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In partial fulfillment of the requirements for the degree of

Master in Computer Science

By

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AfiaMed:Ai-Driven Multiservice Healthcare Platform for Large and Quick Medical Services

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ملخص:

يتضمن هذا المشروع موضوع تسيير الهياكل الصحية بالاعتماد على الرقمنة وتقنيات الذكاء الاصطناعي، والذي يهدف إلى تلبية احتياجات العاملين في المجال الصحي (أطباء، تقنيي تحاليل، تقنيي أشعة، مسعفين.....) من خلال تسهيل عملهم داخل المستشفى والمختبر الطبي وقسم الراديو لوجيا.

من أجل هذا، قمنا بإنجاز منصة باستخدام لغات PHP وJavaScript وCSS بمحرر الأكواد Visual Studio Code، بالإضافة إلى قاعدة البيانات MySQL، كما أنه تم تصميم هذا البرنامج بالاعتماد على لغة UML التصميمية التي ساعدتنا كثيراً على تصميم البرنامج وتحليل وظائفه قبل البرمجة.

Abstract:

This project includes the topic of managing health facilities based on digitalization and artificial intelligence technologies, which aims to meet the needs of health workers (doctors, analysis technicians, radiology technicians, paramedics) by facilitating their work within the hospital, medical laboratory, and radiology department.

For this purpose, we created a platform using PHP, JavaScript, and CSS with the Visual Studio Code editor, as well as the MySQL database. This program was designed based on UML diagrams, which helped us a lot in designing the program and analyzing its functions before programming.

Keywords:

Artificial Intelligence, Healthcare Digitalization, Multiservice Health Platform, Health Facility Management, Smart Diagnosis, Health Information Systems, PHP, MySQL, UML.

Dedication:

To those whose names I proudly bear, and whose love and gratitude my heart beats with...

I dedicate the fruit of my effort, the harvest of sleepless nights, and the patience of years, to the pure source of giving and the source of my eternal inspiration: my beloved mother, whose prayers behind me were a carpet of light with which I could overcome every hardship, and a safety valve that gave me strength whenever my passion was about to be extinguished. And to my support in this life and my role model in patience and struggle; My dear father, who never skimped on effort or advice for me, and fenced my path with his broad hopes so that my stature would always be raised among people. And to my brother and supporter, with whom I strengthened my resolve and who was a blessing of help and a safe shoulder in all my situations, and to my large family who were always my safe haven, my first supporter, and the warm fortress to which I took refuge from the scourge of study and its pressures.

Loyalty for loyalty... To those who gave meaning to the journey and a palatable taste to fatigue; My companions and sisters of my soul, with whom I shared the length of the nights with me, and with whom I shared the sincere laughter of achievement, just as we shared the anxiety and bitterness of obstacles, so be my support in absence, and the motivator in retreat, and be kind to their beautiful impact and sweeten their conversation with the hardship of the road and the long journey.

To all of you, who were the light in the darkness of my steps, I dedicate this graduation and this humble work. You are the true partners in every success I have achieved, and without your presence and prayers, my joy would not have been complete, nor would my achievement have been equal.

Daoud Lina El-khansa

Acknowledgment:

I extend my sincere thanks and appreciation to God Almighty for success and completion. Then to my esteemed teacher, Said Gadri, for his valuable guidance and continuous support throughout the stages of completing this work. I also extend my sincere thanks to the business incubator for providing the necessary facilities. I cannot fail to thank my honorable family, especially my father and mother, for their endurance, patience and encouragement, which was the main motivation for completing this research. Finally, I would like to thank everyone who contributed, even with a kind word, to bringing this work to light.

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General Introduction:

The field of computer science is undergoing a revolutionary transformation in modern life and is witnessing amazing progress in all sectors. The invention of the computer certainly made it possible to computerize database systems, facilitating the storage and processing of information with high efficiency. It thus plays a pivotal role in addressing the various problems caused by traditional business management and contributes significantly to the development of businesses in general, and healthcare institutions, medical analysis laboratories, and radiology and ambulance departments in particular.

Healthcare institutions (hospitals, medical laboratories, radiology departments, and ambulance services) are currently facing numerous challenges, as they witness a significant increase in demand for healthcare services, placing significant pressure on them. These institutions require rational and rapid management, as this pressure leads to errors in preparing medical documents, recording data, difficulty searching patients' medical records, and long waiting periods in different departments.

From this perspective, the need arose to design a healthcare facility management platform based on artificial intelligence technologies. This is intended to solve several problems, particularly reception and orientation services, laboratory services (medical analysis), radiology technicians (radiology), and ambulance services. The need also aims to leverage the multiple functions provided by information technology through software solutions and artificial intelligence. Lack of structure and coordination would lead to a loss of efficiency of health institutions.

This thesis work will allow us to gain knowledge in the field of artificial intelligence and health information management, and improve our intellectual background in designing and developing an intelligent health management website.

By addressing this topic, we will consider the following questions:

- Does computing and the use of artificial intelligence affect the management of health services (medical analyses, radiology, ambulance)?
- Is the level of automation in Algerian health institutions satisfactory for overcoming all problems?
- How can artificial intelligence help doctors provide an accurate and rapid initial diagnosis?

In order to achieve this goal, we have adopted the following approach, on the basis of which our current manuscript is based, which is reflected in three chapters:

Chapter One: Presenting the most important basic concepts related to the project, such as: defining the "Zahraoui" public hospital institution, its various departments, the medical laboratory, radio, ambulance, in addition to artificial intelligence in health and smart diagnosis.

Chapter Two: Dedicated to analysis, identifying and describing actors (doctors, laboratories, radiology technicians, patients, paramedics) and completing the necessary diagrams using the UML standardized modeling language (use case diagrams, sequences, and categories).

Chapter Three: presents the work that was carried out, by presenting the work environment (hardware and software used: PHP, JavaScript, CSS, MySQL, Visual Studio Code), and presenting the different interfaces of our completed program (login interface, main interface, adding a medical file, smart diagnosis, booking an appointment).

Chapter four: focuses on the economic and financial study of the project. It provides an in-depth market analysis, explores the competitive environment, and outlines the marketing strategy using the Business Model Canvas (BMC). Additionally, it includes financial projections and statements to demonstrate the economic feasibility and viability of the platform as an innovative startup.

We conclude with a general conclusion summarizing the achieved functions (medical files, AI diagnosis, booking, tests, and ambulance) and proposing future perspectives like automated billing, mobile apps, and telemedicine. This work serves as a reference for subsequent research in the field

Chapter 1: Baground And Preliminary Study

1.Introduction:

The goal of this study is to analyze literature concerning the design and development of intelligent healthcare systems powered by artificial intelligence .... Integration of artificial intelligence into healthcare became one of the most important technology advancements in recent times, especially for diagnostics, medical decisions, patient monitoring, and healthcare management.

Selection of this topic was motivated by the growing worldwide interest in healthcare solutions with the use of AI and the necessity to advance the medical care through technological means. In Algeria, there are many issues in healthcare systems that need to be addressed in terms of accessibility, efficiency, and decision support ... Thus, development of an AI-powered medical assistant could make a substantial contribution to advancing the healthcare experience

2.Definition of The Public Hospital Institution "Al-Zahraoui:

Al Zahraoui Hospital is one of the most important public health institutions in the state of M'Sila, as it is located on Al Borg Road and provides integrated medical services for the benefit of the residents of the region and neighboring areas. The hospital includes a range of medical and paramedical departments, including emergency, surgery, and general medicine, in addition to the biological analysis and radiology department, which allows it to manage various health conditions from diagnosis to treatment and follow-up. The hospital operates on a continuous shift system (24/7) to ensure that patients are received at all times, especially in urgent cases. It also contributes to organizing medical campaigns and surgical days in coordination with other health institutions, with the aim of improving the quality of health services. I had the opportunity to conduct a 15-day field internship at this hospital, which enabled me to gain an up-close insight into the workflow within the various departments and acquire valuable practical experience in the healthcare field.

The name "Al Zahraoui" refers to Abu al-Qasim Khalaf ibn al-Abbas al-Zahraoui (known in the West as *Abulcasis*), one of the greatest Muslim physicians and surgeons of the medieval Islamic world. Born in Al-Zahra, near Cordoba (present-day Spain), in 936 CE, he is best known for his monumental medical encyclopedia, ***Al-Tasrif***, which served as a primary reference for medicine and surgery in Europe and the Islamic world for over 500 years. Al-Zahraoui is often called the "father of modern surgery" due to his pioneering inventions of surgical instruments—such as the scalpel, forceps, and surgical needle—and his introduction of techniques like catgut sutures and the treatment of hemophilia. The naming of the hospital after him symbolizes a commitment to excellence, innovation, and humanity in healthcare, honoring his legacy as a healer who bridged knowledge between civilizations.

The hospital’s name thus carries deep historical and scientific significance, reminding us that quality healthcare is rooted in both tradition and progress

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Figure 1 :Al Zahraoui Hospital entrance

3.The Role and Tasks of The Public Hospital Institution:

A general organization that aims to provide various medical services to the population and ensure good care for patients in various situations. Its role and tasks are as follows:

- Providing health and therapeutic care to patients.
- Receiving and treating urgent cases 24 hours a day.
- Conducting various medical and diagnostic tests
- Performing surgeries and following up on patients.
- Providing healthcare within various medical departments.
- Contributing to health prevention and disease awareness.
- Training and training students and trainees in the health field.

4.Departments of The Public Hospital Institution:

There are many services, including:

Service	Role
Emergency Department	A department that receives emergency cases and accidents and treats them immediately (24/24)
Internal Medicine Department	Concerned with treating internal diseases such as diabetes and high blood pressure.
General Surgery Department	Performs surgical operations and treats cases that require surgical intervention
Pediatrics Department	Concerned with children's health and the diagnosis and treatment of their diseases.
Radiology Department	Uses medical imaging devices to diagnose diseases inside the body.
Medical Analysis Department (Laboratory)	Performs blood and urine tests to detect diseases.
Hospital Pharmacy	Provides medicines to patients in the hospital according to medical prescriptions.

Tableau 1:Departments of The Public Hospital Institution

5.Problems and Obstacles of Managing Health Structures:

Health facilities suffer from several problems, including:

- Great pressure on health services due to the daily increase in the number of patients [2]
- Long waiting periods in emergency rooms, medical services and laboratories. [2]
- Partial reliance on manual work in recording data, which causes slowness and potential errors .[3]
- Congestion of the Medical Analysis Department (informant), especially during peak times .
- Lack or weakness of digitization in some departments, which hinders the rapid exchange of information .[3]
- Intermittent shortage of some medical equipment or materials .
- Work pressure on medical and paramedical staff compared to the number of patients .
- Difficulty organizing and following up on patients' medical files quickly and accurately. [2]

6.Medical Laboratory:

A medical laboratory is a specialized health facility where analyses and examinations are performed on biological samples taken from the human body, such as blood, urine, and tissues, with the aim of diagnosing diseases, monitoring patients' health, and assisting in making appropriate medical decisions [5].

The medical laboratory is also an essential part of the health system [7], providing doctors with accurate and reliable results that contribute to early detection of diseases and evaluation of treatment effectiveness.

Figure2 : Laboratory sample management within the e-Health platform framework.

7.The Role and Tasks of Medical Laboratories:

Laboratories provide a range of services and tasks as follows: [5].

- Helping the doctor choose or determine the appropriate diagnosis for a specific disease from the list of required diagnoses
- Monitoring the concentration of some body components such as salts during fluid treatment
- Detecting diseases and epidemics and monitoring their development and spread in a region
- Receiving and registering patients and samples
- Sample collection (blood, urine, tissue...) In safe ways [6].
- Conducting various laboratory tests (biochemical, hematological, bacterial...)
- Ensure accurate results through quality control

- Store and preserve samples in an organized manner
- Issuing medical reports and results
- Maintenance of laboratory equipment and devices [6] .
- Adherence to safety and hygiene rules inside the laboratory

8.Problems and Obstacles of Medical Laboratories:

Several limitations and difficulties have been observed regarding the functioning of medical laboratories, which can be summarized as follows:"

- High pressure and overcrowding [4].
- Partial reliance on manual work [7].
- Lack or weakness of digitization: [7].
- Intermittent shortage of equipment or reagents [6].
- Difficulty in organizing and tracking patient files [4].
- High workload on medical and paramedical staff [4].

9.Radiology (Medical Imaging):

Radiology is a medical field concerned with the use of various imaging techniques, such as X-rays, ultrasound, and magnetic resonance imaging, to obtain accurate images of organs and tissues inside the human body [11] [12], with the aim of diagnosing diseases, monitoring health conditions, and helping to direct treatment without the need for surgical intervention

Figure 3: Display and Analysis of Digital Radiographic Images.

10.Role and Tasks of Radiology:

The Radiology Department is one of the most important departments in health institutions, as it relies on medical imaging techniques to see the internal organs of the human body without surgical intervention, which helps in accurate diagnosis and follow-up treatment [11]:

- Receiving patients and verifying their identity and medical files
- Preparing the patient for examination (mineral removal, explaining the procedure...):

1. Conducting tests using different devices such as:
2. X-rays (Radiographie)
3. Computed tomography (Scanner)
4. Magnetic Resonance (IRM)
5. Ecography (Ultrasound)

- Image processing and analysis [12]
- Preparing accurate medical reports and sending them to the treating physicin
- Save and archive photos and results in an organized manner
- Maintaining devices and ensuring their readiness
- Adherence to radiation safety rules to protect patients and staff

11.Problems and Obstacles of Radiology:

The functioning of the radiology department is hindered by several problems and obstacles, including:"

- Long waiting times for examinations and reports [8]
- High patient pressure and overcrowding [8]
- Partial reliance on manual processes [10]
- Lack of digitization and integration: [10]
- Intermittent shortage of equipment or consumables [9]
- Heavy workload on radiology staff [8]

12.Ambulance Service

The ambulance provides a set of initial and rapid medical procedures to an injured or sick person in emergency situations, with the aim of saving his life, preventing the deterioration of his condition, and alleviating pain until he is transferred to a health institution to receive full treatment.

Ambulance includes immediate intervention in cases such as accidents, bleeding, loss of consciousness, or sudden health crises, and is provided by trained personnel using special means and equipment.

Figure 4: Ambulance and rapid medical intervention services.

13.Ambulance Tasks:

The primary tasks performed by the ambulance service are as follows:

- Rapid intervention in the event of accidents or emergencies
- Evaluation of the injured person's condition (consciousness, breathing, pulse....)
- Providing first aid
- Securing the respiratory tract and helping the patient breathe
- Pain relief and psychological reassurance for the injured person
- Transport the injured person safely to the nearest health facility
- Monitor the condition during transportation
- Contact the hospital's medical staff to prepare the reception

14.Artificial Intelligence in Healthcare:

14.1.Definition of Artificial Intelligence:

Artificial intelligence (AI) is a set of technologies that enable machines and computer systems to simulate human intelligence, including learning, reasoning, and decision-making [13], without direct human intervention for every step.

14.2.Applications in Health Domain:

Artificial intelligence has found multiple applications in the healthcare sector, significantly transforming medical practices. The main applications include:

- Diagnosis of diseases
- Medical image analysis
- Disease prediction
- Help with decision making

14.3.Advantages:

The integration of artificial intelligence into healthcare offers several notable advantages that improve both patient outcomes and system efficiency. These advantages include:

- Speed
- Accuracy
- Reduce errors

14.4.Challenges:

The primary challenges limiting the widespread use of AI in health are:

- Cost
- Data protection
- Need for experts

15.AI-Based Diagnosis:

Diagnosis by artificial intelligence is a system that relies on entering the patient's symptoms and medical data, analyzing them using algorithms such as machine learning, then suggesting possible diseases or the closest diagnosis, while helping the doctor make the final decision. [13]

16.Comparison Between Classical Medical Diagnosis and AI-Based Diagnosis:

A comparison between classical medical diagnosis and AI-based diagnosis reveals several distinct differences, as summarized in the table below:

Comparison Aspect	Classical Diagnosis	AI-Based Diagnosis
Method	Depends on the doctor's experience, clinical examination, analyses, and radiology	Depends on data entry and analysis by algorithms
Speed	Relatively slower, especially in complex cases	Very fast in data analysis
Accuracy	Depends on the doctor's experience and may be affected by the human factor	High accuracy when good data is available

Differential Diagnosis	A limited number of possibilities	Offers several pathological possibilities
Interaction with the Patient	Direct and includes the human aspect	Limited or non-existent
Role / Dependence	Essential and indispensable (the doctor is the decision-maker) [13]	Only a tool to help the doctor (the doctor remains responsible)

Tableau 2:Comparison Between Classical Medical Diagnosis and AI-Based Diagnosis:

17.Health Structure Management and Administration Program:

17.1.Definition:

The Health Structure Management Program HSMP is a multi-functional information system designed to organize and facilitate work within health institutions by providing a digital work environment that helps improve the quality of health services and ensure the accuracy and speed of information processing

17.2.HSMP Features:

The Health Structure Management Program provides a range of services aimed at facilitating the work of medical staff and improving the quality of patient care. It allows quick access to patient information and verifies their identity in a short time. It also ensures that each patient is linked to his or her test results accurately, organized, and without any ambiguity

This program features:

- A simple and easy-to-use user interface that allows all users of the program, including medical and administrative staff, to deal with it without difficulties.
- Create a comprehensive and large database that includes various data, such as patients, doctors, pharmacies, medical files, and administrative information, ensuring accurate organization of information.
- The ability to register and add doctors and link them to patients and medical files, which facilitates monitoring cases and determining medical responsibilities for each patient.
- Linking medical files with operational information specific to each case, allowing accurate tracking of the course of treatment and tests.
- Entering medical test results in an organized manner within the information system, while reducing errors resulting from manual recording.
- The ability to send and save x-ray images (Radio) within the system and link them to the patient's file to facilitate diagnosis and follow-up.
- Providing an integrated archiving system that allows for easy saving and retrieval of medical data and files when needed.
- Extract and print detailed and organized reports containing patient information, tests, results, and diagnoses in an accurate and clear manner...

17.3.HSMP Objectives:

- Facilitating the process of managing medical and administrative information within the hospital or laboratory.
- Improving the speed and accuracy of recording patient and physician data and various medical files.
- Reducing errors resulting from manual processing of medical data.
- Accelerating the process of entering medical test results and distributing them to patients and doctors.
- Improving communication between the various hospital departments (informant, doctors, administration).

- Providing a unified and comprehensive database that facilitates the search and retrieval process.
- Supports digital archiving of medical files and old data.
- Facilitating the extraction and printing of medical reports in an organized and accurate manner.
- Contributing to the digitalization of the health sector and improving the quality of services provided to patients.

18.Conclusion:

In this chapter, we discussed some concepts related to our topic, represented by the concept of the public hospital institution, its role and tasks. We also discussed the departments of the public hospital institution. Of course, health facilities face obstacles and problems, for which we decided to create our program, the concept of which was proposed and presented.

Chapiter 2

System Analysis and Platform Design

1.Introduction:

After discussing the idea of a platform for managing the healthcare system,

In this chapter we will focus on modeling using UML, which helps simplify understanding of the system before development. UML is based on diagrams that represent the system from different angles such as interaction, data, and internal processes

2.UML Diagrams

UML (Unified Modeling Language) is a standard visual modeling language used in software engineering to specify, design and document the structure and behavior of a system.

In my work, I used three types of UML diagrams:

The use case diagram: that describes the interactions between a user and a system to achieve a functional goal.

The sequence diagram: that illustrates the time-dependent exchange of messages between different objects or classes during a given scenario.

The class diagram: that represents the static structure of the system by showing classes, their attributes, methods and relationships.

3.UML Schema Design in Afiamed Platform:

The program has been designed, which is considered an essential stage for understanding the program and achieving the project, using plans the UML [14]

3.1.Use Case Diagram Design :

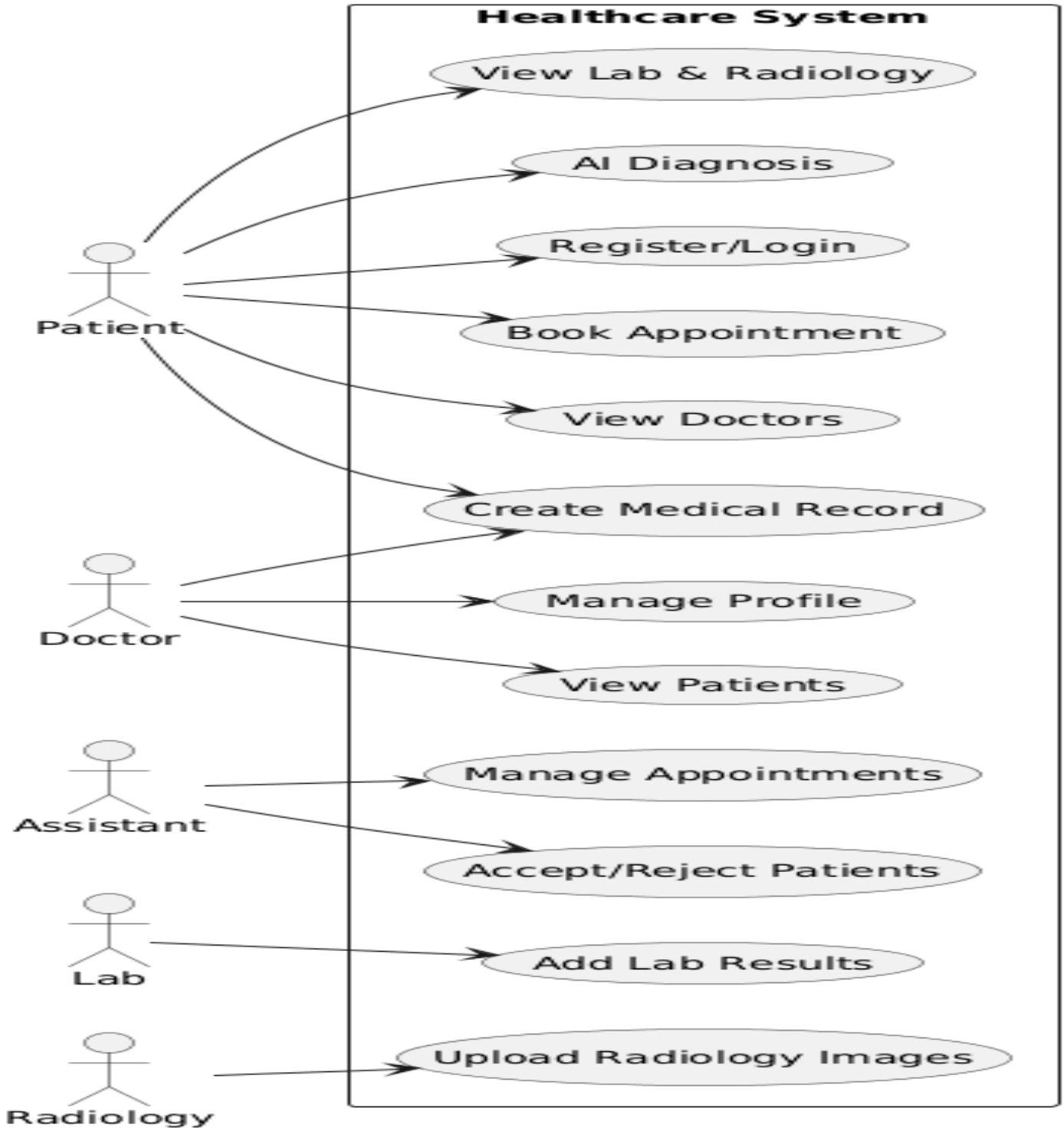

Figure 5: Use case diagram

3.1.1.Description of The Use Case:

The use case diagram shows the actors represented by the doctor, analysis informant, radiology technician, and medical assistant, where the doctor assumes the pivotal role of conducting diagnosis and managing the patient's file with the possibility of requesting tests, x-rays, or ambulance when necessary, while the analysis informant enters the results and the radiology technician uploads Images to ensure data integrity, while the ambulance service is responsible for receiving emergency requests and the medical assistant provides support and assistance (Assistance) It should be noted that all these operations require login as a mandatory procedure to ensure system security, while requests for tests and x-rays appear as extension relationships (Extend) for the basic medical diagnosis process.

3.2 Sequence Diagram:

3.2.1.Login Sequence Diagram:

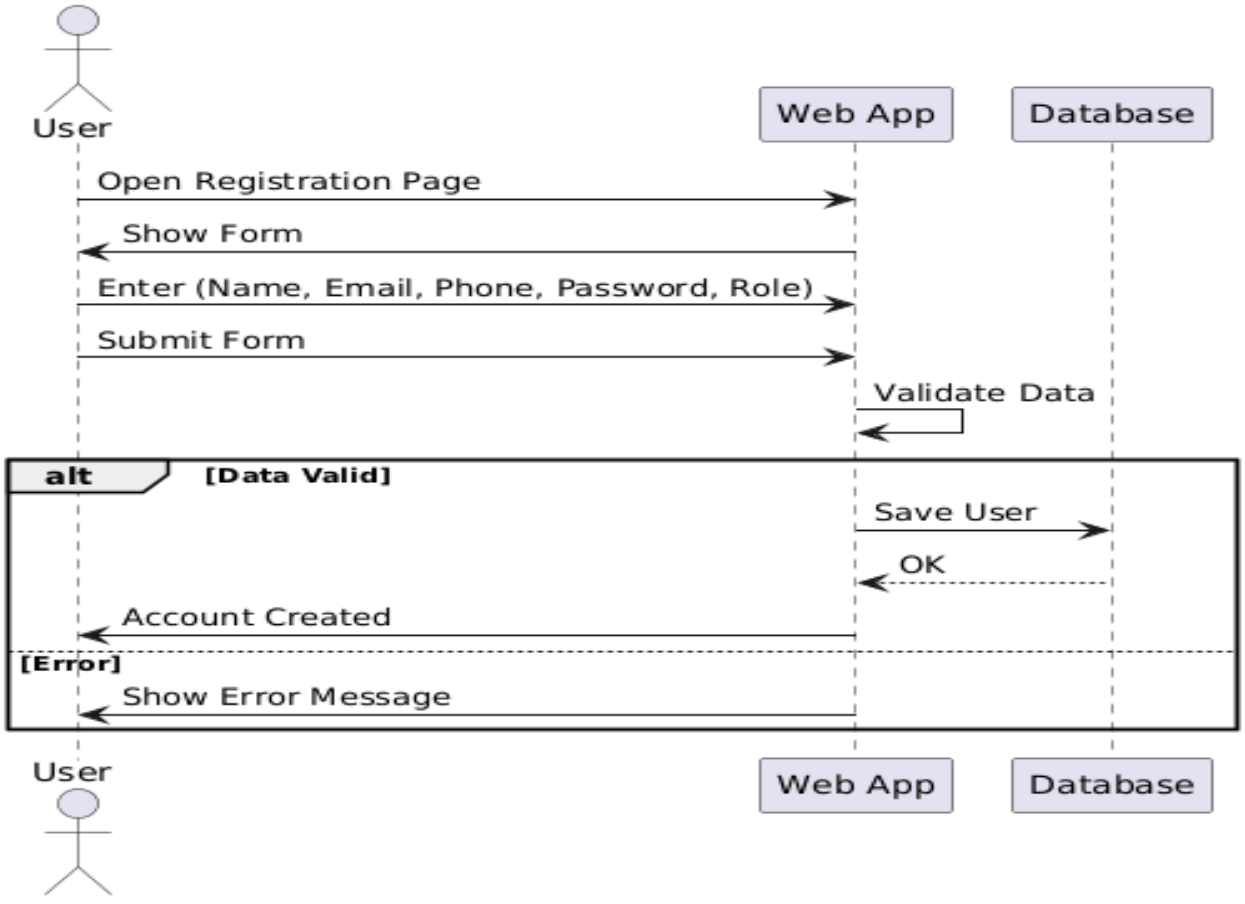

Figure 6: sequence diagram

3.2.2.Description of The Sequence Diagram:

Process name: Login (Login).

• Primary goal: Secure access to the appropriate interface by verifying (username, password, and account type).

• Actors (Actors): administrator, receptionist, informant, doctor and patients

• Restrictions and conditions:

- Prerequisite: The application is closed and its features can only be accessed after identification.
- Subsequent condition: Automatically direct the user to the main interface of his powers.

• Successful path (normal scenario):

- Enter credentials (name and password).
- Select the account type (roll) from the list.
- Click the "LOGIN" button.
- The system verifies that data matches in the database.
- Successful entry to the main interface.

• Error path (alternative scenario):

- Activated if fields are empty or data does not match.
- The system blocks access and displays an alert message (Error Message).
- Return to the starting point to re-enter data correctly.

3.2.3.Forget the Password Sequence Diagrams:

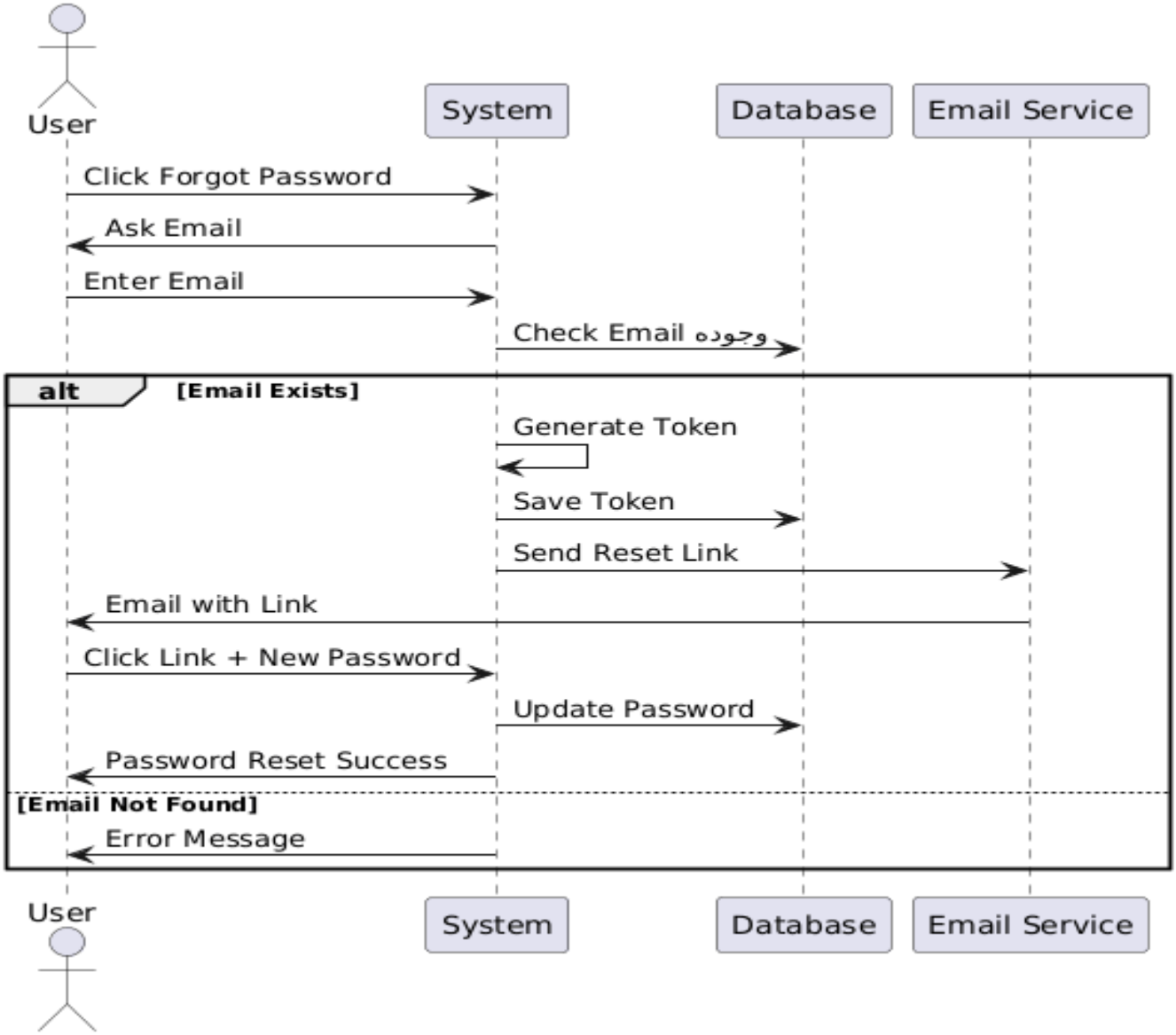

Figure 7: sequence Diagram

3.2.4.Description of The Sequence Diagram:

Actors: The diagram shows the interaction between four basic elements: the user (User), the system (System), the database (Database), and the email service (Email Service).

• Start of the process: The process begins with the user requesting to recover the password, as the system asks him to enter his email to verify his identity.

• Security verification: The system checks the presence of email in the database as a proactive step to ensure that the account is actually registered.

• Conditional logic (Alt):

- If mail exists (Email Exists): The system generates a secure token (Token), saves it in the database, and then sends a reset link via the email service.
- In the absence of mail (Email Not Found): The system displays an error message to the user to prevent hacking or alert for an input error.

• End of process: The cycle ends with the user successfully setting and updating a new password in the database, and receiving a success confirmation message (Success).

• Service integration: The diagram shows the importance of using external services (such as Email Service) to enhance security and communication with the user outside the immediate application interface.

3.2.5.Medical Diagnosis Sequence Diagram:

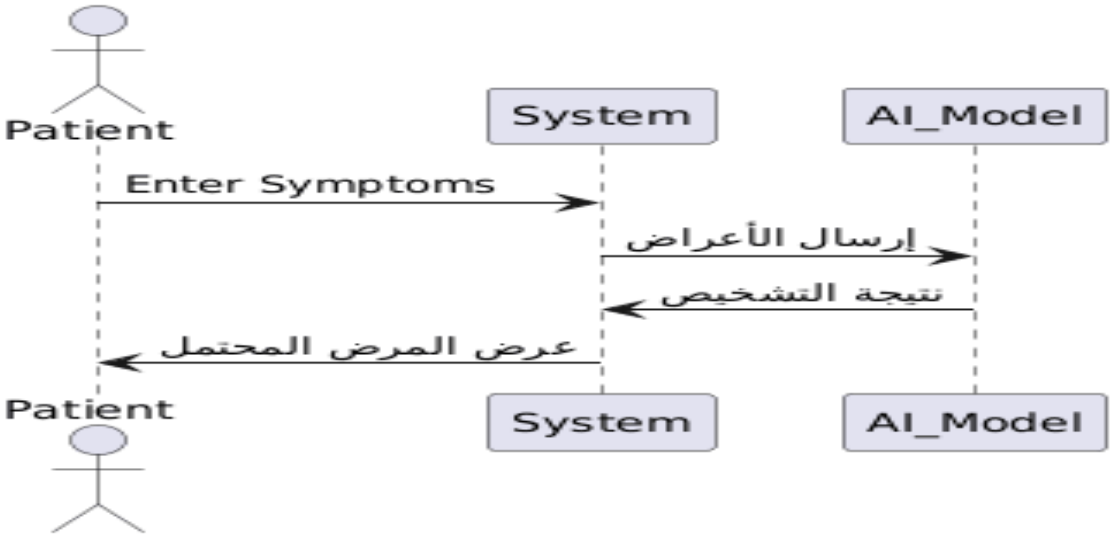

Figure 8: sequence Diagram

3.2.6.Description of The Sequence Diagram:

Actors: The diagram shows the interaction between the patient (Patient), the system (System), and the artificial intelligence model (AI_Model).

• Patient input: The process begins with the patient entering the symptoms he feels through the system interface.

• The role of artificial intelligence: The system acts as a mediator, sending these symptoms to the artificial intelligence model for processing and technical analysis.

• Drawing conclusions: The AI_Model returns the inferred diagnostic result based on the big data and algorithms it was trained on.

• Final outputs: The chart concludes with a presentation of the patient's potential illness, facilitating the initial understanding of the condition before going to specialists.

• Technical objective: The scheme highlights the integration of modern technologies (AI) into healthcare to provide fast and interactive solutions to users

3.2.7.Make an Appointment Sequence Diagram:

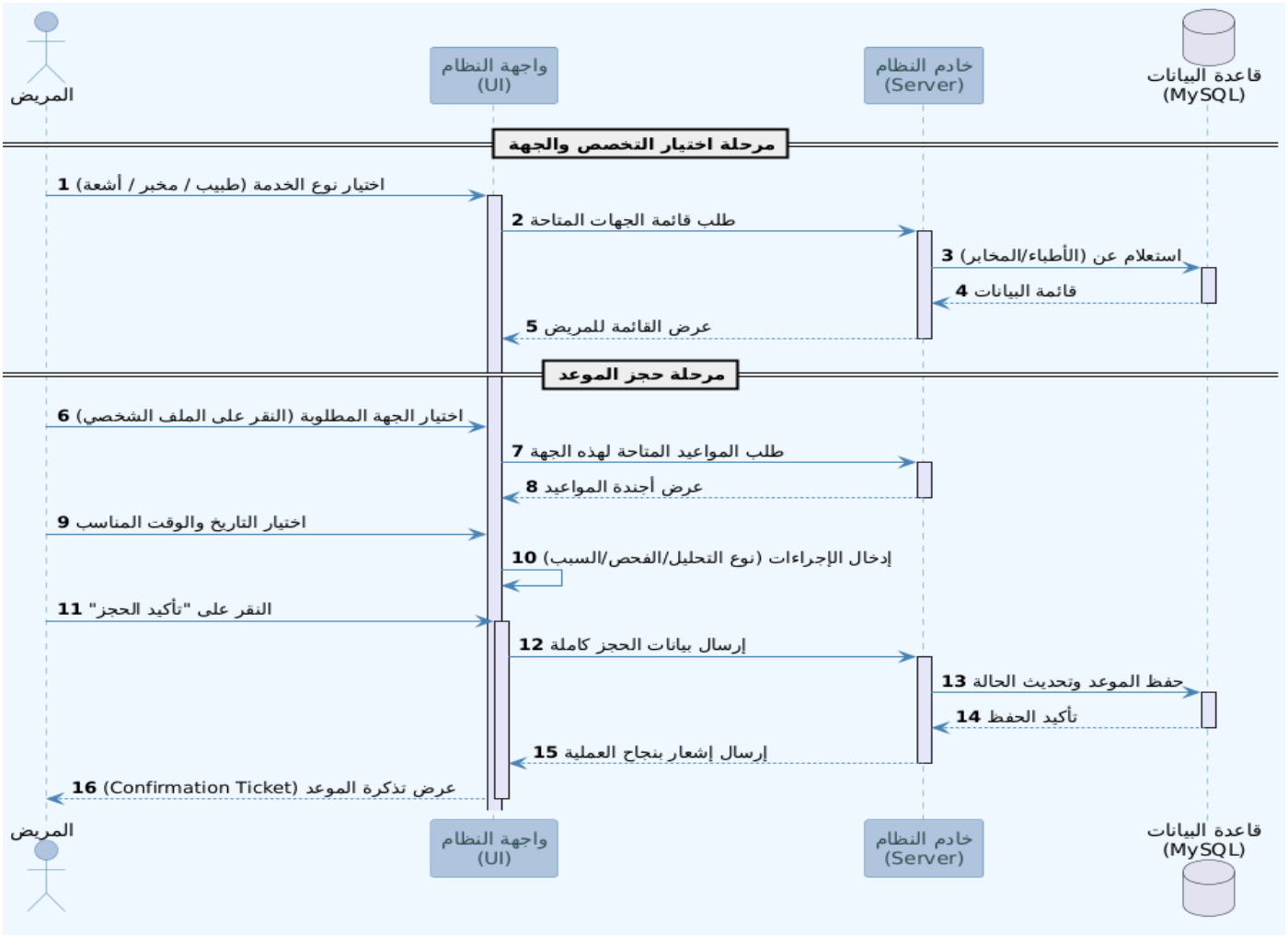

Figure 9: sequence Diagram

3.2.8.Description of The Sequence Diagram:

Comment on the relay plan (book an appointment)

This diagram shows the temporal interaction between the patient and the system with its various layers (interface, server, database):

• Multiple options: The diagram highlights the system's ability to handle different categories (doctor, laboratory, or radiology center) within a unified technical path.

• Data Dynamics: Steps (2-5) show how to fetch data live from the database (MySQL) to ensure that only medical entities available to the patient are displayed.

• Appointment Management: The second phase explains the time selection process and details of the medical procedure, reducing manual human intervention.

• Documentation and verification: The process ends with saving the data in the database and issuing a "confirmation ticket" (Confirmation Ticket) that serves as a reference for the patient.

Second: Comment on the use case diagram (medical analysis laboratory)

This diagram focuses on the functions and powers within the laboratory:

• Structure of powers: The plan precisely distributes tasks among three main actors:

1. Receptionist: Focuses on the administrative aspect (adding a patient, registering an analysis request, printing the receipt).

2. Laboratory: Focuses on the technical aspect (searching for analyses, entering results, and printing reports).

3. Administrator (Administrator): Has the authority to manage the system as a whole (managing users, managing the test list).

• Functional interdependence (Relations):

• <<include>> relationship: Shows that the "login" process is a mandatory requirement for all processes to ensure data security.

• <<extend>> relationship: Additional options such as (Print Report) that come after previewing the results stand out.

• Comprehensiveness: The plan covers the entire cycle of work within the laboratory, from receiving the patient to delivering final results and managing staff accounts.

3.2.9.Medical File Sequence Diagram:

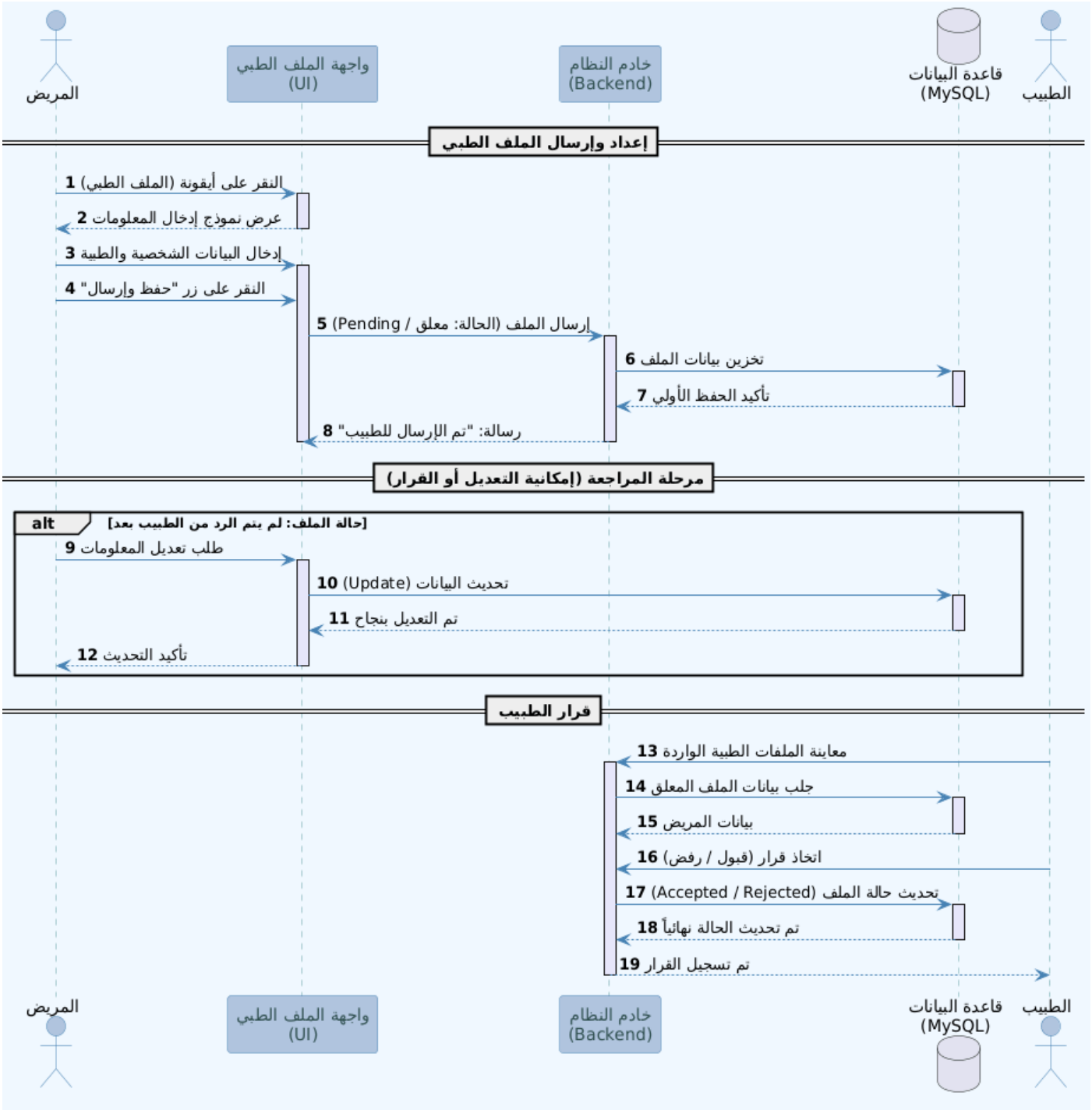

Figure 10: sequence Diagram

3.2.10.Description of The Sequence Diagram:

Simplified Comment on "Patient Data Life Cycle" Diagram

This diagram shows how patient data moves through the system:

- **Initiative:** The patient starts the process and enters their own data.
- **Temporary state:** The system saves the file as "pending" until the doctor reviews it.
- **Modification flexibility:** The patient can update their data as long as the doctor has not made a decision yet.
- **Database interaction:** Data is stored and updated in real time.

Simplified Comment on "Doctor's Decision" Diagram

This part represents the final review stage:

- **Authority:** The doctor is the only one who can accept or reject patient files.
- **Transparency:** The doctor's decision is recorded in the database and cannot be changed afterward.
- **Status change:** The file changes from simple input data into an officially approved medical record.

Simplified Comment on "Intelligent Medical Management System" Diagram

This diagram brings all parties together in one place:

- **Multiple actors:** The system includes the doctor, patient, ambulance staff, radiology technician, and medical assistant.
- **Diagnosis as the center:** Diagnosis determines the need for X-rays, lab tests, or an ambulance.
- **Information security:** Login is mandatory to access any function, protecting patient privacy.

3.3.Class Diagram:

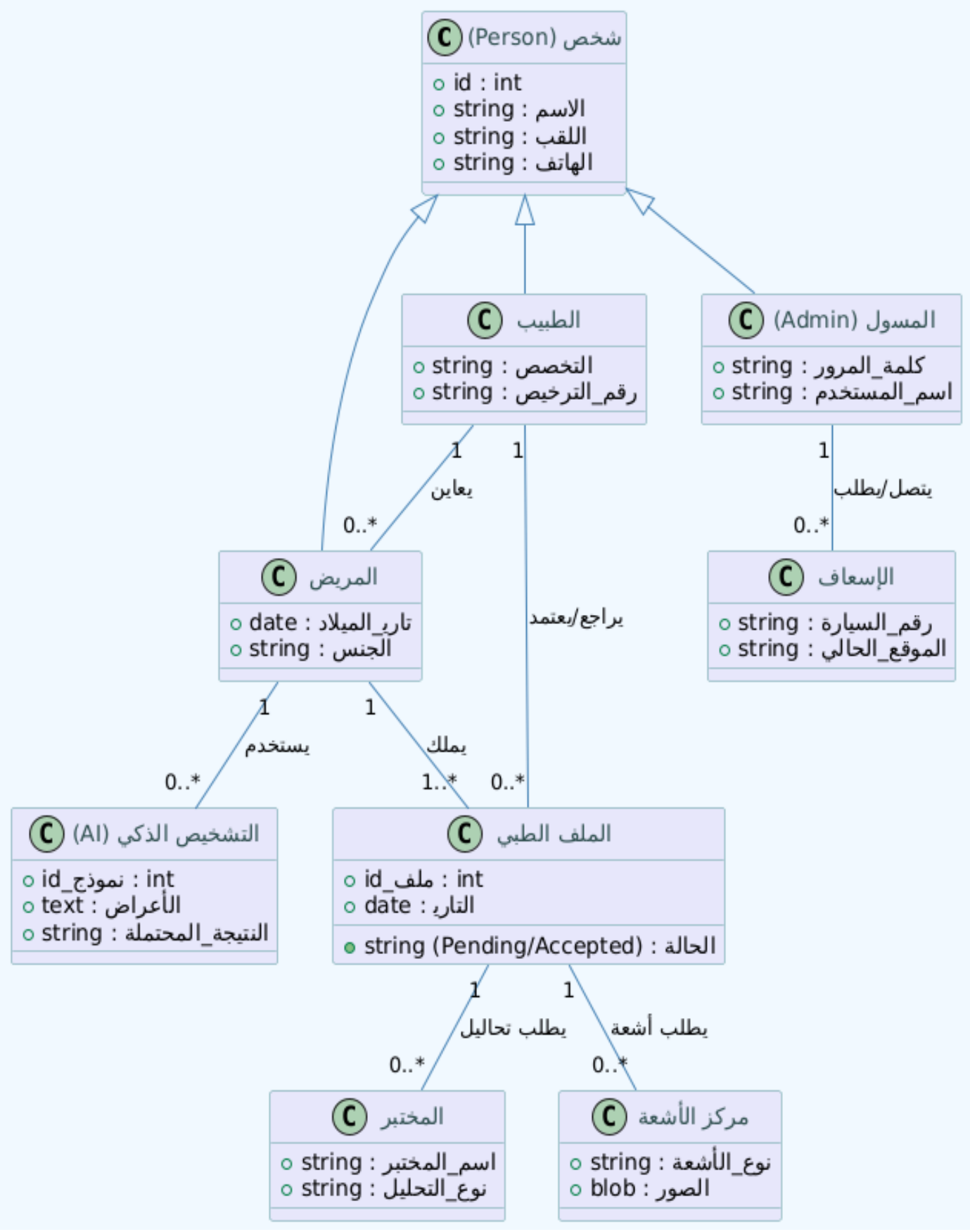

Figure 11:Class Diagram

3.3.1.Relational Model:

Person (#id, Last Name, First Name, Tel)

Patient (#Id_patient, Date_birth, Sex, *id)

Doctor (#Id_doctor, Specialite, Num_licence, *id)

Admin (#Id_admin, user_name, pass_mot, *id)

Ambulance (#Id_amb, Vehicle_number, Location, *Id_admin)

Medical_File (#Id_file, Date_creation, Etat_pending_accepted, *Id_patient, *Id_doctor)

Smart Diagnosis (#Id_ai, Symptomes, Resultat_probable, *Id_patient)

Lab (#Id_lab, Nom_lab, Type_analyse)

Radiology (#Id_radio, Type_radio, Images)

4.Conclusion:

In this chapter, we discussed the design of the program using the unified modeling language and the design of some of its diagrams with description Text and then comes the final stage (Chapter Three) in which we will complete the application.

Chapiter 3: Platform Development and Implementation

1.Introduction:

After discussing a comprehensive idea of our platform of managing a healthy structure, and reaching the design stage in the previous two chapters.

In this chapter we will move to the practical implementation stage of the project, and for this reason the appropriate programs used and languages must be chosen to achieve the necessary interfaces and multiple functions of the program.

2.Work Environment:

2.1.Material Means:

To create the health structure management program, a laptop computer "DELL" and "TOSHIBA" manufactured by "Intel" were used, which It is characterized by the following:

Windows 10; - **Screen resolution**: [1080, 1920] ;

- **Installed memory**: 4GB; - **Processor C**: Intel(R) Core(TM) i5-5450U;

- **Hard disk**: 500GB HDD;

2.2.Software Methods:

Figure 12:PHP image

2.2.1.PHP Language: (Hypertext Preprocessor) is a server-side (server-side) scripting language, widely used in developing web applications and dynamic website. PHP is an open source (open source), cross-platform (cross-platform) language, and supports most database systems such as MySQL. It is also fast and secure, and is used by millions of global sites such as Facebook, Wikipedia, and WordPress.

Figure 13: CSS image

2.2.2.CSS Language: (Cascading Style Sheets) is a style language (style sheet language) that specializes in describing the appearance and formatting of documents written in HTML. CSS is the second fundamental pillar of web development, and is responsible for formatting and designing user interfaces (colors, fonts, layout) to make them attractive and easy to use . Css is a cross-platform language, and operates according to a sequencing system (cascading) that prioritizes the application of styles

Figure 14: JavaScript image

2.2.3.JavaScript Language: JavaScript (JS) is a high-level, interpreted (interpreted), object-oriented (object-oriented) programming language, primarily used for developing interactive and dynamic web pages. JavaScript is one of the three cornerstones of web technologies, along with HTML and CSS. It is characterized as a cross-platform language, running on the client side (client-side within browsers, and can also be used on the server side (server-side) via Node.js.

Figure 15: My SQL Server

2.2.4.Database: (MySQL Server) is an open source, fast, multi-user, and powerful relational database management system (RDBMS). It is based on SQL language to store, retrieve and manage data. Listen to communications from client software and manage access to databases and tables on their behalf. It is compatible with most operating systems and programming languages, making it ideal for web application development and data management.

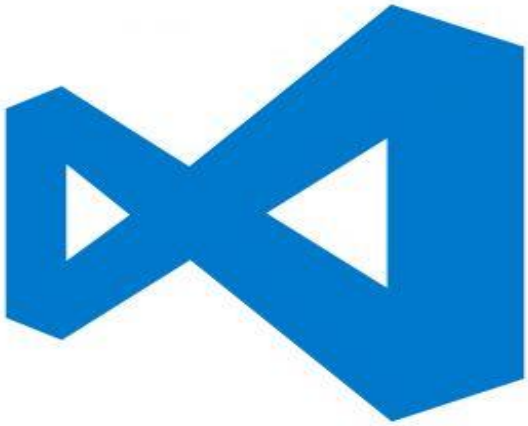

Figure 16: Visual Studio Program

2.2.5.Visual Studio Program: Visual Studio is an advanced, multilingual integrated development environment (IDE), developed by Microsoft, designed to help developers write, debug, and deploy software. The work environment includes a smart code editor that provides IntelliSense (auto-code completion), a powerful debugger (Debugger) that can work at the source and device levels, and tools for building graphical user interfaces and designing databases. Visual Studio supports many languages such as C#, C++, Python, JavaScript, Visual Basic and many technologies such as. .NET and UWP, designed to work with version control systems such as Git. Thanks to its expandable structure via add-ons (Extensions), it is one of the most powerful tools used to develop anything from desktop and web applications to phone and cloud applications.

3.Environment Setup:

To guarantee the reproducibility, security, and performance of the proposed e-Health platform, the development and production environments were established following standardized protocols. This section details the hardware infrastructure (Section 4.2.1) and the complete software stack (Section 4.2.2).

3.1.Hardware Configuration : The hardware architecture was designed to support concurrent access from medical staff, real-time AI inference, and secure storage of sensitive patient data. Two main profiles were defined: **server** (hosting the database, AI models, and backend) and **client** (used by clinicians and administrators).

Server Specifications

Component	Specification	Justification
Processor	Intel Xeon Silver 4214 (12 cores / 24 threads, 2.2 GHz)	Handles parallel requests (database queries + AI model inference)
RAM	64 GB DDR4 ECC	Loads AI models (e.g., Random Forest, CNN) and caches frequent DB queries
Storage	1 TB NVMe SSD (OS + DB) + 2 TB HDD (medical images/logs)	NVMe for low-latency transactions; HDD for cost-efficient archival
Network	Gigabit Ethernet (1 Gbps)	Supports simultaneous teleconsultation video streams and data transfers
GPU	NVIDIA T4 (16 GB VRAM)	Accelerates inference for imaging-based AI (e.g., X-ray classification)

Tableau 3:Server Specifications

Client (End-User) Minimum Requirements :

Component	Minimum	Recommended
Processor	Intel Core i5-8250U or equivalent	Intel Core i7-1165G7
RAM	8 GB	16 GB
Storage	128 GB SSD	256 GB SSD
Display	1366×768 (14”)	1920×1080 (15.6”)
Camera & Mic	720p, noise-cancelling microphone	For teleconsultation features
OS	Windows 10 / macOS 11 / Ubuntu 20.04	Any modern 64-bit OS

Tableau 4:Client (End User) Minimum Requirements

3.2.Software Stack and Tools:

The software stack was selected to ensure modularity, maintainability, and seamless integration of AI capabilities into clinical workflows. It is divided into three layers: **database & server**, **frontend**, and **AI & analytics**.

4.Database and Backend Environment:

Technology	Version	Purpose
MySQL	8.0.32	Primary relational database for patient records, appointments, prescriptions (ACID compliance).
PhpMyAdmin	5.2.1	Web-based admin interface for database management.

XAMPP	8.1.12	Local development stack (Apache + MySQL + PHP + Perl) – used for prototyping before containerization.
Apache	2.4.54	HTTP server to host RESTful APIs (PHP-based endpoints).
PHP	8.1.12	Backend logic for session handling, user authentication, and data validation.
Docker	20.10.23	Containerization of MySQL, Apache, and AI inference microservices for reproducibility.

Tableau 5:Database and Backend Environment

Frontend Web Development:

Technology	Version	Role
HTML5	–	Structure of clinical dashboards and patient forms.
CSS3 + **Bootstrap**	5.3	Responsive design (mobile-friendly for tablets used by doctors).
JavaScript	–	Client-side validation, dynamic content update, REST API calls (fetch / axios).
Chart.js	4.4	Visualisation of patient vital signs (trends of blood pressure, glucose).

Tableau 6:Frontend Web Development

Platform Security:

The security architecture of the proposed platform is designed as a foundational layer, not an add-on feature. It directly addresses the confidentiality, integrity, and availability of patient medical records throughout the system lifecycle.

We have implemented a comprehensive security strategy to protect medical files and patient data, in accordance with approved standards. It began implementing full data encryption in all its cases: while storing it on servers, and while transferring it between users and the system, ensuring that the encryption keys are managed securely and completely isolated from the data itself.

As for access control, I have designed a precise, role-based permissions system that ensures that only those directly involved in the case can view the medical file, based on the principle of granting the minimum possible permissions to each user. It also tightened the requirements for accessing the system to ensure that user accounts are not hacked using the registration number and password.

5.Realized Platform:

5.1.Database:

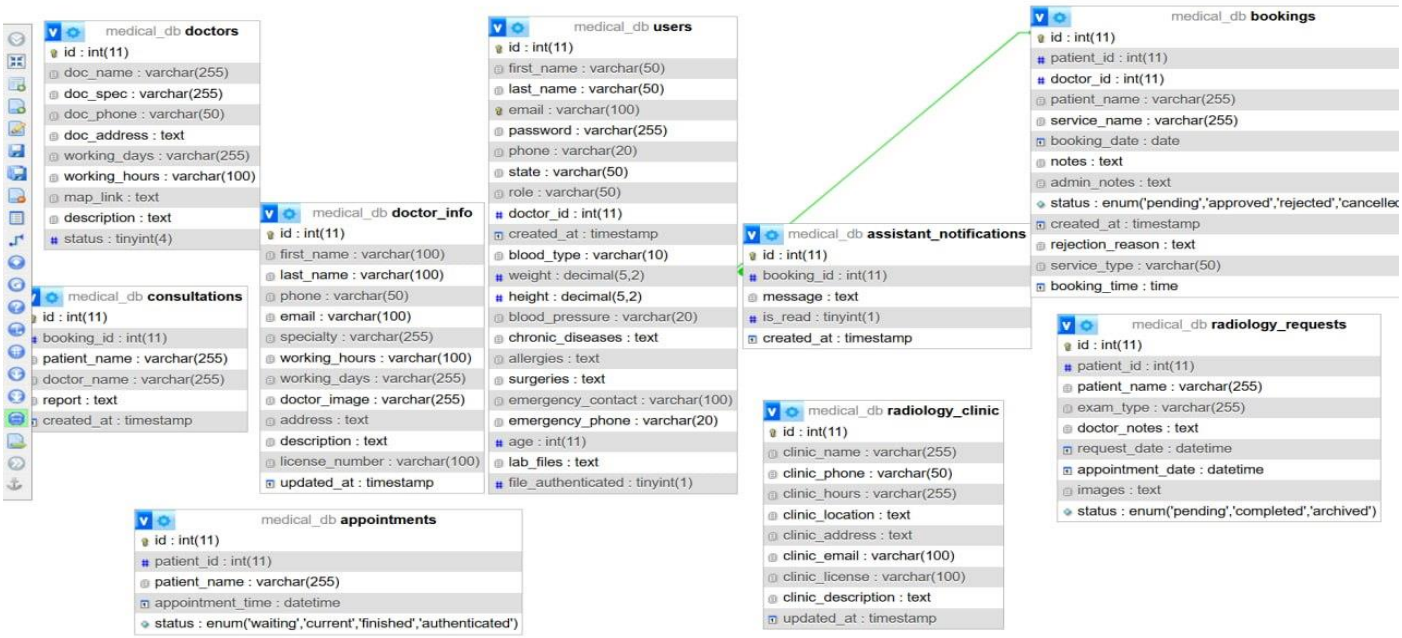

Figure 17:Database

5.2.Graphical Interfaces:

5.2.1.Login Interface: When you open the program, a login interface opens which allows the user to enter: Patient, doctor, receptionist, laboratory, radiology. This is done by entering the name and password and choosing the job type.

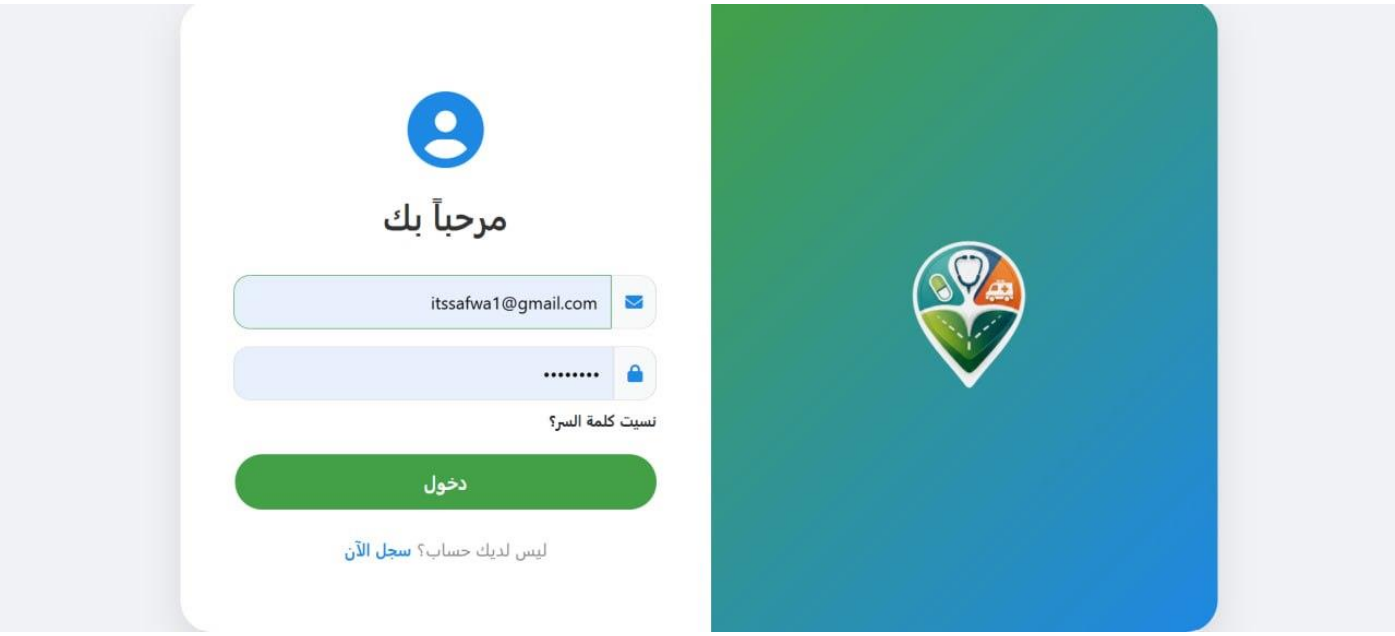

Figure 18:Login interface

5.2.2.Main Interface: After logging in correctly, the program displays the main interface of each user, and considers the initial view of him So when we click on one of the icons, we move to other interfaces.

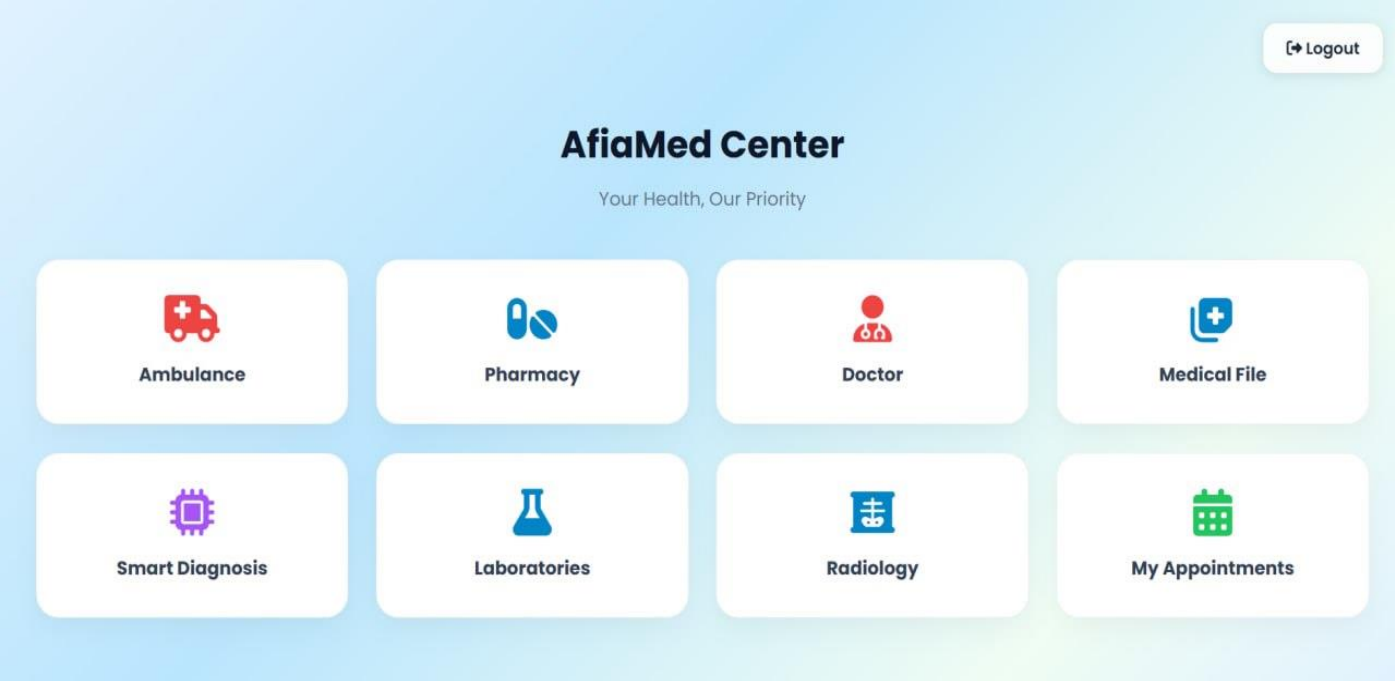

Figure 19:Main interface

5.2.3.Interface Book an Appointment: After successfully logging into the program, the user is shown the main interface, which is his first starting point. This main interface contains a set of icons (icons) that represent various functions of the program. When the "Medical File" icon is clicked, the user is taken to a dedicated interface to enter their medical information or update an existing file.

Figure 20:the appointment interface

5.2.4.Smart Diagnostics Interface: After successfully logging into the program, the user is shown the main interface containing a set of icons. When clicking on the "Intelligent Diagnosis" icon, the user goes to a dedicated interface to help the doctor analyze symptoms and suggest a possible diagnosis using artificial intelligence techniques.

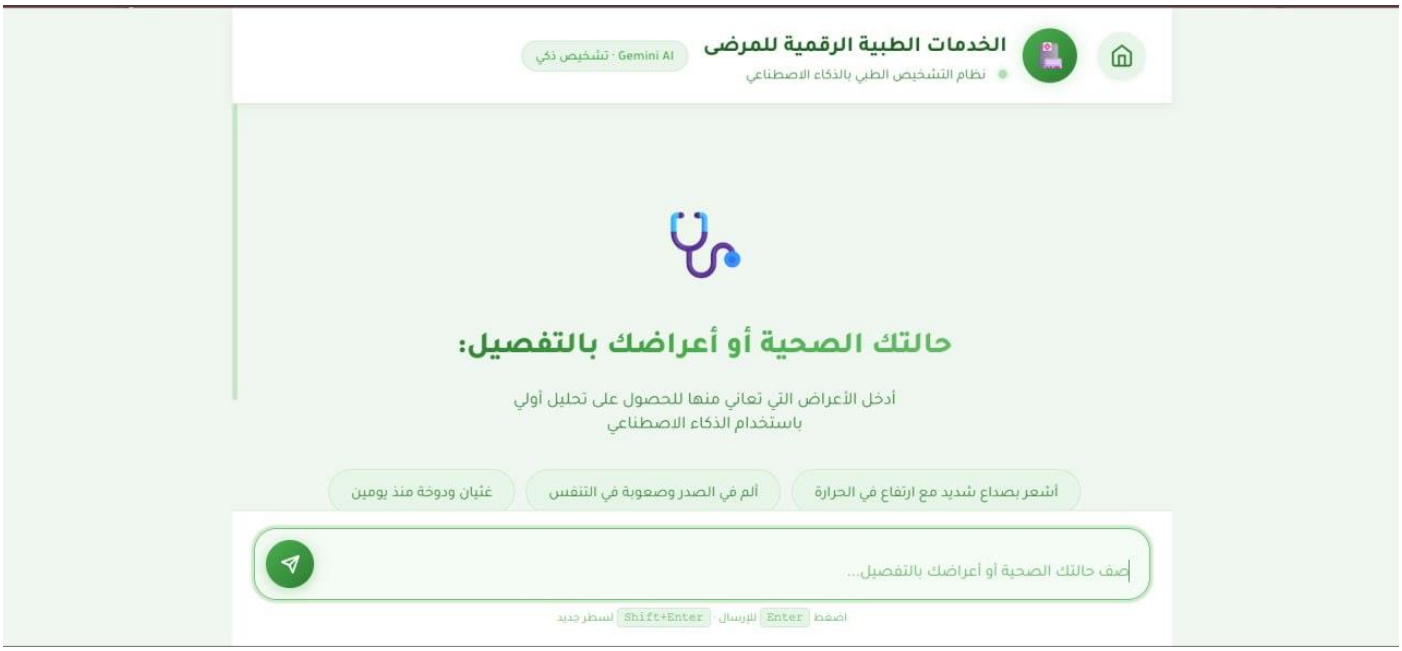

Figure 21:digital patient medical service

5.2.5.Interface Add a Medical File: After successfully completing the login process, the user goes to the main interface to choose the desired service from among the available icons, whether it is a doctor's office, radiology department, or radio. Once he selects the appropriate section, he clicks on the "Book an Appointment" option, where a dedicated form appears for him to write down all the necessary information and data. In the final step, the user confirms the order by clicking the "Book an Appointment" button, thus successfully installing the appointment into the system.

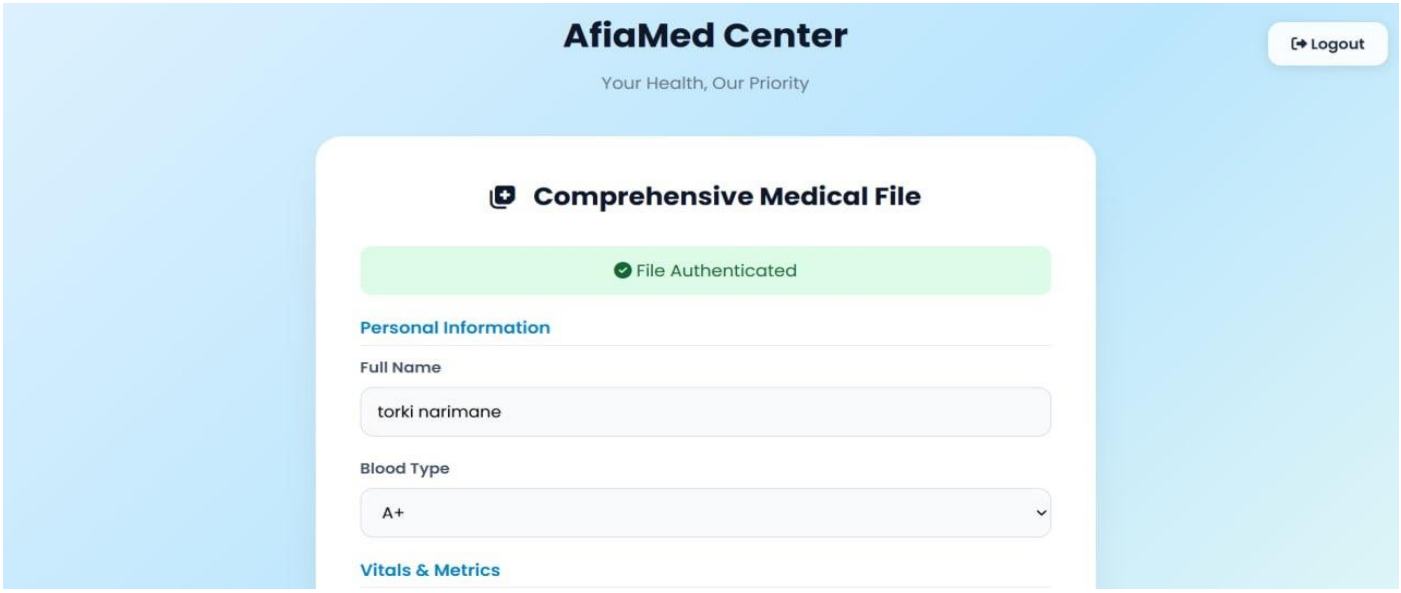

Figure 22:medical file interface

6.Afiamed Platform Vs well-known Platforms:

The following table presents a comparison between the Afiamed platform we have developed and the existing platforms or systems currently used in healthcare facility management, based on several technical and functional criteria:

Criterion	Afiamed Platform	E-tabib Platforms	Sehhaty	Riayati/NUMR
Core Technology	AI-powered, PHP, MySQL, JavaScript, CSS	Web platform for remote medical consultations	Mature, government-grade infrastructure, unified national platform	Uses **SNOMED CT** (global clinical terminology standard) for data interoperability
Data Management	Structured relational database (MySQL) with integrated security	Patient-centered medical file ecosystem	Unified national data for 24M+ users	Unified national data, connects 3,000+ healthcare facilities
User Interface	Modern, responsive web interface (works on desktops and tablets)	Web-based teleconsultation interface	Comprehensive, unified app integrating multiple previous services	Primarily an integration platform, not end-user focused
AI Integration	Predictive models for diagnosis support (e.g., readmission risk, medical image analysis)	No evidence of AI integration in available sources	Advanced – includes "Digital Twin" technology for health simulation	**Planned** – mentioned in future roadmaps (Analytics & AI)
Deployment & Access	Web-based system accessible from	Online teleconsultation platform	Mobile app + web; government-	FHIR Interface – integrates

	inside and outside the institution		operated, unified access	with Alhosn, NABIDH, Malaffi
Cost & Maintenance	Moderate initial development cost, easy centralized maintenance	Reduced operational costs mentioned in sources	Government-funded; free for citizens; massive operational cost	Government-funded; major national investment
Security	Multiple security layers compliant with health data privacy standards	Partnership with "Fortinet" to ensure data security	Encryption in transit; strict privacy policies	Global security standards; SNOMED CT for data normalization
Future Scalability	Easily expandable (adding new diagnostic modules, supporting mobile platforms)	Company plans to expand services internationally	Continuously expanding; integrating new servicesthrough strategic direction	Nationally scalable; gradually connecting all Emirates

Tableau 7:Afiamed Platform Vs well-known Platforms

7.Advantages and Limitations of the Proposed Platform:

A critical reflection on the platform's practical deployment yields specific operational trade-offs that define its current clinical value.

7.1.Advantages:

Highlights the core strengths, such as minimizing clinical administrative overhead, reducing diagnostic turnaround times via AI assistance, and securing patient data integrity through structured database administration.

7.2.Limitations:

Addresses existing constraints, including the systemic dependency on stable network infrastructure and the initial learning curve required for healthcare staff to fully adopt the digital workflow.

7.3.Security:

Addresses existing constraints, including the systemic dependency on user compliance with authentication protocols such as multi-factor verification and credential non-sharing, as well as the initial administrative overhead required for configuring granular role-based access policies for each staff member. Additional constraints include the increased storage demands for maintaining immutable audit logs over extended retention periods, and the clinic operator's responsibility for safeguarding master encryption keys, where loss of keys could result in permanent data inaccessibility.

8.Conclusion:

In this chapter, the work environment represented by the programs and devices used was discussed, in addition to presentation and explanation

Some of the application interfaces are the login interface, the main interface, and the patient interfaces, which consist of the smart diagnosis interface, booking an appointment, and creating a medical file. In the next chapter, we discuss the economic study

Chapter4:

Economic Study of The Institution

1.Introduction:

This chapter focuses on the economic evaluation of the proposed system. It includes an analysis of the expected costs, the anticipated financial and operational benefits, and a feasibility assessment to determine the viability of implementing this system in a real-world healthcare environment. Key economic indicators.

2.Nature of Innovations:

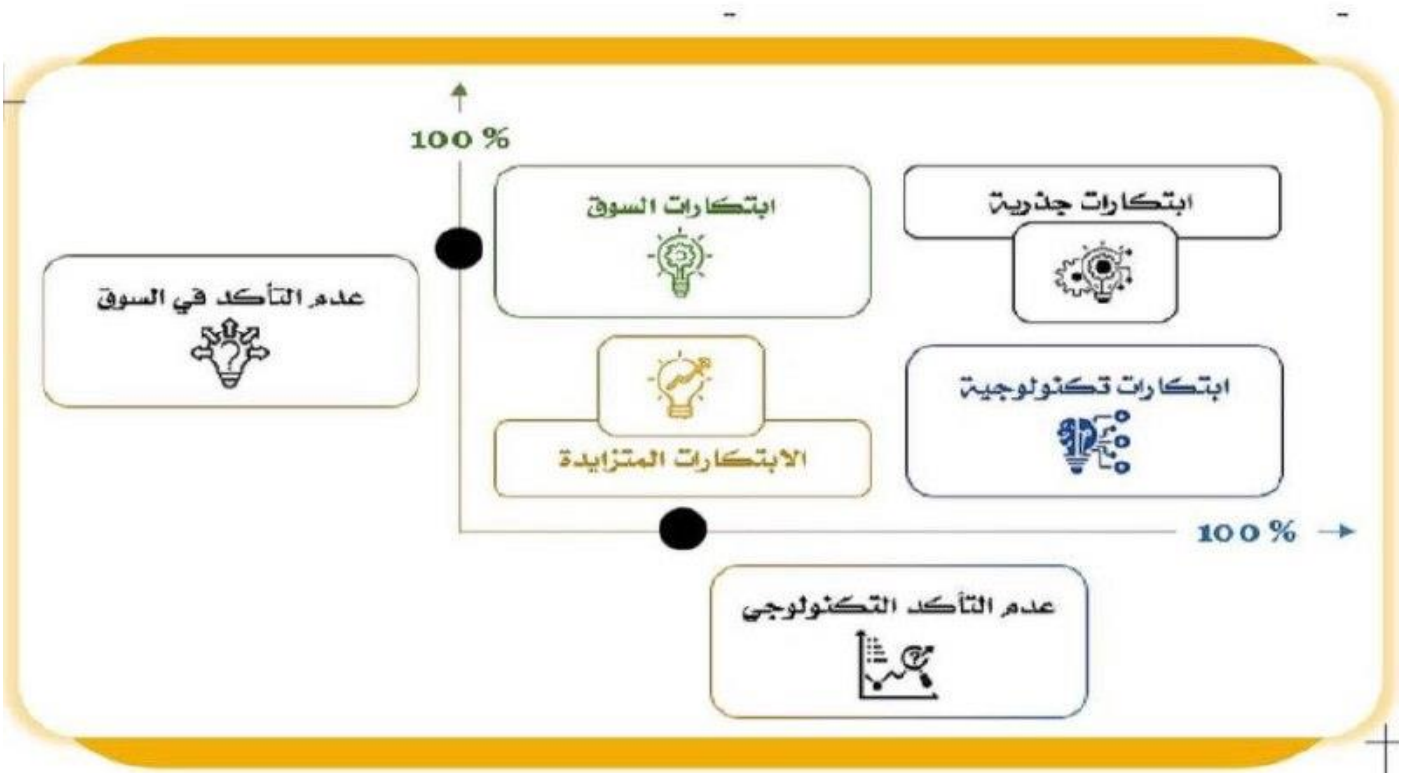

Table 1:nature of innovations

The digital health platform project falls under the category of "market innovations" and is characterized by a high degree of market uncertainty. This is because this type of virtual medical and healthcare services is still relatively new in the Algerian market, as the local arena lacks specialized digital platforms that provide these medical and healthcare services in an integrated, secure, and systematic manner.

In contrast, the project has a high degree of technological certainty, as it relies on advanced, reliable, and already available software technologies. This includes medical consultation mechanisms, communication systems and smooth interaction between doctors and patients, in addition to providing digital awareness and health content using modern and smooth methods

3.Areas of Innovation in The Project:

The health platform project is based on a set of integrated innovations that give it a unique character and contribute to providing real value to the target group:

1.New operations:

The project relies on providing medical services and managing health facilities digitally using cost-effective methods, which contributes to increasing profitability by improving the efficiency of operational processes (such as reducing the need for paper files and large physical headquarters to manage appointments, and reducing waiting periods), and full reliance on integrated digital tools and a unified database.

2.New experiences:

The project reframes the healthcare and medical diagnosis experience for patients, providing medical support and intelligent diagnosis using artificial intelligence in daily life contexts close to users' reality, in a simplified and practical manner that links the patient with the doctor, informant, and radiology department in one platform, which contributes to increasing patient interaction and enhancing their loyalty to the digital service.

3.New features:

The platform offers advanced and improved healthcare services such as an AI-based intelligent diagnostic system to provide rapid initial symptom readings, the ability to book instant appointments with doctors, laboratories, radiology centers, and unified digital medical files for patients, in addition to a **rapid ambulance call system**, representing a qualitative leap compared to traditional sources and hospitals.

4.New customers:

The project expands the scope of regular medical services to reach a wide and new segment of clients. The platform targets patients seeking rapid and remote diagnosis, doctors and private clinics wishing to digitize their work, in addition to hospitals, medical analysis laboratories, and radiology centers that were not easy to integrate into a unified and interconnected digital system in the past.

5.New offers:

The project represents a completely new offering in the Algerian digital health services market, offering a multi-service platform (Multiservice) driven by artificial intelligence and exclusively powered by a modern electronic method that ensures immediate integration between initial examinations, appointment booking, and analysis and radiology management simultaneously.

6.New models:

The project adopts a gradual, cloud-based subscription model tailored to different categories. It relies on providing basic services and software facilities to medical facilities, with plans to integrate multiple payment and subscription systems (for doctors, laboratories, and hospitals, depending on the volume of operations). This represents a radical shift from the traditional business model of manually managing healthcare facilities in Algeria.

2.Strategic Market Analysis:

2.1.Market Sector Presentation:

The potential market includes all individuals, families, and medical institutions in Algeria who have health and regulatory needs, and are looking for ways to digitize examinations and speed up urgent medical services. This market consists of multiple categories such as :

Patients with chronic diseases or normal conditions: They seek continuous, periodic follow-up and a unified digital medical file to avoid missing tests and x-rays.

New doctors and private clinics: They need flexible digital appointment planning and reduced overcrowding in waiting rooms.

Public and private hospitals: They lack many mechanisms for rapid electronic management and early patient guidance.

Technical users (youth and students): A flexible group ready to adopt intelligent diagnostic solutions via artificial intelligence for their simple health conditions.

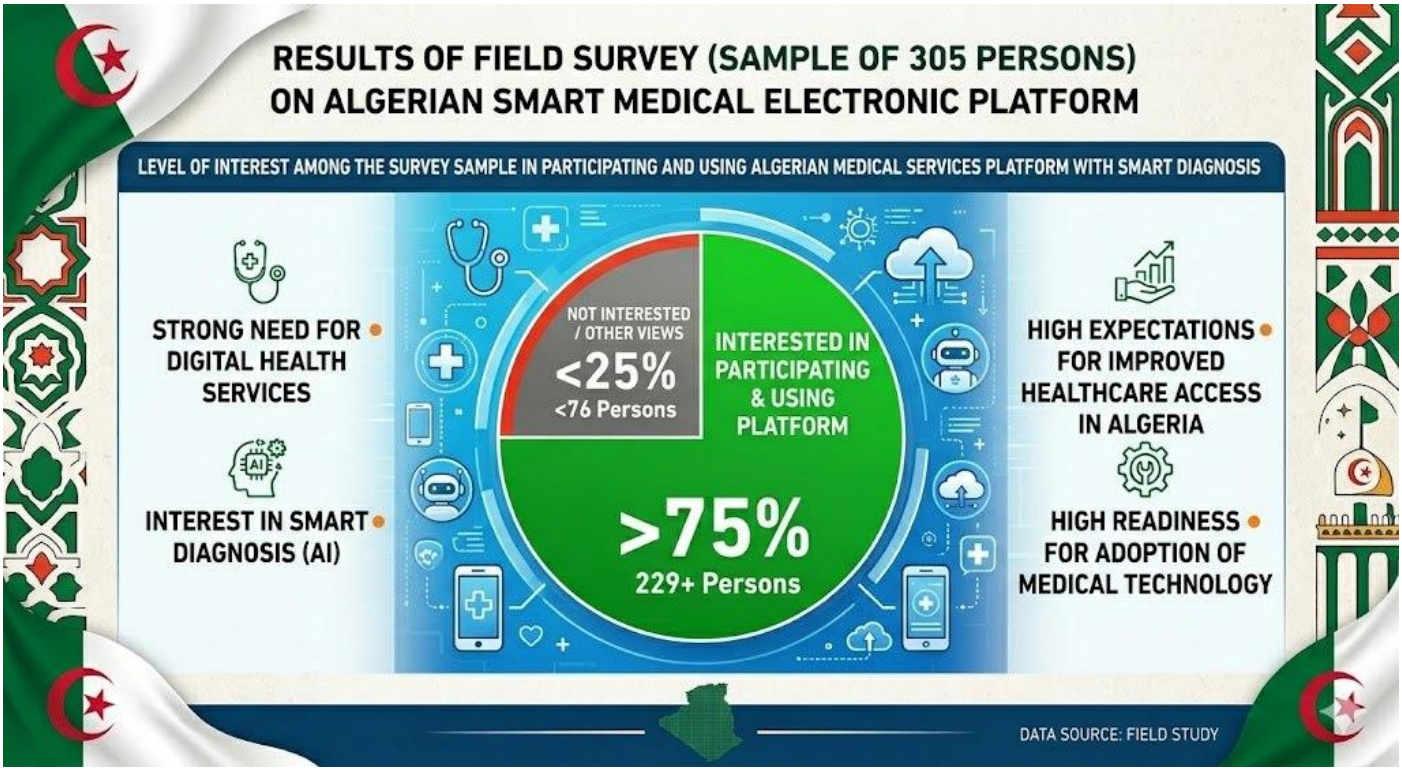

Table 2:Market sector presentation

2.2.Motivations for Purchasing and Dealing Digitally:

1. Desire to avoid long queues and administrative pressure in hospitals

2. Find fast and accurate initial medical diagnosis and guidance powered by AI.

3. Lack of reliable digital resources and integrated platforms in Arabic and French locally.

4.Lack of rapid logistical coordination between doctors, informants, radiologists, and ambulances in official facilities.

3.The Most Important Digital Medical Services That Will Interest Users in The Future:

Based on the priorities and interests of the surveyed sample, health needs were ranked as follows (out of a total of 305 responses):

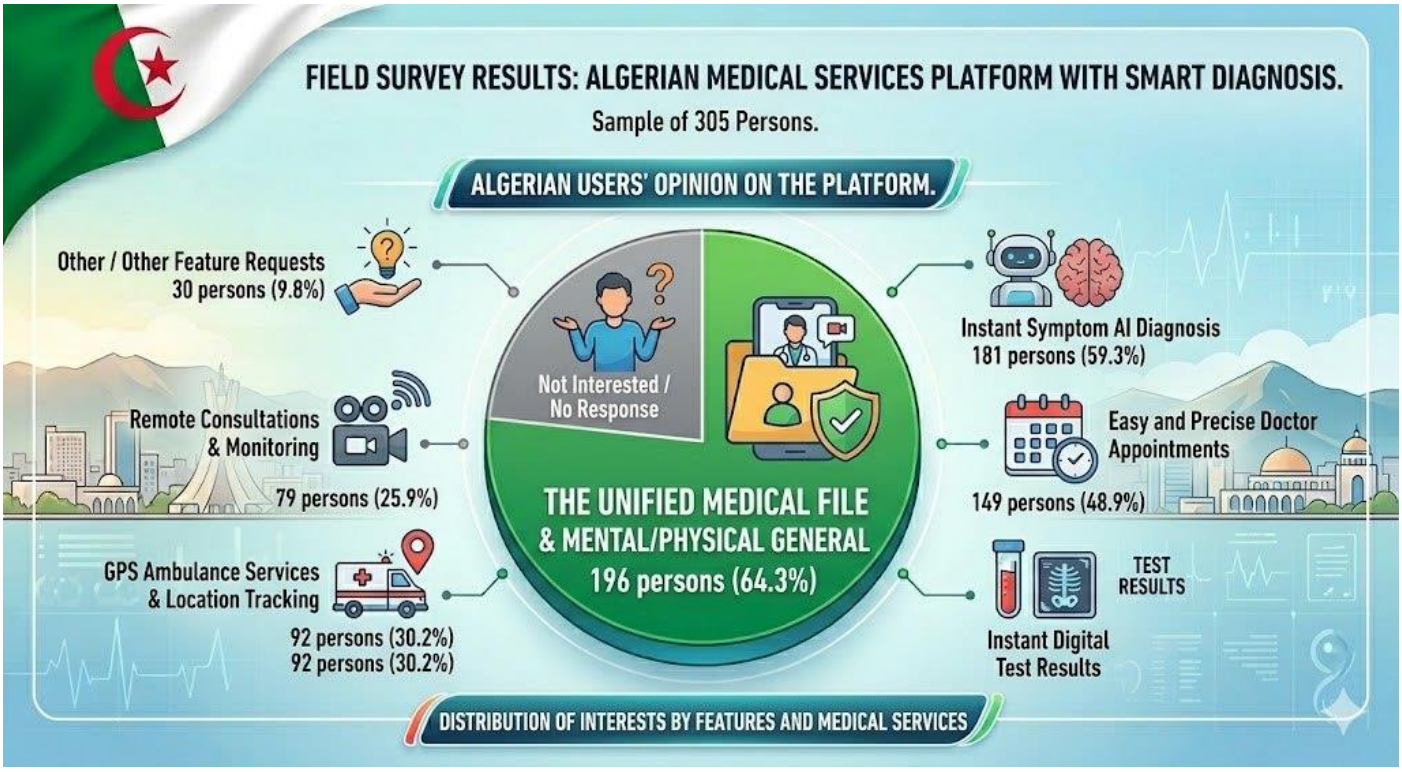

Table 3:The most important digital medical services

4.Incentives for Participation and Registration on The Afiamed Platform:

When the sample was asked, "What most encourages you to register and benefit from the services of this medical platform?" The responses were decisive:

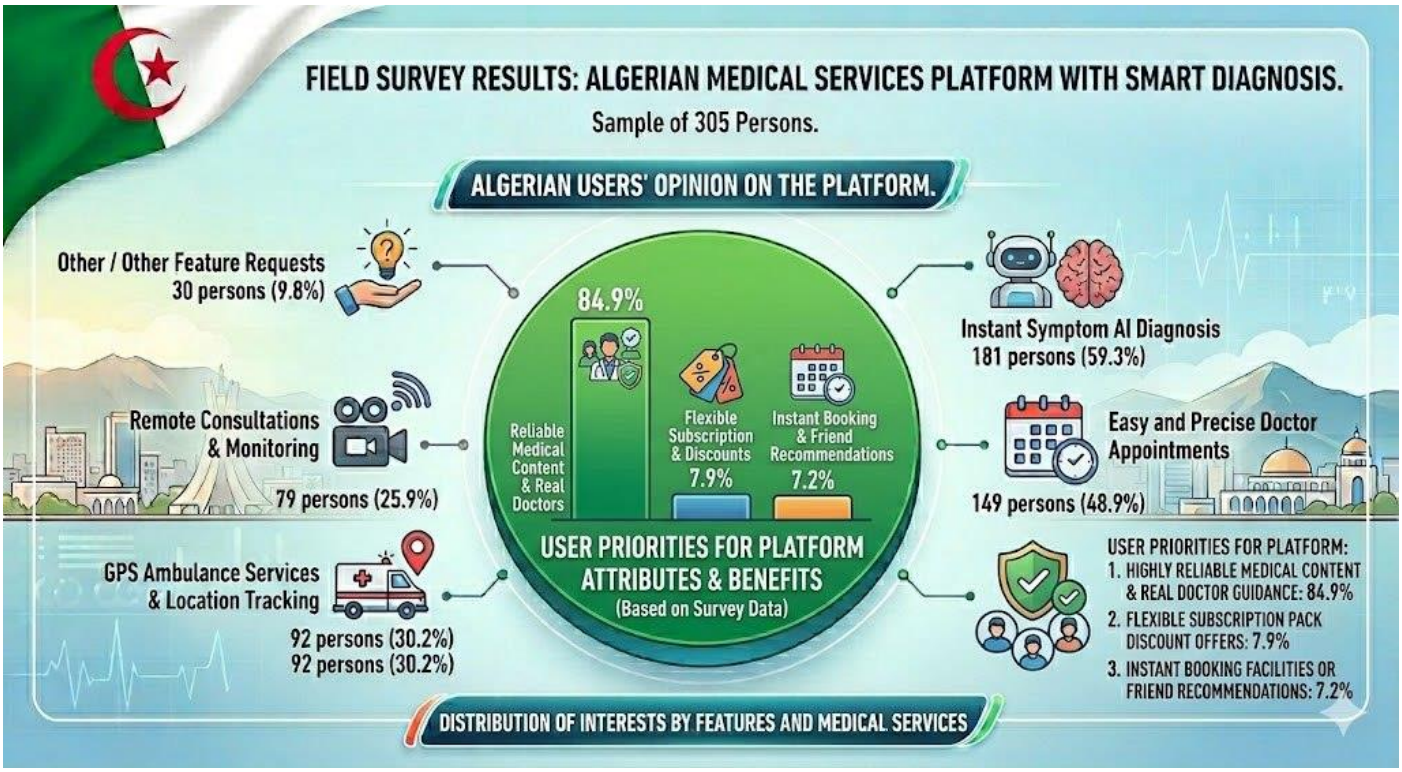

Table 4:Incentives for participation and registration

5.Digital Presence Places:

Online: Especially on Facebook, LinkedIn (targeting doctors and intelligence), Instagram and Telegram (targeting patients and young people).

In the field: university institutions, hospitals, field health centers, and medical charities.

6.Initial Estimate of The Potential Market in Algeria:

Those undergoing examinations and operations annually: +300,000 registered and followed-up medical cases.

Patients need periodic follow-up (last 5 years): +1 million Algerian citizens.

Parents and users looking for quick family care: millions of families across the country.

Doctors, laboratories, and university students interested in digitization: more than 1.7 million active technical users.

7.The Target Market in The First Phase:

The priority target market for the Afiamed platform is:

1. Patients and citizens seeking rapid counseling and guidance (age group from 18 to 55 years).

2. Private doctors and independent medical clinics (those wishing to move digitally).

3. Hospitals and regional laboratories (such as clinics and laboratories in the state of M'Sila as a launching pad for training).

Justifications for choosing this segment:

- These groups actually suffer from problems of slow medical coordination, long queues, and lost paper files.
- Their high interest in smart applications, evident through their daily digital interaction.
- Their willingness to adopt cloud software solutions that reduce effort, time, and unnecessary mobility expenses.
- The lack of a comprehensive, local digital solution in Algeria that connects all these medical circles with unified artificial intelligence.

8.The Possibility of Concluding Contracts or Partnerships:

The Afiamed platform can negotiate and establish strategic partnerships with:

Medical software preparation and development centers and national health associations.

Social security insurance institutions or private examination clinics to facilitate file processing.

Municipalities, university and public hospitals to integrate the queue management system and smart ambulance.

9.Measuring Competition Intensity Via Analysis (SWOT):

1. Strengths:

1. An innovative and comprehensive idea that integrates artificial intelligence with the management of several health services simultaneously (Multiservice).

2. Relying on responsive, easy-to-use interfaces built in flexible languages (PHP / JS/MySQL).

3. Direct field support gained through a real-life case study at Al-Zahraoui Hospital.

4. A skilled team specializing in artificial intelligence from the prestigious University of M'Sila.

5. A flexible and gradual business model (Freemium) makes it easier to attract early customers.

2.Weaknesses:

1. The platform is new to the market and needs to build a reputation and a broad fan base from scratch.

2. The need for high-performance servers (Servers) to ensure that AI data and large medical files are processed quickly and stably.

3. Failure to fully integrate local electronic payment mechanisms (such as the Gold Card / CIB) into an official and approved version in the initial version.

4. Absence of official medical certificates and accreditations from the Ministry of Health at the beginning of the trial launch.

5. Limited financial resources for mass marketing compared to large companies.

3.Opportunities:

1. The growing and urgent demand in Algeria for digitizing the health sector and moving towards a "digital Algeria."

2. Lack of real, comprehensive competition; Most current solutions are limited to a phone book, simple appointment booking without artificial intelligence, or connectivity with laboratories and ambulances.

3. Possibility of cooperating with a university business incubator and benefiting from the advantages of the Start-up Law (Innovative Project Certificate / Label).

4. The general direction of the state to support student projects and innovations (Ministerial Resolution 1275).

4.Threats:

1. The entry of new competitors who have huge funds and offer free, fully subsidized content or services.

2. The difficulty of convincing traditional medical staff or the elderly to rely entirely on applications and artificial intelligence in their daily work.

3. Internet infrastructure and controls to protect sensitive medical data that may impose strict legal conditions.

4. Technical problems in gaining the trust of Algerian users regarding electronic payments and software purchases.

5. Lack of continuous digital interaction on the part of some clinics if they are not inspected and followed up in the field regularly.

10.Costs:

10.1.Investment Costs:

Table shows the investment costs distributed between hardware costs, software costs, and installation and setup costs:

Retour au sommaire

	à intégrer	
Durée d'amortissement	5	années

	à intégrer	à intégrer	Quantité	à intégrer	à intégrer	à intégrer	à intégrer	à intégrer	à intégrer
	Désignation du matériel	Fonctionnalité du matériel	Quantité	Prix unitaire	Année 01	Année 02	Année 03	Année 04	Année 05
Matériel N°01	Main Server	Hosting database & API	2	500	1,000,000		0	0	0
Matériel N°02	Computers	pour Workstations	5	120	600		0	0	0
Matériel N°03	Chauffe-bain ou bain-marie	pour Display radiology results	5	35	175		0	0	0
Matériel N°04	Additional Screens	pour Peripherals	10	5	50		0	0	0
Matériel N°05	thermométre	our SaaS hosting (annual subscriptio	1	240	240		0	0	0
Matériel N°06	Keyboard + Mouse	pour Operating system	2	80	160				
Matériel N°07	Cloud Service (AWS/GCP)	pour Database	1	150	150				
Matériel N°08	Windows Server License	pour Patient data protection	1	200	200				
Matériel N°09	SQL Server License	pour Power outage protection	2	60	120				
Matériel N°10	Network Switch	pour Connectivity	2	25	50				
Matériel N°11	Professional Router	pour Secure remote access	1	40	40				
Matériel N°12	NVIDIA T4 GPU	pour AI diagnosis acceleration	1	850	850				
Total					3,635,000				

Figure 23:Investment Cost

10.2.Revenue:

The following table shows details of the expected revenues of the system

Chiffre d'affaires

			FY23	FY24	FY25	FY26	FY27	FY28
			N-1 (historique)	Année 01	Année 02	Année 03	Année 04	Année 05
Produit/Service N°01	Désignation:	Annual License						
	Quantité:			3	5	8	12	18
	Prix unitaire:			500	550	600	650	700
	Sous-Total:		-	1 500,00	2 750,00	4 800,00	7 800,00	12 600,00
			N-1 (historique)	Année 01	Année 02	Année 03	Année 04	Année 05
Produit/Service N°02	Désignation:	subscription						
	Quantité:			20	35	50	75	100
	Prix unitaire:			15	16	17	17	20
	Sous-Total:		0	3,600,000	6,720,000	10,200,000	16,200,000	24,000,000
			N-1 (historique)	Année 01	Année 02	Année 03	Année 04	Année 05
Produit/Service N°03	Désignation:	AI Diagnosis						
	Quantité:	1/mois		1000	2500	5000	8000	12000
	Prix unitaire:	150000		500	500	500	500	500
	Sous-Total:		0	500000	1250000	2500000	4000000	6000000
			N-1 (historique)	Année 01	Année 02	Année 03	Année 04	Année 05
Produit/Service N°04	Désignation:	Training/Telemedicine						
	Quantité:	6/mois		5	10	15	20	30
	Prix unitaire:	4000		200	220	250	280	300
	Sous-Total:		0	1000	2200	3750	5600	9000
			N-1 (historique)	Année 01	Année 02	Année 03	Année 04	Année 05
Produit/Service N°05	Désignation:							
	Quantité:							
	Prix unitaire:							
	Sous-Total:		0	0	0	0	0	0
		TOTAL:	-	6,600,000	12,920,000	21,250,000	33,600,000	51,600,000
		Progression:		-	96%	64%	58%	54%

Figure 24:Revenue:

10.3.Direct Procurement

The table shows a list of direct purchases by type and quantity

Achats directs

			FY23	FY24	FY25	FY26	FY27	FY28
			N-1 (historique)	Année 01	Année 02	Année 03	Année 04	Année 05
Produit/Service N°01	Désignation:	Services Cloud						
	Quantité:			1	1	1	1	1
	Prix unitaire:			240000	250000	260000	270000	280000
	Sous-Total:		0	240000	250000	260000	270000	280000
			N-1 (historique)	Année 01	Année 02	Année 03	Année 04	Année 05
Produit/Service N°02	Désignation:	APIs médicales						
	Quantité:			1	1	1	1	1
	Prix unitaire:			100000	110000	120000	130000	140000
	Sous-Total:		0	100000	110000	120000	130000	140000
			N-1 (historique)	Année 01	Année 02	Année 03	Année 04	Année 05
Produit/Service N°03	Désignation:	Maintenance & Sécurité						
	Quantité:			1	1	1	1	1
	Prix unitaire:			150000	160000	170000	180000	190000
	Sous-Total:		0	150000	160000	170000	180000	190000
			N-1 (historique)	Année 01	Année 02	Année 03	Année 04	Année 05
Produit/Service N°04	Désignation:	Base données médicales						
	Quantité:			1	1	1	1	1
	Prix unitaire:			80000	85000	90000	95000	100000
	Sous-Total:		0	80000	85000	90000	95000	100000
			N-1 (historique)	Année 01	Année 02	Année 03	Année 04	Année 05
Produit/Service N°05	Désignation:	google cloud et louer server						
	Quantité:	1/mois		1	1	1	1	1
	Prix unitaire:	1600		60000	65000	70000	75000	80000
	Sous-Total:		0	60000	65000	70000	75000	80000
		TOTAL:	0	630000	670000	710000	750000	790000
		Progression:		-	6%	6%	6%	5%

Figure 25:Direct Procurement

10.4.Collective Salary:

Collective salaries include the total wages paid to employees working on the system. The following table details these salaries by tasks and responsibilities.

Retour au

ASF ALGERIAN STARTUP FUND

		Mensuel									à intégrer ↓				
		à intégrer ↓	à intégrer ↓	Calcul automatique	Calcul automatique	à intégrer ↓	Calcul automatique	Calcul automatique	Calcul automatique	Calcul automatique	ETP				
		Salaire Base Mensuel	Indemnité Mensuel	Retenue Sécurité	Retenue Sécurité	Prime Panier &	Salaire imposable	IRG	Salaire Net Mensuel	Salaire chargé Annuel	N-1 (historique	Année 01	Année 02	Année 03	Année 04
Poste N°01	General Manager	30 000	50	2 705	7 813	30	27 376	2	27 374	454 716	0,00	1,00	1,00	1,00	1,00
Poste N°02	Technical Director	120 000	40	10 804	31 210	30	109 266	25 900	83 366	1 815 365	0,00	1,00	1,00	1,00	1,00
Poste N°03	IT Project Manager	120 000	30	10 803	31 208	20	109 247	25 900	83 347	1 815 094	0,00	1,00	1,00	1,00	1,00
Poste N°04	Full-stack Developer 1	60 000	20	5 402	15 605	15	54 633	8 500	46 133	907 682	0,00	0,00	0,00	0,00	0,00
Poste N°05	Full-stack Developer 2	60 000	20	5 402	15 605	15	54 633	8 500	46 133	907 682	0,00	0,00	0,00	0,00	0,00
Poste N°06	AI Developer	85 000	25	7 652	22 107	15	77 388	15 400	61 988	1 285 758	0,00	0,00	0,00	0,00	0,00
Poste N°07	DevOps Engineer	75 000	20	6 752	19 505	15	68 283	12 550	55 733	1 134 482	0,00	0,00	0,00	0,00	0,00
Poste N°08	Cybersecurity Expert	110 000	25	9 902	28 607	15	100 138	22 900	77 238	1 663 758	0,00	0,00	0,00	0,00	0,00
Poste N°09	Consulting Physician	65 000	30	5 853	16 908	20	59 197	9 850	49 347	983 494	0,00	0,00	0,00	0,00	0,00
Poste N°10	Sales / Pre-sales	120 000	15	10 801	31 204	10	109 224	25 900	83 324	1 814 747	0,00	0,00	0,00	0,00	0,00
Poste N°11	Customer Support	120 000	10	10 801	31 203	10	109 219	25 900	83 319	1 814 671	0,00	0,00	0,00	0,00	0,00
Poste N°12		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°13		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°14		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°15		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°16		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°17		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°18		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°19		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°20		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°21		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°22		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°23		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°24		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°25		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°26		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Poste N°27		0		0	0		0	0	0	0	0,00	0,00	0,00	0,00	0,00
Total											0,00	3,00	3,00	3,00	3,00

Figure 26:Collective Salary

10.5.External Loads:

External charges are indirect operating cost items and include services such as electricity, internet, maintenance, insurance, and legal services. The following table shows its details:

Charges externes

	à intégrer ↓ Historique (n-1)	à intégrer ↓ Année 01	à intégrer ↓ Année 02
DZD	FY23	FY24	FY25
Sous-traitance		210 000,00	220 000,00
Loyers		252 000,00	264 000,00
Energie/eau/gaz		24 000,00	66 000,00
Frais Marketing		126 000,00	126 000,00
Honoraires d'avocat		10 000,00	10 000,00
Honoraires du Notaire		50 000,00	50 000,00
Honoraires d'expert-comptable	-	30 000	30 000
Honoraires Commissaire aux Comptes		25 000,00	25 000,00
Frais du transit		-	-
Frais télécom		12 000,00	12 000,00
Divers fournitures		15 000,00	15 000,00
Frais de formation		10 000,00	10 000,00
R&D		100 000,00	100 000
assurances		150 000,00	150 000,00
colaboration avec dermatologue/laboratoires medicaux			
Total	**-**	**1 014 000,00**	**1 078 000,00**

Figure 27:External Loads

10.6.WCR:

WCR (Working Capital Requirement) depends on three elements: Clients, Fournisseurs, and Stocks. The table below details the BFR for the first five years:

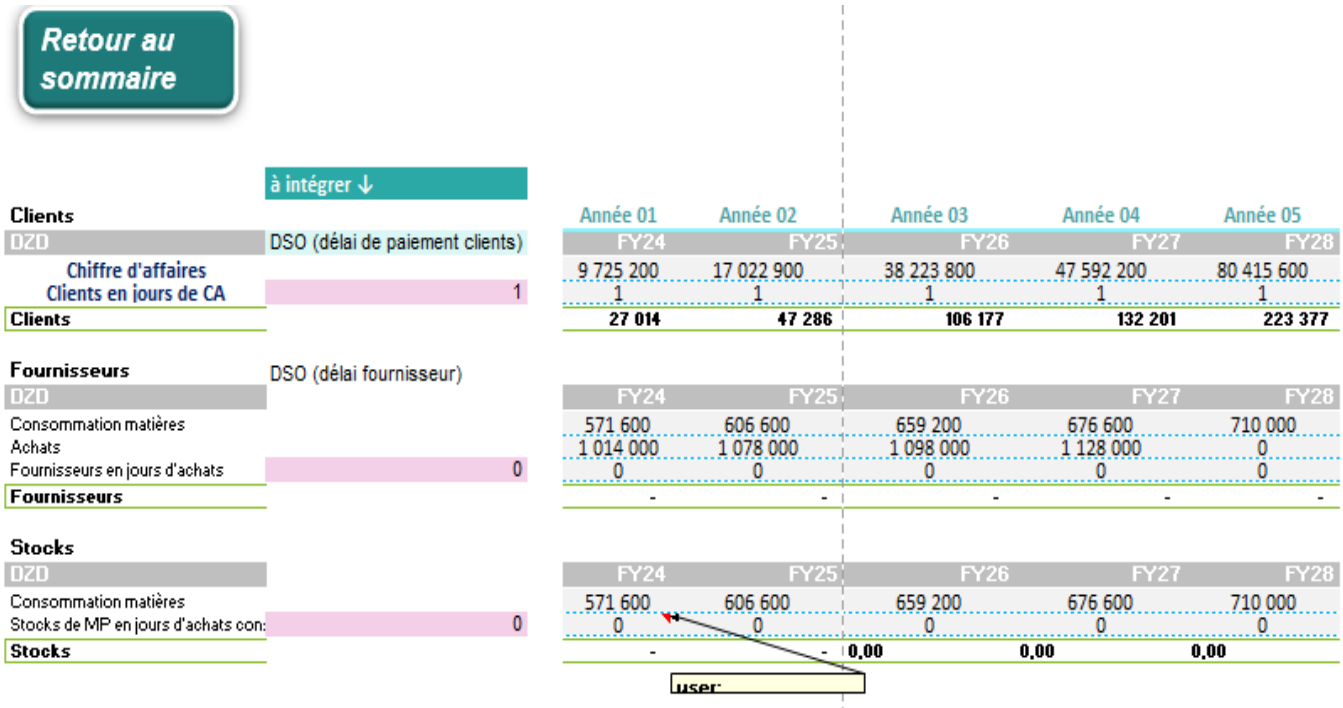

Figure 28:BFR

11.Financial Statements:

11.1.Bilan:

The following financial statements are presented to assess the project's financial viability:

Bilan

DZD	FY24	FY25	FY26	FY27	FY28
Immobilisations	2 369 600	1 777 200	1 184 800	592 400	-
Clients	27 014	47 286	106 177	132 201	223 377
Stock	-	-	-	-	-
Autres actifs courants					
Autres passifs courants					
Trésorerie	3 940 986	18 049 414	53 247 523	97 799 499	176 204 323
Fournisseurs	-	-	-	-	-
Actif Net	**6 337 600**	**19 873 900**	**54 538 500**	**98 524 100**	**176 427 700**
Capital social					
Résultat de l'exercice	6 337 600	13 536 300	34 664 600	43 985 600	77 903 600
Réserves légales					
Reports à nouveau		6 337 600	19 873 900	54 538 500	98 524 100
Total capitaux propres	**6 337 600**	**19 873 900**	**54 538 500**	**98 524 100**	**176 427 700**
Check	-	-	-	-	-

Figure 29:Bilan

11.2.P&L:

The table below shows the Profit & Loss Statement for the years FY24 to FY28:

	N-1 (historique)	Année 01	Année 02	Année 03	Année 04	Année 05
DZD	FY23	FY24	FY25	FY26	FY27	FY28
Chiffre d'affaires	-	9 725 200	17 022 900	38 223 800	47 592 200	80 415 600
Achats consommés	-	(571 600)	(606 600)	(659 200)	(676 600)	(710 000)
Marge brute	**-**	**9 153 600**	**16 416 300**	**37 564 600**	**46 915 600**	**79 705 600**
Charges externes	-	(1 014 000)	(1 078 000)	(1 098 000)	(1 128 000)	-
Salaires et charges sociales	-	(1 209 600)	(1 209 600)	(1 209 600)	(1 209 600)	(1 209 600)
EBITDA	**-**	**6 930 000**	**14 128 700**	**35 257 000**	**44 578 000**	**78 496 000**
Amortissements et provisions		(592 400)	(592 400)	(592 400)	(592 400)	(592 400)
EBIT		**6 337 600**	**13 536 300**	**34 664 600**	**43 985 600**	**77 903 600**
Charges financières						
Résultat avant impôts		**6 337 600**	**13 536 300**	**34 664 600**	**43 985 600**	**77 903 600**
Impôts sur les sociétés		-	-	-	-	-
Résultat net		**6 337 600**	**13 536 300**	**34 664 600**	**43 985 600**	**77 903 600**
Evolution du chiffre d'affaires		**-**	***75%***	***125%***	***25%***	***69%***
Tx de marge brute	*#DIV/0!*	*94%*	*96%*	*98%*	*99%*	*99%*
Tx d'EBITDA	*#DIV/0!*	*71%*	*83%*	*92%*	*94%*	*98%*

Figure 30:P&L

11.3.TFT:

The following table shows the investment costs of the system:

	Année 01	Année 02	Année 03	Année 04	Année 05
DZD	**FY24**	**FY25**	**FY26**	**FY27**	**FY28**
EBITDA	6 930 000	14 128 700	35 257 000	44 578 000	78 496 000
Variation de BFR	**(27 014)**	**(20 271)**	**(58 891)**	**(26 023)**	**(91 176)**
BFR d'exploitation	27 014	47 286	106 177	132 201	223 377
BFR hors exploitation					
BFR	27 014	47 286	106 177	132 201	223 377
IBS	-	-	-	-	-
Flux de trésorerie provenant de l'exploitation	**6 902 986**	**14 108 429**	**35 198 109**	**44 551 977**	**78 404 824**
CAPEX (Investissements)	(2 962 000)	-	-	-	-
Flux de trésorerie provenant de l'investissement	**(2 962 000)**	-	-	-	-
Free cash flow	**3 940 986**	**14 108 429**	**35 198 109**	**44 551 977**	**78 404 824**
Emprunt bancaire					
Apport en capital					
Charges financières	-	-	-	-	-
Dividendes					
Flux de trésorerie provenant du financement	-	-	-	-	-
Net Cash flow	3 940 986	14 108 429	35 198 109	44 551 977	78 404 824
Solde initial	-	**3 940 986**	**18 049 414**	**53 247 523**	**97 799 499**
Solde final	**3 940 986**	**18 049 414**	**53 247 523**	**97 799 499**	**176 204 323**

Figure 31: TFT

11.4.Actif Immo & BFR:

The table below presents fixed assets (Actif immo) and Working Capital Requirement (BFR) over the five-year period:

	Année 01	Année 02	Année 03	Année 04	Année 05
DZD	FY24	FY25	FY26	FY27	FY28
Immobilisations	2 369 600	1 777 200	1 184 800	592 400	-
Actif immobilisé	**2 369 600**	**1 777 200**	**1 184 800**	**592 400**	**-**
Clients	27 014	47 286	106 177	132 201	223 377
Stock	-	-	-	-	-
Actifs courants (hors tréso)	**27 014**	**47 286**	**106 177**	**132 201**	**223 377**
Fournisseurs	-	-	-	-	-
Autres passifs courants					
Total passifs courants	**-**	**-**	**-**	**-**	**-**
BFR	**27 014**	**47 286**	**106 177**	**132 201**	**223 377**

Figure 32:Actif immo & BFR

11.5.Synthèse Financement :

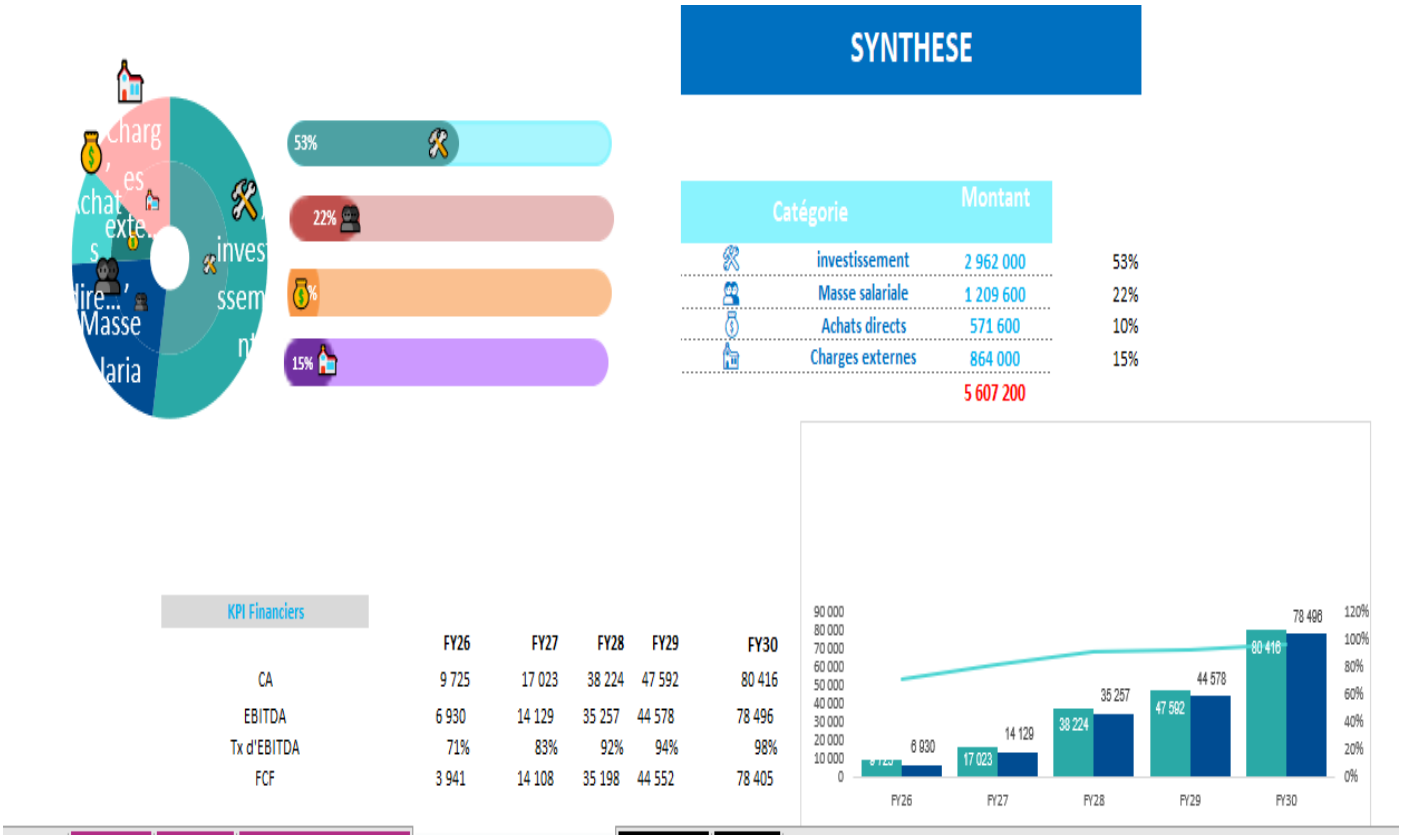

Figure 33:Synthèse Financement

12.Business Model Canvas:

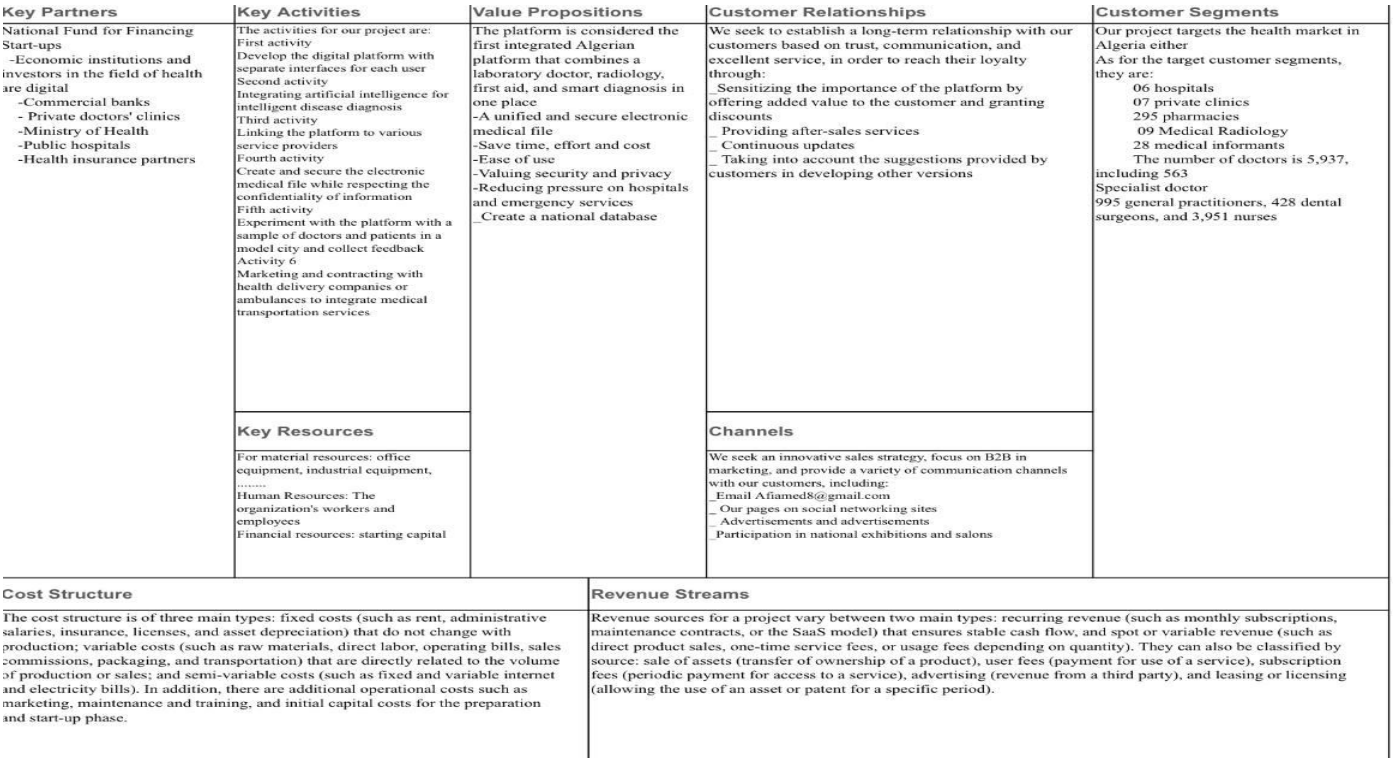

Figure 34:BMC

13.Conclusion:

In this chapter, a comprehensive economic study of the proposed system is presented, analyzing investment and operating costs, as well as forecasting annual revenues over five years. The prepared financial statements (profit and loss statement, working capital requirement, balance sheet, and cash flow statement) showed that the project is achieving positive profits starting from the first year, with continuous growth in turnover and net profits. The results also showed that the project is capable of generating sufficient liquidity to cover its obligations without the need for significant external financing. Based on these results, the proposed system can be said to be economically viable.

General Conclusion:

In the present project, which represents the end of our Master 2 studies in Computer Science, specifically the "Computer Science and Management" track, and which was carried out as a graduation project rated with startup, we proposed a platform to manage health structures. This platform is characterized by centralized management of patients, doctors, appointments, and medical records; role-based access control; real-time scheduling with automated notifications; secure data storage; and a user-friendly interface. This project has been classified as a startup under Decree 1275 by the Business Incubator of M'Sila University. Our work is divided into a theoretical part and an implementation part. In the theoretical part, we presented an overview of the health structure, notably EL-Zahraoui hospital in M'Sila, including its different services (emergency, surgery, cardiology, etc.), actors (doctors, nurses, administrative staff, patients), roles, and existing systems (paper-based and semi-digital). For the implementation part, we developed a functional web-based platform using PHP, JavaScript, CSS, and MySQL within the Visual Studio Code environment. The design of the platform follows a modular architecture with UML diagrams (use case, sequence, class) to model the system. We implemented the most important services, including: patient service (registration, medical history, appointment booking), doctor service (schedule management, access to medical records, prescription writing), and authentication service (login with role-based access). To ensure a high-quality implementation, we have used many tools: VS Code, Git and GitHub, phpMyAdmin, Postman for API testing, Bootstrap for the frontend, and project management tools like Trello.

Self-Benefit: This project allowed us to deepen our knowledge in full-stack development and database design; teamwork and field research improved our programming and systems analysis skills, and enhanced our sense of responsibility in managing engineering projects, enabling us to integrate into the professional field in the future.

Meet difficulties: We faced several challenges, including understanding and modeling complex interactions between hospital actors, ensuring data consistency (avoiding appointment conflicts), securing patient data confidentiality, fully integrating the artificial

intelligence model with the database, collecting real medical data due to privacy restrictions, and time constraints.

Future work and perspectives: We hope to integrate the platform with medical devices, add telemedicine features (video consultations, e-prescriptions), implement an AI-based diagnostic assistant, deploy the platform on cloud infrastructure with Docker, and develop a mobile application for patients and doctors.

This experience was our first experience in designing an intelligent system that integrates artificial intelligence technologies and health information management. Teamwork and field research have allowed us to improve our cognitive abilities in programming and systems analysis, and enhance our sense of responsibility in managing engineering projects, allowing us to integrate into the professional field in the future.

As for the presentation of our platform, we point out that we were unable to provide 100% of what we wanted to achieve, due to time constraints, technical challenges in fully integrating the artificial intelligence model with the database, and the difficulty of collecting real medical data for reasons related to the confidentiality of health information. But we hope in the future to provide the best and improve the completed program.

We ask God that we have succeeded in this humble work as an initial step towards contributing to the digitization and modernization of the health sector in Algeria, and God is behind the intention.

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