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Topic

A mobile application for Doctor appointments and House Calls

Defended Publicly in Front of the Jury Composed of

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This thesis is dedicated

First and foremost, praises and thanks to ALLAH the most graceful and merciful, and his strength that contained me throughout my research work for its successful completion.

I dedicate this diary to my parents who have always been my pillars throughout my life. Your constant support and constant encouragement have allowed me to achieve my goals and realize my dreams. Thank you for instilling values such as perseverance and discipline which were decisive for the success of this Master program.

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Abstract

The healthcare industry is growing rapidly worldwide, with a rising demand for medical services. In the past, scheduling appointments involved phone calls or in-person visits. However, the emergence of online appointment systems has transformed healthcare by providing timely and efficient access to services. MyClinic, a cutting-edge mobile application, integrates appointment booking, house calls, and telemedicine capabilities. It aims to revolutionize healthcare by connecting doctors and patients directly, eliminating third-party involvement. By utilizing an agile approach based on Scrum, MyClinic ensures efficient development and enhances accessibility and convenience for users.

keywords: healthcare industry, online appointment systems, MyClinic, mobile application, house calls, telemedicine, Agile approach, Scrum.

مُلخّص

يشهد مجال الرعاية الصحية نمواً سريعاً حول العالم خاصة مع زيادة الطلب على الخدمات الطبية. في الماضي، كان حجز المواعيد يقتصر على المكالمات الهاتفية أو الزيارات الشخصية ومع ظهور نظم حجز المواعيد عبر الإنترنت، تطور نظام الرعاية الصحية من خلال توفير وصول سريع وفعال للخدمات، مشروعنا هو عبارة على تطبيق متقدم على الهواتف المحمولة، يجمع بين حجز المواعيد والزيارات المنزلية وخدمة الرعاية عن بُعد. يهدف التطبيق إلى احداث ثورة في ميدان الرعاية الصحية من خلال ربط الأطباء والمرضى مباشرةً باستخدام نهجٍ مرِنٍ يعزز إمكانية الوصول والراحة للمستخدمين.

الكلمات المفتاحية: الرعاية الصحية، نظم حجز المواعيد عبر الإنترنت، تطبيق محمول، زيارات منزلية، الرعاية عن بُعد، نهج مرِن

Résumé

L'industrie des soins de santé connaît une croissance rapide à travers le monde, avec une demande croissante de services médicaux. Dans le passé, la prise de rendez-vous impliquait des appels téléphoniques ou des visites en personne. Cependant, l'émergence des systèmes de rendez-vous en ligne a transformé le domaine de la santé en offrant un accès rapide et efficace aux services. MyClinic, une application mobile de pointe, intègre la réservation de rendez-vous, les visites à domicile et les capacités de télémédecine. Son objectif est de révolutionner les soins de santé en connectant directement les médecins et les patients, éliminant ainsi l'intervention de tiers. En utilisant une approche agile basée sur Scrum, MyClinic garantit un développement efficace et améliore l'accessibilité et la commodité pour les utilisateurs.

mots-clés: Industrie des soins de santé, prise de rendez-vous , MyClinic, application mobile, visites à domicile, télémédecine, Approche Agile, Scrum.

Table of Contents

Acknowledgements	i
Abstract	ii
Table of Contents	v
List of Figures	viii
List of Tables	x
Background Introduction	1
I Problem Statement Introduction	2
1 Introduction	2
2 Context of Study	3
3 Problem Statement	4
4 Project Objectives	4
5 Methodology	5
6 Audience	6
7 Thesis Outline	6
II Technical Background	8
1 Introduction	8
2 An overview of the healthcare sector	9
2.1 Health Care definition	9
2.2 Healthcare Stages	10
3 Mobile software development	11
4 Mobile Development and Health Care	12
4.1 Telemedicine and Remote Consultations	12
4.2 Remote Patient Monitoring	13

4.3	Health and Wellness Tracking	13
4.4	Electronic Health Records "EHR" Access	13
4.5	Medication Management	13
4.6	Health Education and Awareness	13
4.7	Medical Research and Clinical Trials	14
4.8	Communication and Collaboration	14
5	Literature Review	14
5.1	Review of existing mobile applications for doctor appointments and house calls	14
5.1.1	Doctor appointments applications	14
5.1.2	House calls applications	17
5.2	User experiences and feedback from existing solutions	20
5.3	Advanced Analysis of Mobile Applications for Doctor Appointments and House Calls	22
5.3.1	Impact on Patient Outcomes	22
5.3.2	User Engagement	23
5.3.3	Future Growth and Innovation	24
6	Problematic	25
7	Proposed Solutions: Aligning Project Objectives for Success	27
8	Conclusion	28
III Challenges and Implementation of Agile Methodology		29
1	Introduction	29
2	Agile methodology	30
3	Agile Principles and Practices	32
3.1	Agile Principals and Values	32
3.2	Agile Practices	32
4	Agile Methods	34
4.1	Scrum	34
4.2	Extreme Programming	37
4.3	Feature Driven Development	37
4.4	Test Driven Development	38
4.5	Dynamic Systems Development Method	39
4.6	Kanban	40
5	Tools and Technologies	42
6	Definition of project management	43
7	Definition of Agile project management	44

8	Challenges and Benefits	44
8.1	Challenges of agile project management	44
8.2	Benefits of agile project management	45
9	Conclusion	47
IV Design And Implementation		48
1	Introduction	48
2	Definition UML	49
3	UML Diagrams	50
3.1	Use Case Diagrams	50
3.2	Sequence Diagrams	56
3.3	Class Diagram	59
4	Presentation of the application	60
4.1	Interfaces	60
5	Conclusion	71
V Frameworks, Tools and Libraries		72
1	Introduction	72
2	Development Environment	72
2.1	Android SDK	72
2.2	Android Studio	73
2.3	Emulator	74
2.4	Flutter	75
3	Development Languages	76
3.1	Dart	76
4	Firestore	77
5	Laravel	78
6	MySQL	79
7	Conclusion	80
General Conclusion		81
References		82

List of Figures

II.1 Doctolib Interfaces	15
II.2 ZocDoc Interfaces	16
II.3 eTabib Interfaces	16
II.4 HouseCall Interfaces	17
II.5 Doctor On Demand Interfaces	18
II.6 Heal Interfaces	19
II.7 SantéDom	19
III.1 MyClinic project on Azure DevOps	43
IV.1 UML logo	49
IV.2 Patient Use Case Diagram	51
IV.3 Medical Professional Use Case Diagram	53
IV.4 Admin Use Case Diagram	55
IV.5 Book Appointment Sequence Diagram	57
IV.6 Manage Appointments Sequence Diagram	58
IV.7 MyClinic mobile application Class Diagram	59
IV.8 Patient Register Interface	60
IV.9 Doctor Log in Interface	61
IV.10 Sign Up Interface	62
IV.11 Home Interface	63

IV.12	Schedule Interface	64
IV.13	Schedule Interface	65
IV.14	Doctor Profile Interface	66
IV.15	Book Appointment Interface	67
IV.16	Log out Interface	68
IV.17	Admin Panel Interface	69
V.1	Android SDK logo	73
V.2	Android Studio logo	74
V.3	Flutter logo	75
V.4	Dart programming language logo	76
V.5	Firebase logo	77
V.6	Laravel logo	78
V.7	Mysql logo	79

List of Tables

III.1 Comparison of Agile Methodologies	41
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Background Introduction

Smartphones have become an integral part of our lives, revolutionizing various aspects of society. Their attributes, including mobility, instant connectivity, convenience, and location awareness, have contributed to their widespread acceptance worldwide. Today, smartphones are no longer solely communication devices; they are viewed as handheld computing devices. The rise of mobile applications, or apps, has further enhanced the smartphone experience. Apps, specialized software programs accessible on mobile devices, have gained popularity due to their simplicity, user-friendliness, speed, and portability. They provide users with quick access to a wide range of services, from booking tickets to shopping and even healthcare. Mobile apps have expanded into various sectors, including m-commerce, entertainment, advertisement, education, and healthcare, offering users easy access to information whenever and wherever needed.

The widespread availability of mobile devices and applications have made them highly suitable for medical professionals. The healthcare sector has witnessed a surge in the development of mobile health (mHealth) apps, which are transforming the delivery of healthcare services worldwide. These apps, focusing on patient monitoring, data collection, documentation, and advertising, are proving invaluable to clinicians. By leveraging healthcare apps, professionals can significantly enhance the efficiency and timeliness of accessing, analyzing, and responding to clinical data and reference information.

Chapter I

Problem Statement Introduction

1 Introduction

Software systems have become increasingly complex and sophisticated, posing challenges in their development. Effective management of this complexity is crucial for the success and cost-efficiency of software projects. Software Engineering has emerged as a key player in addressing these challenges through methodologies like Scrum, eXtreme Programming, and Rational Unified Process, as well as approaches such as Waterfall, Agile, Prototyping, and Iterative. Software Engineering equips developers with tools and techniques, including abstraction mechanisms like Object-Oriented programming and UML, to handle complexity and promote manageable development processes. Quality assurance and verification are also essential for ensuring high-quality software systems.

Mobile computing has rapidly evolved in software development, driven by advancements in mobile devices and operating systems. These advancements have made mobile applications an integral part of our daily lives, replacing traditional activities with a wide range of applications leveraging various capabilities like the Internet, gestures, GPS, video, and audio. This popularity is attributed to the efforts of major industry players like Google, Apple, and Microsoft, who have played a significant role in

promoting their products. Since 2005, the World Health Organization (WHO) has stressed the importance of developing healthcare infrastructure in information and communication technology (ICT) for equal, affordable, and universal access to healthcare. This collaboration aims to reduce costs and successfully implement eHealth, which can provide significant support for rehabilitation. However, the interchangeable use of terms like eHealth, mHealth, telehealth, telerehabilitation, and telemedicine can lead to confusion and misunderstandings in the field. The utilization of ICT, particularly smartphones and tablets, is experiencing rapid growth. The worldwide number of smartphone mobile network subscriptions reached nearly 6.6 billion in 2022 and is projected to surpass 7.8 billion by 2028. The mobile app market is expected to expand further, with the number of mHealth apps available to Android users through the Google Play Store reaching over 65,300 thousand in the last quarter of 2021.

The application of ICT in healthcare has demonstrated significant potential in improving the quality of life for people, especially older individuals. Furthermore, ICT has proven valuable in enhancing communication between patients and healthcare providers, resulting in improved healthcare outcomes and enhanced patient experiences.

2 Context of Study

This thesis was conducted under the supervision of Professor Kahloul Laid, the head of the LINFI computer science laboratory at the University of Biskra and Doctor Tigane Samir. It was carried out in collaboration with the entrepreneurship house, which is responsible for providing training to students to establish their own startup enterprises. The project idea was approved by the Health Directorate of Biskra Province in relation to the master's degree program in software engineering and distributed systems at the University Mohamed Khider Biskra. The LINFI Group has been involved in various projects within the healthcare field, particularly those related to mHealth. One such project is a mobile application developed in 2020-2021 that enables users

to access basic information about doctors in the Biskra region and determine their geographical locations.

Furthermore, this research work is intrinsically related to the objective of assisting individuals in refreshing their skills and empowering them to develop their own projects, thereby enabling them to actively participate in the dynamic startup ecosystem.

3 Problem Statement

Limited accessibility to traditional healthcare poses significant challenges for individuals in various situations. These include individuals with mobility issues who cannot easily visit a doctor's office, patients with chronic illnesses who struggle with frequent appointments, elderly patients facing age-related limitations, individuals with busy schedules unable to find time for traditional appointments, and patients with contagious illnesses seeking to avoid crowded healthcare settings. These limitations create barriers to timely and necessary healthcare services, exacerbating healthcare disparities. Addressing these challenges requires effective telemedicine solutions that can provide remote healthcare services, irrespective of individuals' location or physical proximity to healthcare facilities.

4 Project Objectives

The main goal of this project is to develop a secure and reliable m-healthcare application that caters to different healthcare communities. Our objective is to leverage technology to improve access to healthcare, enhance convenience and flexibility, facilitate timely medical care, enable remote monitoring and chronic disease management, reduce healthcare costs, enhance continuity of care, and empower patient education and engagement. Through these objectives, our project aims to revolutionize healthcare delivery, making it more accessible, convenient, cost-effective, and patient-centered.

5 Methodology

Throughout the development of the MyClinic application, the Agile Scrum methodology, complemented by Azure DevOps, was adopted to promote collaboration and optimize the software development process.

The project was divided into multiple sprints, each spanning one to two weeks, with clearly defined goals and deliverables. Initially, a product backlog was created, consisting of a prioritized list of features and requirements, which was efficiently managed using Azure DevOps. This platform facilitated transparent and accountable tracking and updating of the backlog.

During each sprint, sprint planning sessions were conducted to select backlog items based on priority and estimate the effort required for each item. These items were further divided into tasks and assigned to individual team members. Azure DevOps provided a collaborative environment for task assignment and progress tracking.

Daily scrum meetings were held throughout the sprint to discuss progress, address obstacles, and plan the day's work. Azure DevOps played a vital role in coordinating these meetings, offering tools for tracking work items and sharing updates, ensuring seamless communication and collaboration.

Azure DevOps also supported continuous integration and testing by enabling automated building and testing of the application whenever changes were pushed to the repository. This approach facilitated early issue detection and prompt resolution.

Additionally, Azure DevOps facilitated efficient version control by creating branches for new features or bug fixes. The developers worked on their respective branches and merged changes to the main branch when ready, streamlining the development process and reducing conflicts. At the end of each sprint, sprint reviews were conducted to showcase the completed work to stakeholders, gather feedback, and adjust priorities if necessary. Retrospective meetings were held to reflect on the sprint and identify areas for the process.

Azure DevOps provided valuable insights during these meetings, offering data on sprint performance, backlog completion, and potential bottlenecks. This iterative approach allowed for continuous development and enhancement of the doctor appointment application. By combining Agile Scrum principles with Azure DevOps, effective collaboration, improved coordination, and a streamlined development lifecycle were achieved. The resulting application met the needs of end-users, and the combination of Flutter development and Azure DevOps collaboration proved successful for the project.

6 Audience

This work is aimed to patients seeking convenient and remote access to healthcare services, healthcare providers interested in offering virtual consultations and remote monitoring, healthcare facilities and organizations looking to expand their reach and enhance service offerings, and caregivers and family members wanting to actively participate in the care of their loved ones.

7 Thesis Outline

The structure of the thesis is as outlined below:

- **Chapter 2: Technical Background.**

This chapter delves into the realm of healthcare, exploring the transformative impact of mobile development in the field. It examines the current state of the art regarding highly-rated mobile applications worldwide and specifically in Algeria. Furthermore, the chapter analyzes the results derived from the literature review, unveiling several issues associated with traditional doctor appointments. Subsequently, we propose solutions that align with our project objectives, highlighting their significance.

- **Chapter 3: Challenges and Implementation of Agile Methodology.**

This chapter provides a comprehensive definition of agile methodology, encompassing its principles and practices. It explores the various implementation tools and technologies associated with agile, and delves into the specific utilization of agile in our project management approach. Additionally, it highlights the challenges encountered throughout the process and discusses the benefits obtained from adopting agile methodologies.

- **Chapter 4: Design and implementation.**

In this chapter, we present a comprehensive definition of the Unified Modeling Language (UML) along with its corresponding diagrams that were employed during the conception phase of our study. We explore the application interfaces' presentation and demonstrate how UML diagrams capture system designs effectively.

- **Chapter 5: Frameworks, Tools and Libraries.**

This chapter provides an overview of the frameworks, tools, and libraries utilized in this work.

- **General Conclusion.**

We summarize and review our ideas and results and giving some perspectives.

Chapter II

Technical Background

1 Introduction

In today's rapidly evolving world, advancements in technology have had a profound impact on various industries, and healthcare is no exception. With the widespread adoption of mobile devices and the growing availability of mobile applications, the healthcare sector has witnessed a shift in how healthcare services are accessed and delivered. This chapter delves into the applications of mobile development in healthcare, focusing specifically on doctor appointments and house calls. Additionally, we explore the challenges and benefits associated with these applications through a comprehensive literature review. Furthermore, we present a solution to address the limitations of traditional doctor appointments in Algeria, introducing our innovative mobile application, 'MyClinic'. By examining the evolving landscape of healthcare technology and proposing a practical solution, this chapter aims to shed light on the potential of mobile development to revolutionize healthcare delivery and improve accessibility for patients.

2 An overview of the healthcare sector

The healthcare industry is a vast and complex sector encompassing various activities, services, and professionals dedicated to the preservation and improvement of human health. It includes healthcare providers such as hospitals, clinics, and individual healthcare professionals who deliver direct patient care. The pharmaceutical industry focuses on the research, development, production, and distribution of medications and drugs. Medical technology and devices play a crucial role in diagnostics and treatments. Health insurance companies provide coverage plans to manage healthcare costs. Public health initiatives prioritize disease prevention and health promotion. Research and development drive medical advancements, while regulatory and government bodies ensure safety and quality. The healthcare industry faces challenges but also presents opportunities for improved patient care and innovative solutions to evolving health concerns.

2.1 Health Care definition

In a medical dictionary healthcare is "*The prevention, treatment, and management of illness and the preservation of mental and physical well-being through the services offered by the medical and allied health professions.*" [1].

According to Cambridge dictionary it is "*The set of services provided by a country or an organization for the treatment of the physically and the mentally ill*" [2].

The Definition of MBN (Market business news) is "*Healthcare refers to the efforts that medical professionals make to restore our physical and mental well-being. The term also includes the provision of services to maintain emotional well-being*" [3].

Healthcare is an extensive concept that includes a range of activities aimed at preventing, identifying, treating, and overseeing ailments, injuries, and conditions with the goal of enhancing the overall health and welfare of individuals. It encompasses a collaborative effort involving diverse medical

experts, healthcare establishments, technologies, and systems to provide medical care to patients.

2.2 Healthcare Stages

Depending on health problem, healthcare is staged into four different stages:

Primary Healthcare

Primary healthcare encompasses essential healthcare services that are universally accessible to individuals and families in the community. It caters to a person's overall health needs throughout their lifetime, focusing on physical, mental, and social well-being. Primary healthcare adopts a people-centered approach rather than a disease-centered one, encompassing health promotion, disease prevention, treatment, rehabilitation, and palliative care.[4]

Secondary Healthcare

Secondary healthcare arises when individuals are referred by their primary care provider to a specialist. At this level of care, individuals receive specialized treatment from experts with specific knowledge in their particular health condition. Specialists often concentrate on specific bodily systems or diseases/conditions. For example, cardiologists specialize in heart health and its pumping system, while endocrinologists focus on hormone systems and may specialize in conditions such as diabetes or thyroid disease. Secondary healthcare is required when individuals need specialized medical attention.[5]

Tertiary Healthcare

Tertiary healthcare provides specialized care to patients who have been referred from secondary care for diagnosis or treatment that exceeds the capabilities of primary or secondary care. Tertiary care facilities are commonly found in medical schools and teaching hospitals. Tertiary healthcare is particularly relevant for rare conditions or when diagnostic or treatment facilities are limited or require scarce combinations of resources. In some cases, tertiary healthcare may still be primarily focused on research efforts[6].

Quaternary healthcare

Quaternary healthcare represents an advanced stage in the medical field that focuses on experimental and cutting-edge treatments and procedures. This stage goes beyond tertiary healthcare[7], aiming to address rare and complex medical conditions for which conventional treatments have limited effectiveness. Quaternary healthcare involves exploring innovative techniques, therapies, and technologies, such as gene therapies, personalized medicine, regenerative medicine, advanced surgical techniques, and targeted therapies[8].

3 Mobile software development

Mobile software development or mobile development is a multifaceted process that encompasses the creation of mobile applications. It involves several crucial tasks, starting with requirements gathering, where the development team strives to understand the needs of both the users and the business. This stage sets the foundation for the entire development process by determining the core features and functionalities the app should possess. Subsequently, the design phase comes into play, where a visual representation of the application is created, including its user interface and user experience elements. Once the design is finalized, the actual development phase begins, wherein skilled developers write the necessary code to bring the application to life, ensuring it is compatible with various mobile platforms and devices. Rigorous testing follows to guarantee that the app functions flawlessly, meets the specified requirements, and provides a seamless user experience.

Finally, the deployment stage involves making the application available to users, either through app stores or enterprise distribution channels, ensuring its accessibility and usability. Overall, mobile software development demands a comprehensive and iterative approach to deliver high-quality applications that meet the needs and expectations of users in today's mobile-driven world.

4 Mobile Development and Health Care

The enormous potential of mobile communication to revolutionize healthcare and clinical intervention in the community is evident. Previous studies have extensively examined the utilization of mobile phones in supporting healthcare and public health initiatives. These studies have focused on various aspects, such as data collection for healthcare research, medical and healthcare education, and clinical practice in the community.

Notably, mobile phones have proven successful in facilitating telemedicine and remote healthcare in developing nations. Examples include their use in off-site medical diagnosis and as information support in the treatment of HIV care in rural areas that are challenging to reach.

Recent literature has explored specific functionalities of smartphones. For instance, studies have examined the use of on-board digital diaries for symptom research, the utilization of SMS text messages for behavior change management, and improving patients' adherence to antiretroviral treatment. Additionally, comparisons have been made between mobile phone records and traditional paper-based records in controlled drug trials.

The incorporation of GPS and location-enabled smartphones opens additional application opportunities. These technologies can enhance the independent living of individuals with disabilities and/or multiple chronic conditions. They also prove useful in epidemiology/public health surveillance and community data collection.

4.1 Telemedicine and Remote Consultations

Mobile apps enable patients to have virtual appointments with healthcare providers through video calls, bringing medical consultations directly to the patient's smartphone or tablet. This facilitates remote access to healthcare

services, particularly for individuals in rural areas or those with limited mobility.

4.2 Remote Patient Monitoring

Mobile apps and wearable devices allow for remote monitoring of patient health data, such as vital signs, glucose levels, or medication adherence. This data can be securely transmitted to healthcare providers, enabling proactive care management and early intervention.

4.3 Health and Wellness Tracking

Mobile health (mHealth) apps empower individuals to track and manage their health conditions, monitor fitness activities, set medication reminders, and access educational resources. These apps can provide personalized insights and support individuals in making informed decisions about their health.

4.4 Electronic Health Records "EHR" Access

Mobile apps provide healthcare professionals with on-the-go access to electronic health records, allowing them to view patient information, update medical records, and make informed decisions regardless of their location.

4.5 Medication Management

Mobile apps help patients manage their medication schedules by sending reminders for medication intake, tracking medication adherence, and providing information about drug interactions or potential side effects. These apps enhance medication safety and improve patient compliance.

4.6 Health Education and Awareness

Mobile apps offer a platform for healthcare providers to disseminate health education materials, raise awareness about specific conditions or diseases, and provide guidance on healthy lifestyles. Users can access educational resources, articles, videos, and interactive tools on their mobile devices.

4.7 Medical Research and Clinical Trials

Mobile apps facilitate patient recruitment and data collection for medical research studies and clinical trials. Researchers can engage with study participants, collect real-time data, and monitor study progress through mobile platforms.

4.8 Communication and Collaboration

Mobile development supports secure and efficient communication and collaboration among healthcare professionals. Messaging apps, secure messaging platforms, and teleconferencing tools enable timely exchange of patient information, consultation among specialists, and remote collaboration.

5 Literature Review

This review explores the existing mobile applications for doctor appointments and house calls. By examining their features, functionalities, and user experiences, we aim to understand their potential benefits and limitations in improving patient access to healthcare services. Additionally, we provide a comparative analysis of top-rated applications in different countries, including Algeria. While our focus is on applications available on popular platforms like Google Play and the App Store, it is important to note that they may be considered as scientific resources. Nonetheless, this review offers valuable insights for healthcare providers, policymakers, and app developers to enhance appointment booking and house call services.

5.1 Review of existing mobile applications for doctor appointments and house calls

5.1.1 Doctor appointments applications

- **Doctolib**

Doctolib is a widely used online healthcare booking platform in Europe, connecting patients with healthcare professionals[9]. Users can easily book appointments with doctors, dentists, specialists, and more. Some

healthcare providers offer telehealth consultations, enabling virtual appointments from the comfort of home. Doctolib also offers features for healthcare professionals to manage appointments, synchronize schedules, and facilitate online prescription renewals. Patients can access reviews and ratings to make informed decisions, and the platform integrates with health records for streamlined healthcare management with its user-friendly interfaces.

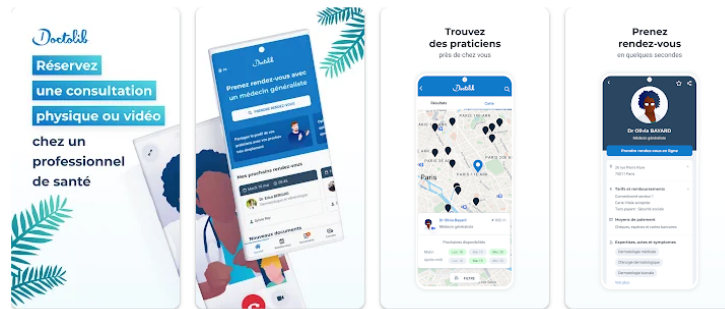


Figure II.1: Doctolib Interfaces

- **ZocDoc**

ZocDoc aims to simplify and expedite the process of scheduling appointments with doctors and healthcare providers. The platform allows users to select the type of care they need, such as primary care, dentistry, psychiatry, vision, or dermatology, and provide basic information about their location, preferred appointment time, and insurance coverage. ZocDoc then displays a list of providers with available appointment slots within the next 24 hours like it shows Figure II.2, enabling patients to book appointments instantly online. The app also sends reminder notifications to patients. Although ZocDoc's practitioner network is currently limited to major metropolitan areas like New York, Baltimore, Washington D.C., Seattle, Atlanta, Houston, Dallas, Austin, Boston, Philadelphia, Chicago, Denver, San Francisco, Miami, Los Angeles, and San Diego[10].

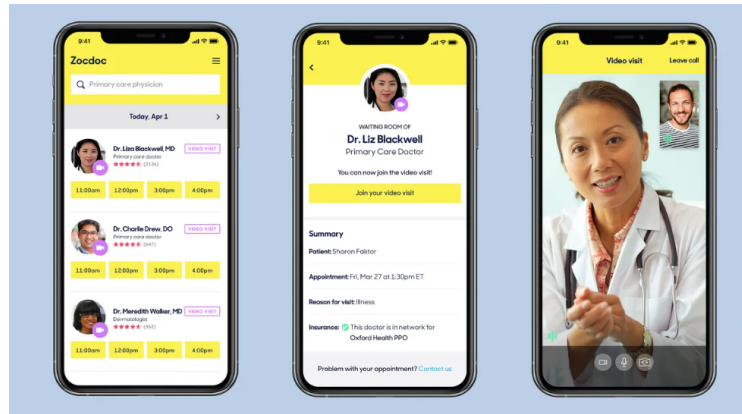


Figure II.2: ZocDoc Interfaces

- **eTabib**

eTabib is a telemedicine platform and mobile application that offers virtual healthcare services. It is the first medical platform in Algeria that allows users to connect with licensed doctors and healthcare professionals remotely for medical consultations and advice. The platform provides convenient access to healthcare services, eliminating the need for in-person visits. Users can schedule appointments, have video consultations, receive prescriptions, and access medical advice and support from the comfort of their own homes. eTabib aims to provide accessible and efficient healthcare services through digital means[11].



Figure II.3: eTabib Interfaces

5.1.2 House calls applications

- **Housecall**

Housecall is a telemedicine platform and mobile app based in the UAE that provides full-service healthcare accessible virtually or at home. Led by young Emirati co-founders, Housecall offers primary care services through in-person, virtual, and at-home consultations. The app enables patients to schedule appointments, receive at-home blood sample collections, and have prescriptions delivered. It offers longer, personalized consultations and is covered by a growing list of insurance providers in the UAE, ensuring convenient and comprehensive medical care for patients in Dubai, Abu Dhabi, and Al Ain[12].

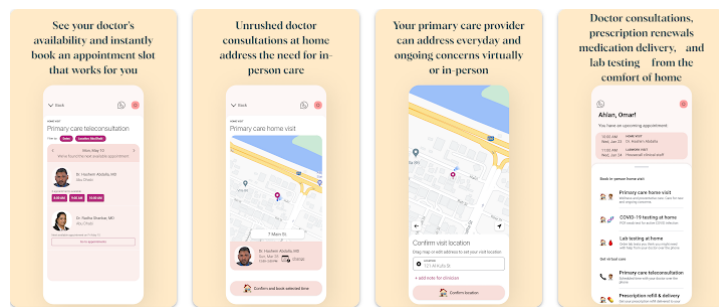


Figure II.4: HouseCall Interfaces

- **Doctor On Demand**

Doctor on Demand is a telemedicine platform that can provide medical assistance both on-demand and by appointment for various physical and mental health problems like it shows Figure 2.5. Doctor On Demand primarily serves customers in the United States. Users can have a brief video consultation with a licensed physician who can offer guidance and treatment for common ailments such as cold and flu, allergies, rashes, headaches, and more. The service can also be used by patients with chronic conditions like asthma, diabetes, and high blood pressure to help manage their health issues. Doctor on Demand has therapists and psychiatrists available for behavioral and mental health care as well.

The platform is free to download, and there are no subscription fees. Uninsured users are charged a flat rate for different services, while those with health insurance can use their coverage. Additionally, Doctor on Demand has partnered with national companies like American Airlines and Wal-mart to offer employee discounts for their services[13].



Figure II.5: Doctor On Demand Interfaces

- **Heal**

The Heal app seeks to increase the accessibility and affordability of house calls through technology. The app enables users to book a house call visit with a doctor for various services As depicted in Figure II.6. Patients without insurance are charged a flat fee of 159 dollar per visit, based on the information provided on this website [14], while those with insurance typically pay the same as their co-pay. Heal's medical team can provide care for severe conditions like viruses, infections, and rashes, as well as preventative care such as flu shots and physicals. Pediatric care, including vaccines and health screenings, is also available. Heal's services are available in 11 states, including California, Maryland, Georgia, Illinois, Louisiana, North Carolina, New Jersey, New York, Virginia, Washington, and Washington D.C., covering 130 million Americans.

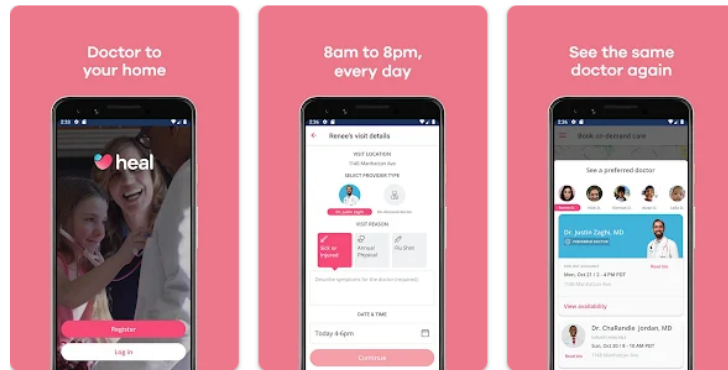


Figure II.6: Heal Interfaces

- **SantéDom**

SantéDom is an approved home care service in Algeria, authorized by the Ministry of Health. It provides medical consultations, nursing procedures, and hospitalization at home. Their teams of doctors and nurses are available 24/7 and can be requested by calling 3344. The specialized telephone coordinators at SantéDom will arrange for a healthcare team to visit your home and address your medical needs promptly[15].



Figure II.7: SantéDom

5.2 User experiences and feedback from existing solutions

- **Doctolib**

According to the official website of Doctolib[9], the percentage of patients who would recommend Doctolib to others is 97%. This information is based on an anonymous survey conducted by Doctolib in France and Germany in March 2022. Doctolib boasts a significant user base, with approximately 70 million patients and a network of 340,000 healthcare professionals. This extensive reach highlights the widespread adoption and trust placed in the platform by both patients and healthcare providers.

The Doctolib mobile application has received high acclaim on both Google Play and the App Store. With a rating of 4.4 out of 5 stars from 430,671 votes on Google Play and a stellar rating of 4.9 out of 5 stars from 133,459 reviews on the App Store, Doctolib is recognized for its reliability and user satisfaction. The app's user-friendly interface and comprehensive features make it a valuable tool for patients and healthcare providers alike.

- **Housecall**

The Housecall application in the UAE has garnered positive feedback from users, reflected in its solid rating of 4.0 out of 5 on the App Store. This rating indicates a favorable user experience, showcasing the app's effectiveness in facilitating healthcare services. Users have appreciated the convenience and accessibility offered by Housecall, making it a reliable choice for availing medical assistance.

- **Doctor on demand**

Doctor On Demand mobile application has received widespread acclaim on the Google Play Store, boasting an impressive rating of 4.9 out of 5 stars from over 106,931 votes. Similarly, on the Apple App Store, it maintains a strong reputation with a rating of 4.8 out of 5 stars from 65,538 votes. These ratings affirm the app's reliability and user satisfaction, making it a trusted platform for healthcare services.

- **ZocDoc**

At the time this article was written, Zocdoc received a score of 4.3 out of 5 stars on Trustpilot, based on over 7,100 reviews. The platform provides a range of services beyond just mental health, so the reviews reflect the overall experience. The Zocdoc app has been highly rated on the Apple App Store, with a score of 4.6 out of 5 stars based on over 11,700 ratings, and on Google Play, with a score of 4.4 out of 5 stars based on over 11,700 ratings.

- **Heal**

As of June 9, 2023, Heal, while not particularly active in offering discounts or coupons, has still garnered positive reviews from users, as evidenced by its ratings on two prominent app platforms. With an impressive rating of 4.3 out of 5 stars on the Google Play Store, based on feedback from a substantial user base of 539 votes, and a remarkable rating of 4.8 out of 5 stars on the Apple App Store, reflecting the satisfaction of 3278 users, the Heal mobile app has received high praise. These ratings and votes underscore the app's excellence and its positive impact on users' healthcare journeys. It is worth noting that in comparison to other brands in the doctors on demand industry, Heal's score may be slightly lower. Nevertheless, the app distinguishes itself by providing e-commerce features that enhance its overall offering.

- **eTabib**

eTabib, a prominent healthcare application, has garnered mixed reviews from users on popular app platforms. On Google Play, it has attained a rating of 2.4 out of 5 stars, drawing feedback from an extensive user base comprising over 7,080 individuals. Similarly, on the Apple App Store, eTabib has achieved a rating of 2.6 out of 5 stars, reflecting the sentiments of users who have shared their experiences with the application.

- **SantéDom**

As of the time of writing this article, SantéDom, a healthcare mobile application, has received mixed ratings and reviews across different platforms. On Google Play, it has obtained a rating of 3.4 out of 5 stars based on feedback from over 82 users. Meanwhile, on Facebook, it has received a more positive rating of 4.3 out of 5 stars based on feedback from over 131 users. However, on Business Directory Algeria, SantéDom has received a lower rating of 2.7 out of 5 stars based on feedback from 17 users.

5.3 Advanced Analysis of Mobile Applications for Doctor Appointments and House Calls

In this section, we delve deeper into the mobile applications for doctor appointments and house calls, focusing on their impact on patient outcomes, user engagement, and potential for future growth and innovation. This advanced analysis will help identify key trends and opportunities for enhancing healthcare services through mobile applications.

5.3.1 Impact on Patient Outcomes

Mobile applications for doctor appointments and house calls have the potential to significantly improve patient outcomes by increasing access to healthcare services, reducing wait times, and facilitating better communication between patients and healthcare providers.

- **Access to Healthcare Services**

By offering a convenient and user-friendly platform for booking appointments and accessing healthcare services, these applications can help overcome barriers to care, such as long wait times, limited availability of healthcare providers, and geographical constraints. This increased access can lead to earlier diagnosis and treatment, ultimately improving patient outcomes.

- **Reduced Wait Times**

One of the key benefits of these applications is their ability to reduce wait times for appointments. By providing real-time information on available appointment slots and enabling patients to book appointments instantly online, these applications can help minimize delays in accessing care, leading to more timely diagnosis and treatment.

- **Improved Communication**

Mobile applications can also facilitate better communication between patients and healthcare providers by offering features such as secure messaging, video consultations, and electronic health record integration. This improved communication can help ensure that patients receive the appropriate care and support, ultimately leading to better health outcomes.

5.3.2 User Engagement

User engagement is a critical factor in the success of any mobile application. By offering a seamless and enjoyable user experience, these applications can encourage users to engage with their healthcare services more actively, leading to better health outcomes and increased patient satisfaction.

- **Personalization**

Personalization features, such as tailored appointment reminders, customized healthcare recommendations, and the ability to save preferred healthcare providers, can help enhance user engagement by making the application more relevant and useful to individual users.

- **Gamification**

Incorporating gamification elements, such as rewards, badges, and progress tracking, can help motivate users to engage with the application and take a more active role in managing their healthcare. This increased engagement can lead to better adherence to treatment plans and improved health outcomes.

5.3.3 Future Growth and Innovation

The mobile applications for doctor appointments and house calls have significant potential for future growth and innovation, as technology continues to advance and the demand for convenient, accessible healthcare services increases.

- **Integration with Emerging Technologies**

As new technologies, such as artificial intelligence, machine learning, and the Internet of Things, continue to develop, there are opportunities for these applications to integrate these technologies to enhance their services and improve patient outcomes. For example, AI-powered chatbots could be used to provide personalized healthcare advice and support, while IoT devices could enable remote monitoring and management of chronic conditions.

- **Expansion of Services**

There is also potential for these applications to expand their range of services, offering additional features such as appointment booking for allied health professionals, integration with pharmacy services, and support for mental health and wellness services. This expansion could help meet the diverse healthcare needs of users and further improve patient outcomes.

In conclusion, this advanced analysis of mobile applications for doctor appointments and house calls highlights their potential to improve patient outcomes, enhance user engagement, and drive future growth and innovation in the healthcare sector. By identifying key trends and opportunities, healthcare providers, policymakers, and app developers can work together to leverage these applications to deliver better healthcare services and improve patient access to care.

6 Problematic

Patients often encounter a range of challenges when making traditional doctor appointments, which can hinder their timely access to healthcare services. These problems include:

1. Lengthy wait times: Patients may experience significant delays in securing appointments, leading to prolonged periods of discomfort or delayed treatments.

2. Limited availability of appointments: The availability of appointment slots may be limited, particularly for specialized services or sought-after healthcare providers, making it difficult for patients to schedule timely appointments.

3. Communication difficulties: Patients may face challenges in effectively communicating their needs or scheduling appointments due to busy phone lines, long hold times, language barriers, or hearing impairments.

4. Lack of flexibility in scheduling: Fixed office hours and rigid appointment slots may not align with patients' work or personal commitments, forcing them to make inconvenient arrangements or potentially miss appointments.

5. Complex referral processes: Patients requiring consultations with multiple healthcare providers or specialized care may encounter difficulties in navigating the referral process, coordinating appointments, and ensuring seamless communication between providers.

6. Geographical barriers: Patients residing in rural areas may face geographical barriers that hinder their access to healthcare facilities, requiring long travel distances and potential financial burdens.

7. Transportation barriers: Challenges related to commuting or travelling pose a significant obstacle for patients in accessing healthcare services, even if they have a provider and a scheduled appointment. Patients who lack transportation options due to physical limitations, financial constraints, or other factors often find it difficult to reach the clinician's office, resulting in a lack of necessary care.

Overcoming these challenges necessitates enhancements in appointment management systems, the adoption of technology-driven solutions, and the optimization of healthcare processes. In the following section, we will propose potential solutions to address these problems.

7 Proposed Solutions: Aligning Project Objectives for Success

The proposed project encompasses a comprehensive mobile application that offers two essential features: an appointment booking system and a house call functionality.

Firstly, the mobile application provides patients and users with a convenient way to book doctor's appointments online. Through a user-friendly interface, individuals can effortlessly schedule appointments with healthcare providers of their choice. This streamlined process eliminates the need for time-consuming phone calls or in-person visits to clinics or hospitals.

Additionally, the application includes a house call feature, allowing medical practitioners to visit patients' homes to deliver healthcare services. Instead of patients having to travel to a healthcare facility, the healthcare provider travels to the patient's location for consultations, examinations, treatments, or follow-up visits. This personalized approach ensures that patients can receive necessary medical care without the inconvenience and challenges of traveling.

Moreover, the application integrates telemedicine and virtual consultations, enabling patients to connect with healthcare professionals remotely. Through video calls or secure messaging platforms, patients can receive medical advice, discuss symptoms, and even obtain prescriptions. This virtual healthcare delivery method eliminates the need for in-person visits, offering convenience and accessibility to patients, regardless of their geographical location.

By combining an efficient appointment booking system, house call services, and telemedicine capabilities, the mobile application aims to revolutionize the way patients access healthcare services. It enhances convenience, reduces travel burdens, and enables remote medical consultations, ultimately improving patients' overall healthcare experience.

8 Conclusion

In conclusion, this chapter has provided a comprehensive overview of healthcare and the applications of mobile development within the industry. We began by defining healthcare and highlighting its significance in maintaining and improving human health. We then explored the role of mobile development in healthcare, focusing on its applications in doctor appointments and house calls. Through an in-depth analysis of existing literature, we gained valuable insights into the benefits and challenges associated with these healthcare applications. Building upon this knowledge, we proposed a solution for traditional doctor appointments in Algeria through the development of our innovative application called 'MyClinic'. By leveraging the power of mobile technology, 'MyClinic' aims to revolutionize the way patients access healthcare services, providing a convenient and efficient platform for scheduling appointments and connecting with medical professionals. This solution has the potential to significantly enhance the healthcare experience in Algeria and improve healthcare accessibility for individuals across the country.

Chapter III

Challenges and Implementation of Agile Methodology

1 Introduction

The development of mobile applications across various sectors needs to happen rapidly due to the mobile app industry's competitive nature and short time-to-market demands.

Previously, mobile app development focused on smaller entertainment apps with limited attention to development processes. However, the current expansion of mobile apps necessitates specific methodologies to ensure high-quality results. Mobile app development is more complex than traditional applications, with unique UI/UX challenges and platform fragmentation.

Traditional software engineering approaches are insufficient to meet these challenges in the mobile app industry, as it has outpaced traditional software engineering methods.

Researchers and software engineers[16] worldwide have shown significant interest in Agile software development processes and methods, with numerous studies regarding Agile as a highly suitable approach for the mobile app industry .

2 Agile methodology

The agile software development methodology is based on a quick and iterative approach[17]. It promotes collaboration between self-organizing teams and emphasizes customer satisfaction through rapid and continuous delivery of small, useful software increments. Unlike traditional models, agile delivers working software at regular intervals and measures progress through the delivery of working models. This methodology allows for flexibility and easy incorporation of changes, with a focus on technical excellence and effective collaboration between business stakeholders and developers.

Agile organizations have the flexibility to adjust their project portfolios according to shifting business priorities. They follow a regular delivery schedule, typically on a weekly or biweekly basis, and prioritize the implementation of high-value features as determined by the business. This approach minimizes the risk of diverting resources away from agile projects, as there is minimal unfinished work at any given time. Consequently, the completed work holds significant value, and the project's status remains clear and unambiguous.[18]

In today's fast-paced business environment, companies face constant pressure to adapt to changing market conditions. To maintain competitiveness, software-producing companies are increasingly turning to agile development practices. Agile processes emphasize collaboration, iteration, and the rapid and repeatable delivery of software. While some practices, such as pair programming and regular retrospectives, may initially seem to slow down teams, the benefits of embracing agile methodologies outweigh any associated costs.

The commonly used agile methodologies are as follows[19]:

- Scrum
- Extreme Programming (XP)
- Feature Driven Development (FDD)
- Test Driven Development (TDD)
- Dynamic Software Development Method (DSDM)
- Kanban

It is noteworthy that these methodologies can be tailored and adjusted to align with the specific requirements of a project and the dynamics of the team. Various organizations have the flexibility to incorporate elements from multiple methodologies or even develop their own hybrid approach.

In our research, we conducted a survey of research papers focusing on mobile application development utilizing Agile methods. As a result, we identified four Agile approaches, some of which incorporate elements from non-Agile approaches. These approaches include[20]:

- Mobile-D
- Hybrid Method Engineering (HME)
- Mobile Application Software Agile Methodology (MASAM)
- Scrum and Lean Six Sigma (SLeSS)

3 Agile Principles and Practices

3.1 Agile Principals and Values

Before a process can be considered Agile, it must reflect essential Agile principles such as being human-centric and prioritizing technical excellence to produce high-quality code[21]. The Agile Manifesto ,created in 2001, outlines 12 principles for Agile development processes, which have been grouped into four values: **Individuals and interactions** over processes and tools, **Working software** over comprehensive documentation, **Customer collaboration** over contract negotiation **Responding to change** over following a plan[22][23].

These values represent a shift in focus towards collaboration, adaptability, and customer satisfaction, and have been instrumental in shaping the Agile movement.

3.2 Agile Practices

Agile Software Development is primarily based on the core values and principles articulated in the Agile Manifesto[22]. These principles are implemented through specific practices known as Agile practices, while a combination of these practices is referred to as Agile methods. Scrum and Extreme Programming (XP) are examples of commonly utilized Agile methods[24].

Agile practices are situated at a lower level compared to agile methods since they constitute specific and focused components within a method that address various aspects[25]. Examples of these practices include pair programming and daily meetings, refactoring, continuous integration, early expert customer feedback, and minimal documentation[26]. While there is no universally defined literature interpretation of agile practices, an accessible explanation can be derived from examining XP[27], which encompasses primary, business, and corollary practices as part of its framework.

Agile software development methodologies prioritize delivering high-quality software in a collaborative and adaptive manner. To achieve this, various agile practices are employed to ensure effective development processes and outcomes. The following is a list of key agile practices that contribute to successful software development[28]:

- Quality check
- Refactoring
- Customer involvement
- Unattached communicative teams
- Validation practice
- Learning loop
- Outcome review
- Planning meeting
- Time boxing
- Common knowledge
- Progress monitoring
- Product vision
- Evolving and hierarchical specification
- Continuous integration/deployment
- Delivering frequent releases
- Small cross-functional teams
- Daily discussion
- Continuous specification analysis

In our study, we utilized this list of practices, which encompasses the commonly employed agile methods, to gather evidence relevant to our project objectives.

4 Agile Methods

Agile methods refer to specific approaches or frameworks that follow the principles and practices of Agile software development. These methods provide structured guidelines and processes for teams to effectively deliver software in an iterative and collaborative manner. Some well-known agile methods include:

4.1 Scrum

Scrum is an agile methodology framework that offers the flexibility to manage and control software development and requirements[29]. It is an iterative and incremental model that builds software in small, iterative modules. The primary purpose of Scrum is to enhance the productivity of the development process, align individual and organizational goals, establish a culture focused on performance, generate shareholder value, foster effective communication at all levels, and improve both individual development and quality of life. [30]This flexible model can be applied to any project in any industry, regardless of its size.

The Scrum Process

The Scrum process begins with the product owner[31], who gathers input from end-users, customers, stakeholders, and other sources to create a product backlog - a list of features - that are prioritized according to business requirements and owned by the product owner [32]. The product owner is responsible for constantly reviewing and updating the product backlog, and is the only person authorized to make changes to it. The team then selects items from the product backlog to create a sprint backlog, which is executed in each sprint as the team works to build the product.

A sprint refers to a fixed period of time during which the team commits to working on the development of the product[33][34]. The length of the sprint is determined jointly by the team and the product owner, and once established, the end date of the sprint cannot be altered. The team commits to delivering a set of work during the sprint, and this commitment cannot be changed during

the sprint[35]. However, if a significant issue arises, the product owner may direct the team to terminate the current sprint and start a new one.

According to the Scrum methodology, the ideal team size is between 5 and 9 members with a maximum of 7 ± 2 people[36][37]. The team is expected to be self-organizing and self-managing, and must be cross-functional, with members from different areas of expertise needed for developing the product. Together, the team decides what it will deliver by the end of the sprint, and creates a task-level plan for how they will deliver it. All team members, regardless of experience level, take part in this process.

To track progress, the team updates a simple chart called a burndown chart each day, which shows the remaining tasks and total hours left for all tasks. Additionally, the team holds a daily meeting of less than 15 minutes where everyone stands up to keep it fast and informal[38]. During this meeting, each team member reports on three things[39]:

- 1. done since yesterday
- 2. done by tomorrow
- 3. blocks and obstacles

The Scrum Master is responsible for taking note of any blocks or obstacles that team members report during the daily meeting [40], and helping the team to resolve them. This role can be fulfilled by an existing team member or former project manager. The Scrum Master's main responsibility is to protect and serve the team, helping to remove any impediments to progress and shielding the team from internal or external interference. Having a Scrum Master is essential for ensuring the success of the team, as without one, the team is at a high risk of failure.

The main goal of the Scrum team is to complete 100% of the work they committed to during the sprint, ideally resulting in an increment that is potentially shippable for the project. This means that every potentially increment should be fully implemented and tested, with no major defects[41].

At the end of each sprint, two reviews take place. The first is called the Sprint Review Meeting, where the product owner, team, Scrum Master, stakeholders, and others come together to see a demo of the working software and provide feedback. The second is called the Retrospective Meeting, which is primarily for the team, product owner, and Scrum Master. During this meeting, they review their way of working and look for ways to improve their effectiveness. The Sprint Review is a "product review," while the Retrospective is a "process review"[18].

We implemented SCRUM practices in our project, which involved conducting status update meetings to discuss tasks related to implementation and testing phases. During these meetings, we made reviews and changes to the plan, architecture, tools and technologies, source code, and quality assurance scenarios. The meetings were held either face-to-face, on Google Meet, or through phone calls. While a typical SCRUM team consists of around seven members, we adopted certain SCRUM practices to help us develop our secure-backup Android application with a smaller team of three members. In our case, each team member shared multiple roles, including Scrum Master, developer, software tester, and Quality Analyst, among others.

In addition to SCRUM and Agile practices, we used DevOps to host our project code and related documents as part of our version control system. This helped ensure the integrity of the artifacts being developed throughout the development lifecycle. Web hosting also allowed us to share documents internally within the team, keep track of team members' activities, follow up on deliverables, provide feedback on accomplished tasks, and keep project-related data up-to-date.

4.2 Extreme Programming

Extreme Programming (XP) is a widely used agile methodology for developing high-quality software. Its focus is on improving software quality and responsiveness to changing requirements. According to its creator Kent Beck, XP is a lightweight methodology for small to medium-sized teams facing rapidly changing requirements[42]. Teamwork is emphasized in XP, and there are five essential ways in which it improves software projects: communication, simplicity, feedback, respect, and courage. XP practitioners maintain constant contact with customers and fellow programmers, keep designs as simple and clean as possible, and continuously test the software for feedback. They deliver the working software to customers as early as possible and make changes as suggested, even later in the life cycle. XP encourages programming in pairs or extensive code review, unit testing of all code, avoiding programming features until they are needed, a flat management structure, simplicity and clarity in code, expecting changes in customer requirements, and frequent communication with customers and among programmers. XP takes traditional software engineering practices to "extreme" levels. The name "extreme programming" signifies the heightened emphasis on the positive elements of traditional software engineering practices. [43].

4.3 Feature Driven Development

FDD is an agile software development process that uses a short-iterative and incremental model. It's a lightweight agile methodology that combines key benefits from various agile methodologies and other industry best practices. FDD is particularly suitable for scaling up larger projects and teams[44]. In FDD, a feature refers to a small, valuable function expressed in terms of client value. If a set of features is too large to be completed within two weeks, it must be broken down into smaller sets. The primary roles in FDD are Project Manager, Chief Architect, Development Manager, Domain Experts, Class Owners, and Chief Programmers[45]. FDD follows a step-by-step process that includes developing an overall model, building a features list, planning by

feature, designing by feature, and building by feature. This process ensures that team members gain knowledge and shared understanding of the problem domain, features are organized hierarchically, schedules and responsibilities are assigned, design teams collaborate, and features are implemented, tested, and inspected[46].

4.4 Test Driven Development

Test-driven development (TDD) is a software development approach where tests are written before the actual code is written[47]. This means that instead of writing the code first and then testing it, the developer writes the tests first and then writes code to pass those tests.

The idea behind TDD is that writing tests first can help improve code quality, reduce bugs, and increase the speed of development[48]. TDD involves these basic steps[49]:

- Write a test.
- Run all tests and see if the new one fails.
- Write the code.
- Run tests again.
- Refactor the code.
- Repeat the process

TDD is often used in agile software development methodologies and has become increasingly popular in recent years to create high-quality, maintainable code.

4.5 Dynamic Systems Development Method

DSDM is an agile project delivery framework that offers a structured and systematic approach to managing and delivering software projects[50]. It prioritizes the delivery of business value by involving key stakeholders throughout the development process and emphasizing frequent delivery of working software. In 2007, DSDM was recognized as a generic framework for project management and solution delivery[51], with the aim of developing industry standards for the method. DSDM is a well-established agile approach that has been proven effective for business-related projects. It employs techniques such as MoSCoW, timeboxing, prototyping, testing, and configuration management. The framework is guided by nine key principles, including[52]:

- It's crucial to have active user involvement in the development process.
- Teams should have the power to make decisions.
- Frequent delivery should be prioritized.
- Deliverable must meet the business requirements.
- Iterative and incremental development is necessary.
- All changes made during development should be reversible.
- High-level requirements should be baselined.
- Testing should be integrated throughout the entire lifecycle.
- A collaborative and cooperative approach is key.

4.6 Kanban

Kanban is a methodology used for managing knowledge work that focuses on delivering work just in time without overloading team members. In this methodology, the development process is made transparent, from task definition to delivery to the customer, and is displayed for all participants to see[53]. The Kanban method is an approach to incremental, evolutionary process and systems change for organizations. It employs a work-in-progress limited pull system as the core mechanism to reveal system operation problems and encourage collaboration to continuously improve the system. Visualizing the work and workflow is essential in Kanban to understand the process. The Kanban method is based on four basic principles[53]:

- Work should be visualized, meaning that it should be represented visually on a board or other display.
- The amount of work in progress should be limited to avoid overburdening team members.
- The focus should be on optimizing the flow of work through the system.
- Continuous improvement should be emphasized, with regular reviews and refinements of the process.

Table III.1: Comparison of Agile Methodologies

Characteristic	SCRUM	XP	FDD	TDD	DSDM	KANBAN
Approach of Development	Iterative and incremental	Iterative and incremental	Iterative and incremental	Iterative	Iterative and incremental	Incremental
Time period for one iteration	2-4 weeks	1-6 weeks	<2 weeks	Reasonable Amount of Time based On product Built	2-3 days	Time from the start of work until bugfix is live
team Size	7+/-2	<20	Many members (More than one team)	First 2/3 developers get used to TDD. Later members are added accordingly	Independent team of any size	Any skilled or cross-functional team can work
Project Size	All types of projects	Small projects	Complex projects	Small scale projects	All types of projects	Small projects usually with < 300 LOC
team communication	Informal	Informal	Based on documentation	Open communication b/w managers and developers about issues	Based on documentation	Informal face to face
Customer Involvement	Product owner acts on behalf of customer throughout the process	Throughout the process	Customer through reports	Involved only at acceptance testing	Involve in frequent releases	Customer through incremental release

5 Tools and Technologies

In Agile methodologies, various tools and technologies are employed to support software development, collaboration, and project management. Tools like **Jira** and **Trello** facilitate user story creation, backlog management, and workflow visualization. Version control systems such as **Git** and **Subversion** enable code collaboration and version management. **Jenkins** and **Bamboo** automate build, test, and deployment processes for continuous integration and deployment. Collaboration platforms like **Slack** and **Microsoft Teams** promote real-time communication and teamwork.

In our project, **Azure DevOps** is our primary tool, providing comprehensive features for Agile project management, version control, continuous integration and deployment, and collaboration. It serves as a centralized platform, ensuring efficient coordination throughout the software development lifecycle within our Agile team.

Azure DevOps

In our mobile application project, we rely on Azure DevOps as our go-to tool for managing the development process within an Agile environment. With Azure DevOps, we efficiently plan, develop, test, and release our mobile applications. We leverage its features and services to create and manage user stories and tasks specifically tailored to mobile app development.

Azure DevOps also seamlessly integrates with popular mobile development platforms and tools such as Flutter, which we utilize for developing our mobile application. This integration enables us to collaborate effectively, maintain version control for our app's source code, and streamline our development workflows. By utilizing Azure DevOps' build pipelines, we automate the building, testing, and packaging of our mobile applications, ensuring high quality and compatibility across various platforms and devices. Furthermore, Azure DevOps' release pipelines facilitate smooth deployment to different distribution channels.

Overall, Azure DevOps empowers us to efficiently manage our mobile application project, fostering seamless collaboration, streamlined workflows, and the delivery of high-quality releases.

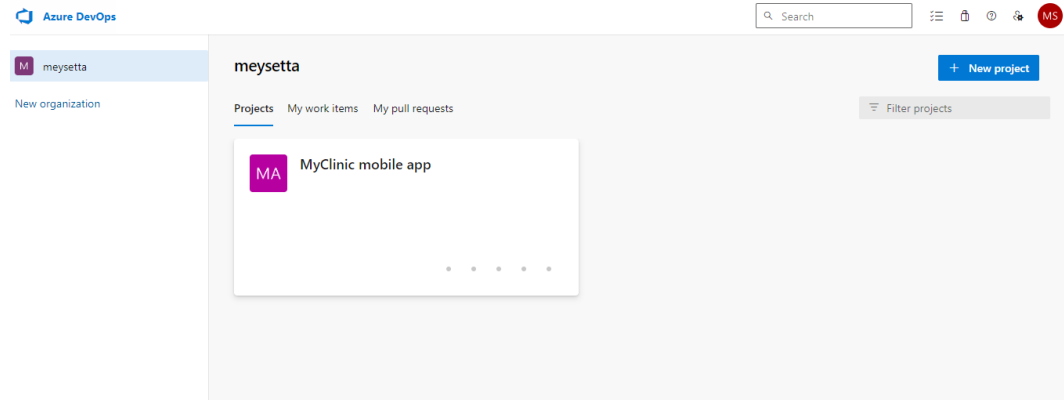


Figure III.1: MyClinic project on Azure DevOps

6 Definition of project management

To differentiate between a project and project management, it is essential to establish separate definitions for each term. A project refers to the successful attainment of a specific goal, involving a sequence of tasks and activities that consume resources. It must be completed according to predetermined specifications within a defined start and end date.

On the other hand, project management can be defined as the process of overseeing the accomplishment of project objectives. By utilizing existing organizational structures and resources, it aims to effectively manage the project through the application of various tools and techniques while minimizing disruption to the company's regular operations. The responsibilities of project management encompass identifying work requirements, determining the project's scope, allocating necessary resources, planning the execution of tasks, monitoring progress, and making adjustments to address deviations from the original plan[54].

7 Definition of Agile project management

Agile project management is an iterative and flexible approach to managing projects that focuses on delivering value in small increments or iterations, rather than following a linear, sequential process. From an agile project management classification perspective, the Iterative, Adaptive, and Extreme strategies defined by Wysocki [55] fall under the agile project management umbrella. It is a project management framework that emphasizes collaboration, adaptability, and continuous improvement[56].

8 Challenges and Benefits

8.1 Challenges of agile project management

One of the significant challenges of Agile Project Management (APM) lies in the difficulty of scheduling project tasks. APM discourages detailed specifications and plans at the project's outset, making it challenging to estimate project duration. This lack of accurate schedules impacts resource acquisition planning and exposes projects to risks such as price fluctuations. Moreover, the uncertainty around project completion time makes it difficult for organizations to plan for other projects, potentially increasing overall project costs. Therefore, proper project scheduling becomes crucial for companies utilizing APM.

Monitoring and controlling the project scope can be a challenge within the Agile Project Management (APM) approach. APM may encourage frequent changes to project requirements, leading to cost and time increases, as well as scope creep. It becomes difficult for the project team to distinguish between necessary and nice-to-have changes. Additionally, the absence of predetermined specifications and plans in APM makes quality assurance and control more challenging, as there is no established benchmark for measuring and verifying performance.

APM poses challenges in knowledge management. Traditional project like Waterfall method [57] management emphasizes formal communication

channels and documentation, while APM promotes a reduction in structured communication and decision-making. Consequently, much of the knowledge in APM remains tacit and undocumented, residing within the project team members' minds. This situation may be viewed as unacceptable by organizations, as it shifts the balance of power from management to the project implementation team and hinders knowledge transfer across the organization.

The success of the APM approach heavily relies on people-related issues. APM prioritizes collaboration, communication, and cooperation among project teams and stakeholders. The effectiveness of this project management approach is contingent upon individuals working together towards a common goal. Building and maintaining strong interpersonal relationships and fostering a culture of collaboration are essential for the success of APM.[58]

8.2 Benefits of agile project management

Agile Project Management (APM) offers numerous advantages compared to traditional project management methods. One significant benefit is cost reduction through the elimination of expensive changes and rework. Traditional approaches rely on rigid plans that often result in significant changes and rework when unexpected alterations occur. In contrast, APM is designed to handle unforeseen changes and enables teams to adapt without extensive rework. Its iterative approach identifies risks and unexpected changes in advance, making it indispensable for companies that aim to avoid costly revisions.

Another advantage of APM is its ability to facilitate timely project completion by eliminating last-minute changes to plans, scope, requirements, and designs. Unlike waterfall methods that can cause delays and rework, APM incorporates changes throughout the project, promoting continuous improvement and faster delivery. The minimal documentation associated with APM also saves time and enables prompt product delivery. With short-term scope, plans, and designs, APM empowers companies to make successful changes during implementation without wasting time, cost, or scope, making

it essential in a competitive and rapidly changing market.

Active stakeholder involvement is a distinguishing feature of APM, leading to improved customer satisfaction. APM ensures that stakeholders' interests and requirements are integrated into the project, resulting in a better product that meets their needs. By actively engaging stakeholders in project development, a sense of ownership and commitment is fostered, and their feedback after each cycle enhances the product in subsequent iterations. APM's emphasis on stakeholder involvement helps companies deliver the right product or service to meet changing customer demands, contributing to customer satisfaction.

APM also provides enhanced performance visibility through regular status meetings, progress monitoring, and sprint reviews. These strategies enable timely assessment of project performance and team progress, allowing for corrective actions to be taken promptly, reducing the need for costly rework. APM's customer-centric approach, which incorporates feedback throughout the implementation process, increases the likelihood of delivering a product that meets customer expectations without significant cost escalation. APM's flexibility in accommodating customer feedback helps companies make necessary changes to meet consumer demands and boost sales, a critical aspect in today's ever-changing market.[59]

In summary, Agile Project Management offers cost reduction, timely project completion, improved customer satisfaction, and enhanced performance visibility. Its adaptability, iterative nature, stakeholder involvement, and focus on customer feedback make it an invaluable tool for companies striving for success in a competitive and dynamic business environment.

9 Conclusion

In conclusion, agile project management, particularly the Scrum-based approach, is valued for its simplicity. Roles within the project are clearly defined, and features can be developed and tested in short iteration cycles. This approach promotes team members taking responsibility for their work, resulting in broad ownership of the project. Extensive communication enforced by agile project management methods also helps teams organize more effectively, leading to increased productivity. However, caution is necessary when implementing agile methods. While frequent communication is essential, documentation is still required, and without adequate oversight, the project may become disorganized. Additionally, enforcing important facets of agile methods can be challenging for novice project managers. Successful implementation of the agile approach requires commitment from all parties involved, including upper management. Nonetheless, agile project management remains an effective means of enhancing the development cycle by eliminating unnecessary bureaucracy and practices. This methodology allows all parties to focus on productive work rather than administrative tasks.

Chapter IV

Design And Implementation

1 Introduction

The analysis and system design of the Medical Appointment application involve considering multiple perspectives to ensure that the application meets the necessary requirements. During the analysis phase, the problem at hand is identified, serving as a benchmark for developing a high-quality application. Additionally, research on similar systems and applications is conducted during this phase. The system design phase aims to provide a more detailed understanding of the system flow, enabling the development of an application that aligns with user requirements and the overall system.

In the design phase, the system is divided into two parts: the database design and the system application design. To facilitate this process, the team opts to utilize the UML (Unified Modeling Language) language. UML offers a graphical representation of concepts and allows for modeling of mobile applications. By employing UML modeling, the team can identify the various actors involved in the application and define their respective roles. To aid in the mobile app development process, the team utilizes StarUML to create a variety of UML diagrams.

2 Definition UML

UML (Unified Modeling Language) is a standardized modeling language widely used in software engineering to visually represent and communicate the design and structure of software systems. With its comprehensive set of diagrams, such as use case, class, sequence, activity, and component diagrams, UML enables effective modeling, analysis, and documentation of system behavior, structure, and interactions. By providing a common language and notation, UML promotes clarity, consistency, and collaboration among software development teams, facilitating better understanding and communication of complex systems. It serves as a valuable tool throughout the software development lifecycle, aiding in the design, implementation, and maintenance of high-quality software solutions[60].

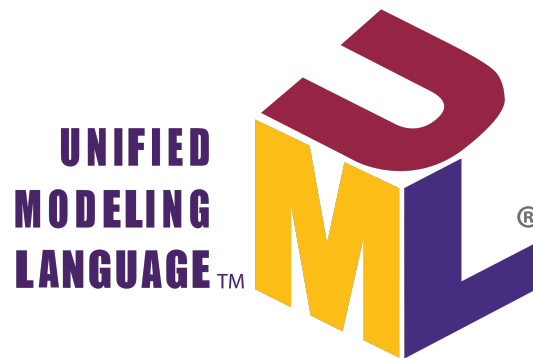


Figure IV.1: UML logo

3 UML Diagrams

UML offers a variety of diagrams that capture different perspectives of a system including:

3.1 Use Case Diagrams

Use Case Diagrams: Represent the interactions between actors (users or systems) and the system being modeled, showing the functionality and behavioral aspects of the system.

Identifications of the actors

In 'MyClinic' mobile app, the principal actor is the "Patient." The patient is the primary user of the app who seeks medical services and interacts with various functionalities provided by the application.

Principal Actor:

-Patient: The primary user of the app who registers, logs in, views available medical professionals, books appointments, cancels appointments, sets reminders, and manages their own appointments.

Supporting Actors:

-Medical Professional: The secondary user of the app who logs in, manages their availability, views their schedule, views patient appointments, communicates with patients, and provides medical services. This actor represents various healthcare professionals such as doctors, nurses, therapists, or any other medical practitioners.

-Admin: The privileged user of the app who manages the overall functioning of the system, including managing medical professional profiles, appointments, and generating reports.

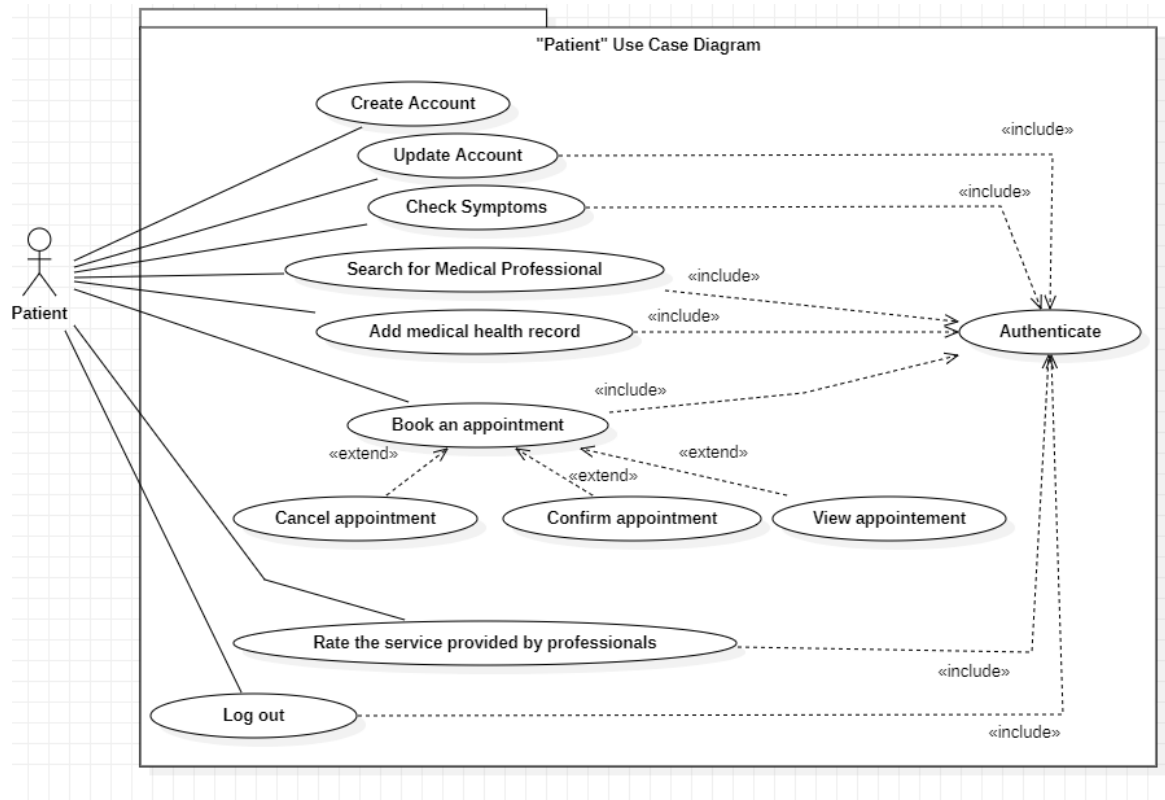


Figure IV.2: Patient Use Case Diagram

Patient: Here's a description of the Patient actor:

- **Register:** Patients can register themselves on the mobile application by providing necessary information such as their name, contact details, and possibly their medical history.
- **Book:** Patients can search for available doctors, view their profiles, and schedule appointments based on their preferences and availability.
- **View:** Patients can view their upcoming and past appointments, along with relevant details such as the doctor's name, appointment time, and location.
- **Cancel:** Patients can cancel their scheduled appointments if they are unable to attend or need to reschedule.
- **Reminders:** Patients can set reminders for their upcoming

appointments to ensure they don't miss them.

- **Rate:** Patients can provide ratings and reviews for doctors they have consulted, helping other patients make informed decisions.
- **Update Profile:** Patients can update their personal information, contact details, and medical history within their profile.

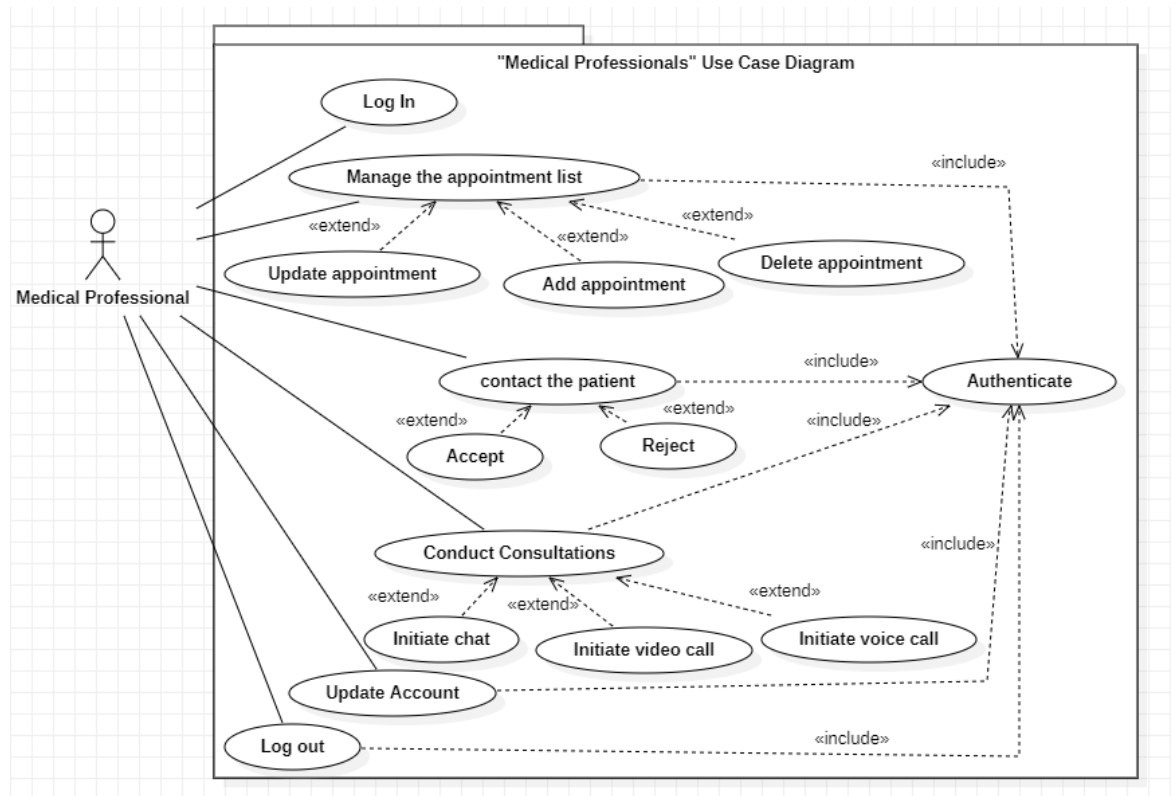


Figure IV.3: Medical Professional Use Case Diagram

Medical Professional: Here's a description of the Medical Professional actor:

- **Login:** Medical professionals can log in to the mobile application using their credentials to access their account and related features.
- **Manage Appointments:** Medical professionals can view and manage their upcoming and past appointments, along with relevant details such as the patient's name, appointment time, and reason for the visit. They have the ability to control and organize their availability and appointments through the application's scheduling system. They can set working hours, block off time slots, and specify their availability for appointments.
- **Accept/Reject Appointments:** Medical professionals can accept or reject appointment requests based on their availability and preferences.

They can review appointment details and make decisions accordingly.

- **Conduct Consultations:** Medical professionals can provide consultations to patients through video calls, voice calls, or chat within the application. They can discuss medical issues, provide advice, and prescribe medication as necessary.
- **Update Profile:** Medical professionals can update their professional profile within the application. They can add or modify their qualifications, specializations, contact information, and other relevant details.

The Medical Professional actor represents healthcare professionals who actively participate in the online appointment mobile application, offering their expertise and services to patients. They have specific functionalities related to managing their schedule, interacting with patients, and updating their professional profile within the application.

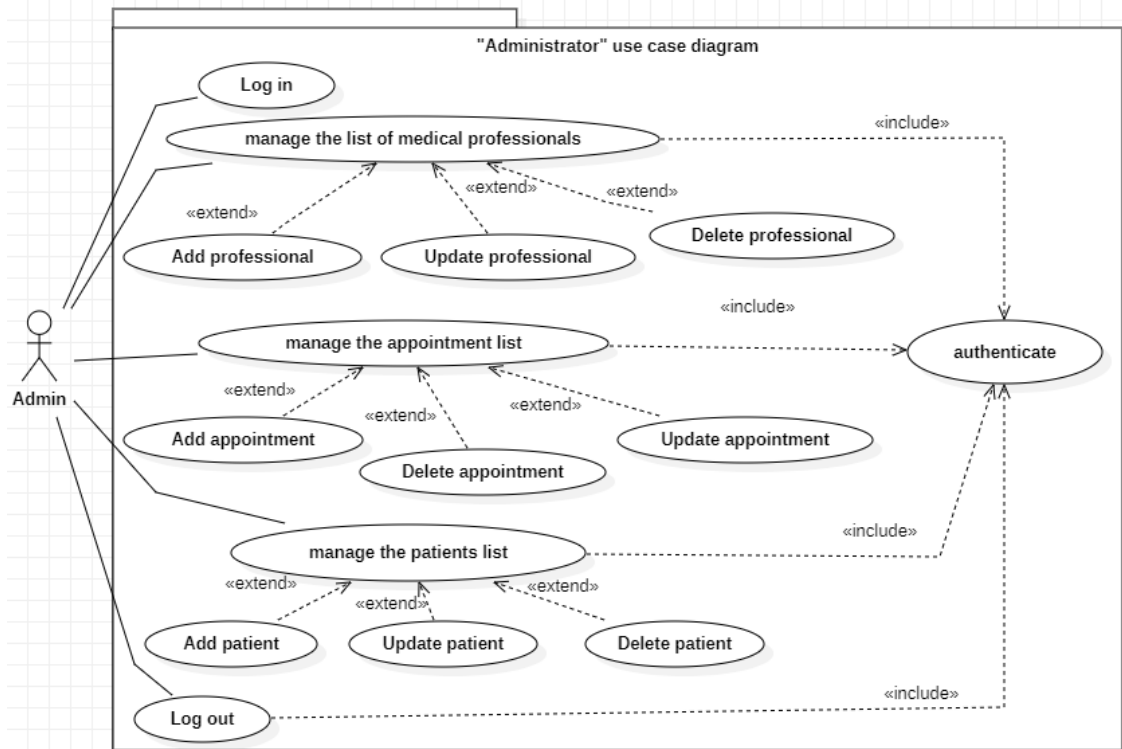


Figure IV.4: Admin Use Case Diagram

Admin actor: The "Admin" actor plays an important role in managing and overseeing the online appointment mobile application.

Here's a description of the Admin actor:

- **Manage Users:** The Admin can manage user accounts, including patient and doctor profiles. They can create, modify, or delete user accounts as necessary.
- **Manage Medical Professionals:** The Admin has the authority to add, update, or remove medical professionals like 'doctor profiles' from the application. They can verify doctors' credentials and ensure the accuracy of the information.
- **Manage Appointments:** The Admin can oversee the appointment system and manage appointments if necessary. They may have

the authority to reschedule or cancel appointments in exceptional circumstances.

The Admin actor holds administrative privileges within the online appointment mobile application and performs tasks related to user management, system configuration, and overall application maintenance.

3.2 Sequence Diagrams

Show the dynamic behavior of the system by representing the interactions and messages exchanged between objects over a specific time sequence. Sequence diagrams are useful for understanding the flow of actions and collaborations between objects.

Sequence Diagrams Scenarios To provide a comprehensive sequence diagram for the doctor appointment mobile app, we can focus on two primary scenarios: patient booking an appointment and admin managing appointments. Here are the sequence diagrams for these scenarios:

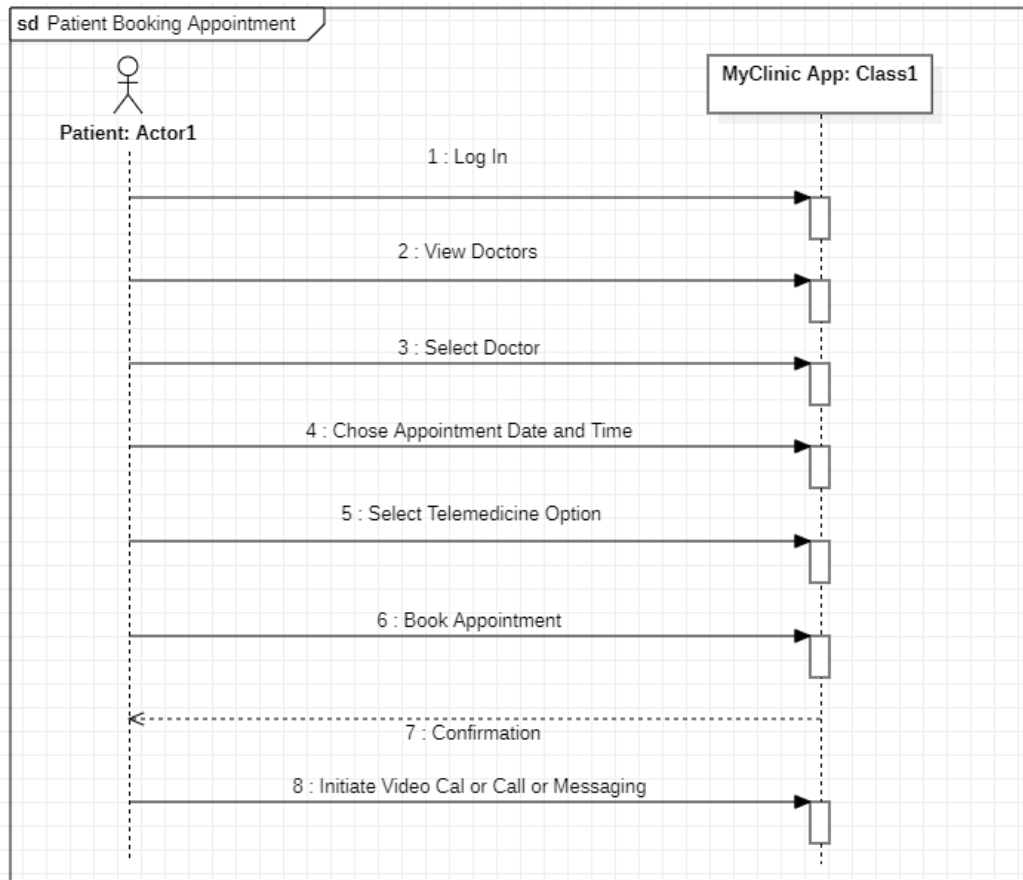


Figure IV.5: Book Appointment Sequence Diagram

Description The patient logs into the app (1) and views the available doctors (2). The patient selects a specific doctor (3) and chooses an appointment date and time (4). The patient chooses telemedicine option that could be video call, message or a call (5) books the appointment (6) and receives a confirmation (7). The patient can then initiate a video call or messaging session (step 8) with the medical professional to conduct the telemedicine appointment.

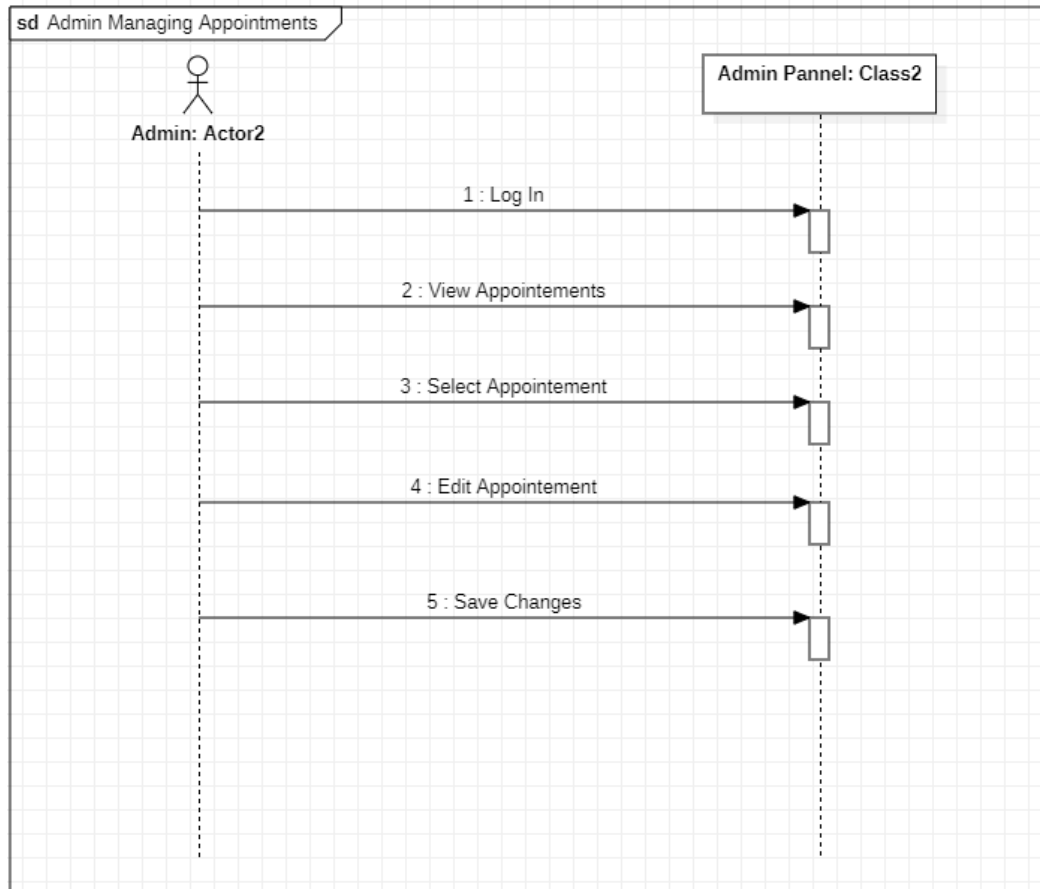


Figure IV.6: Manage Appointments Sequence Diagram

Description The admin logs into the app (1) and views the appointments (2). The admin selects a specific appointment (3) and edits its details (4). The admin saves the changes (5).

3.3 Class Diagram

Class diagram illustrates the static structure of the system, including the classes, their attributes, methods, and the relationships between them. Class diagrams help visualize the system's object-oriented design.

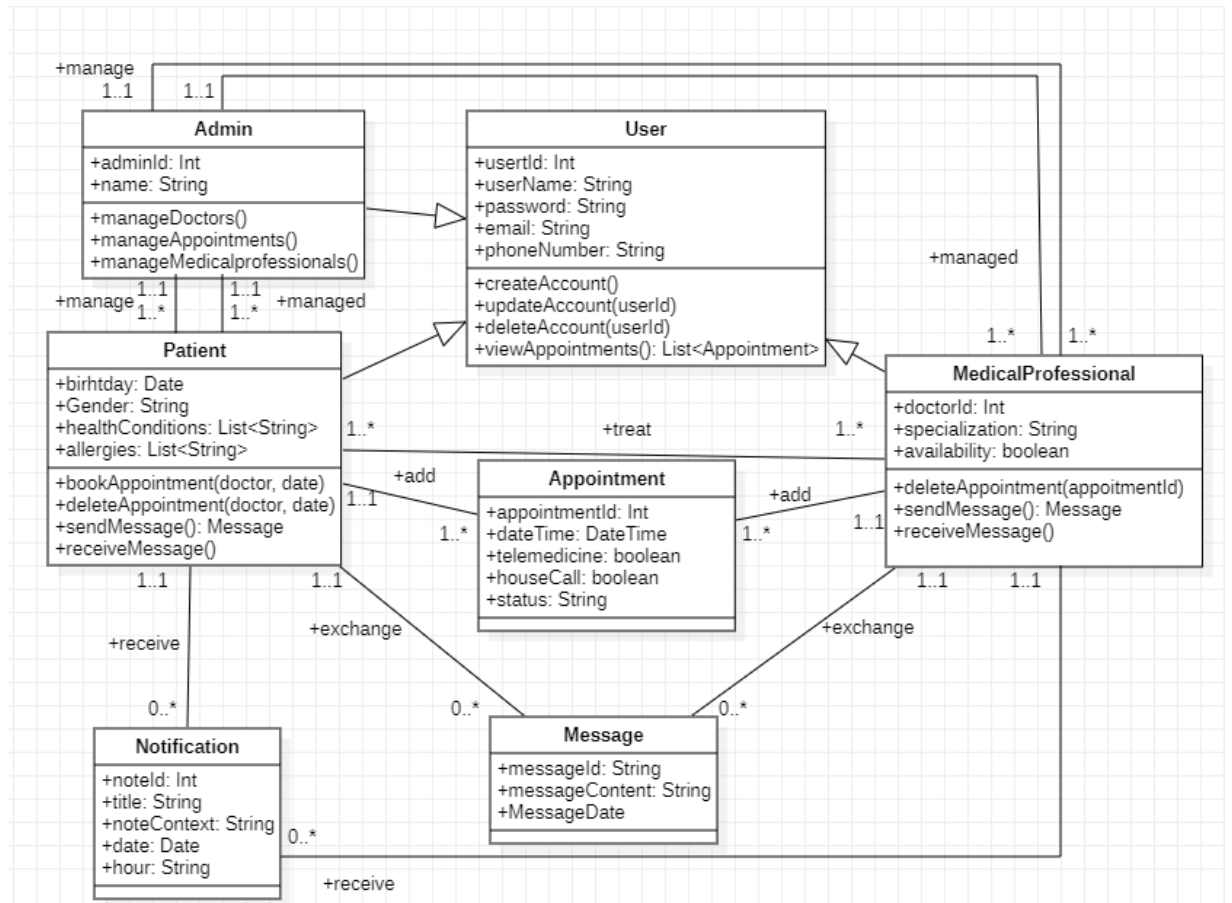


Figure IV.7: MyClinic mobile application Class Diagram

4 Presentation of the application

4.1 Interfaces

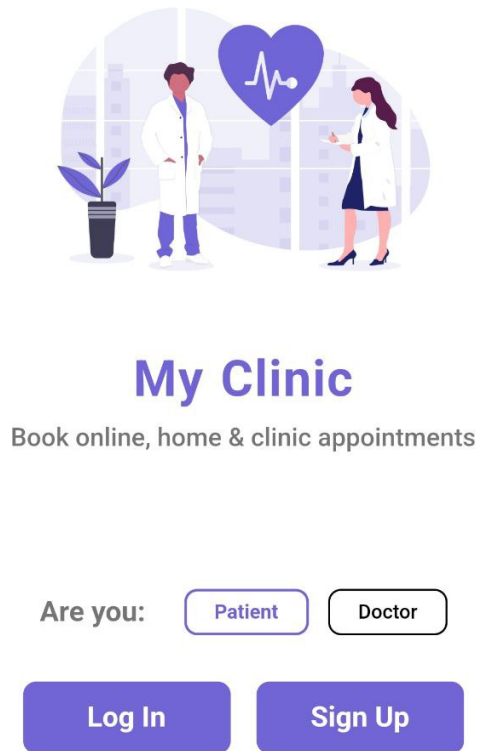


Figure IV.8: Patient Register Interface

The registration screen allows new users to create an account within MyClinic mobile application. Users are prompted to choose their role as either a **Doctor** or a **Patient**. If the user selects 'Patient,' they can proceed to log in to an existing account or sign up if they do not have an account. However, if the user selects 'Doctor,' a different interface will appear, which will be shown on the next page.



My Clinic

Book online, home & clinic appointments

Are you:


Patient

Doctor

Log In

Figure IV.9: Doctor Log in Interface

The doctor login interface allows doctors to log in to their personal accounts. It is important to note that doctors cannot sign up directly, as account creation is typically managed by an administrator or the application's support team. This approach helps prevent the creation of fake or unauthorized accounts, ensuring the integrity and authenticity of the doctor accounts.



First name

Last name

Birthdate

Gender Male Female

Phone Number

Email Address

Account Password

Sign Up

Figure IV.10: Sign Up Interface

The sign-up screen includes typically fields for users to enter their registration details, such as username, email and password. The interface also includes options for password recovery. Additionally, the sign-up form includes fields for the user's birthday, allowing doctors to determine the age of their patients, especially for children or adults. Furthermore, it includes a field to specify the gender of the patient, enabling doctors to provide more tailored and appropriate healthcare services based on the patient's gender, such as considering gender-specific medical conditions or treatments.

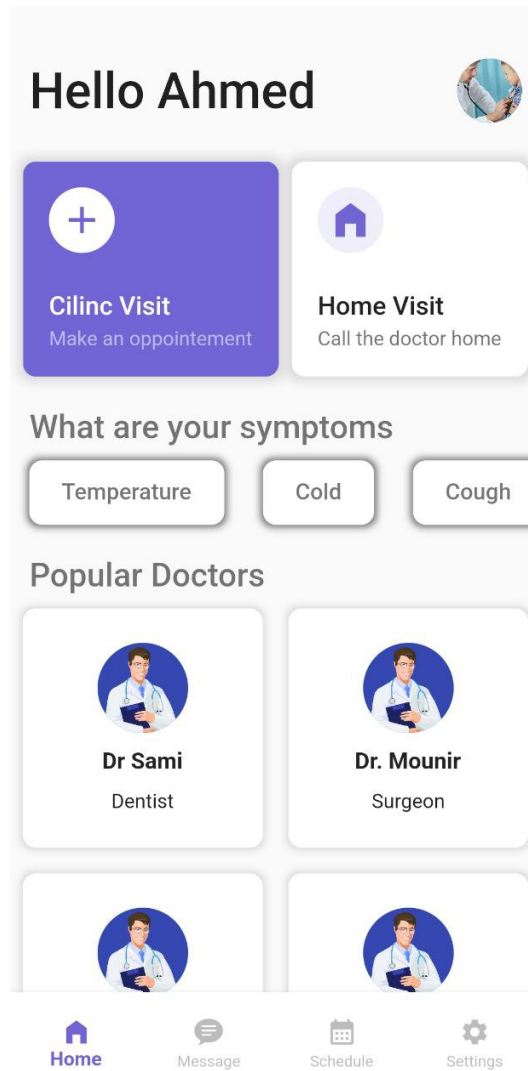


Figure IV.11: Home Interface

The home screen serves as the main hub of the doctor appointment mobile application. It displays a user-friendly interface that provides access to various features and functionalities. The interface includes sections like symptom checker ,viewing popular doctors profiles and quick links to popular features like messaging , booking appointments, and accessing to settings.

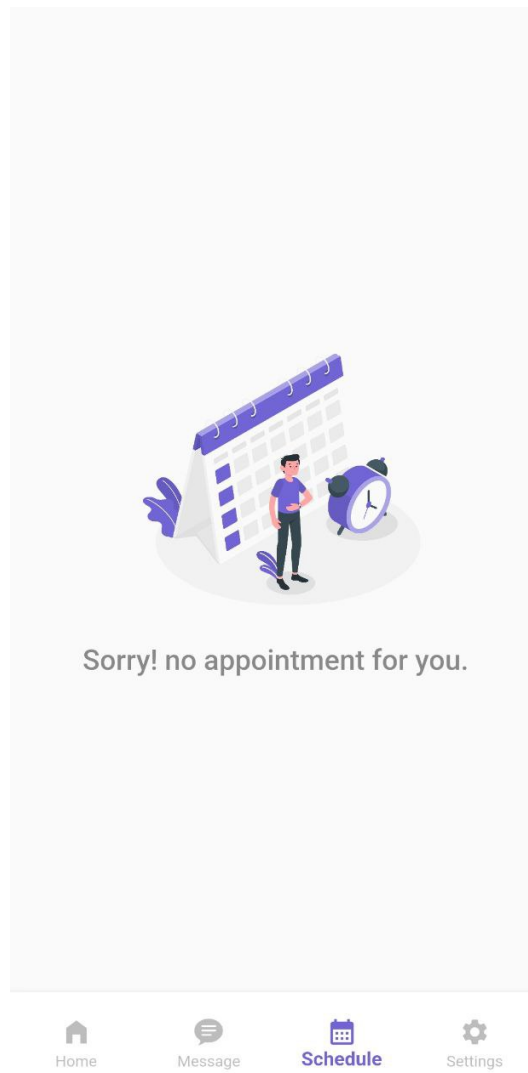


Figure IV.12: Schedule Interface

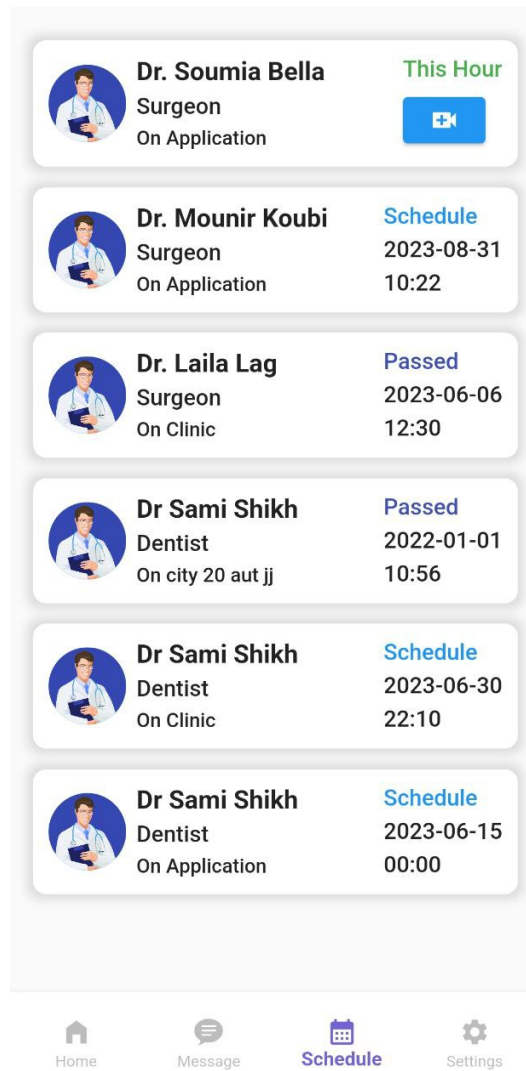


Figure IV.13: Schedule Interface

The appointment details screen presents comprehensive information about a booked appointment. It includes details such as the date, time, doctor's name, doctor's specialization, and the type of appointment (e.g., at Home, doctor's clinic, or online). The interface also includes an option to indicate whether the appointment is scheduled in the past, present, or future. It is important to note that online appointments cannot be scheduled before the designated appointment time to ensure proper scheduling and availability.

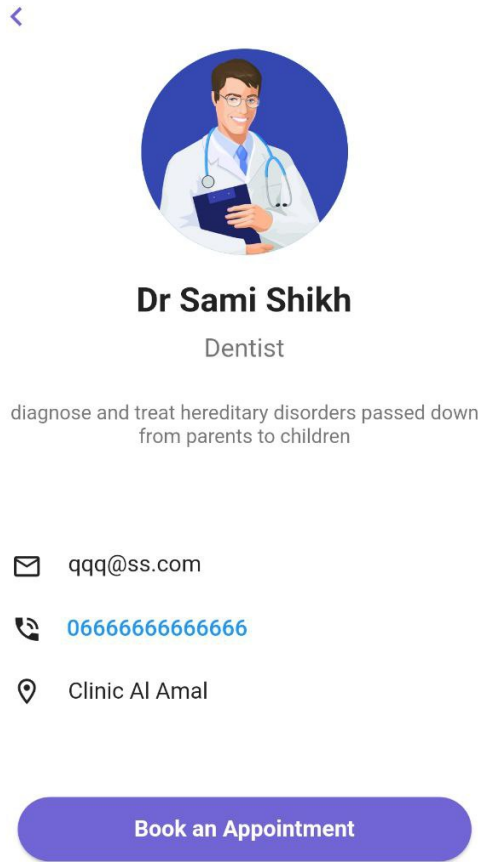


Figure IV.14: Doctor Profile Interface

The doctor profile interface offers a concise and informative overview of a healthcare professional's background, qualifications, and expertise. It provides essential details such as the doctor's name, phone number, the clinic address, specialty, education, professional experience, and certifications. Additionally, the interface includes a photo of the doctor to personalize the profile. The doctor profile interface serves as a valuable resource for patients, helping them gain insights into the doctor's skills and expertise before making an appointment or seeking medical advice.

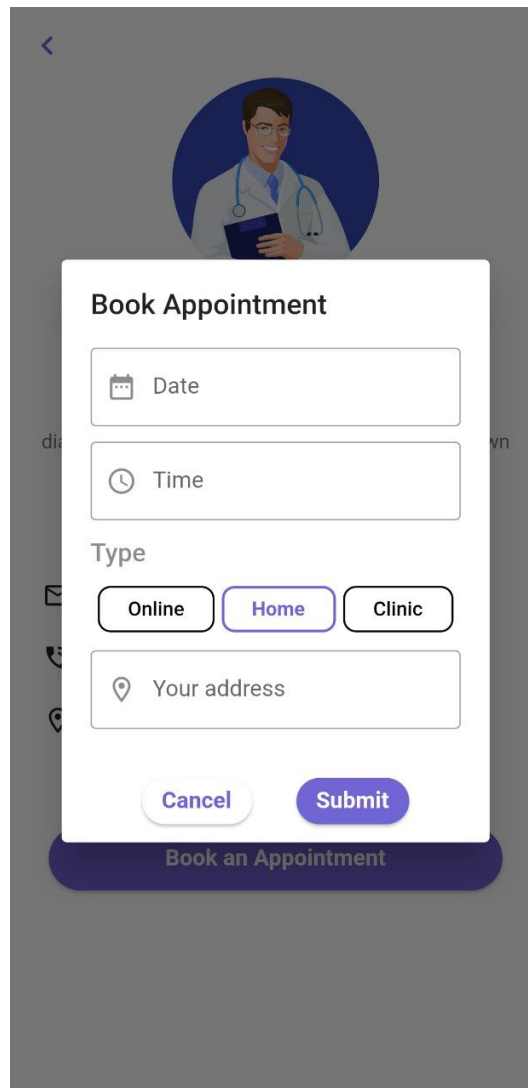


Figure IV.15: Book Appointment Interface

The book appointment interface is a user-friendly feature within a healthcare application that enables patients to schedule appointments with healthcare providers conveniently. This interface typically includes a user-friendly calendar or scheduling system where patients can select their preferred date and time for the appointment. It also provides options to filter the appointment type online, at home, or at clinic. The book appointment interface streamlines the appointment booking process, allowing patients to easily secure their desired appointment slots and receive confirmation details.

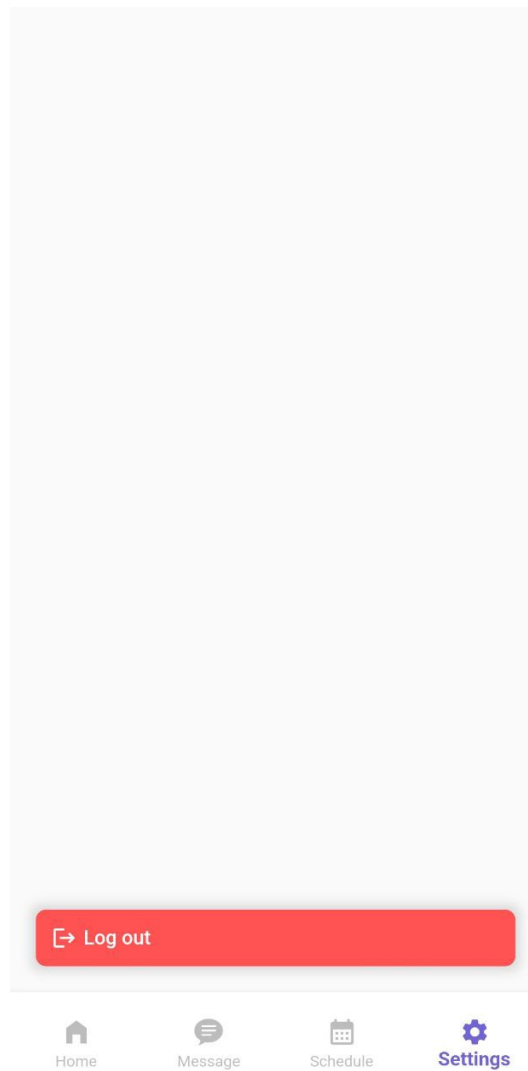


Figure IV.16: Log out Interface

The log out page in 'MyClinic' mobile application allows users to securely log out and end their session. It typically features a "Log Out" button, and upon confirmation, the application clears session data and returns the user to the login or home screen.

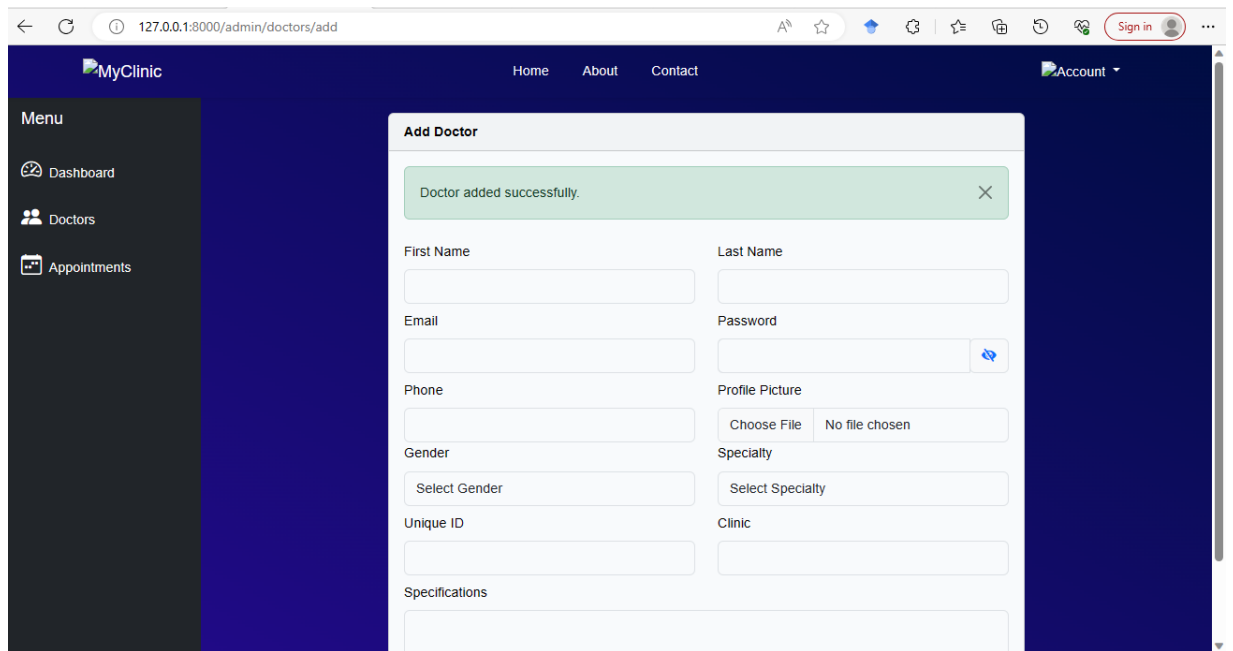


Figure IV.17: Admin Panel Interface

The admin panel for MyClinic mobile application, is a user interface specifically designed for administrators or authorized personnel to manage and oversee the system's operations. In the following paragraphs a description of the admin panel's key features and functionalities:

1-Dashboard: The admin panel includes a dashboard that provides an overview of important metrics and statistics related to the doctor appointment system. It may display data such as the total number of registered doctors and patients, appointment statistics, and recent activities.

2-User Management: The admin panel allows administrators to manage user accounts within the system. It includes functionalities for creating, editing, and deleting doctor and patient accounts.

3-Appointment Management: The admin panel provides features to manage appointments within the system. Administrators can view and modify appointment details, including the date, time, doctor, patient, appointment type (home, clinic, online), and status (scheduled, completed, canceled). They can also reschedule or cancel appointments if needed.

4-Doctor Management: The admin panel allows administrators to manage doctor profiles and information. They can add new doctors to the system, edit existing profiles, and remove doctors if necessary. Administrators can update doctor details such as name, specialization, contact information, clinic location, and working hours.

5-Patient Management: The admin panel includes functionalities to manage patient profiles and information. Administrators can view and update patient details such as name, contact information, gender, and age. They can also handle patient records, manage medical histories, and track patient appointments and interactions within the system.

6-System Settings: The admin panel allows administrators to configure and customize various settings of My Clinic application. This includes setting up appointment duration, defining working hours, managing notification preferences, and adjusting system parameters. Administrators can also control the availability of appointment slots and manage other system-related configurations.

7-Support and Help: The admin panel provides access to support resources and documentation for administrators. It includes a knowledge base, FAQs, and support channels to assist administrators with any issues or inquiries they may have.

5 Conclusion

In conclusion, this chapter focused on the design of doctor appointment and house calls mobile applications, employing UML and its associated diagrams, such as use case diagrams, sequence diagrams, and class diagrams. The utilization of these UML diagrams provided a structured and visual representation of the system design. Additionally, we presented the user interfaces of the applications, showcasing the intuitive and user-friendly design elements aimed at enhancing the user experience.

Furthermore, we introduced the web page for the admin panel, which serves as a centralized platform for managing and monitoring various aspects of the applications. The admin panel provides essential functionalities for healthcare providers to efficiently handle appointments, access patient information, and effectively manage their services.

By incorporating UML diagrams and designing user interfaces that prioritize usability, our applications aim to streamline the process of doctor appointments and house calls, providing convenience and accessibility for both healthcare providers and patients. This chapter sets the foundation for the subsequent development and implementation phases, where the designed solutions will be transformed into functional and robust mobile applications.

Chapter V

Frameworks, Tools and Libraries

1 Introduction

The main intention behind dedicating this section is to provide a comprehensive overview and detailed explanation of the various tools and frameworks that have been employed in the context of our project. By doing so, we aim to shed light on the specific software and technology resources that have been utilized to support and enhance the development and functionality of our system.

2 Development Environment

A development environment, alternatively called a dev environment or environment development, is the collection of software tools, resources, and configurations employed by software developers for the purpose of coding, testing, and debugging. This encompasses the hardware, software, and network setups that create a controlled and separate space for development.

2.1 Android SDK

The Android SDK (Software Development Kit) is a comprehensive set of tools, libraries, and resources provided by Google for developers to build Android applications. It serves as a cornerstone in the development process, equipping developers with everything they need to create innovative and feature-rich Android apps. The Android SDK includes a wide range of

APIs (Application Programming Interfaces) that allow developers to interact with various hardware and software components of Android devices, such as sensors, camera, location services, and more. Additionally, the SDK offers a robust set of development tools, including the Android Studio IDE (Integrated Development Environment), which provides a powerful code editor, debugging tools, and an intuitive interface for efficient app development. The Android SDK also includes comprehensive documentation, sample codes, and developer resources, enabling developers to quickly understand and utilize the various features and capabilities of the Android platform. By leveraging the Android SDK, developers can create high-quality, performance-optimized Android applications that cater to the diverse needs of users worldwide[61].



Figure V.1: Android SDK logo

2.2 Android Studio

Android Studio serves as the official integrated development environment (IDE) for Google's Android operating system. Developed on JetBrains' IntelliJ IDEA software, it is meticulously tailored for the purpose of Android app development. Android Studio can be downloaded and installed on various operating systems including Windows, macOS, and Linux. It has replaced the Eclipse Android Development Tools (E-ADT) to become the primary IDE for native Android application development. Offering a comprehensive set of tools and features, Android Studio facilitates the creation, testing,

and optimization of code for Android apps. It includes a built-in emulator that allows developers to test their applications on virtual devices. The IDE seamlessly integrates with various Google services such as Firebase, providing developers with additional functionalities and services for their app development projects. Furthermore, Android Studio supports version control systems like Git, enabling effective collaboration and efficient management of source code[62].



Figure V.2: Android Studio logo

2.3 Emulator

An emulator is a fundamental tool in software development that replicates the behavior and functionality of a specific hardware or software environment. It enables developers to simulate and test their applications on virtual devices without the need for physical devices. Emulators provide an efficient and cost-effective means to validate the performance, functionality, and compatibility of software across various platforms and configurations. They allow developers to identify and debug issues, optimize code, and ensure a consistent user experience across different devices and operating systems. With advanced features such as screen resolution adjustments, network simulation, and input simulation, emulators offer a comprehensive testing environment that closely mimics real-world usage scenarios. This invaluable tool significantly streamlines the development process, facilitates rapid iterations, and ultimately contributes to the delivery of robust and high-quality software products[63].

2.4 Flutter

Flutter, an open-source UI software development kit (SDK) developed by Google, revolutionizes mobile application development by enabling developers to write code once and deploy it across multiple platforms. With Flutter, developers can build high-performance applications that seamlessly run on Android, iOS, Linux, Mac, Windows, and the web. Leveraging the Dart programming language, Flutter offers a comprehensive collection of pre-built widgets, empowering developers to create customized and visually captivating user interfaces. One notable feature of Flutter is its "hot reload" functionality, which allows developers to witness real-time results of code changes, expediting the development and testing process. As a result, Flutter has emerged as a favored framework for crafting feature-rich, visually striking applications with exceptional performance[64].



Figure V.3: Flutter logo

3 Development Languages

In our project, we relied on a pivotal programming language, which is outlined as follows:

3.1 Dart

Dart is a modern and object-oriented programming language specifically designed for building high-performance, cross-platform applications. Developed by Google, Dart offers a robust set of features and tools that enable developers to create reliable, scalable, and efficient software solutions. With its strong static typing and Just-in-Time (JIT) compilation, Dart provides enhanced performance and runtime efficiency. Its syntax is concise and readable, making it easier for developers to write and maintain code. Dart also offers a comprehensive standard library and a rich ecosystem of packages, enabling developers to leverage existing solutions for common tasks. Moreover, Dart's compatibility with Flutter, a popular UI toolkit, allows for seamless development of visually appealing and responsive applications for mobile, web, and desktop platforms. Overall, Dart empowers developers with a powerful and versatile language that facilitates the creation of modern, high-quality software applications [65].



Figure V.4: Dart programming language logo

4 Firebase

Firebase is a comprehensive platform developed by Google that offers a range of backend services and tools to support app development. It provides developers with a suite of services such as real-time database, cloud storage, authentication, analytics, and more. Firebase simplifies the development process by providing pre-built functionality that can be easily integrated into mobile and web applications. With Firebase, developers can quickly add features like user authentication, data storage, and serverless computing to their apps without the need for extensive backend infrastructure development. Additionally, Firebase offers robust SDKs and APIs for various platforms and programming languages, enabling developers to seamlessly integrate Firebase services into their projects. The platform also provides powerful analytics capabilities, allowing developers to gain insights into user behavior and app performance. Firebase's scalability, ease of use, and extensive feature set make it a popular choice for developers looking to build high-quality, scalable, and feature-rich applications[66].



Figure V.5: Firebase logo

5 Laravel

Laravel is a popular PHP framework known for its elegant syntax and powerful features. It follows the MVC pattern, simplifies common development tasks, and has a supportive community. With features like routing, caching, authentication, and database management, Laravel enables developers to build scalable and maintainable web applications efficiently[67].



Figure V.6: Laravel logo

6 MySQL

MySQL is an open-source relational database management system (RDBMS) that is widely used for storing, managing, and retrieving data. It provides a reliable and scalable solution for both small-scale and large-scale applications. MySQL offers various features, including support for multiple storage engines, ACID-compliant transactions, user management, and advanced querying capabilities through the SQL language. It is compatible with different operating systems and can be easily integrated with popular programming languages and frameworks. MySQL is known for its performance, reliability, and extensive community support[68].



Figure V.7: Mysql logo

7 Conclusion

In conclusion, this chapter provided an overview of the essential frameworks, tools, and technologies required in this domain, specifically in terms of front-end development using Flutter, as well as back-end development and database management.

By identifying the appropriate frameworks and tools, we ensure the availability of a robust and efficient development environment for our project. Flutter, known for its cross-platform capabilities, offers a powerful solution for creating visually appealing and responsive user interfaces. Additionally, selecting suitable back-end technologies and database management systems enables us to handle data processing, storage, and retrieval effectively.

By leveraging these frameworks and tools, we can develop a comprehensive and well-integrated solution that fulfills the requirements of our project. This chapter serves as a crucial foundation for the subsequent development phases, where we will utilize these technologies to create a sophisticated and high-performing application.

General Conclusion

In conclusion, The increasing demand for healthcare services has emphasized the importance of leveraging technology and tools to provide remote healthcare services, particularly through remote patient monitoring. Recognizing this need, we have developed a mobile application aimed at delivering medical treatment to patients by their healthcare providers, either online or at home. Our application focuses on specific areas, such as ensuring timely access to healthcare, promoting preventive care and early intervention, enhancing health outcomes and patient satisfaction, addressing health disparities, facilitating effective communication and coordination among healthcare providers, supporting patient education and empowerment, optimizing resource utilization, promoting cost-effective practices, and continuously improving the quality and safety of healthcare delivery. Our ultimate goal is to improve the overall health and well-being of individuals and contribute to the betterment of population health. By embracing technology and incorporating these principles into healthcare, we aim to adapt and respond to the challenges posed by the health crisis, ultimately enhancing the delivery of healthcare services in the modern world.

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