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desktop application for managing a dental clinic

Persented by :

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DEDICATION

Whoever said "she attained it"

The journey was neither short nor should it have been,

Knowledge wasn't easily acquired, nor was the path paved with ease,

But I did it, and I achieved it.

All praise be to God, out of love, gratitude, and appreciation. By His grace, here I am today, witnessing a dream long awaited, now realized, one I am proud of.

To my father, who taught me the values of patience and hard work. Thank you for everything you have done for me.

To my mother, the source of affection and continuous support. Thank you for your dedication and care throughout every stage of my life.

To my sisters, who have always been by my side, sharing in the good times and the tough ones. Thank you for your friendship and support.

To my brothers, thank you for your wonderful presence and support in my life.

I dedicate this work to you all with love and appreciation.

May Allah have mercy on the martyrs of Al-Aqsa and grant us a near victory, God willing.

Free Palestine.

Ahdibi Halima Saadia

Firstly, I thank God that I have reached this stage , then I thank everyone who helped me, my parents, my family, and my teachers

Toumiate Imane

ACKNOWLEDGEMENTS

In the name of **Allah**, the Most Gracious, the Most Merciful

First and foremost, all praise and thanks are due to **Allah** for granting us the success to reach this high academic stage and paving the way for us to be here today to discuss our Master's thesis. Our success is only by the grace of **Allah** Almighty.

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All praise is due to Allah, Lord of the worlds.

CONTENTS

LIST OF FIGURES

Part I

GENERAL INTRODUCTION

This part provides a general introduction to our dissertation which have overview, motivation and organization of dissertation.

1

GENERAL INTRODUCTION

1.1 OVERVIEW

In the era of modern digital technology, software solutions and smart applications have become an integral part of various aspects of life, including the healthcare sector. Healthcare service providers, whether general practitioners in private clinics or medical centers, face several challenges in efficiently managing information and daily operations. Private clinics are an excellent example of these challenges, where doctors, nurses, and administrative staff must deal with scheduling patient appointments, recording medical information, issuing invoices, managing inventory, and many other tasks.

1.2 MOTIVATION

In the face of rapid technological advancement and its continuous evolution, many areas of life are undergoing a radical shift towards digitization and ongoing improvement. One of these areas is healthcare, and therefore, we aim to develop a desktop application for managing private clinics, representing a qualitative leap in improving service quality and facilitating the management of daily operations.

1.3 THE PROBLEMS AND CONTRIBUTIONS

Many private clinics face significant challenges in efficiently and effectively managing daily operations. These challenges include scheduling appointments, managing patient records, tracking invoices and payments, analyzing health data to make informed medical decisions, and more. Without a centralized and unified system, reliance on traditional methods and paper documents can lead to increased errors, wasted time, and document misplacement. Therefore, we propose a desktop application specifically designed to manage clinics to contribute to improving management efficiency, reducing errors, and enhancing the quality of healthcare provided. This study aims to explore possible technical solutions and design an application that effectively meets the clinic's needs.

1.4 ORGANIZATION OF DISSERTATION

Our dissertation is organized into four main sections. The first section provides a general introduction to the project, discussing the overview, motivation, and key issues. The second section covers the literature review, helping the reader gain a deeper understanding of the field, and is divided into two chapters. The third section focuses on the design and implementation of our proposed solution. The final section presents the general conclusion and outlines future work.

Part II

THE LITERATURE PART

This part contains the literature topics which help the reader to understand more about this field, and is include two chapter E-Health and Healthcare, and Private dental clinic.

2

E-HEALTH

2.1 INTRODUCTION

Over time, the medical industry has undergone a significant transformation towards the use of modern technology to enhance healthcare and facilitate access to it. This has led to the emergence of the concept of electronic health. E-health represents a vital part of modern medical advancements in this digital age, playing a crucial role in improving healthcare quality and empowering both patients and healthcare professionals alike.

2.2 E-HEALTH

This section will address the definition of e-health and examine its current status and implementation in Algeria.

2.2.1 *Definitions*

e-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only

a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology [9]. And WHO defines e-Health as the cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research.[40]

2.2.2 *The state of e-health in Algeria today*

Today, with the advancement of the world in the healthcare field, Algeria has made efforts to keep pace with this development by relying on digital technology to provide an integrated, global, and automated information and communication system for healthcare institutions to improve the management of healthcare institutions in Algeria. By leveraging digital technology, there has been a contribution to reducing healthcare expenses, streamlining processes, and enhancing patient experiences. However, the results are not yet fully satisfactory due to challenges in training, lack of knowledge, and experience on the part of the healthcare workforce.[5]

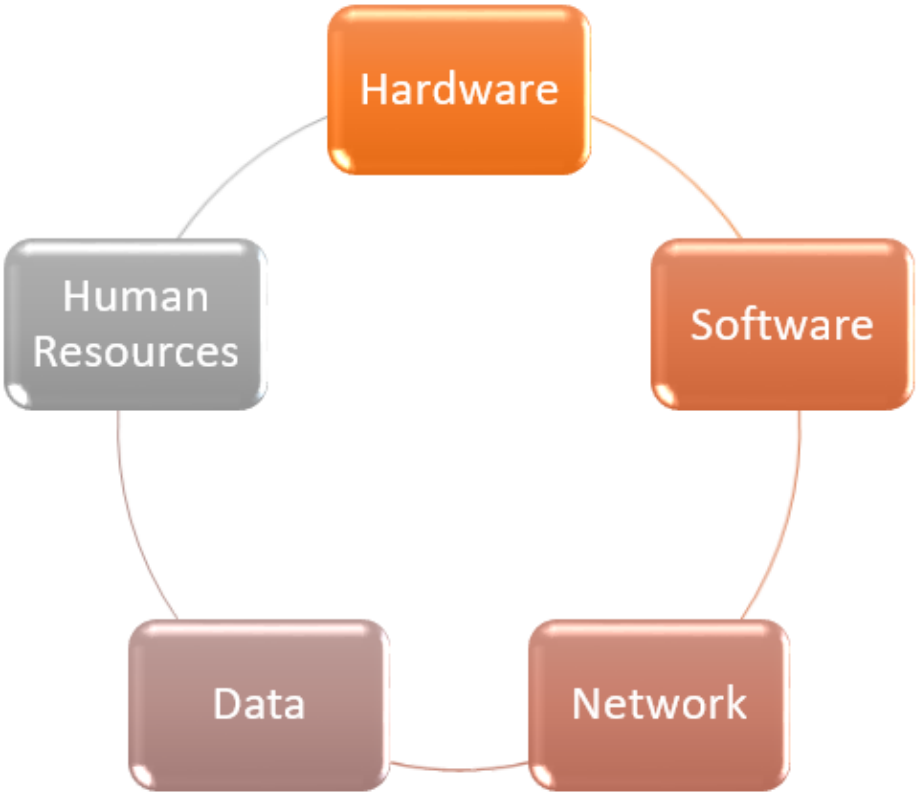
2.3 INFORMATION SYSTEM (IS)

An information system (IS) can be defined technically as a set of interrelated components that collect, process, store, and distribute information to support decision making and control in an organization.[4]

2.3.1 *Components of information system*

The components of information systems are computer hardware and software, Network, Data and human resources. The hardware, software, and Network constitute information technology (IT) , which is now ingrained in the operations and management of organizations. Let's look at these component :

Figure 1: IS Components



- **Hardware:** Hardware is the tangible, physical portion of an information system, the part you can touch. Computers, keyboards, disk drives, and flash drives are all examples of information systems hardware. [4]

- **Software:** Computers are just shiny black mirrors without the programs running behind the scenes telling the hardware what to do. Software can be broken down into two types:

  - System software: which allows you to manage the computer's files and overall interface (think operating systems like Windows 10).

  - Application software: the programs that take care of specific tasks (think Google Sheets and Microsoft Outlook). System software creates a starting point from which application software can build. [33]

- **Network:** A network is a complex system of interconnected components that allow information to go from one location to another. Smartphones, for example, rely on wireless communication networks to transmit data. Similar to the relationship between software and hardware, networks, software, and hardware are frequently complementary. [36]

- **Data:** Data are the raw facts and figures that are unorganized that are later processed to generate information. Softwares are used for organizing and serving data to the user, managing physical storage of media and virtual resources. As the hardware can't work without software the same as software needs data for processing. Data are managed using Database management system.

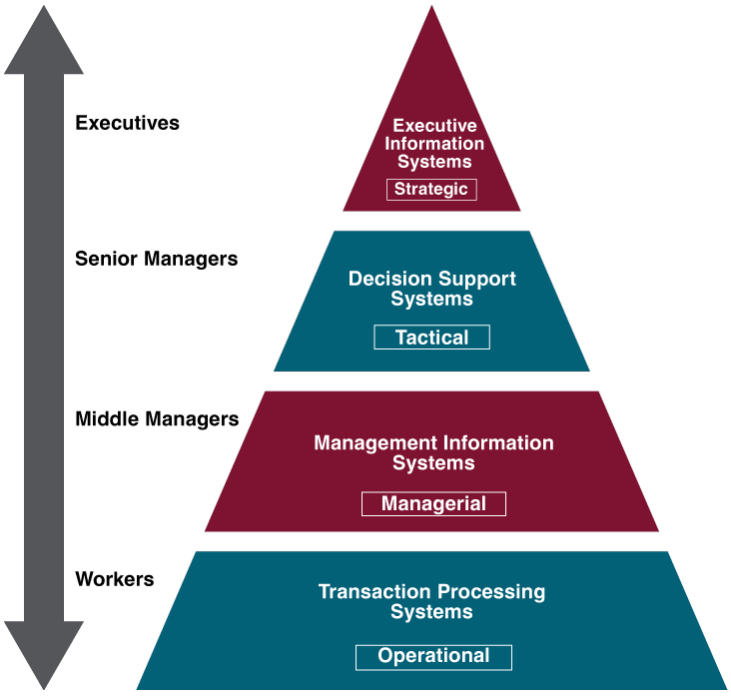
  Database software is used for efficient access for required data, and to manage knowledge bases.[13]

- **Human Resources:** It is associated with the manpower required to run and manage the system. People are the end user of the information system, end-user use information produced for their own purpose, the main purpose of the information system is to benefit the end user. The end user can be engineers, customers or managers etc. People are also responsible to develop and operate information systems. They include systems analysts, computer operators, programmers, and other clerical IS personnel, and managerial techniques. [13]

2.3.2 *Types of information system*

There are six types of information systems divided into four categories:

Figure 2: Types of IS



1. **Operational Level:** Operating systems are used by administrators (frontline managers), operators, and clerical staff. The primary purpose of systems at this level is to respond to routine inquiries and track transaction flow across the organization[37], and it has one type, which is:

    - **Transaction Processing System(TPS):**Operational managers use transaction processing systems that can track and capture automated or semi-automated transactions between different departments within the same organization. The main job of a transaction processing system is to validate, sort, merge, calculate and update data from these transactional events and produce summary reports or lists from which decisions can be made [11].

2. **Knowledge Level:** The knowledge level spans across all organization levels. Knowledge Management system are used to capture, store, and disseminate organization knowledge, ensuring that valuable information and expertise are available to support decision-making and problem-solving at all level [15]. And it contains two types, which are:

    - **Knowledge Work System:** The KWS is a specialized system that expedites knowledge creation and ensures that the business's technical skills and knowledge are correctly applied. The Knowledge Work System aids workers in creating and disseminating new information using graphics, communication, and document management tools. Here are some examples of KWS: Computer-Aided Design Systems (CAD), Financial Workstations, virtual Reality Systems. [29]

- **Office Automation System OAS:** An office automation system is an information system that automates different administrative processes like documenting, recording data, and office transactions, among others. The office automation system is divided into managerial and clerical activities. [20]

3. **Tactical Level** The tactical level supports middle-level managers and their decision-making processes.

   - **Management information systems (MIS):** Play a vital role at this level, providing summarized and aggregated data from various TPS to help managers monitor performance, analyze trends, and plan for the short medium term.[15]

4. **Strategic Level:** The top-most level is the strategic level, also known as the C-suite level. The C-suite makes strategic decisions that affect and shape the future survivability of an organization. [11]

   - **Decision Support System (DSS):** DSS is an interactive information system that provides information, models and data manipulation tools to help in making the decision in a semi-structured and unstructured situation.[12]
   - **Executive Support System (ESS):** The ESS provides greater telecommunication, better computing capabilities, and more efficient display options than the DSS. Executives use ESS to make effective decisions through summarized internal data taken from DSS and MIS and external sources. In addition, executive support systems help monitor performances, track competitors, spot opportunities, and forecast future trends. [29]

2.4 WHAT ARE INFORMATION SYSTEM USED FOR?

Information systems are crucial for businesses, allowing them to make decisions, execute ongoing management tasks, and engage with customers. They are used for supply chain analysis, financial account processing, invoice submission to suppliers, and automating HR tasks. Businesses of all sizes utilize information systems in various ways to achieve diverse objectives. Personal computers, cloud computing, and social networking sites like Facebook and Twitter are reliant on information systems. Similarly, internet-based organizations like Google, eBay, and others depend on information systems to provide essential products and services.[36]

2.5 HEALTHCARE

Health care refers to the prevention, diagnosis, treatment, amelioration, or cure of disease, illness, injury, and other physical and mental impairments in people. It is provided by healthcare professionals and allied health fields, including medicine, dentistry, pharmacy, nursing, and other health professions. [44] So, what are its types?

2.5.1 *Type of healthcare*

In medicine, levels of care refer to the complexity of the medical cases that healthcare providers treat and the skills and specialties of the providers. Levels are divided into four categories:

1. **Primary Care:** Most people are very familiar with primary care. This office is your first stop for most of your symptoms and medical concerns. You might seek primary care for the following: Illness, Injury, referral. In addition, you'll probably see a primary care provider (PCP) for regular health screenings, general checkups, and wellness visits.

   Primary care providers may be: Doctors, Nurse practitioners, Physician assistants and there are some primary care specialties as well. For instance, obstetrics and gynecology (OB-GYN) specialists, geriatricians who treat older people, and pediatricians are all primary care providers. But they also happen to specialize in caring for a particular group of people. [35]

2. **Secondary Care:** Secondary Health Care is the specialist treatment and support provided by doctors and other health professionals for patients who have been referred to them for specific expert care, most often provided in hospitals. Secondary care services are usually based in a hospital or clinic, though some services may be community-based. They may include planned operations, specialist clinics such as cardiology or renal clinics, or rehabilitation services such as physiotherapy. Secondary healthcare includes a wide range of specialists such as psychiatrists, cardiologists, obstetricians, dermatologists.[16]

3. **Tertiary care:** Refers to highly specialized equipment and expertise with the goal of treating specific, complex health conditions. At this level, you will find procedures such as: National Health Service, Plastic surgeries, Neurosurgeries, Organ transplants. Other specialized procedures, like dialysis, a coronary artery bypass graft (CABG), or burn treatment, are provided at a tertiary care facility. A small,

local hospital may not be able to provide advanced care, so you may be transferred to a tertiary medical facility.[35]

4. **Quaternary care:** The term quaternary care is sometimes used as an extension of tertiary care in reference to advanced levels of medicine which are highly specialized and not widely accessed. Experimental medicine and some types of uncommon diagnostic or surgical procedures are considered quaternary care. These services are usually only offered in a limited number of regional or national health care centers. [44]

2.5.2 *Hospitals*

In this subsection, we will provide a brief historical overview of hospitals and their definition.

2.5.2.1 *Brief history*

Hospitals have a long history dating back to ancient Mesopotamia, evolving through the Graeco-Roman era and the Middle Ages. Initially serving as hospices for pilgrims, hospitals developed under Christian influence, with the first Roman hospital established in the 4th century AD by Fabiola. Monastic infirmaries and public hospitals emerged during the Middle Ages, funded by various sources. This historical progression highlights the transformation of hospitals from charitable shelters to vital centers of medical care and innovation.

The history of hospitals dates back to ancient times, with the evolution of hospitals traced from their inception in ancient Mesopotamia to the Middle Ages. Initially, hospi-

tals served as hospices for pilgrims and messengers, evolving under Christian influence into modern healthcare institutions. The first hospital in Rome was built in the 4th century AD by Fabiola, a wealthy widow. During the Middle Ages, monastic infirmaries became common in every monastery, and public hospitals funded by various sources emerged. The Muslim world during the Golden Age of Islam also had advanced hospitals. Hospitals transitioned from charitable shelters to centers of medical excellence, reflecting continuous innovation and societal importance.[8]

2.5.2.2 *Definition*

According to the American Hospital Association (AHA), hospitals are licensed institutions with at least six beds that provide diagnostic and therapeutic patient services for medical conditions. The World Health Organization (WHO) defines a hospital as an establishment where at least one physician is permanently present, providing inpatient accommodation and active medical and nursing care.[7]

It is also defined as a healthcare facility that provides a range of different services for patients of various age groups and with varying disease conditions. Hospitals can be general, offering a variety of services, or specialized, focusing on specific diseases or age groups.[23]

2.5.3 *Algeria's Healthcare System*

A health system or healthcare system is an organization of people, institutions, and resources that delivers health care services to meet the health needs of target populations.

Algeria's healthcare sector is heavily reliant on imported goods and is facing challenges due to rising rates of cardiovascular diseases, cancer, hypertension, diabetes, respiratory illnesses, and allergies. Despite this, the government allocated 7.3% of the total national operating budget to health in 2018, with the Ministry of Health, Population and Hospital Reform receiving the fourth largest portion of the national government budget. However, the registration and sale of brand-name health products in Algeria can be uncertain due to ineffective licensing of generic pharmaceuticals and lack of clear coordination between the Ministry of Health and the Algerian patent office. Companies may face delays of weeks or months for goods to be cleared by Algerian customs.[2]

2.5.4 *Goal of Healthcare System*

These are some of the objectives:

- High-quality health care helps prevent diseases and improve quality of life. Healthy People 2030 focuses on improving health care quality and making sure all people get the health care services they need.[1]
- Helping health care providers communicate more effectively can help improve health and well-being. Strategies to make sure health care providers are aware of treatment guidelines and recommended services are also key to improving health.[1]
- Some people don't get the health care services they need because they don't have health insurance or live too far away from providers who offer them. Interventions to increase access to health care services like lowering costs, improving insurance coverage, and increasing use of telehealth can help more people get the care they need.[1]

2.6 HEALTHCARE INFORMATION SYSTEM (HIS)

In this section, we will explore Healthcare Information System its types, benefits, examples, and more.

2.6.1 *What is HIS*

This system is known as the healthcare planning system or hospital information system. Its development can be dated back to 1960 when its major functions were limited to administrative management only. After 1970, sizable hospitals gradually set up internal information sectors, and private information companies started to develop high commercial value computer information systems, which contributed to the prosperous development of the healthcare information system. [24]

2.6.2 *HIS types*

There are multiple types of health information systems available. And this are some of them:

1. **Medical Practice Management System:** The medical practice management system forms an integral part of the healthcare system. It takes care of different administrative and clinical aspects of your practice. It is geared towards a facility's clerical work, such as managing various documents, scheduling appointments, etc. Information systems in healthcare automate and streamline multiple activities, which makes it easy to run the facility smoothly.[21]

2. **Patient Portals:** This information system enables patients to peruse their health data. They can access appointment information, medications they may receive, and their lab results via the internet. Some patient portals also facilitate active communication with healthcare professionals, including physicians and pharmacists, regarding their prescription refill requests and scheduling of appointments. [28]

3. **Electronic Health Record Systems (EHR):** This system allows Doctors or nurses can fill out all the information on the EHR system. The best part is that electronic medical record systems can be accessed instantly using a mobile or computer. It also enables doctors to easily share data across different departments, allowing them to provide quick and accurate treatment. It deals with electronic health information, which generally contains information on a patient's medical history, allergies, laboratory charges, and more. Some of the benefits of implementing EHR include the following:

    - Electronic health records and information technology increase efficiency and giving immediate patient data access.
    - An electronic medical record system improves the quality of patient health care as the same information is shared across all departments, avoiding any medical errors.

4. **E-prescribing Software (EPS):** E-prescribing software is beneficial as it enables doctors to generate prescriptions electronically. It allows them to directly send prescriptions to the pharmacy in just a few clicks, and when the patient gets there, the store is already ready with their supplements.

In addition, the system eliminates the need to create handwritten notes, which are generally hard to decipher, and instead generates a legible online prescription. Plus, there is no prescription mix-up, the pharmacist ensures patient safety by giving them the correct one. It also eliminates the chances of misplacing a prescription. The advantages of using e-prescribing software are:

- It allows healthcare providers to send prescriptions directly to pharmacies without the risk of getting misplaced.
- It gives quick and easy access to a patient's medication history with the help of a pharmacy's database.

2.6.3 *Benefits of healthcare information system*

There are many benefits of health information systems. Let's take a look at some of the benefits of health information systems. [21]

Better Patient Safety: By storing and sharing information across multiple databases, using health information systems makes it easier to retrieve patient data and improves patient safety. The system additionally permits timely alert alerts for any health-related concerns. By being proactive, you can help avoid major mistakes that arise from making decisions based on incomplete knowledge. [21]

Seamless Performance Analysis: By utilizing HIS's data analysis, you can keep an eye on the performance of your employees, evaluate patient care, and evaluate the reliability and efficacy of your organization. By digitizing all records, HIS reduces paperwork and enables you to make well-informed staff decisions based on competencies and prior performance.[21]

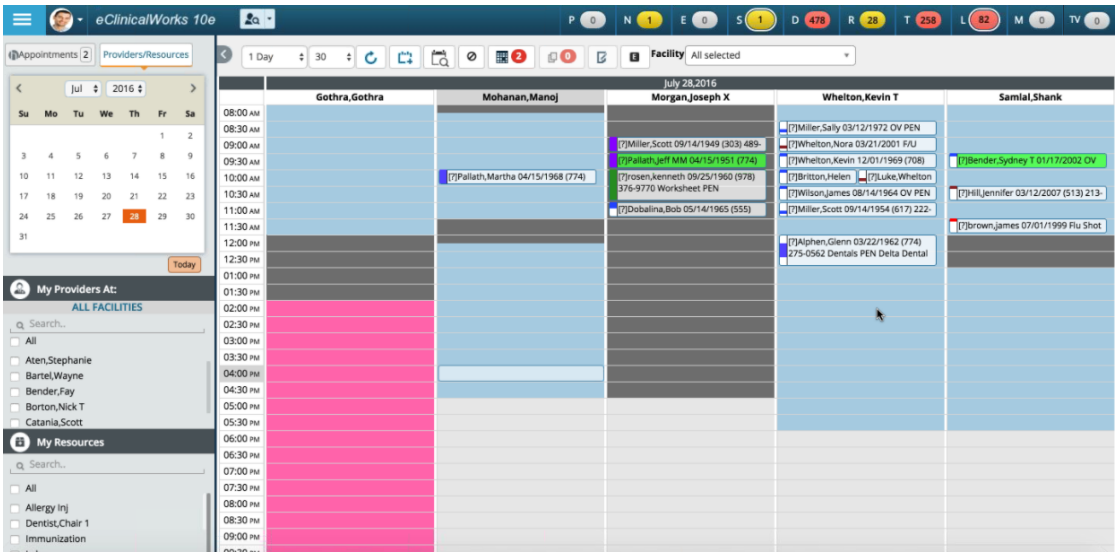
Organized Team Process: Patients can benefit from seamless and well-coordinated treatment from healthcare providers with the HIS system, especially if their illnesses call for considerable medical information management and collaboration across specialties. The most significant benefit of implementing a health information system is that it improves patient outcomes and service delivery. [21]

2.6.4 *Examples of HIS*

There are a lot of examples of healthcare information system and here are just a few of them:

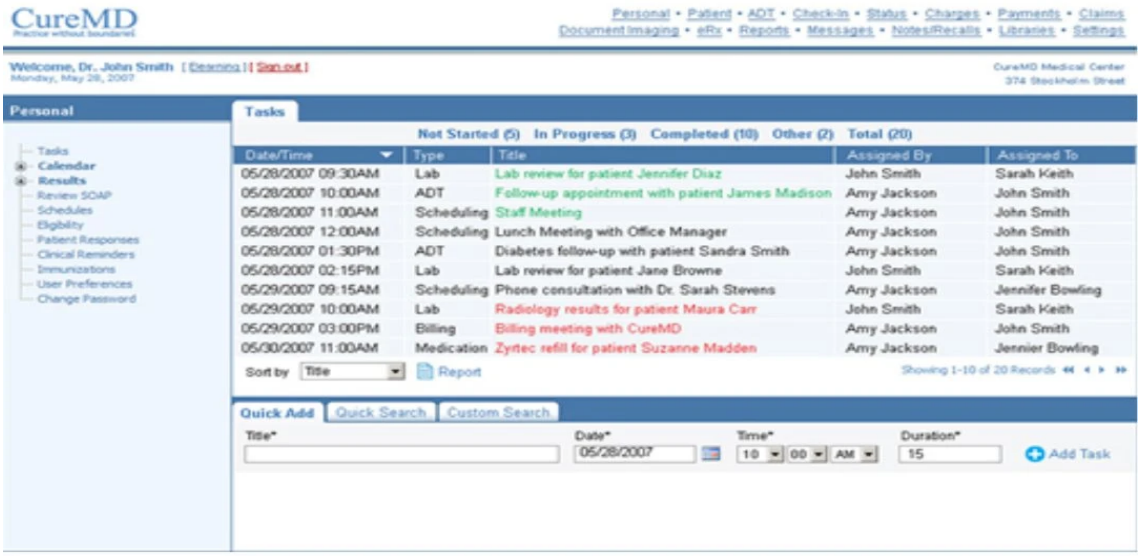
1. **eClinicalWorks:** eClinicalWorks is an online-based electronic medical records software for healthcare and it. These emr systems suitable for all size of companies. Serves the way of features i.e emergency care facilities, ambulatory practices, connect with patients problem and give treatment.[30]

Figure 3: eClinicalWorks



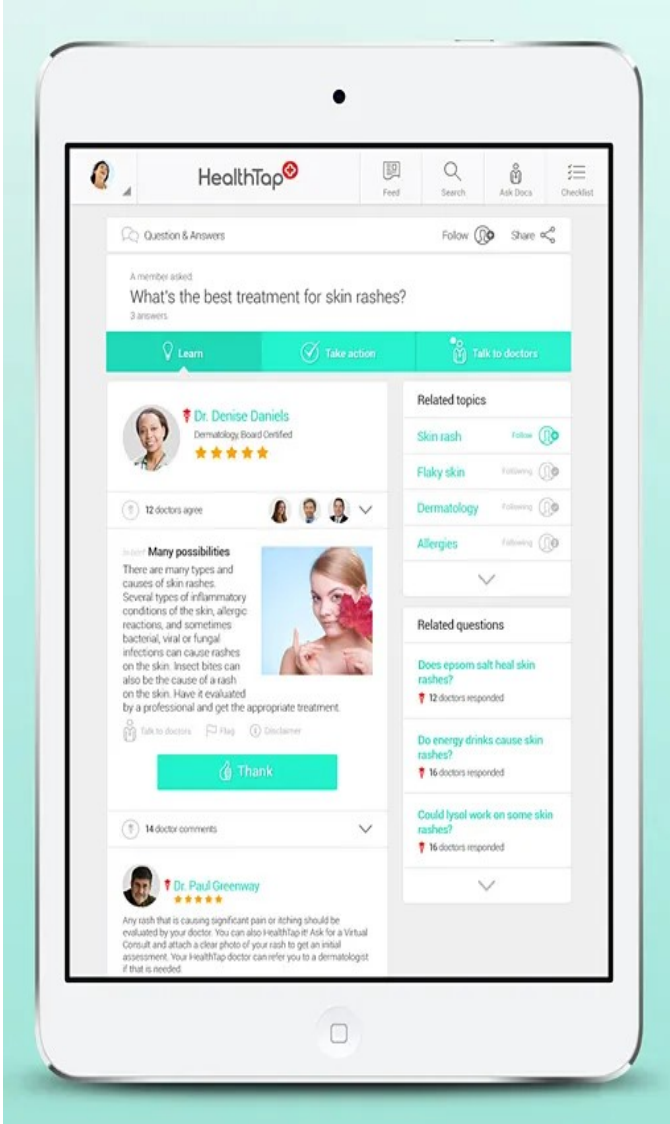
2. **CureMD**: CureMD is the leading provider of innovative health IT solutions that transform administrative and clinical operations of healthcare organizations. [31]

Figure 4: CureMD



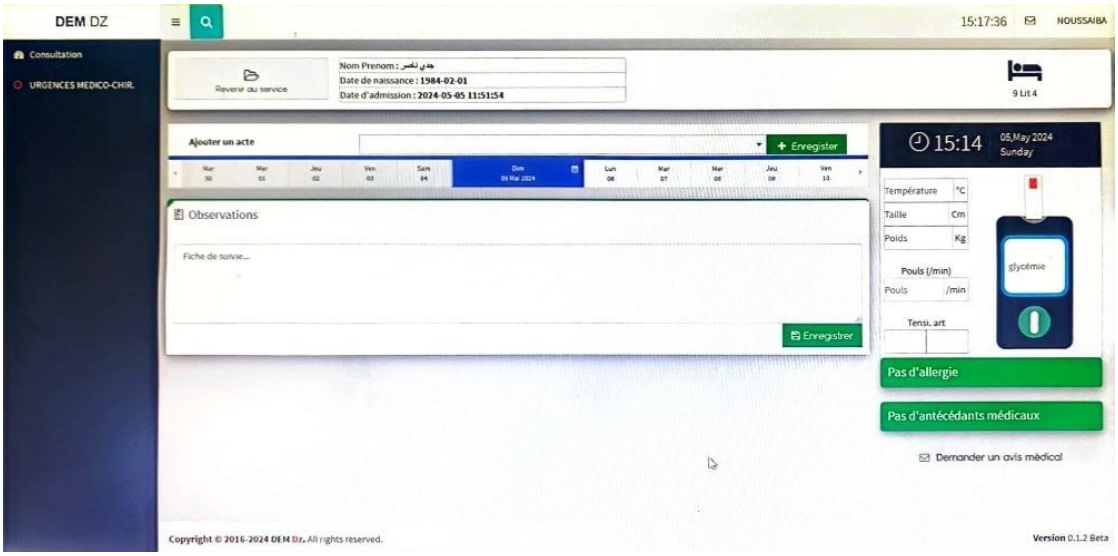
3. **HealthTap:** is a medical group and technology company delivering telehealth virtual healthcare via the web and health apps. Their customers include health consumers in the United States, health systems, insurance companies, and self-insured employers. [42]

Figure 5: healthtap



4. **DEM DZ:** As part of digitizing the healthcare sector, the Patient Electronic File (PEF) program has been established to enhance the sector and move towards paperless operations. Each department has its own interface for doctors, paramedical teams, and administrators, all aimed at facilitating work and providing the best treatments for patients.

Figure 6: DEM DZ



2.6.5 *Challenges of healthcare information systems*

The challenges of healthcare information systems include a range of issues that impact the effective management and utilization of health information within healthcare organizations. Some common challenges identified in the sources provided are:

- **Privacy Concerns:** Ensuring the privacy and security of health information is a critical challenge, as breaches in privacy can lead to legal and ethical issues, affecting patient trust and data integrity. [22]

- **Policy Issues:**Challenges related to policy development and implementation can create barriers to the effective use of healthcare information systems, impacting data sharing, interoperability, and system integration.[22]

- **Managing Big Data:** Healthcare organizations are generating vast amounts of data, both structured and unstructured, which poses challenges in storing, organizing, and analyzing this data effectively.[34]
- **Staying Up-To-Date:** Keeping abreast of the latest developments in healthcare technology and regulations is a challenge for healthcare information managers, impacting their ability to implement up-to-date systems and practices.[34]
- **Accuracy and Completeness of Data:** Ensuring that data is accurate and complete is crucial for providing quality patient care, but it can be challenging due to the volume and complexity of healthcare data.[34]

2.7 CONCLUSION

The integration of information systems and electronic health records has revolutionized healthcare delivery, facilitating better patient care, efficient management, and improved outcomes. However, challenges persist, including issues related to data privacy, interoperability, and ensuring equitable access to technology across different demographics.

3

PRIVATE DENTAL CLINIC

3.1 INTRODUCTION

Dental clinics represent a vital point in healthcare, playing a crucial role in oral and dental health, and therefore in an individual's overall health. Private and public clinics exist all over the world, providing diagnostic and treatment services for patients of all ages. They are an integral part of public health care.

3.2 DEFINITIONS

Here are some important definitions to know :

1. **Clinic:** A clinic is a building where people go to receive medical advice or treatment. [6]

2. **Private Clinic:** Private Clinics means a doctor's surgery or medical Center where Doctors charge patients a fee for services provided.[17]

3. **Private dental clinic:** A private dentist refers to a dental professional who offers dental services and treatments on a privately-paid basis. These dentists operate independently or as part of a private dental practice. The patients are responsible

for the payment of their treatment fees without any external funding or assistance, such as that provided by the NHS (National Health Service). Private dentists usually offer a wide range of specialized treatments and services that may not be available through the NHS. [3]

3.3 DOCUMENTS REQUIRED TO OPEN A PRIVATE MEDICAL CLINIC

According to Ministerial Directive No. 01 dated 1999/01/20, the required documents are as follows:

- Handwritten request.
- Birth certificate.
- Nationality certificate.
- Certificate of Good Conduct.
- Original copy authenticated by the Civil Status of the Diploma.
- Two medical certificates.
- Certificate or document proving the individual's status towards national service.
- Registration certificate in the regional ethical medical authority.
- Lease agreement or ownership deed, authenticated [Ownership certificates certified by the National Fund for Social Security and Reserve or by the Real Estate Management and Promotion Office].
- Verification record for the premises.

- Certificate of non-membership in the National Social Security Fund [Honorary declaration certificate].
- Salary suspension certificate.
- Resignation decision for specialists practicing in the healthcare sectors.
- Joint ministerial decision for resignation for university hospital specialists.
- Two passport-sized photos.
- Diploma authentication certificate (Authentification).
- Store design.

3.4 ADVANTAGES OF CHOOSING A PRIVATE DENTIST

In this part, we will explore the advantages of private dentistry and why it may be the best choice for you.

1. **Shorter Wait Times:** Choosing a private dentist means you can be seen much quicker, with hardly a wait at all. If there is time to fit you in, you could even be seen the same week. [25]
2. **Flexibility in Appointment Times:** Private dentists, often have more flexible schedules and can offer appointments outside of regular business hours. This means that you can schedule appointments that fit into your busy schedule and are less likely to have to take time off work or school.[27]

3. **A Wide Range of Treatments:** Private dentists offer a wider range of treatments than NHS dentists, including cosmetic procedures like teeth whitening and orthodontic treatments, as well as advanced procedures like dental implants.[27]

4. **Personalised Care:** Private dentists offer more personalized care than NHS dentists. With smaller patient lists, they can spend more time with each patient, understanding their individual needs and concerns, resulting in tailored treatment and better communication, trust, and understanding of dental needs. [27]

5. **Advanced Technology:** Private dentists utilize cutting-edge technology for precise diagnoses and treatments. They may use digital X-rays, CBCT scans, lasers, and CAD/CAM for custom dental restorations.[27]

6. **Privacy and Comfort:** Private dental facilities are often more comfortable and private than those of NHS dentists, with amenities such as comfortable waiting rooms and private treatment areas, reducing stress and anxiety.[27]

7. **Cost:** Private dentistry may cost more than NHS dentistry, but benefits like payment plans and insurance acceptance can offset the expense. Costs vary based on treatment and location.[27]

3.5 DENTAL FIT CLINIC

It's a private dental clinic located on the Algeria Road next to the Oasis Shrine in the city of Bou Saada. It operates daily from 8:30 AM to 6:00 PM, except on Fridays from 2:00 PM until the end of scheduled appointments.

3.5.1 *Clinic components*

The clinic includes:

1. **Reception area:**The front desk area where patients check-in, make appointments.
2. **Treatment room:** Room equipped for dental procedures and examinations (see figure 7). It consists of:
    - Dental chair
    - Compressor
    - Digital radiography system (RVG)
    - X-ray machine 70 KVA
    - Amalgamator
    - Micromotor
    - Teeth whitening lamp

Figure 7: Treatment room

3. **Sterilization room:** A room dedicated to sterilizing dental instruments and equipment to maintain hygiene.And it contains sterilization materials and Autoclave being 23L class B.

4. **Waiting area:** The place where patients wait for their appointments. There are two rooms, one for women and one for men.

5. **Dentist's office:** The workspace where the dentist conducts consultations and plans treatments(see figure 8).

Figure 8: Doctor's office

3.5.2 *Staff team*

Let us now get to know the staff

1. **Doctors:** In this clinic, there are two doctors who rotate working days.
2. **Medical assistants:** There is one physician assistant who receives and schedules patient appointments. They update patient histories, assist the physician in examinations, administer medications, maintain records, handle administrative tasks, and manage sterilization.
3. **Dental Laboratory Technician:**
4. **Cleaner:** The cleaning lady is a weekly worker who cleans and sterilizes the clinic once a week.
5. **Dental Laboratory Technician:** He is the person responsible for crafting dental prosthetics based on the structure and specifications provided by the dentist.

3.5.3 *Services Offered*

The clinic offers a variety of services to address various dental issues. These services include:

- **Preventive Services:** This involves cleanings and routine dental check-ups.
- **Restorative Services:** Dentists repair damaged or decayed teeth using procedures like fillings, crowns, bridges.

- **Cosmetic Dentistry:** Cosmetic services focus on improving the appearance of teeth and smile. This includes teeth whitening, bonding, and gum contouring.
- **Endodontic Treatment:** Dentists perform root canal therapy to treat infected or damaged tooth pulp.
- **Oral Surgery:** This includes procedures like tooth extraction, dental implant placement.
- **Periodontal Treatment:** Dentists treat gum disease and related conditions through procedures like scaling and root planing, gum grafts, and periodontal surgery.
- **Prosthodontics:** Dentists create and fit prosthetic devices like dentures, bridges, and dental implants to replace missing teeth.

3.5.4 *Hygiene and sterilization procedures*

The cleaning and sterilization procedures are carried out by the cleaning lady and the dental assistant. The cleaning lady dusts and cleans the floor once a week. As for the instruments, they are sterilized after each patient, with each patient having their own set of instruments. These instruments are sterilized at the end of each day by the dental assistant using special sterilization materials (figure 9), then wrapped and placed in the autoclave.

Figure 9: Instruments after packaging and sterilization

3.5.5 *How the clinic is managed?*

The clinic is managed manually. To book an appointment, patients can call or visit the clinic. As for patient records, they are kept in paper files, and inventory levels are tracked weekly to ensure that materials are always available for treatments. Additionally, the clinic communicates with patients through phone calls or text messages to follow up on treatments or send important information.

3.5.6 *Problems and Challenges*

Due to manual recording, several difficulties have been encountered, including:

- **Appointment Confusion:** Due to manual scheduling, there can be confusion or double booking of appointments, leading to delays and inconvenience for patients.
- **Patient Records Misplacement:** Paper-based patient records can be misplaced or lost, resulting in difficulty accessing important medical information during treatments.
- **Inventory Shortages:** Manual inventory tracking may lead to shortages of essential dental materials, impacting the ability to perform certain treatments.
- **Limited Accessibility:** Patients may face difficulty in booking appointments outside of clinic hours or accessing their records remotely due to manual systems.
- **Data Security Risks:** Paper records are vulnerable to loss, damage, or unauthorized access, posing risks to patient confidentiality and compliance with privacy regulations.

3.6 CONCLUSION

Finally, private clinics, especially dental clinics, are among the most vital healthcare facilities. We discussed the specific dental fit clinic and the issues it faces, such as appointment overlaps and the risk of losing paper records. This prompted us to propose our program to solve these problems, which we will learn about in the next chapter.

Part III

APPLICATION PART

This part consists of a chapter detailing the design and development of our system, providing a comprehensive overview of our work from concept to final product, along with the tools we used.

4

APPLICATION PART

4.1 INTRODUCTION

In this chapter, we will delve into the foundational concepts of our desktop application, providing a comprehensive overview of its design and functionality. Additionally, we will discuss the general structure of the development environment that facilitated the creation of our website. Finally, to give a clearer understanding of the website, we will showcase a series of basic snapshots that highlight key features and components of the system, offering a visual representation of its interface and capabilities.

4.2 OBJECTIVE

Our goal is to create a program that streamlines and expedites the clinic's operations through:

- Improving administrative efficiency
- Enhancing the quality of healthcare
- Enhancing security and privacy
- Facilitating the tracking of payments and revenues
- Reducing the burden on staff

4.3 GENERAL STRUCTURE OF THE ENVIRONMENT

In this section, we will discuss the environment in which we developed our desktop app, including the programming language used and some of the libraries and packages that were incorporated.

4.3.1 *Programming language*

In the development of the Dental Fit, we used the Python language.

4.3.1.1 *Python*

Python is a high-level programming language characterized by its interpreted, object-oriented nature and dynamic semantics. It boasts built-in data structures at a high level, along with dynamic typing and binding, making it particularly appealing for Rapid Application Development. Additionally, Python serves well as a scripting or glue language for integrating existing components. Its straightforward syntax prioritizes readability, thus lowering the maintenance cost of programs. Python also promotes modularity and code reuse through support for modules and packages. Furthermore, the Python interpreter and comprehensive standard library are freely available in source or binary form for all major platforms, facilitating widespread distribution.

Python's appeal lies in its ability to boost productivity for programmers. Its lack of a compilation step ensures a rapid edit-test-debug cycle. Debugging Python programs is straightforward, with errors typically resulting in exceptions rather than segmentation faults. Python offers a source-level debugger written in Python itself, allowing for variable inspection and expression evaluation. Additionally, the quick edit-test-debug cycle makes adding print statements an effective debugging method.[26]

Figure 10: Python

4.3.2 *Development environment*

We'll explore the Microsoft development environment Visual Studio Code, along with MySQL for data storage, Xampp for local server configuration, and design using Figma.

4.3.2.1 *Visual Studio Code*

Visual Studio Code is a lightweight but powerful source code editor which runs on your desktop and is available for Windows, macOS and Linux. It comes with built-in support for JavaScript, TypeScript and Node.js and has a rich ecosystem of extensions for other languages and runtimes (such as C++, C, Java, Python,PHP, Go, .NET). Begin your journey with VS Code with these.[18]

Figure 11: Visual Studio Code

4.3.2.2 *MySQL*

MySQL is an Oracle-backed open source relational database management system (RDBMS) based on Structured Query Language (SQL). MySQL runs on virtually all platforms, including Linux, UNIX and Windows. Although it can be used in a wide range of applications, MySQL is most often associated with web applications and online publishing.

MySQL is an important component of an open source enterprise stack called LAMP. LAMP is a web development platform that uses Linux as the operating system, Apache as the web server, MySQL as the relational database management system and PHP as the object-oriented scripting language. (Sometimes Perl or Python is used instead of PHP).[19]

Figure 12: MySQL

4.3.2.3 *Xampp*

Is a free and open-source cross-platform web server solution stack package developed by Apache Friends consisting mainly of the Apache HTTP Server, MariaDB database, and interpreters for scripts written in the PHP and Perl programming languages. Since most actual web server deployments use the same components as XAMPP, it makes transitioning from a local test server to a live server possible.[43]

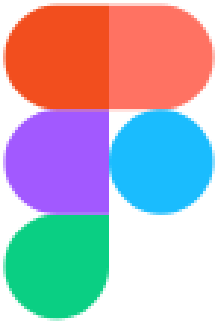
Figure 13: Xampp

4.3.2.4 *Figma*

Figma's mission is to make design accessible to everyone. The site helps people from different backgrounds and roles express their ideas visually and make things together.

- **Figma design:** is for people to create, share, and test designs for websites, mobile apps, and other digital products and experiences. It is a popular tool for designers, product managers, writers and developers and helps anyone involved in the design process contribute, give feedback, and make better decisions, faster.
- **FigJam:** lets you create online whiteboards where anyone can take part. People often use FigJam for meetings, brainstorms, diagrams, planning, and research. In FigJam, you can use text, shapes, drawings, images, sticky notes, and other elements to visually represent ideas and jam on work together.[10]

Figure 14: Figma



4.3.3 *Framework and Library*

During the development process, we utilized various libraries and frameworks, such as:

4.3.3.1 *TKinter*

Is a standard Python GUI (Graphical User Interface) library that provides a set of tools and widgets to create desktop applications with graphical interfaces. Tkinter is included with most Python installations, making it easily accessible for developers who want to build GUI applications without requiring additional installations or libraries.[14]

4.3.3.2 *SQLALchemy*

SQLAlchemy is the Python SQL toolkit and Object Relational Mapper that gives application developers the full power and flexibility of SQL.

It provides a full suite of well known enterprise-level persistence patterns, designed for efficient and high-performing database access, adapted into a simple and Pythonic domain language.[32] The picture shows an example of how to create a table(figure 15)

Figure 15: SQLAlchemy Example

```
class User(Base):
    __tablename__ = 'users'  # Table name

    id = Column(Integer, primary_key=True)
    fullname = Column(String(50))
    age = Column(Integer)
    adress = Column(String(50))
```

4.4 DESIGN

We will now talk about the conceptual side of our work using Unified Modeling Language (UML).

4.4.1 *Use Case Diagram*

A use case diagram is a graphical representation of potential user interactions with the system. The diagram shows various use cases and different types of system users.[45] The design heavily relies on this diagram, through which we will identify the active users and administrators who interact with the system. In our diagram, it is shown that the admin has all the privileges in the program, while the doctor and the worker have limited permissions(see figure 16).

4.4.2 *Class diagram*

In software engineering, a class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects.[41] In our diagram, it appears that the admin has all the powers in the program, while the doctor and the worker have limited powers. We have used a number of categories such as clinic category, doctors category, etc (see figure 17).

Figure 16: Use Case Diagram

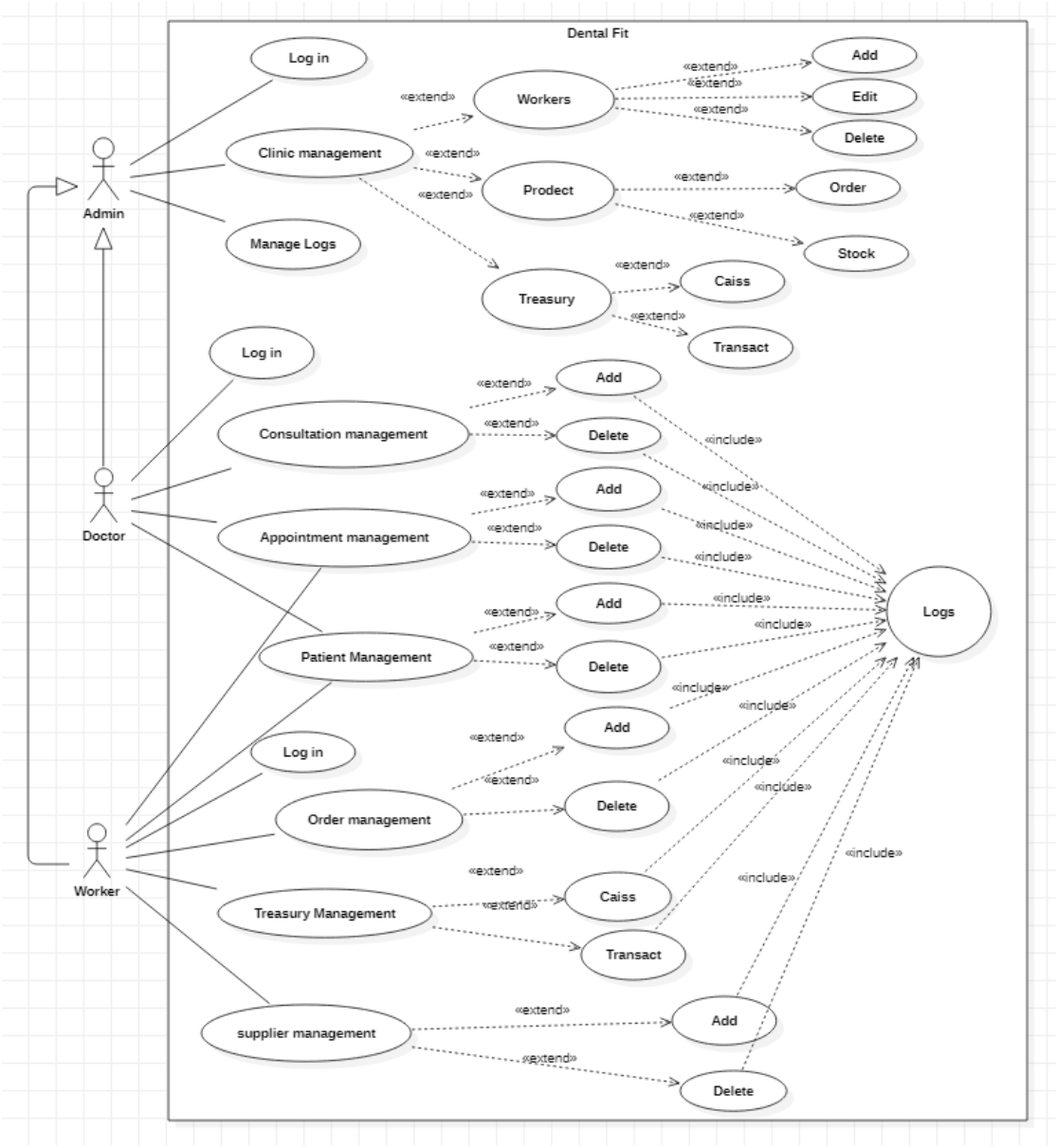
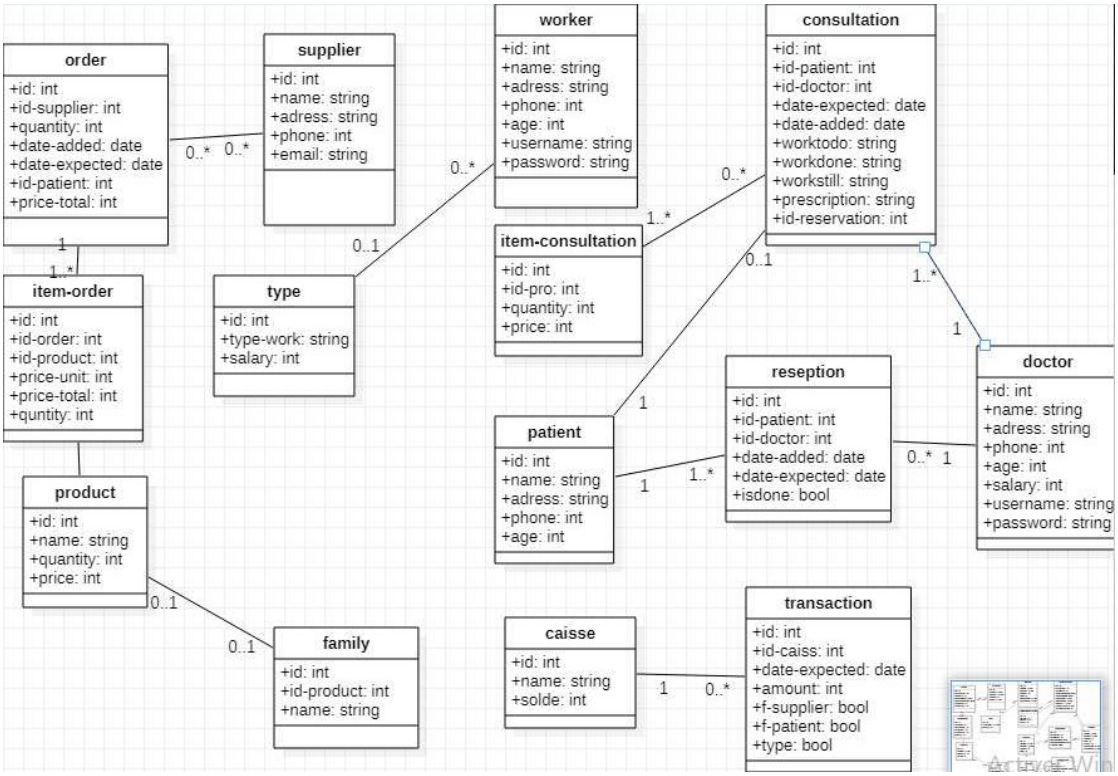


Figure 17: Class Diagram



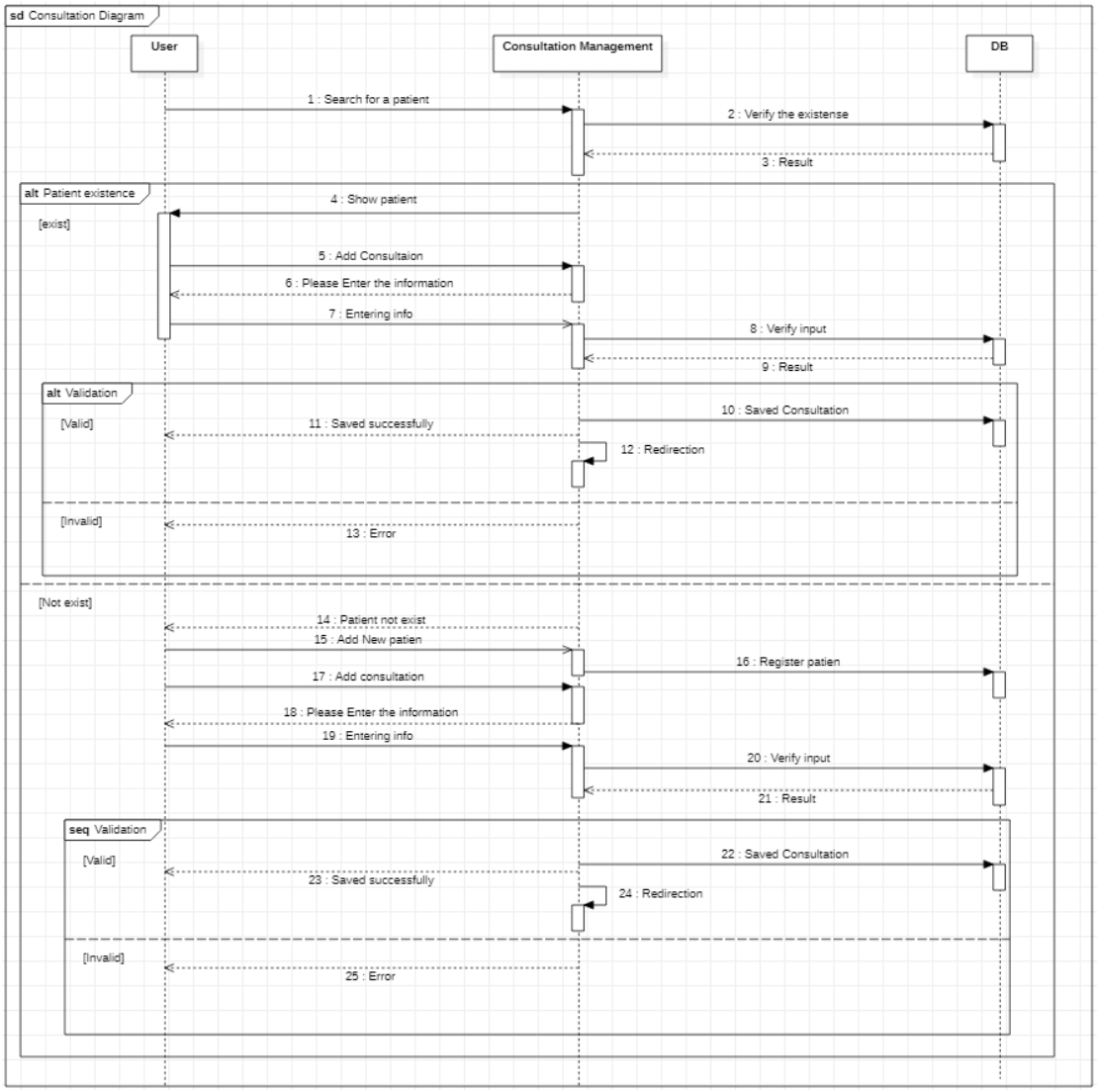
4.4.3 *Sequence Diagram*

UML Sequence Diagrams are interaction diagrams that detail how operations are carried out. They capture the interaction between objects in the context of a collaboration. Sequence Diagrams are time focus and they show the order of the interaction visually by using the vertical axis of the diagram to represent time what messages are sent and when.[39]

4.4.3.1 *Consultation sequence diagram*

This sequence diagram shows the process of adding a consultation for a patient. The user first searches for the patient. If found, they enter and verify the consultation details. If not, they register the patient and then proceed with the consultation details. The user can save the consultation to store it in the system or cancel to discard all data.

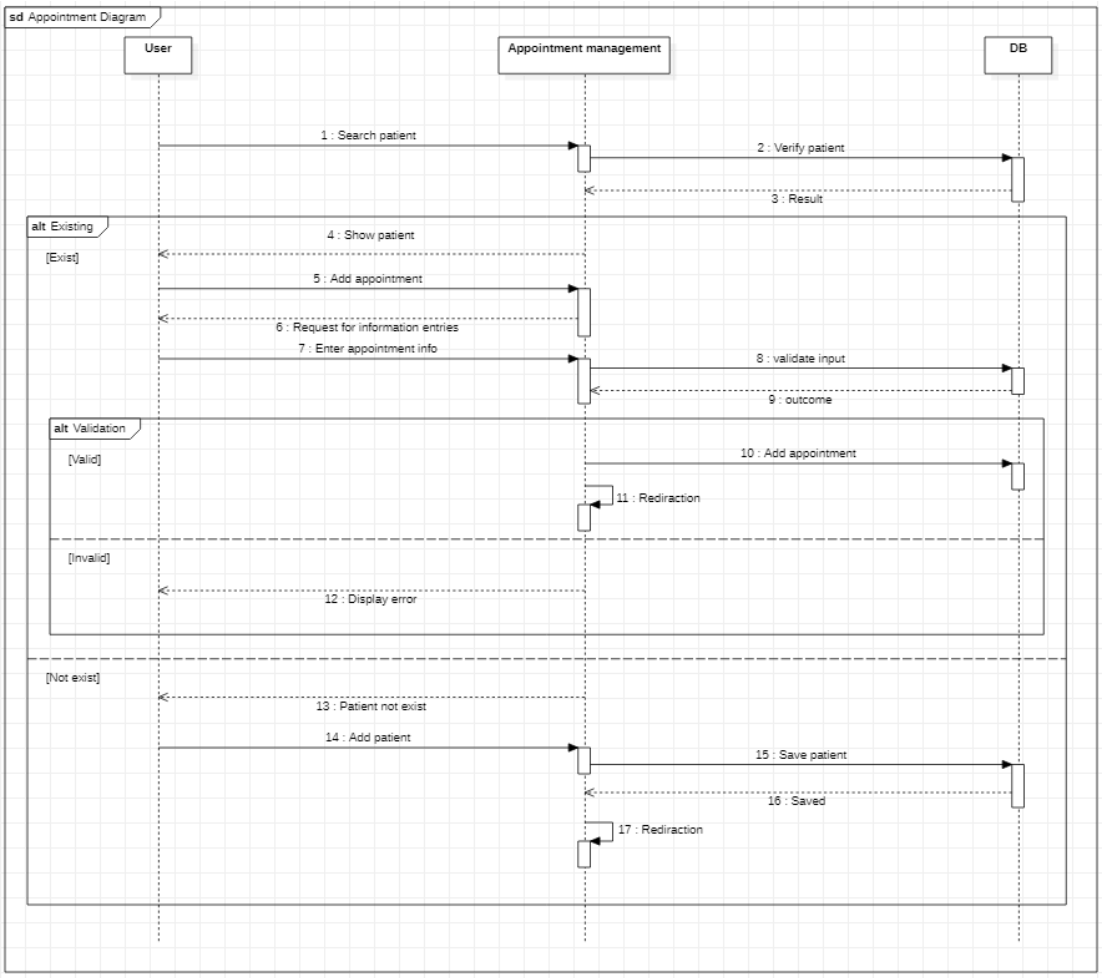
Figure 18: Add consultation sequence diagram



4.4.3.2 *Appointment Sequnce*

After the user logs in and goes to the appointments page, he or she searches for the patient. If the patient is present, the appointment is confirmed. If the patient is new, a new patient is registered and a suitable appointment is scheduled.

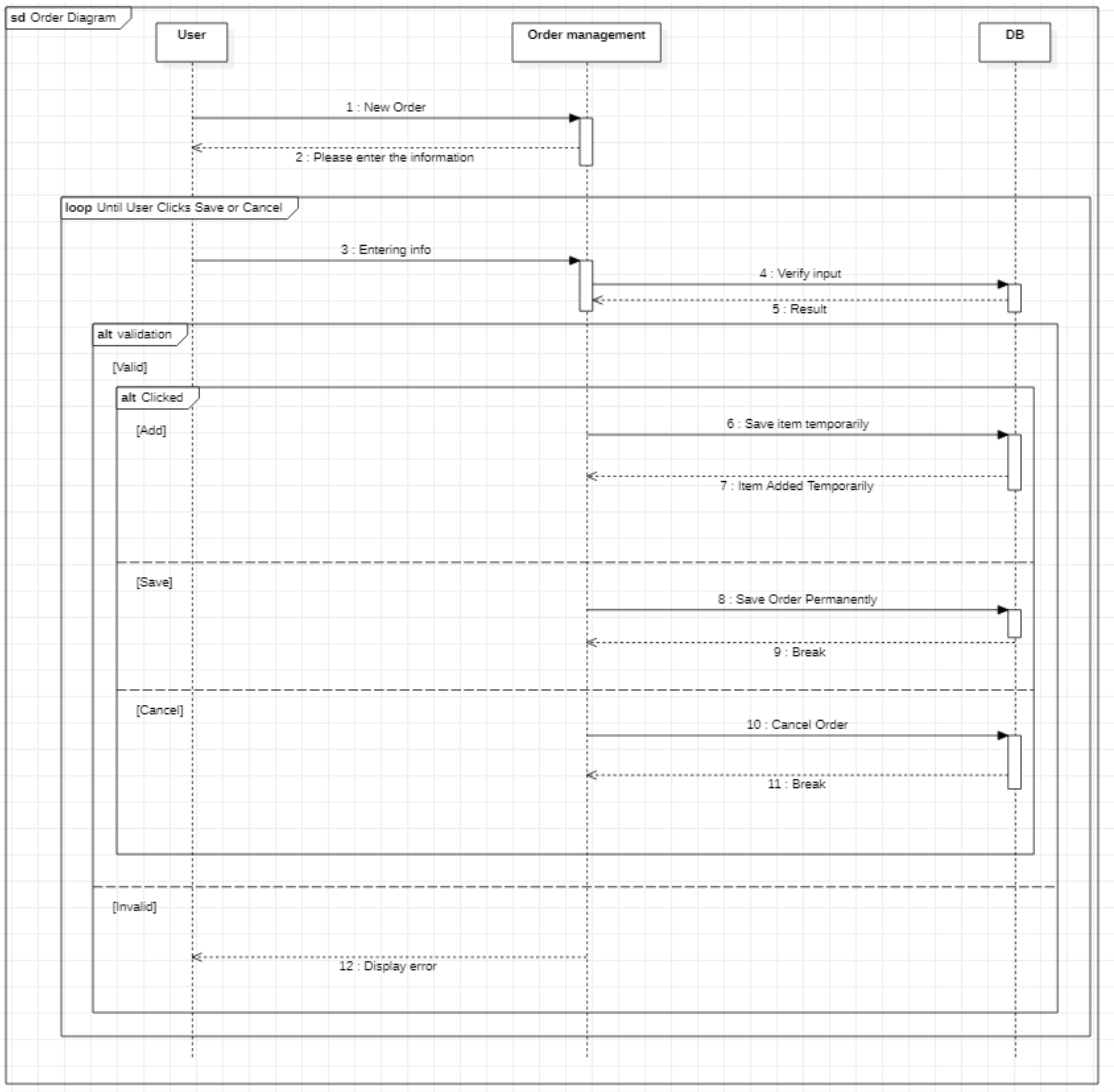
Figure 19: Add appointment sequence diagram



4.4.3.3 *Order Sequence diagram*

Here is a sequence diagram for adding an order so that the user clicks on New and then enters the required information and finally saves or cancels the order.

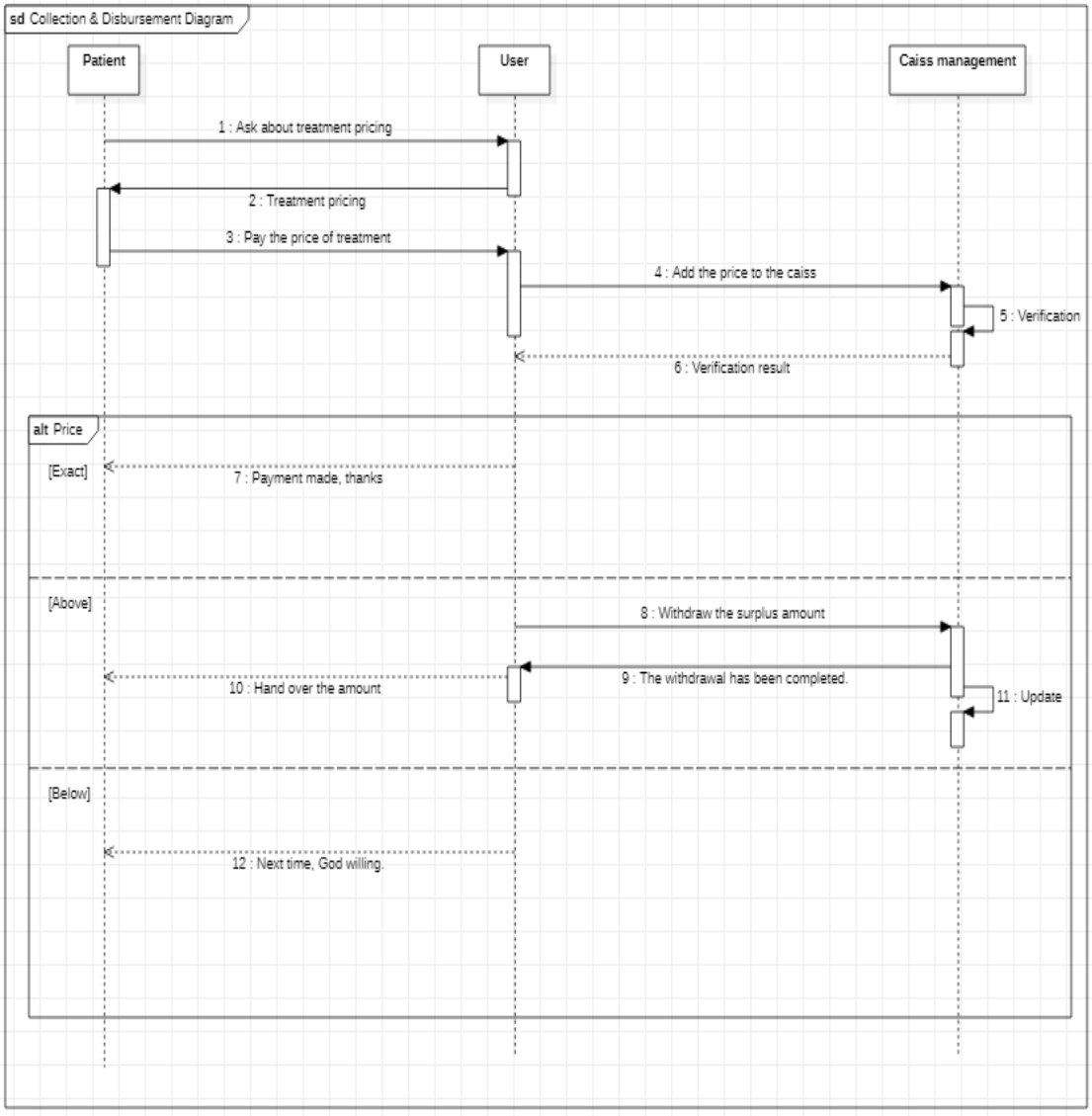
Figure 20: Order sequence diagram



4.4.3.4 *Collection and disbursement sequence diagram*

Below is a diagram of the process of paying consultation fees, so that the patient pays, while the user verifies the amount, and depending on the payment status, the transaction is done.

Figure 21: Collection & Disbursement sequence diagram



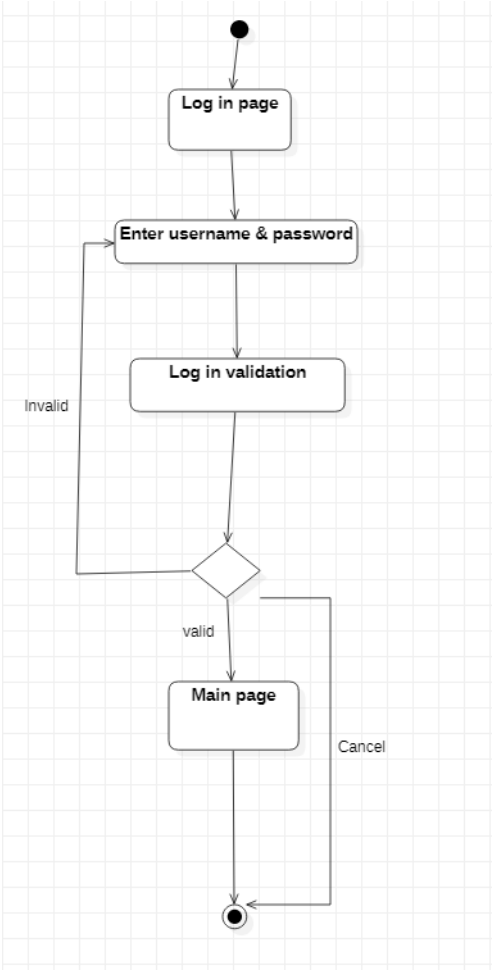
4.4.4 *Activity diagram*

Activity diagram is another important behavioral diagram in UML diagram to describe dynamic aspects of the system. Activity diagram is essentially an advanced version of flow chart that modeling the flow from one activity to another activity.[38] and we will see the following activity diagrams:

4.4.4.1 *Login Activity*

Activity diagram for login user

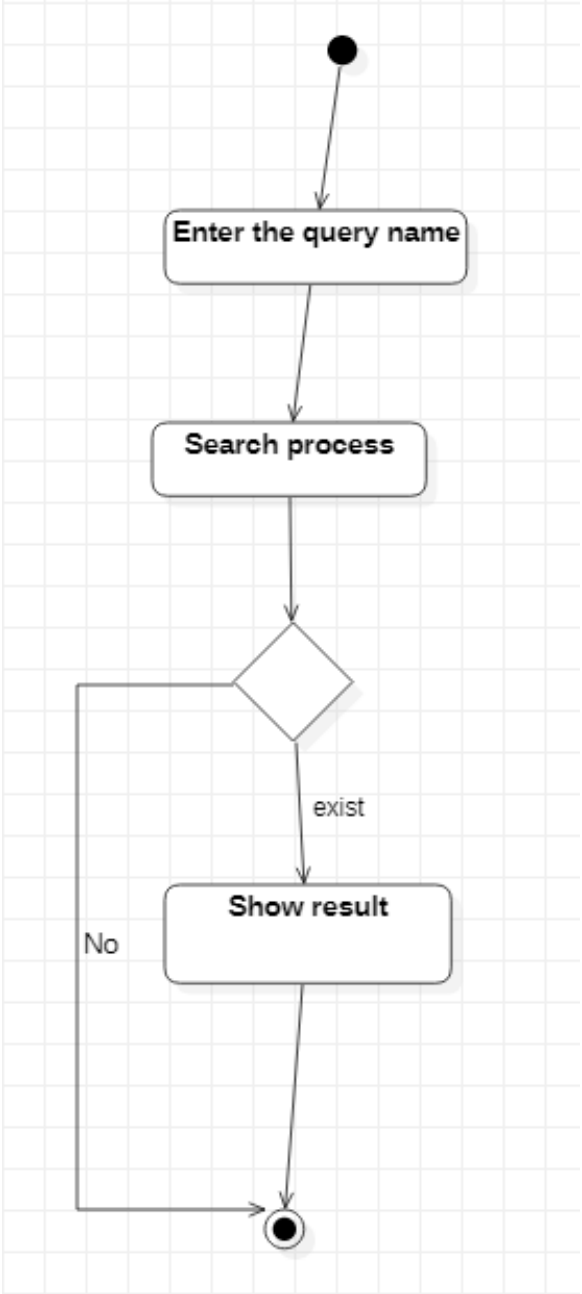
Figure 22: Log in activity diagram



4.4.4.2 *Search Activity*

Activity diagram to search for a task to obtain input information, whether it is a patient, worker, product.. etc

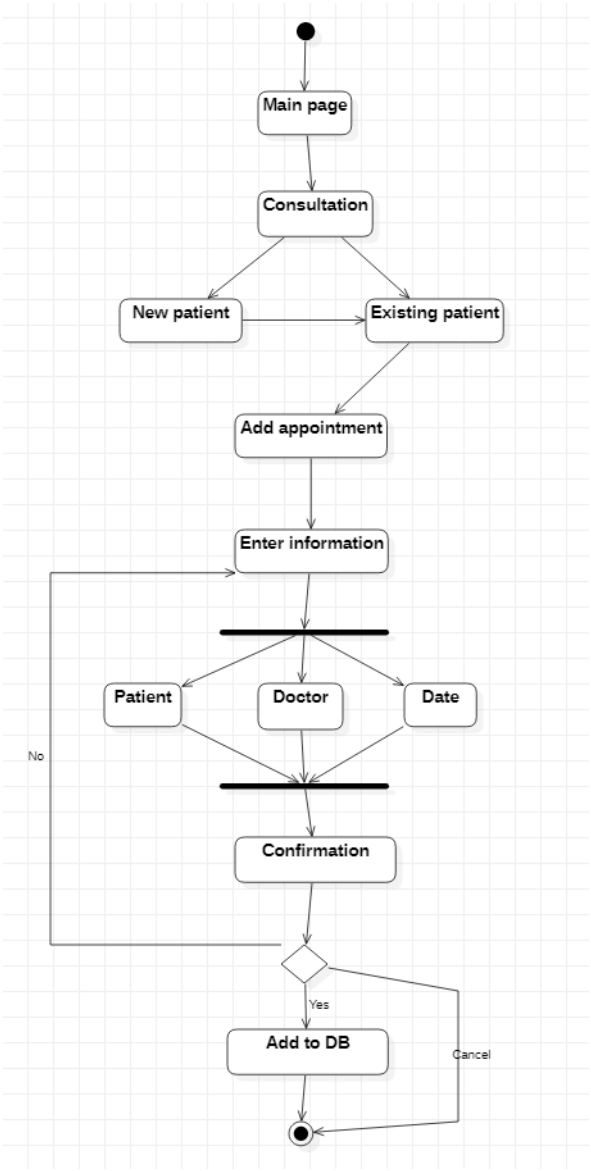
Figure 23: Search activity diagram



4.4.4.3 *Add Appointment activity diagram*

In this activity, we add an appointment. If the patient is registered with the clinic, he is chosen from the list. If he is new, we first register the patient and then record an appointment for him.

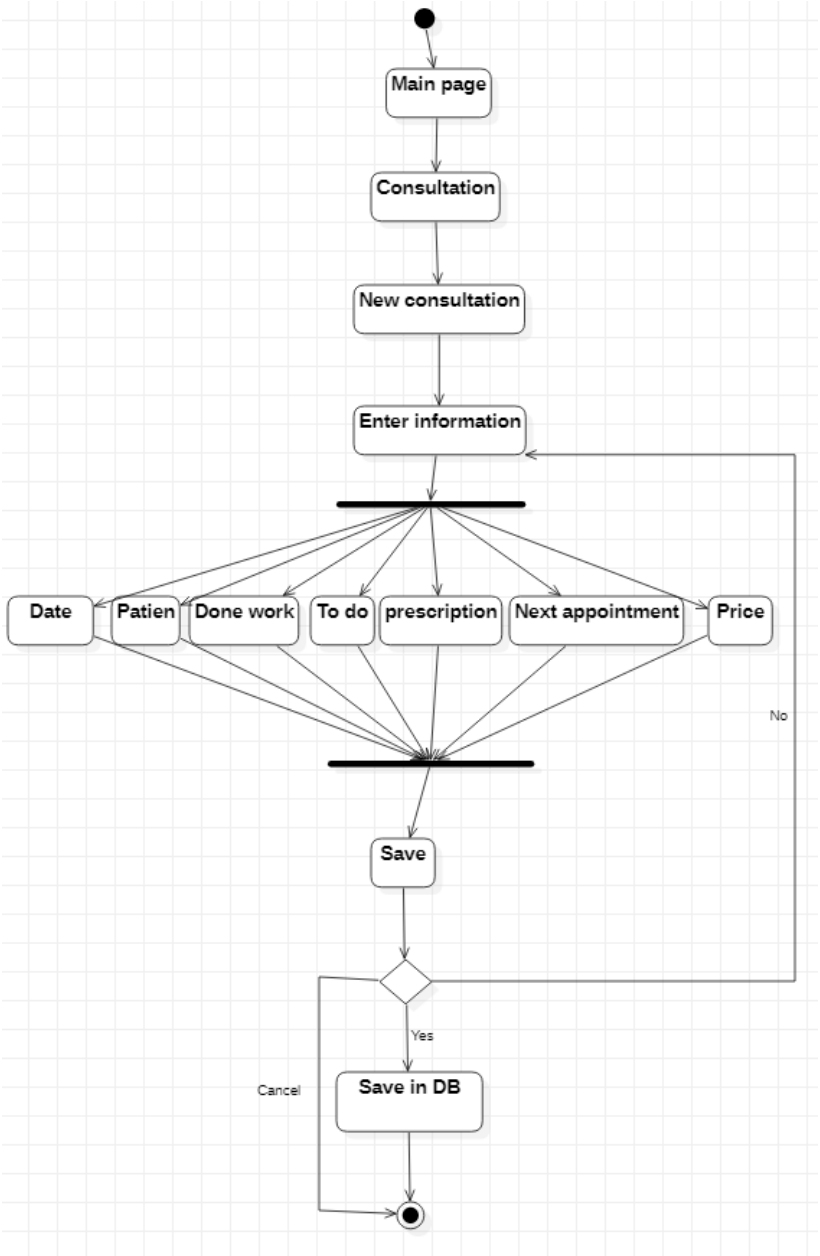
Figure 24: Appointment activity diagram



4.4.4.4 *Consultation Activity Diagram*

The consultation activity is almost the same with the appointment activity only differing in the information entered.

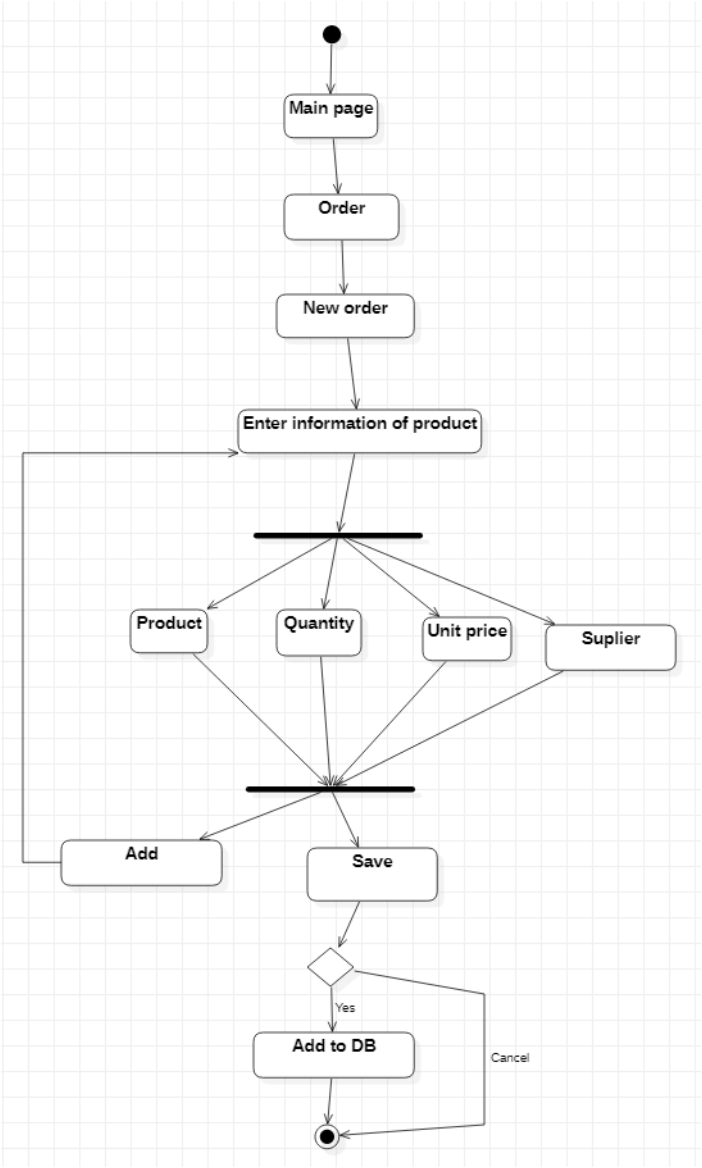
Figure 25: Consultation activity diagram



4.4.4.5 *Order Activity*

In the ordering activity, we go to the order page and then we place a new order by entering the information about the product or products to be ordered, such as the product name, quantity, and unit price. The order can be saved in the database, modified, or even cancelled.

Figure 26: Order activity diagram



4.5 IMPLEMENTATION

In this section, we will display snapshots of the primary sections of our desktop app.

Figure 27: Reservation or Appointment page

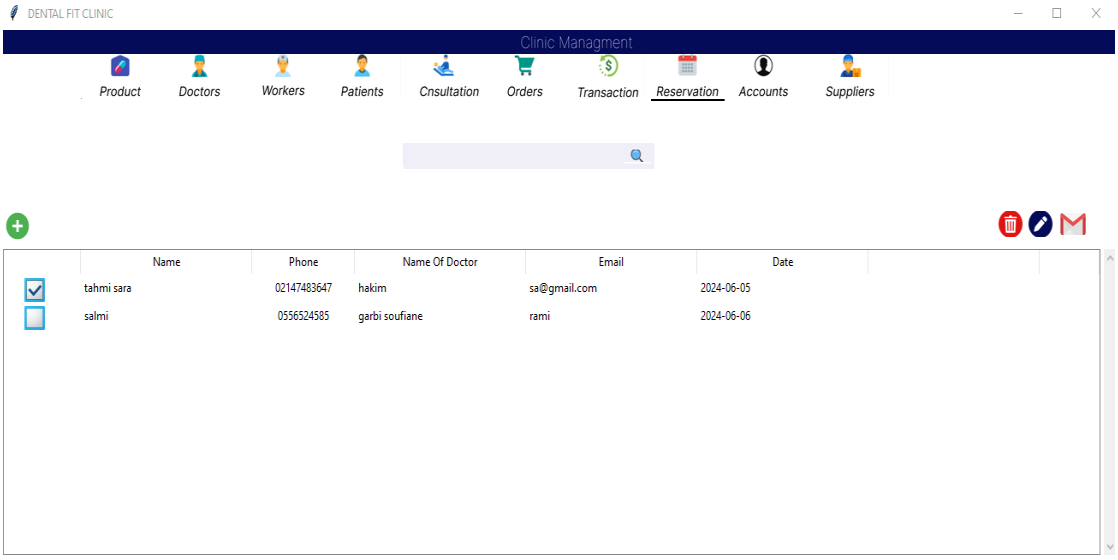


Figure 28: Patient page

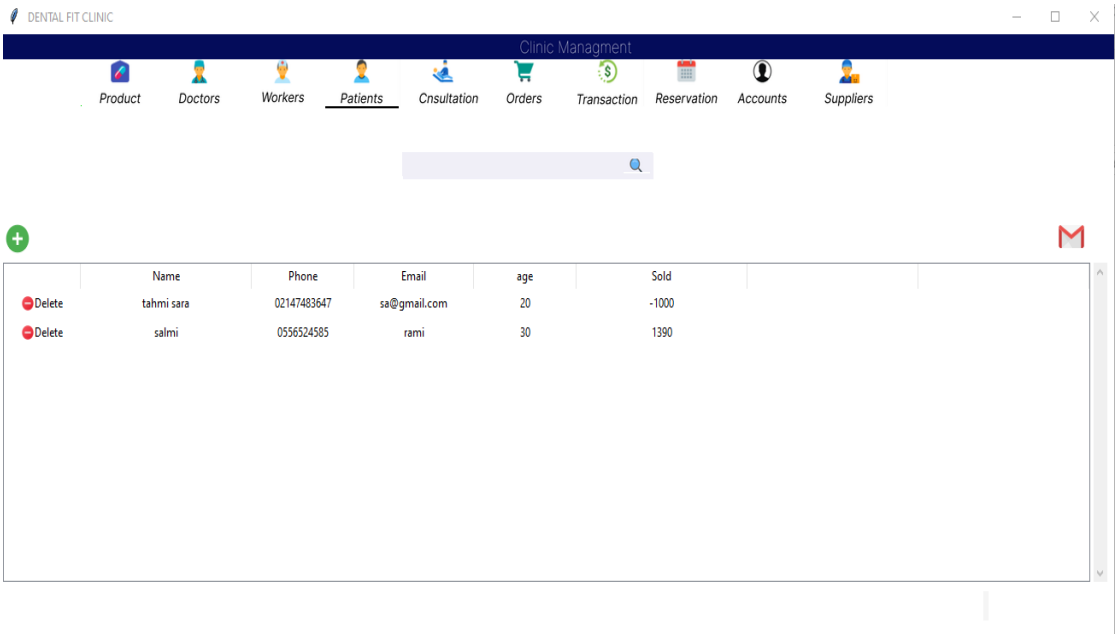


Figure 29: Order page

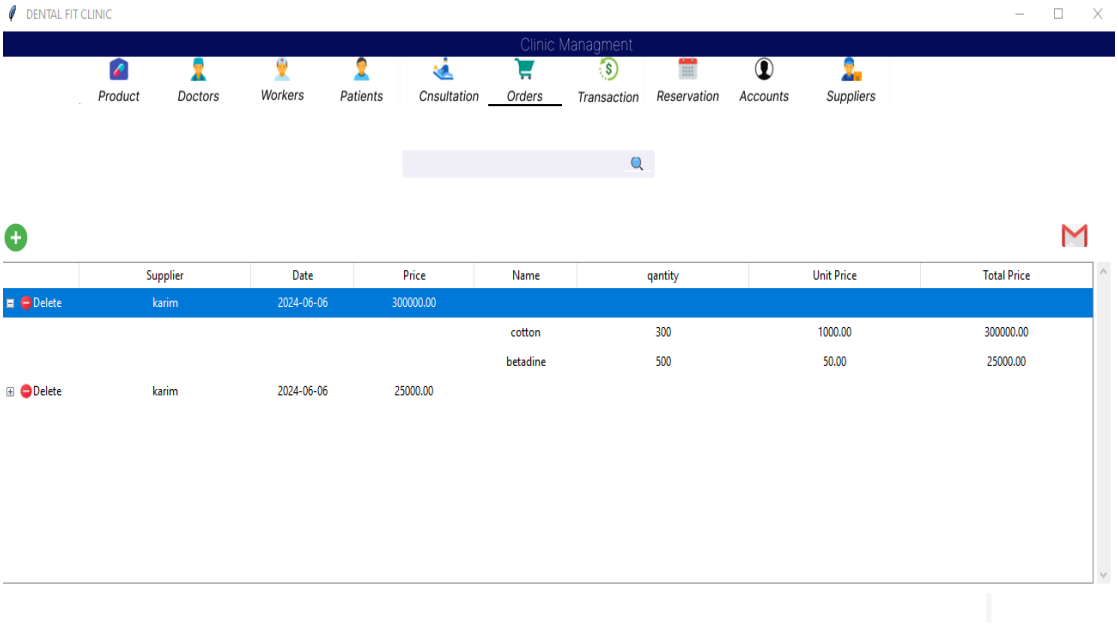


Figure 30: Add order page

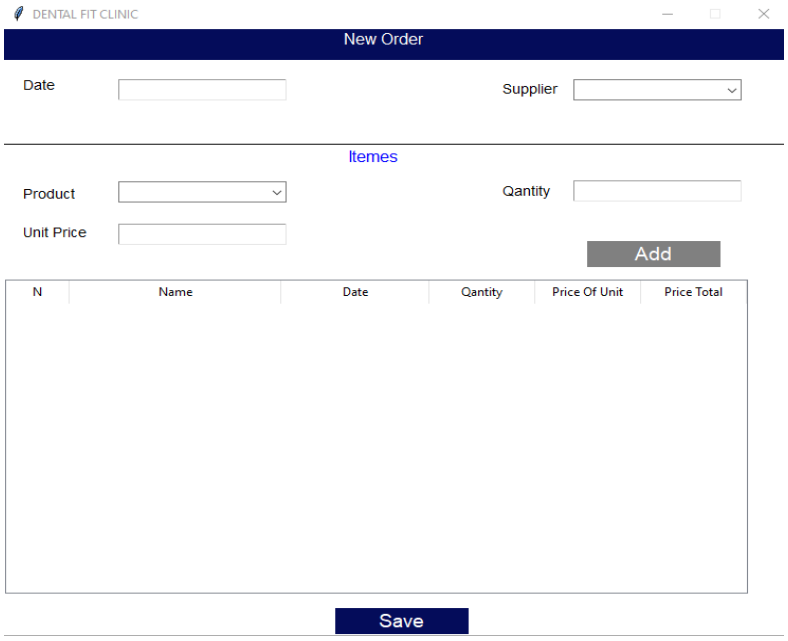
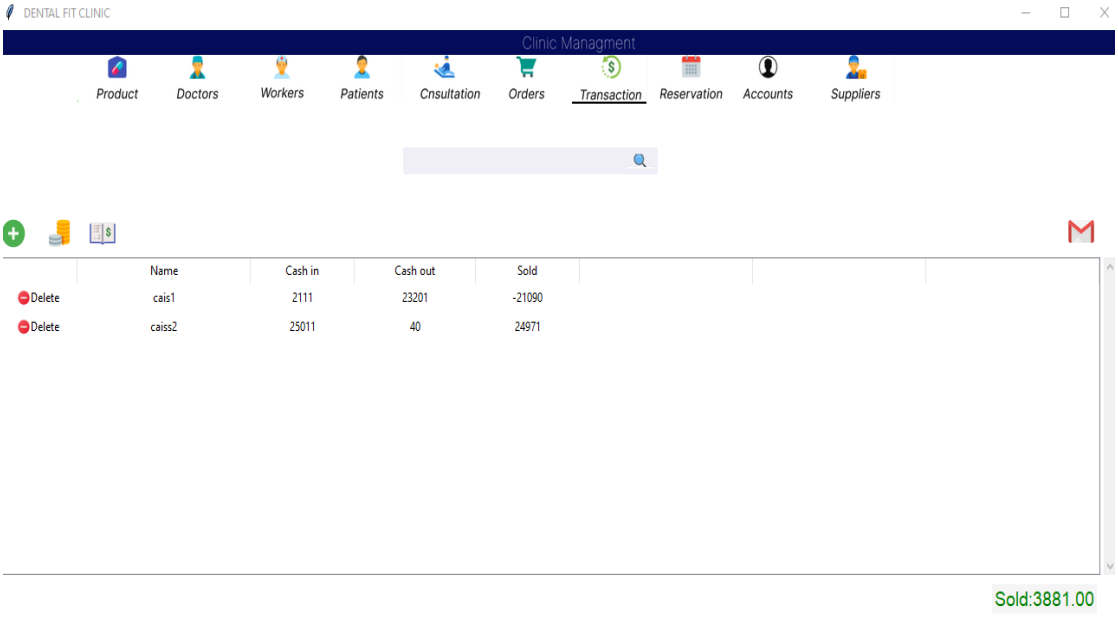


Figure 31: Transaction page



4.6 CONCLUSION

In this part, we explained the application of dental alignment through diagrams and snapshots, and God willing, it will play an important and essential role in providing high-quality health care in the future.

Part IV

GENERAL CONCLUSION

The final section covers the general conclusion and future work.

5

GENERAL CONCLUSION

In this thesis, we developed a desktop application aimed at managing a private dental and oral surgery clinic. This application is designed to facilitate and enhance healthcare services in the clinic through numerous features it offers, such as easy clinic management and data access. We encountered some obstacles after developing the design on Figma, but fortunately, we overcame them by finding alternatives.

We tried several models of our system, and we ended up choosing the most appropriate and efficient one. We also designed the application in a way that we ensured the simplicity of the user interfaces so that users could use our application easily.

Our project is not yet final, and we are still working on completing it and adding more features and enhancements. These include an appointment reminder system for patients via text messages, the ability to analyze data to improve medical performance, and support for a multilingual interface to facilitate use. We strive to achieve the highest possible performance improvements, and this is one of the areas we will focus on in the future.

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