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Design and Development of a Web Application for Telehealth Services

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Dedicate

To my grandmother, Fatma Mekideche "May ﷻ grant her a place in the highest level of jannah."

To my parents, Mohamed and Noura.

To my second parents, Sidi Omar and Amti Aldjia.

To my cousin Brahim and his wife Lila.

To my cousin Souhila and her husband Rachid.

To my dear cousins, Tata Lila and Faiza, Nawel and Dalila

To my brothers, Oussama and Kamel, and my sister Ikram.

To my friends Lila, Samia.

To all those who helped and supported me.

I dedicate this thesis...

Asma Benatmane

Abstract

The objective of this study is to develop and offer a web application as a service to different customers. The application was designed to be used by patients and medical analysis laboratories. The study has succeeded in producing an application that will offer each customer the possibility of communicating with the medical analysis centres by searching for the appropriate and nearest laboratory that has the required analyses. It is also possible to ask for mobile nurses to take blood samples at home and transport the samples to the laboratory in complete safety. In addition, medical analysis results can be obtained directly through the application without having to travel to the laboratory, which is very beneficial for patients and medical analysis laboratories and helps to improve and facilitate the services of health care. The application provides complete protection for user data.

Keywords: Web Application, Telehealth, ICT, Telemedicine, Telecare.

ملخص

الهدف من هذه الدراسه هو تطوير و تقديم تطبيق ويب كخدمه لفئة مختلفة من العملاء. تم تصميم التطبيق ليتم استعماله من قبل المرضى و مخابر التحاليل الطبيه. تمكنت الدراسه من إنتاج التطبيق الذي من شأنه ان يكون مساحه لكل عميل من أجل التواصل مع مراكز التحاليل الطبيه من خلال البحث عن المخبر المناسب و الأقرب و الذي يتوفر على التحاليل المطلوبه يمكن أيضا طلب ممرضين متنقلين لاجراء سحب دم في المنزل و نقل العينه إلى المختبر بكل أمان كما يمكن استلام نتائج التحاليل الطبيه مباشره عبر التطبيق دون عناء التنقل للمختبر الأمر الذي يعود بفائده كبيره على المرضى و المخابر الطبيه بحد سواء و يساعد على تحسين و تسهيل خدمات الرعاية الصحية. يوفر التطبيق الأمان التام للبيانات المنقولة بين العملاء و هذا توافقا لخصوصية المجالات الصحية.

الكلمات المفتاحية: Web Application, Telehealth, ICT, Telemedicine, Telecare

Résumé

L'objectif de cette étude est de développer et de proposer une application web en tant que service pour différent clients. L'application a été conçue pour être utilisée par les patients et les laboratoires d'analyses médicales. L'étude a réussi à produire l'application qui offrira à chaque client la possibilité de communiquer avec les centres d'analyse médicale en recherchant le laboratoire approprié et le plus proche qui dispose des analyses requises. Il est également possible de demander des infirmiers mobiles pour effectuer des prélèvements de sang à domicile et de transporter les échantillons au laboratoire. De plus, les résultats des analyses médicales peuvent être obtenus directement via l'application, ce qui est très avantageux pour les patients et les laboratoires, et aide à améliorer les services de soins de santé. L'application offre une protection complète des données de l'utilisateur.

Mots-clés : Web Application, Telehealth, ICT, Télémédecine, Telecare.

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Chapter 3: Anlysis and design

Abbreviation

- **AI**: **A**rtificial **I**ntelligence
- **CDNs: C**ontent **D**istribution **N**etworks
- **COVID-19: C**oronavirus **D**isease 2019
- **CRM: C**ustomer **R**elationship **M**anagement
- **CSS: C**ascading **S**tyle **S**heets
- **DNS: D**omain **N**ame **S**ystem
- **EHRs: E**lectronic **H**ealth **R**ecords
- **FTP: F**ile **T**ransfer **P**rotocol
- **GUI: G**raphical **U**ser **I**nterface
- **HCP: H**ealth**C**are **P**ersonnel
- **HTML: H**ypertext **M**arkup **L**anguage
- **HTTP: H**ypertext **T**ransfer **P**rotocol
- **HTTPS: S**ecure **H**ypertext **T**ransfer Protocol
- **ICT: I**nformation and **C**ommunication **T**echnologies
- **IDE: I**ntegrated **D**evelopment **E**nvironment
- **IoMT: I**nternet of **M**edical **T**hings
- **IP: I**nternet **P**rotocol
- **ML: M**achine **L**earning
- **MySQL: M**ichael Widenius **S**tructured **Q**uery **L**anguage
- **PHP: H**ypertext **P**reprocessor
- **RDBMS: R**elational **D**atabase **M**anagement **S**ystem
- **SLPs: S**peech-**L**anguage **P**athologists
- **SMTP**: **S**imple **M**ail **T**ransfer **P**rotocol
- **TCP: T**ransmission **C**ontrol **P**rotocol
- **UI: U**ser **I**nterface
- **UML: U**nified **M**odeling **L**anguage
- **URL: U**niform **R**esource **L**ocator
- **URLs: U**niform **R**esource **L**ocators
- **UX: U**ser e**X**perience
- **VR: V**irtual **R**eality
- **WWW: W**orld **W**ide **W**eb
- **XAMPP:** Cross-Platform (**X**) **A**pache **M**ySQL **P**HP and **P**erl

General Introduction

Nowadays, new technologies have revolutionized the field of health by offering innovative solutions to improve health care services. In this context, web applications have become an essential tool to improve communication between patients and healthcare professionals.

The mobility of people with chronic illnesses or specific medical needs is often a major obstacle to obtaining healthcare services. Furthermore, the COVID-19 pandemic has amplified this problem by limiting travel and making access to healthcare centres more difficult for some patients. In this context, it is essential to implement innovative solutions to facilitate access to healthcare, particularly for medical analyses.

How to design and develop an efficient web application to facilitate communication between patients and medical analysis laboratories by allowing the laboratories to send nurses to patient's homes to perform sample collections and transmit analysis results via the application?

The main objective of this project is to facilitate access to healthcare services for patients by providing a convenient solution for conducting medical analyses at home. On the other hand, this application will also enable medical laboratories to streamline their workflow by eliminating delays in transmitting analysis results to patients.

This thesis is composed of four chapters. The first chapter provides a **« General information on telehealth »**, focusing specifically on telemedicine and telecare. It examines each type of field of practice, the technologies and modes of transmission used in telehealth, and discusses their respective benefits. Finally, it explores the current state of telehealth around the world, with a specific focus on Algeria.

The second chapter is dedicated to the **« Web Technology »** starting with its fundamental building blocks and the underlying of web site and web application, we conclude with the technologies that power the web.

The third chapter will focus on **« The Analysis and design »** of the web application using UML diagrams.

The fourth chapter is dedicated to the phase of **« Implementation and Realization »** it deals with the tools and programming languages used.

Chapter 1:
General information on Telehealth

1.1. Introduction

The world is witnessing great development in digital information and communication technology (ICT), which has led to the finding of many solutions in several fields, including the health field. The exploitation of (ICT) in medicine has facilitated the process of communication between the healthcare provider and their patients, where patients can perform medical services and consultations remotely. This combination of health and technology has led to the creation of a new space called “Telehealth”.

This chapter provides a detailed presentation of telehealth and its types. It will focus on each type of field of practice, the technologies, modes of transmission, and communication used in, discuss their benefits, and finally talk about telehealth in the world and in Algeria.

1.2. Definition of telehealth

Telehealth is a remote service using digital information and communication technology (ICT) to connect health professionals and their patients. This technology can include computers, smartphones, and tablets to transfer medical information for consultation, therapy, and education using telecommunication networks (Figure 1.1).

The medical information may include messages, images, live video and audio, video and sound files, patient medical records, and output data from medical devices.

Technologies, tools, and services of telehealth are becoming an important part of the healthcare system.

Telehealth is a method of supporting people with mobility impairments and those living in remote areas and it is useful to make communication with doctors and hospitals easier, especially in an emergency.

Figure 1. 1: Telehealth [1]

1.3. Telehealth transmission and communication mode

In telehealth, there are multiple ways patients and doctors can use to transfer and receive information. The mode of communication and transmission used should be selected on the objective of the interaction.

In general, the type of intervention depends on the mode and the time of communication between health professionals and their patients.

1.3.1. Telehealth transmission mode

There are three major types of telehealth transmission: [1]

1.3.1.1. Synchronous

In synchronous transmission, the healthcare provider and patients are interacting with each other quickly and in real-time.

This can occur through video conferencing or phone calls, where both parties are present and engaged in the conversation at the same time.

Asynchronous transmission is commonly used consultations, follow-up appointments, and urgent care situation.

1.3.1.2. Asynchronous

The asynchronous transmission mod is also called the "store and forward", in this mode of transmission, there is no real-time interaction between healthcare providers and patients, they don’t need to be present at the same time to communicate. The users of telehealth can react or respond in their time frame.

Asynchronous transmission is commonly used for sending and receiving medical records, test results and other information that can be reviewed and responded to later time.

1.3.1.3. Remote monitoring

It is a technique that allows healthcare providers to monitor patients' health at home in a nursing home or a hospital remotely. Remote monitoring uses various technologies to collect patient health data. This data is electronically transmitted to the healthcare providers, who can monitor it and make a decision about patient care as needed.

1.3.2. Telehealth communication mode

The choice of telehealth communication mode may depend on the patient's needs, the nature of the appointment, and the healthcare provider's preferences and capabilities.

1.3.2.1. Text-based

Text messages allow for a simple, convenient, and quick consultation. The Contact between the telehealth provider and patients can be direct and in real-time when both parties are present in the conversation at the same time. In addition, each participant can reply to messages as soon as they become available. Text-based platforms also allow for better transmission of documents such as laboratory reports and historical medical records.

1.3.2.2. Audio

Audio calls are considered one of the best ways for remote medical consultation in real time. Through verbal interaction, the healthcare provider can acquire medical information quickly and efficiently. Audio consultation is not suitable for conditions that require visual inspection.

1.3.2.3. Video

Video communication is the best technology for remote consultation. Healthcare providers can see and speak directly to patients in real time. Video consultation allows for more accurate and effective diagnosis.

1.4. Types of telehealth

Telehealth is made up of two areas of activity (Figure 1.2):

- Telemedicine for activities performed remotely by medical professionals (doctors, midwives, dentists).
- Telecare for activities performed remotely by paramedical or pharmacists.

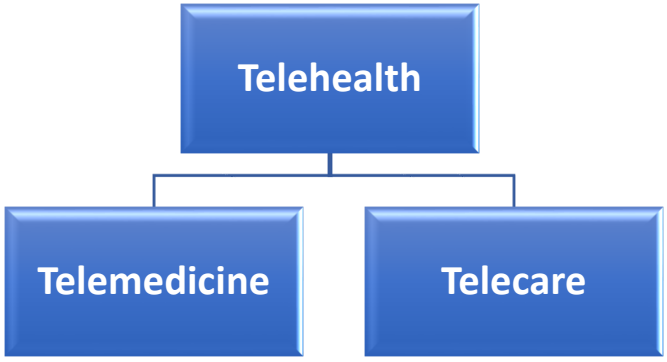

Figure 1. 2: Types of Telehealth

1.4.1. Telemedicine

1.4.1.1. Definition

"*The word telemedicine signifies medicine delivered at a distance"* [2]

This definition means that doctors and patients can communicate remotely in cases of obstacles such as distance, difficulty in mobility, or other issues.

This communication uses information and telecommunication technology to exchange information between, doctors, and patients for medical consultation, testing, or regular patient follow-up.

1.4.1.2. Technology used in telemedicine

Telemedicine uses a variety of technologies to facilitate remote medical consultations, examinations, and treatments. Some of the technologies commonly used in telemedicine include:

- **Video conferencing:** video conferencing allows healthcare providers and patients to communicate in real-time, using audio and video.
- **Remote patient monitoring devices**: remote patient monitoring devices are used to monitor patient vital signs and other health parameters, such as blood pressure, heart rate, and blood glucose levels.
- **Electronic health records (EHRs):** electronic health records enable healthcare providers to access patient health information remotely, allowing for more efficient and effective care.
- **Mobile and web health apps**: can use mobile and web health apps to track their health, monitor symptoms, and communicate with healthcare providers.
- **Secure messaging platforms**: secure messaging platforms enable healthcare providers and patients to communicate securely and efficiently, allowing for quick and effective consultations.

In addition to the technologies mentioned above, there is another type of advanced technology that helps in the rapid development of the field of telemedicine (Figure 1.3).

- **Artificial Intelligence and Machine Learning:** Analyze clinical data from patient records and make care recommendations using artificial intelligence (AI) and machine learning (ML).

- **Internet of Medical Things:** Monitor and store patient health signs using the Internet of Medical Things (IoMT).

- **Biosensors:** are used to detect properties of blood, tissue, and other parts of the body.
- **Big Data Analytics**: Use of Big Data Analytics for remote patient monitoring.
- **Chatbots:** are computer programs designed to simulate conversation with human users, often through a messaging interface**.** Use telemedicine chatbots to interact with patients as needed.
- **Virtual Reality**: Use virtual reality (VR) to improve communication interfaces.

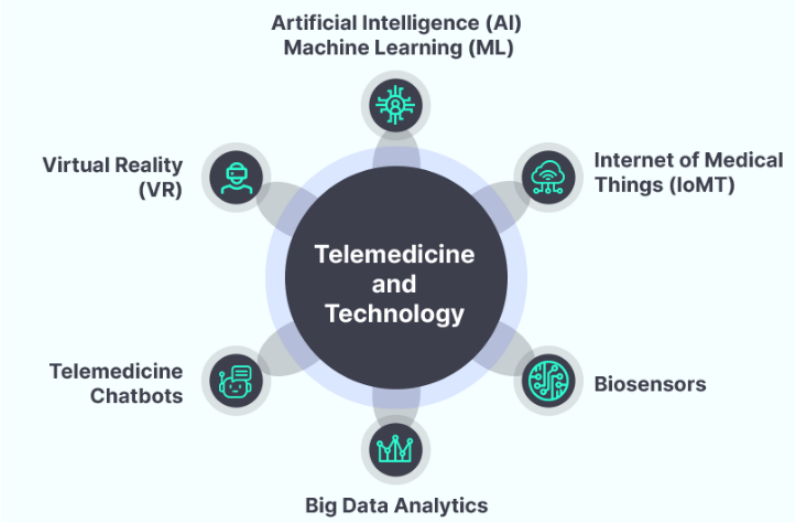

Figure 1. 3: Technology used in telemedicine [2]

1.4.1.3. Types of Telemedicine Practices

The types of telemedicine practices have changed as the technology has developed. Currently, we can identify six different types (Figure 1.4):

- **Teleconsultation:** allows a medical professional to give a consultation remotely using information and communication technology (ICT) such as video conferencing, which gives the possibility to the patients to consult their doctors in their own homes. The doctors can also assess a patient's health status and determine the next actions.
- **Tele-expertise:** enables medical professionals to seek the advice of one or more other colleagues remotely via digital technology to improve the quality of care. [3]
  The question asked and the answer given could be in real-time or in a time frame.
- **Telemonitoring:** is a type of remote patient care that uses telecommunication technology to remotely monitor and track a patient's health status. Telemonitoring allows telemedicine providers to interpret data collected from a patient's home using a variety of devices such as wearable sensors, mobile apps, and others.

- **Tele-assistace:** enables healthcare personnel (HCPs) to remotely assist their colleagues in action to carry out a medical, imaging, or chirurgical procedure. In the case of an emergency tele-assistance can provide assistance remotely to first responders or others who provide assistance to people in danger while awaiting the arrival of the doctor.

- **Telesurgery:** it is practiced in two ways. Teleassistance, as we have seen, surgeons performing a surgical procedure remotely. In general, assistance is offered via video conferencing that can be extended elsewhere in the building or via telecommunication to another country. [4]

  The other approach is telepresence surgery that allows a surgeon to operate on a patient who is located in a different physical location [4]. This is made possible by using advanced technologies such as high-speed internet connections, robotic systems, and real-time video and audio communication.

- **Tele-education:** Also known as, educational telemedicine refers to the (ICT) for distance medical education. This form of distance learning allows students and healthcare professionals to access online educational sources, such as online courses, lectures, tutorials, videos, and webinars, from anywhere in the world.

  Tele-education can be used to train and provide continuing education to medical students, residents, and the (HCPs) helping them to keep their skills up to date and familiarize themselves with the latest medical technologies and advancements.

Figure 1. 4 : Types of Telemedicine Practices [3]

1.4.2. Telecare

1.4.2.1. Definition

Telecare is for healthcare professionals and pharmacists whose mission is to enable patients to access healthcare from home.

Telecare can be arranged for patients who require speech therapy or psychological sessions. Once the face-to-face assessment has been completed, a speech therapist or psychologist schedules follow-up care in several remote sessions.

Physiotherapists can also organize remote rehabilitation sessions to avoid movements that are too complex for the patient.

With the help of telecare, nurses can also offer remote therapeutic training sessions for the chronically ill.[4]

1.4.2.2. Types of Telecare Practices

- **Tele-pharmacy:** refers to the use of telecommunications technology to provide pharmaceutical care from a remote location to patients in another location. This technology enables pharmacists to remotely review and dispense medication orders, communicate with patients, and provide drug information and counselling. The use of tele-pharmacy can improve patient outcomes by increasing access to medication and reducing medication errors. It can also reduce costs by allowing pharmacists to serve multiple sites from a central location and by reducing the need for on-site staffing.[4]
- **Tele-psychiatry:** it is one of telecare practices refers to the use of information and communication technology to provide mental health care and psychiatric services remotely. This technology enables psychiatrists and mental health professionals to communicate with patients, conduct assessments, provide therapy, and prescribe medication from a remote location. The use of tele-psychiatry can improve patient outcomes by increasing access to mental health care, reducing the stigma associated with seeking mental health treatment, and improving patient engagement and adherence to treatment plans.
- **Telepsychology:** refers to the use of technology to provide psychological services remotely, such as through video conferencing or messaging platforms. This form of mental health care allows psychologists and mental health professionals to deliver therapy, conduct assessments, and provide counselling from a remote location. Telepsychology has become increasingly popular in recent years, particularly in areas with limited access to mental health care or in a situation where traditional in-person therapy may not be possible, such as during a pandemic.

- **Tele-speech therapy:** (also known as telepractice or teletherapy) refers to the delivery of speech therapy services using technology, such as video conferencing or other virtual platforms. This form of therapy allows speech-language pathologists (SLPs) to provide evaluation, diagnosis, and treatment services to clients remotely, without the need for in-person sessions. Tele speech therapy can be used to treat a wide range of speech and language disorders, including stuttering, articulation disorders, language delays, and voice disorders. It has been found to be as effective as in-person therapy in many cases, and may even offer some advantages, such as increased convenience and greater access to specialized expertise.[4]

1.5. Advantage of telehealth

Telehealth has several benefits for both patients and health professionals

1.5.1. Benefits for patients

- **Improving access to health services:** Telehealth can improve access to healthcare services for patients who live in remote or rural areas or who have mobility or transportation problems
- **Comfortable:** Telehealth allows patients to receive medical services from the comfort of their own homes, eliminating the need to travel to clinics, wait in waiting rooms, or take time off work.
- **Cost savings:** Telehealth can be more cost-effective than in-person visits, as it eliminates the need for travel and reduces the need for medical facilities and staff.

1.5.2. Benefits for healthcare professionals

- **Improved efficiency:** Telehealth can improve the efficiency of healthcare delivery by reducing administrative tasks, such as scheduling and documentation, and allowing healthcare professionals to see more patients in a shorter amount of time.
- **Increased flexibility:** Telehealth can provide healthcare professionals with greater flexibility in their work schedules, as they can often provide services from remote locations and outside of traditional office hours.
- **Enhanced collaboration:** Telehealth can improve collaboration among healthcare professionals by allowing for real-time consultations and team meetings, regardless of location.

- **Reduced costs:** Telehealth can reduce healthcare costs by eliminating the need for in-person visits, reducing travel expenses, and reducing the need for expensive medical.
- **Equipment improved patient outcomes**: Telehealth can improve patient outcomes by allowing for more frequent and timely monitoring of patient conditions, leading to more proactive care management and improved outcomes.

1.6. Telehealth around the world

The use of telehealth around the world has increased in recent years, especially due to the COVID-19 pandemic. This will enable healthcare providers to offer remote consultations, monitor patient health, and provide medical advice remotely.

1.6.1. Telehealth in Europe

Telehealth is growing in popularity in Europe due to an aging population and increasing demand for health services. Many European countries have introduced telemedicine solutions, and some countries such as Denmark and the Netherlands are the most advanced in terms of telemedicine adoption. In the UK, telehealth is used to monitor patients with long-term conditions such as diabetes and heart disease.

1.6.2. Telehealth in America

Telehealth has seen rapid adoption in North America due to the COVID-19 pandemic. The United States is one of the largest markets for telemedicine, with many providers now offering virtual consultations for routine appointments, follow-up, and emergency care. Canada has also made significant progress in recent years in implementing telemedicine solutions, especially in rural and remote areas.

1.6.3. Telehealth in Australia

Telehealth in Australia has become increasingly popular over the years, especially in remote or rural areas where access to healthcare services may be limited. It has also become more widely used during the COVID-19 pandemic as a way to reduce the risk of transmission of the virus. The Australian government has implemented various initiatives to support and promote telehealth services, such as the Medicare Benefits Schedule, which provides rebates telehealth consultations. This has made telehealth more accessible and affordable for patients.

1.6.4. Telehealth in Asia

In Asia, telehealth is becoming increasingly popular due to the region's aging population and a shortage of healthcare professionals in some areas. Countries such as China, Japan, and South Korea are leading the way in terms of telehealth adoption, with many healthcare

providers offering virtual consultations and remote monitoring services. In India, telehealth is used to provide medical services to patients in rural areas.

1.6.5. Telehealth in Africa

In Africa, telehealth is seen as a promising solution to improve access to healthcare in remote and underserved areas. However, the adoption of telehealth solutions in Africa is still in its early stages, and there are significant challenges to overcome, including poor infrastructure, limited resources, and a lack of trained healthcare professionals. Countries such as South Africa, Kenya, and Nigeria are leading the way in terms of telehealth adoption, with many initiatives aimed at improving access to healthcare services in rural and remote areas.

1.7. Telehealth in Algeria

In Algeria, telehealth is still in its early stages, but there has been some progress in recent years. In 2020, the Algerian government has launched several initiatives to encourage the development of telehealth in the country, including a telemedicine program that is aimed at improving access to healthcare services. Additionally, some private hospitals in Algeria have begun offering telemedicine services to their patients, such as remote consultations and follow-up appointments. However, there are still some challenges that need to be addressed to fully integrate telehealth into the Algerian healthcare system.

1.7.1. Challenges of telehealth in Algeria

Here are some of the main difficulties of telehealth in Algeria:

- **Access to technology:** Technological infrastructure in Algeria is not yet sufficiently developed to allow for widespread adoption of telehealth. Internet penetration rates remain relatively low, particularly in rural areas, and access to equipment such as computers and tablets is often limited.
- **Training and awareness**: Healthcare professionals in Algeria need to be trained in the use of telehealth, as well as in managing the confidentiality and security of medical data. Patients also need to be informed and educated about the benefits and limitations of telehealth.
- **Funding and regulation:** There is not yet a clear regulatory framework for telehealth in Algeria, and funding for these services can be difficult to obtain. Healthcare professionals also need to be appropriately compensated for the telehealth services they provide.

- **Cultural barriers:** Some people in Algeria may prefer in-person healthcare services over remote care, due to a preference for direct human interaction in healthcare.

  The Algerian government has launched several initiatives to encourage the development of telehealth in the country, and demand for remote healthcare services is likely to continue to grow as technology becomes more accessible and the benefits of telehealth are better understood.

1.7.2. Solution to improve telehealth in Algeria

The government decisions can play a critical role in improving telehealth in Algeria, it's important to note that a collaborative effort is needed from all stakeholders, including healthcare providers, patients, and technology companies. Here are some specific steps the government can take to help improve telehealth in Algeria:

- **Invest in technology infrastructure:** The government can allocate funds to improve the country's technology infrastructure, such as providing better internet connectivity, telecommunication networks, and computer hardware. This will help to provide a stable and reliable platform for telehealth services.
- **Establish legal and regulatory frameworks:** To ensure that telehealth services are secure and meet high standards, the government can establish clear legal and regulatory frameworks. This will help to protect patients' privacy and promote safety in telehealth practices.
- **Provide financial incentives:** The government can provide financial incentives to healthcare providers to encourage them to adopt telehealth services. This can help to increase the adoption of telehealth technologies and make healthcare more accessible to people in remote or underserved areas.
- **Increase healthcare workforce training:** The government can provide training and education programs for healthcare providers to improve their knowledge and skills in telehealth practices. This will help to ensure that healthcare professionals are equipped to provide high-quality telehealth services.
- **Promote public awareness:** The government can promote public awareness of the benefits of telehealth services and encourage people to use them. This can be done through targeted public education campaigns and community outreach programs.

1.8. Conclusion

In this chapter, we presented telehealth as an innovative solution for bringing medical consultations and care to patients in remote locations. We delved into the various technologies used in telehealth and explored its diverse areas of practice. We talked about the benefits of telehealth for both patients and healthcare providers. Our discussion included an in-depth analysis of the challenges facing the implementation of telemedicine in Algeria and proposed actionable solutions to overcome these hurdles.

In the next chapter, we will present one of the technologies used in telehealth, which is web technology.

Chapter 2: Web Technology

2.1. Introduction

The invention of the internet has had a major impact on the development of the world and its current state. The Internet depends on several tools such as the Web.

The web is one of the most important communication tools that programmers are constantly developing.

This chapter provides a comprehensive overview of the web, starting with its fundamental building blocks. We explore the difference between the internet and the web and delve into the underlying types of websites and web applications. We conclude with the technologies that power the web.

2.2. Web presentation

The terms "web" and "internet" are often used interchangeably, but they actually refer to different things.

2.2.1. The Internet

"*The internet is a global network of connected computers and servers that communicate with each other using standardized protocols* ***TCP/IP****"*. [6] It enables the exchange of information and data between computers located anywhere in the world (Figure 2.1).

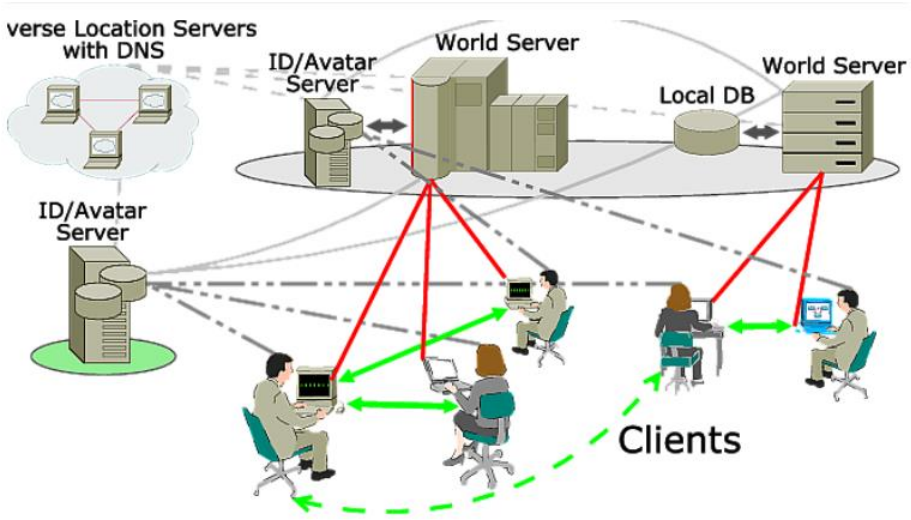

Figure 2. 1: The internet [4]

2.2.2. The Web

The World Wide Web (www), commonly referred to as the "web," is a system of interconnected documents and resources it was invented several years after the Internet, but it was it that contributed to the explosion of Internet use by the public. It is accessed through the

internet that are linked together using hyperlinks and **URLs** (Uniform Resource Locators). The web is one of many services that can be accessed through the internet.[6]

The web consists of web pages, multimedia content, and other resources that are stored on web servers and can be accessed through web browsers such as Google Chrome, Mozilla Firefox, Safari, and Microsoft Edge. The web allows users to interact with information, services, and other users across the globe in a variety of ways, such as through social media, online marketplaces, and e-commerce platforms.

2.2.2.1. Evolution of the web

The World Wide Web has come a long way since its beginning within the early 1990s. in recent decades, there have been many critical changes within the way we utilize and associated with the internet. Here are a few advancements that have formed the advancement of the internet:

- **Web 1.0 (1991-2004):** The first generation of the web, commonly referred to as Web 1.0, was primarily a one-way communication system. Websites were static and users could only consume information but not interact with it. Basic HTML pages and the emergence of early search engines like Yahoo and AltaVista characterized this era.
- **Web 2.0 (2004-2010):** Web 2.0 marked the beginning of the interactive web. Websites became dynamic, with user-generated content and social networking sites like Facebook and YouTube. This era saw the rise of rich internet applications like Google Maps, and the adoption of technologies like AJAX and RSS.
- **Mobile web (2010-present):** With the proliferation of smartphones and tablets, the web has become more mobile-centric. Mobile-optimized websites and mobile apps have become increasingly important, and responsive web design has emerged as a critical consideration for web developers.
- **Web 3.0 (2010-present):** Web 3.0, also known as the semantic web, is still in its early stages of development. This era is characterized by the use of artificial intelligence and machine learning to make the web more intelligent and personalized. The goal of the semantic web is to create a more intuitive and intelligent web experience, with applications like voice search and chatbots.
- **Web 4.0 (2020-present):** Some experts predict that we are currently in the early stages of Web 4.0, which is characterized by the use of blockchain technology to create a more decentralized web. The goal of Web 4.0 is to create a more secure, transparent, and user-

centric web, with applications like decentralized social networks and peer-to-peer marketplaces.

2.3. The web site and web application

2.3.1. The web site

A website is a collection of web pages and resources linked together by hypertext links that users can access through a web address called URL, all registered under the same website. Domain. A web page or web page consisting of text and multimedia is hosted on a web server, accessible over the internet or an intranet.[6]

A web page can be defined as a collection of structured HTML documents, hosted on a server connected to the global network, the internet, which is essentially text, enriched with images, animated videos, and sometimes audio, and links from this page to other websites.

2.3.1.1. The different types of web sites

There are several different types of websites that serve different purposes and audiences. Here are a few examples of the many types of websites that are available

- **Showcase sites**: (also called brochure sites or identity sites) are sites whose objective is to highlight the company's brand image, for example by presenting its products or services. [7]
- **Catalog Website:** this is a type of website that showcases a collection of products or services, similar to a print catalog. The website usually features a list or database of products, often with detailed descriptions, pricing, and images. Visitors can browse the catalog, search for specific items, and add products to a shopping cart to purchase.
- **Information website:** is a website that provides information on a particular topic or a wide range of topics. The information provided on these sites can include news, articles, research, statistics, how-to guides, and other relevant content. These sites are often used for research, learning, or general knowledge purposes. Information sites can cover a variety of topics, such as news, health, science, technology, history, business, finance, and more. They can be run by individuals, organizations, governments, or companies, and can be accessed by anyone with an internet connection.
- **E-commerce sites:** These sites allow customers to purchase items or services online. Examples include Amazon, eBay, and Etsy.
- **Social networking websites:** These websites allow users to connect and interact with each other. Examples include Facebook, Twitter, and LinkedIn.

- **Educational websites:** These websites provide educational resources and courses online. Examples include Coursera, edX, and udemy.
- **Entertainment websites:** These websites offer entertainment-related content, such as movies, TV shows, music, and games. Examples include Netflix, Hulu, and Spotify.
- **Personal websites:** These websites are created by individuals for personal purposes, such as blogs, portfolios, or online resumes.
- **Government websites:** These websites provide information and services related to government agencies and departments. Examples include the IRS, Social Security Administration, and state and local government websites.
- **Non-profit websites:** These websites are created by non-profit organizations to promote their cause, raise awareness, and accept donations. Examples include the American Red Cross, World Wildlife Fund, and UNICEF.

2.3.2. Web Application

A web application is a software program that runs on a web server and can be accessed using a web browser over the internet or an intranet. Unlike a static website that displays information only, a web application is interactive and allows users to perform various tasks, such as inputting data, manipulating data, and generating reports.[7]

2.3.2.1. The different types of web Applications

Here are some common examples of web applications:

- **Online Banking:** Many banks provide online banking services that allow users to access their accounts, transfer funds, pay bills, and manage their finances.
- **E-commerce:** E-commerce websites are web applications that allow users to purchase products or services online. These websites typically offer features such as shopping carts, payment gateways, and order tracking.
- **Social media:** Social media platforms such as Facebook, Twitter, and Instagram are web applications that allow users to connect and interact with each other, share information, and create and join communities.
- **Customer relationship management (CRM):** CRM systems are web applications that help businesses manage their customer interactions, track leads, and opportunities, and analyze customer data. Project management: Project management tools such as Trello, Asana, and Jira are web applications that help teams collaborate, manage projects, and track progress.

- **Healthcare Web Applications:** are designed to help healthcare providers and patients access healthcare services, manage healthcare data, and improve healthcare outcomes such as Cardioline, Norav, Polytex, Brainlab, and Sysmex.

2.4. The technology of the web

Web technology alludes to the different instruments and methods that are utilized within the handle of communication between diverse sorts of gadgets over the web. A web browser is utilized to get to web pages. Web browsers can be characterized as programs that show content, information, pictures, liveliness, and video on the Web. Hyperlinked resources on the World Wide Web can be gotten by utilizing computer program interfacing given by Web browsers.

2.4.1. Web browsers

The Web browsers are software applications used to access and navigate the World Wide Web. They allow users to view web pages, download files, and interact with online services. It gives an interface between the server and the client and requests to the server for web documents and services. There are several web browsers available, each with its own set of features, advantages, and disadvantages such as Google Chrome, Mozilla Firefox, Microsoft Edge, Safari and Opera (Figure 2.2).

Figure 2. 2: web browsers [5]

2.4.2. Web Server

A web server may be a computer program that serves substance to clients over the web (Figure 2.3). The client is ordinarily a web browser, which demands assets such as HTML

records, pictures, and scripts from the server. This trade takes put utilizing Hypertext Exchange Convention (HTTP)

There are several popular web server software options, including Apache, Nginx, and Microsoft IIS. Each has its strengths and weaknesses, and which one to use depends on factors such as the operating system being used, the server's intended purpose, and personal preference.

Web servers are typically designed to be highly scalable, and able to handle thousands or even millions of simultaneous connections. They may use techniques such as load balancing, caching, and content distribution networks (CDNs) to ensure efficient and reliable delivery of content to clients.

In recent years, there has been a trend toward using containers and micro services to deploy web applications. This approach allows for greater flexibility, scalability, and resilience, and can help to streamline the development and deployment process.

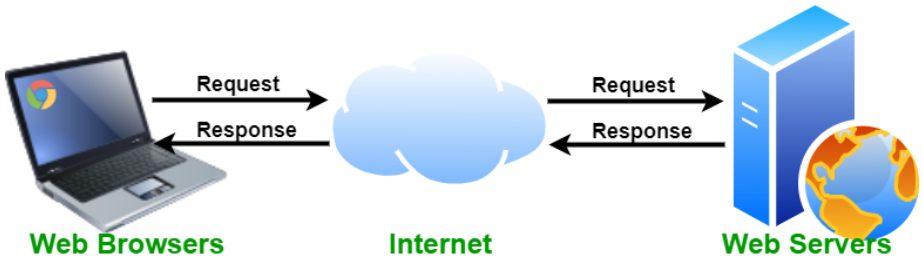

Figure 2. 3: Web server [6]

2.4.3. Web Pages

The web page is a digital document that is accessed through a web browser over the internet (Figure 2.4). It typically contains a combination of text, images, multimedia content, and hyperlinks to other web pages or resources. It is can be static or dynamic. Static pages are pre-built and do not change unless they are manually edited. Dynamic pages are generated on the fly in response to user input or other variables, and may draw content from databases or other sources.

The web pages are hosted on web servers, which store the files that make up the page and deliver them to users who request them. When a user types a web address (URL) into their browser, the browser sends a request to the web server for the page, which is then delivered back to the user's browser and displayed on their screen.

Web pages can be created for a wide variety of purposes, such as sharing information, selling products or services, providing entertainment or education, or facilitating

communication and collaboration. They can be accessed from anywhere in the world, making them a powerful tool for connecting people and sharing knowledge and ideas.

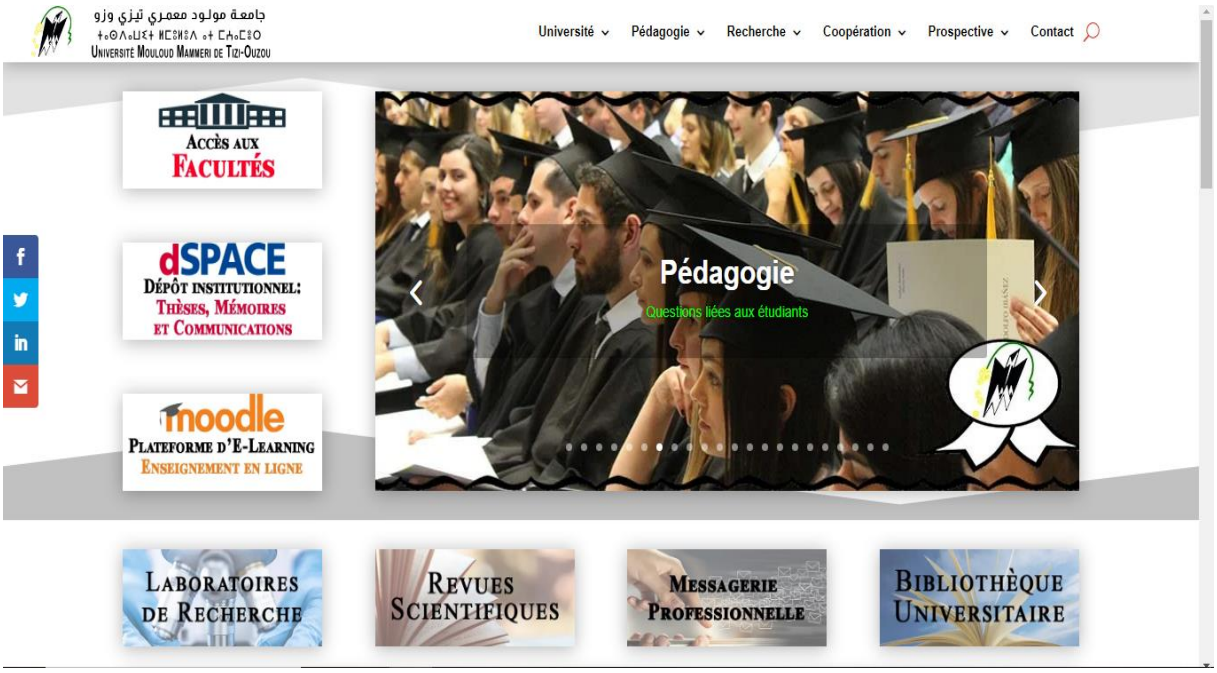

Figure 2. 4 : Web Pages.[7]

2.4.4. Web Development

Web development is the method of creating, planning, and keeping up websites and web applications. It incorporates different innovations, programming languages, systems, and devices to construct dynamic and intelligent web pages that can run on diverse gadgets, browsers, and platforms

2.4.4.1. Front-end Development

Front-end development refers to the process of designing and developing the user interface (UI) and user experience (UX) of a website or web application. The front-end developers are responsible for creating the layout and visual elements of a website or application, as well as ensuring that it is functional, responsive, and optimized for performance. The front-end involves working with the client-side technologies that users interact with using some languages (Figure 2.5), which are discussed below:

- **HTML:** (Hypertext Mark-up Language) is a mark-up language used to create web pages and other information that can be displayed in a web browser. It is the standard language for creating web pages and is used in conjunction with CSS (Cascading Style Sheets) and JavaScript to create dynamic and interactive websites.

To define the structure and content of a web page HTML uses tags.These tags are enclosed in angle brackets, and most come in pairs with an opening tag and a closing tag. For example, the <html> tag marks the beginning of an HTML document, and the </html> tag marks the end of the document.

- **CSS:** (Cascading Style Sheets) is a simply designed language used to style an HTML document and make web pages presentable CSS describes how HTML elements should be displayed [8]. More importantly, CSS enables a developer to do this independently of the HTML that makes up each web page.
- **JavaScript:** JavaScript is a high-level programming language used to create interactive and dynamic web pages. It is one of the core technologies used for front-end web development along with HTML and CSS. JavaScript can be used for a variety of such as adding interactivity to web pages, manipulating the content and appearance of web pages in real-time, creating animations and effects, accessing and manipulating web page elements, and validating user input.

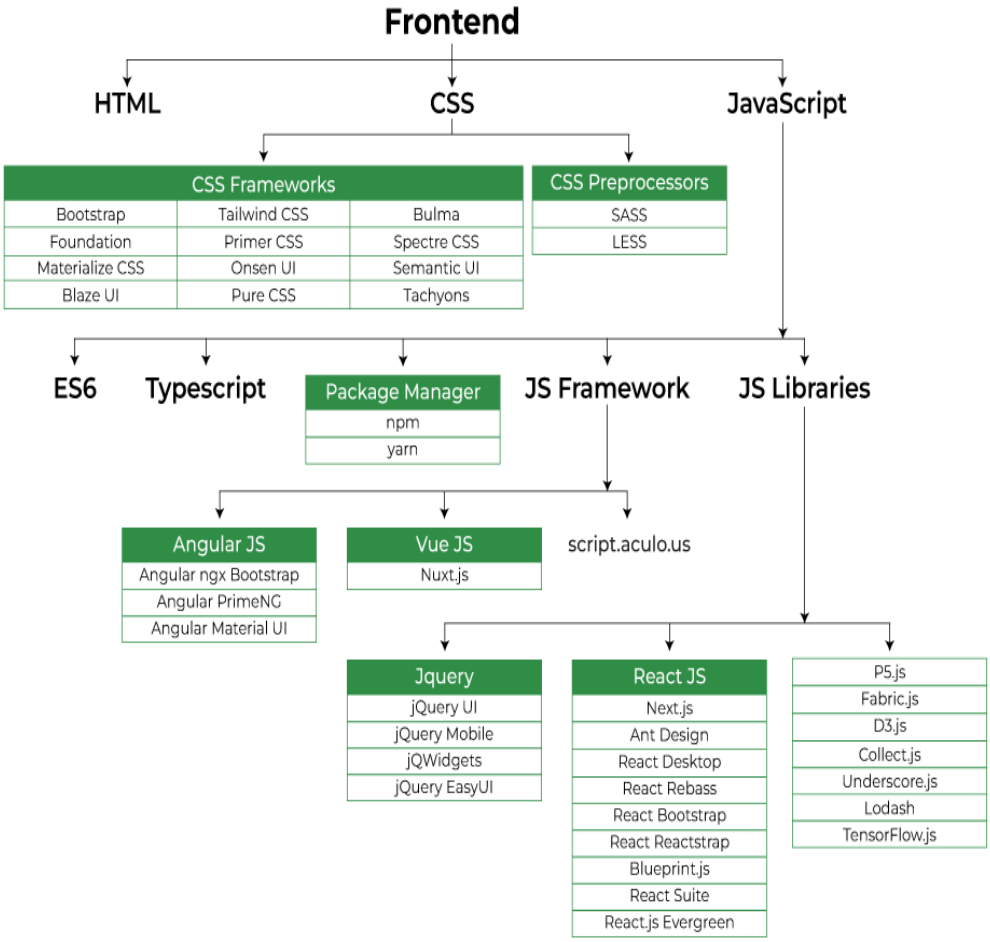

Figure 2. 5: Front-end languages [8]

2.4.4.2. Back-end Development

Back-end development refers to the process of designing and developing the server-side components of a website or web application. These components are responsible for processing and storing data, handling user authentication and authorization, and executing business logic. Back-end developers typically work with server-side programming languages such as:

- **PHP:** (Hypertext Pre-processor) is a server-side scripting language that is primarily used for web development. It is often used in back-end development to create web applications.
- **Python:** is a general-purpose programming language that is widely used in various domains such as scientific computing, data analysis, artificial intelligence, web development, and more. It is known for its simplicity and readability, making it easy to learn for beginners. Python has a large standard library and a thriving community, which makes it a popular choice for a wide range of programming tasks

The back-end developer use databases such as MySQL, MongoDB, and PostgreSQL. They also use various frameworks and tools to streamline development, such as Node.js, Django, Flask, and Laravel.

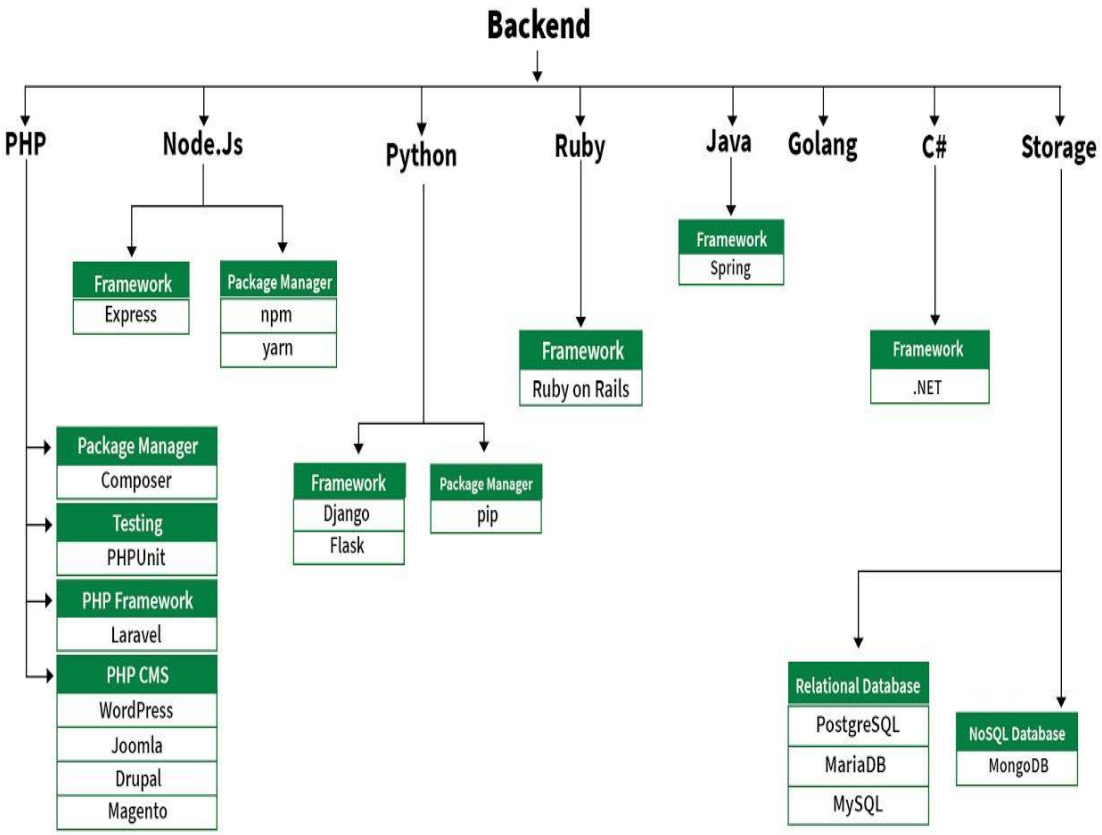

Figure 2. 6: Back-end languages [9]

2.4.5. Protocols

The Web Protocol refers to the set of rules and standards used to govern the communication between computers on the World Wide Web (WWW). There are several different protocols that are used in the functioning of the web, but the most important ones are:

- **Hypertext Transfer Protocol (HTTP):** This is the primary protocol used for transferring data over the web. Web browsers to send and receive web pages, images, videos, and other web content use it.
- **Secure Hypertext Transfer Protocol (HTTPS):** This is an extension of HTTP that adds encryption and authentication mechanisms to provide secure communication over the web. It is used for sensitive transactions, such as online banking, e-commerce, and other secure data transfers.
- **File Transfer Protocol (FTP):** This protocol is used for transferring files between servers and clients on the web. It allows users to upload and download files from remote servers.
- **Simple Mail Transfer Protocol (SMTP):** This protocol is used for sending and receiving email messages over the web. Email clients, such as Microsoft Outlook, Gmail, and Yahoo Mail, to send and receive messages.
- **Domain Name System (DNS):** This protocol is used for translating domain names into IP addresses. It allows users to type in a website URL, such as www.asmaben.com, and be directed to the corresponding IP address where the website is hosted.

2.5. The relationship between the health and the web

Health information is very compelling but relatively difficult to obtain for most lay people, and members of the public often claim that it is increasingly difficult to spend quality time with physicians. As a result, many people are now turning to the Internet to get information they cannot easily get elsewhere. Web users routinely searched the Web to find Health or medical information [9].

Health organizations and commercial companies have created health websites and applications to provide public health information and telehealth services to meet the growing demand for such services and information. There are many websites and web applications used in various health fields including those used for professional purposes or public use by people and patients.

2.6. Conclusion

In this chapter, we introduced the basic concepts of Web technology, with a particular emphasis on the types of websites and web applications, as well as the technologies and protocols used for web development and the programming languages and databases utilized. We provided examples of the most commonly used types of websites and applications, browsers, and web applications. By exploring these foundational concepts, we gained a better understanding of the complex web ecosystem that powers the internet and how developers can leverage various tools and technologies to create compelling and dynamic websites and applications that meet the needs of users.

The next chapter is devoted to the analysis and design of our telehealth application.

Chapter 3: Analysis and design

3.1. Introduction

This chapter will cover the analysis and the design phase part of the project. We chose UML diagrams, which allows us to explicitly model the exact structure and behaviour of a system independent of any method or programming language.

3.2. General project presentation

It is an application that connects patients with nurses and laboratories of medical analysis to organize the blood test directly at the user's home or in the laboratories, moreover, it can be done without a prescription for home care. Once the analysis is done by the laboratory, the application transmits the results in a secure mode and send a notification that the results are ready to be retrieved.

This notification is a feature of the application that alerts the patient when the laboratory has completed the medical analysis of their blood sample and the results are ready to be accessed. Once the patient receives this notification, they can log into the application and access their results securely. The notification may include information on how to retrieve the results, such as where to go and what to bring.

3.3. Identification of actors

3.3.1. Visitors

These are an unregistered user who can view the medical analysis laboratory profile or register as a user of the web application.

3.3.2. Patients

It is a visitor who has already created an account on the web application as a patient.

3.3.3. Nurses

The application connects patients with qualified nurses who can perform the blood test at the patient's home.

3.3.4. Laboratory of medical analysis

The application facilitates the connection between patients and medical laboratories that can perform the required medical analysis on the blood samples collected by the nurses.

3.3.5. webmaster

The responsible for developing the application, managing its features, and ensuring its security.

3.4. Description of the role of each actor

Actor	Actions
Visitor	Consult the website
	Search for laboratory of medical analyses
	Register
Patients	Authentication
	Modify profile
	Search for laboratory of medical analysis laboratory
	View the profile of medical analysis laboratory
	Contact the laboratory
	Receive notification that the result is ready to be retrieved
	Receive the result blood test
Laboratory	Authentication
	Modify profile
	Contact patients
	Send result blood test
	Send notification
webmaster	Managing and updating the website content, design, and functionality
	Ensuring website security and data privacy
	Laboratory manager
	Consult the list of patients
	Region manager

Tableau 3. 1: Table of actors and actions

3.5. The UML diagrams

The UML diagram is a unified modelling language, it represents processes and modelled data as graphs, and each graph represents a specific concept of a software system.

3.5.1. Context diagram

Context is a diagram that defines the boundary between a system or part of a system and its environment and shows the entities that interact with it.

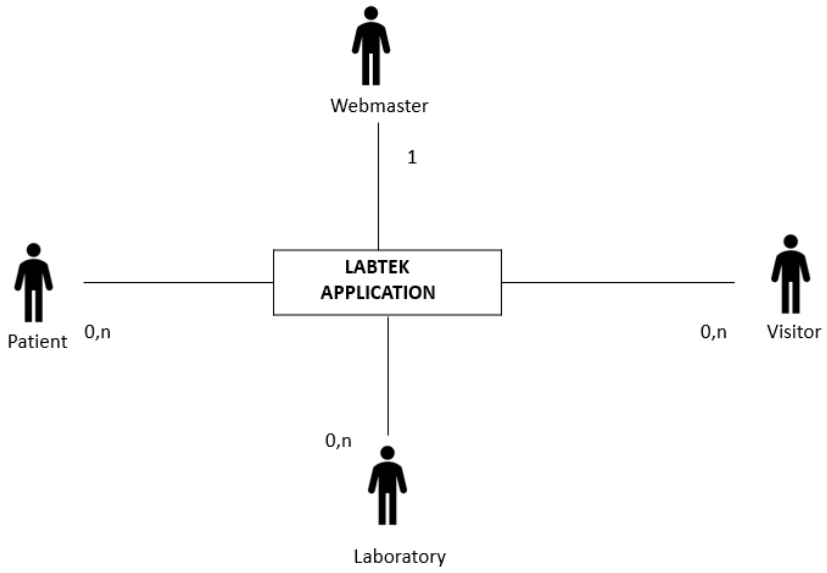

Figure 3. 1: Context diagram

3.5.2. Use cases diagram

The use case diagram is a visual representation of the different interactions between the system and the actors. In the case of this web application, there are four main actors are visitors, patients, laboratories, and webmasters.

Visitors can view information about the application and its features but cannot access any of the patient or laboratory functions. Patients can use the application to schedule a blood test, view their results, and receive notifications when their results are ready. Laboratories can access the test orders, collect blood samples, and upload the results to the system. Webmasters have administrative access to manage the application, add new features, and resolve technical issues. By using a use case diagram, the interactions between the actors and the system can be clearly visualized, making it easier to design and develop the application (see Figure 3.2).

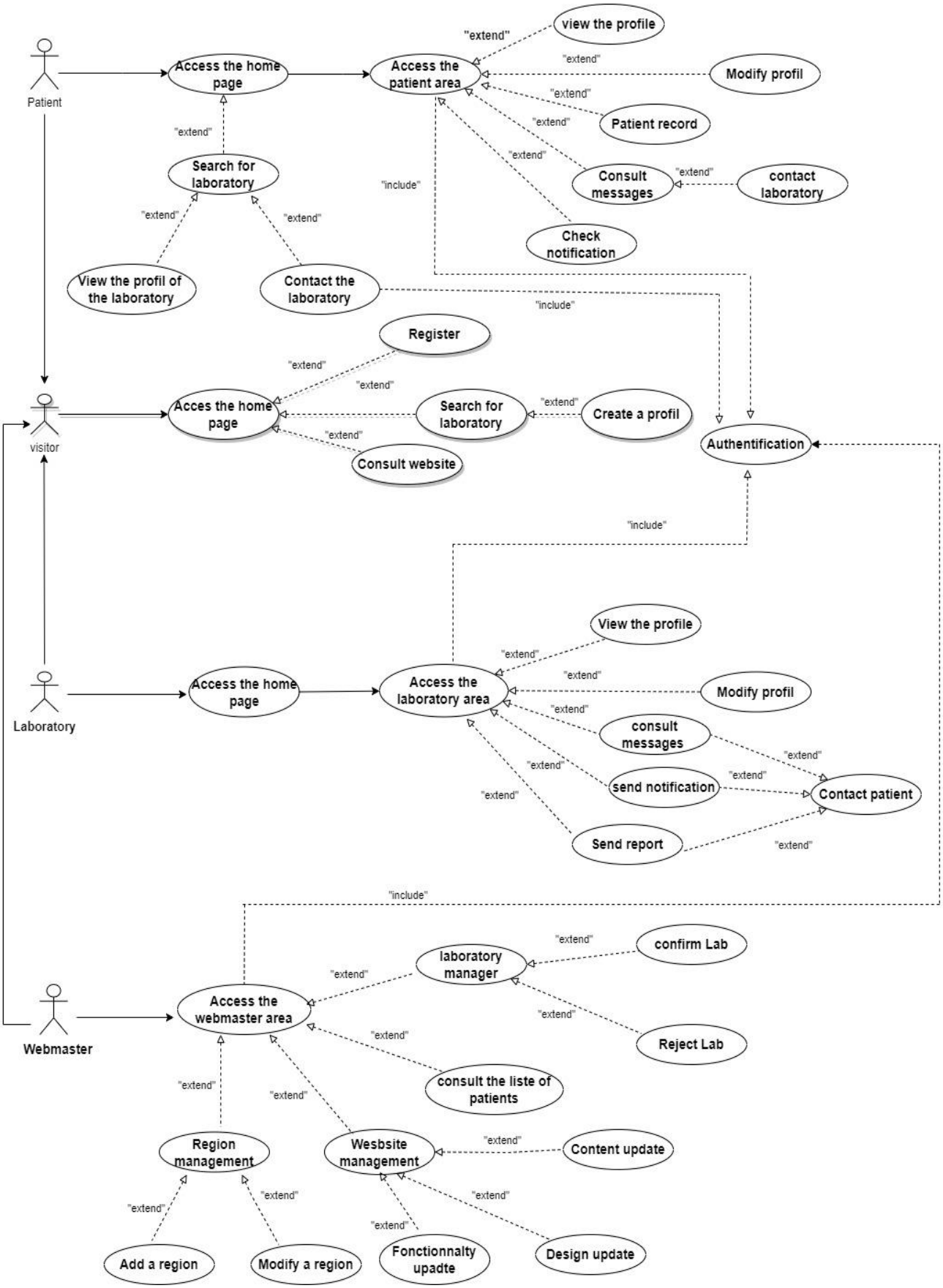

Figure 3. 2: Use case Diagram

3.5.3. Sequence diagram

A sequence diagram is a type of interaction diagram that shows how objects interact in a particular scenario or use case over time.

For this web application, there are several cases of sequence diagrams, we will only focus on the essential ones.

3.5.3.1. Sequence diagram of registering

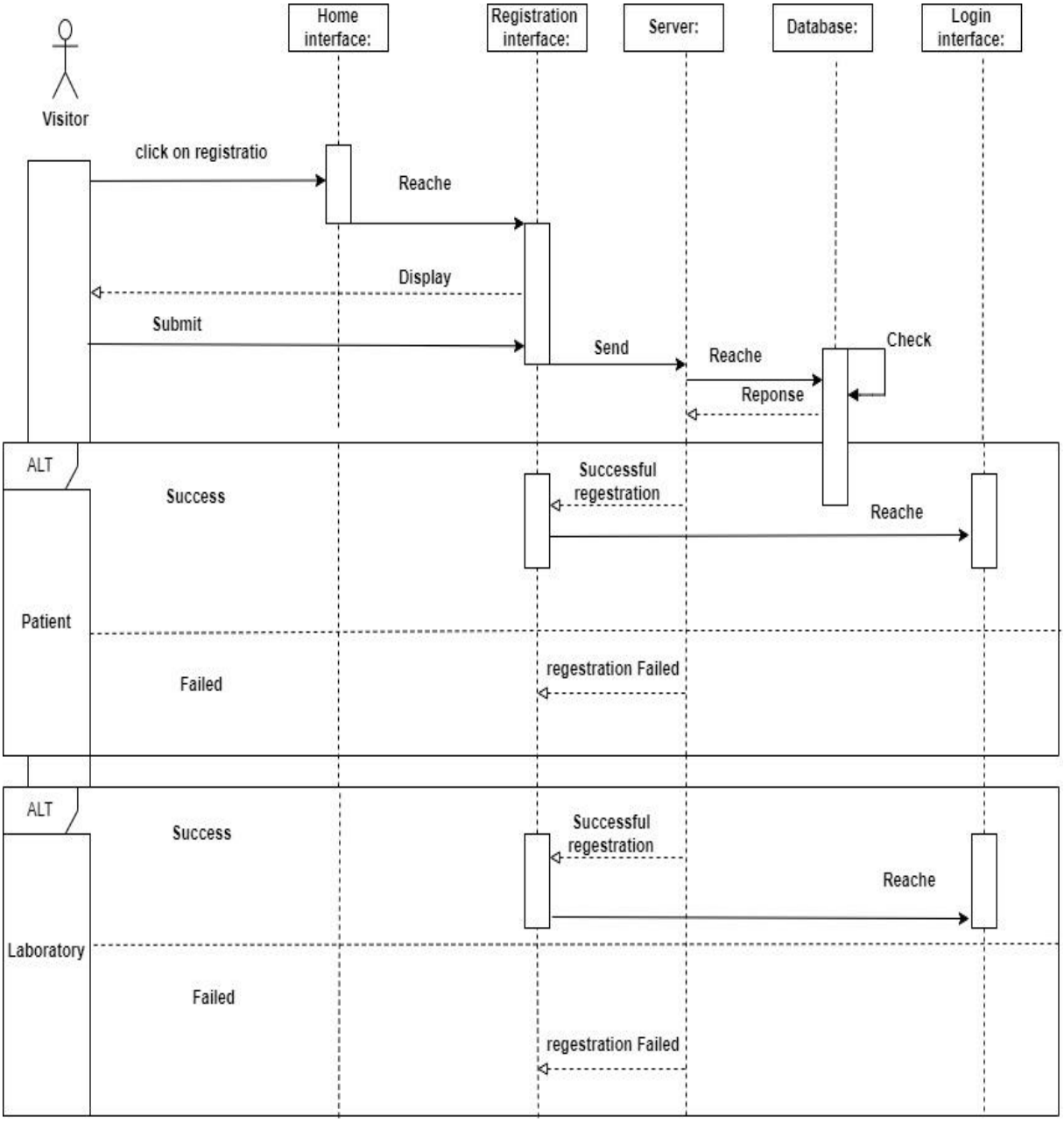

Figure 3. 3: Sequence diagram of registering

3.5.3.2. Authentication sequence diagram

The authentication sequence diagram is the same for the three actors of the web application "patient, laboratory, and webmaster" (see figure 3.4).

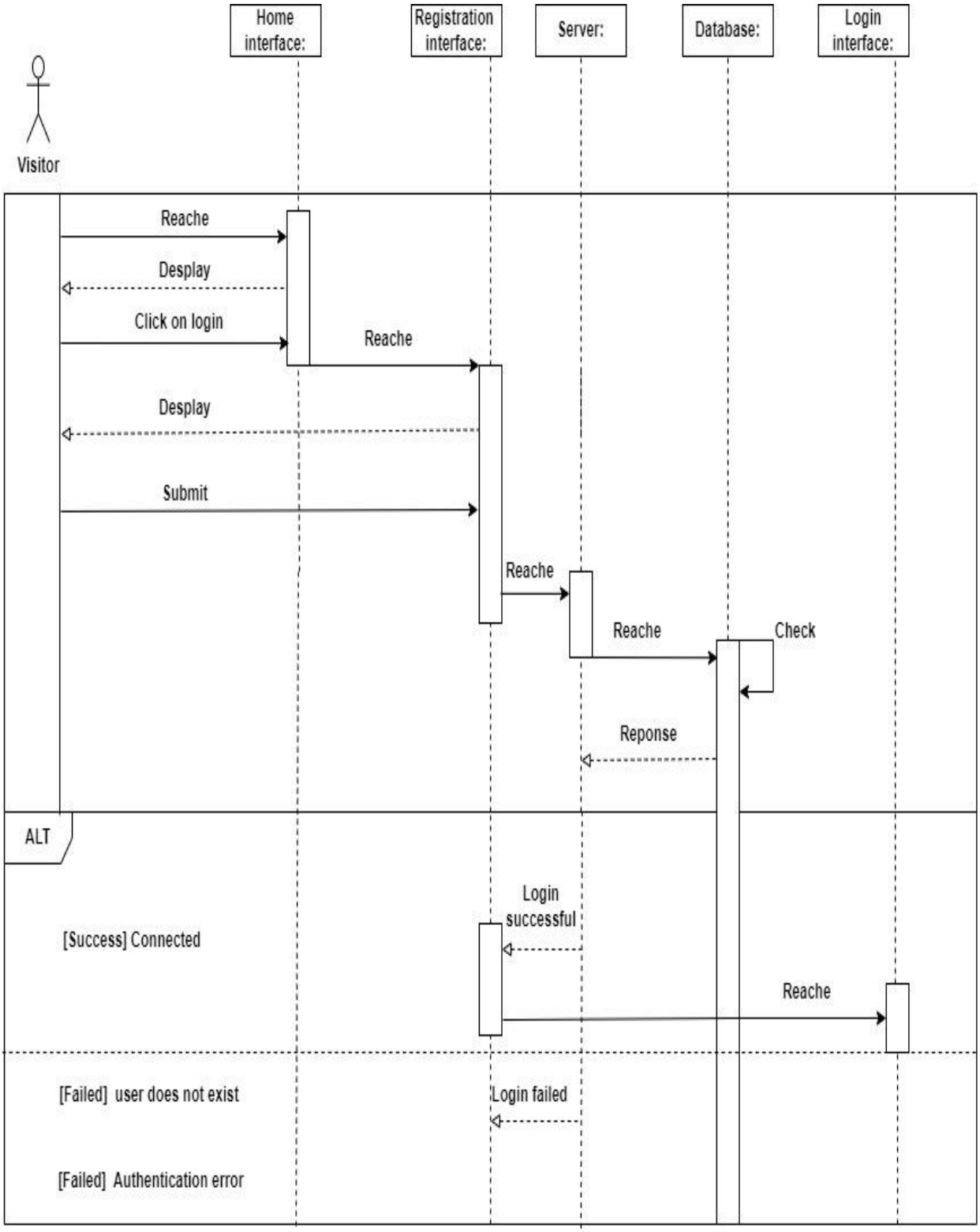

Figure 3. 4: Authentication sequence diagram

3.5.3.3. Sequence Diagram: Search for a Medical Analysis Laboratory (Patient)

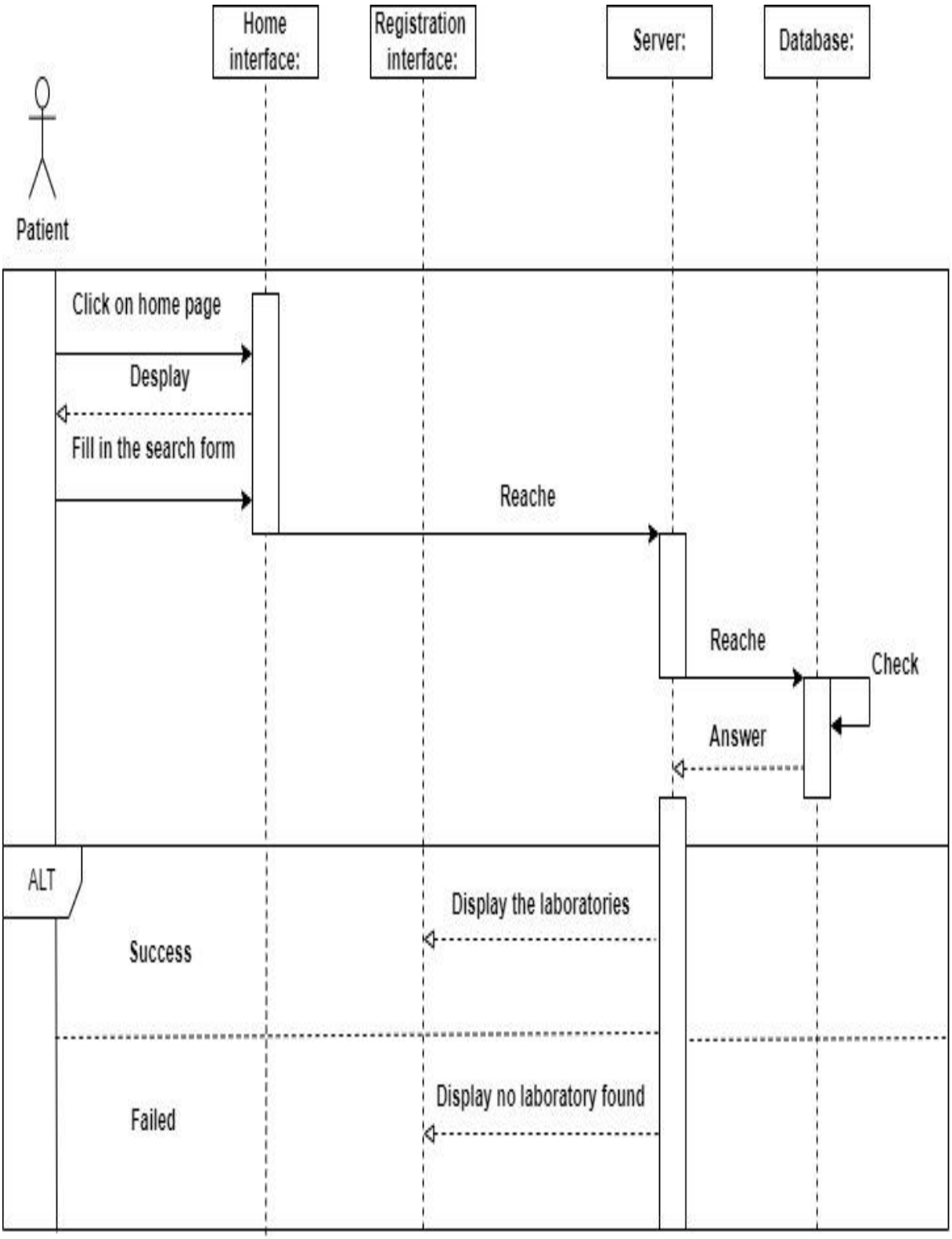

Figure 3. 5: Sequence Diagram: Search for a Medical Analysis Laboratory (Patient)

3.5.3.4. Sequence Diagram: consult messages

The sequence diagram for viewing messages is the same for patients and medical analysis laboratories (see figure 3.6)

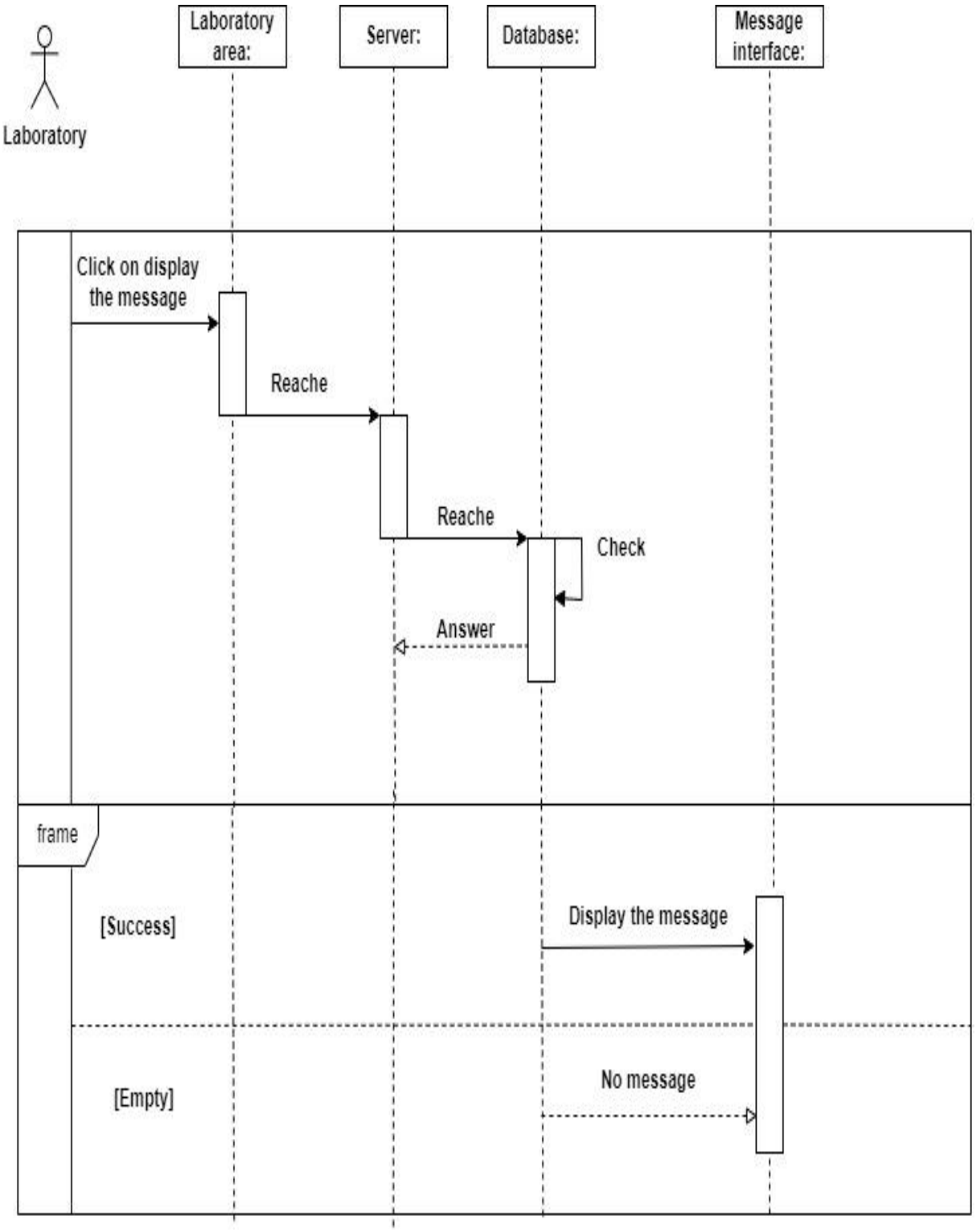

Figure 3. 6: Sequence Diagram : Consult messages

3.5.3.5. Sequence Diagram : Region management

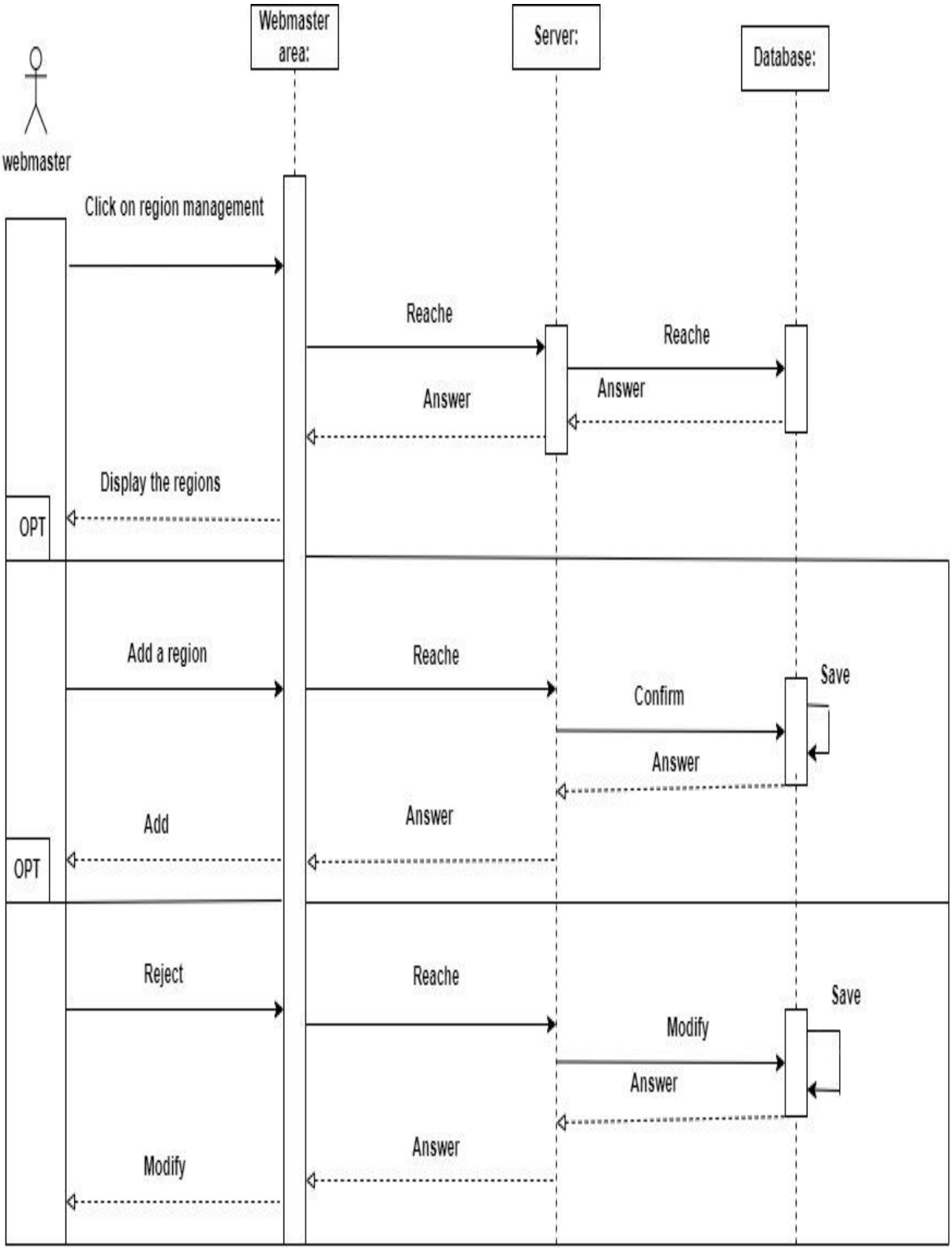

Figure 3. 7: Sequence Diagram: Region management

3.5.4. Class diagram

A class diagram is a Unified Modelling Language (UML) diagram used to represent classes, interfaces, associations, and relationships between objects in an object-oriented software system (See figure 3.8).

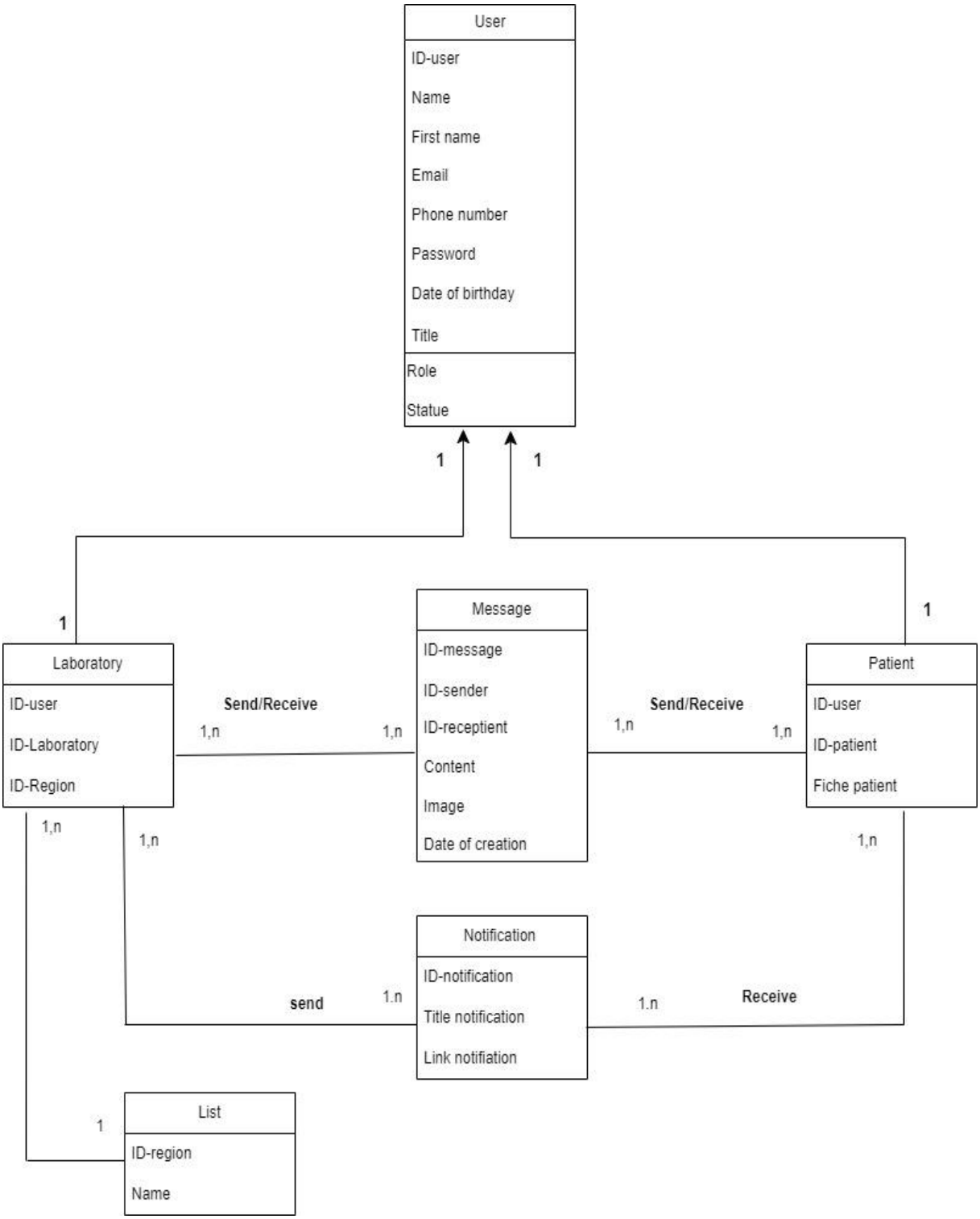

Figure 3. 8: Class Diagram

3.5. Conclusion

In this chapter, we used the UML language to develop our application through a modeling process. We focused on selecting the primary structural and dynamic diagrams such as use Context diagram, cases diagram, sequence diagram and ending with Class diagram.

Chapter 4: Implementation and Realization

4.1. Introduction

This chapter is the last part of this thesis; it deals with the tools and programming languages used for implementation and realization and gives an overview of the work done in terms of screenshots.

4.2. The tools and programming languages used

4.2.1. Front-End

The programming languages used in the front end of this web application are web HTML, CSS and JavaScript (Figure 4.1).

All the programming languages used have been defined in detail in chapter 2

Figure 4. 1: Front-end languages logo [10]

4.2.2. Back-End

Back-end development refers to the process of designing and developing the server-side components of a web application. The server-side scripting language used in this web application is PHP (Figure 4.2).

Figure 4. 2: Php language logo [11]

4.2.2.1. MySQL

MySQL (Michael Widenius Structured Query Language) is a relational database management system (RDBMS) used to store and retrieve data for web applications. That is widely used for web applications and other software development projects (Figure 4.3).

Figure 4. 3: MySQL logo [12]

4.2.3. Visual Studio Code (version 1.77)

Visual Studio Code is a free and open-source code editor developed by Microsoft for Windows, Linux, and MacOS [10].

It can be used for many programming languages and projects. It's a complete integrated development environment (IDE) that you can use to write, modify, build, and then publish your website or application (Figure 4.4).

Figure 4. 4: Visual Studio Code logo [13]

4.2.3.1. The User Interface of visual studio code

Here are some of the key features of the visual studio code interface (Figure 4.5):

A) Activity Bar: This allows the user to switch between views and gives additional context-specific indicators, such as the number of changes submitted when Git is enabled.

B) Side Bar: It contains different panels, like the "Search" panel, which allows the user to search for text within the project, and the "Git" panel, which provides Git version control features.

C) Editor groups: The main area of editor groups is to edit the files.

D) Panel: The user can display different panels below the editor area to output debug information or information, errors and warnings, or an embedded terminal.

E) Status Bar: It gives information about the open project and the files you are editing.

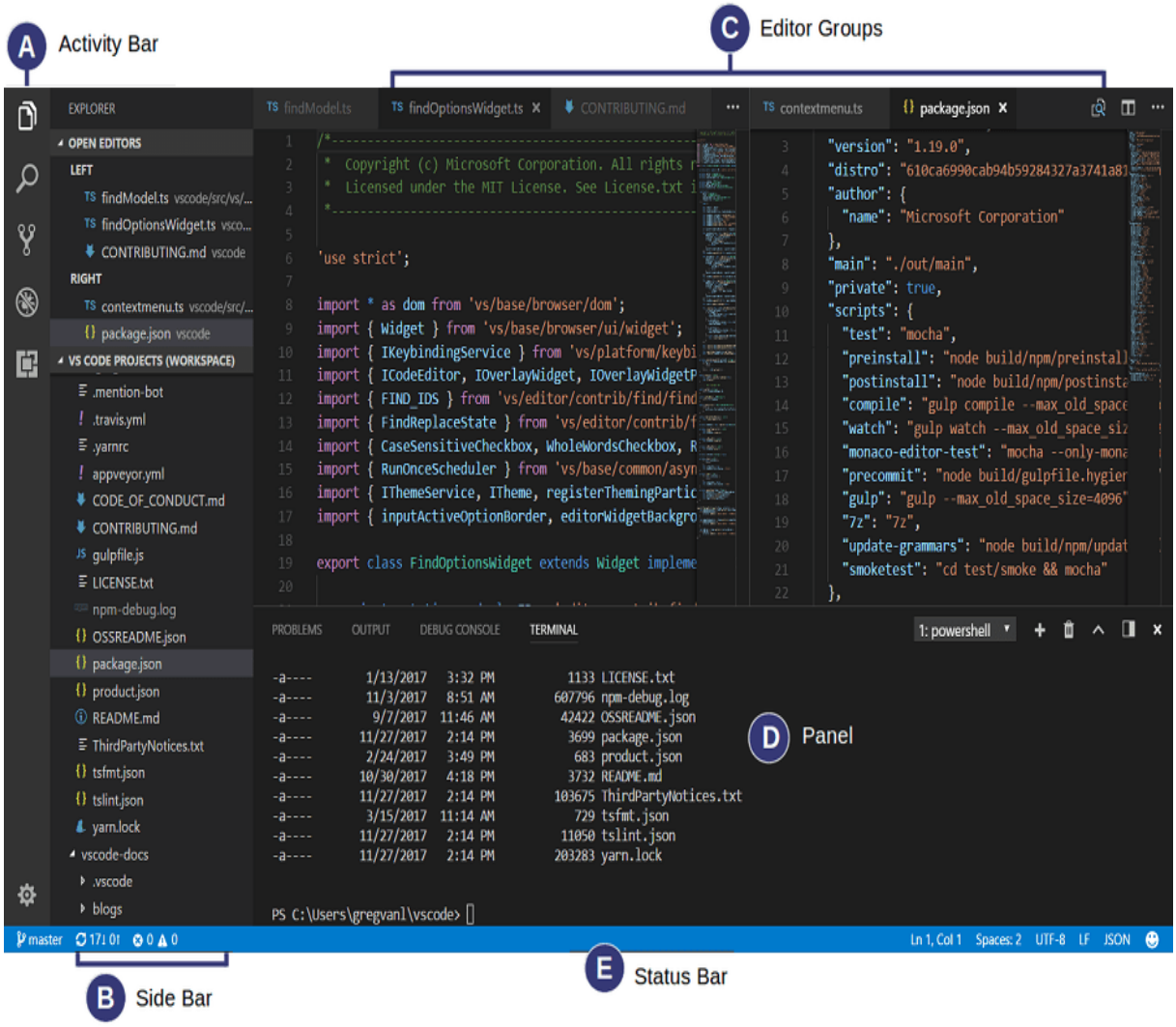

Figure 4. 5: The User Interface of visual studio code [14]

4.2.3.2. Creating a new file in Visual Studio Code

To create a new file in Visual Studio Code, follow these steps:

1. Open Visual Studio Code and click on " File" button in the top-left corner of the window

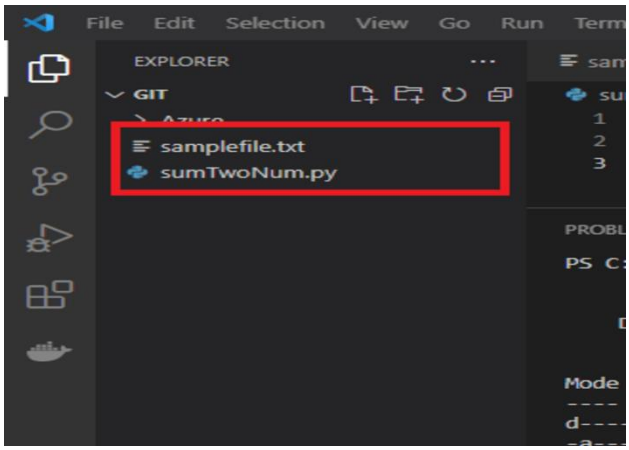

Figure 4. 6: File button [15]

2. Click on the "New File" from the dropdown menu. or press the shortcut key "Ctrl+N" (Windows).

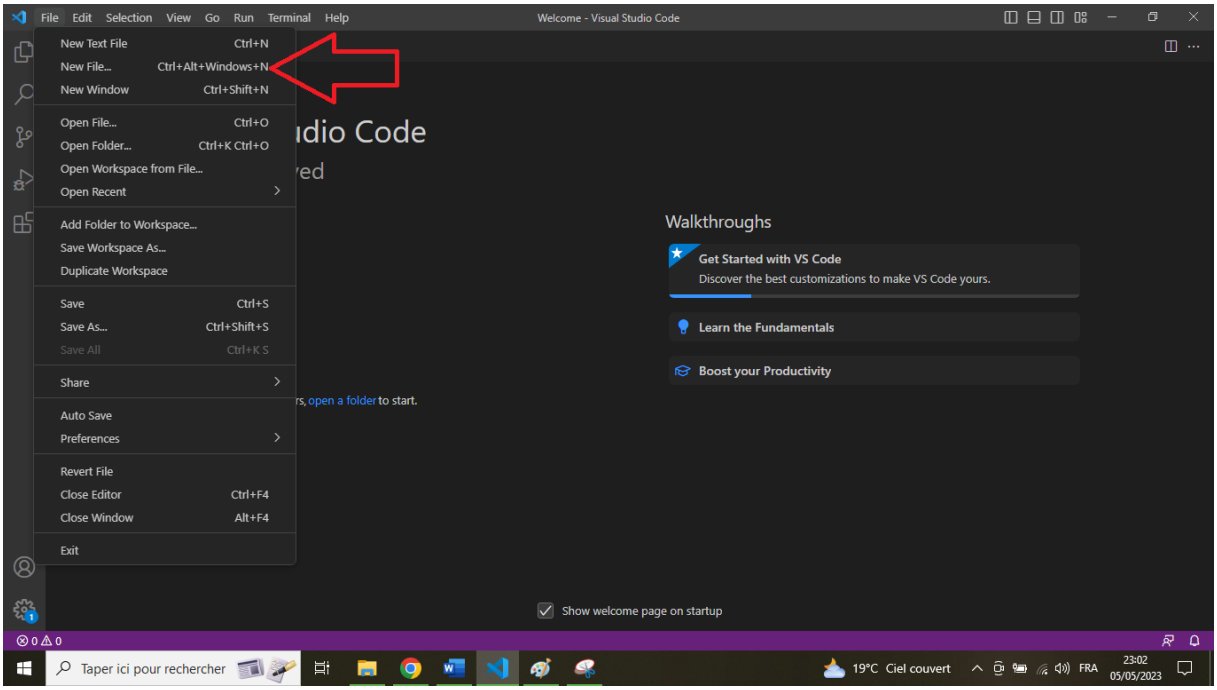

Figure 4. 7: New File button [16]

3. Once the file has been created, it should be saved by clicking on "File" in the top menu and selecting "Save As." A name for the file should be chosen, the folder where it is to be saved should be selected, and then "Save" should be clicked.

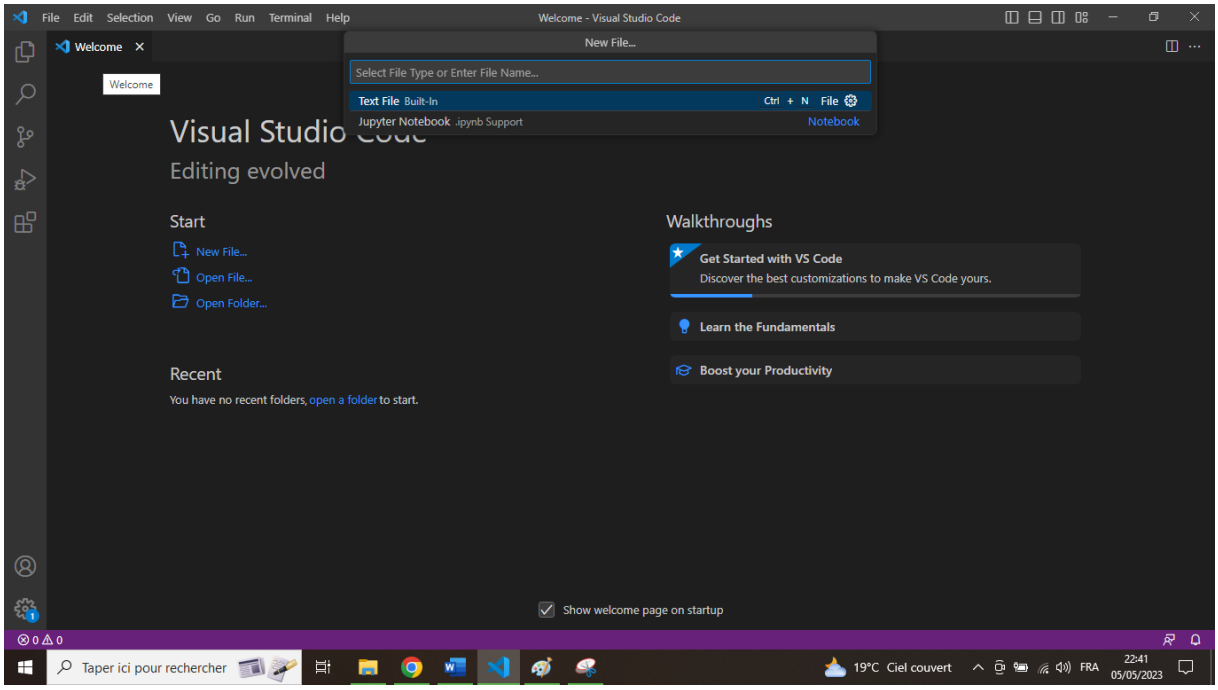

Figure 4. 8: Save as new file [17]

Any name can be chosen for the file but in visual code studio but for better organization it is recommended to follow certain conventions.

- For HTML files, use a name that describes the content of the page like" Labtek.html".
- For CSS files, use a name that describes the purpose of the stylesheet like "Labtek.css".
- For JavaScript files, use a name that describes the functionality of the script Labtek.js
- For PHP files, it is also recommended to use a name that describes the purpose or content of the file like "auth.php" for file that use authentication or "login.php" for file that use login or "signup.php" for file that use signup.

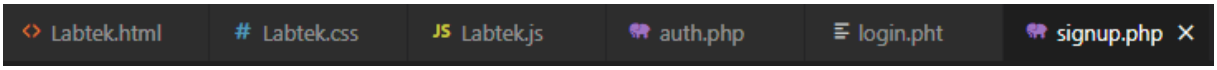

Figure 4. 9: Different names of files

4.2.4. Xampp

XAMPP is an open-source and free web server, FTP server, and email server that stands for Cross-Platform (X), Apache (A), MySQL (M), PHP (P), and Perl (P). It offers good flexibility of use. It provides an easy-to-use graphical user interface (GUI) that allows you to start, stop, and manage the Apache web server, MySQL database, and other components (Figure 4.5).

XAMPP is designed to be user-friendly and convenient for local web development and testing purposes.

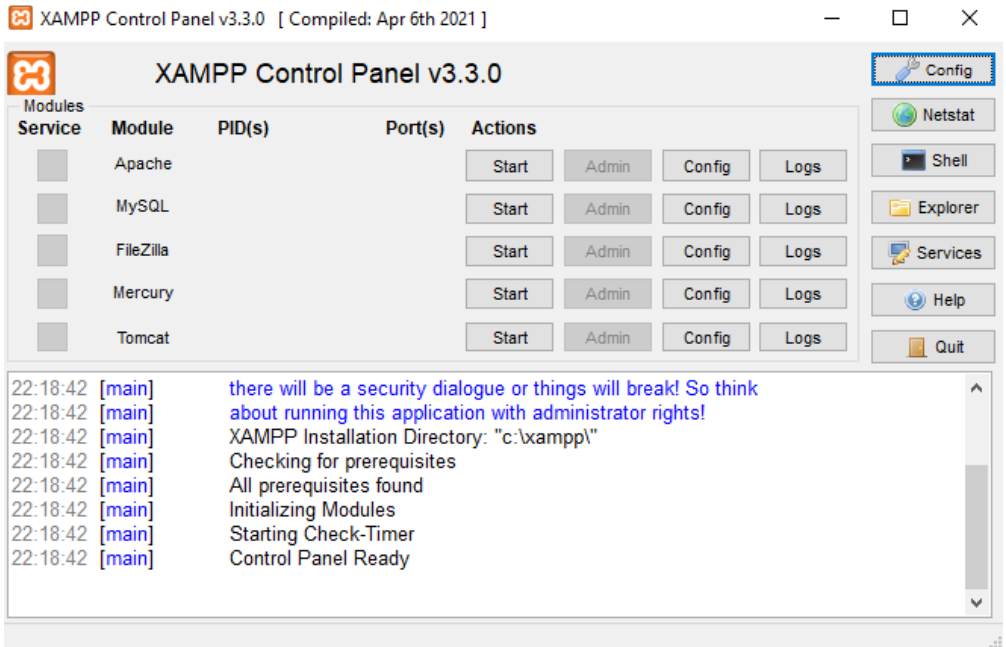

Figure 4. 10: The User Interface of Xampp [19]

4.3. Application presentation

The application is a responsive, A responsive application means that it is designed to adapt and provide an optimal user experience across different devices and screen sizes. This ensures that users can access and use the application seamlessly on desktop computers, laptops, tablets, and smartphones (See figure 4.11).

The responsiveness of Labteks allows patients to conveniently access and use the application on their preferred device, whether they are at home or on the go.

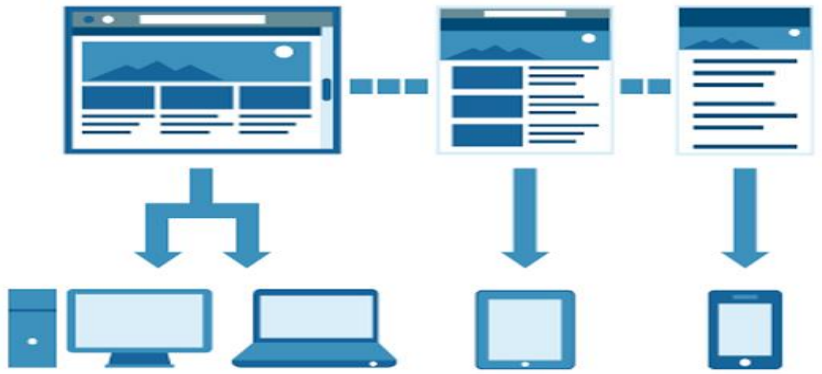

Figure 4. 11: Responsive of the application [20]

4.3.1. The web application interface

The web application interface of our platform offers a user-centric experience with easy navigation and intuitive design. The home page serves as a gateway to the various features and functionalities that our platform offers. Users can quickly access essential information and get an overview of our services (See figure 4.12).

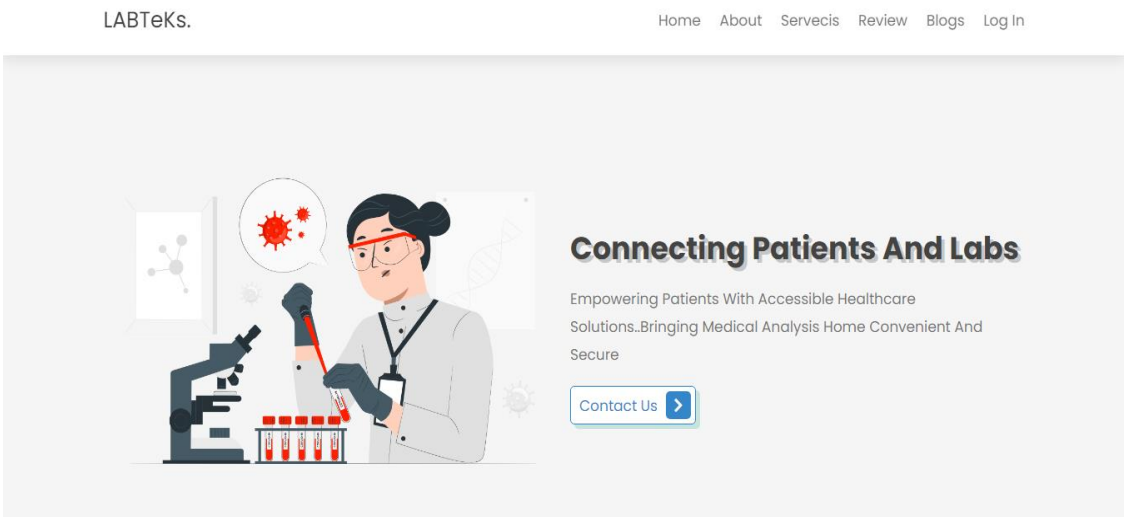

Figure 4. 12: The web application interface

- **The About section**

The "About" section provides a comprehensive overview of our platform, detailing its purpose, mission, and values. Users can learn about our team, their expertise, and the technology behind our platform (See figure 4.13).

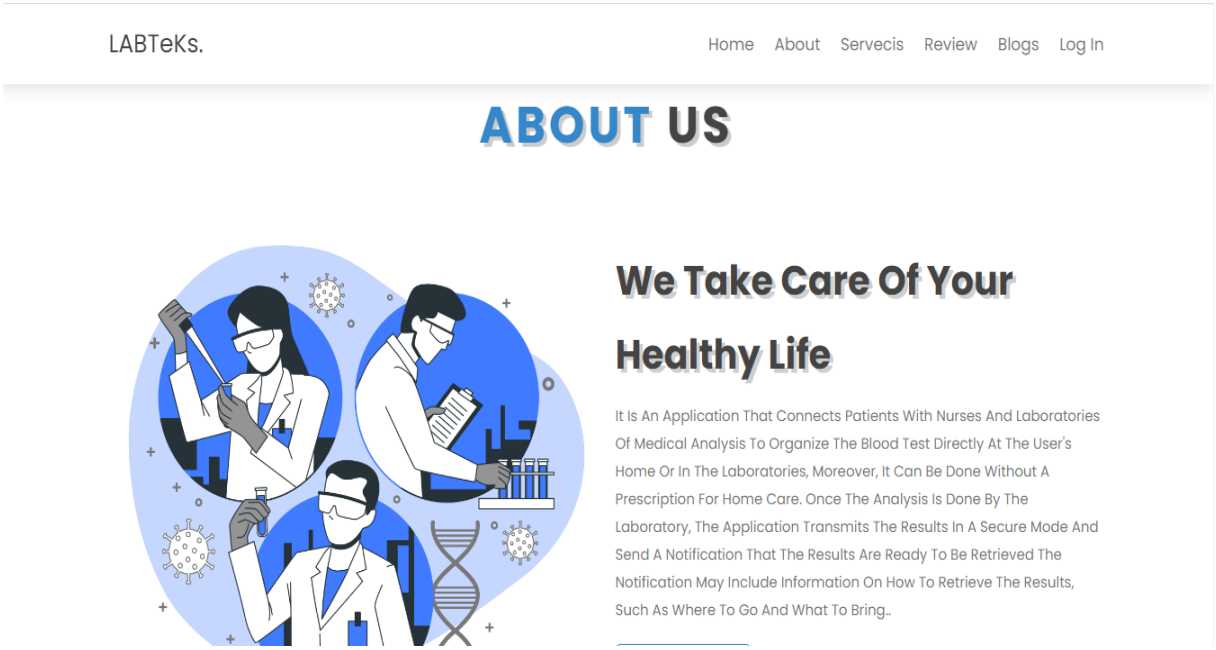

Figure 4. 13: About us section

- **Our services section**

Our services section showcases the range of services we offer.

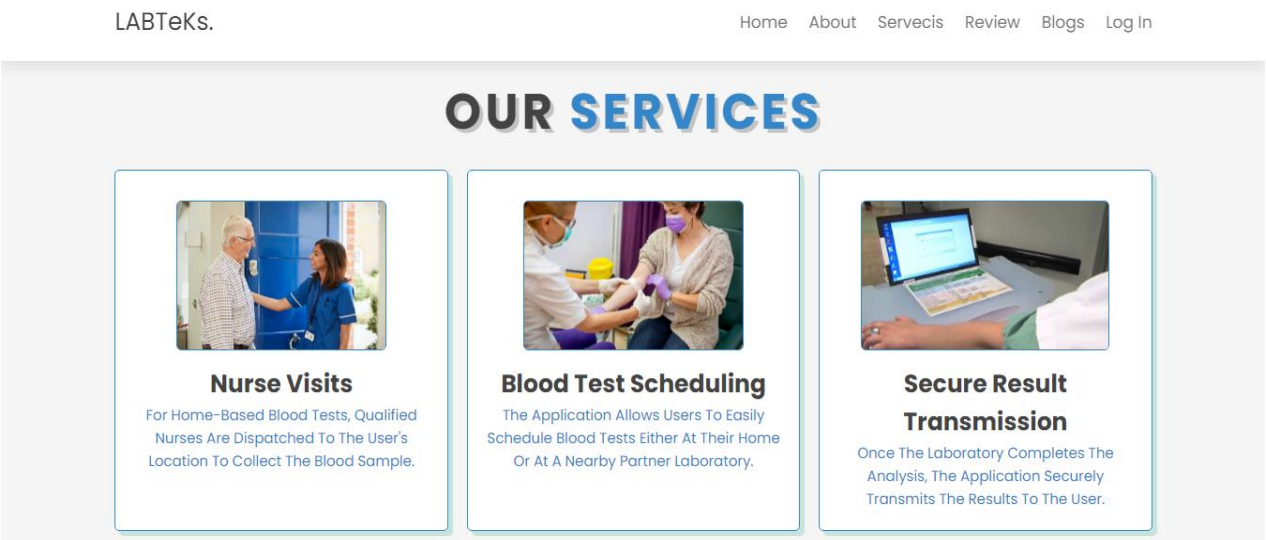

Figure 4. 14: Our Service section

- **Professional's reviews section**

To instill confidence and trust in our platform, we have a dedicated section for professional reviews. Here, renowned healthcare professionals and experts share their positive experiences and endorse the effectiveness and reliability of our services. Their testimonials serve as a testament to our commitment to excellence and patient satisfaction.

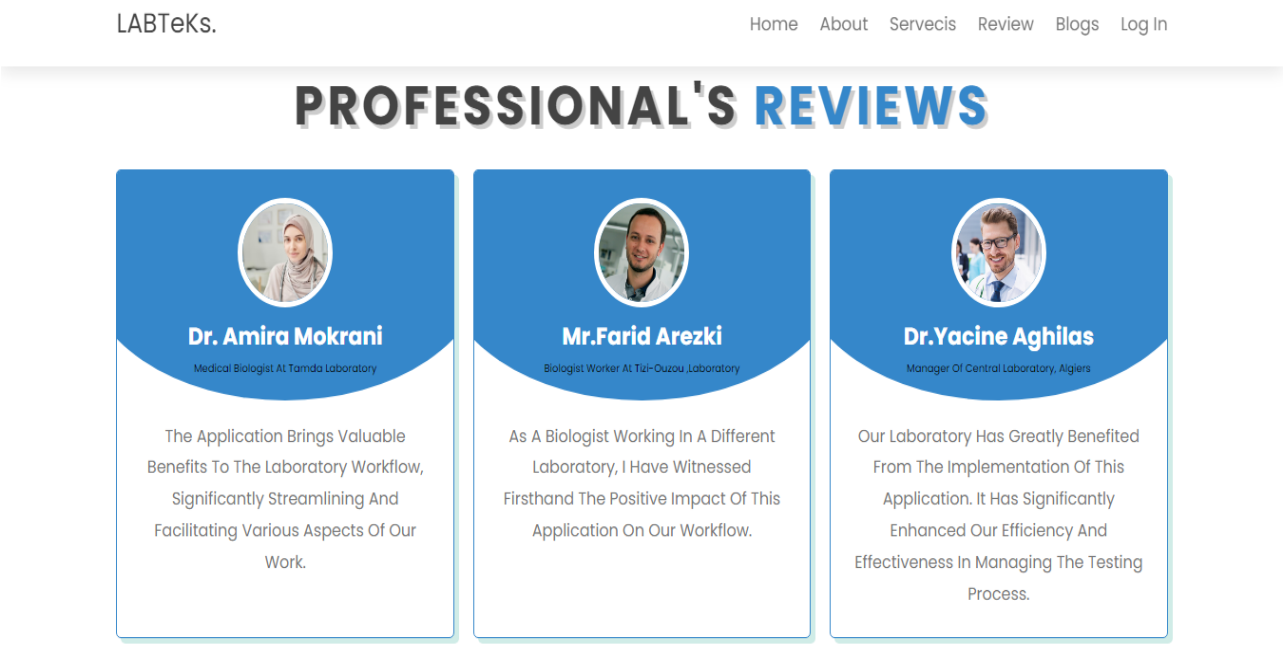

Figure 4. 15: Professional's reviews section

- **User's reviews section**

In addition to professional reviews, we also value the feedback and experiences of our users. The user review section allows individuals to share their first-hand experiences using our platform. This helps prospective users gain insights into the real-life impact and benefits of our services, fostering a sense of trust and transparency.

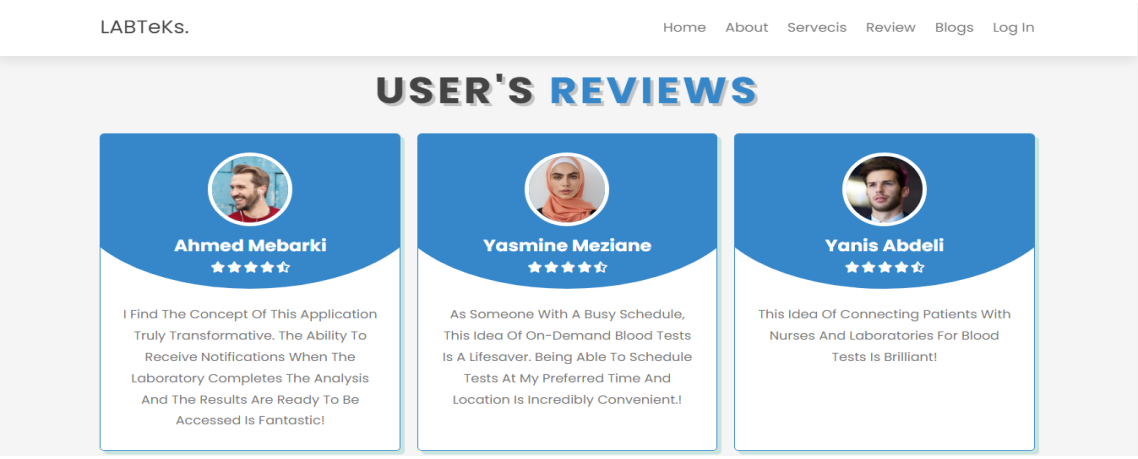

Figure 4. 16: User's reviews section

- **Blogs section**

our platform features a blog section where we regularly publish informative articles, news updates, and health-related insights. Users can stay informed about the latest developments in the healthcare industry, read expert opinions, and access valuable resources to support their well-being.

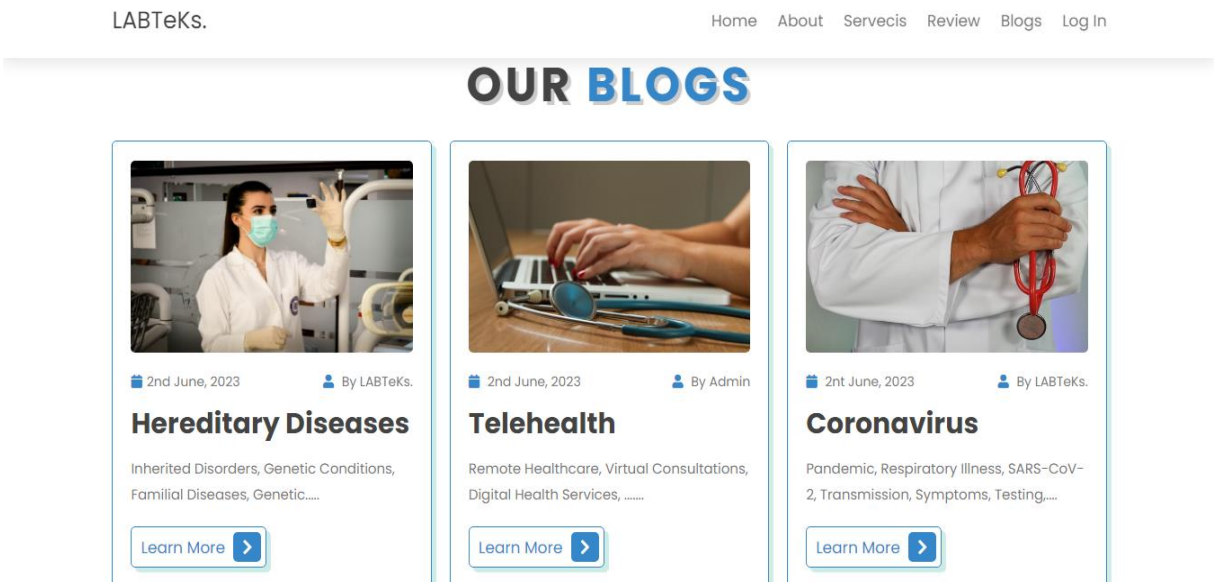

Figure 4. 17: Blogs section

- **The footer sections**

The footer section of our web application interface is designed to provide important information and navigation options to users. It appears at the bottom of each page and serves as a consistent element throughout the platform.

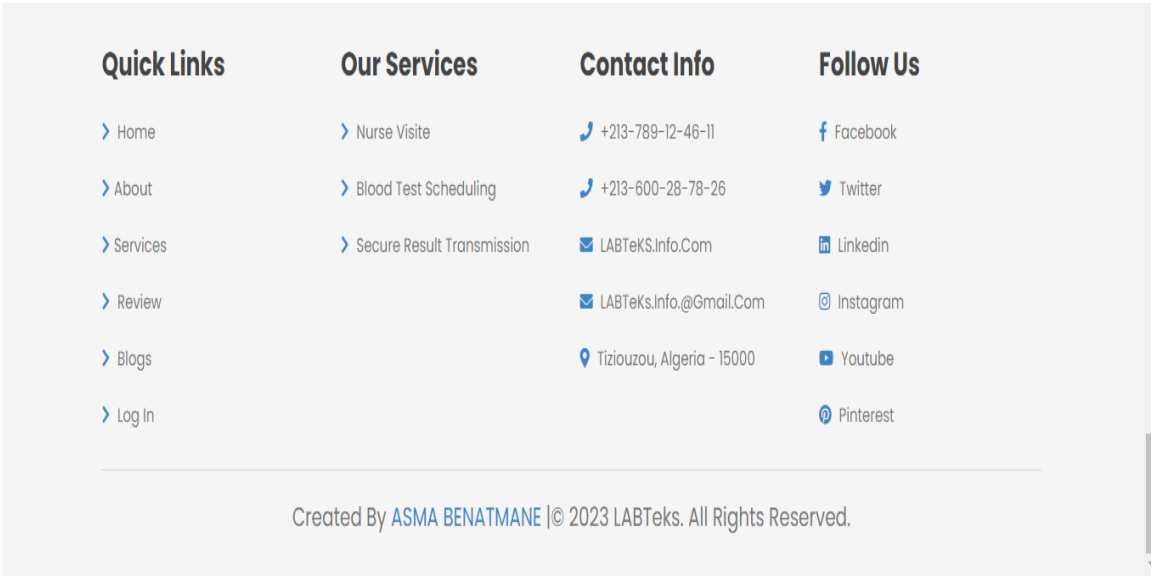

Figure 4. 18: Footer section

4.3.2. Sign-up

The sign-up process for our application is quick and convenient. Users can easily create an account by signing up through their Gmail, Facebook, LinkedIn, or Twitter accounts, streamlining the registration process and providing a seamless experience.

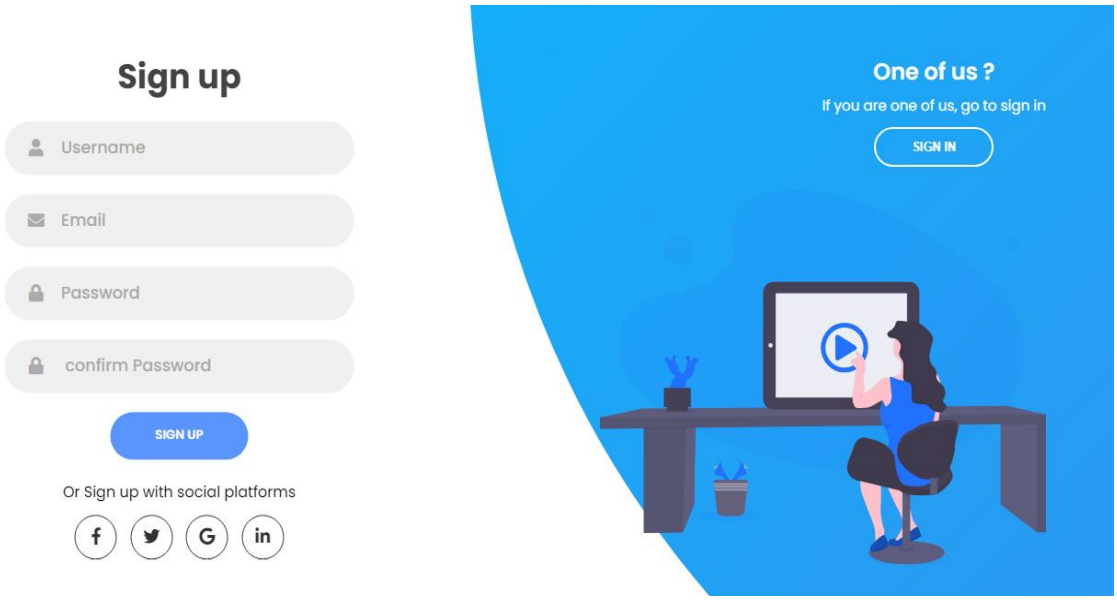

Figure 4. 19: Sign-up

4.3.3. sign-in

Our application offers a hassle-free sign-in process. Users can securely access their accounts by entering their username or email and password.

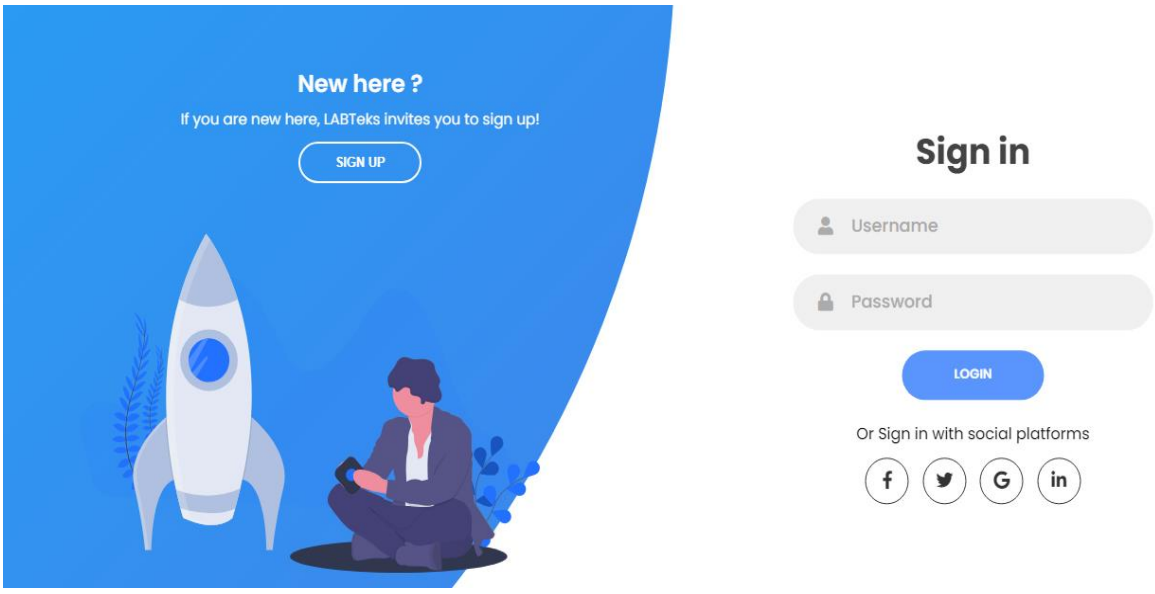

Figure 4. 20: Sign-in

4.3.4. LABTeKs - Laboratory Registration

After completing the sign-up process, laboratories can easily register by entering their information. This includes details such as the name of the laboratory, location, contact information, and any other necessary credentials.

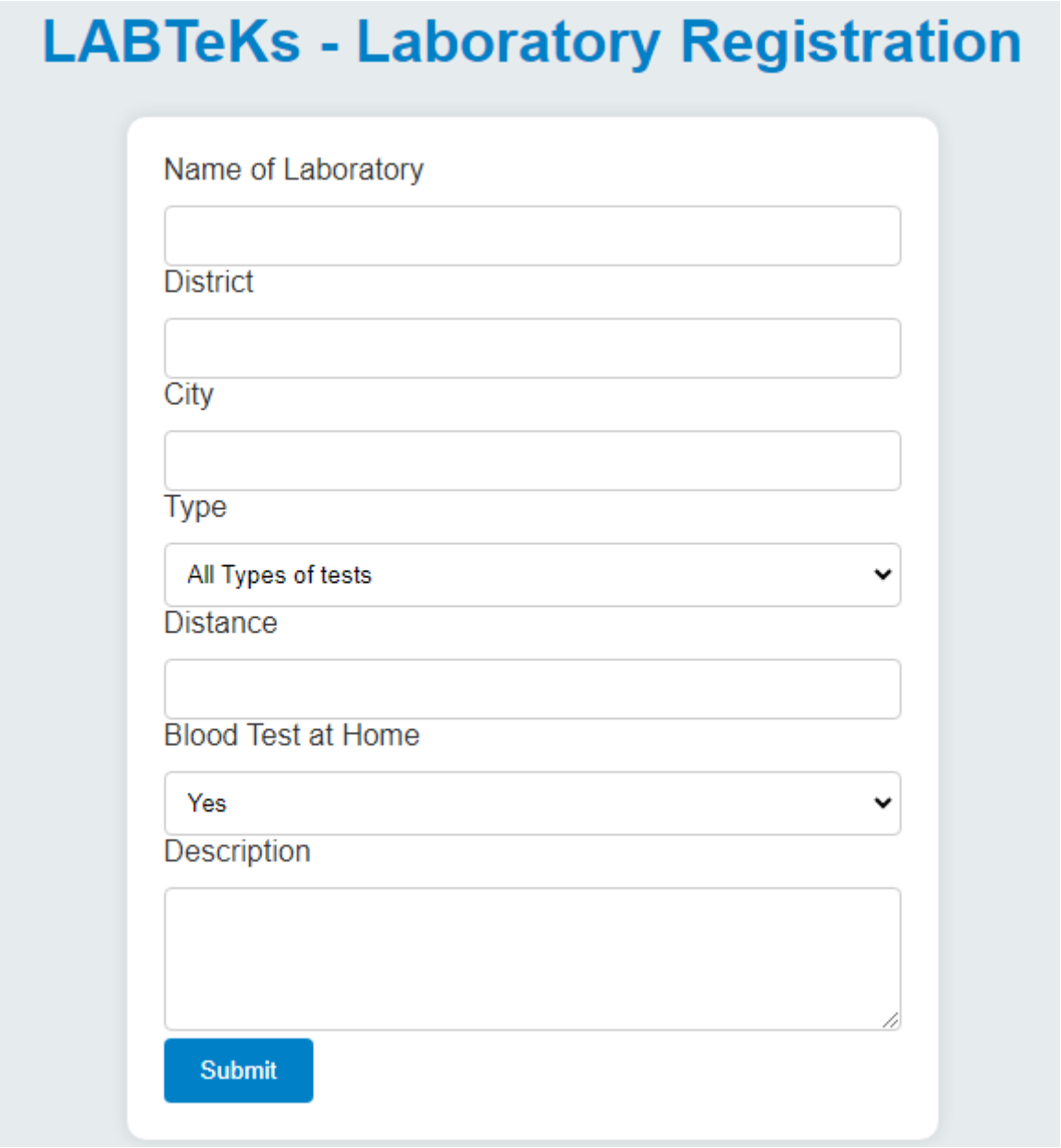

Figure 4. 21: LABTeKs - Laboratory Registration

4.3.5. Keyword-based laboratory research page

In this page, users can search for a laboratory by its name

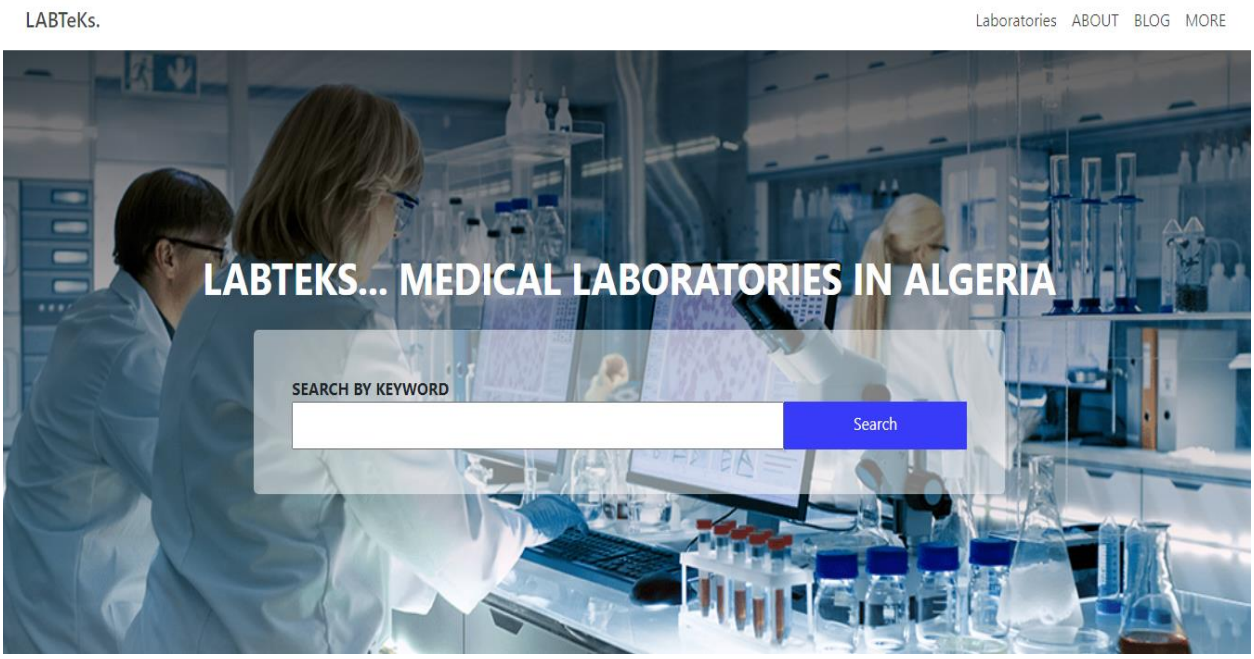

Figure 4. 22: Keyword-based laboratory research page

4.3.6. Filtered research page

The research page offers an additional option to filter results based on laboratory name, district, city, distance, and laboratory availability. This feature allows users to refine their search and find the most relevant laboratories that meet their specific criteria. With the ability to filter by various parameters, users can easily access the information they need and make informed decisions about their laboratory choices.

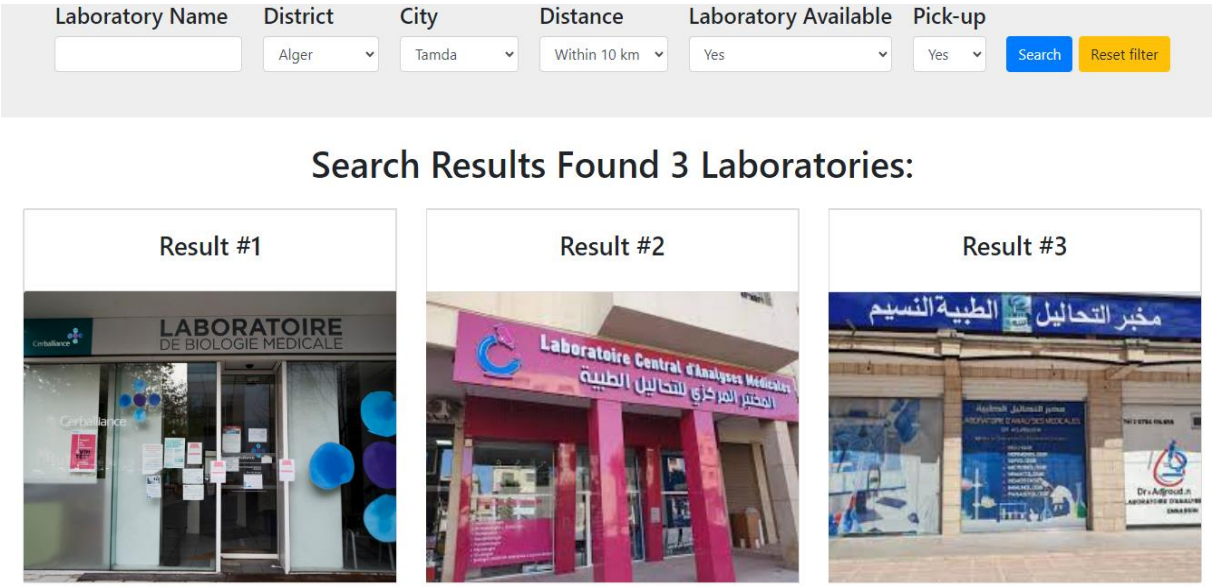

Figure 4. 23: Filtered research page

4.3.7. The Laboratory information page

On the Laboratory information page, users can find comprehensive details about the laboratory, including its phone number, Blood test at home if it is available or not, Type of test, and precise location, providing all the necessary information in one convenient place.

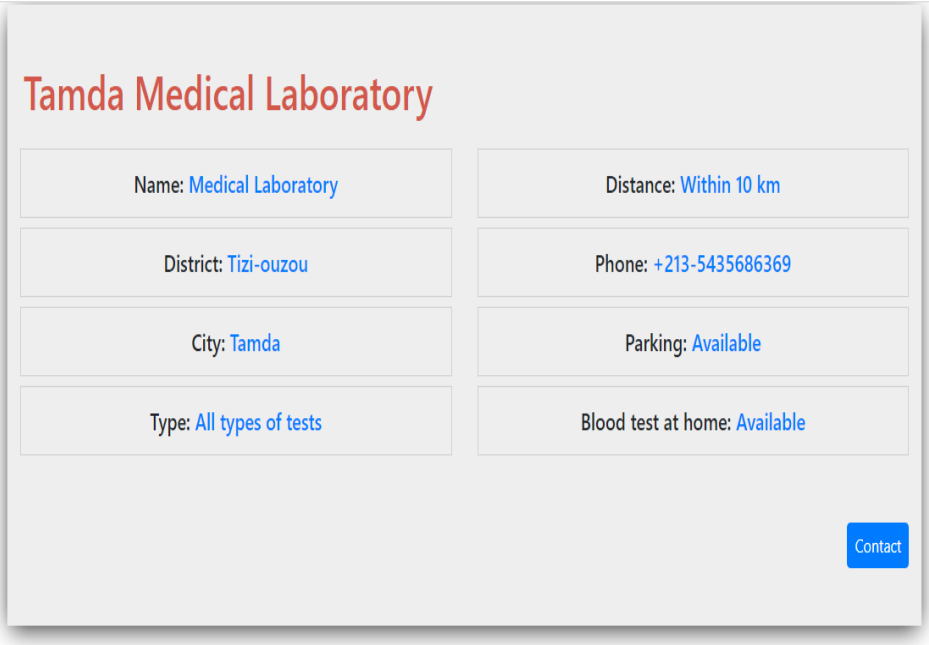

Figure 4. 24: Filtered research page

- **The localisation of the Laboratory**

In the laboratory information page, users can easily locate the laboratory using Google Maps integration, ensuring a seamless navigation experience.

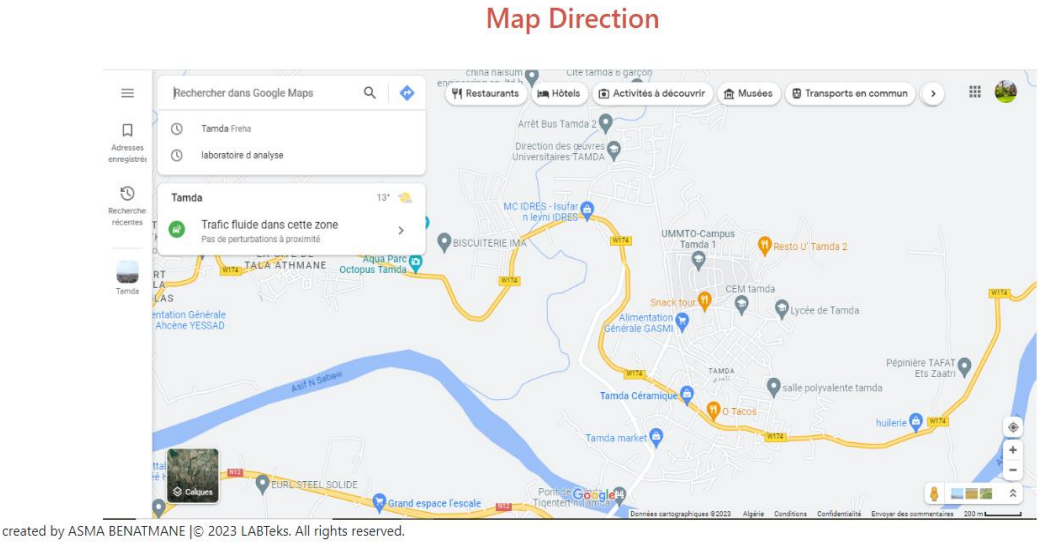

Figure 4. 25: The localisation of the Laboratory

4.3.8. The contact Option

Users can easily contact the laboratory by clicking on the "Contact" option. From there, they will have access to contact information or a convenient contact form to communicate their inquiries or requests efficiently. Additionally, users can also inquire about their blood test results through the designated contact channels, ensuring a seamless and comprehensive healthcare experience.

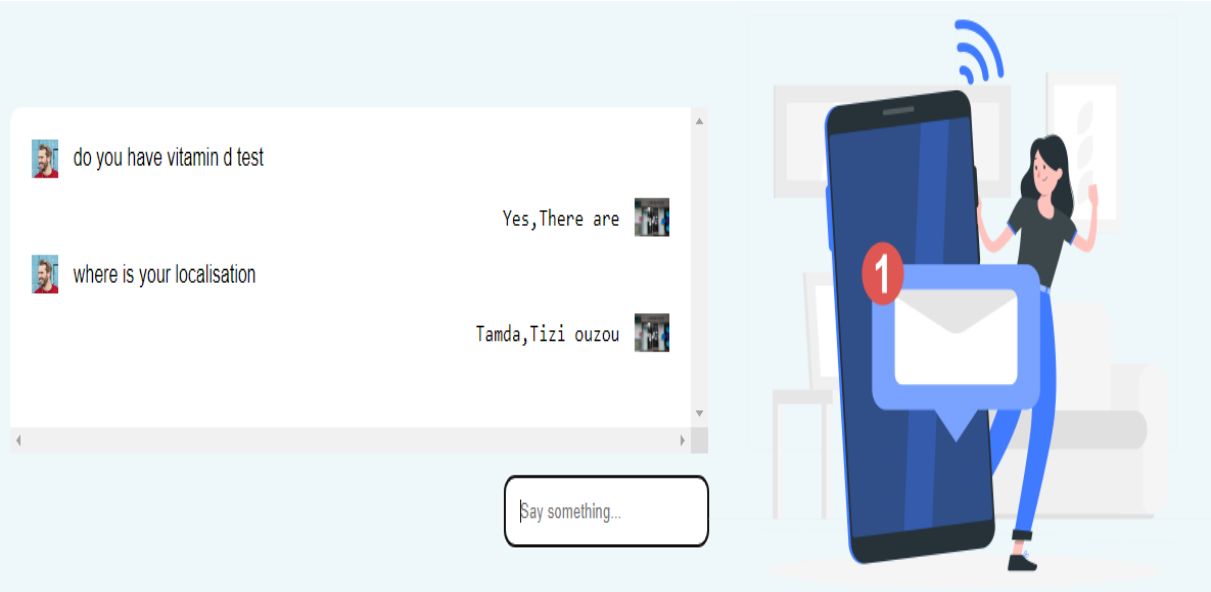

Figure 4. 26: The contact option

4.4. Conclusion

In this chapter, we have highlighted all the techniques needed to create this web application. We have demonstrated the development environment, and tools needed to create web applications, and we have given specific examples of creating web pages.

General conclusion

In recent years, technology, particularly telehealth, has become importance in the healthcare industry. Telehealth offers great benefits in improving the quality of healthcare services by providing intelligent solutions in the healthcare field. Therefore, we have decided to work in this field and develop a web application as service to facilitate communication between patients and medical analysis by allowing the laboratories to send nurses to patient's homes to perform sample collections and transmit analysis results via the application.

The objective of LABTeKs is to help the community and address the problems facing the laboratory sector. The application aims to make laboratory operations more efficient and improve the accessibility of tests. It will allow users to search for the best laboratories, receive notifications, and securely access test results online. By reducing physical contact and waiting times, the application prioritizes safety and convenience. Data security will be ensured, and the app will assist in contact tracing efforts. LABTeKs aims to provide a practical solution to manage challenges in laboratories and improve healthcare services.

As a prototype, this work primarily focuses on the user side of the application. By prioritizing user experience and satisfaction, we have designed the application to be intuitive and user-friendly. The goal is to provide a seamless and convenient experience for patients, allowing them to easily schedule blood tests, receive messages about completed analyses, and securely access their results. Through user-centric design and testing, we aim to create an application that meets the needs and preferences of users, ultimately improving their healthcare journey

Both professionals and individual users have expressed their enthusiastic support for LABTekS, appreciating its innovative concept and user-friendly design. The positive feedback from these stakeholders underscores the potential impact of LABTekS in enhancing healthcare accessibility and user experience

In order to improve the medical sector in Algeria, we are actively working on enhancing the application by adding new options and functionalities. These additions will provide healthcare providers and patients with more comprehensive tools and services. Additionally, we are prioritizing the strengthening of information security measures to ensure the privacy and confidentiality of medical data. By implementing these improvements, we aim to foster a secure and efficient healthcare environment in Algeria

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مسؤول الحاضنة العلمية

أ. لشهب سمير