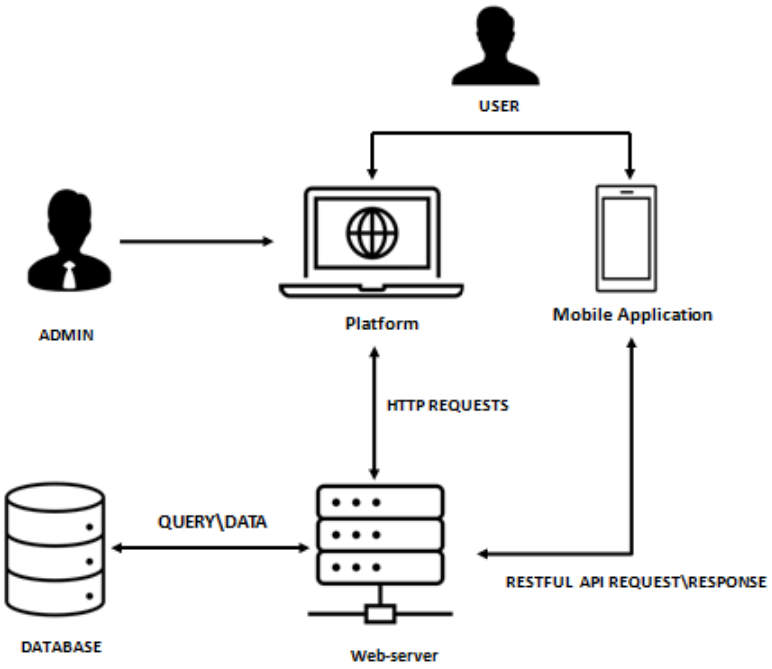

Figure 3.2 – Hospital management system detailed architecture

3.3.1 Mobile aplication

Consists of two important components: the User Module and the RESTful API Request/Response. These components work together to provide a seamless and secure user experience in accessing healthcare services.

User module: This unit is designed for patients and doctors and can be accessed through mobile app or online platform The unit enables infected people to perform various obligations associated with their health care, along with booking dates, showing their clinical records, and arriving at test results, before recovering those records that the patient must log into the program. It also enables the category of doctors to see the patient records,show the patient's call and generate prescriptions for patient (Figure 3.4),(Figure 3.3).

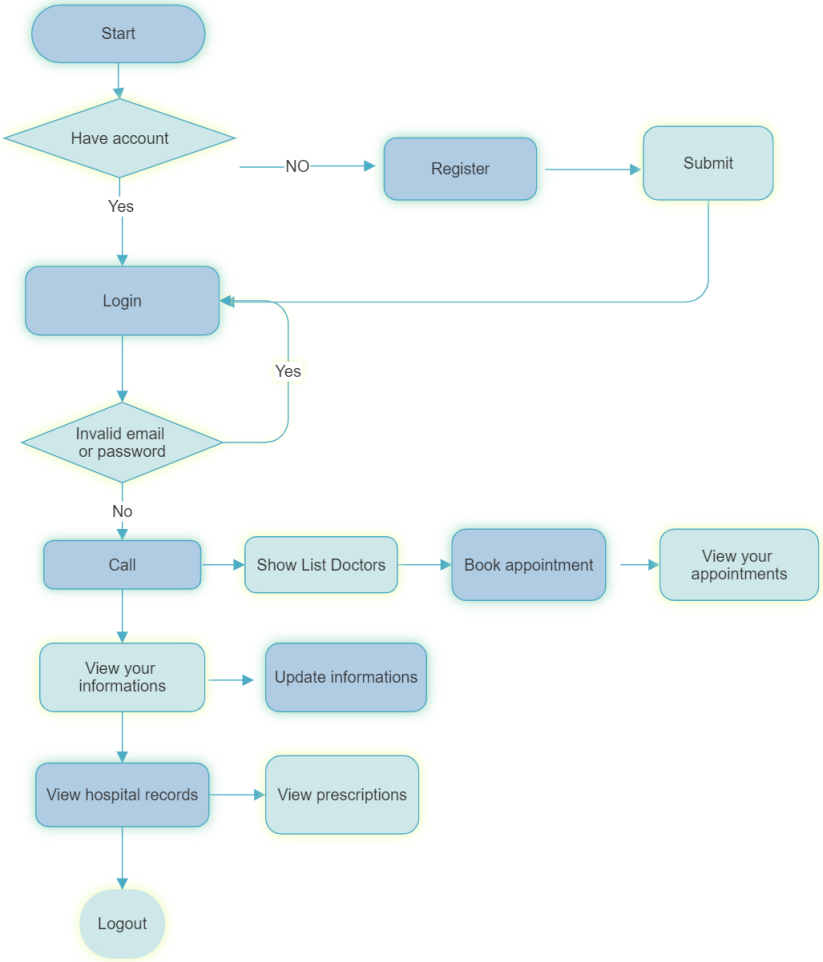

Figure 3.3 – Patient module flowchart

Algorithm 1: Function: TakeAppointment

Input: FormElement

Function *TakeAppointment(FormElement)*:

```
Input: FormElement (DoctorName, ClientName,reason,DateSelected)
if validate(FormElement) = true then
    TakeAppointmentApi(FormElement);
    if TakeAppointmentApi.msg = "success" then
        msg ← 'Send Successhully wait accept or reject';
    end
    else
        msg ← 'Error Sending';
    end
end
```

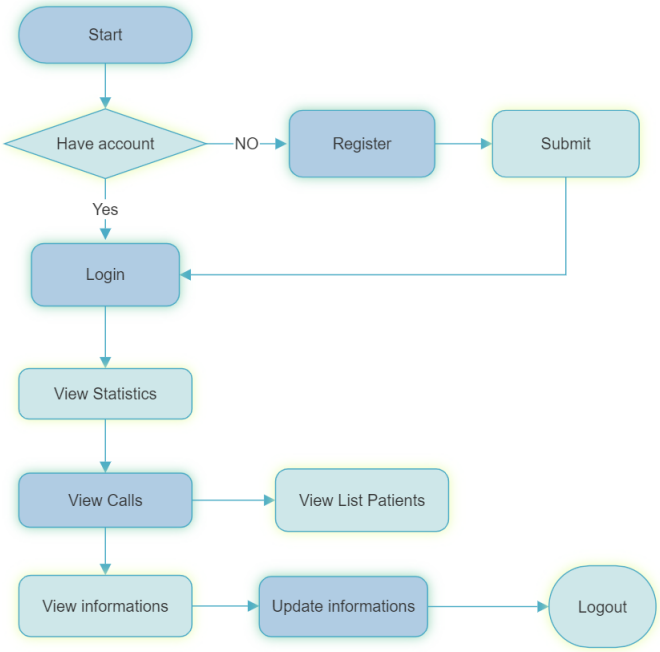

Figure 3.4 – doctor module flowchart

Algorithm 2: Function: Login

```
Input: credentials

Function Login(credentials):
    Input: credentials (email, password)
    if validate(credentials) = true then
        loginApi(credentials);
        if loginApi.error = false then
            if role = 'patient' then
                patientsPage();
            end
            else if role = 'doctor' then
                doctorsPage();
            end
        end
        else
            msg ← 'Invalid Email or Password';
        end
    end
```

RESTful API request/response RESTful application programming interface is an interface used by two computer systems to securely share information online, tracking the principles of the well-known REST architectural model, which is commonly used in the development of web services.

Enables customers to interact with server applications by submitting HTTP requests and receiving corresponding responses. These requests usually include methods such as GET, POST, PUT and DELETE, which represent different processes over available resources.

Through it data is transferred in a uniform format such as JASON (JavaScript Object Notation), making it easier to be consumed by different systems. It also provides a stateless communication mechanism, which means that each request from the client contains all the information necessary for the server

to process, without the need for prior interactions also can achieve a secure and effective communication between different systems, enable data exchange and efficiently execute operations online.

the User Module and the RESTful API Request/Response form a cohesive system within the Mobile Application. The User Module provides an intuitive interface for users to access healthcare services, while the RESTful API facilitates secure communication and data exchange between the Mobile Application and the server-side applications. This integration ensures a smooth user experience and efficient management of healthcare-related tasks.

3.3.2 Platform

This module is an internet platform and is designed for sanatorium supervisors, administrators service headers. It offers an overview of health facility operations, which includes affected person information, mattress occupancy, and financial records.

It also includes features which includes facts visualization, report generation, and signals for important activities. Hospital supervisors can use the dashboard to make informed selections approximately resource allocation, staffing, and strategic planning.(Figure 3.5).

- Admin module: It is used by supervisors and can be accessed through an online platform. Provides the manager with the ability to manage important information within the hospital. This includes patients' information, doctor's information, nurses' information, service information, room information and bed information.

Using this module, the administrator can perform various tasks such as adding, updating and deleting records related to the categories mentioned. They can also watch and follow up transactions in the hospital, as well as manage the schedule of various activities within the hospital.

In general, the Unit aims to streamline administrative processes and provide a central platform for the management and management of hospital-related information and activities.

- Doctors: Doctors have access to patient information, medical records, and appointment scheduling. They can review and update patient records, generate electronic prescriptions, and communicate with other healthcare professionals for consultation and collaboration.

- Service Heads: Service heads are responsible for managing specific departments within the health facility, such as the pharmacy, laboratory. They have access to department-specific information, resources, and staff management. Service heads can allocate resources, monitor department performance.

- Administrators: Administrators have comprehensive access to the platform module and oversee the overall functioning of the health facility. They can view and analyze facility-wide data, generate reports on financial performance, bed occupancy, and resource utilization. Administrators make strategic decisions regarding resource allocation, staffing, and long-term planning.

- Pharmacys: Pharmacy users have access to the pharmacy module of the platform. They can manage medication inventory, track stock levels, and handle prescription dispensing. Pharmacy users can also maintain a database of medication information, including dosages, side effects, and interactions. They play a crucial role in ensuring the availability and safe dispensing of medications within the hospital.

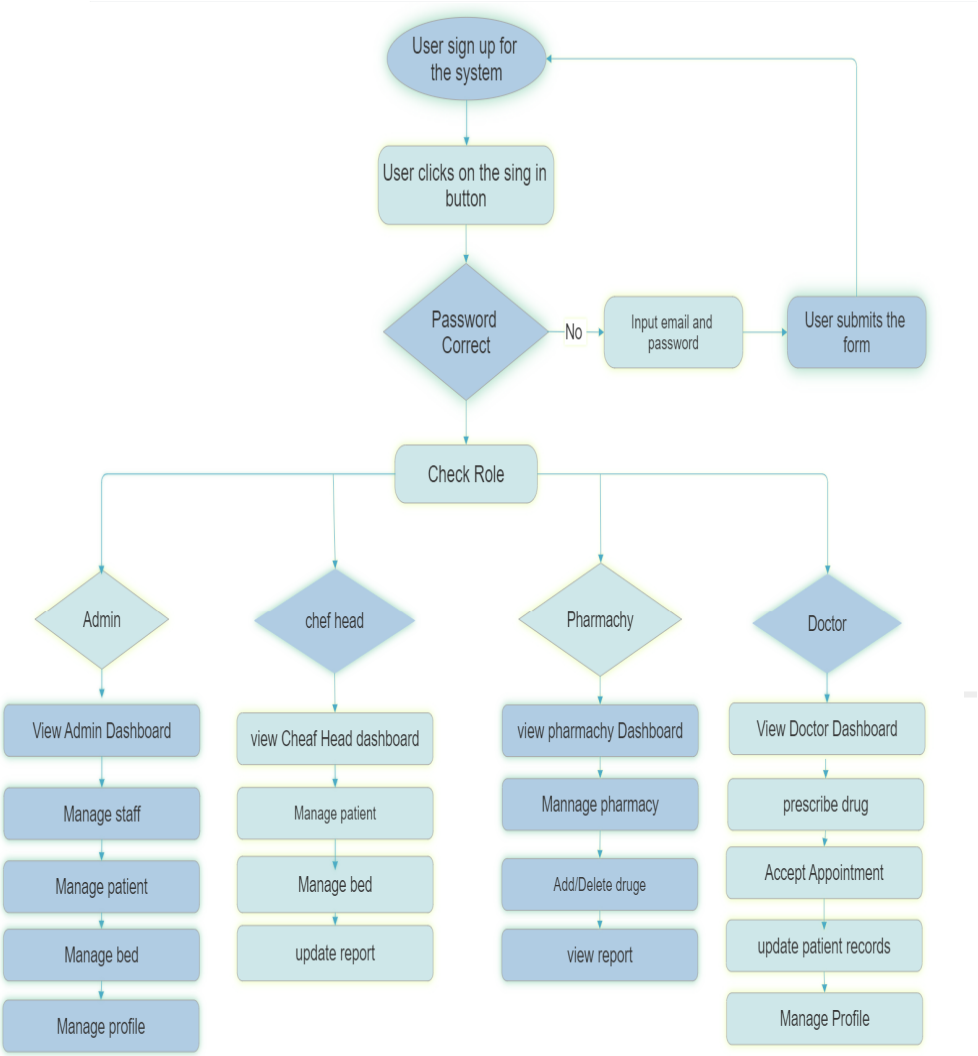

Figure 3.5 – Flowchart of SHMS

the architecture of the SHMS system has been constructed with scalability, security, and ease of maintenance in mind. It gives hospital managers an extensive view of the hospital's operations, as well as helping healthcare professionals to become more efficient in their work and therefore offer better care to those they are treating.

3.3.3 Query/Data:

The Query/Data component in the Mediquora Hospitals system interacts with the database, retrieving information through queries like data retrieval, insertion, deletion, and updating.

It follows the MVC pattern for organized code management. By adopting MVC, it promotes professionalism, separation of concerns, modularity, and maintainability. This structured approach enables streamlined database access, ensuring accurate and up-to-date information for effective decision-making and smooth healthcare facility operations.

3.3.3.1 Model

The Model represents the data layer of the application. It encapsulates the database queries and operations such as data retrieval (show), insertion of new data (insert), deletion of existing data (delete), and updating of data (update). The Model handles the communication with the database, executes the queries, and retrieves or manipulates the data. It defines the structure of the database tables and contains the business logic associated with data operations.

Algorithm 3: Function: getBedStatesAndIds

Input: roomId, bedNumber

Output: roomWithBeds

Function *getWithBedStatesAndIds(roomId, bedNumber)***:**

```
roomWithBeds ← empty list;
for each room in allRooms do
    if room.roomId = roomId and room.bedNumber = bedNumber
     then
        bedState ← room.bedState;
        bedId ← room.bedId;
        roomWithBeds.append({bedState, bedId});
    end
end
return roomWithBeds;
```

3.3.3.2 View

The View component in MVC is responsible for the presentation layer. It focuses on rendering the data retrieved or manipulated through the database queries. The View receives the processed data from the Controller and determines how it should be displayed to the user. The View does not interact directly with the database or perform any database queries; its main role is to provide a user-friendly representation of the data.

Algorithm 4: Function: roomWithBeds

Input: roomId, bedNumber

Output: request

Function *roomWithBeds()*:

```
requestParams ← {roomId: roomId, bedNumber: bedNumber};
request ← createAjaxRequest ({url: ”beds.getBedId”, type:
 ’POST’, dataType: ’json’, data: requestParams});
return request;
```

3.3.3.3 Controller

The Controller acts as the intermediary between the Model and the View. It handles the user's requests and orchestrates the flow of data. When a database query is needed, the Controller interacts with the Model to execute the appropriate query and retrieve or modify the data. It then prepares the data to be passed to the View for presentation. The Controller also handles any additional logic or transformations required before or after the database queries.

Algorithm 5: Function: getBedId

Input: roomId,bedNumber

Output: jsonResponse

Function *getBedId()*:

```
roomId ← roomId;
bedNumber ← bedNumber;
bed ← null;
roomWithBeds ← (roomId, bedNumber);
bed ← roomWithBeds;
bedId ← null;
if bed is not null then
    bedId ← bed-¿id_bed;
end
jsonResponse ← createJsonResponse (bedId);
return jsonResponse;
```

3.4 Functionality of the system

To understand more the functionality of the system, it would be better to represent it in form of diagram, in this section we are going to provide a representation of our system in form of use case (figure 3.9), sequence diagram (figure **??**) ,and database diagram (figure 3.7). It shows all the action that can the admin, the doctor/nurse and the patient do:

Step 1:

- The admin logs in to the system.
- The admin adds all the different types of users .
- The admin manages users, appointments, and reports

Step 2:

- The patient logs in to the mobile application.

- The patient can perform various tasks such as booking appointments, viewing medical records, accessing test results.
- The doctor logs in to the mobile application.
- The doctor can access patient information, record diagnoses, prescribe medications, accept appointments, and generate prescriptions for patients.

Step 3:

- The hospital supervisors and administrators log in to the web platform.
- The dashboard provides an overview of hospital operations, including patient statistics, bed occupancy, and financial data.

Step 4:

- The patient logs out of the mobile application.
- The doctor logs out of the mobile application.
- The hospital supervisors and administrators log out of the web platform.

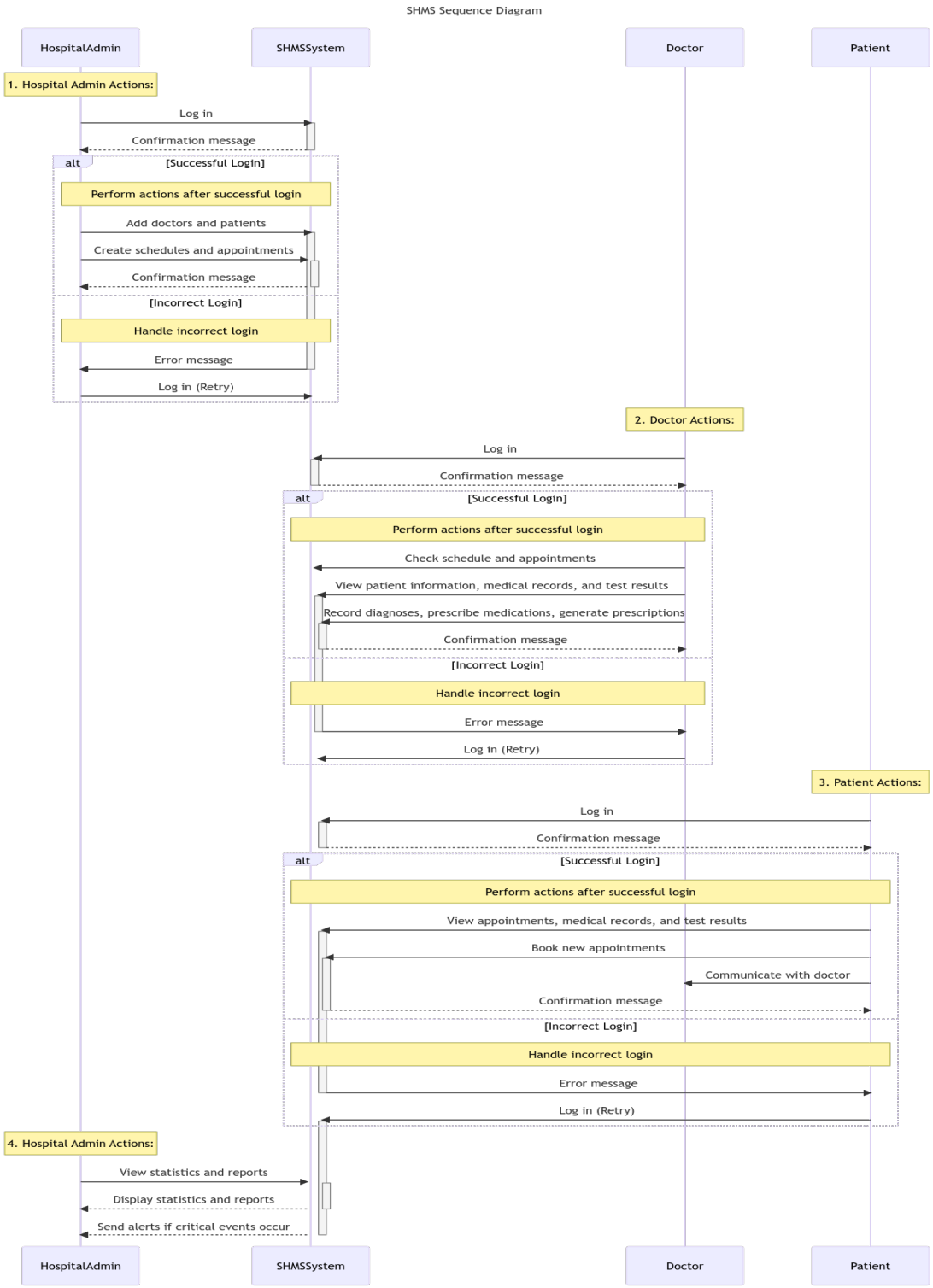

Figure 3.6 – Sequence diagram of the system

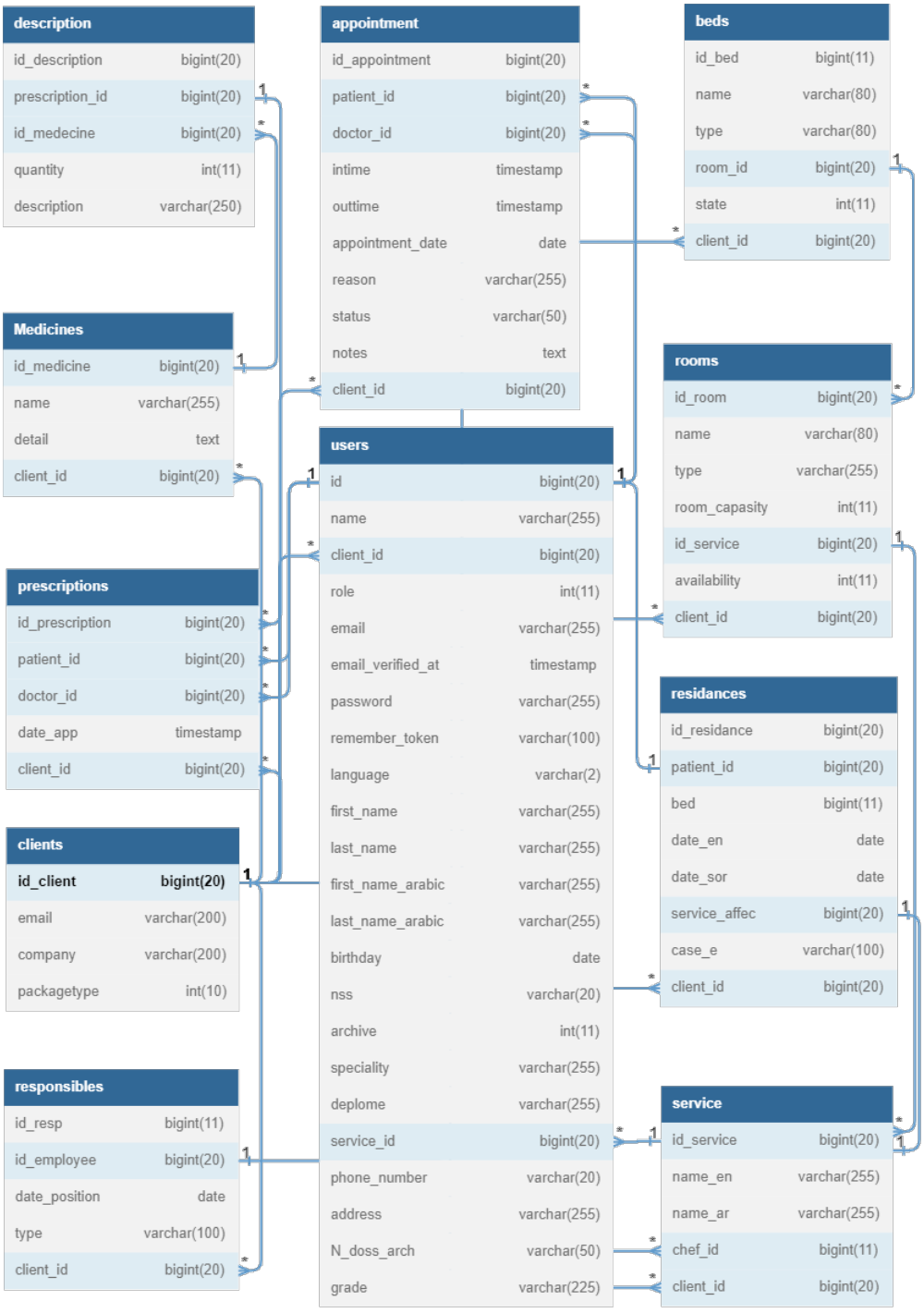

Figure 3.7 – Association entity diagram

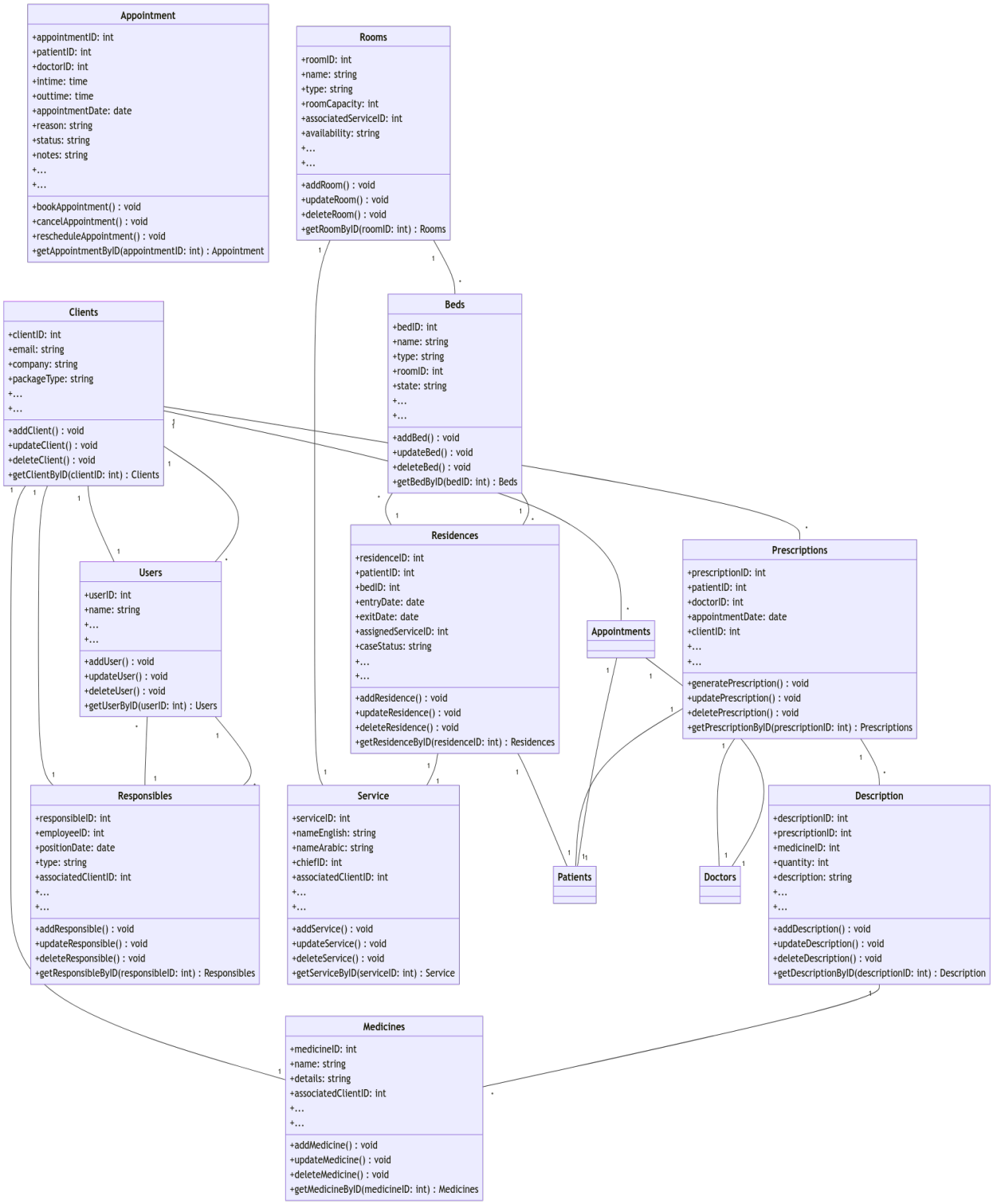

Figure 3.8 – Conceptual Class diagram

The (figure 3.7) present a conceptual class diagram of BD of the system consists of several tables interconnected through foreign keys:

- clients maintains essential information about the clients of HMS. It includes fields such as client ID, email address, company affiliation, and package type.it serves as a professional repository for storing and managing client data within the HMS

-usersit refers to users, such as patients and doctors chef services. It contains identifier, name and all the information of the users

- appointment class represents appointments that is booked by patients .

- beds class it represents all the beds and they're state and type .

- prescriptions it refers tothe prescriptions that is generated by doctors to their patients.

- description it contain the details of the medicines that is in the generated prescribtion

- Medicines it stores details about medicines that exist in the facility.

- residances it represents the inhospital patients . It contains information like: bed ID, entry date, exit date if existed, assigned service and case status.

- responsibles records responsible individuals and their positions. It includes columns like responsible ID, employee ID, position date, type, and associated client ID.

- rooms it represents the rooms within the facility. It includes information such as room ID, name, type, room capacity, associated service ID, and availability.

-service it refers to the services of the hospital, such as service ID, name ,the head chef, and associated client ID.

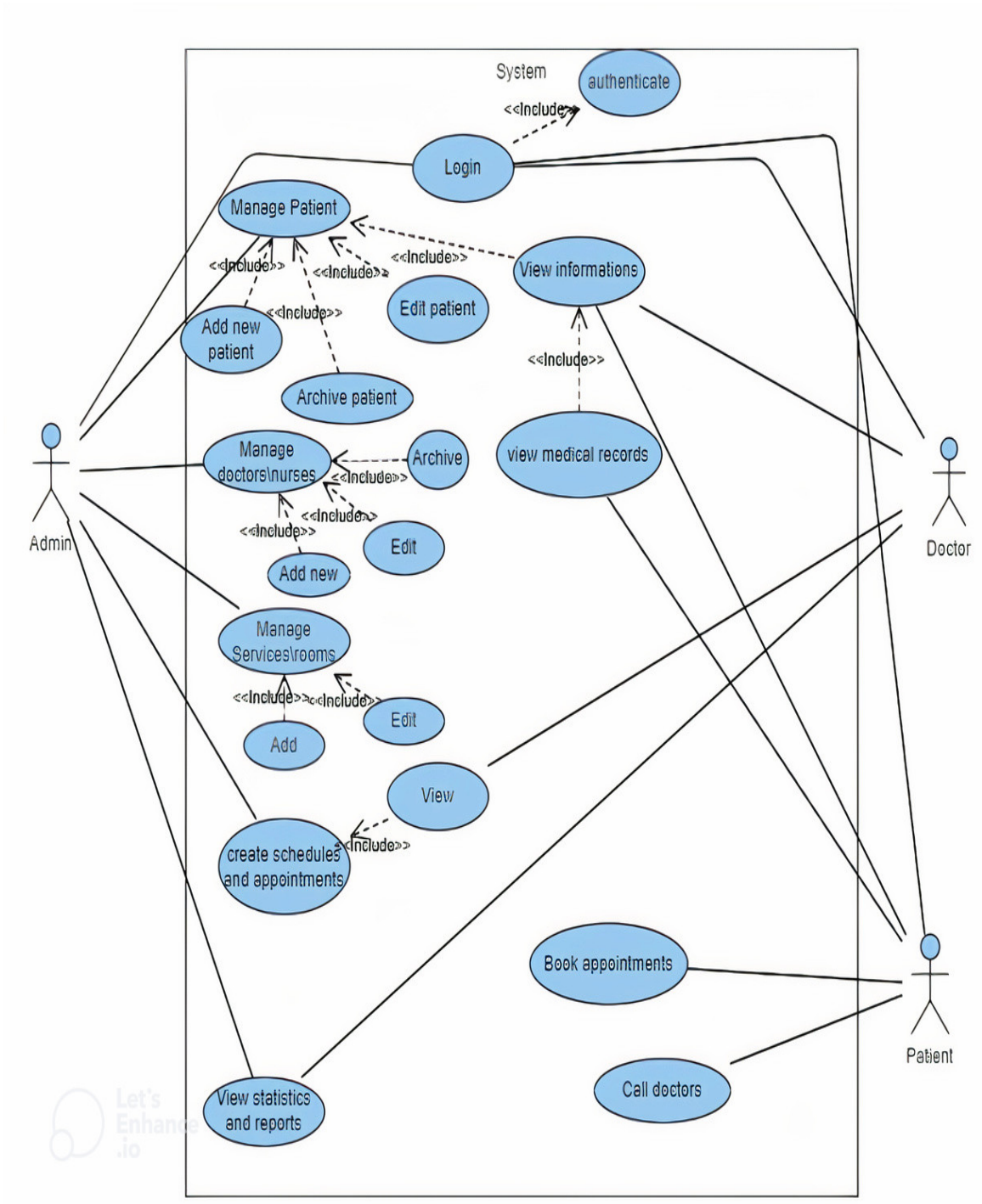

Figure 3.9 – Use case diagram of the system

3.5 Conclusion

In this chapter, we have introduced the solution for our smart hospital management system and described it in detail. We presented the system's general architecture, including the actors involved in the system. Additionally, we provided a detailed architecture that discussed each component's functionality and algorithms used in the system. We also described the smart bin's architecture and functionality, including pseudo algorithms and flowcharts.

Furthermore, we discussed the system's functionality using use case and sequence diagrams, and we represented the system's structure through a conceptual class diagram.

In the next section, we will discuss the implementation of our smart hospital management system. We will provide details on how the system was implemented, the technologies used, and any challenges that we faced during the implementation process.

Chapter 4

Implementation of the system

4.1 Introduction

After detailing the architecture of the smart hospital management system and describing the main concept of our solution in the last chapter, in this chapter we will focus on the implementation and the practical side of the project.

We will start the chapter by presenting the software and hardware tools used in the project. Then, we will introduce the obtained results in the form of screenshots and pictures.

4.2 Software tools

We used JavaScript, HTML, and CSS for the SHMS web dashboard, and Laravel and Bootstrap frameworks for development efficiency. Laravel provided useful features like database migrations, user authentication, and routing, while Bootstrap offered pre-designed UI components and styles for a professional-looking dashboard.

This combination of tools helped us create a user-friendly and functional SHMS with ease.

4.2.1 Laravel

Laravel is an open-source PHP framework, which is robust and easy to understand. It follows a model-view-controller design pattern. Laravel reuses the

existing components of different frameworks which helps in creating a web application. The web application thus designed is more structured and pragmatic [26]. Laravel offers a rich set of functionalities which incorporates the basic features of PHP frameworks like CodeIgniter, Yii and other programming languages like Ruby on Rails. Laravel has a very rich set of features which will boost the speed of web development [26].

Figure 4.1 – laravel logo

4.2.2 Bootstrap

Bootstrap is a free and open-source web development framework. It's designed to ease the web development process of responsive, mobile-first websites by providing a collection of syntax for template designs [27].

In other words, Bootstrap helps web developers build websites faster as they don't need to worry about basic commands and functions. It consists of HTML, CSS, and JS-based scripts for various web design-related functions and components Bootstrap's primary objective is to create responsive, mobile-first websites. It ensures all interface elements of a website work optimally on all screen sizes. Bootstrap is available in two variants – precompiled and based on a source code version.

Experienced developers prefer the latter since it lets them customize the styles to suit their projects [27].

Figure 4.2 – Bootstrap logo

4.2.3 Flutter

Flutter is a free and open-source mobile UI framework created by Google and released in May 2017. In a few words, it allows to create a native mobile application with only one codebase. This means that the developer can use one programming language and one codebase to create two different apps (for iOS and Android) [28]. Flutter consists of two important parts:

- An SDK (Software Development Kit): A collection of tools that are helpful to develop applications. This includes tools to compile a code into native machine code (code for iOS and Android).
- A Framework (UI Library based on widgets): A collection of reusable UI elements (buttons, text inputs, sliders, and so on) that everybody can personalize for their own needs

Figure 4.3 – Flutter logo

4.2.4 XAMPP

XAMPP is an abbreviation where X stands for Cross-Platform, A stands for Apache, M stands for MYSQL, and the Ps stand for PHP and Perl, respectively.

It is an open-source package of web solutions that includes Apache distribution for many servers and command-line executables alongwith modules such as

Apache server, MariaDB, PHP, and Perl.

XAMPP helps a local host or server to test its website and clients via computers and laptops before releasing it to the main server. It is a platform that furnishes a suitable environment to test and verify the working of projects based on Apache, Perl, MySQL database, and PHP through the system of the host itself Among these technologies [29].

the architecture of the SHMS system has been constructed with scalability, security, and ease of maintenance in mind. It gives hospital managers an extensive view of the hospital's operations, as well as helping healthcare professionals to become more efficient in their work and therefore offer better care to those they are treating.[29].

Figure 4.4 – xxamp logo

4.2.5 AJAX

AJAX is an approach to web application development utilizing a combination of established web technologies.

XMLHttpRequest is an API implemented by most modern web browser scripting engines to transfer data to and from a web server using HTTP, by establishing an independent communication channel in the background between a web client and server.

Adopting AJAX has become a serious option not only for newly developed applications, but also for migrating existing web sites to increase the responsiveness.

The REST style makes a server-initiated HTTP request impossible, precluding servers from sending asynchronous notifications without a request from the client. There are several solutions used in the practice that still allow the client to receive (near) real-time updates from the server[30].

4.3 Implementation of the system

In this section we are going to present the implementation of our system in form of screenshots.

4.3.1 Platform

The platform consists two parts: guest access and user access. Guest access allows visitors to access public information about the platform . User access, on the other hand, is designed for registered users and provides personalized features and functionality. based on the user role This division helps in managing user accounts.

4.3.1.1 Guest Access

Guest access plays a vital role in managing user accounts, ensuring security and privacy, driving user engagement and conversion, and providing a seamless experience for visitors who want to learn more about the platform before committing to registration.

- home page:

The guest homepage serves as the landing page for visitors who have not yet registered or logged in. It showcases the key features and benefits of the system, emphasizing its unique qualities and value proposition it has the feature changing the web language based on the preference of the guest like :(figure 4.5) , (figure 4.6).

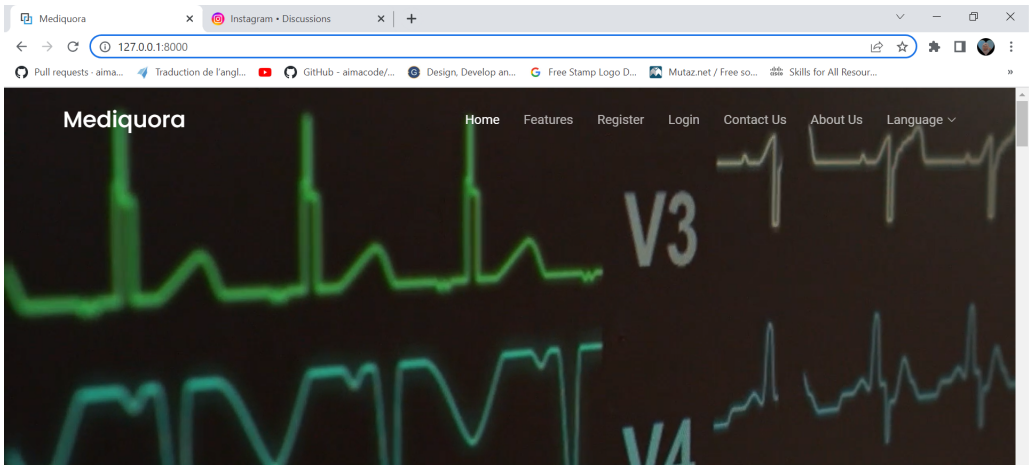

Figure 4.5 – Home page

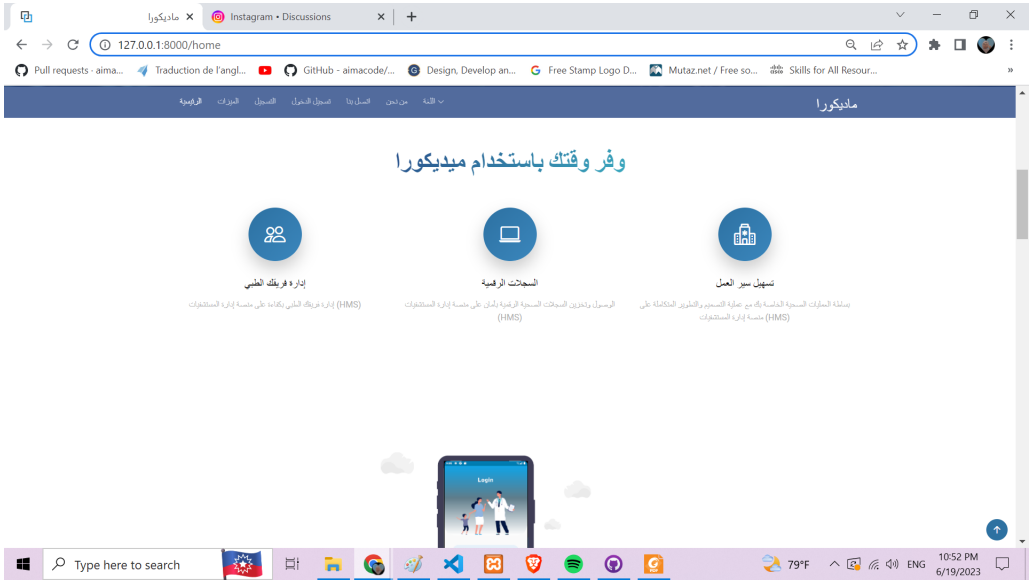

Figure 4.6 – Home page in arabic

-Features page:

Provides an in-depth overview of the system's capabilities and highlights its unique qualities. It showcases the key features, such as comprehensive patient management, streamlined workflows, advanced reporting, and integration with other healthcare systems(figure 4.7) ,(figure 4.8).

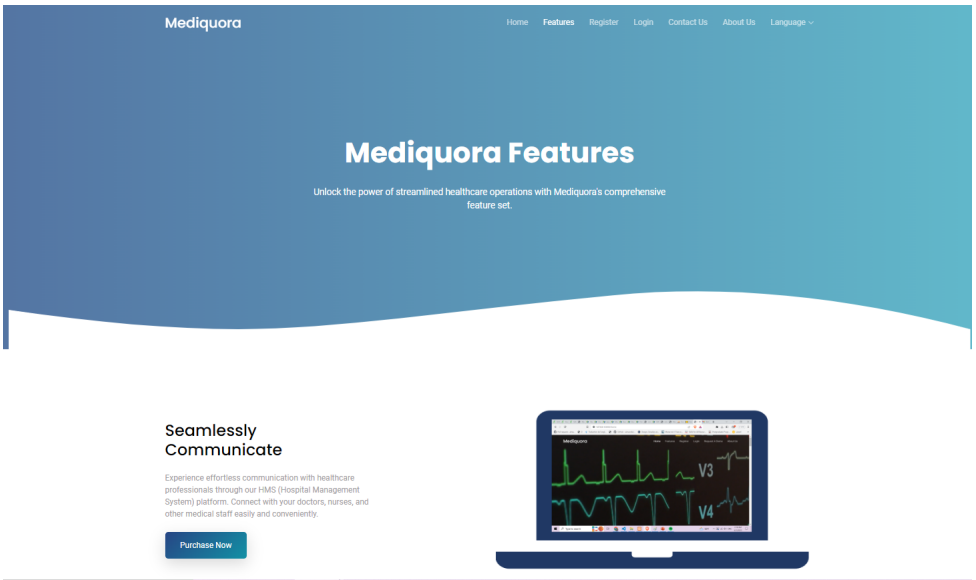

Figure 4.7 – Features p1 page

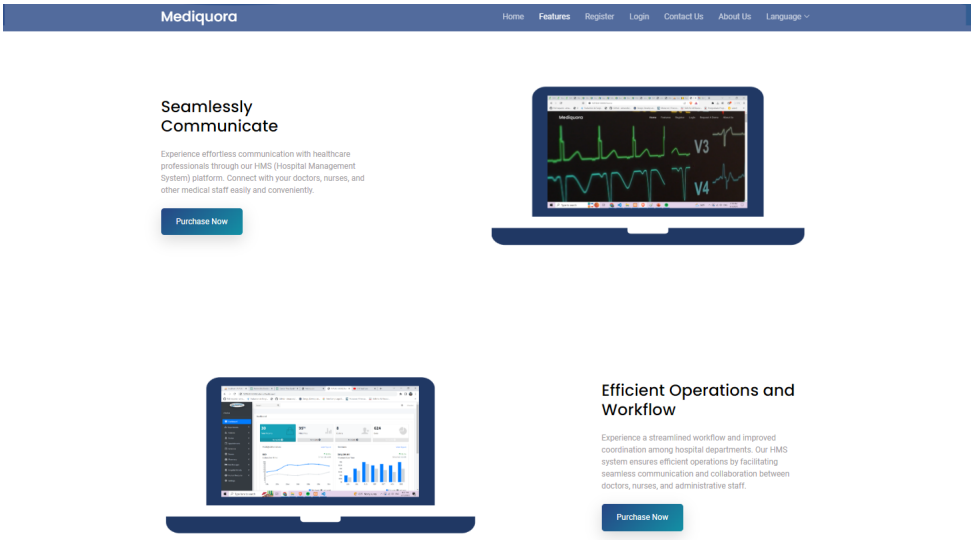

Figure 4.8 – Features p2 page

-Contact Us page:

The user can easily get in touch with the hospital or app support team (figure 4.9).

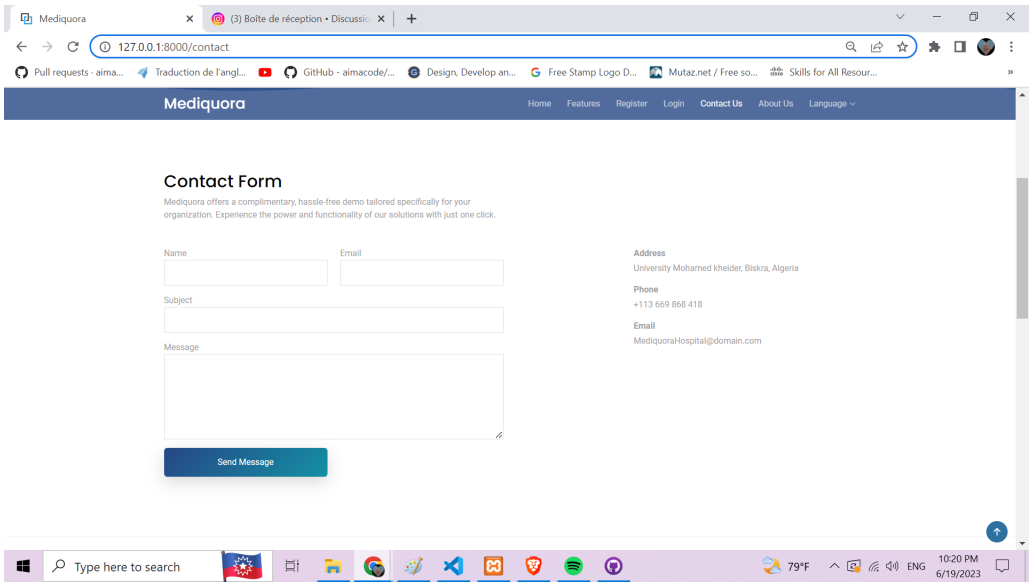

Figure 4.9 – contact page

-About us page:

Provides a comprehensive overview of Mediquora hospitals and showcases team members (figure 4.10).

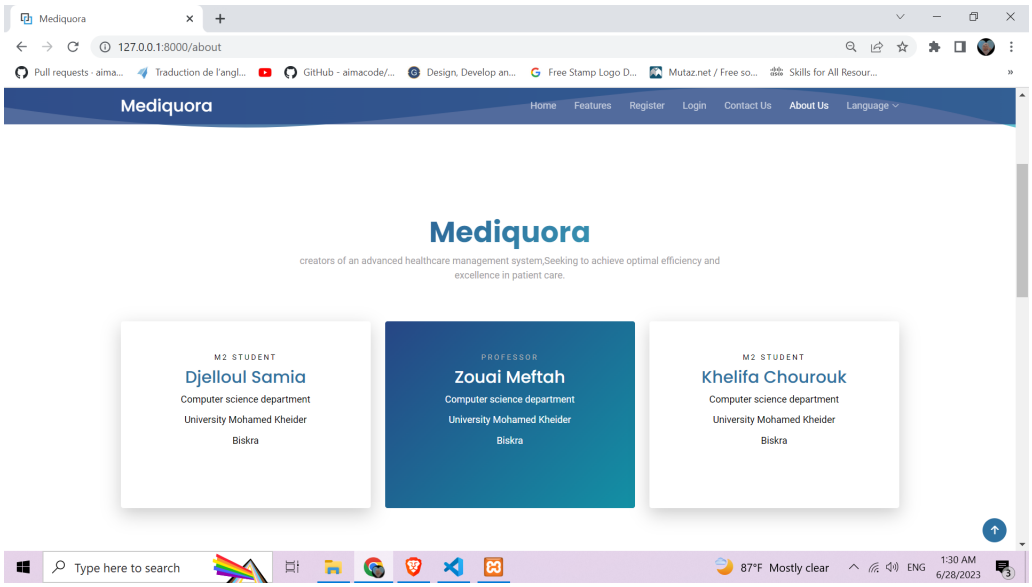

Figure 4.10 – About us page

-Register page

The registration page allows guests to create an account and gain access to the full functionality of the system (figure 4.11).

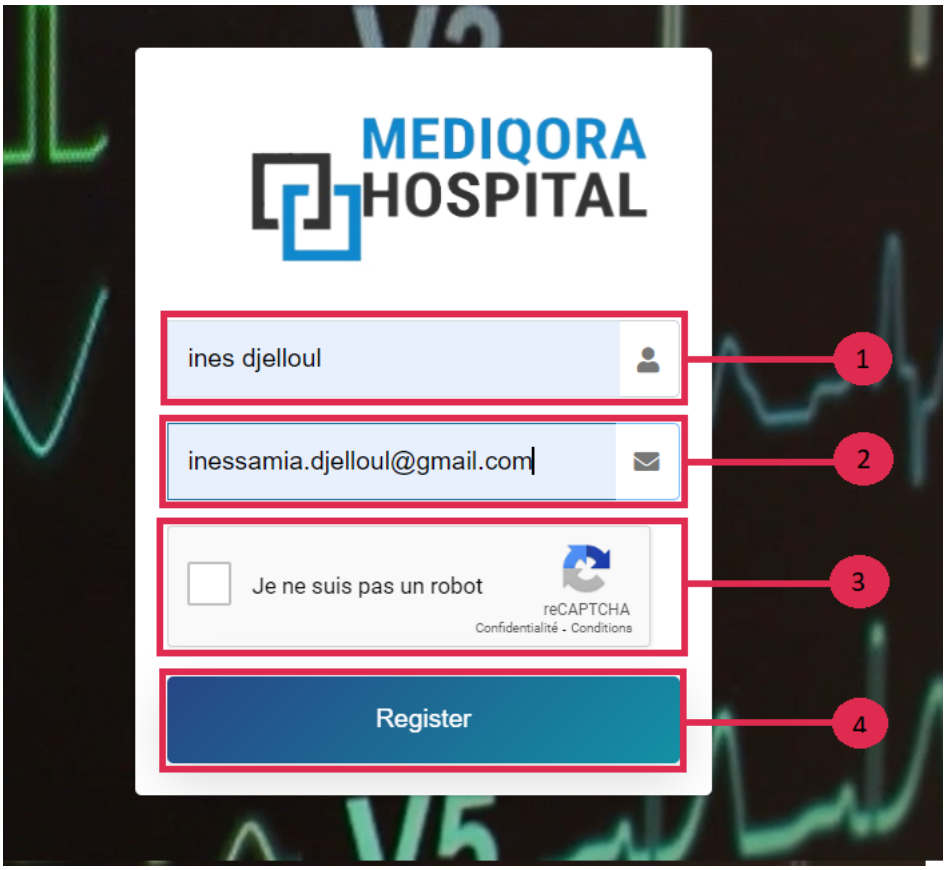

Figure 4.11 – Registration Page

(1) **Name Input:** A text input field is provided for users to enter their name during the registration process.

(2) **Email Input:** An input field is available for users to enter their email address, which will be used as their login credentials.

(3) **Captcha:**A captcha component is included to ensure the security of the registration process and prevent automated submissions. Users may be required to complete a visual or interactive challenge to verify their authenticity.

(4) **Register Button:** A prominent button is placed on the page to initiate the registration process and create a new account.

(5) **Modal Registration Successful:** a modal window appears, instructing the user to verify their email address to continue the registration process. The user must click on the verification link sent to their email to enter the password (figure 4.12).

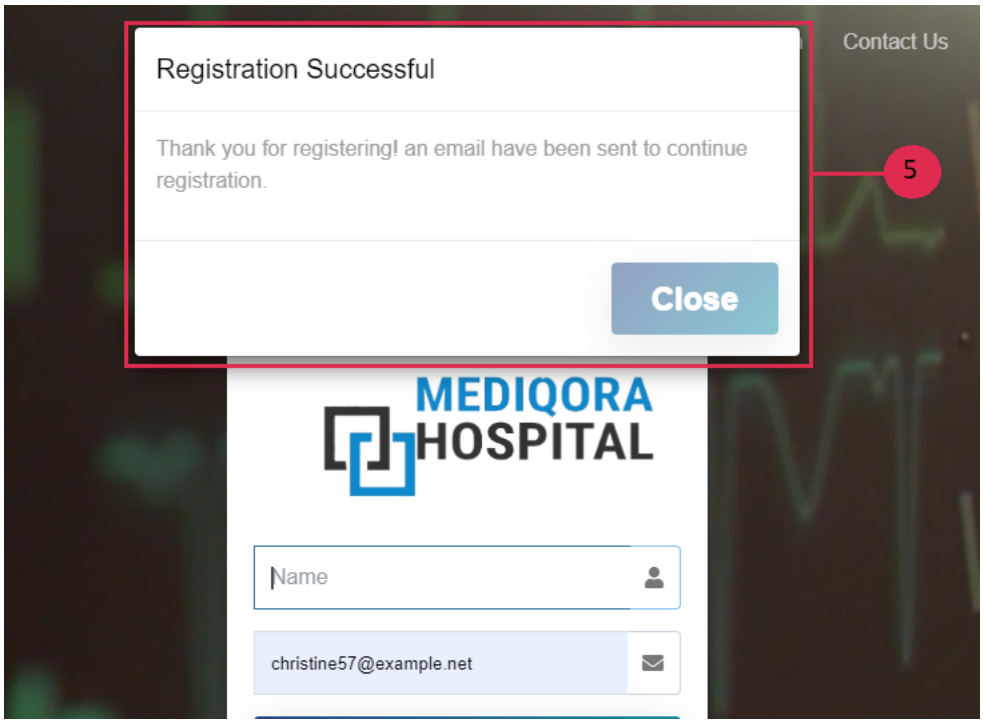

Figure 4.12 – Registration Model

-Set password page:

After clicking on the passwordset link received in the email, users are redirected to the ”Set Password” page.

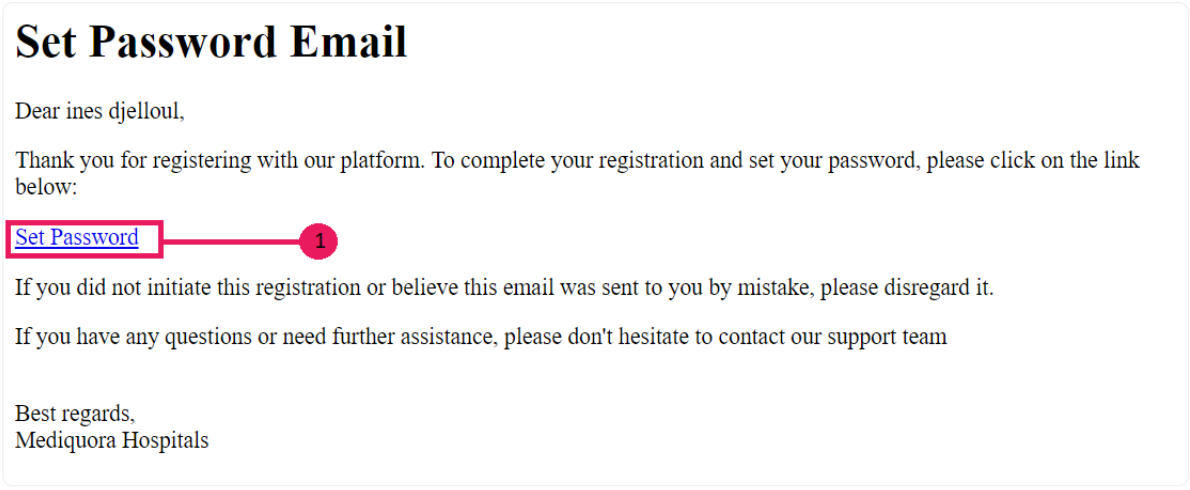

Figure 4.13 – Email sent

This page allows users to securely set a password for their account. The following steps are involved in the process:

(1) **Follow password link:** The user clicks on the password reset link provided in the email (figure 4.13).

(2) **The password link:** The link contains a unique token that is associated with the user's account and ensures the authenticity of the request (figure 4.14).

(3) **Set password Form:** When the user lands on the "Set Password" page, they are presented with a form to enter password.

- Password: Users can enter their desired password in this field. It is recommended to set strong passwords that include a combination of uppercase and lowercase letters, numbers, and special characters for enhanced security.

- Confirm Password: Users are required to re-enter their new password in this field to ensure accuracy.

If the Registration is successfully Done, the user is redirected to the login page.

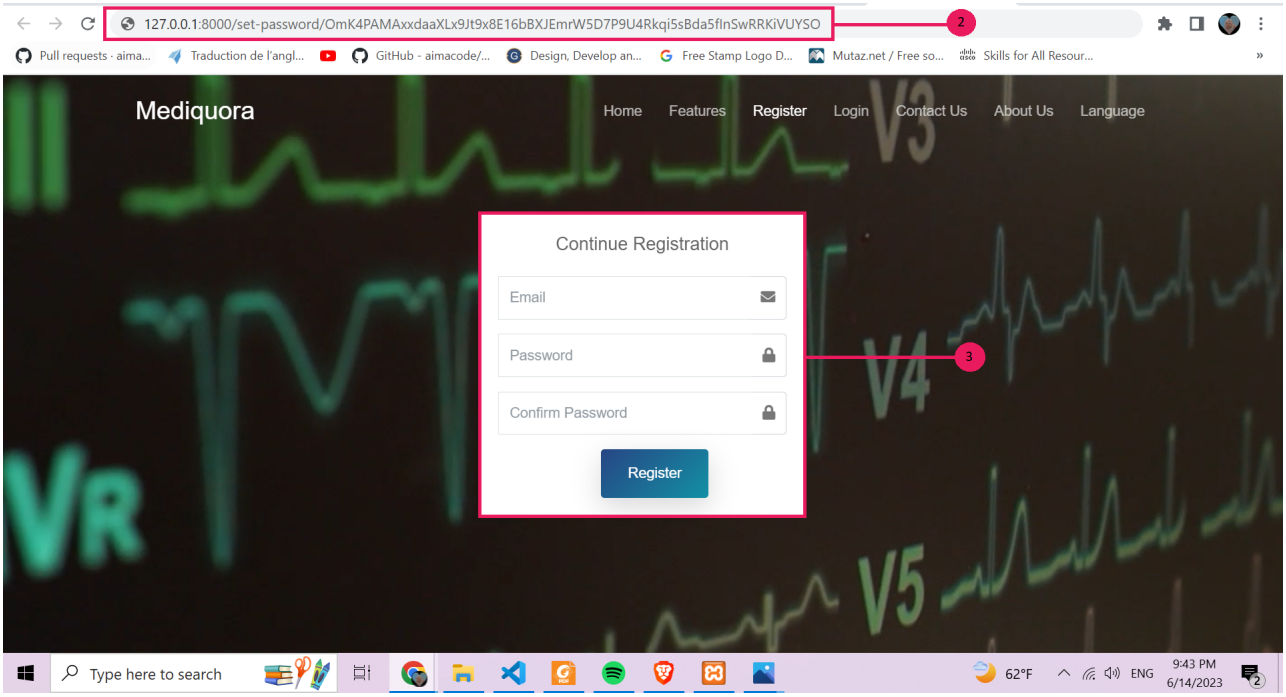

Figure 4.14 – Continue Registration

-Login page:

When accessing our website, the login page (figure 4.15) is displayed.

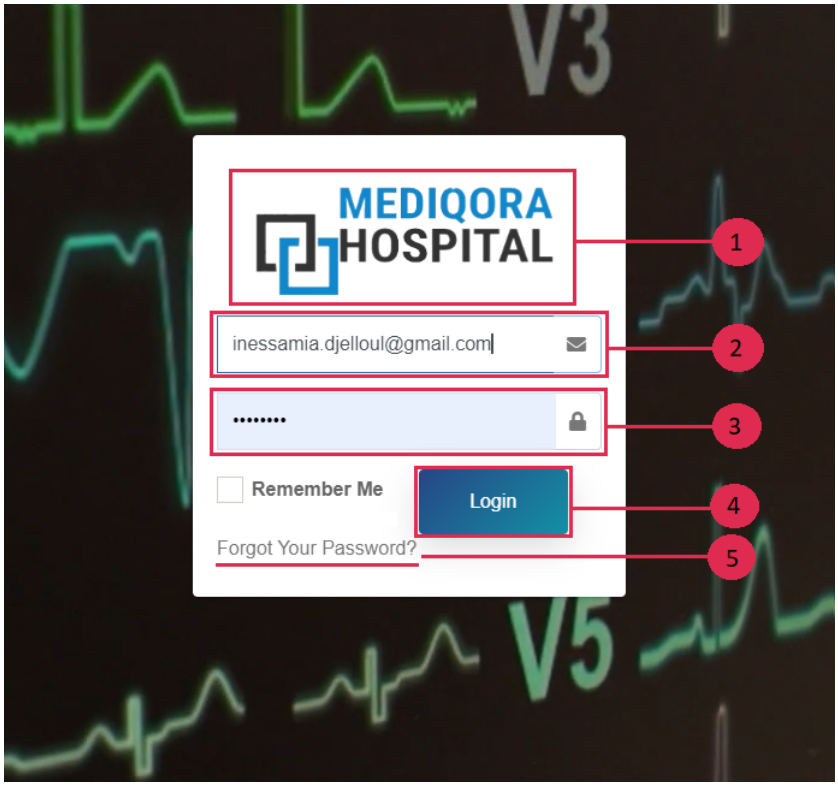

Figure 4.15 – Login Page

It consists of the following elements:

(1) **Logo:** At the top of the page, our Mediquora Hospitals logo is prominently displayed, representing our brand identity.

(2) **Email Input:** An input field is provided for entering the user's email address. This allows users to provide their login credentials.

(3) **Password Input:** A password input field is available for users to enter their respective passwords securely.

(4) **Forgot Your Password?:** In case users forget their passwords, a link is provided to help them recover their accounts. Clicking on this link redirects users to the password recovery process (figure 4.16).

(5) **Login Button:** A prominent button is placed on the page, allowing users to initiate the login process and access their accounts securely.

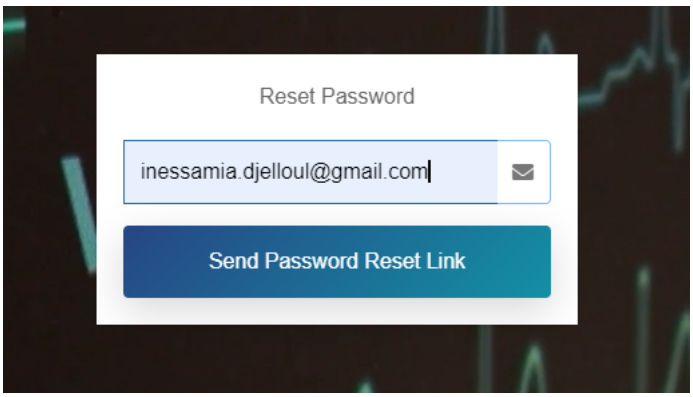

Figure 4.16 – reset password

4.3.1.2 Web site structure

The front end of the system after login in is structured into three components:

(1) **header:** At the top of the page, our Mediquora Hospitals logo is prominently displayed, representing our brand identity.

(2) **Side bar:** in the left side of the page, it is structured into A website logo in the top, under that, a search input, and then a navigational links to the other pages of the website .

(3) **Content:** The main content on the middle of the page.

(4) **footer:** section at the bottom contains additional content we puted the copyrights of mediquora hospitals.

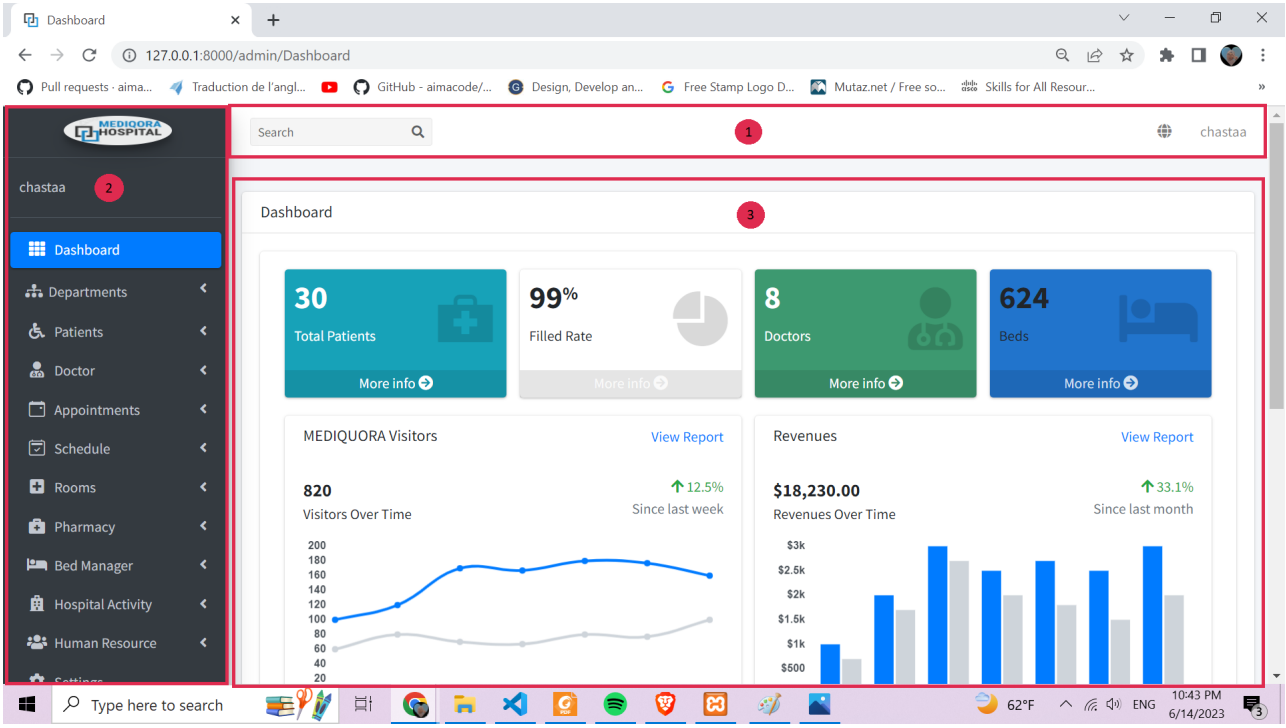

Figure 4.17 – Dashboard Page Page

4.3.1.3 Admin

Users with administrative privileges have full access to all platform features and functionalities. They can manage user accounts, roles, and permissions, configure system settings and preferences, generate reports, and perform administrative tasks.

-Dashboard:

After logging in, Admins are directed to their personalized dashboard, which provides an overview of relevant information and quick access to the features corresponding to their assigned role.

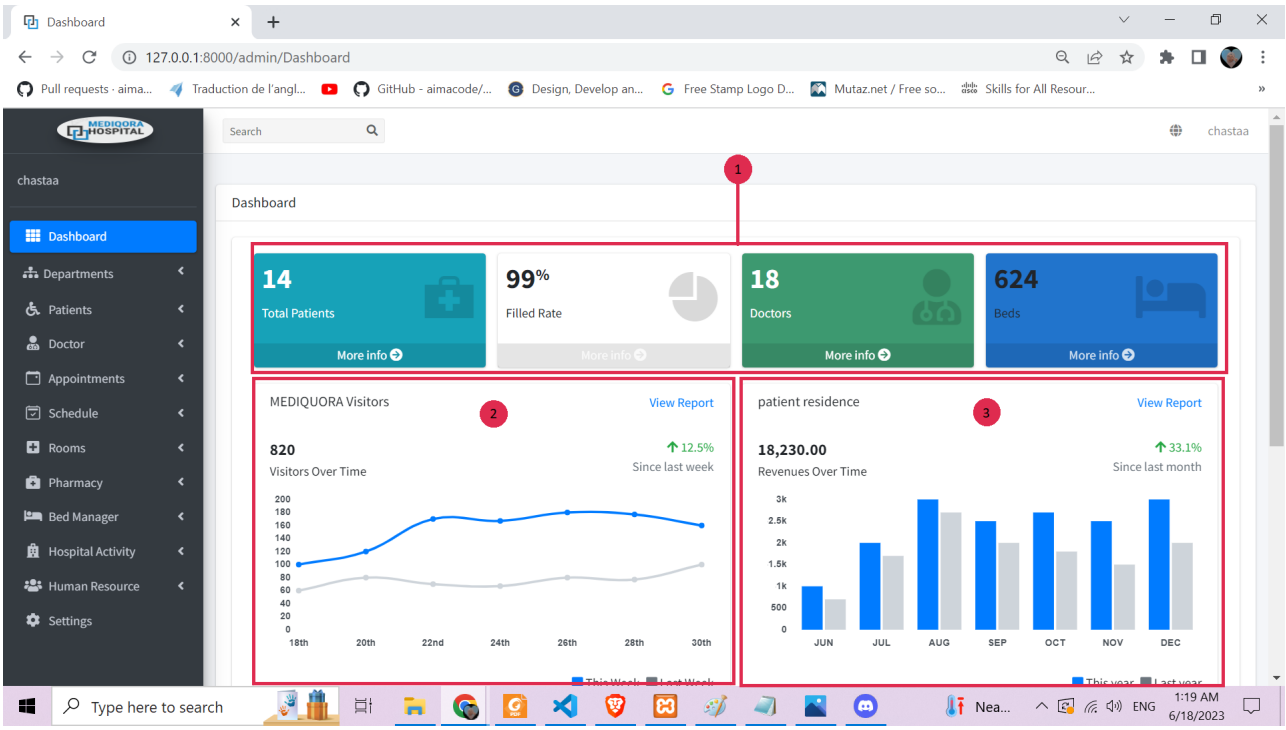

Figure 4.18 – Admin Dashboard Page

(1) **Data Summary:** presents key data such as the total number of patients, beds, and doctors. It calculates the number of filled beds and determines the percentage of availibilaty

(2) **visitors chart:** to provides administrators with valuable insights into user behavior, platform performance, and user engagement, enabling data-driven decision making and goal tracking.

(3) **patient residance chart:** allows administrators to visually track and analyze changes in patient residency patterns over a specific period, aiding in data-driven decision making and resource allocation.

-Patients page:

that provides functionalities and features related to managing patients. As an administrator, you have the ability to perform various actions on this page:

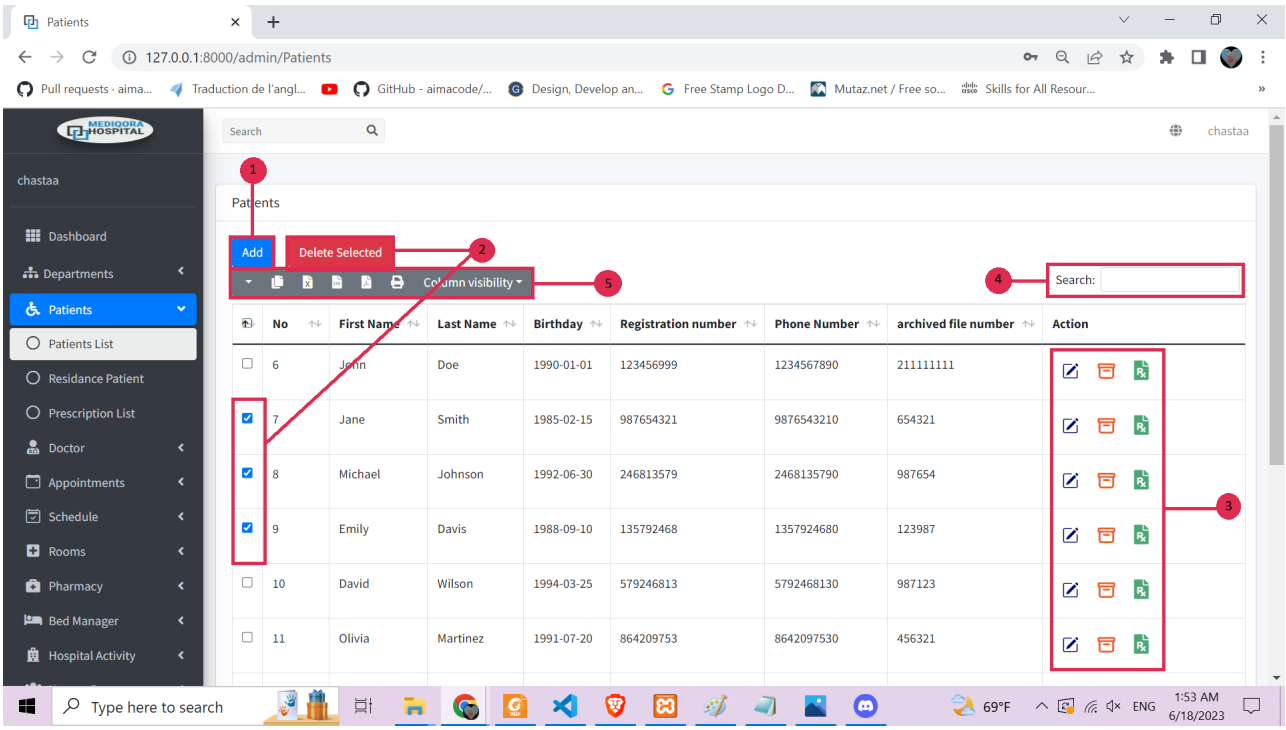

Figure 4.19 – patient Page to admin

(1) **Add new patient:** By clicking on this button, admin can input and submit relevant details about a patient, such as their personal information it pops up the model in the (figure 4.20).

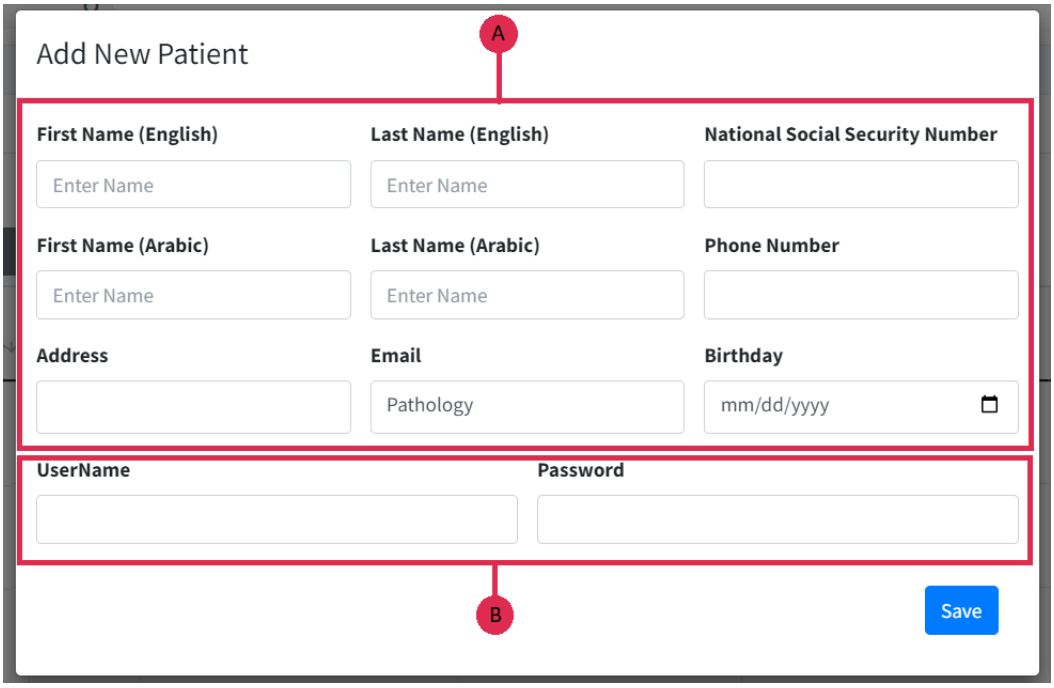

Figure 4.20 – ADD patient model

(A) **information:** the admin input the data of the patient

(B) **login acces:** This section formed by two inputs username and password, these inputs enables the patient to log into the app.

(1) **Delete selected:** By clicking on this button, admin can delet from the table multiple rows at ones (figure 4.21).

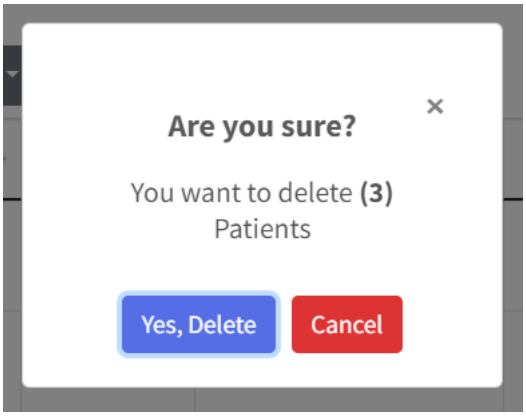

Figure 4.21 – Delete selected

(3) **action buttons:** such as ”Edit,” ”Archive,” and ”Generate Prescription,” provide users with specific functionalities for managing data entries: resource allocation.

-Edit button: it allows the user to modify the details of a selected data entry(figure 4.22).

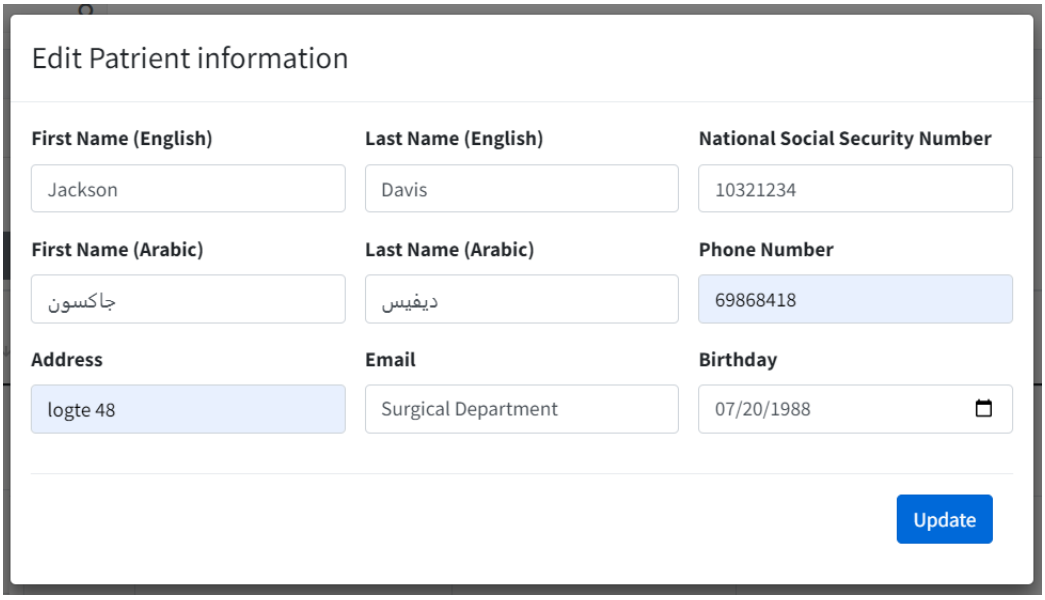

Figure 4.22 – edit patient model

-Generate Prescription: The button creates a prescription or medical document based on the selected data entry. This functionality streamlines the prescription process, reducing manual paperwork and ensuring accurate and standardized prescription generation.

-Archive: This button allows users to move a data entry into an archived state, indicating that it is no longer active or relevant. Archiving helps declutter the datatable while retaining a record of the information for historical purposes or future reference.

(4) **search table:** a convenient way to search and filter through the data displayed in the table

(5) **export data:** The export patient list to PDF, Excel, and printing features enhance data accessibility, enabling users to save, analyze, and share data in different formats for offline use and physical documentation.

- Residance page :

The Residence page shows the location and admission dates of infected patients, providing important information for monitoring and managing their residency it contains two main parts table of all the residance the placement of beds and there avalibilaty.

(1) **Table of Residences:** This section displays a table containing information about all the residences. It includes details such as the location and admission dates of infected patients. This table serves as a comprehensive overview, allowing for efficient monitoring and management of patient residency.

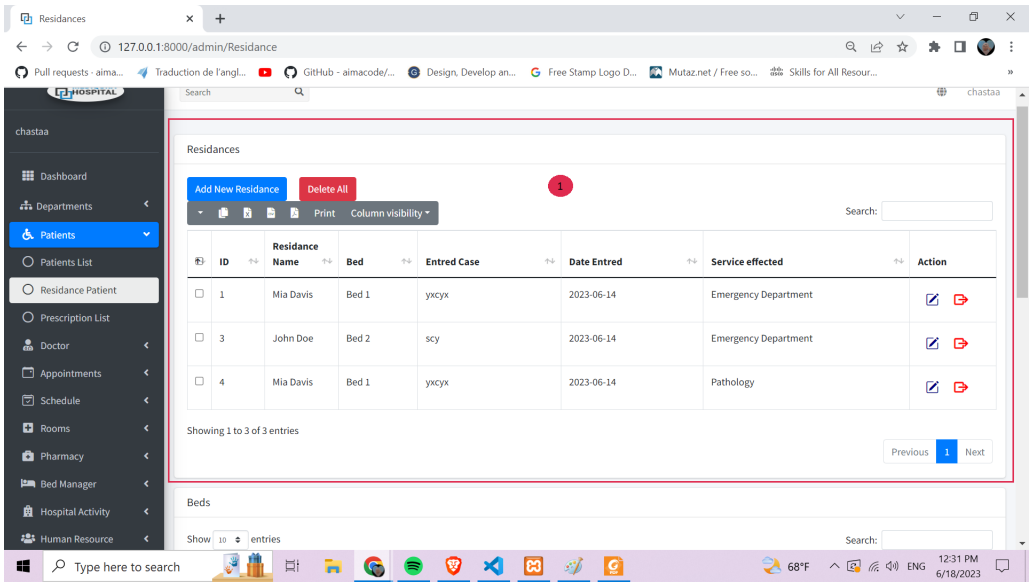

Figure 4.23 – Residance Page

(2) **Bed Placement and Availability:** The second section focuses on the placement of beds and their availability. It provides real-time information on the status of beds, indicating whether they are occupied or vacant. This feature enables healthcare providers to make informed decisions about patient placement and optimize bed utilization effectively.

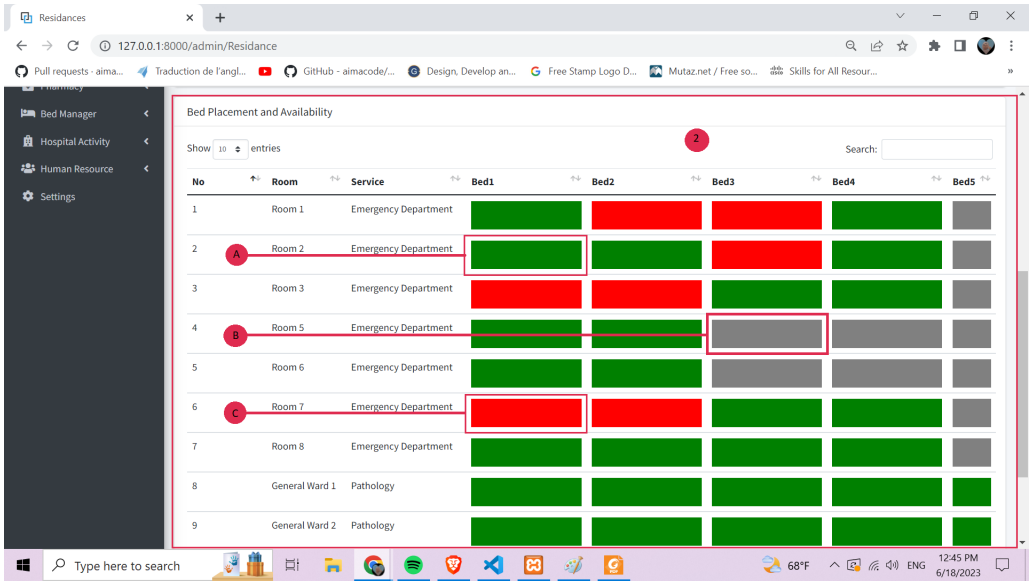

Figure 4.24 – Bed Availibility Part

(A) **Availabale Bed:** An available bed is visually highlighted in green, indicating its readiness for assignment to a patient. Upon clicking on an available bed, a model or dialog box appears, facilitating the process of assigning a patient to that specific bed we can assign a patient to on click it the pop up model is shown in (figure 4.25).

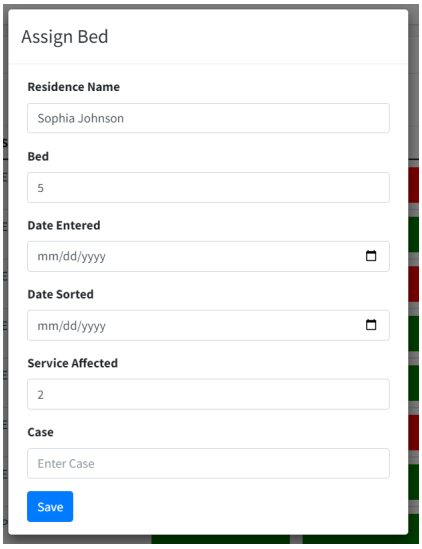

Figure 4.25 – Bed Assign Model

(B) **Reserved Bed:** A reserved bed refers to a bed that has already been assigned to a patient and is currently occupied. This status indicates that the bed is not available for new patient assignments.

(C) **No Bed:** This designation signifies the unavailability of any vacant beds. This indicates that there are currently no beds in that placement in the room.

- Profile page:

Profile page contains all the information of the current admin (figure 4.26).

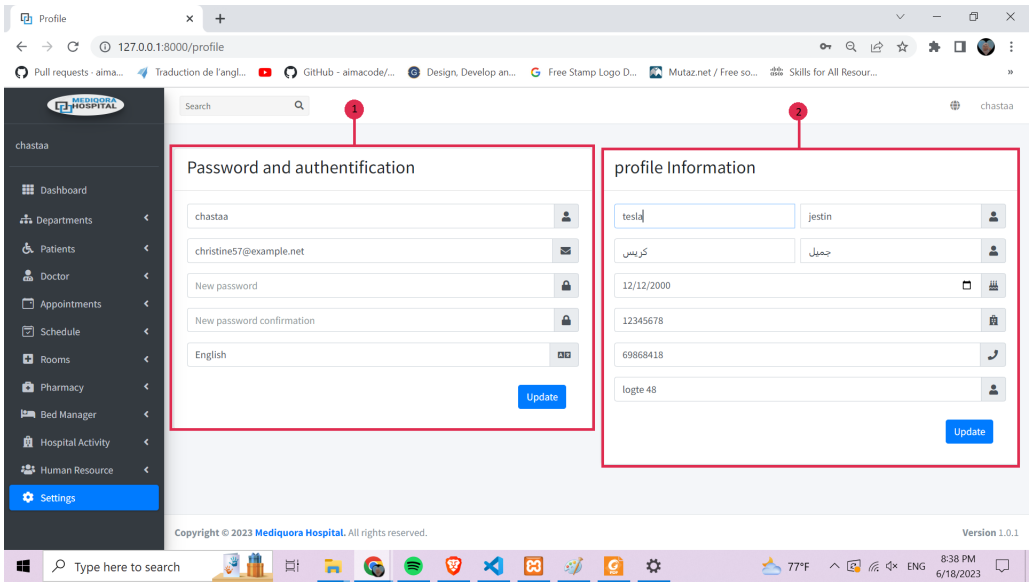

Figure 4.26 – profile

(1) **Password and authentification:** A reserved bed refers to a bed that has already been assigned to a patient and is currently occupied. This status indicates that the bed is not available for new patient assignments.

(2) **profile Information:** This section enables users to update their password, configure . Additionally, users have the option to modify their language preference in this section, allowing them to select a preferred language for the system or interface.

- subscription page:

It is displayed for the admin, who is either the owner of the clinic or the Hospital Management System (HMS), and it provides the necessary information and options to select the desired buying package for the clinic or HMS.

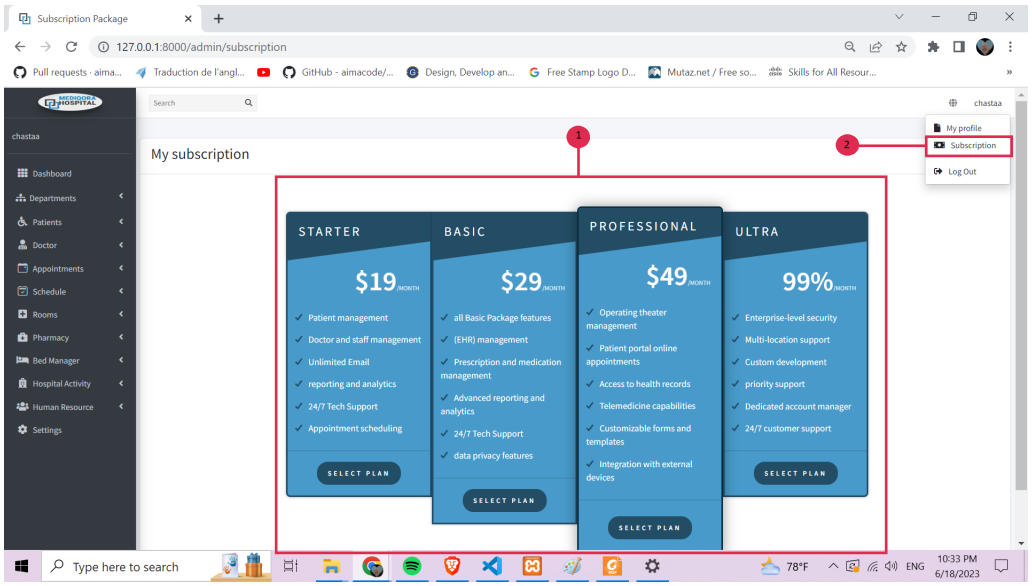

Figure 4.27 – subscription page

(1) **subscription path:** Clicking on this path will redirect the admin to view the available packages for subscription.

(2) **subscription packages:** these packages offer different subscription options and services for the admin to choose from, providing flexibility in selecting the most suitable package for their clinic or HMS.

- Description

It contain the details of the medicines that is in the generated prescription.

- Medicines

It stores details about medicines that exist in the facility.

4.3.1.4 Chef service

Users with chef services privileges have almost the full access to platform features but it can be only applied to manage they're service.

- Dashboard

After logging in chef services are directed to their personalized dashboard have a view about they're service, which provides an overview of relevant information and quick access to the features corresponding to their assigned role (figure 4.28).

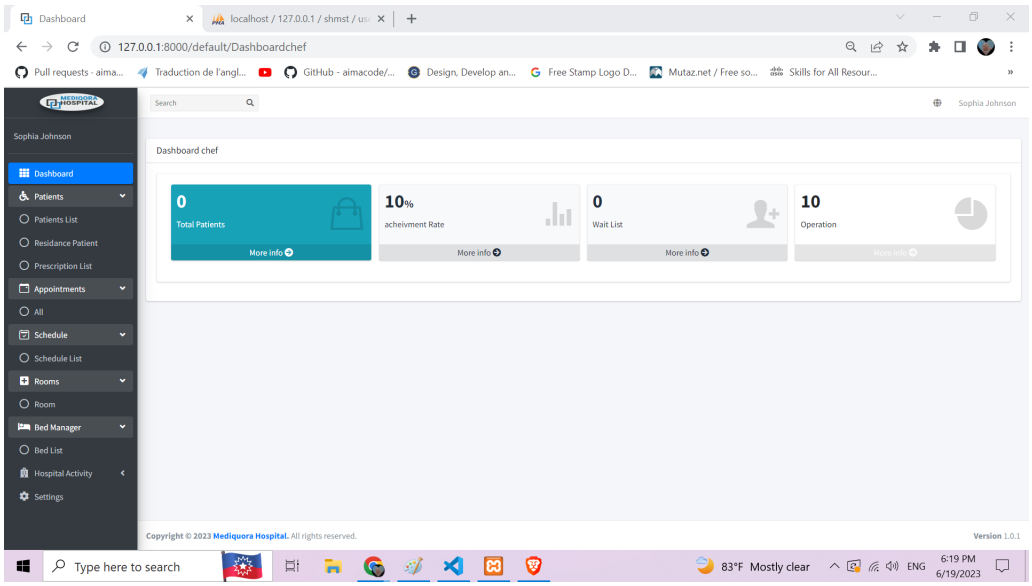

Figure 4.28 – chef department page

4.3.1.5 Doctor

Users with doctor privileges have access to specialized features for patient management, medical record documentation and prescription management.

- Dashboard

After logging in doctors are directed to their personalized dashboard , which provides an overview of relevant information and quick access to the features corresponding to their assigned role (figure 4.29).

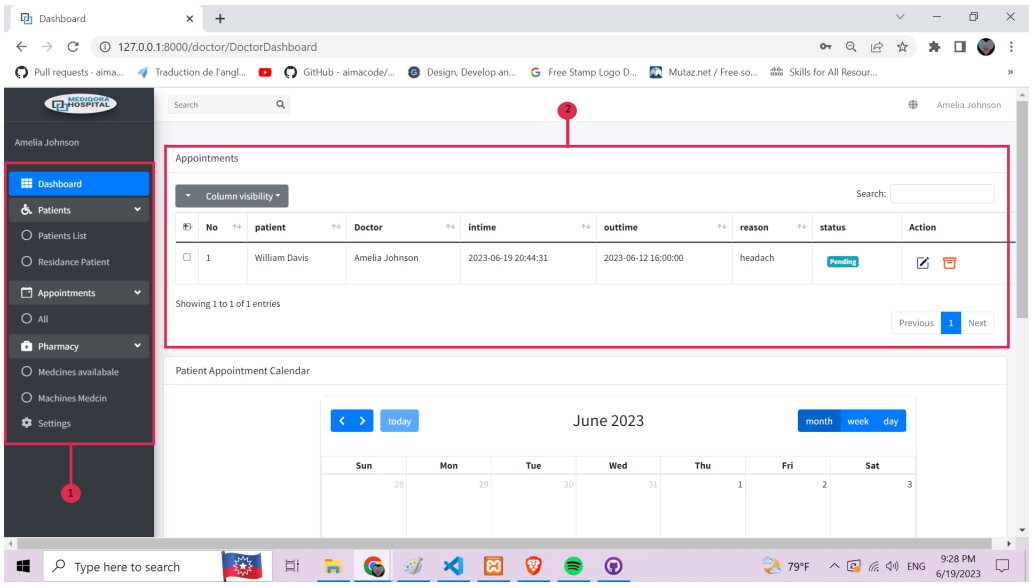

Figure 4.29 – doctor dashboard page

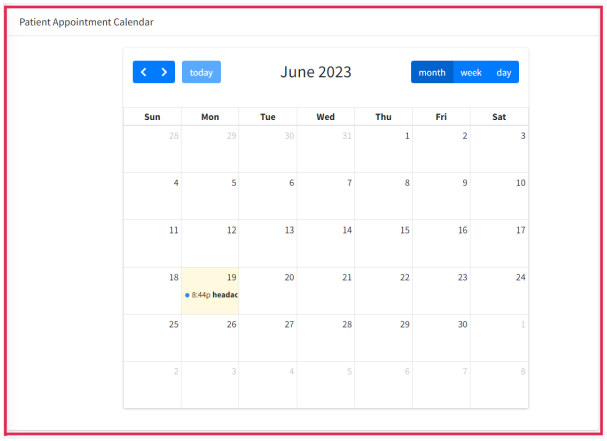

Figure 4.30 – doctor calendar page

(1) **Pending appointment:** Clicking on this path will redirect the admin to view the available packages for subscription.

(2) **Appointment calendar:** the appointment calendar is a feature that allows the doctor to visualize and manage the scheduling of appointments. It provides a graphical representation of appointments over a specified time period, facilitating efficient appointment management and resource allocation.

(3) **Doctor Sidebar:**it displays relevant information and options related to the doctor. It includes options for managing doctor-related tasks, such as assigning or editing doctor schedules, accessing doctor-specific settings.

- Patient page

Within this page, doctors have limited functionality not like the admin ,specifically the ability to generate prescriptions for patients (figure 4.32).

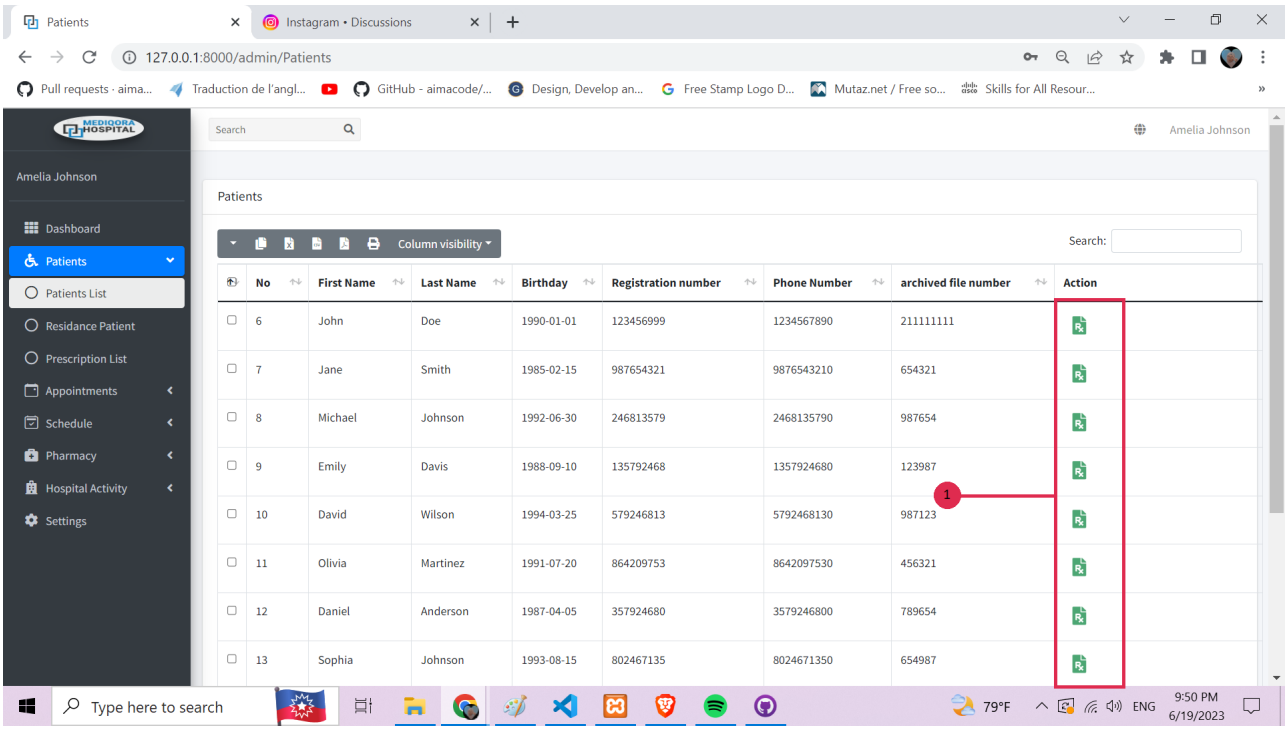

Figure 4.31 – doctor patient page

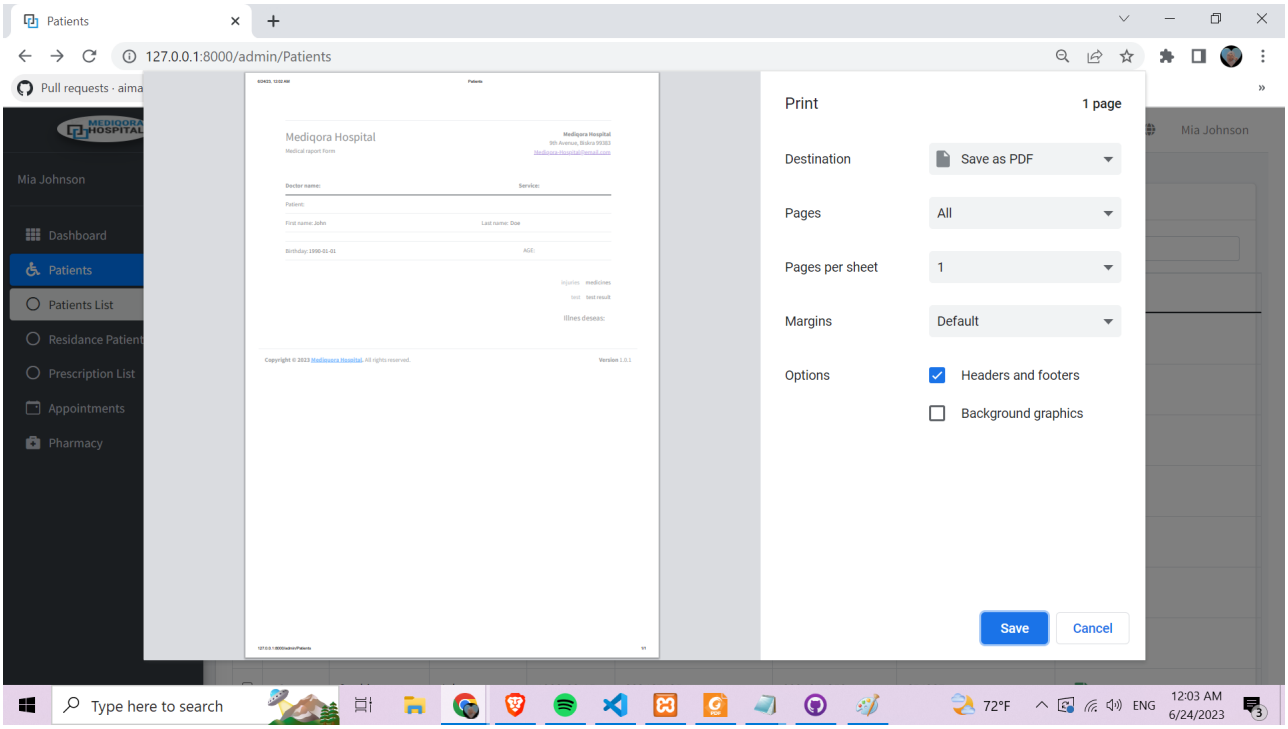

Figure 4.32 – prescription patient page

4.3.2 Mobile App

The application is divided into two main sections: patient access and doctor access. Patients who have a registered medical history on the platform can utilize the patient section to access their personal and medical information. Additionally, they can conveniently schedule appointments with doctors through the platform and make call if they are in the hospital. Creating their own account grants them access to these features.In contrast, the doctor login allows doctors to access the platform and perform various functions. They can view their list of patients, including those who have made calls from the hospital. Additionally, doctors can access relevant statistics for the day, providing valuable insights.

4.3.2.1 Login page

On the login page, users are provided with a designated area where they can input their login details, their email address and password. By filling in these required fields and submitting the information, users can proceed to access their personal accounts.

The purpose of the login page is to authenticate the identity of users and verify their authorization to access the protected resources or services within the system. It serves as a gateway that restricts unauthorized individuals from gaining entry to sensitive information or functionalities. enabling them to access the relevant sections of the application based on their role (patient or doctor)(figure 4.33) (figure 4.34).

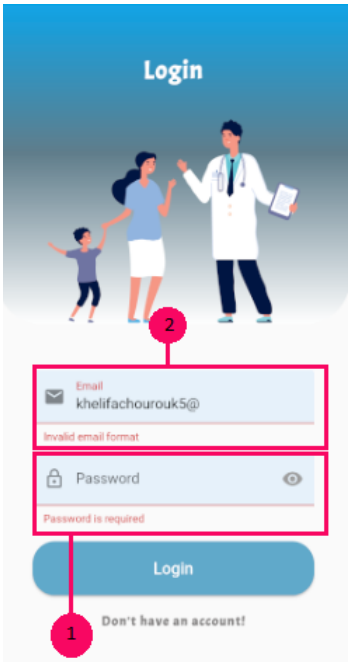

Figure 4.33 – Login page

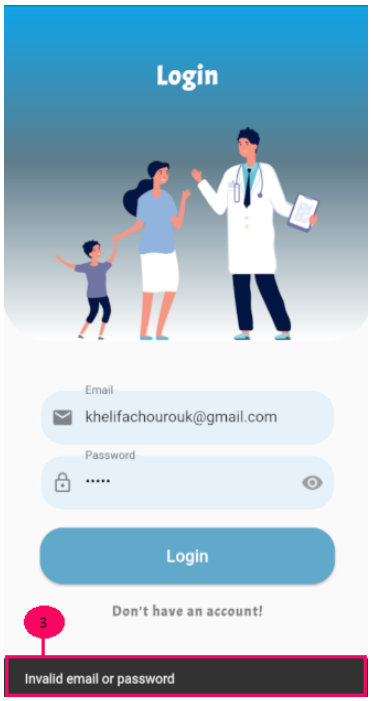

Figure 4.34 – Login page

(1) **Required email or password:** The login page prominently displays a message indicating that both an email and a password are required to proceed with the login process. This message serves as a visual reminder to the user that both fields need to be filled out.

(2) **Email format:** To ensure the validity of the entered email address, the login page incorporates a validation mechanism. If a user enters an email address in an incorrect format, such as missing the ”@” symbol or including invalid characters, the login page will display an error message indicating that the email format is invalid. This message notifies the user about the issue and prompts them to correct their input before proceeding with the login process.

(3) **Invalid email or password:** In case the user enters an incorrect email or password , the login page displays an error message indicating that the credentials provided are invalid.

4.3.2.2 Register page

The registration page is a crucial step for both patients and doctors to join the application ,The registration form ensures that patients and doctors can securely create their accounts, allowing the application to authenticate their identities and provide appropriate access levels and functionalities based on their respective roles (figure 4.35) (figure 4.36).

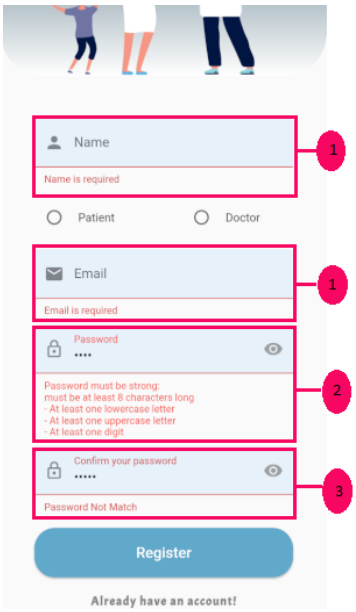

Figure 4.35 – Register page

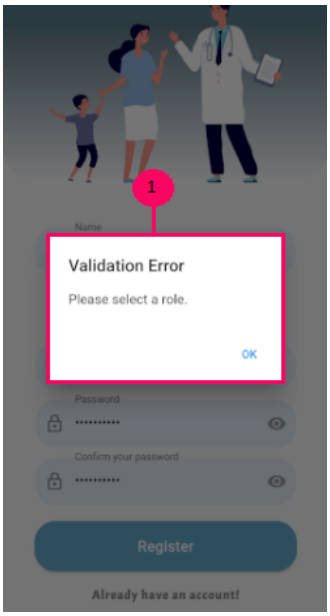

Figure 4.36 – Register page

(1) **Required Elements:** The registration page requires new users to provide their name, role, email address, password, and confirm password in order to create an account and gain access to the application. This comprehensive form collects essential information for account setup .

(2) **Strong Password:** When creating an account on the registration page, users are encouraged to choose a strong password. A strong password is one that is secure and difficult for others to guess or crack. It includes a combination of uppercase and lowercase letters, numbers.

(3) **Match password:** The match password functionality refers to the procedure of determining whether the user-provided password input and confirm password input are identical.

4.3.2.3 Patient pages

The implementation of the login page distinguishes between patients and doctors based on the provided email or password.

- Home Page

The home page offers two screens. The first screen allows patients to make calls directly if they are currently hospitalized (figure 4.37).

On the second screen, they can access and view their appointments list. This section provides an organized overview of their upcoming appointments, helping patients stay informed and prepared for their scheduled medical consultations (figure4.38).

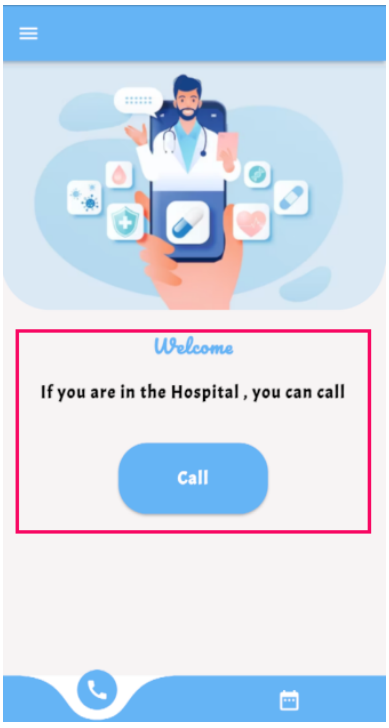

Figure 4.37 – Call Screen

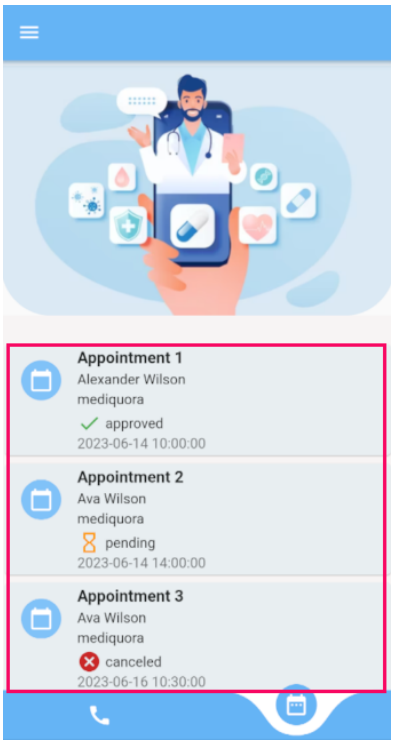

Figure 4.38 – Appointments List Screen

- Drawer Screen

The Drawer Screen contains an ensemble of pages accessible through a side navigation drawer. This navigation component allows users to easily navigate between different sections of the application (Figure 4.39).

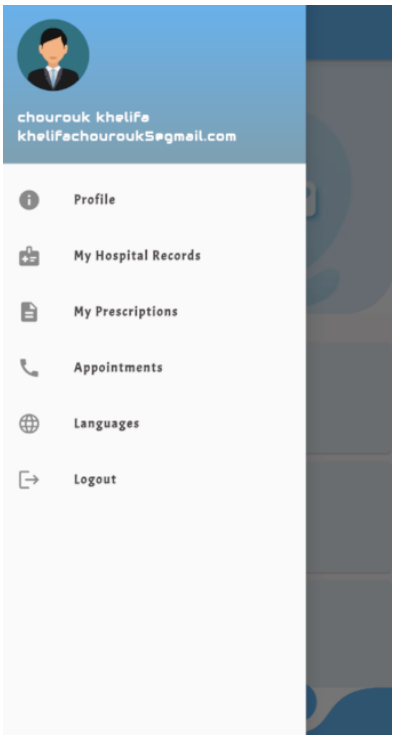

Figure 4.39 – Drawer Screen

- Profile Page The profile page is a dedicated section within the application where users can view and manage their personal information(figure 4.40)(figure 4.41).

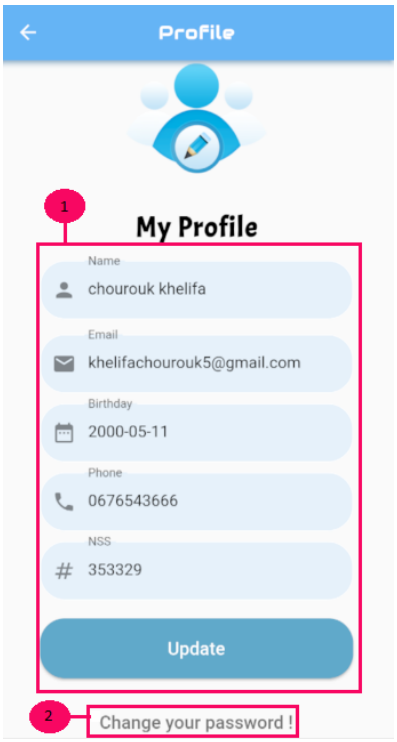

Figure 4.40 – Profile Update

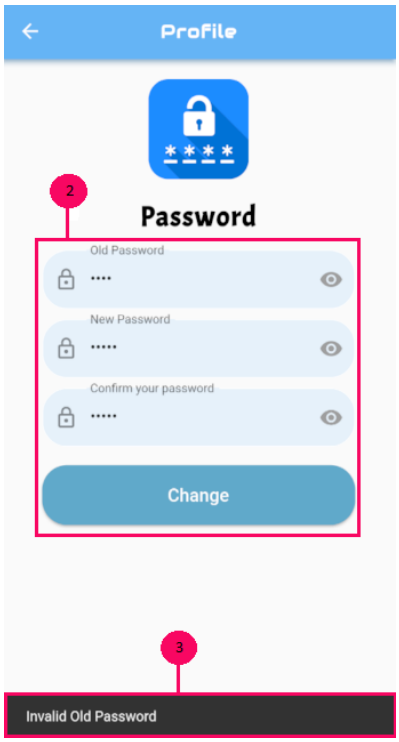

Figure 4.41 – Change Password

(1) **Update:** The profile page provides users with the ability to update their information when necessary. This includes features such as editing their name , email or modifying any other relevant information associated with their account. By offering this functionality, users have control over their personal data and can keep it relevant and accurate.

(2) **Change Password:** The profile page also includes a feature to change the account password. This functionality allows users to update their password and enhance the security of their account. Users can initiate the password change process by entering their current password and then specifying the new password they wish to set.

(3) **Invalid Old Password:** If users enter an incorrect current password when trying to change their password, they will receive an error message indicating the invalidity of the old password. This ensures that only authorized users can modify their account password.

- Hospital Records Page

The Hospital Records page is a crucial section within the application that provides users with access to a list of their medical records.this page displays a comprehensive list of medical records associated with the user (figure 4.42).

When users click on a specific record from the list, they are directed to a dedicated Record Details page. This page provides a more comprehensive view of the selected medical record(figure 4.43).

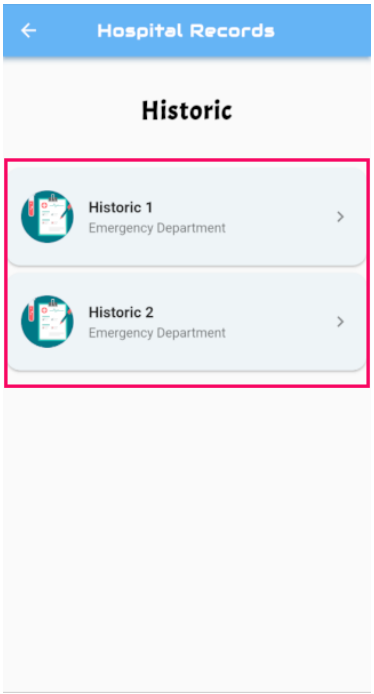

Figure 4.42 – Hospital Records Page

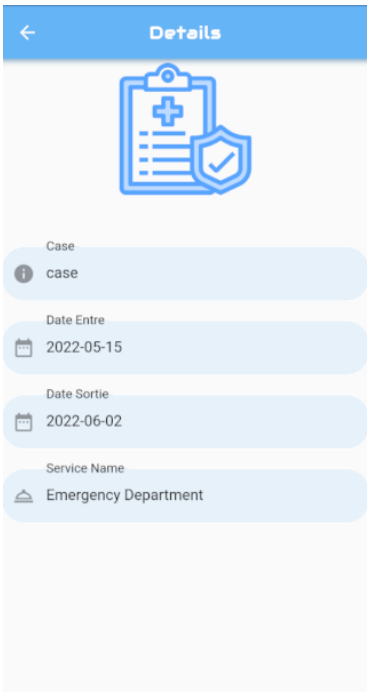

Figure 4.43 – Records Details Page

- Prescriptions Page

The prescription page in the patient app provides users with a centralized location where they can access their prescribed medications. This page displays a comprehensive list of their active prescriptions, ensuring that patients have easy and convenient access to the details of their prescribed treatments (figure 4.44).

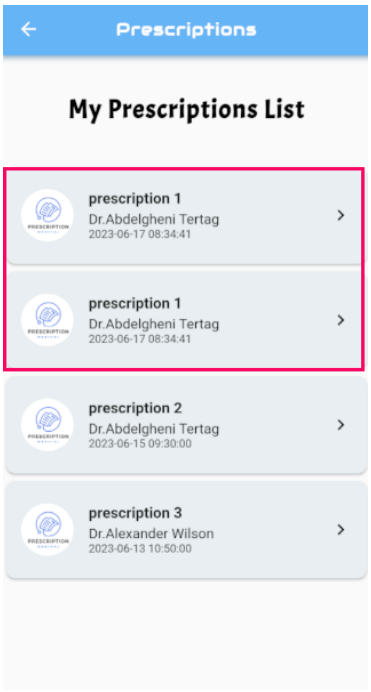

Figure 4.44 – Prescriptions page

Each item on the prescription page includes essential information such as the prescription number, the name of the prescribing doctor, and the date of the prescription.

When users click on a specific prescription item, they are taken to the detailed description of that medication. The description provides information about the prescribed medication, including its name, dosage instructions This allows patients to gain how to properly take it.

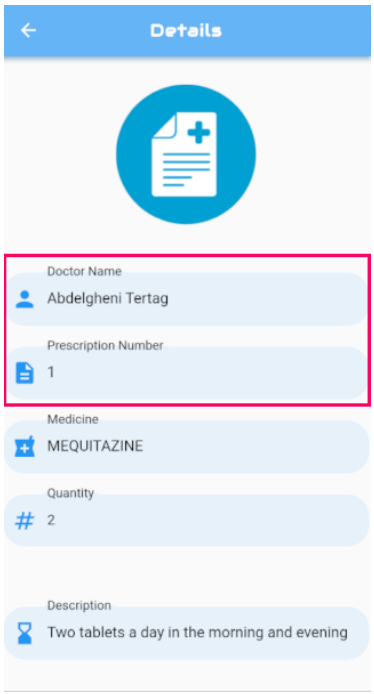

Figure 4.45 – First Medication For Prescription 1

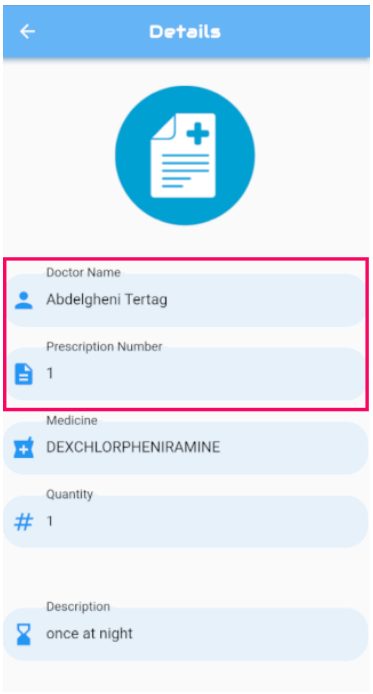

Figure 4.46 – Second Medication For Prescription 1

- Appointments Page

The Appointments Page provides users with a full list of available doctors on the platform. Each doctor on the list is accompanied with vital information such as their name, specialization, and the name of the hospital or private clinic with which they are affiliated. Users can use this list to research various healthcare providers and specialties, making it easier to choose a doctor who suits their individual needs (figure 4.47).

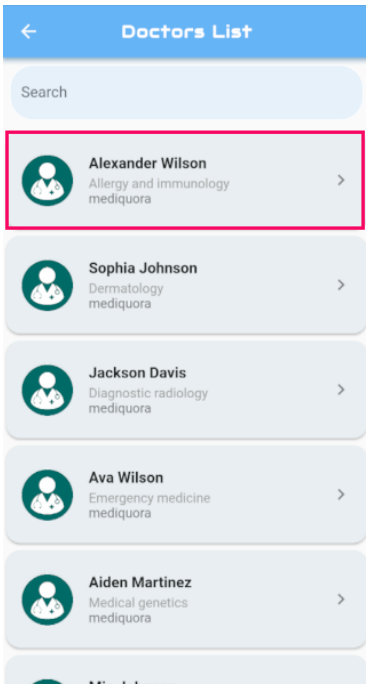

Figure 4.47 – Doctors List

Once users have identified a doctor they are interested in, they can select the doctor from the list. This action directs them to a dedicated page where they can proceed to book an appointment. On this page, users are presented with an appointment booking form that typically includes fields such as preferred date, time slot, and reason for the appointment. Users can fill out these details according to their preferences and requirements (figure 4.48) (figure 4.49) .

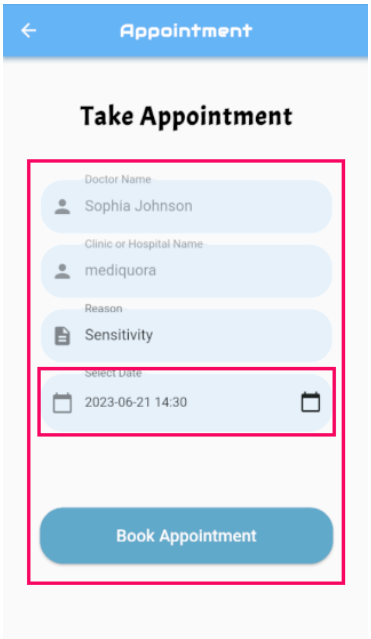

Figure 4.48 – Take Appointments

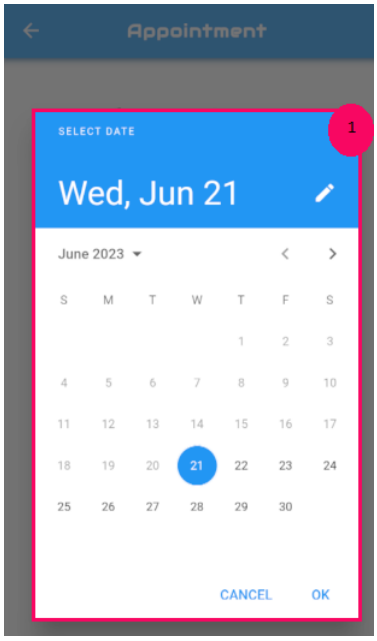

Figure 4.49 – Select Date

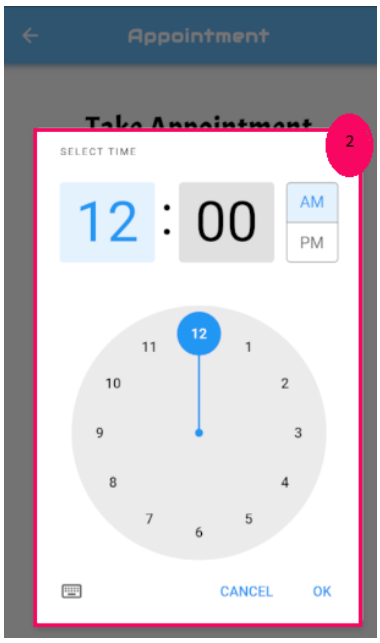

Figure 4.50 – Select Hour

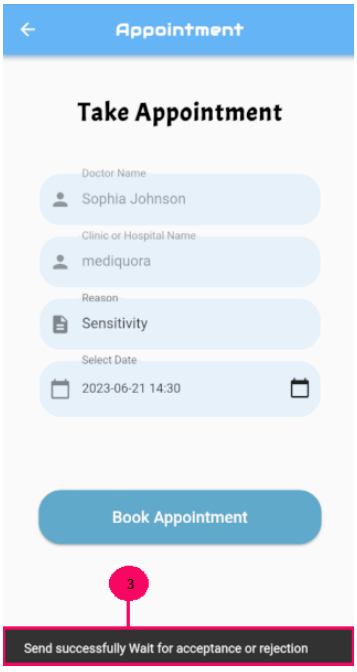

Figure 4.51 – Send Book

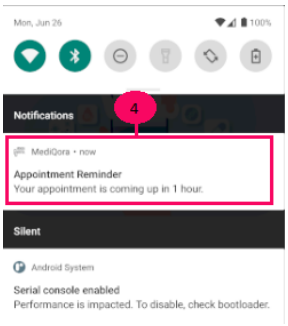

Figure 4.52 – Appointment Notification

(1) **Select Date:** When users click on the ”Select Date” field, a calendar is displayed, allowing them to choose a specific date for their appointment.

(2) **Select Hour:** After selecting a date for the appointment, users are presented with the option to choose the specific hour for their appointment..

(3) **Send Book:** After completing the appointment booking form, users can click on the ”Book Appointment” button to finalize and submit their appointment request. Upon clicking the button, the system processes the form data and initiates the booking process.

(4) **Appointment Notification :** The appointment notification feature is responsible for notifying patients about their upcoming appointments. This feature ensures that patients receive timely reminders and stay informed about their scheduled appointments.

- Languages

The application is designed to be multilingual, offering users the flexibility to switch between different languages according to their preferences and needs.

When users access the language , they are presented with a list of available languages to choose from. This list includes used languages English, Arabic and French, depending on the supported languages of the application.(figure 4.65)

Figure 4.53 – Change Languages

Upon selecting a different language, the application dynamically adjusts its content and user interface to reflect the chosen language.

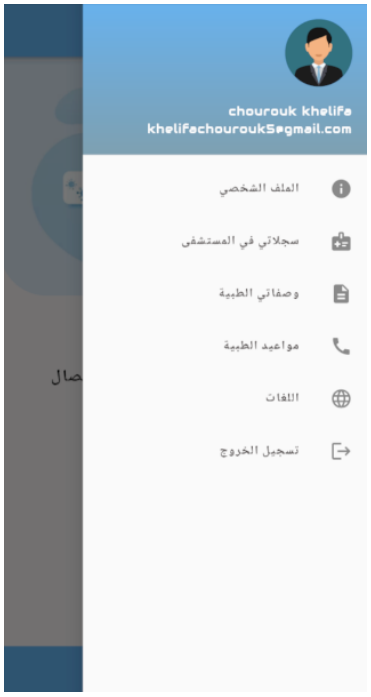

Figure 4.54 – Drawer In Arabic

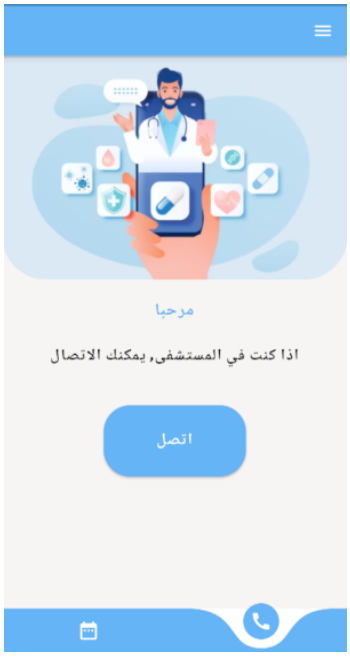

Figure 4.55 – Home in Arabic

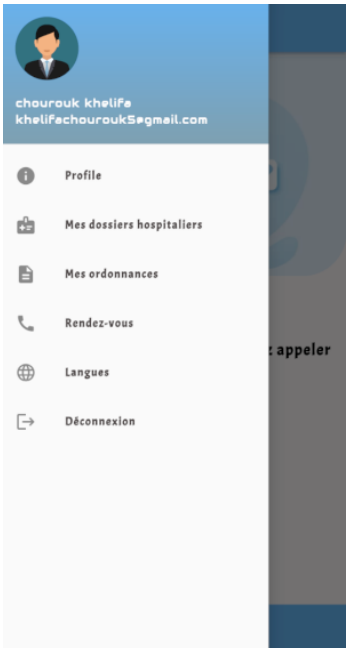

Figure 4.56 – Drawer In French

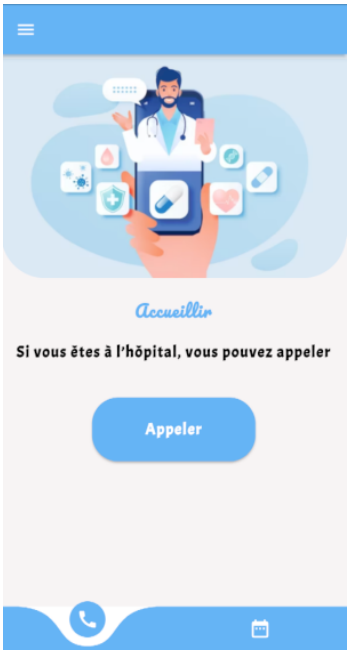

Figure 4.57 – Home in French

- Logout

The Logout feature allows users to securely log out or sign out from their account within the application. When users choose to log out, the system terminates their current session and removes their access to the application's protected resources and functionalities.(figure 4.58),(figure 4.59).

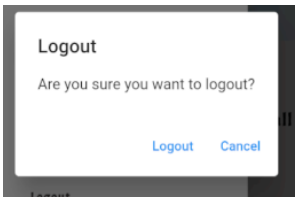

Figure 4.58 – Logout In English

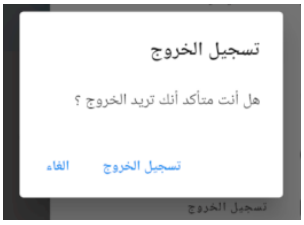

Figure 4.59 – Logout In Arabic

4.3.2.4 Doctor pages

When doctors log into the application using their unique credentials, they are granted access to Doctor Pages, which provide them with specialized tools and features tailored to their profession.

- Home Page

The home page of the Doctor Pages serves as a centralized hub for doctors, offering two key functionalities (figure4.60) ,(figure4.61) :

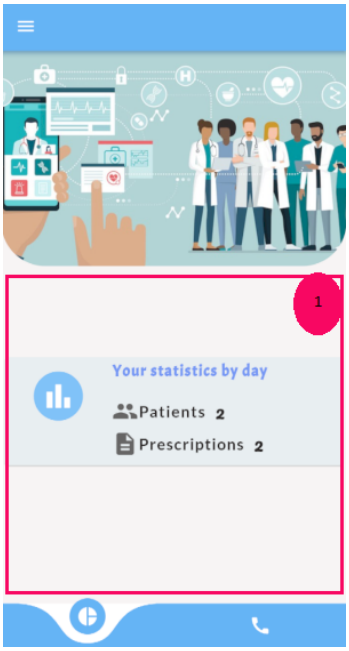

Figure 4.60 – Statistics Screen

Figure 4.61 – Call List Screen

(1) **Statics Screen:** The Statistics Screen provides doctors with valuable insights into their practice. It presents relevant data and metrics that help doctors analyze and assess their performance. This include information the number of patients seen in a day, the frequency of prescription consultations. By having access to these statistics, doctors can make informed decisions, track their progress, and identify areas for improvement.

(2) **Call List Screen:** The call list screen within the doctor's application is designed to facilitate effective communication between doctors and their hospitalized patients. It provides a list of patients who require immediate attention or consultation from the doctor.

The screen periodically updates every 30 seconds to check for any new incoming calls or contact requests from patients.

If there is an incoming call from a patient, the call list screen generates a notification to alert the doctor.

Additionally, the call list screen displays relevant information about the contacting patient. This information include the patient's name,hospital name service ,room number and bed number.

- Drawer Screen

The Drawer Screen is a convenient feature available to doctors in the application. It provides quick and easy access to various options and tools that doctors can utilize for efficient navigation and task management (figure 4.62).

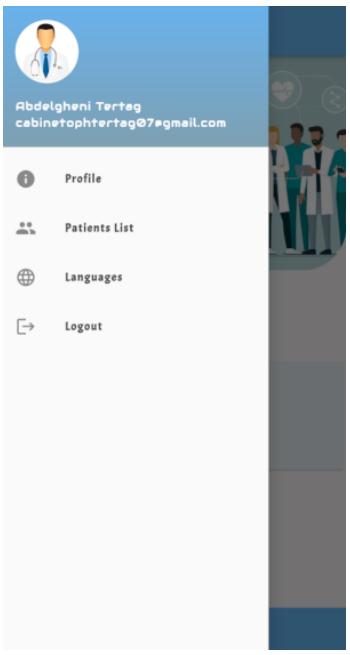

Figure 4.62 – Doctor Drawer

- Profile

The Profile page in the doctor's interface is a dedicated area where doctors can manage and update their personal information within the application (figure 4.63).

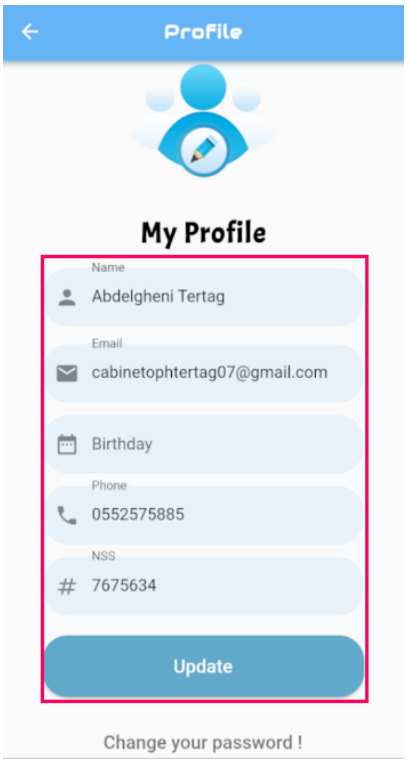

Figure 4.63 – Doctor Profile

- Patients List

A patient list is an essential component of a doctor's interface. It provides doctors with a comprehensive view of their registered patients (figure 4.64).

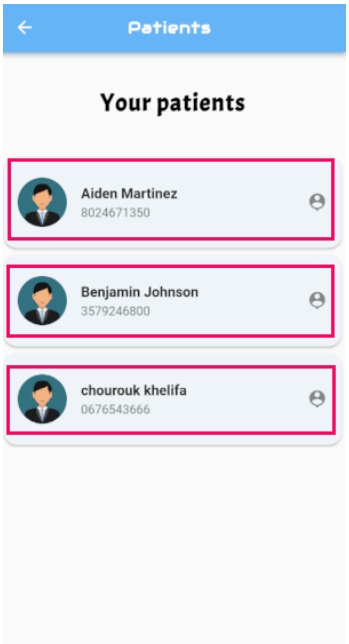

Figure 4.64 – Patients List

- Languages

multi-language support is implemented to cater to the diverse needs of users. This feature allows doctors to change the language settings according to their preference or the language they are most comfortable with (figure 4.65).

Figure 4.65 – Change Languages

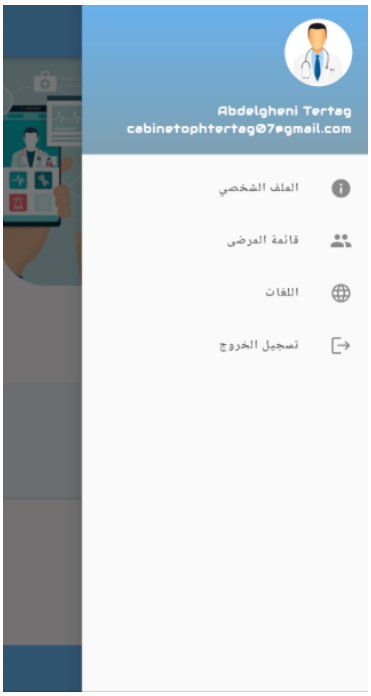

Figure 4.66 – Drawer In Arabic

Figure 4.67 – Home in Arabic

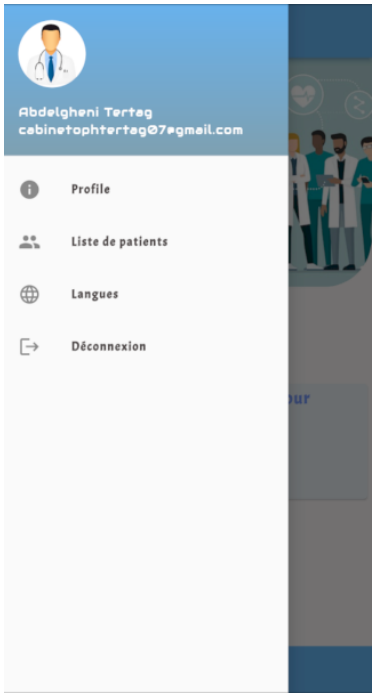

Figure 4.68 – Drawer In French

Figure 4.69 – Home in French

4.4 Conclusion

In conclusion, this chapter has delved into the implementation of our solution for the Smart Healthcare Management System (SHMS).

We have showcased the software tools utilized in the development process, emphasizing their significance. Furthermore, we have introduced the comprehensive web-based dashboard, meticulously designed with separate pages tailored for doctors and patients, fostering seamless interaction and streamlined healthcare management.

The mobile applications developed for doctors and patients were also highlighted, illustrating the accessibility and convenience provided by our system. Lastly, we described the prototype of the smart medical device integrated within our solution, underscoring its role in enhancing the overall efficiency and effectiveness of healthcare delivery. Collectively, these advancements demonstrate the tangible progress made in revolutionizing healthcare through the integration of technology and intelligent systems.

Conclusion

Hospital management is a critical issue worldwide, especially with the growing human population and increasing waste generation. To address this, we have proposed a new hospital management system . This system provides real-time insights on various aspects.

In our project, we have developed a Platform provides functionalities such as appointment scheduling, patient registration, electronic health records management, and resource allocation. Administrators can monitor key performance indicators, make informed decisions, and optimize resource allocation based on real-time data and analytics.

Mobile Application enhances accessibility to healthcare information and services for both doctors and patients. It offers features such as appointment management and prescription services. The mobile app empowers doctors to manage their schedules, access patient information securely. Patients can conveniently schedule appointments, access their health records, promoting patient engagement and satisfaction.

By developing these components, this dissertation contributes to the advancement of hospital management practices.

Looking ahead, our future work focuses on enhancing the Smart Hospital Management System by incorporating optimization techniques. This will further improve the efficiency and effectiveness of hospital operations, resource allocation, and decision-making processes by incorporating machine learning algorithms into the Smart Hospital Management System to enable predictive maintenance of medical equipment. By analyzing equipment performance data, the system can identify potential issues and schedule maintenance activities in ad-

vance, reducing downtime and ensuring the availability of critical equipment.

In conclusion, the proposed Smart Hospital Management System represents a significant advancement in the healthcare industry. It streamlines processes, improves patient care, and optimizes resource utilization, ultimately contributing to more efficient and effective hospital management practices.

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