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SOFTWARE ENGINEERING
Theme

Design and Development of a Hospital Management System

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whose unwavering support and guidance have shaped us into what

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loved ones and dear friends, for they have enriched our lives in

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summary

This project introduces a comprehensive Hospital Enterprise Resource Planning (ERP) System designed to enhance the efficiency, coordination, and quality of healthcare services. The system integrates a wide range of hospital operations, including patient registration, doctor management, appointment scheduling, billing, inventory tracking, prescription handling, and medical reporting.

By centralizing hospital data and automating workflows, the system significantly reduces administrative burdens and minimizes waiting times, leading to improved patient satisfaction. It supports accurate record-keeping, real-time access to critical information, and seamless communication between departments and healthcare professionals.

The ERP system also includes features such as inventory monitoring, and detailed reporting to support strategic decision-making and compliance. Designed for scalability and adaptability, it enables hospitals to optimize resource usage, reduce operational costs, and deliver better outcomes for patients.

Keywords: Hospital ERP, Patient Management, Healthcare Efficiency, Appointment Scheduling, Medical Reporting, Inventory Management, Hospital Administration.

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General Introduction

General Introduction

1. 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.

2. Problem Statement

The current hospital management system faces significant challenges, including inefficiencies in appointment scheduling, restricted access to patient records, communication gaps among healthcare professionals, reliance on manual processes, and poor resource allocation. These issues result in delays, increased errors, and hindered decision-making, ultimately affecting patient care and hospital efficiency.

A modern Hospital ERP System aims to address these shortcomings by automating key operations, improving accessibility to patient information, enhancing communication, and optimizing resource management. This solution will streamline workflows, reduce errors, and contribute to a more efficient and effective healthcare delivery system.

General Introduction

3. Objectives

The objective of this dissertation is to develop a Hospital ERP 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 system that serves as the central hub for managing hospital operations. This platform will include features such as patient registration, appointment scheduling, electronic health records (EHR) management, billing, and inventory management.
- **Doctor & Staff Portal** – Provide a dedicated interface for doctors and hospital staff to access patient records, manage appointments, update prescriptions, and monitor hospital resources efficiently.
- **Patient Portal** – Enable patients to register, book appointments, view medical history, receive prescriptions, and access billing information securely.
- **Automated Reporting & Analytics** – Implement a reporting system that generates real-time insights on hospital operations, patient statistics, financial reports, and inventory tracking to improve decision-making.
- **Data Security & Access Control** – Ensure the protection of sensitive medical data by implementing role-based access control, encryption, and secure authentication methods.

This Hospital ERP System aims to enhance operational efficiency, improve patient care, and streamline hospital management processes.

This dissertation is organized into four chapters:

- **Chapter 1: Hospital Management System** – The first chapter introduces the concept of a Hospital ERP System and examines the shortcomings of traditional hospital management approaches. It also presents related research and existing solutions in the field.
- **Chapter 2: ERP Systems and Data Warehousing** – This chapter introduces the concept of Enterprise Resource Planning (ERP) systems, focusing on their role in

General Introduction

centralizing and streamlining operations within an organization. It explains the architecture, benefits, and limitations of ERP systems in the context of healthcare or clinic management. The chapter also explores the importance of data warehousing as a complementary component to ERP, enabling advanced analytics, historical data storage, and better decision-making through Business Intelligence tools. Together, ERP and Data Warehouses create a powerful infrastructure for operational efficiency and strategic planning.

- **Chapter 3: Design of the Proposed Solution** – This chapter provides a detailed overview of the Hospital ERP System, explaining its architecture, features, and functionalities from different perspectives, including administrators, doctors, and patients.
- **Chapter 4: Implementation of the System** – The fourth chapter focuses on the practical implementation of the system, covering the software tools used, system architecture, and the development process

Chapter 1

Hospital Management System

1. Introduction

The healthcare sector is one of the most vital industries in the world, playing a crucial role in ensuring the well-being and safety of millions of patients. As the number of patients and medical staff continues to grow, hospitals generate an increasing volume of data and transactions, making manual management or reliance on outdated systems increasingly difficult. To address these challenges, hospitals are adopting digital solutions to streamline their operations, comply with international standards, and enhance the quality of patient care.

In this chapter, we will explore hospital management systems and their transformative impact on the healthcare sector. We will discuss their key features and functionalities, as well as how they help healthcare providers efficiently manage patient data, medical records, and inventory. Additionally, we will examine similar systems and the services they offer to better understand the potential of this technology in advancing healthcare management.

2. Hospital definition

According to the *Online Etymology Dictionary*, the word “hospital” is derived from the Old French “ospital,” meaning hostel, shelter, lodging, or shelter for the needy. The origin can be traced to the Latin “hospitale” and persists in the modern French “hôpital.”

A hospital is a healthcare facility that provides around-the-clock medical care and attention to patients in need. Hospitals have medical experts who monitor patients, perform tests and procedures, administer medications, and tend to any health issues that arise.



Figure 1: Picture Of Hospital

3. Hospital Management definition

Hospital Management is the process where healthcare providers effectively and efficiently administer everything from patient registration to appointment scheduling, document management, consultation management, lab management, drug safety, report generation, staff management, outpatient management, and so much more.

Hospital Management is the practice of strategizing, structuring, harmonizing, directing, and continually enhancing the diverse operations and tasks carried out within the hospital. Its objective is to accomplish specific targets, deliver superior healthcare to patients, fulfill their requirements, and ensure a secure and healthy workplace for staff. Hospital administration encompasses numerous roles and responsibilities, including overseeing human, financial, technological, managerial, and informational assets, as well as infrastructure and other organizational services.[1]

The department's role focuses on enhancing the standard of healthcare, boosting the productivity and efficacy of medical service provision, regulating expenses and income, and fulfilling the requirements and expectations of patients, community members, and authorized healthcare stakeholders.

4. Hospital Management systems

Hospital Management System is a system enabling hospitals to manage information and data related to all aspects of healthcare – processes, providers, patients, and more, which in turn ensures that processes are completed swiftly and effectively. When one thinks of the various aspects and departments of a hospital, it becomes apparent that an HMS is critical.

The hospital database management system was introduced in 1960, and has greatly evolved since then – with the ability to integrate with the existing facilities, technologies, software, and systems of a hospital.

In today’s world, patients can begin the process of healthcare in the palm of their hand, the mobile devices and apps make this possible. This process then moves to the healthcare providers and hospitals.[2]



Figure 2: Hospital Management System

5. The functionalities of Hospital Management System

The main functions of the clinic management system include the following:

- **Patient Management:** Handles patient registration, appointment scheduling, and storing electronic medical records. It also manages patient invoices and billing details.
- **Doctor Management:** Maintains doctor profiles, specializations, and availability schedules for consultations.
- **Appointment Management:** Allows patients to book appointments online or through reception, with automatic scheduling based on doctor availability.
- **Billing and Invoicing:** Manages financial transactions, generates invoices for consultations, and tracks payments.
- **Medical Prescriptions:** Enables doctors to create and manage prescriptions, specifying medications, dosage, and duration.
- **Inventory Management:** Tracks medical supplies and medications, monitors stock levels, and manages expiration dates.
- **Reports and Analytics:** Generates statistical reports on patient visits, financial performance, doctor availability, and inventory usage.
- **Security and Access Control:** Ensures role-based access for different users, protecting sensitive medical and financial data.

6. Hospital Management systems in Algeria

It's becoming more and more common to see healthcare workers use digital tools and patient software these days. This really shows how things are changing, not just in how hospitals are run, but also in the general mindset of the healthcare field. Because of this, doctors and nurses can really start to make the most of what tech has to offer.

In Algeria, you can definitely see this shift towards digital healthcare happening. Hospital management is getting better, and they're really starting to use things like computers and the internet to their full potential. You saw this a lot during the pandemic, when a bunch of new e-

health apps and digital tools popped up, which helped slow down the virus and made it easier for medical staff to do their jobs.

Algeria's healthcare system still faces hurdles in adopting and implementing these new technologies. One of the biggest challenges is the lack of trained personnel many workers don't have the necessary knowledge or skills to use these tools effectively. Without proper training and upskilling, the transition won't happen as smoothly as needed.

7. Conclusion

In this chapter, we discussed the challenges faced by hospital management and explored how hospital management systems can address these issues. We also examined the current state of hospital management systems in Algeria.

Chapter 2

Introduction to ERP Systems and Data Warehousing

1. Introduction

The digital transformation of enterprises has become a driving force behind operational efficiency, competitiveness, and innovation. In today's fast-paced and data-driven environment, organizations—particularly those in the healthcare sector—are increasingly turning to integrated software solutions to manage their growing complexity. One such solution is the Enterprise Resource Planning (ERP) system, which centralizes data and streamlines processes across various departments, from patient management to billing, inventory, and reporting. By enabling a unified view of operations, ERP systems enhance communication, reduce redundancies, and support informed decision-making.

However, as the volume of operational data expands, ERP systems alone may fall short in meeting the needs of strategic analysis. This is where the concept of data warehousing becomes essential. A data warehouse complements an ERP by aggregating historical data from multiple sources, structuring it for analysis, and powering business intelligence tools. It transforms raw operational data into actionable insights, allowing healthcare providers to track trends, optimize performance, and plan strategically.

In this chapter, we will explore the foundations of ERP systems and data warehouses, their architecture, and their synergistic role in modern organizational management. We will examine how combining ERP with data warehousing enables not just operational control but also long-term strategic planning through advanced analytics.

2. ERP Systems :Concepts and Functionalities



Figure 3: Enterprise Resource Planning

2.1 Definition

ERP stands for “Enterprise Resource Planning”. An Enterprise Resource Planning (ERP) system is a business management software that centralizes and integrates a company’s various operational activities, such as accounting, human resources management, sales, supply chain control, finance, and production.

The main aim of an ERP is to enable more efficient management of company data by integrating it into a single system, which can help reduce errors, improve the quality of decision-making and speed up operational processes.

Users can access data and applications via a web browser or dedicated application, enabling them to work remotely or from any device.

In general, an ERP is considered an essential solution for companies wishing to improve

operational efficiency, streamline developments and make more informed decisions. To better understand this solution, we need to go back to the origins of ERP. [3]

2.2 Key Objectives of ERP in Healthcare

Healthcare ERP systems are often built to make everything easier for healthcare providers. It helps to streamline and enhance each aspect of operations efficiency in healthcare. These ERP systems mainly unify various platforms into one centralized platform.

Here are some of the key features and functionalities of ERP systems:

- **Integration Capabilities:** Enables health interoperability by integrating a different healthcare system and device. It will make smooth data transfer through APIs and secure data connections.
- **Patient Management:** Handles and centralizes patient records, appointment scheduling, and communication between patients and healthcare staff.
- **Data Analytics and Reporting:** The advanced analytics tools found in the ERP systems track KPIs and develop insightful reports.
- **Financial Management:** This also simplifies financial management since it automates the processes of billing, revenue cycles, and financial reporting.
- **Clinical Management:** The ERP solution helps manage clinical orders and coordinate patient care while providing decision-support tools to assist in clinical decision-making.
- **Administrative and Operational Support:** ERP systems support general activities such as document management, employee scheduling, and resource management.
- **Supply Chain Management:** The objective is to utilize ERP to optimize inventory, procurement, and logistics that ensure punctuality, reduce wastages and result in overall good supply chain efficiency.
- **Human Resources:** ERP systems include the core HR functionalities, which include payroll, training, and compliance checks. [4]



Figure 4: Key Objectives Of ERP In HealthCare

2.3 ERP Architecture and Components

ERP architecture refers to the structured design of an ERP system, illustrating how its various modules and technical components are interconnected to support business processes efficiently.

A common and widely used model is the three-tier architecture, which consists of:

ERP architecture has three layers :

- **Presentation layer:** This is the user interface layer where users interact with the ERP system via web browsers or desktop applications. It provides access to ERP functionalities in a user-friendly manner.
- **Application layer:** This layer handles the core business logic and processes. It executes business rules, processes data, and manages workflows across different ERP modules.
- **Database layer:** The centralized repository where all ERP data is stored, organized, and managed. It supports real-time data access and ensures data consistency across the system.

The ERP architecture helps to increase profits and reduce losses by looking into every perspective of the business by means of the different ERP components. Let's next understand the various ERP components and how they streamline business departments and the business in totality.

Behind every efficient ERP is a solid technical architecture. It determines how computing resources, such as servers, databases, and interfaces, are used and interconnected to ensure the system's fluidity and efficiency.

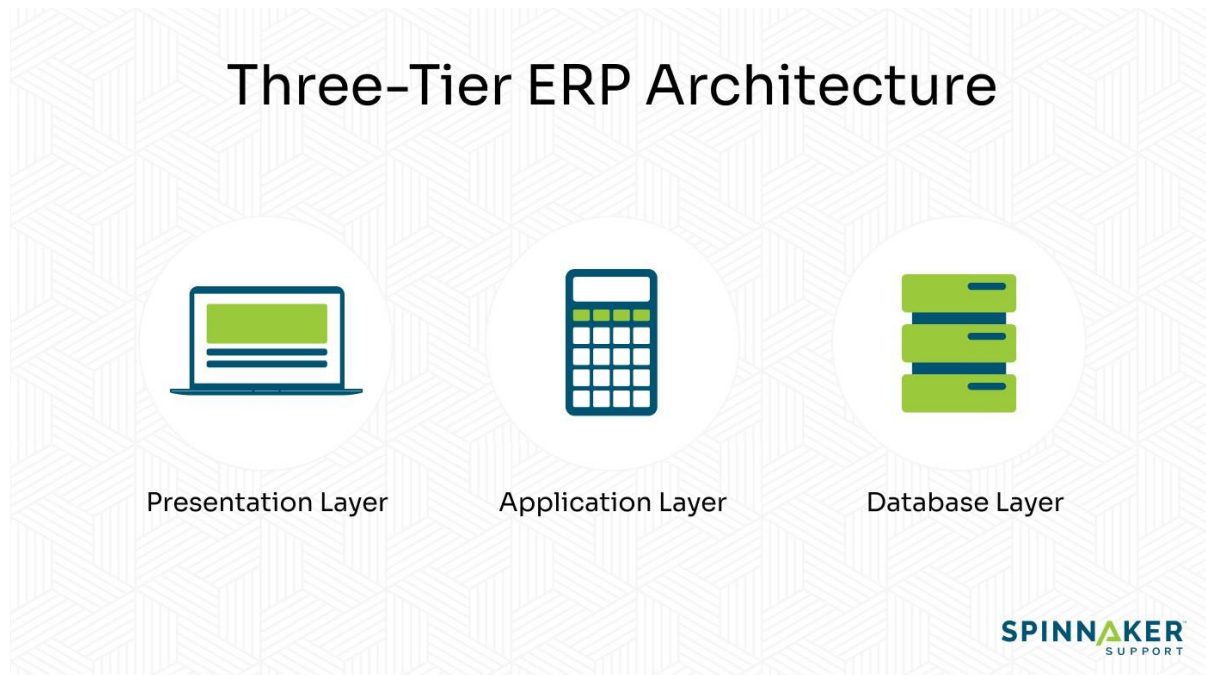


Figure 5: ERP Architecture

ERP systems are composed of multiple modules or components, each dedicated to managing specific business functions. These modules collect data from their respective areas and feed it into a centralized database, enabling unified and real-time visibility across the organization. Key ERP components commonly include:

- **Financial Management:** Manages accounting, budgeting, accounts payable/receivable, payroll, and financial reporting. It helps track all financial transactions and assets, ensuring accurate financial control and compliance.
- **Human Resources (HR):** Handles employee records, payroll, recruitment, performance management, and benefits administration. This module streamlines workforce management and HR services.
- **Customer Relationship Management (CRM):** Manages customer data, interactions, sales, and marketing efforts. It helps improve client relations and drives sales growth.
- **Supply Chain Management (SCM):** Coordinates procurement, inventory management, order processing, and logistics. It optimizes supply chain operations to reduce costs and improve efficiency.
- **Inventory and Warehouse Management:** Tracks stock levels, manages warehouse operations, and supports order fulfillment to prevent stockouts and excess inventory.

- **Manufacturing and Logistics Management:** Supports production planning, scheduling, and logistics operations, especially relevant for industries with manufacturing processes.
- **Business Intelligence (BI):** Provides analytical tools and reporting capabilities, often integrated with ERP to enable data-driven decision-making.

These components are modular, allowing organizations to implement only the modules they need and expand as required. All modules share a common database, ensuring data consistency and enabling seamless workflow integration across departments.[5]

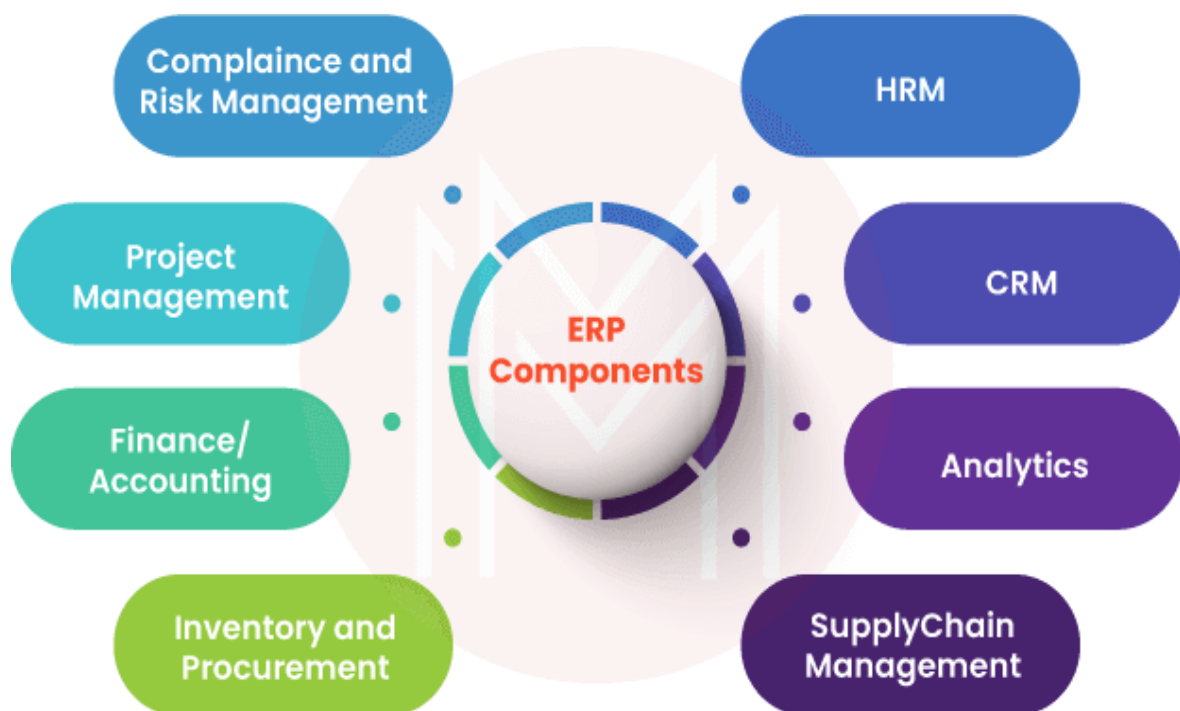


Figure 6 : ERP Components

2.4 Functionalities of ERP in Hospital ERP Systems

The importance of ERP in hospital management cannot be overstated. Hospitals deal with enormous volumes of patient data and numerous operational tasks. Implementing ERP systems in healthcare helps manage this data efficiently and improves service delivery. ERP facilitates better coordination between departments, enhances the quality of patient care, and ensures compliance with health regulations.

- **Enhanced Operational Efficiency** - ERP systems help in achieving operational efficiency in hospitals by automating
- **Improved Patient Care** - ERP solutions for hospitals directly contribute to patient care improvement. With centralized data, healthcare providers get a comprehensive view of patient history, treatment plans, and medical records, leading to better diagnosis and treatment outcomes.
- **Cost Reduction and Financial Management** - ERP systems in healthcare lead to significant cost reductions by streamlining processes and reducing wastage. Integrated hospital billing software and financial management tools help in efficient budget allocation, expense monitoring, and overall financial planning.
- **Better Inventory Management** - Effective inventory management in healthcare is essential for maintaining adequate supplies of medical equipment and pharmaceuticals. ERP systems provide real-time tracking of inventory levels, ensuring that hospitals are well-stocked and reducing the risk of shortages. [6]

2.5 Limitations and Challenges of ERP Systems in Healthcare

The implementation of ERP in healthcare industry can encounter several challenges that need to be carefully addressed to ensure successful integration and utilization.

Data security concerns

One of the primary challenges in implementing ERP systems in healthcare settings is the need to maintain robust data security. Healthcare organizations handle vast amounts of sensitive patient data, and any breach or compromise can have severe consequences. To address this challenge, healthcare providers need to invest in robust cybersecurity measures, encryption protocols, and access control mechanisms to safeguard patient information. Additionally, compliance with data protection regulations such as HIPAA is crucial to ensure the secure handling of patient data within the healthcare ERP system.

Integration with existing systems

Healthcare organizations often have a complex network of existing systems and software applications that are integral to their operations. Integrating a new ERP system with these legacy systems can be a daunting task. Compatibility issues, data migration challenges, and interoperability concerns can arise during the integration process. To overcome this challenge, healthcare providers should conduct a thorough assessment of their existing infrastructure, develop a comprehensive integration strategy, and leverage middleware solutions to facilitate seamless data flow between the ERP system and other systems.

Lack of IT expertise

Implementing and managing an ERP system requires a high level of technical expertise, which may be lacking within the healthcare workforce. Healthcare providers often struggle to find IT professionals with the specialized skills and knowledge required to oversee ERP implementation, configuration, and maintenance. Addressing this challenge entails investing in staff training and development programs, partnering with external IT service providers, or engaging ERP vendors that offer comprehensive support and training services to bridge the expertise gap.

Limited budget

Budget constraints are a common hurdle in implementing ERP systems. The cost of acquiring, customizing, and maintaining an ERP system can be substantial, especially for smaller healthcare facilities or non-profit organizations. To address this challenge, healthcare providers can explore cost-effective ERP solutions, consider cloud-based deployment models to minimize infrastructure costs, and prioritize key functionalities that align with their operational needs and strategic objectives.

Customization challenges

Every healthcare organization has unique processes, workflows, and requirements that necessitate customization of the ERP system to align with their specific needs. However, excessive customization can lead to complexity, increased costs, and potential issues with system upgrades and maintenance. Healthcare providers should strike a balance between tailoring the ERP system to meet their specific needs and leveraging standard best practices to minimize customization challenges.[7]

3. Data Warehousing

3.1 Definition And Purpose

A data warehouse is a platform used to collect and analyze data from multiple heterogeneous sources. It occupies a central position within a Business Intelligence system.

A healthcare data warehouse is a central system that collects, stores, and organizes data from multiple sources, such as electronic health records, medical records, and lab databases. This information undergoes a transformation phase to comply with a standardized format for efficient analysis and reporting. Integrating global health data supports analyses and informed decision-making.[8]

3.2 Components of Data Warehousing

A typical data warehouse has four main components: a central database, ETL (extract, transform, load) tools, metadata, and access tools. All of these components are engineered for speed so that you can get results quickly and analyse data on the fly.

- **Central database:** A database serves as the foundation of your data warehouse. Traditionally, these have been standard relational databases running on premise or in the cloud. But because of Big Data, the need for true, real-time performance, and a drastic reduction in the cost of RAM, in-memory databases are rapidly gaining in popularity.
- **Data integration:** Data is pulled from source systems and modified to align the information for rapid analytical consumption using a variety of data integration approaches such as ETL (extract, transform, load) and ELT as well as real-time data replication, bulk-load processing, data transformation, and data quality and enrichment services.

- **Metadata:** Metadata is data about your data. It specifies the source, usage, values, and other features of the data sets in your data warehouse. There is business metadata, which adds context to your data, and technical metadata, which describes how to access data – including where it resides and how it is structured.
- **Data warehouse access tools:** Access tools allow users to interact with the data in your data warehouse. Examples of access tools include: query and reporting tools, application development tools, data mining tools, and OLAP tools.

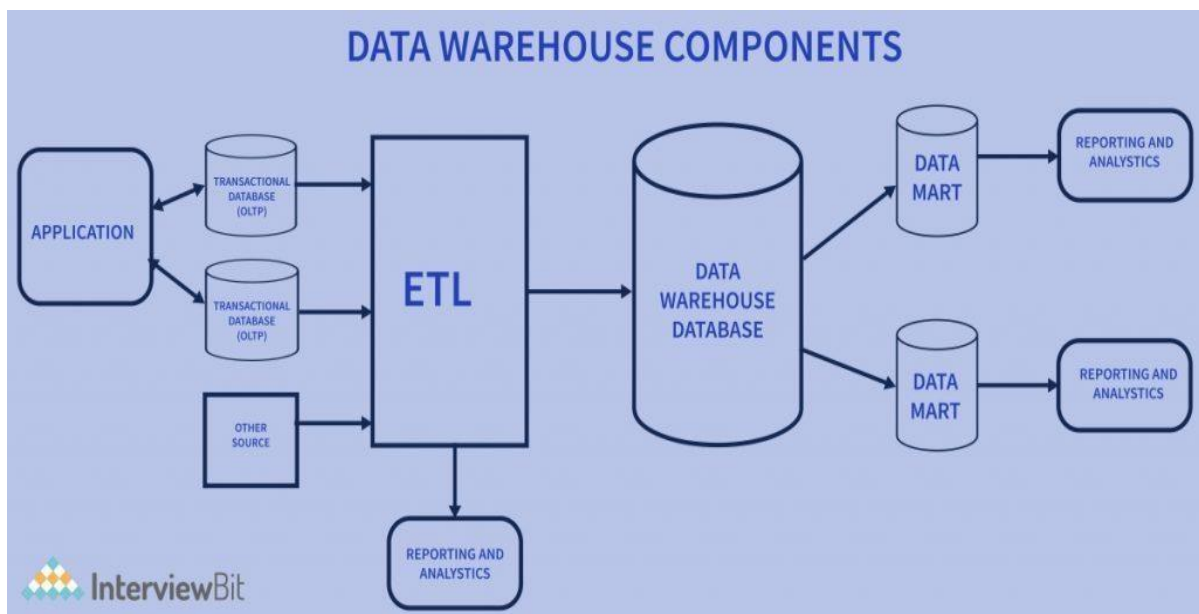


Figure 7: Date WareHouse Components

3.3 Data Warehousing Architecture

Data warehousing architecture organizes the flow and processing of data through multiple layers to support efficient storage, integration, and analysis. It enables seamless transformation of raw data into actionable insights for business users.

Data layer: Data is extracted from your sources and then transformed and loaded into the bottom tier using ETL tools. The bottom tier consists of your database server, data marts, and

data lakes. Metadata is created in this tier – and data integration tools, like data virtualisation, are used to seamlessly combine and aggregate data.

Semantics layer: In the middle tier, online analytical processing (OLAP) and online transactional processing (OLTP) servers restructure the data for fast, complex queries and analytics.

Analytics layer: The top tier is the front-end client layer. It holds the data warehouse access tools that let users interact with data, create dashboards and reports, monitor KPIs, mine and analyse data, build apps, and more. This tier often includes a workbench or sandbox area for data exploration and new data model development.[9]

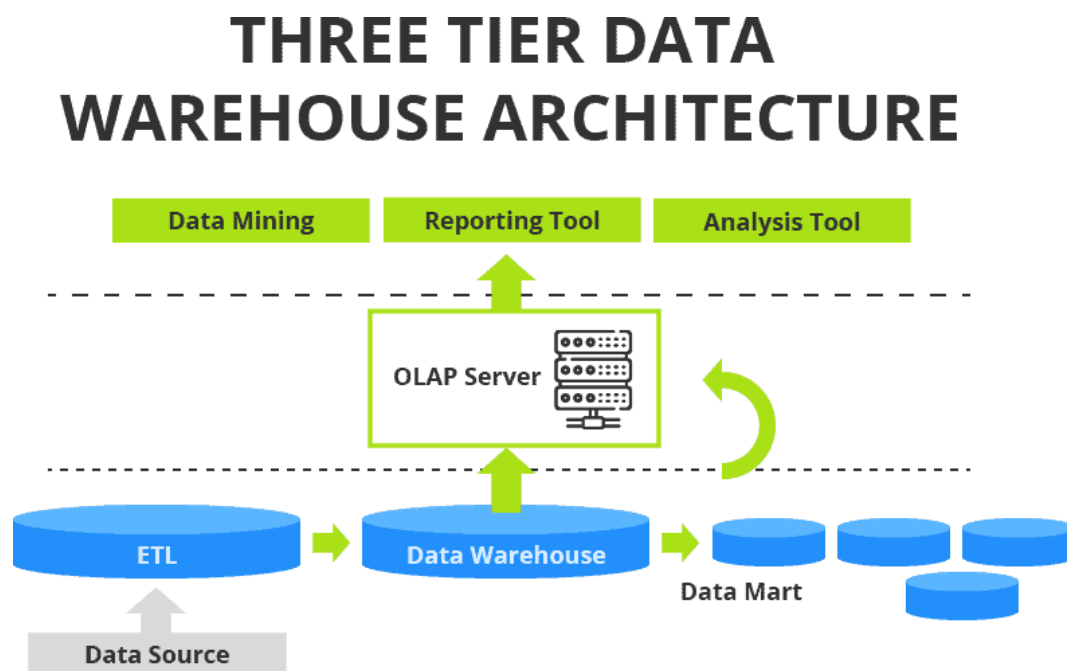


Figure 8: Data Warehouse Architecture

3.4 Benefits of Data Warehousing in Hospital Management

The benefits of data warehousing in hospital management are extensive and impactful across clinical, operational, financial, and compliance domains:

Improved Patient Care and Outcomes

One of the primary benefits of data warehousing is its ability to improve patient care. By centralizing patient data from different departments—such as medical histories, lab results, and treatment plans—clinicians have a comprehensive view of each patient. This complete and accurate information helps healthcare providers make informed decisions, leading to better diagnoses and improved treatment plans. As a result, patients experience better outcomes, with fewer medical errors and quicker recovery times.

Streamlined Clinical and Operational Processes

Data warehousing also plays a significant role in streamlining clinical workflows and operational processes. By integrating data from various sources, healthcare organizations can automate and optimize daily operations such as patient scheduling, billing, and resource management. With a centralized system in place, departments can collaborate more effectively, reducing administrative delays and improving overall efficiency.

Improved Data Accuracy and Consistency

One of the biggest challenges in healthcare is ensuring data accuracy and consistency across departments and systems. Data warehousing helps by consolidating and standardizing data from multiple sources, reducing the risk of errors and discrepancies. This ensures that healthcare professionals have access to accurate and up-to-date information, which is critical for making effective clinical and administrative decisions.

Regulatory Compliance and Reporting

Compliance with healthcare regulations such as the Health Insurance Portability and Accountability Act (HIPAA) is a top priority for healthcare organizations. Data warehousing helps healthcare providers meet these regulatory requirements by ensuring accurate and secure data storage. Additionally, it simplifies the generation of reports required for audits, enabling organizations to maintain compliance with ease.

Enhanced Data Security and Privacy

Data security and patient privacy are paramount in healthcare. Data warehouses are equipped with robust security features such as encryption, role-based access control, and audit trails to ensure the protection of sensitive patient data. These features help healthcare organizations maintain compliance with data privacy laws and protect against potential security breaches, giving patients confidence in how their data is handled. [10]

4. Integration of ERP and Data Warehousing in Hospital Management Systems

Enterprise Resource Planning (ERP) systems in hospitals generate operational data by integrating and managing diverse hospital functions into a single platform. These functions include patient management, billing, inventory and supply chain management, human resources, and financial reporting. As hospitals conduct daily activities—such as patient admissions, treatment documentation, billing transactions, staff scheduling, and supply usage—the ERP system captures and records this data in real time. This centralized collection ensures that all operational data, from clinical records to financial transactions, is unified and accessible across departments, enabling streamlined workflows and accurate data capture

How Data Warehouses Aggregate and Analyze ERP Data

Data warehouses in healthcare serve as centralized repositories that aggregate data from ERP systems and other sources like Electronic Health Records (EHR) and laboratory systems. Unlike transactional databases, data warehouses are optimized for complex queries and

analysis. They consolidate large volumes of historical and current operational data, organizing it to facilitate comprehensive reporting, trend analysis, and decision support. By integrating ERP data into a data warehouse, hospitals can perform advanced analytics, such as identifying patterns in patient care, resource utilization, and financial performance. This aggregation supports predictive modeling, machine learning, and strategic planning, ultimately enhancing medical decision-making and operational efficiency.

Use Cases of Combined ERP and Data Warehouse Systems in Hospitals

- **Enhanced Patient Care Coordination:** ERP systems centralize patient data and treatment plans, while data warehouses analyze this data to identify care gaps, optimize treatment protocols, and improve outcomes.
- **Financial and Operational Performance Monitoring:** ERP captures real-time billing, inventory, and staffing data; data warehouses enable trend analysis and cost allocation, supporting budgeting and resource optimization.
- **Regulatory Compliance and Reporting:** Combined systems automate compliance tracking and generate detailed reports required by healthcare regulators.
- **Inventory and Supply Chain Optimization:** ERP manages real-time inventory data; data warehouses analyze consumption trends to forecast demand and reduce waste.
- **Workforce Management:** ERP tracks staff schedules and performance; data warehouses analyze staffing patterns to improve productivity and patient care delivery.

5. Conclusion

In this chapter, we highlighted the critical importance of ERP systems and data warehousing in enhancing hospital management through integrated operations and advanced analytics. This foundation paves the way for the upcoming design and implementation chapters of the Hospital Management System.

Chapter 3

Application analysis and design

1. Introduction

The second chapter of this thesis focuses on the analysis and design of the Hospital management application (ERP). This section is of great importance as it lays the foundation for the successful implementation of the project. Before starting the development of such an application, it is essential to carry out a thorough analysis in order to understand the needs of the Hospital and provide a solid and efficient design.

In this chapter, we first present the requirements specification, which helps formally identify the expected features of the system. We then move on to the design phase of the ERP. For this purpose, we have chosen the UML language to model the different components of our system, with a particular focus on managing patients, appointments, billing, and medical inventory.

2. Requirements Elicitation

Requirements elicitation first involves identifying the stakeholders of our system and listing the functional and non-functional (technical) requirements.

2.1 Data Collection Methods

Every study requires a structured process in order to effectively achieve its objectives. We employed several techniques to identify the requirements of end users, as well as the needs of the various entities and stakeholders involved in the project. In the following sections, we present the methods used for data collection, including meetings, questionnaires and surveys, which helped us build a clear and accurate understanding of the system.

Meetings

Regular meetings were held with various stakeholders at the clinic, including doctors, nurses, administrative staff, and the system administrator. These discussions helped us understand the functional needs of the ERP system, clarify expectations from each role, and identify project priorities. Meeting notes were documented after each session and used to develop a clear and realistic requirements specification.

Questionnaires

Anonymous questionnaires were distributed to medical and administrative personnel to gather quantitative data on the use of current tools. The results highlighted key shortcomings, such as slow manual processes and the lack of integration between existing modules. These insights helped shape the functional direction of the application.

Direct Observation

A field observation phase was carried out in different departments of the clinic (reception, consultation, pharmacy, billing). This on-site immersion made it possible to identify repetitive tasks, friction points, and opportunities for automation. It also revealed discrepancies between standard procedures and actual day-to-day practices.

Document Analysis

We analyzed various documents used daily in the clinic, such as paper consultation forms, medication stock registers, handwritten invoices, and Excel-based patient records. This analysis helped us identify critical information flows and design a database structure tailored to the clinic's operational needs.

Prototyping and User Feedback

Interactive mockups were developed for key modules (patients, doctors, appointments, prescriptions, billing) and presented to end users. Feedback was collected during short test sessions, allowing us to refine the interface and adjust features before moving into the final development phase.

2.2 Identification of Actors

The first step in the requirements analysis process is to identify the actors (categories of users) of the system. An actor represents a role played by an individual, a group of individuals, or an entity that interacts with the system.

Our ERP system includes the following actors:

- **Doctor:** This actor is responsible for managing patient consultations, issuing prescriptions, and viewing medical history. The doctor interacts mainly with the appointment, patient, and prescription modules.
- **Receptionist:** This actor manages patient registration, schedules appointments, and updates basic patient records. The receptionist plays a key role in the daily administrative tasks of the clinic.
- **Administrator:** The administrator oversees the system's configuration, manages user accounts, and generates reports. This actor ensures that data flows correctly across all modules and has access to system-wide management features.
- **Nurse :** this actor manage Medical Prescriptions.

2.3 Requirements Specifications

The requirements specification is a crucial step in the development process of the ERP system. It defines in a precise and detailed manner the expected functionalities and requirements of the system, taking into account the needs of

the users and the objectives of the project. The software requirements can be classified into two sections: functional and non-functional requirements. The functional requirements describe the specific actions, tasks, and functionalities that the software must perform. On the other hand, the non-functional requirements describe the overall quality attributes that the software must possess to be considered successful, such as performance, security, and usability.

2.3.1 functional requirements

- **Authentication:** Each user (administrator, receptionist, doctor, nurse) has a personal account to access the web application.
- **User Management:** The administrator can add, modify, and delete users (receptionists and doctors).
- **User Consultation:** The administrator can view the list of registered users.
- **Access Rights Management:** The administrator can assign specific permissions to each role.
- **Security Management:** The administrator can view activity logs and configure security settings.
- **Dashboard Management:** The administrator can view global statistics (number of patients, appointments, revenue, expenses, etc.).
- **Accounts Management:** The administrator can manage the clinic's financial accounts.
- **Payroll Management:** The administrator can add, modify, and delete salary and payroll data for staff.
- **Reports Management:** The administrator can view and export detailed reports in PDF format.

- **Settings Management:** The administrator can configure general clinic information (name, logo, working hours, etc.).
- **About Us Section:** The administrator can edit the "About Us" section of the application.
- **Patient Management:** The receptionist can add, modify, and delete patient information.
- **Patient Consultation:** The receptionist can search for and view patient records.
- **Appointment Management:** The receptionist can schedule, edit, or cancel medical appointments.
- **Billing Management:** The receptionist can generate invoices and register received payments.
- **Prescription Consultation:** The receptionist can view recorded prescriptions.
- **Doctor Availability:** The receptionist can view available time slots for each doctor.
- **Appointment Viewing:** The doctor can view their scheduled appointments.
- **Prescription Creation:** The doctor can write and save prescriptions (medicine, dosage, duration, etc.).
- **Medical Observations Management:** The doctor can record symptoms, diagnoses, and treatments.
- **Patient Record Consultation:** The doctor can access the full medical history of patients.
- **Report Consultation:** The doctor can view reports related to their consultations.
- **Medication Management:** Authorized users can add, edit, or delete medications available in the clinic.

- **Medical Inventory Management:** View and update the stock levels of medications.
- **Search Functionality:** Each module includes advanced search features by name, date, type, etc.
- **Multi-language Support:** The application supports multiple languages (English, French).

2.3.2 Technical Specifications

- **Security:** Every management action (add, edit, delete) requires valid user authentication.
- **Confidentiality:** Each user (administrator, doctor, receptionist) has access only to the functionalities and data corresponding to their specific role.
- **Availability:** The system is designed to be available and accessible 24/7 to ensure continuous service.
- **Data Backup:** Regular backups are performed to ensure data recovery in case of system failure.
- **Data Integrity:** All input data is validated and controlled to prevent inconsistencies or entry errors.
- **Compatibility:** The application is accessible through modern web browsers and is compatible with standard screen resolutions.
- **Performance:** The system is optimized to deliver fast response times to user requests, even under high load conditions.

3. Application Design

In this section of the chapter, we will present the design of our system, known as the "Clinic ERP." For this purpose, we have chosen UML (Unified Modeling

Language) to design our system. First, we define what UML is and then present the UML diagrams that we have created to illustrate the different components and workflows within the system.

3.1 UML Definition

The Unified Modeling Language (UML) is a modeling language for software applications. It is designed to provide a standard way for visualizing the design of a software system. With the unified modeling language, you can create a beneficial visual representation of application software.

Various organizations and persons developed UML. It was created and developed by Grady Booch, Ivar Jacobson, and James Rumbaugh at Rational Software between 1994 and 1996. Since 1997, it has been maintained by OMG (the Object Management Group). In 2005, the Unified Modeling Language was also published by the International Organization for Standardization (ISO) as an approved ISO standard.

To design our application, we will use diagrams to clearly and visually represent the various aspects of the system. These diagrams will allow us to capture the application's functionalities, structures, and behaviors. They will play a vital role in facilitating communication and understanding between development team members and project stakeholders. Using these diagrams will allow us to effectively visualize and document our design, which will contribute to the creation of a well-designed and functional application.[11]

3.2 Use Case Diagram

In the Unified Modeling Language (UML), a use case diagram can summarize the details of your system's users (also known as actors) and their interactions with the system. To build one, you'll use a set of specialized symbols and

connectors. An effective use case diagram can help your team discuss and represent:

- Scenarios in which your system or application interacts with people, organizations, or external systems.
- Goals that your system or application helps those entities (known as actors) achieve.
- The scope of your system.

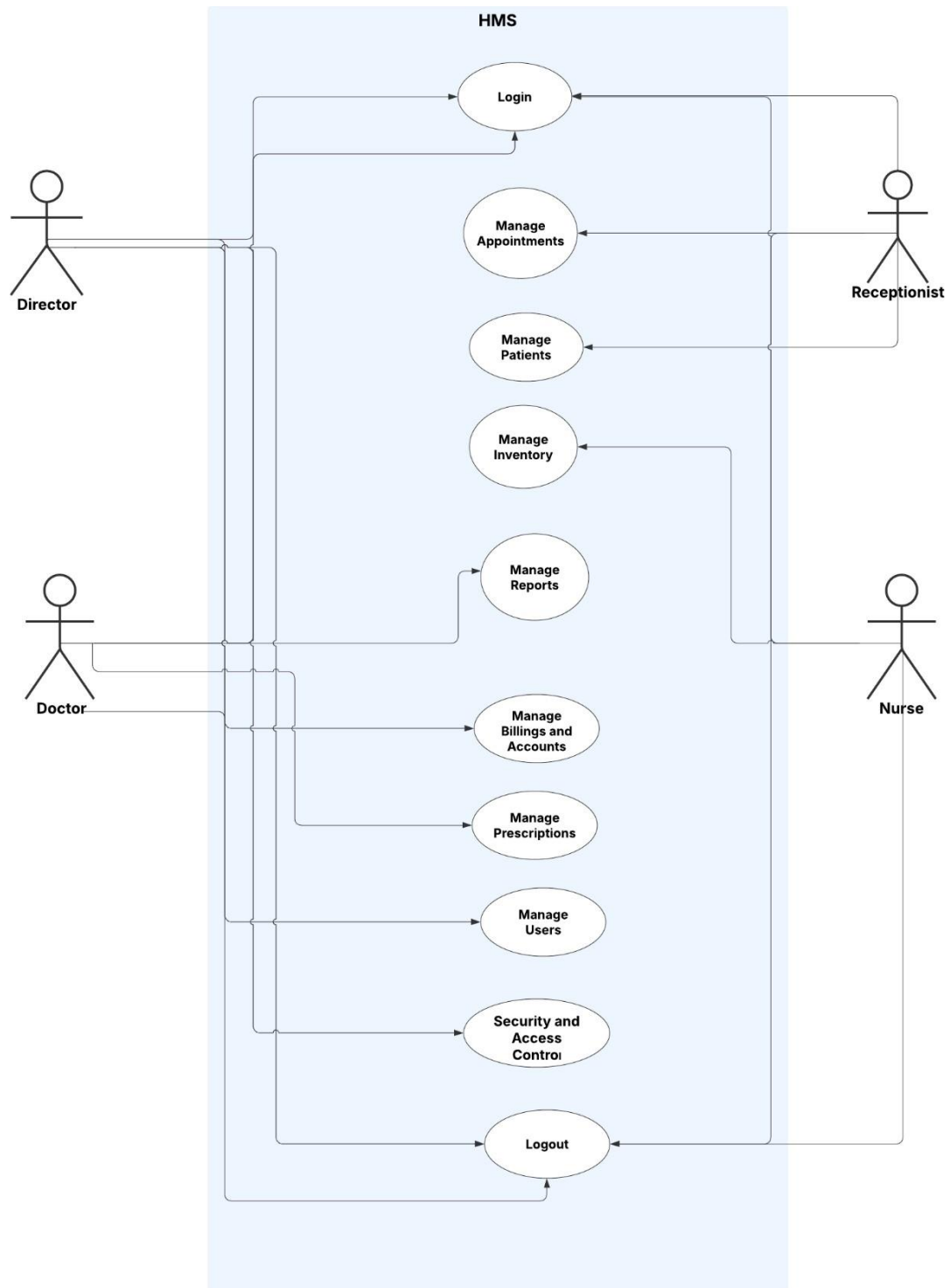


Figure 9: System Use Case Diagram

3.3 Activity Diagram

An activity diagram is a type of Unified Modeling Language (UML) flowchart that shows the flow from one activity to another in a system or process. It's used to describe the different dynamic aspects of a system and is referred to as a 'behavior diagram' because it describes what should happen in the modeled system.

Even very complex systems can be visualized by activity diagrams. As a result, activity diagrams are often used in business process modeling or to describe the steps of a use case diagram within organizations. They show the individual steps in an activity and the order in which they are presented. They can also show the flow of data between activities.

3.3.1 Add Patient Activity Diagram

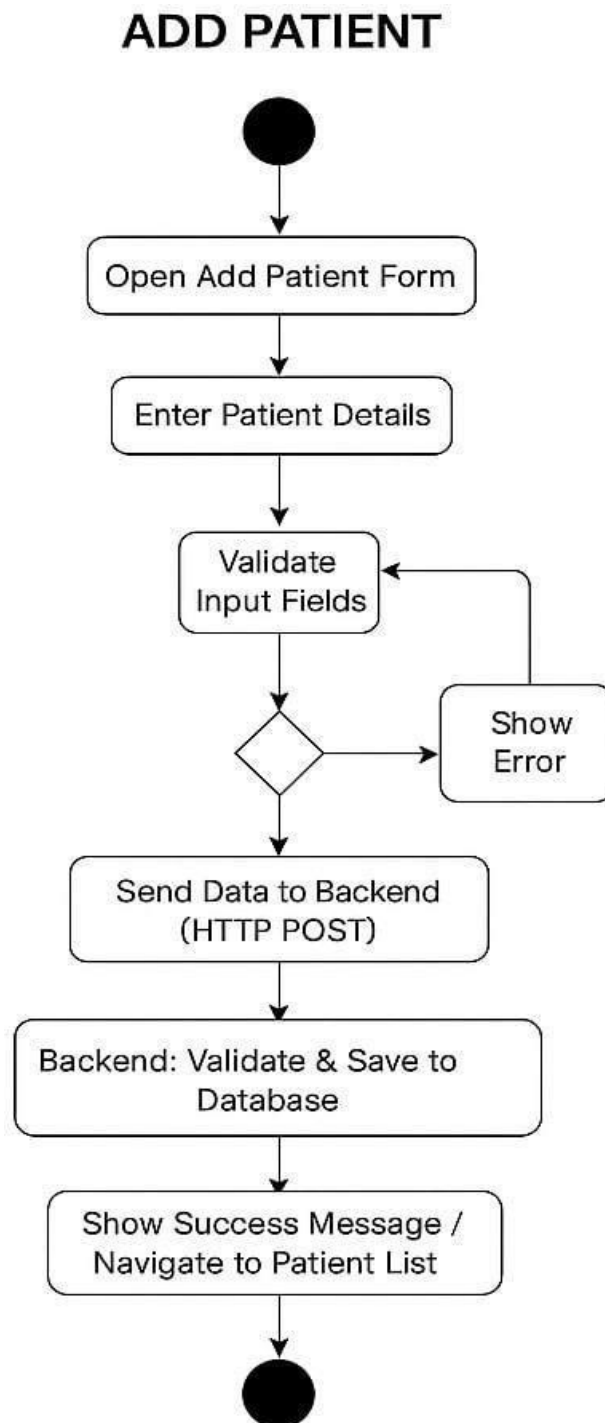


Figure 10: Add Patient Form Activity Diagram

3.3.2 Shedule Appointment Activity Diagram

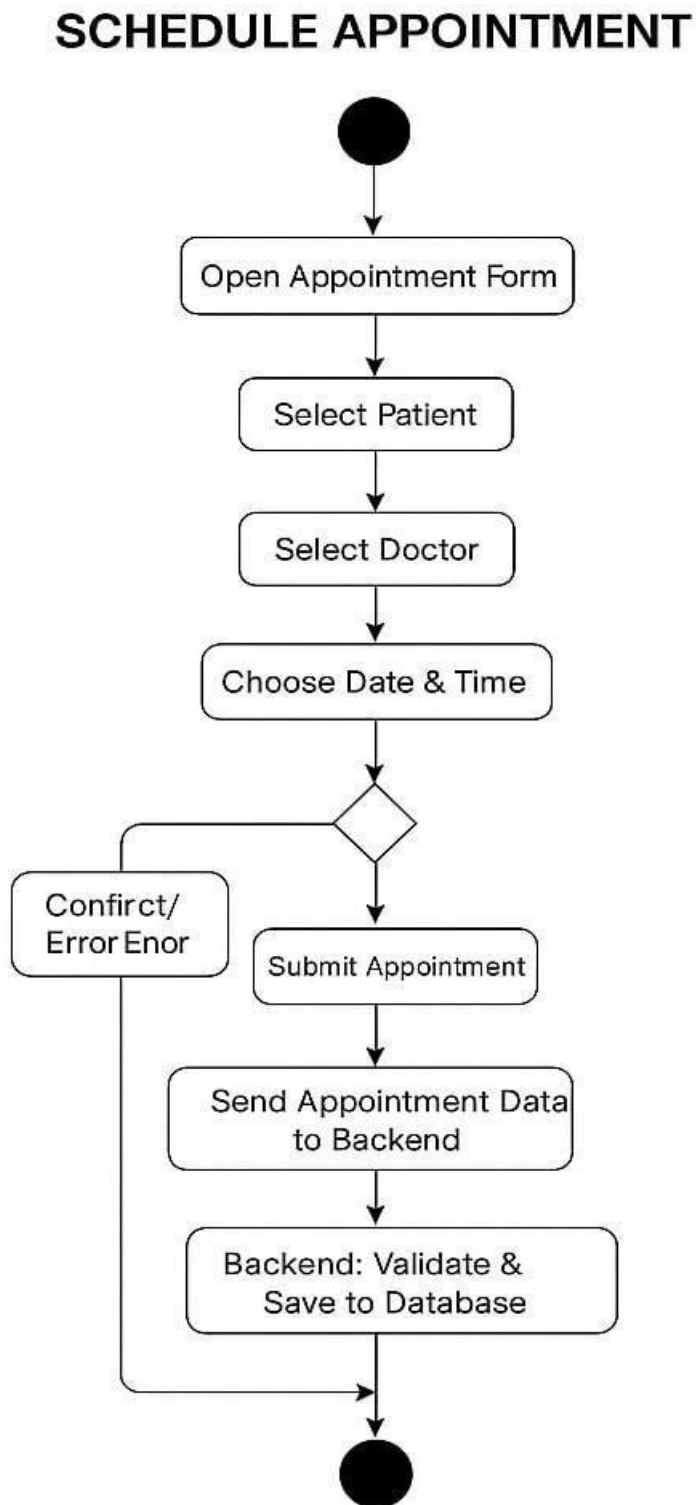


Figure 11: Shedule Appointment Activity Diagram

3.4 Class Diagram

A class diagram is a type of static structure diagram in the Unified Modeling Language (UML) that describes the structure of a system by showing its classes, their attributes, methods (operations), and the relationships between the classes. It is commonly used in software engineering to model the object-oriented structure of a system and serves as a blueprint for both system design and implementation.

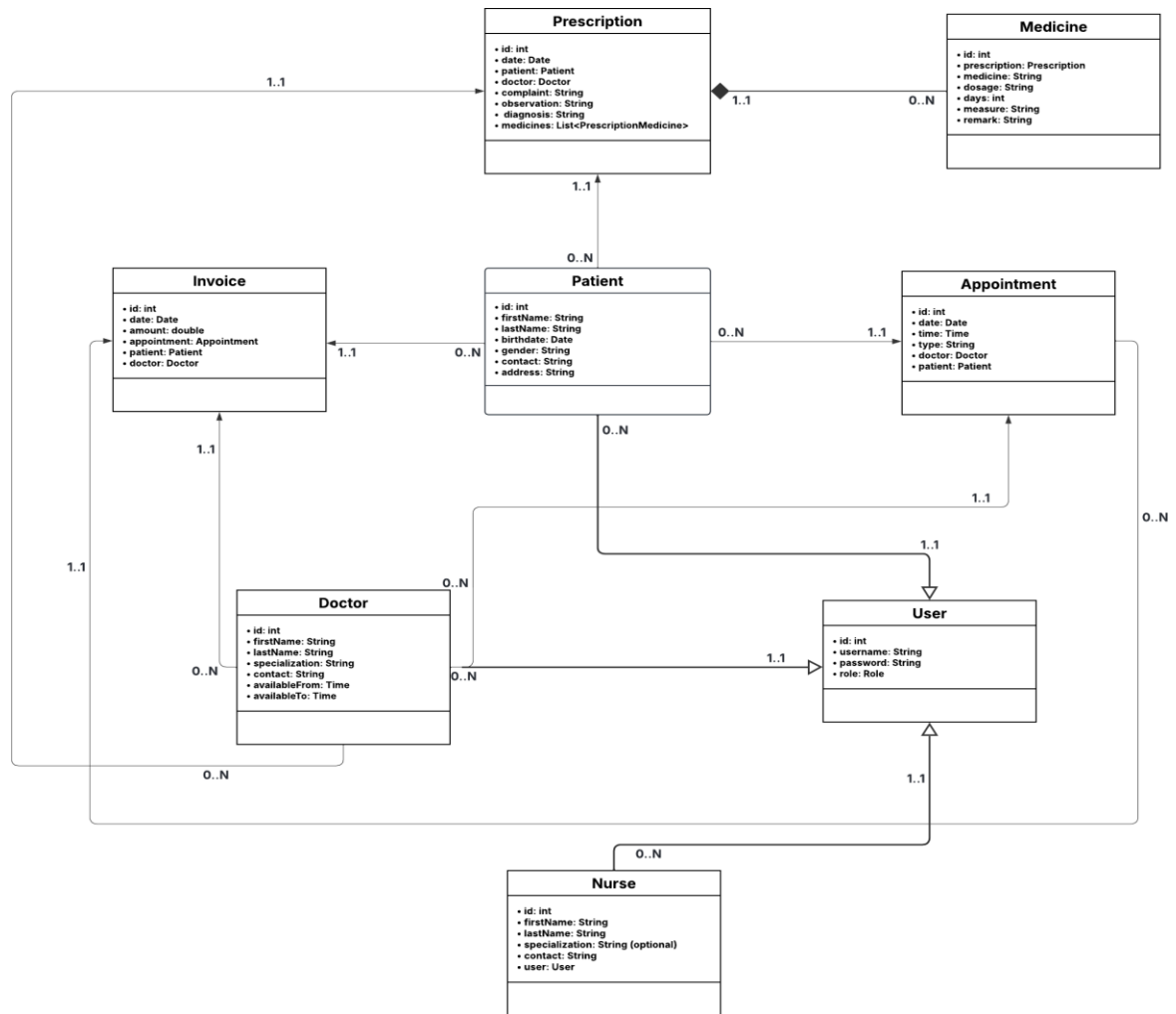


Figure 12: Class Diagram

3.4 Sequence Diagram

A sequence diagram is a Unified Modeling Language (UML) diagram that illustrates the sequence of messages between objects in an interaction. A sequence diagram consists of a group of objects that are represented by lifelines, and the messages that they exchange over time during the interaction.

A sequence diagram shows the sequence of messages passed between objects. Sequence diagrams can also show the control structures between objects. For example, lifelines in a sequence diagram for a banking scenario can represent a customer, bank teller, or bank manager. The communication between the customer, teller, and manager are represented by messages passed between them. The sequence diagram shows the objects and the messages between the objects.

3.4.1 Login Sequence Diagram

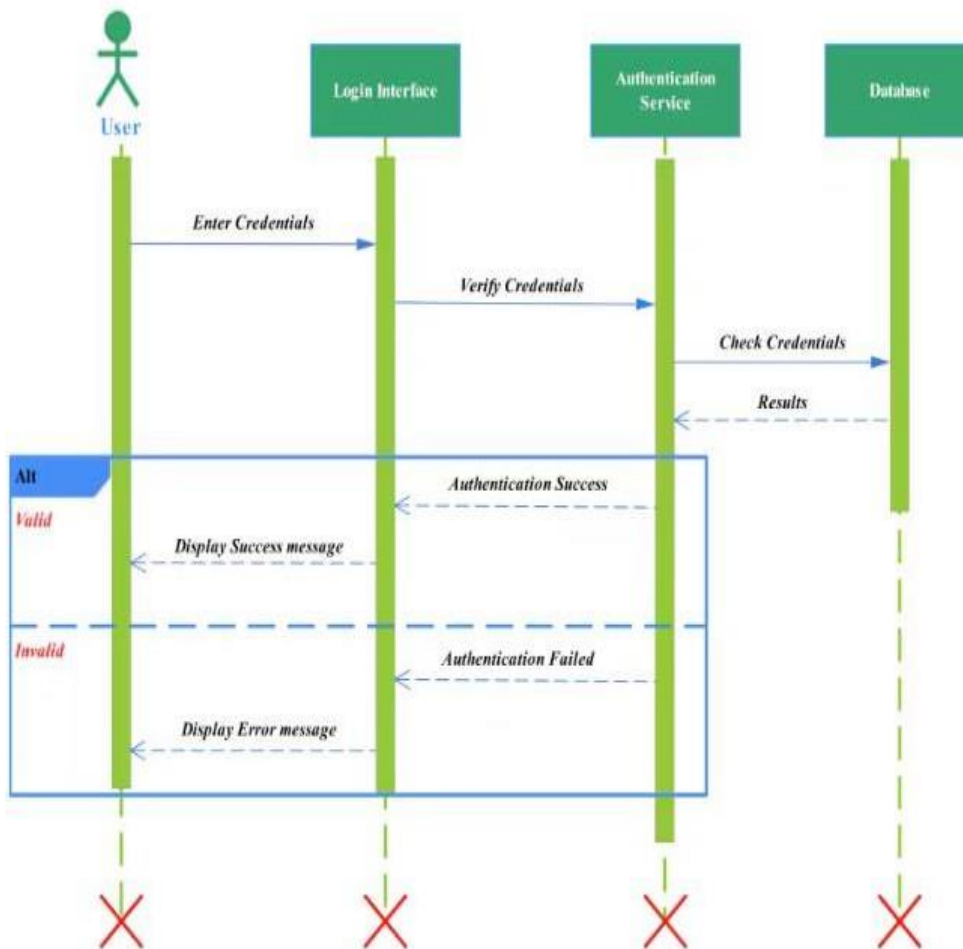


Figure 13: Login Sequence Diagram

3.4.2 Add Doctor Sequence Diagram

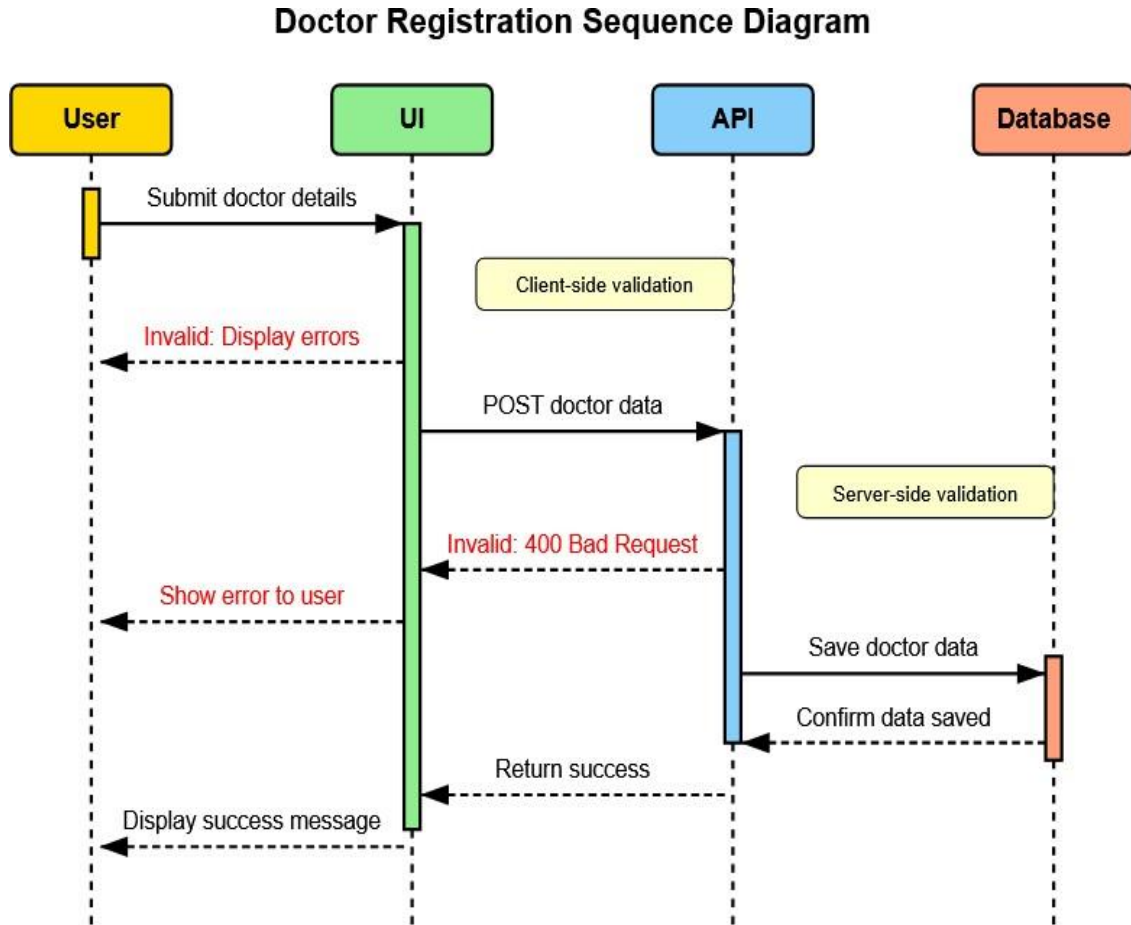


Figure 14: Add Doctor Sequence Diagram

3.4.2 Medical Prescription Generation Sequence Diagram

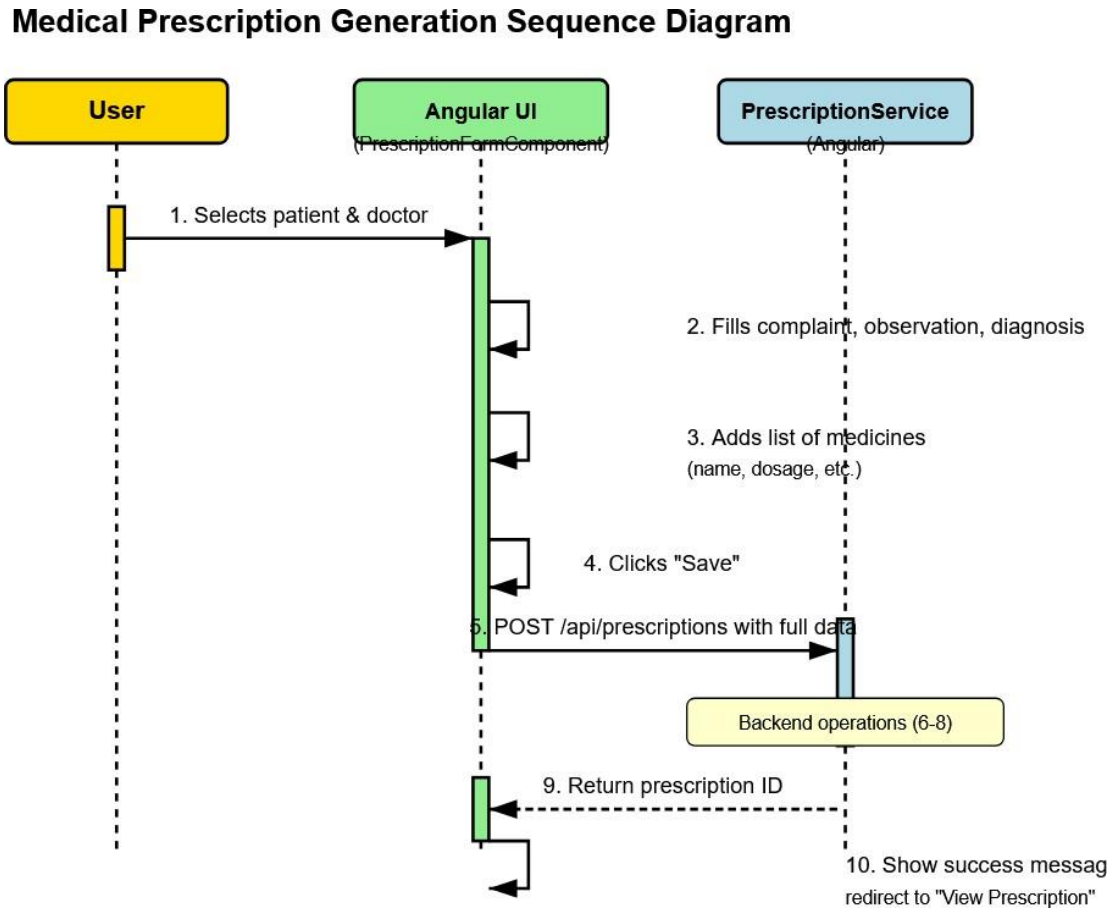


Figure 15: Medical Prescription Generation Sequence Diagram

4. Conculsion :

In this chapter, we have introduced the solution for our hospital management ERP system and described it in detail. We presented the system's functional and non-functional requirements, as well as the roles of the key actors involved. Additionally, we explained the requirements gathering techniques used to accurately capture the needs of the clinic.

We also provided a detailed design of the application using UML diagrams, including use case diagrams, activity diagrams, sequence diagrams, and class diagrams. These diagrams allowed us to model the behavior, workflows, and structure of the system efficiently.

Chapter 4

Implementation of the application

1. Introduction

After detailing the design of our solution in the previous section, we now reach the final stage of our project's development cycle, where we will bring our project to fruition. The objective of this chapter is to present the technical perspective of our solution and justify the tools and programming languages chosen. We will then visualize the results of our work in the form of screenshots.

2. Presentation of Software and work tools

In this section, we present the various tools and software used throughout the project. First, we chose IntelliJ IDEA as our integrated development environment (IDE) for both frontend and backend development, due to its powerful features and versatility. For version control and collaborative development, we used Git along with GitHub. To generate professional reports, we integrated JasperSoft Studio into the project. Finally, the project logo was designed using Canva, a user-friendly graphic design tool.

Figure 15 , illustrates all the software logos used in the implementation of our project.



Figure 16:Logos of the software used

2.1 IntelliJ IDEA

IntelliJ IDEA is a highly popular integrated development environment (IDE) developed by JetBrains. It is designed primarily for Java but also supports a wide range of programming languages including Kotlin, Groovy, Scala, and more. This software development tool is highly beneficial for programmers since with it they can efficiently create, edit, debug, and manage code in various applications.

This editor was used for both frontend and backend development of the application.[12]

2.2 Git And Github:

Git is a version control software created by Linus Torvalds, author of the Linux kernel. It allows you to save the various changes made to a project and to revert to a previous version of the project. In the language of version control systems, a copy of all the files in a project and their version located on a central server is called a repository. Git also calls this a "repository." GitHub is an online service that hosts Git repositories. It is the largest Git repository host in the world. Many of the repositories hosted on GitHub are public, meaning that anyone can download the code from these repositories and contribute to their development by proposing new features. To recap, Git is a version control software, while GitHub is an online Git repository hosting service that acts as a central server for these repositories.

2.3 JasperSoft Studio:

Jaspersoft Studio is an Eclipse-based report designer for JasperReports Library and JasperReports Server; it's available as an Eclipse plug-in or as a stand-alone application. Jaspersoft Studio allows you to create sophisticated

layouts containing charts, images, subreports, crosstabs, and more. You can access your data through a variety of sources including JDBC, TableModels, JavaBeans, XML, Hibernate, Big Data (such as Hive), CSV, XML/A, as well as custom sources, then publish your reports as PDF, RTF, XML, XLSX, CSV, HTML, XHTML, text, DOCX, or OpenOffice. I used it in generating reports , invoices and medical prescriptions.[13]

2.4 Canva:

Canva is a multimedia platform loaded with different design functionalities and features that allow you to create visual content, graphics, presentations, advertising materials, and branded social media content for your business or personal use.

3. Introduction to Programming Technologies

In this section, we present the programming languages and technologies used in the development of our ERP system. For the **front-end** of our application, we chose Angular, a modern framework based on TypeScript, which allows us to build dynamic and responsive web applications. We also used Angular Material to take advantage of pre-designed components and provide a consistent, modern user interface. For styling and customization, we used SASS, an extension of CSS that allows for more structured and flexible style sheets.

For the **back-end**, we opted for Java, a robust language widely used for handling business logic and creating efficient APIs. To facilitate the management of HTTP requests, we used `com.sun.net.httpserver.HttpHandler`, a lightweight server for creating RESTful endpoints. For database management, MySQL was selected for its reliability and performance, ensuring the management of data such as patients, doctors, prescriptions, and billing. Lastly, for report generation, we integrated Jaspersoft Reports, a powerful tool for producing PDF reports from the data stored in the database.



Figure 17:Logos of the technologies used

3.1 Java :

Java is a widely-used programming language for coding web applications. It has been a popular choice among developers for over two decades, with millions of Java applications in use today. Java is a multi-platform, object-oriented, and network-centric language that can be used as a platform in itself. It is a fast, secure, reliable programming language for coding everything from mobile apps and enterprise software to big data applications and server-side technologies.[14]

3.2 Angular :

Angular is a web framework that empowers developers to build fast, reliable applications. Maintained by a dedicated team at Google, Angular provides a broad

suite of tools, APIs, and libraries to simplify and streamline your development workflow. Angular gives you a solid platform on which to build fast, reliable applications that scale with both the size of your team and the size of your codebase.[15]

3.3 Sass :

Sass is a stylesheet language that's compiled to CSS. It allows you to use variables, nested rules, mixins, functions, and more, all with a fully CSS-compatible syntax. Sass helps keep large stylesheets well-organized and makes it easy to share design within and across projects.

3.4 MySql :

MySQL is an open-source relational database management system we can interact with using Structured Query Language (SQL). A query language is a simple programming language that can help you access, manipulate and manage data in a relational database. We use MySQL to store all the information you need to efficiently run large, complex websites.[16]

4. Presentation Of the Application

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

4.1 Login Page

The system provides a login page for authorized users to access the full functionality of the ERP.

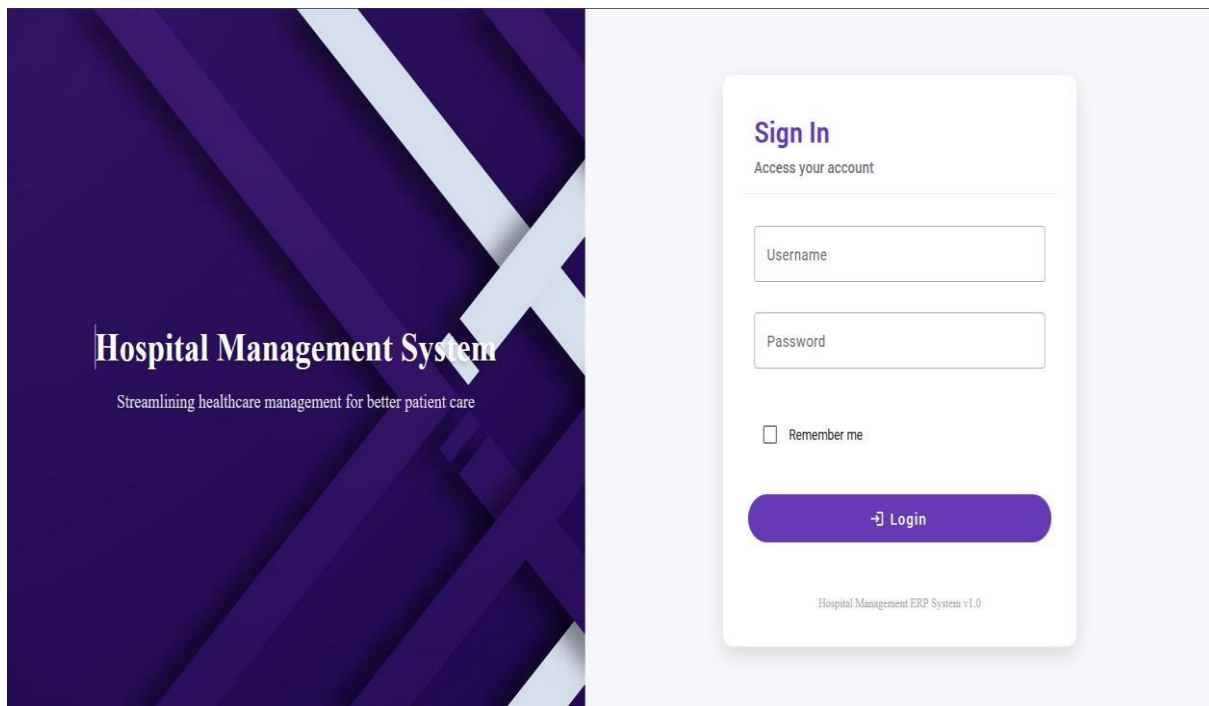


Figure 18: Login Page

It consists of the following elements:

(1) Sign-In Section: A clear heading labeled "Sign In" indicates the login area, accompanied by the instruction "Access your account" to guide users.

(2) Username Input: A field is provided for users to enter their username, serving as the primary credential for authentication.

(3) Password Input: A secure password input field allows users to enter their passwords, ensuring confidentiality during the login process.

(4) Remember Me Checkbox: An optional checkbox labeled "Remember me" enables users to stay logged in for future visits by saving their credentials (unchecked by default in this example).

(5) Login Button: A prominently placed button labeled "Login" (pre-checked in this example, though typically interactive) allows users to submit their credentials and access the system.

(6) Version Information: At the bottom of the page, the text "Hospital Management ERP System v 1.0" displays the system version, providing transparency about the software iteration.

4.2 ERP structure

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

(1) Header : At the top of the page, the hospital or ERP system logo is prominently displayed, representing the brand identity. The header also includes a menu with the following options:

- Theme (toggle between light/dark mode)
- Language (switch system language)
- Logout (end the current session)

Additional elements may include user profile details, notifications, and quick-access shortcuts.

(2) Sidebar: Positioned on the left side, the sidebar features the hospital's logo at the top, followed by a search bar, and a structured list of navigation links including Dashboard, Patients, Doctors, Appointments, Billing, Reports, Inventory Management, Access Rights, Security, Settings, and About Us.

(3) Content Area: The main content occupies the center of the screen, dynamically updating based on user navigation. It presents forms, data tables, and views for managing the clinic's daily operations such as patient management, consultations, prescriptions, and financial records.

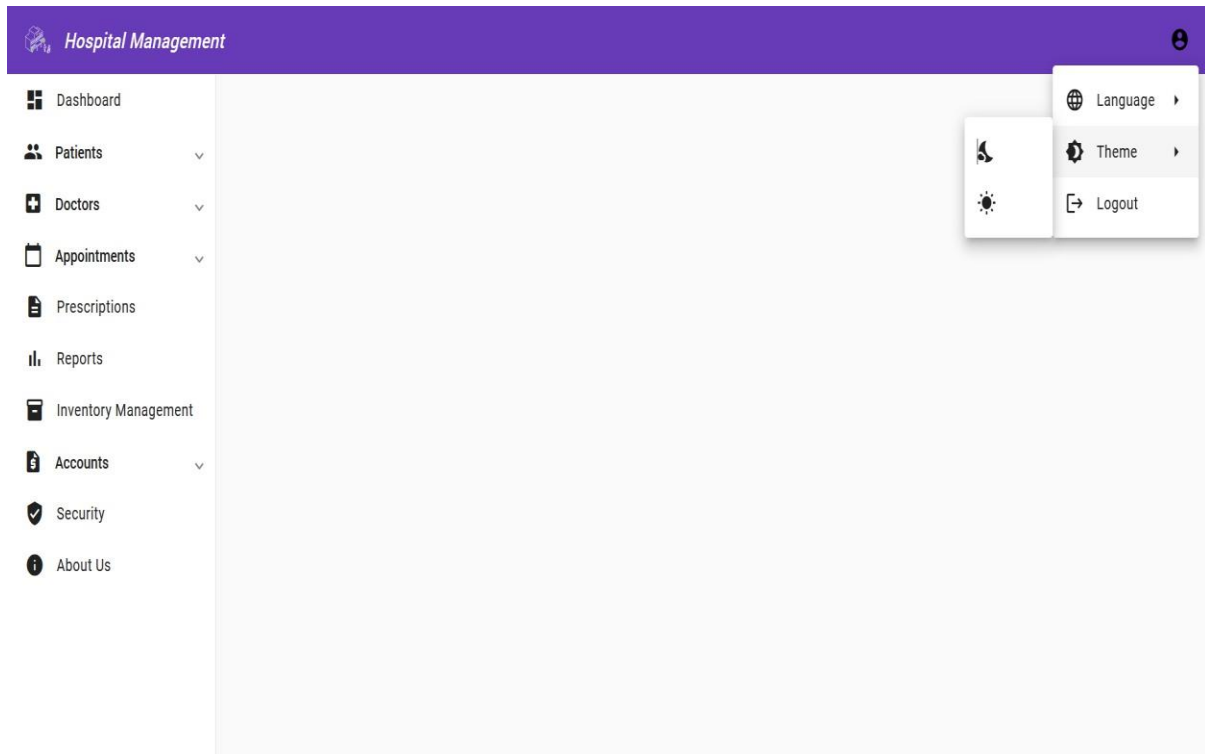


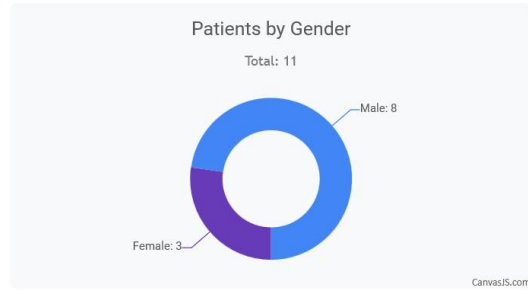
Figure 19: First Page

4.2.1 Dashboard:

After logging in, users are directed to a general dashboard that provides an overview of key information and quick access to the system's core features.

 Today's Appointments 0/9 75% completion rate	 Total Patients 11 ↑ 12% this month	 Expired Medications 592 ↓ 5% from last week	 Monthly Income \$800.00 ↑ 80% this month
--	--	---	--

Patient Demographics



Revenue

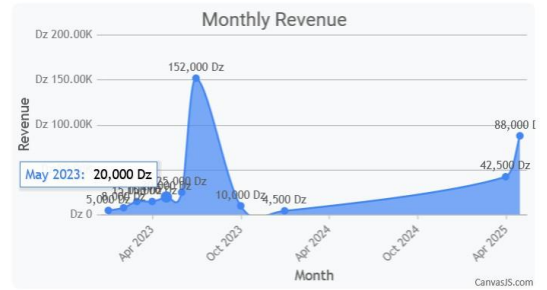
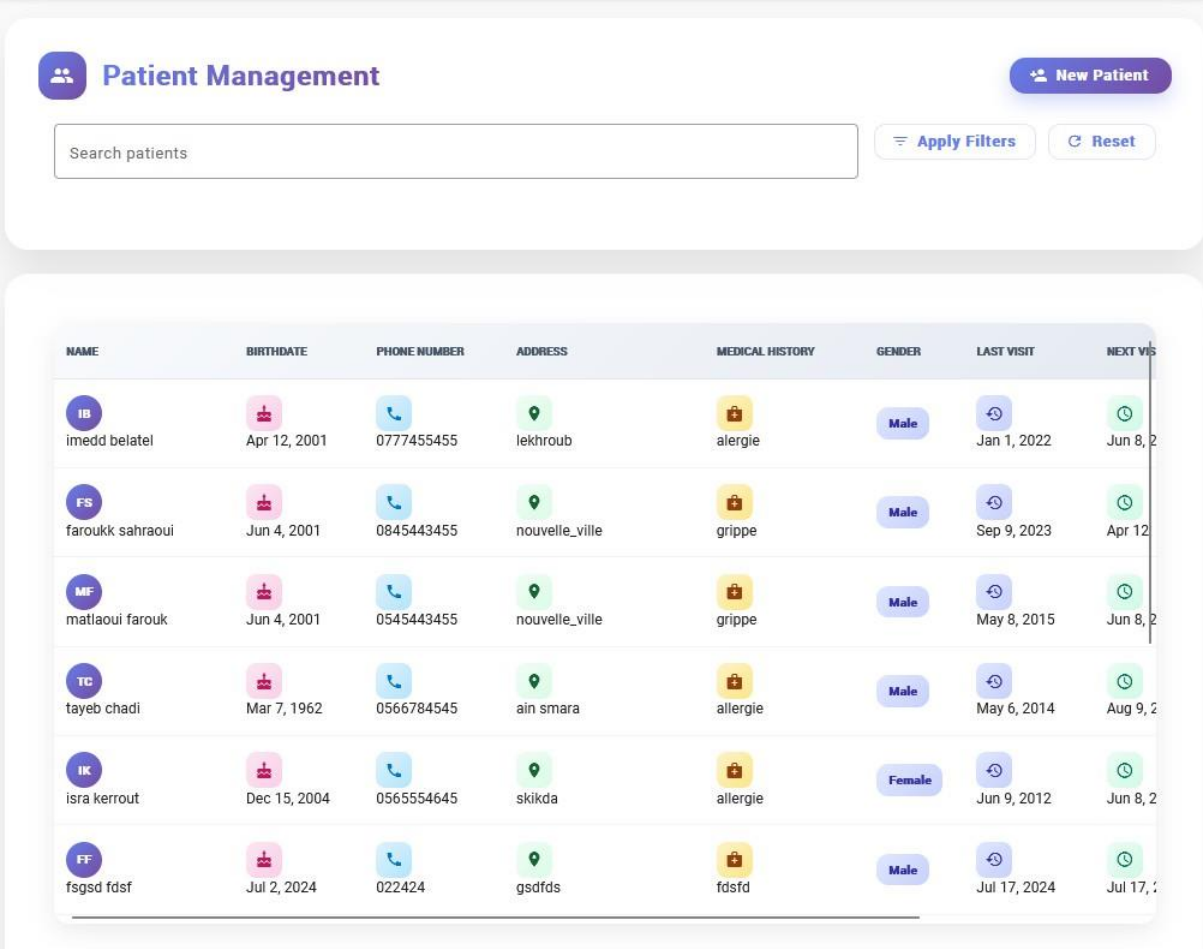


Figure 20: Dashboard Page

4.2.2 Patient Management View:

This interface displays a searchable and paginated list of patients with key details such as birthdate, contact info, medical history, and visit dates.

Users can add new patients or perform actions like view, edit, and delete directly from the table.



The screenshot shows a 'Patient Management' interface. At the top, there is a header with a 'New Patient' button. Below the header is a search bar labeled 'Search patients' and two buttons: 'Apply Filters' and 'Reset'. The main content is a table with the following columns: NAME, BIRTHDATE, PHONE NUMBER, ADDRESS, MEDICAL HISTORY, GENDER, LAST VISIT, and NEXT VISIT. The table contains six rows of patient data.

NAME	BIRTHDATE	PHONE NUMBER	ADDRESS	MEDICAL HISTORY	GENDER	LAST VISIT	NEXT VISIT
imedd belatel	Apr 12, 2001	0777455455	lekhroub	alergie	Male	Jan 1, 2022	Jun 8, 2022
faroukk sahraoui	Jun 4, 2001	0845443455	nouvelle_ville	grippe	Male	Sep 9, 2023	Apr 12, 2024
matlaoui farouk	Jun 4, 2001	0545443455	nouvelle_ville	grippe	Male	May 8, 2015	Jun 8, 2022
tayeb chadi	Mar 7, 1962	0566784545	ain smara	allergie	Male	May 6, 2014	Aug 9, 2022
isra kerrout	Dec 15, 2004	0565554645	skikda	allergie	Female	Jun 9, 2012	Jun 8, 2022
fsgsd fdsf	Jul 2, 2024	022424	gsdfds	fdsfd	Male	Jul 17, 2024	Jul 17, 2024

Figure 21: Patient Management Ui

Add Patient view :

This UI allows clinic staff to register a new patient. It is organized into sections:



- **Personal Information:** Includes required fields for first name, last name, birthdate (with date picker), and gender (dropdown).

- Contact Information: Includes required phone number and address .
- Appointment information :includes last visit and next visit .
- Medical Information : Medical History (*Textarea*) – Allows staff to input a summary of the patient’s past and current health conditions.
- Form Action : includes Cancel button , and Save button (Disabled by default) – Triggers saving the form data once the form is valid



Add Patient

Add Patient Description



Personal Information

First Name*	Last Name*
Birthdate* 	Gender* 

Contact Information


Phone Number* 	Address* 
---	--

Appointment Information

Last Visit* 	Next Visit* 
---	---

Medical Information

Medical History*



Cancel Save

Figure 22 : Add Patient Page

View Patient Details





View Patient

First Name imedd	Last Name belatel
Birthdate 2001-04-12	Gender male
Phone Number 0777455455	Address lekhroub
Last Visit 2022-01-01	Next Visit 2024-06-08
Medical History alergie	

Figure 23 : View Patient Details Page

Update Patient view

Update Patient

First Name* isra	Last Name* kerrout
Phone Number* 0565554645	Gender* female
Birthdate* 12/15/2004 	Address* skikda
Last Visit* 6/9/2012 	Next Visit* 6/8/2020 
Medical History* allergie 	

SAVE **CANCEL**

Figure 24: Update Patient Page

Delete Patient View

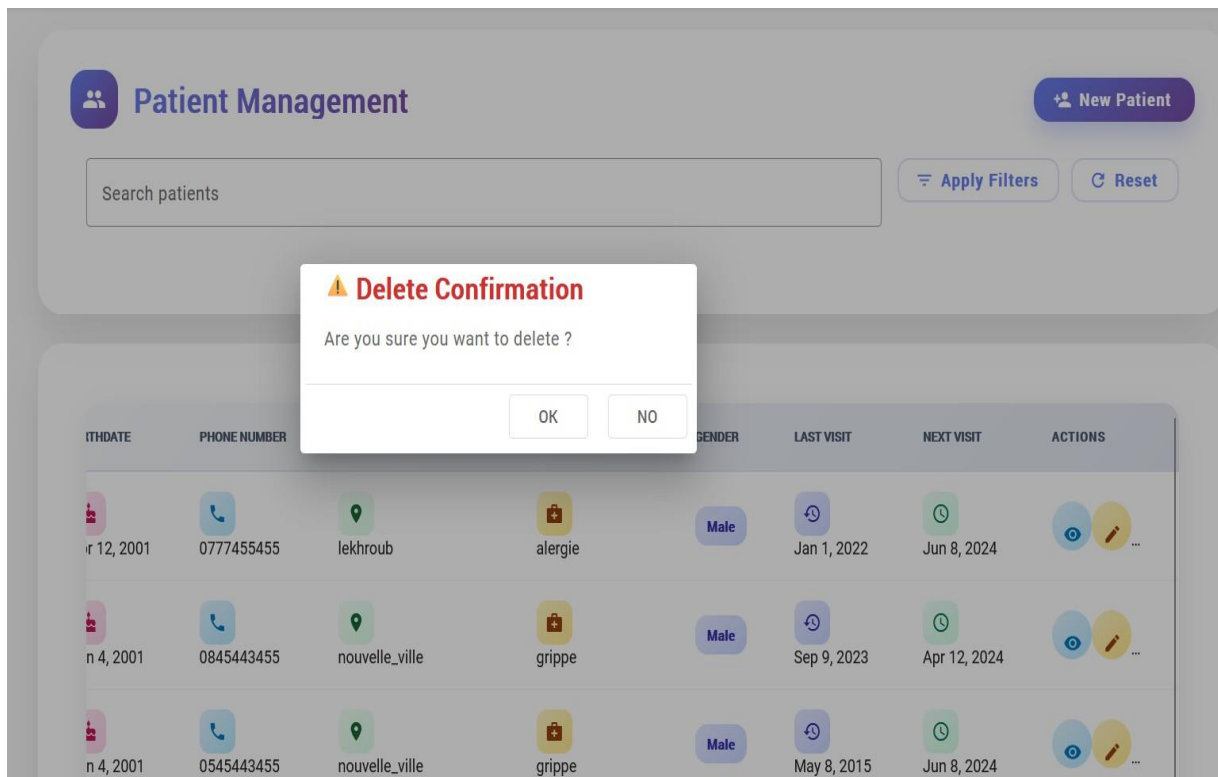


Figure 25: Delete Patient Page

4.2.3 Doctor Management View:

This interface displays a searchable and paginated list of doctors with key details. Users can add new doctor or perform actions like view, edit, and delete directly from the table.

The screenshot shows a web interface for managing doctors. At the top, there is a header with a lock icon and the text "Doctors Management". To the right of the header is a "New Doctor" button. Below the header is a search bar with the placeholder text "Search doctors". To the right of the search bar are two buttons: "Apply Filters" and "Reset".

The main content area contains a table with the following columns: Name, Contact, Specialization, Available From, Available To, Joining Date, and Actions. The table lists six doctors with their respective details and action icons (view, edit, delete).

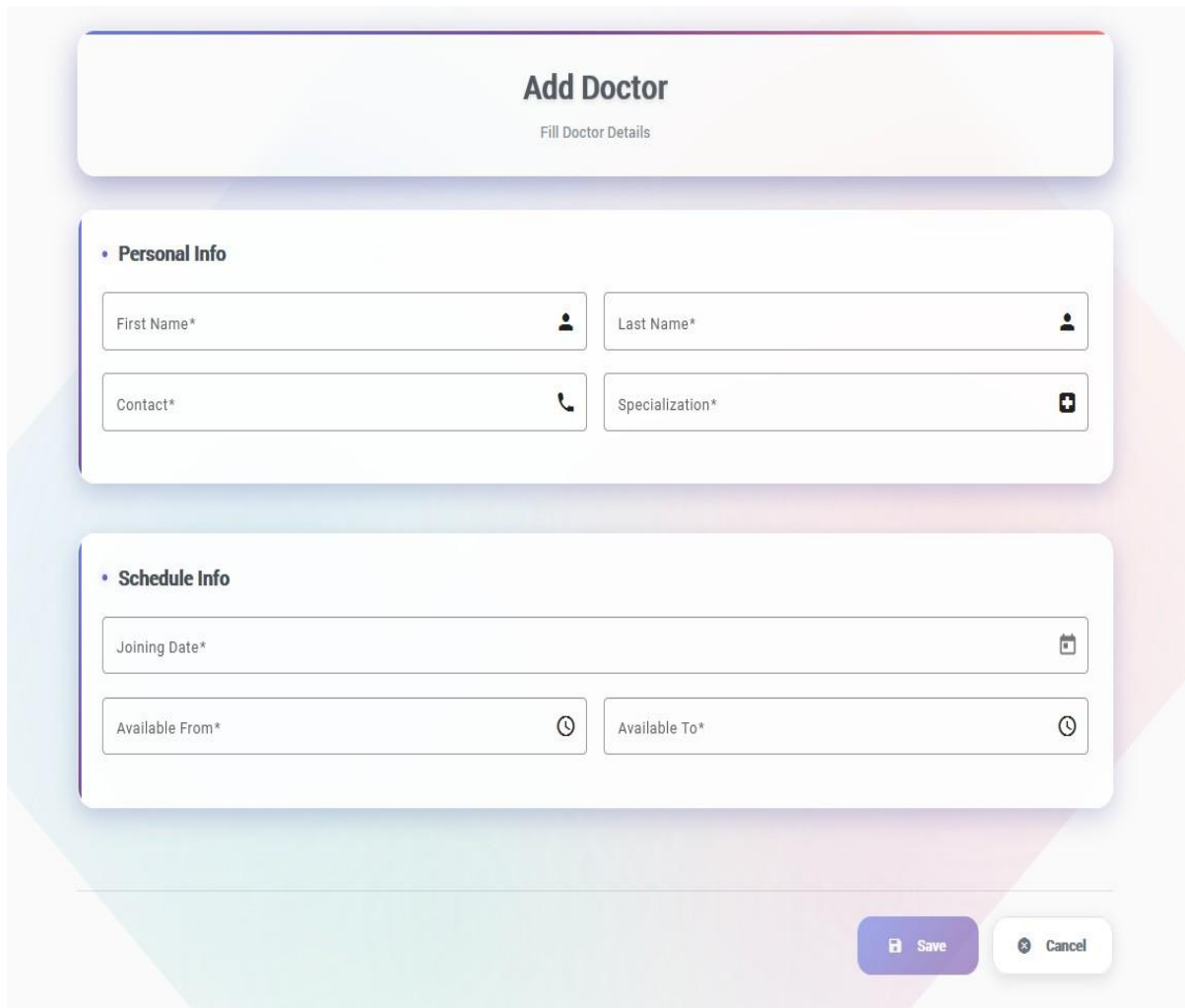
Name	Contact	Specialization	Available From	Available To	Joining Date	Actions
hakim fwili	0546253645	Anesthesiologists	04:00 AM	01:13 AM	Jan 1, 2022	
karim laraba	0545612345	Cardiologists	08:00	16:00	May 6, 2023	
mohamed kradaa	0777546521	Endocrinologists	10:00	18:00	Oct 12, 2024	
benoudina lokmen	0568745669	radiologist	08:00	17:00		
farhi mohamed	0546253645	Anesthesiologists	08:00	16:00		
salim abed	0564865651	radiologist	08:00	14:00		

At the bottom of the interface, there is a pagination section. It includes a dropdown menu for "Items per page" set to "10", a text "1 - 8 of 8", and navigation buttons for first, previous, next, and last page.

Figure 26: Doctors Management Page

Add Doctor View :

this ui represent the add doctor view.



The image shows a user interface for adding a doctor. It features a main title 'Add Doctor' with a subtitle 'Fill Doctor Details'. The form is divided into two sections: 'Personal Info' and 'Schedule Info'. The 'Personal Info' section contains four input fields: 'First Name*' with a person icon, 'Last Name*' with a person icon, 'Contact*' with a phone icon, and 'Specialization*' with a plus icon. The 'Schedule Info' section contains three input fields: 'Joining Date*' with a calendar icon, 'Available From*' with a clock icon, and 'Available To*' with a clock icon. At the bottom right, there are two buttons: a purple 'Save' button and a white 'Cancel' button with a close icon.

Figure 27: Add Doctor Page

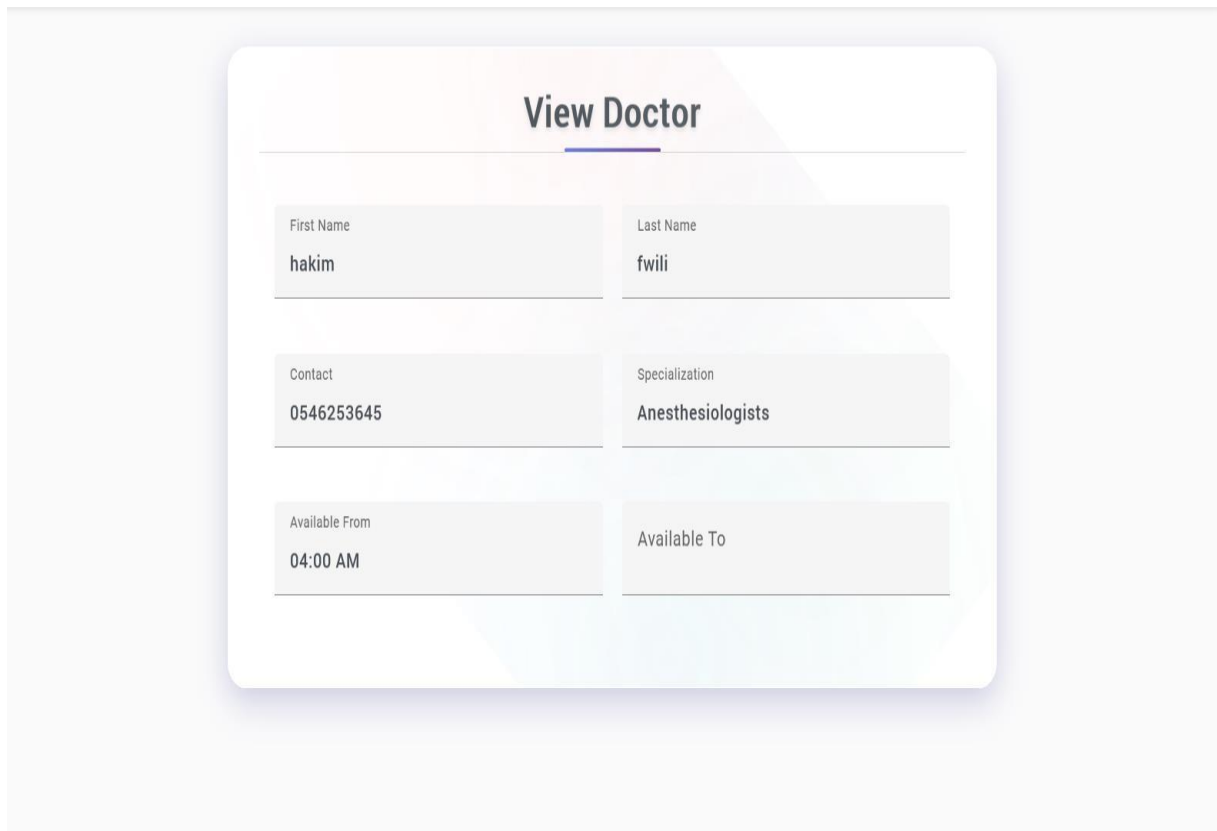
Update Doctor View

The image shows a web form titled "Update Doctor" with a light blue header and a white background. The form contains six input fields arranged in a 3x2 grid. The first row contains "First Name*" with the value "hakim" and "Last Name*" with the value "fwili". The second row contains "Contact*" with the value "0546253645" and "Specialization*" with the value "Anesthesiologists". The third row contains "Available From*" with the value "4:00 AM" and "Available To*" with the value "1:13 AM". Each time field has a clock icon to its right. At the bottom of the form are two buttons: a blue "SAVE" button and a white "CANCEL" button with a grey border.

Field Label	Value
First Name*	hakim
Last Name*	fwili
Contact*	0546253645
Specialization*	Anesthesiologists
Available From*	4:00 AM
Available To*	1:13 AM

Figure 28: Update Doctor Page

View Doctor Details Ui :



The screenshot displays a 'View Doctor' page with a light blue header and a white content area. The page is titled 'View Doctor' in bold black text. Below the title, there are six data fields arranged in a 3x2 grid. The first row contains 'First Name' (hakim) and 'Last Name' (fwili). The second row contains 'Contact' (0546253645) and 'Specialization' (Anesthesiologists). The third row contains 'Available From' (04:00 AM) and 'Available To' (empty). The fields are presented in a clean, modern style with light gray borders and a subtle shadow effect.

View Doctor	
First Name hakim	Last Name fwili
Contact 0546253645	Specialization Anesthesiologists
Available From 04:00 AM	Available To

Figure 29: View Doctor Details Page

4.2.3 Appointments management

This dashboard provides a clear overview of appointments, enabling efficient management through searchable and filterable data, including appointment details and direct action controls. It streamlines the organization of patient visits and doctor schedules within a healthcare or similar appointment-based system.



















ID	TYPE	DOCTOR	PATIENT	DATE	TIME	ACTIONS
#5	حالة طارئة	Dr. karim laraba	imed belatel	Jul 26, 2024	1:21 PM	  
#7	زيارة طبية	Dr. karim laraba	tayeb chadi	Jul 2, 2024	3:12 PM	  
#15	فحص طبي	Dr. benoudina lokmen	matlaoui farouk	Jul 3, 2024	5:00 PM	  
#2025001	حالة طارئة	Dr. mohamed kradaa	matlaoui farouk	Apr 18, 2025	4:00 AM	  
#2025008	زيارة طبية	Dr. mohamed kradaa	isra kerrout	Apr 14, 2025	2:00 PM	  
#25001	حالة طارئة	Dr. mohamed kradaa	imed belatel	Apr 26, 2025	12:00 AM	  

Figure 30: Appointment Management Page

Add Appointment View :

The Add Appointment UI allows selecting the doctor, patient, type, date, and time of the appointment. It ends with Cancel and Save buttons, following a clean and consistent design.

+ Add Appointment

Number* #
Must Be Number

Patient* ▼ 👤

Type* ▼ 👤

Date* 📅

Doctor* ▼ 👤

Time* 🕒

✕ Cancel 💾 Save

Figure 31: Add Appointment Page

View Appointment detail Ui

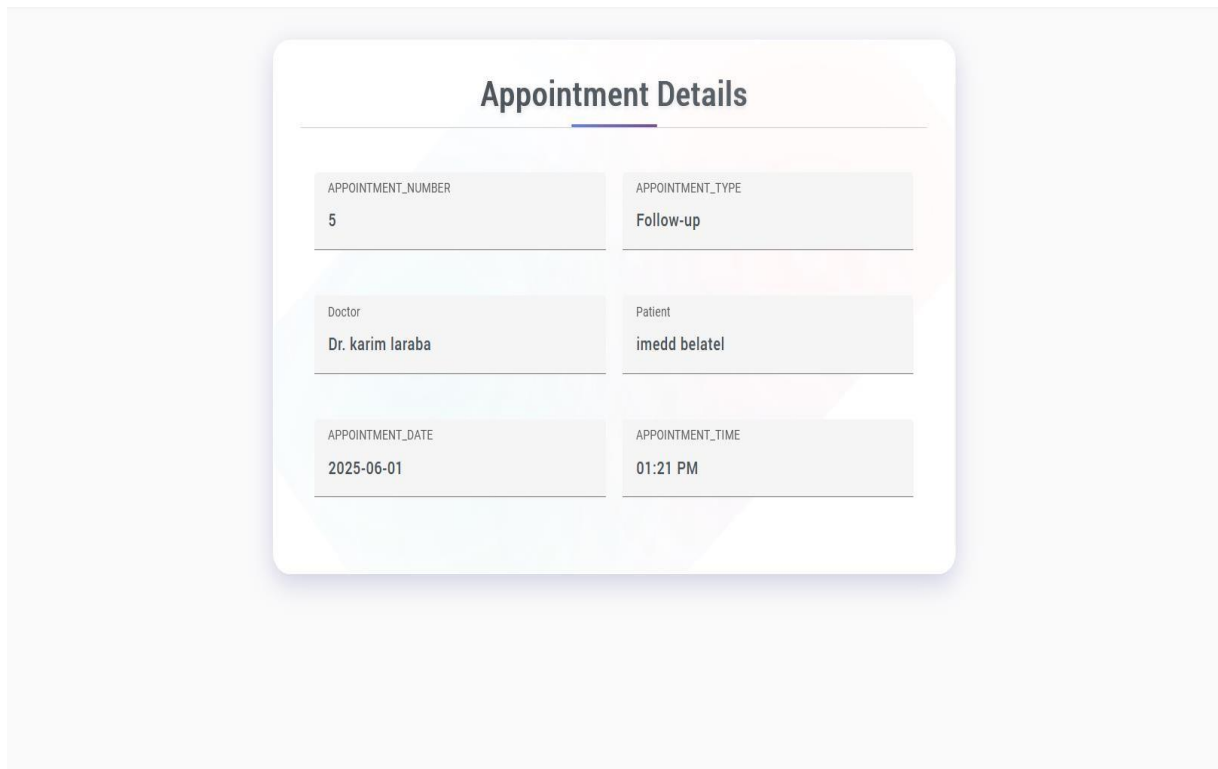


Figure 32: View Appointment Detail Page

Update Appointment View

Update Appointment

Modify appointment details below

Number* 5 #	Type* Follow-up ▾ 📌
<small>Must Be Number</small>	
Doctor* Dr. karim laraba ▾ 👤	Patient* imedd belatel ▾ 🧑
Date* 6/1/2025 📅	Time* 1:21 PM 🕒

Save Cancel

Figure 33: Update Appointment Page

4.2.4 Medical Prescriptions view

This Medical Prescriptions view displays patient and doctor details, diagnosis, and a list of prescribed medications with dosage, duration, and remarks. It uses a structured layout with a table for medications and a print/export option for easy sharing.

Medical Prescriptions

Prescriptions History








Patient	Doctor	Date	Medication	Observation	diagnosis	Actions
faroukk sahraoui	karim laraba	Feb 3, 2025	AMOXAL ATRYLINE	dhdhdhd	hdhdfhf	
isra kerrout	farhi mohamed	Mar 20, 2025		fsdfdsfsf	dfsfsf	
tayeb chadi	hakim fwili	May 14, 2025		dijffgfgf	idkkkk	
tayeb chadi	karim laraba	May 16, 2025		idkkkkkkkkkk	idkkkkkk	
faroukk sahraoui	mohamed kradaa	May 15, 2025		idkkkkkk	idkkkk	
faroukk sahraoui	mohamed kradaa	May 15, 2025		idkkkkkk	idkkkk	


Figure 34 : Table of Medical Prescription


New Prescription View

This view describes generation of medical prescription


+ New Prescription

Date* 5/25/2025  Patient* ▼ Doctor* ▼

Diagnosis* 

Observation* 

Medicines + Add Medicine

Medicine	Dosage	Days	Instructions	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	

✕ Cancel 🖨️ Print 💾 Save Prescription

Figure 35 : Generation of Medical Prescription Page

Clicking Print generates a medical prescription with the entered patient details

Dr. karim laraba
Cardiologists
0545612345



Clinique Internationale Silm
Cit  20 Ao t 1955 43000 Chelghoum el Aid, Algeria
clinique.internationalesilm@gmail.com
0559 43 43 43

Date: 2025-02-03

faroukk sahraoui
nouvelle_ville
0845443455

Medication	Days	Frequency
AMOXAL (125MG/5ML) <i>PDRE. P. SUSP. BUV., 7 days</i>	7	1000mg - after lunch
ATRYLINE (25MG) <i>COMP. ENRO., 7 days</i>	7	500 mg - after breakfast

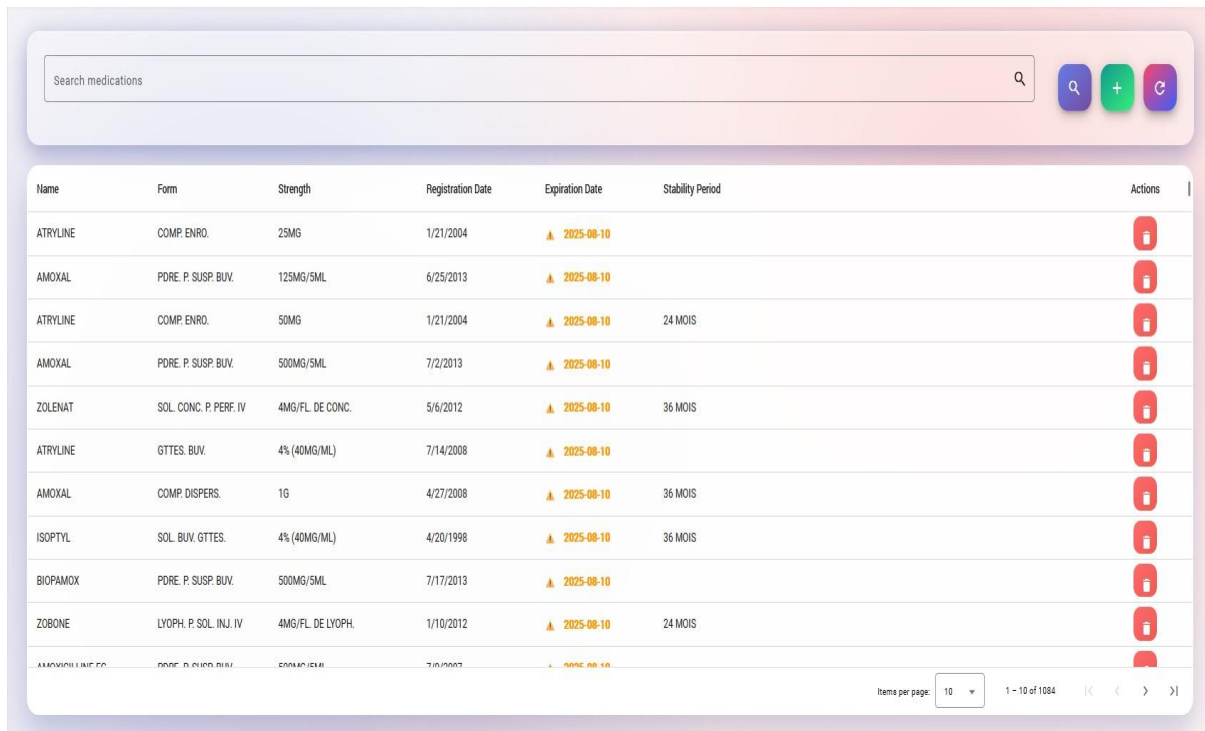
Doctor's Signature

Page 1 of 1

Figure 36 : Example of Medical Prescription

4.2.5 Inventory Management

This figure displays the inventory management UI.



The screenshot shows a web interface for inventory management. At the top, there is a search bar labeled "Search medications" with a magnifying glass icon. To the right of the search bar are three circular icons: a magnifying glass, a plus sign, and a refresh symbol. Below the search bar is a table with the following columns: Name, Form, Strength, Registration Date, Expiration Date, Stability Period, and Actions. The table contains 10 rows of medication data. Each row has a red trash can icon in the Actions column. At the bottom right of the table, there is a pagination control showing "Items per page: 10" and "1 - 10 of 1084".

Name	Form	Strength	Registration Date	Expiration Date	Stability Period	Actions
ATRYLINE	COMP. ENRO.	25MG	1/21/2004	▲ 2025-08-10		
AMOXAL	PORE. P. SUSP. BUV.	125MG/5ML	6/25/2013	▲ 2025-08-10		
ATRYLINE	COMP. ENRO.	50MG	1/21/2004	▲ 2025-08-10	24 MOIS	
AMOXAL	PORE. P. SUSP. BUV.	500MG/5ML	7/2/2013	▲ 2025-08-10		
ZOLENAT	SOL. CONC. P. PERF. IV	4MG/FL. DE CONC.	5/6/2012	▲ 2025-08-10	36 MOIS	
ATRYLINE	GTTES. BUV.	4% (40MG/ML)	7/14/2008	▲ 2025-08-10		
AMOXAL	COMP. DISPERS.	1G	4/27/2008	▲ 2025-08-10	36 MOIS	
ISOPTYL	SOL. BUV. GTTES.	4% (40MG/ML)	4/20/1998	▲ 2025-08-10	36 MOIS	
BIOPAMOX	PORE. P. SUSP. BUV.	500MG/5ML	7/17/2013	▲ 2025-08-10		
ZOBONE	LYOPH. P. SOL. INJ. IV	4MG/FL. DE LYOPH.	1/10/2012	▲ 2025-08-10	24 MOIS	

Figure 37: Inventory Management Page

This figure displays the add Medication UI.

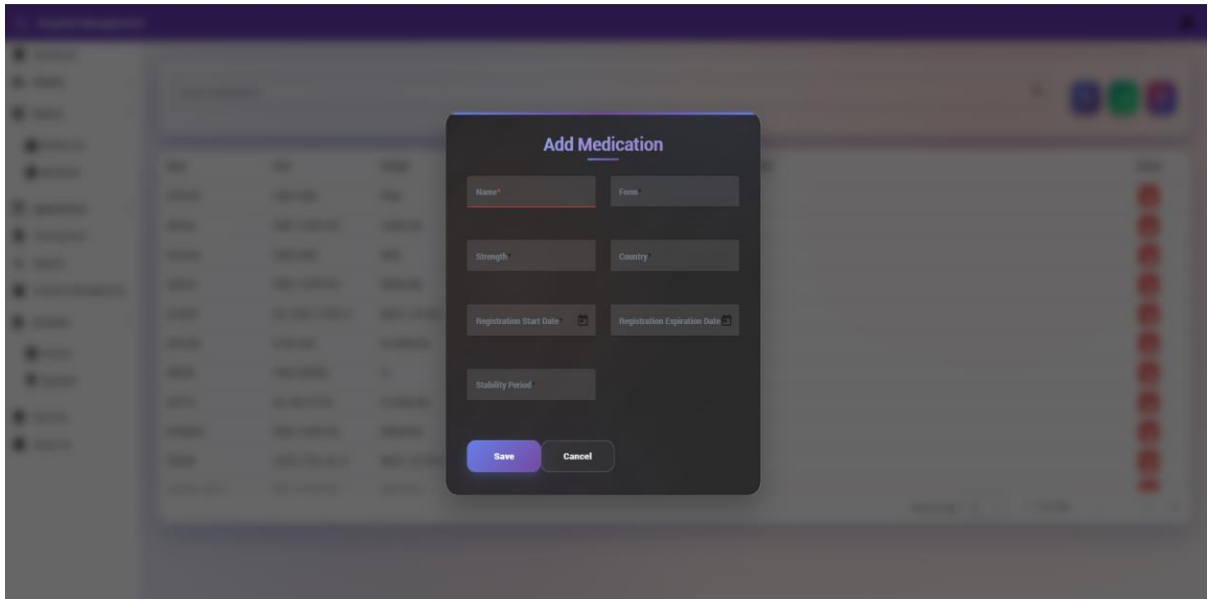
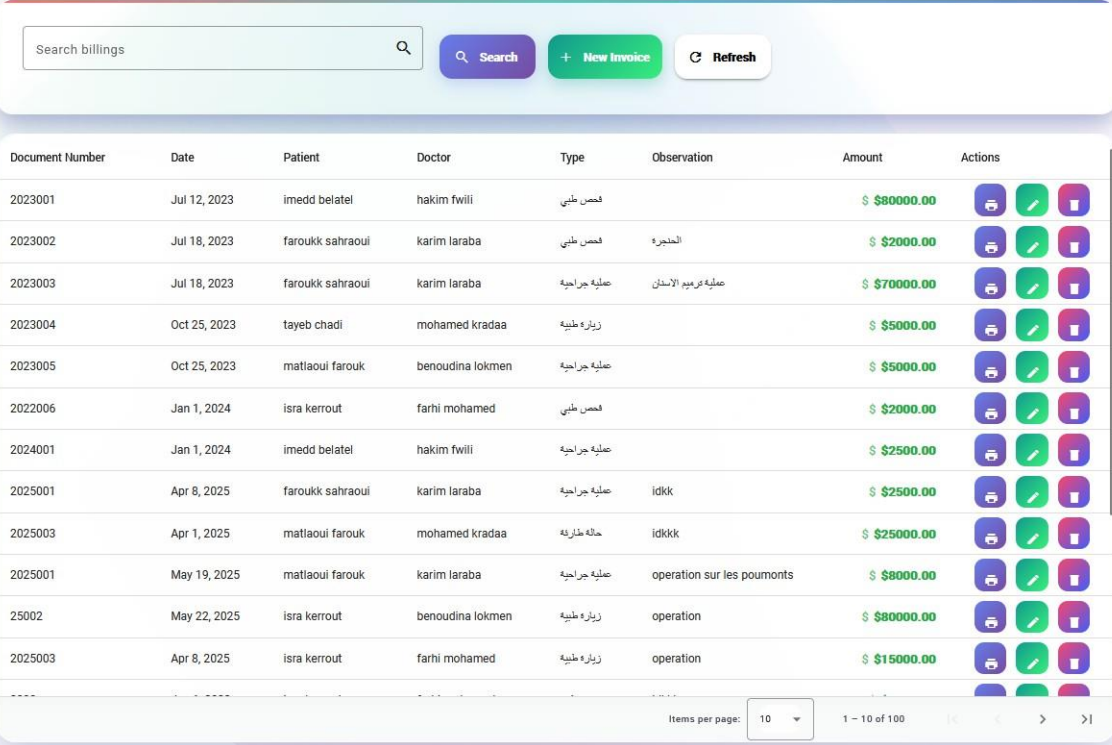


Figure 38 : Insert Medication Page

4.2.6 Accounts Management :

This figure displays the invoices management system



The screenshot displays a web-based interface for managing invoices. At the top, there is a search bar labeled "Search billings" with a magnifying glass icon, a "Search" button, a green "+ New Invoice" button, and a "Refresh" button. Below this is a table with the following columns: Document Number, Date, Patient, Doctor, Type, Observation, Amount, and Actions. The table contains 14 rows of invoice data. At the bottom right of the table, there is a pagination control showing "Items per page: 10" and "1 - 10 of 100".





































Document Number	Date	Patient	Doctor	Type	Observation	Amount	Actions
2023001	Jul 12, 2023	imedd belatel	hakim fwili	فحص طبي		\$ \$90000.00	  
2023002	Jul 18, 2023	faroukk sahraoui	karim laraba	فحص طبي	الخدجرة	\$ \$2000.00	  
2023003	Jul 18, 2023	faroukk sahraoui	karim laraba	عملية جراحية	عملية ترميم الاسنان	\$ \$70000.00	  
2023004	Oct 25, 2023	tayeb chadi	mohamed kradaa	زيارة طبية		\$ \$5000.00	  
2023005	Oct 25, 2023	matlaoui farouk	benoudina lokmen	عملية جراحية		\$ \$5000.00	  
2022006	Jan 1, 2024	isra kerrouit	farhi mohamed	فحص طبي		\$ \$2000.00	  
2024001	Jan 1, 2024	imedd belatel	hakim fwili	عملية جراحية		\$ \$2500.00	  
2025001	Apr 8, 2025	faroukk sahraoui	karim laraba	عملية جراحية	idkk	\$ \$2500.00	  
2025003	Apr 1, 2025	matlaoui farouk	mohamed kradaa	حالة طبية	idkkk	\$ \$25000.00	  
2025001	May 19, 2025	matlaoui farouk	karim laraba	عملية جراحية	operation sur les poumons	\$ \$8000.00	  
25002	May 22, 2025	isra kerrouit	benoudina lokmen	زيارة طبية	operation	\$ \$80000.00	  
2025003	Apr 8, 2025	isra kerrouit	farhi mohamed	زيارة طبية	operation	\$ \$15000.00	  

Figure 39 :Invoice Management Page

Add Invoice View

This figure displays the add Invoice Page

The screenshot shows a web form titled "Add Invoice". At the top right, there are two buttons: "Save" (blue) and "Cancel" (red). The form contains several input fields:

- Document Number***: A text input field.
- Date***: A date input field with a calendar icon, showing the date "6/9/2025".
- Amount***: A text input field with a dropdown arrow on the right.
- Doctor***: A dropdown menu.
- Patient***: A dropdown menu.
- Type***: A dropdown menu.
- Observation***: A large text area with a diagonal line icon in the bottom right corner.

Figure 40 : Add Invoice Page

5. Conclusion

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

We focused on the practical implementation of the Hospital Management System. It covered the software tools utilized, the overall system architecture, and the detailed development process.

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.

Hospital management is a critical challenge in today's healthcare landscape, particularly with increasing demands for efficient patient care, resource optimization, and regulatory compliance. This dissertation addressed these challenges by developing a comprehensive Hospital Enterprise Resource Planning (ERP) System designed to streamline operations, enhance communication, and improve healthcare service quality. The system integrates key functionalities such as patient registration, appointment scheduling, electronic health records (EHR) management, billing, and inventory tracking into a centralized platform, reducing administrative burdens and minimizing errors while improving patient satisfaction. By automating workflows and enabling real-time access to critical data, the ERP system fosters seamless collaboration between departments and supports informed decision-making through advanced analytics. Key achievements include simplified patient management, efficient coordination among doctors and staff, automated reporting for data-driven insights, and robust security measures to protect sensitive medical information. Looking ahead, future enhancements could incorporate predictive analytics and machine learning to further optimize resource allocation, equipment maintenance, and personalized patient care. Ultimately, this project contributes to the evolution of modern healthcare management by leveraging technology to create a more efficient, transparent, and patient-centered hospital environment.

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