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Designing an application to provide psychological and physical care for Arabic patients with Multiple Sclerosis

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Certificate

It is certified that project report has been prepared and written under my direct supervision and guidance.The project report is approved for submission for its evaluation.

Dr. Abeer Alhujaylan

Dedication

First of all, we are producing this project, Allah who gives us the ability to complete it. We dedicate our great accomplishment in completion of this project first to our loving parents, who were the reason for our existence, secondly to our beloved country, which offered all educational instruments for us and to Qassim University, which places a high value on education. Finally, we'd like to thank everyone who has contributed to our success and helped us get here and also thanks a lot to Dr. Dina, for helping us and our supervisor Dr. Abeer Alhujaylan who is support us throughout this project.

Amal Alanzi, Amal Aldbiby, and Raghad Alotaibi

Abstract

During the coronavirus pandemic (COVID-19), many Multiple Sclerosis (MS) patients faced many risks that could pose a risk to their health, leading them to a full and compulsory quarantine and making it difficult for the patient to communicate with doctors. From this point of view, we aim at designing an application to provide psychological and physical care for Arabic patients with MS. For psychological care by communicating with specialized doctors or who have the same disease for the purpose of chatting and mitigating each other or supporting members of the community, providing videos and podcasts for entertainment purposes. Due to the difficulty of transportation for MS patients and visiting hospitals, through our application, we will provide a direct mechanism for the patient to communicate with their doctor to provide them with urgent medical advice. Also provide physical care by providing some exercises that may contribute to improving some muscle weakness.The patient can take a test to determine the level of the disease.They can save their appointments to remind them.

Keywords: A mobile Application, Multiple Sclerosis, Remote Consultation, Doctor-Patient Interaction.

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Abbreviations

APK Android Package Kit

App Application

CNS Central Nervous System

COVID-19 Coronavirus disease

DFDs Data Flow Diagrams

EDSS Expanded Disability Status Scale

FS functional systems

IDE Integrated Development Environment

iOS iPhone Operating System

JSON JavaScript Object Notation

MS Multiple Sclerosis

PPMS Primary Progressive Multiple Sclerosis

QUIS Questionnaire for User Interaction Satisfaction

RRMS Relapsing Remitting Multiple Sclerosis

SDKs Software Development kit

SDLC Software Development Life Cycle

SPMS Secondary Progressive Multiple Sclerosis

UAT User Acceptance Testing

UML Unified Modeling Language

Chapter 1

INTRODUCTION

INTRODUCTION

1.1 Introduction

Multiple sclerosis (MS) is a chronic autoimmune disease where the immune system wrongly targets the central nervous system including the brain and spinal cord [1]. In MS, the nervous system, including the myelin sheath, nerve fibers and even the cells that produce the myelin, is generally damaged [2]. It can lead to chronic inflammation, and loss of neurons that result in motor, sensory and cognitive impairments [3]. Those injuries go away after few days or weeks if they're not very serious, but can cause permanent changes in the spinal cord when severe. These permanent changes are called sclerosis, and because these lesions happen in multiple and different areas, the disease is called multiple sclerosis [4]. Because of this disease, the body's immune system responds abnormally, it leads to sclerosis in the cells and thus slows down or stops the movement of mobile neurons between the brain and the body's organs [5]. A lot of people worldwide suffer from this disease. It is estimated that around the world the number of people living with this disease has grown to 2.8 million since 2022. Most individuals with multiple sclerosis are between 20 and 40 years of age. The incidence of MS among females is two to three times higher than for males. Till now, there is no cure for this disease, but there are treatments which may alter the course of the disease and the cause of this condition is still unknown [6].

There are three types of MS[7]:

1. Relapsing-remitting MS (RRMS): Typically 80-90% of cases.
2. Primary progressive MS (PPMS): 5% to 15% of MS patients.
3. Secondary Progressive MS (SPMS): affects 30% of MS patients, usually occurring after long years of disease.

The symptoms of sclerosis occur suddenly to the patient and those around him, and the symptoms vary in severity depending on the degree and location of the infection, and may include: tingling or numbness of the limbs, bodily imbalance, weakness or muscle spasms, confusion with perception, vision, duplication or non-differentiation of colors, weakness and rapid stress, difficulty speaking and memory affected, and decision-making capacity. These symptoms cause many complications, such as muscle stiffness and spasms, paralysis of the foot muscles, bladder and bowel problems, forgetfulness and loss of concentration, depression and epilepsy [5].

Digital applications and interventions have become popular in self-managing chronic diseases. Many are readily available, cost-effective, and can have a positive impact on clinical outcomes and self-care processes. For MS and despite the increasing number of mobile apps for self-management, designing interventions for effective user interaction remains challenging [8].

Individuals with inflammatory neurological conditions experienced considerable uncertainty during the 2019 coronavirus pandemic (COVID-19), related both to the potential risks posed by their underlying medical condition and to the immunomodulatory treatment required to manage their disease. As a result, people with chronic neurological diseases in several countries have been advised to isolate themselves strictly during periods of high community transmission [9].

Consequently, developing an application that provides psychological and physical care to MS patients is critical. From this standpoint, we aim in this project to design an application

that provides psychological and physical care for patients with MS by communicating with specialists, or who have the same disease or supportive members of the community. Also, due to the difficulty of transportation for MS patients and visiting hospitals, through our application we will provide a direct mechanism for the patient to communicate with their doctor to provide them with urgent medical advice. Finally, our app will provide a lot of services that contribute to enhance the psychological and physical care to MS patients.

1.2 Problem Specification and Motivation

- Many MS patients faced many potential risks that could pose a risk to their health during the coronavirus pandemic (COVID-19), leading them to compulsory full quarantine and making it difficult for the patient to communicate with doctors.
- To the best of our knowledge, there is no actual application supported in Arabic and specialized in this disease.
- The existence of this application to meet the patient's need not to return to the Internet and to look for the causes of his health symptoms, because some information available on the Internet may bear the rate of error and invalidity. Through this application, MS patients can communicate directly with specialists through conversations to know their results better and more accurately.
- We aim to designing an application to provide psychological and physical care for Arabic patients with MS.

1.3 Goals and Objectives

Because there are psychiatric diseases associated with MS as the patient has different internal feelings due to the physical symptoms of the disease and their inability to explain what physical pain they feel. Also, their realization that no one can understand their condition and sudden life change. We seek through the creation of our application (Et'taki) to provide psychological and physical care to MS patient. From the psychological care side, we aim to provide some services that contribute to relieve their feeling of illness and look positively to improve their mental health. Now from the physical care side, we aim to provide some services that include exercises that may contribute to improving some muscle weakness. In addition, we seek to overcome one of the main problems for MS patient which is transportation, whether going to medical and psychological appointments, by providing the communication service with the competent physician or even one of the sufferers or supporters and contribute to saving time and effort of the patient and enhance their psychological and physical health.

1.4 Study Scope

This project focuses on patients with MS and is able to improve the management and living with this disease through the patient's communication with specialized doctors, patients with the same disease, and people who support these patients to help improve their mental health by talking with them. In addition, it contributes to enhance the physical and psychological health of MS patient through the proposed services.

1.5 Study Plan and Schedule

The Figure 1.1 presents a Gantt Chart of all the work that we have done during the first phase of our project.

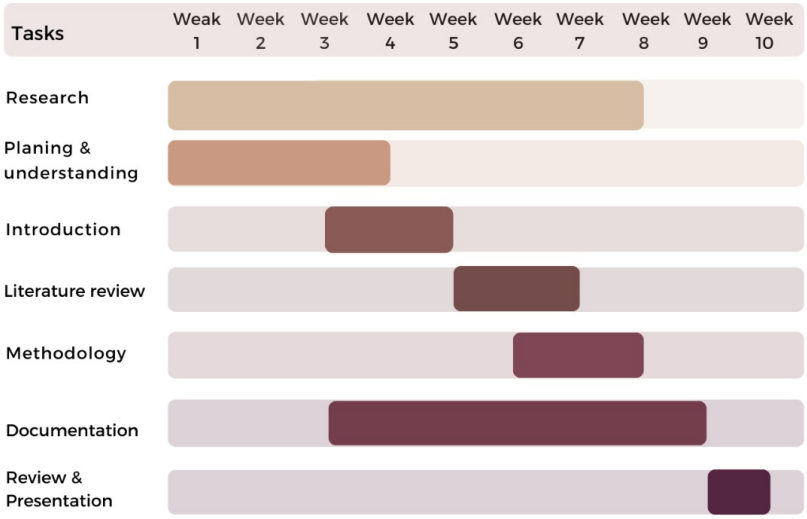

Figure 1.1: Gantt Chart of all the work.

1.6 Organizing Of The Chapters

Our project will be done through two phases. This document represents the first phase which includes:

- **Chapter one:** shows the introduction, which contains: Definition of the disease, a rudimentary glimpse of the project, the description of the issue, the determination of the goals and objectives, and the clarification of the scope, plan, and a schedule of the study.
- **Chapter two:** Reviews the background and the previous studies of our subject, the Issues related to the proposed work, and the proposed work.
- **Chapter three:** discusses the type of study and the methodology that has been used in details.
- **Chapter four:** This chapter covers the implementation steps used in the development of the application and presentation of all application pages. It also describes two types of testing: black box and white box.
- **Chapter five:** Significant findings, discussion of recommended work, and discussion of study objectives are all included in this chapter.
- **Chapter six:** This chapter presents the conclusion, project choice, and contributions. Moreover, limitations, problems of the study, and future work.

Chapter 2

LITERATURE REVIEW

LITERATURE REVIEW

2.1 Introduction

Despite the proliferation of mobile applications in healthcare, health outcomes are still insufficient and show mixed results, particularly in the areas of ease of use and effectiveness [10]. For applications suitable for patients with multiple sclerosis (MS) , self-management programs may be a suitable solution for dealing with them and may improve the patient's adherence to self-management schemes [11]. In addition, a user-generated content, like social media, is a rich source of data for health care professionals and researchers in understanding patient behavior [12]. Although there are many reasons why patients rely on social media programs to obtain health information, including: 1) the perception that physicians are too busy to respond to questions, 2) the potential of social media and electronic business (e-business) platforms as learning sources for users, to understand and decide on health problems and treatment options, particularly in the case of chronic diseases, 3) feeling less embarrassed to ask questions as a result of anonymity [12]. Considering the importance of these aspects in MS management, we can provide a mobile application for self-management of this illness with a dedicated tool for patients, to feel comfortable expressing their views and be the perfect place to analyze the data to understand user reaction and perception of health care intervention.

In this chapter, we will present the background of MS disease which includes its definition, symptoms and complications and so on. Then, we will display the applications and organizations interested in this disease with the services provided by them. Finally, our proposed work will be presented.

2.2 Background

In this section, we will define the MS disease, its types, its world day, symptoms and complications. Then, we will divide the applications and organizations interested in MS disease into three parts regarding to their goal: 1- Psychological Support, 2- Medical Consultation and 3- Psychological Support and Medical Consultation.

2.2.1 Multiple Sclerosis (MS)

MS " is an autoimmune disease characterized by the destruction of oligodendrocytes and axonal loss causes neuronal inflammatory demyelinating in the central nervous system (CNS) " [13]. A myelin is an isolating layer, or sheath, that forms around the nerves, including those of the brain and spinal cord. It contains proteins and fatty substances. The myelin sheath allows quick and effective transmission of electrical impulses along the nerve cells. When myelin is damaged, these pulses slow down [14].

In MS, the immune system attacks the protective sheath (myelin) that covers the nerve fibers and causes communication issues between the brain and the rest of the body. This creates a lesion that, depending on the location in the central nervous system, can cause symptoms such as numbness, pain or tingling in parts of the body. The signs and symptoms of MS vary greatly from patient to patient and depend on the location and severity of damage to nerve fibers in the CNS. Some individuals with MS may lose their ability to walk independently or ambulate at all. Other people may experience long periods of remission without any new symptoms, depending on what kind of MS they have. In the end, the disease may cause permanent damage or damage to nerve fibers [15]. Figure 2.1 shows the effect of melanin damage on CNS [16].

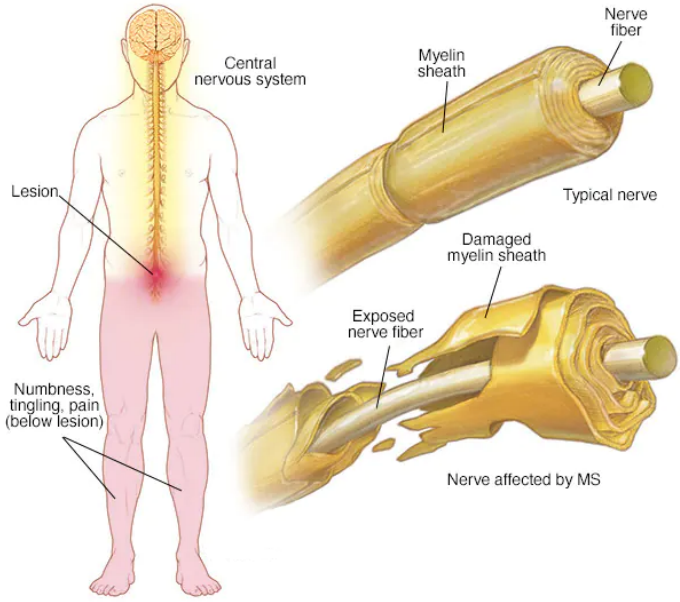

Figure 2.1: Myelin damage and the CNS[16]

2.2.2 Types of Multiple Sclerosis

MS is different for everyone. Even if you have the same type of MS as someone else, you may not experience the same symptoms in the same way. There are three types of MS: relapsing-remitting MS, primary progressive MS and secondary progressive MS [17].

1. Relapsing-Remitting MS (RRMS):

   This type is the most common and constitutes the first stage of MS where the patient is in a stable state and is subsequently exposed to symptomatic crises affecting the patient for more than several days, and may need to be hospitalized for treatment. After the end of the attack, the symptoms can disappear completely, but in some cases, the attack can leave permanent damage to a given center, but keep it stable without deterioration [17].

2. Primary Progressive MS (PPMS):

   This type of sclerosis results from ongoing damage to neurons building up over time. The patient is in a stable state and is undergoing a severe symptomatic crisis, but then there is a relapse that causes the condition to deteriorate constantly, but without another attack[17].

3. Secondary Progressive MS (SPMS):

   This species is the least common of the MS species. The patient suffers from severe progressive symptoms as soon as the disease appears and suffers from deterioration, accompanied by occasional pathological attacks [17].

2.2.3 World Multiple Sclerosis Day

World MS Day, celebrated annually on May 30 [18], which corresponds to the 18th of Shawwal in the Hijri calendar.

Global MS Day goals:

- Address social barriers that may make individuals with MS feel alone and isolated.

- Build communities that support and care for people with sclerosis.
- Promote self-care and healthy living with illness in infected people.

2.2.4 Multiple Sclerosis Symptoms

The signs and symptoms of MS can vary greatly from person to person and during the course of the disease depending on the location of the nerve fibers affected. Common symptoms include: numbness or weakness in one or more limbs that typically occurs on one side of your body at a time, tingling, electric-shock sensations that occur with certain neck movements, lack of coordination, unsteady gait or inability to walk, partial or complete loss of vision, blurry vision, vertigo, slurred speech, cognitive problems and mood disturbances [19].

2.2.5 Multiple Sclerosis Complications

MS complications are: Osteoporosis, increased risk of fracture, increased risk of respiratory infection, pneumonia, difficulty breathing, inability to speak, urinary tract inflammation, intravenous blood clots, nutritional problems leading to severe weight loss and which may require recourse to the feeding tube, in addition to suffering from psychological complications such as depression and anxiety [19].

2.3 Related Work

2.3.1 Previous Studies

Advances in mobile communications have led to the introduction of electronic health (e-health) technologies that contribute to improving access to and quality of health services. Because the Internet is now easily accessible via smart mobile devices, most people can benefit from e-health applications. There has been rapid growth in the development of digital applications and remote communication technologies for MS patients in recent years [20].We have identified a specific group of applications, which are presented briefly in Table 2.1, and categorized them into three main sections: psychological support apps, medical consultation apps, psychological support, and medical consultation apps together.

1. Psychological Support:

   Due to the importance of the psychological aspect for MS patients, many applications have been provided that aim to enhance this aspect, as shown as follows:

   - Bezzy MS:
     Bezzy MS is a free online platform which redefines the sense of the word ”community”. It is available through the App Store, Google Play and the website. We are interconnected humans. Belonging to a community means we feel safe and realize our full potential. But so many times, living with MS can make you feel physically and emotionally isolated. Not only can it be difficult to do the things you enjoyed before your diagnosis, but it can also feel like no one understands what it is. Its mission is to cultivate an area supplied by the MS community and made possible by another. From one-on-one conversations to chat forums, it eases the connection. It is a safe place to find and receive advice, seek and offer support, and discover genuine member stories.The purpose of the app is to create an experience where everyone feels seen, valued and understood, everyone’s story counts, shared vulnerability is the name of the game [21], [22].

- My MSTeam:
  My MSTeam is a social network and support group for persons living with multiple sclerosis. It can be found on the website. It provides emotional support to others and ideas about treatments and therapies. It makes it easy for you to: obtain the emotional support you need from others like yourself, and get practical advice and ideas about managing treatments or therapies for MS. When you or someone in your life is diagnosed, it's not uncommon to feel lonely and uncertain where to find the best information and people who can help you now. It believes in easily finding the best people around you to help you get the answers you need, and to find support from people who can truly relate The most popular sections: the activity page are the ones where everyone posts updates, including pictures, stories, thoughts and anecdotes. this is where day-to-day victories and challenges are shared and sustained, find people like you by location, diagnosis and age. You can go through everybody's story and updates, which helps provide insight as you share with others, questions and answers section you can search for previous questions and answers, and allows you to ask your own question to which other people will respond on My MSTeam [23].

- MS Focus:
  MS Focus (Multiple Sclerosis Foundation) is a non-profit organization that prioritizes helping people with MS and their families maintain their quality of life. It is available on the App store and they have their own website. MS Focus is about luxury. The MS Focus has several features, like: Radio App which is an online radio for its host and includes interesting and informative content available, accessible 24 hours a day. There are a variety of programs, such as how to use breathing and yoga to help with brain fog, the practice of emotional self-care and how we can get the most out of patient-centered care. Provides 24-hour motivation, education, and empowerment for people with MS. Featuring the original content produced by MS Focus: The MS Foundation, along with the best audiobooks and musical inspiration, MS Focus Radio is the MS resource that can support you every day [24].

- Pre-Meet:
  Pre-Meet: Multiple Sclerosis is an application designed this to help patients who have been referred to an MS specialist by helping them prepare in advance of their appointment, knowing what to expect during their examination. This application is available through the App Store and Google Play. This app helps calm the many patients who feel anxious and frightened prior to their appointment. Furthermore, the app provides a useful overview of each stage of the neurological examination and the main steps to follow after the appointment, including a general overview of MS and MS relapses. Ultimately, it allows patients to feel more in control of their medical appointments. The app also provides advice to people who may not be diagnosed with MS after the initial consultation [25].

- Overcoming MS:
  Overcoming MS supports people with MS to live well by making informed lifestyle choices. They have clear and practical actions to take by following an evidence-based self-management program. This program uses substantial scientific evidence on how holistic self-care, in addition to medical treatments, benefits people's physical and mental health. Knowing that people are able to change the risk of deterioration through life choices gives us hope. Their vision is that MS sufferers feel empowered to take control of their health, make informed life choices and lead full and healthy

lives. It works in partnership with individuals, communities, health professionals and other charities to create meaningful and lasting benefits for people living with MS. It provides books, exercises, podcasts, recipes, frequently asked questions, guided meditations, past webinars, videos, mental health hubs and stories of hope. It is available in Google play and their own site [26].

- RealTalk MS:
  RealTalk MS is a mobile application available for Android and iOS. RealTalk MS aims to produce and deliver a weekly podcast hosted by Jon Strum. Jon Strum has a deep understanding of how MS affects a loved one and their family. His wife Jeanne was found to have secondary progressive MS. Each week, podcast host Jon Strum presents the latest in MS news, research, advocacy and support for people living with the disease and their caregivers. Each episode features an interview with world-class researchers, clinicians, advocates and policymakers who are committed to making a difference in the lives of those living with multiple sclerosis. Each podcast takes listeners on a journey and connects people living with MS with breaking news, information and current issues. Jon's goal is simple: to continue the conversation until there is no need to talk about MS, except in the past [27].

- Momentum:
  Momentum magazine features people living their best lives with MS, consumer issues, news on progress in MS research and reports on MS activism. You can play Momentum on their website or through the mobile application Apple or Android. It helps to delve deeply into wellness, symptom management and social issues, with a focus on living your best life, the latest science research, discoveries and findings about MS, focus on events that help to raise awareness and funding activities for MS research and programs. It provides practical advice on managing finances, health, nutrition and fitness, profiles of people who have touched lives in the multiple sclerosis community, people affected by MS make their voices heard about an issue, challenge or event, stories submitted by readers and artwork designed to inspire and uplift [28].

- Smartphone-based Application for Self-Management in Multiple Sclerosis:
  The goal of this study was to develop a virtual smartphone-based application for MS self-management. This research was conducted in two phases. During the first phase, user needs were addressed through a questionnaire. During the second phase, a prototype of the application was developed and its usability assessed with the help of the (QUIS) questionnaire. Outcomes most of the educational content, data elements and application functions offered, such as medication time reminder, the assessment of the severity of fatigue and the calculation of the score of the fatigue severity scale were deemed necessary to be included in the application. The use of the app is expected to improve the quality of life and health status of patients. So far, it's not available in App Store nor Google Play [29].

2. Medical Consultation:

   Recently, many mobile applications have appeared that aim to speed up communication between the doctor and the patient, such as applications for diabetes, blood pressure, psychological counseling, MS and other diseases. These applications contribute to the speedy communication of the doctor with his patient and prescribing the appropriate medicine for him without the need to come to the hospital and waiting for appointments. Here are some of the most popular applications for MS:

- MS Trust Conference:
  The MS Trust is there for all those who are impacted by MS, from the time of diagnosis and throughout your journey. you found here for you today, tomorrow and every day after, making sure a life with MS isn't a life defined by MS. Working with the NHS to fund new MS nurses in areas where they are most needed and to ensure that people with MS receive the care and support they need. They also answer your questions about MS, provide information that you can trust, support health professionals with MS in their training and development so that they can provide you with the best possible care, and to listen to and stand up for the MS community, Finally you can find it in the App Store and Google play [30].

- MS Insider:
  MS Insider is a mobile application available for Android and iOS. This application has been designed to help doctors diagnose MS patients and give neurologists valuable scientific data. Doctors can find the latest news from the neurological consultant and can also consult medical articles. They also can consult guidelines on the pharmacological treatment of people with multiple sclerosis. MS Insider gives no medical advice, diagnosis or treatment [31].

- Saudi Multiple Sclerosis Advisory Group:
  Saudi Multiple Sclerosis Advisory Group is a voluntary work initiated in 1998, with the efforts of a group of consultants for neurology in Saudi Arabia, and also adopted in 2003 to work under the Ministry of Health in the Kingdom of Saudi Arabia. This group offers many goals: support and reliable scientific information for infected people, society, and health workers to help those with MS and their relatives live with the disease. They also offer participation in conferences and meetings interested in the disease and create a supportive electronic community for patients and those interested [32].

- BelongMS Improve Life With MS:
  BelongMS improve life with MS is an application that is leading global tech provider of high-engagement patient communities and care platforms. It is available in the App Store and Google play. It is for cancer patients (Belong – Beating Cancer Together) and MS patients (BelongMS) people living with Crohn's and Colitis. The mission is to improve the quality of life and care around the world through technology, engagement, data and artificial intelligence. It allows communities, patients and their caregivers to connect; share information anonymously and discuss matters related to their situation in private with health professionals and the community. Users can also arrange their health documents in one place in a digital filing cabinet. Using machine learning and artificial intelligence, the application customizes content and suggestions based on individual user preferences and needs [33].

- Emilyn - My MS Companion:
  Emilyn - My MS Companion is an application designed to help you understand your symptoms, beat your brain fog, and have more productive conversations with your doctor. It's also discreet and secure so you don't have to worry. For advance our goal is to improve the lives of people with MS. Breakthrough Health, the company behind the MS app Emilyn, has become a part of Mymee. Mymee combines self-monitoring with individual support to help people with MS (and other autoimmune diseases) predict and manage symptoms by identifying their own triggers. An autoimmune

health specialist gives personalized advice every step of the way. You can download this app by the App Store or Google Play [34].

- SM Check:
  SM Check is an application available in the App store and Google Play. It also has a website able to: manage therapy directly on your smartphone, receiving a notification when you are about to run out of medication or when the end of therapy is approaching, remember the drugs the calendar allows you to manage by setting up reminders and keep track of any delay. It can also contact your doctor, and give your doctor access to information about your therapy, and if the app warns you of an interaction with self-medication drugs you can contact them directly for a consultation. For doctors, a reserved area accessible via the web is also available that allows them to view, in addition to the content of the smartphone app, a series of additional statistics related to patients [35].

3. Psychological Support and Medical Consultation together:

   The following applications took into account the psychological aspect in addition to the medical aspect as services provided to patients with MS:

   - BeCare MS:
     BeCare MS link is a mobile application for people with MS. It is easy to use, free, and available for Android and iOS. The BeCare MS Link application offers quantifiable assessments of your neurological function and cognition, whenever you want. BeCare MS Link provides you and your doctor with complete and timed data to help you monitor and enhance your care. With BeCare MS App, you can: share data with your own physician to guide your care, allows you to monitor your MS at home as per your schedule, contribute to the understanding of MS and advance future care for all MS patients and allow Healthcare Providers remote monitoring of your MS patients and your privacy is protected [36], [37].

   - SymTrac MS:
     SymTrac MS is a free app found in the App Store and Google Play. It helps people with MS monitor their overall well-being and symptoms over time to provide a picture of their health. It was designed by people with MS together with health professionals, MS experts, and Novartis Pharmaceuticals Ltd. Data stored in the application can be shared with MS specialist teams to utilize vital consultation time and support the decision-making process. The most commonly used features in the application were appointment function, medication list, symptom monitoring, and how the app could help provide useful information during consultations with their MS team [38]

   - MS Care Connect:
     MS Care Connect is a mobile application that is free and available for Android and iOS. MS experts have created this easy-to-use application to help health professionals and patients monitor the health of MS over time. The MS Care Connect app lets you Compare individual or collective information with MS populations across the country monitor how a variety of actors can affect a patient's health and improve the exchange of information between patients and health professionals. MS Care Connect supports health care professionals through: Quickly viewing your patients' survey results to improve conversations and support shared treatment decisions, monitor your

patients' progress between office visits [39].

- My MS Manager (MSAA):
  MSAA is a free mobile app available on both the App Store and Google Play Store. It helps people with MS keep track of the disease's activity, store medical information, generate reports and the ability to connect to doctors and their healthcare team via the app to share progress and reports safely as required. MSAA provides free programs and services that improve lives. This includes: Helpline and online chat with trained MSAA specialists, security and mobility equipment products, educational programs run by top health professionals, providing vital information and insights, award-winning educational videos, webinars and publications(including MSAA magazine), the Motivator, My MSAA Community peer-to-peer online forum, and podcast episodes covering a range of topics [40].

- Floodlight MS:
  Floodlight MS is a science-based smartphone app for people living with MS. It is available for Android and iOS. Powered by regulated digital healthcare technology, the app keeps track of the areas of MS function that often matter the most. Floodlight MS has been developed in conjunction with MS experts and people living with MS to create an application you can use to share your health data with your doctor. You can use Floodlight MS at home and on the move, by collecting information you can share with your doctor to inform conversations about your care. The activities in Floodlight MS provide views of measurements of your cognition, manual function, and ability to walk over time. The app also includes a personal diary that includes day-to-day questions and a symptom tracker to help you keep a more detailed record of your health [41].

- MS-Mate:
  MS-Mate is an application available in Google Play. It contains two major zones: My MS Mate and MS Mate Net. My MS Mate: this zone helps you monitor the activity of multiple sclerosis, you can add new symptoms, medications, medical events, and test. You can also enter personal notes that are associated with your MS. Any activity you enter can be viewed in the history section where you can have an overview of your MS activity. This may help you better describe your symptoms when talking with your doctor. MS Mate Net: this zone includes 3 sections:

  A- News: which presents the latest MS news, you can read articles by uploading the application to your device and then load all articles through this app.

  B- Request help: You can contact the administrator if you need help with the app or if you have a question about your symptoms or medication. The admin will seek for expert help and answer your question.

  C-forum: All questions posted by users will be made public once the administrator has answered them. This will help others get answers without having to wait for the administrator [42].

Table 2.1: Summarize the previous studies

APPS	Logo	Available			Categorization	Shared experiences	Shared information	Podcast and Essay
		IOS	Android	Website				
Bezzy		Yes	Yes	Yes	Psychological Support	Yes		
MS-Mate			Yes		Psychological Support and Medical Consultation together		Yes	Yes
MS MSTeam				Yes	Psychological Support	Yes		
BeCare MS		Yes	Yes		Psychological Support and Medical Consultation together		Yes	Yes
Floodlight		Yes	Yes		Psychological Support and Medical Consultation together	Yes	Yes	
MS Insider		Yes	Yes		Medical Consultation	Yes		Yes
Saudi Multiple Sclerosis Advisory Group			Yes		Medical Consultation			Yes
Emilyn		Yes	Yes		Medical Consultation		Yes	
MS Trust Conference		Yes	Yes		Medical Consultation	Yes		Yes
Overcoming MS			Yes	Yes	Psychological Support	Yes		Yes

Continued on next page...

APPS	Logo	Available			Categorization	Shared experiences	Shared information	Podcast and Essay
		IOS	Android	Website				
Belong MS		Yes	Yes		Medical Consultation	Yes		Yes
Momentum		Yes	Yes	Yes	Psychological Support	Yes		Yes
SymTrac MS		Yes	Yes		Psychological Support and Medical Consultation together		Yes	Yes
MS Focus		Yes		Yes	Psychological Support			Yes
MS Care Connect		Yes	Yes		Psychological Support and Medical Consultation together		Yes	
MY MS Manager		Yes	Yes		Psychological Support and Medical Consultation together		Yes	Yes
Real Talk MS		Yes	Yes		Psychological Support	Yes		Yes
SM Check		Yes	Yes	Yes	Medical Consultation		Yes	
Pre-Meet		Yes	Yes		Psychological Support		Yes	

2.3.2 Issues related to proposed work

1. To the best of our knowledge, there is no application that supports Arabic.
2. Many applications with complex interfaces and this may cause the patient to not respond to this application.
3. Of our knowledge, few programs focus on both psychological and physical support.

2.4 Proposed Work

Based on our research and in order to avoid some of the problems that were previously mentioned, we offer an application for MS patients that provides psychological care, supports the Arabic language, allows communication with doctors and those who have the same disease or supportive members of the community, also provides free consultation and is available all the time, supports privacy and confidentiality and encourages healthy behavior. It also allows for effective use of limited resources and clinical time, and can allow for quicker response than planned in-person visits. These benefits are important because MS is a long-term, multifaceted chronic disease that requires ongoing surveillance, assessment and treatment.

Our proposed work of this system is summarized as below:

- **Home page:** contains an overview of the disease and information about us.
- **Level determination page:** It contains many questions that can determine the level of disease degree.
- **Exercises page:** contain some pictures and instructions that can help improve the patient's health condition.
- **Reminders page:** Allow the patient to save important dates and refer to them when needed.
- **Be positive page:** aims to help the patient live with the disease and provide some clips that help to do so.
- **Contacting page:** allows members (Patient, Doctor, Supporter) to communicate with each other.

2.5 Summary

At the end of this chapter, we provided a background of the MS disease, its definition, its types, its world day, symptoms and complications. Then, we presented the applications and organizations interested in MS disease and listed the features of each app. Finally, our proposed application with its features was presented after knowing the issues that we discovered in previous applications.

Chapter 3

METHODOLOGY

METHODOLOGY

3.1 Introduction

In this chapter, we will describe the type of study and the methodology used in this project. The proposed methodology is implemented through the Software Development Life Cycle (SDLC). It is a use process that is selected based on the system requirements that must be pursued during the software development process [43].

3.2 Type of study

This study focuses on creating a mobile application to help patients with MS. The application will be created to run on Android devices using java language, but if needed, we will choose an alternative language.

3.3 Methodology

All SDLC processes consist of a series of discrete processes that are used to create applications. It is a structured process that enables the production of high-quality, low-cost software in the shortest possible production time. The goal of SDLC is to produce superior-quality software that meets and exceeds all customer expectations and demands. Figure 3.1 below shows the different stages of a typical software development life cycle [43].

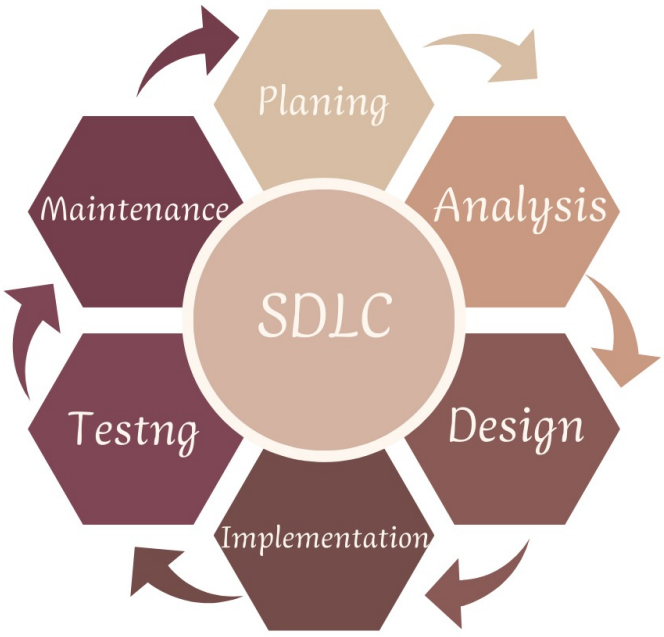

Figure 3.1: software development life cycle

3.3.1 Planning

Through the planning phase, determining primary requirements needed on the Et'taki app.

Project Requirement: The requirements of our project as follow:

- **Requirement 1:** Hardware requirements: A laptop and a smartphone.
- **Requirement 2:** Software requirements: Google Meet, Microsoft Office, Latex, Mendeley desktop, Google scholar, Canva, Dupli Checker, Reverso, Email, Turnitin.
- **Requirement 3:** Internet connection to look for the needed info and download apps.
- **Requirement 3:** Project development in swift language and if we face troubles, we will use other languages.

Functional Requirement:

- The system allows the user to create his own account and log in.
- The system allows the user modify the password.
- The user shall be able to choose the type of registration such as (patient, doctor, supporter).
- The system allows the patient to take a test to determine the level of disease.
- The system should provide a contact between the members.
- The system provides services that help improve the patient's psychological health (videos, podcasts).
- The system allows the patient to save his appointments.
- The system provides exercises to improve the patient's physical health.

1. **Function:** Create a new account.

Description: The ability to create a new account for access to the application.
Input:

1. The user selects the type of registration such as (patient, doctor, supporter).
2. The user enters their first name, and last name.
3. The user enters their email.
4. The user selects his/her gender.
5. The user enters the password.

Output: The account will be created.
Pre-condition: The information must be correct.
Action:

1. The user downloads the app.
2. The user clicks" Create a new account ".

3. The system request user enters his/her information.
4. The system checks the correctness of information.
5. The account will be created.

Post-condition: if the basic flow is successful, the account will be created.

2. **Function:** Determine the level of disease.
Description: The system provides a set of questions for the patient to determine the level of the disease.
Input:

1. The patient answers all questions asked.
2. The patient chooses the consent button if he wants to spread his/her level of disease.

Output: Display the result of the disease level.
Pre-condition: The user logs in as a patient.
Action:

1. The user chooses the type (Patient) when registering the account.
2. Patient selects a level-setting page.
3. The system request patient enters the answers.
4. The patient presses the ”Show Results” button.
5. The results are shown to the patient.

Post-condition: If the basic flow is successful, the result will be shown.

Non-Functional Requirement:

- The system must be available 24 hours.
- The system must be secure.
- The system must be reliable and responsible for all changes that occur to it
- An intuitive user interface that makes it simple for users to interact with the application.
- The system must respond to the user at high speed.
- The system will enable the user to use the application in the Arabic language.
- Usability.

3.3.2 Analysis

Data analysis is a process of finding, collecting, cleaning, reviewing, and modeling data to derive useful information and to understand derived information for data-driven decision-making [44]. Based on the Expanded Disability Status Scale (EDSS) we have identified the questions that we will follow on the disease level determination page.
The EDSS is a commonly used scale and sometimes known as the Kurtzke scale, named after the neurologist who developed it. The EDSS is a method for quantifying disability in MS and

tracking changes in disability levels over time. The EDSS scale ranges from 0-10 per 0.5 units, which represents higher levels of disability. Steps 1.0 to 4.5 of the EDSS refer to people with MS who can walk unaided and are based on measures of impairment in eight functional systems (FS) [45] :

1. Weak muscles and difficulty moving arms and legs (functions of the pyramidal system).
2. Shaking, losing balance and coordination (cerebellar system).
3. Speech disorders, swallowing, and uncontrollable eye movements (brainstem system).
4. Numbness or lack of sensation (sensory system).
5. Bladder and intestinal monitoring (bladder and intestinal system).
6. Problems with thinking and remembering (cerebral system).
7. Vision issues (visual system).
8. Other

The FS represents a network of neurons in the brain that are responsible for special tasks. Steps 5 to 9.5 of the EDSS basically measure deficiencies in your ability to walk. (Stage 10 is death due to MS.) [45]. Figure 3.2 and Table 3.1 below shows the difference between each level of EDSS [46], [47].

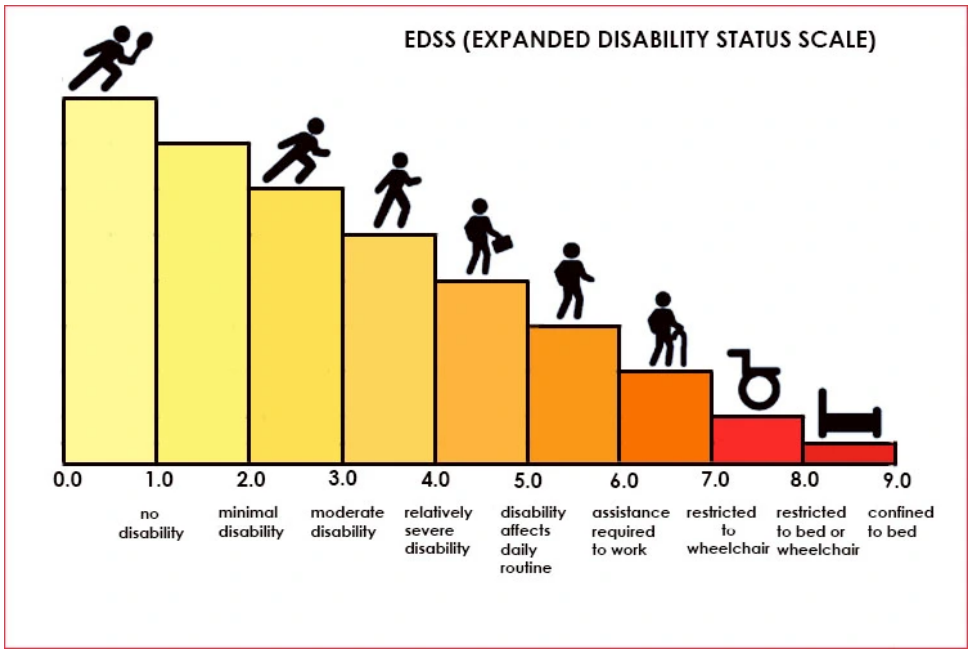

Figure 3.2: Levels of Expanded Disability Status Scale[46].

Table 3.1: Levels of Expanded Disability Status Scale[47].

Score	Description
0	Normal neurological exam, no disability in any FS
1.0	No disability, minimal signs in one FS
1.5	No disability, minimal signs in more than one FS
2.0	Minimal disability in one FS
2.5	Mild disability in one FS or minimal disability in two FS
3.0	Moderate disability in one FS, or mild disability in three or four FS. No impairment to walking
3.5	Moderate disability in one FS and more than minimal disability in several others. No impairment to walking
4.0	Significant disability but is self-sufficient and up and about some 12 hours a day. Able to walk without aid or rest for 500m
4.5	Significant disability but up and about much of the day, able to work a full day, may otherwise have some limitation of full activity or require minimal assistance. Able to walk without aid or rest for 300m
5.0	Disability severe enough to impair full daily activities and ability to work a full day without special provisions. Able to walk without aid or rest for 200m
5.5	Disability severe enough to preclude full daily activities. Able to walk without aid or rest for 100m
6.0	Requires a walking aid – cane, crutch, etc. – to walk about 100m with or without resting
6.5	Requires two walking aids – pair of canes, crutches, etc. – to walk about 20m without resting
7.0	Unable to walk beyond approximately 5m even with aid. Essentially restricted to wheelchair; though wheels self in standard wheelchair and transfers alone. Up and about in wheelchair some 12 hours a day
7.5	Unable to take more than a few steps. Restricted to wheelchair and may need aid in transferring. Can wheel self but cannot carry on in standard wheelchair for a full day and may require a motorized wheelchair
8.0	Essentially restricted to bed or chair or pushed in wheelchair. May be out of bed itself much of the day. Retains many self-care functions. Generally has effective use of arms
8.5	Essentially restricted to bed much of day. Has some effective use of arms retains some self-care functions
9.0	Confined to bed. Can still communicate and eat
9.5	Confined to bed and totally dependent. Unable to communicate effectively or eat/swallow
10.0	Death due to MS

In Figure 3.3 and Figure 3.4 show the questions that were identified to distinguish between each level.

Figure 3.3: Questions determining the level of disability for MS patients.

Figure 3.4: Completed of questions determining the level of disability for MS patients.

3.3.3 Design

The design stage is a necessary precursor to the main development stage. The design phase can be called the transformation phase because this is when an idea is effectively transformed into a true work system. In addition, the data is transformed into charts, and the design team uses those charts to decide how best to move and store the data [48]. We will present, the system's use case diagrams, the cross-functional flowchart of the system's processes, and the data flow diagram for data flow parameters through the system and data storage.

3.3.3.1 Use Case Diagram

A use case is a methodology that is used in system analysis to identify, clarify and organize system requirements. Use case diagrams are used in Unified Modeling Language (UML), which is a standard notation for modeling real-world objects and systems. It shows how a system relates to external entities. As a result, there are relatively few details on how the system operates internally [49].
Use case diagrams have four key symbols: (1) Actor: is a person, group of people, organization, or external system that plays a role in one or more interactions with the system. This is represented by the stick figure. (2) Use case: shows all system functions that describe a sequence of actions. It is depicted as a horizontal ellipse. (3) Associations: interaction depicted by a use case. It is represented by lines linking use cases and actors with an optional arrowhead at one end of the line. Note that the arrowheads in the use case diagram are used to indicate the direction of the initial invocation of the relation or to indicate the main actor. (4) System boundary: is the rectangle around the use cases, all that is inside this boundary is the functionality in the scope of the system [49]. Figure 3.5, Figure 3.6 and Figure 3.7 below shows the use case diagram functionality of the Et'taki app in various situations and the interaction between the system and the users.

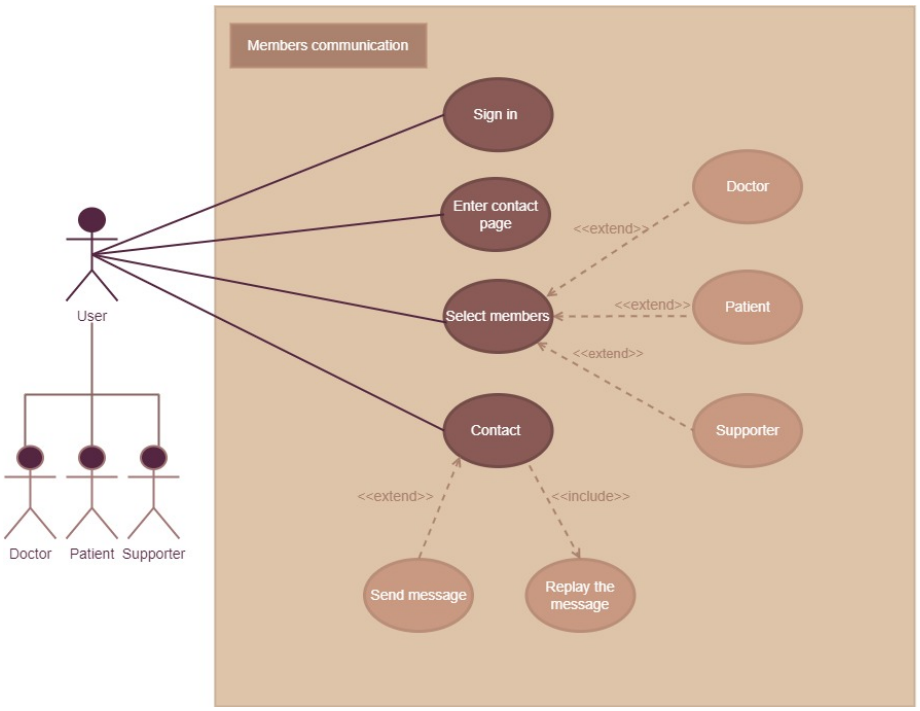

Figure 3.5: Use case of member communication.

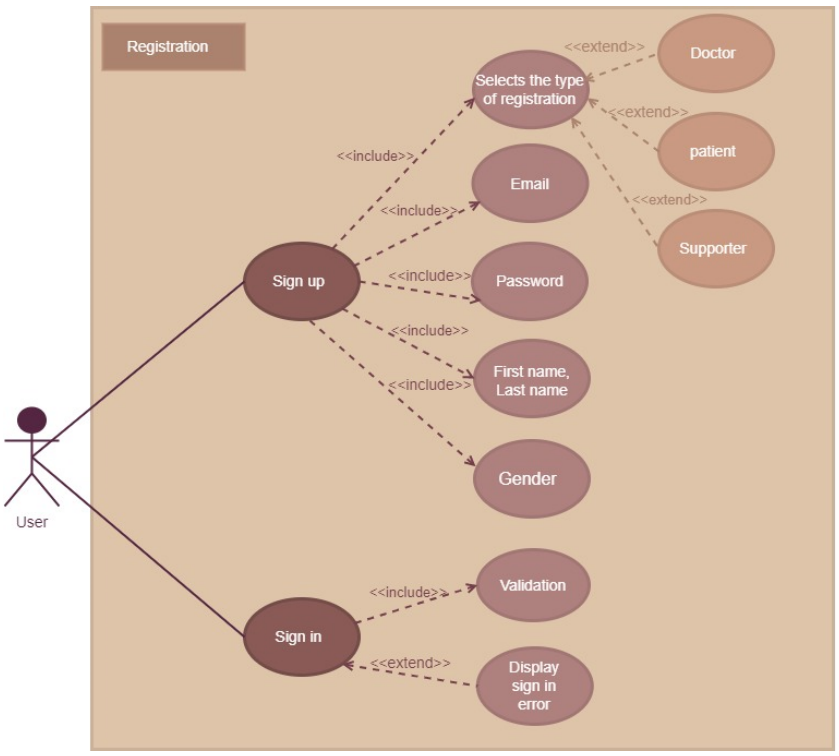

Figure 3.6: Use case of registration.

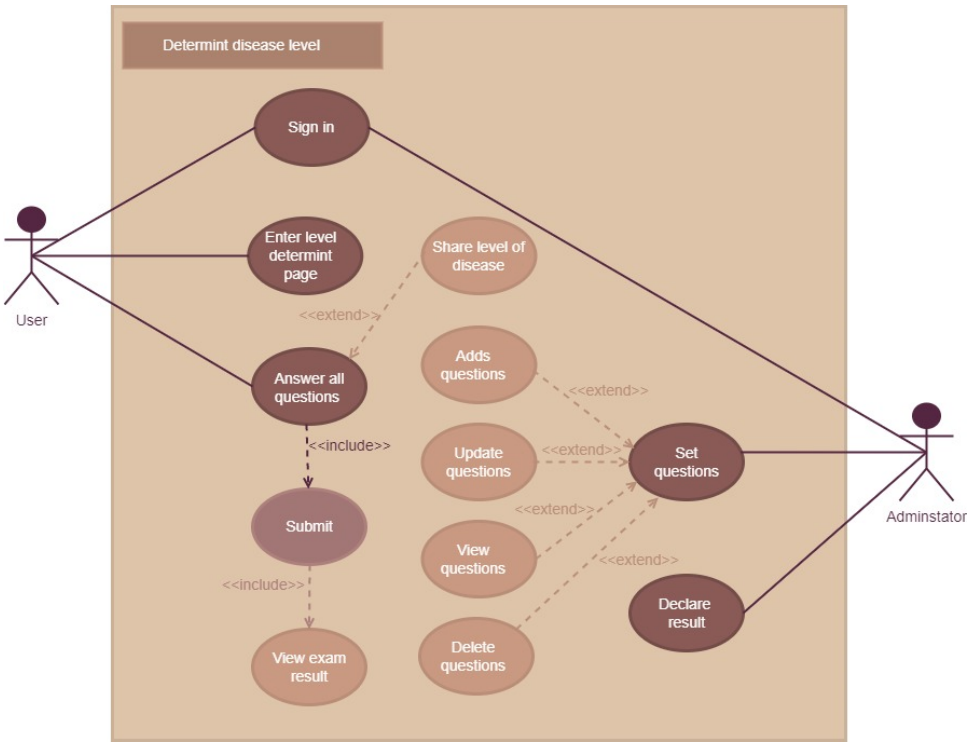

Figure 3.7: Use case determines the disease level.

3.3.3.2 Flowchart

A flowchart is a diagram that describing a process, system or computer algorithm. It is widely used in many fields to document, study, plan, improve and communicate often complex processes in clear and easily understood diagrams. Flowcharts are sometimes referred to by more specialized names such as Process Flowchart, Process Map, Functional Flowchart, Business Process Mapping, Business Process Modeling and Notation, or Process Flow Diagram. They are linked to other popular diagrams, like Data Flow Diagrams (DFDs) and (UML) Activity Diagrams. Flowcharts, use rectangles, ovals, diamonds and potentially many other shapes to define the type of step, as well as connecting arrows to define the flow and sequence [50].

We have used many symbols:(1) Process symbol: also called "Action symbol", this form represents a process, an action or a function. (2) Start/End symbol Also known as the "Terminator Symbol," this symbol represents the start points, end points, and potential results of a path. Often includes "Start" or "End" in the form. (3) Decision symbol: Identifies a question that needs to be answered usually yes/no or true/false. The flowchart can then be divided into different branches depending on the response or consequences thereafter [51]. Figure 3.8 below shows the flowchart of registration process.

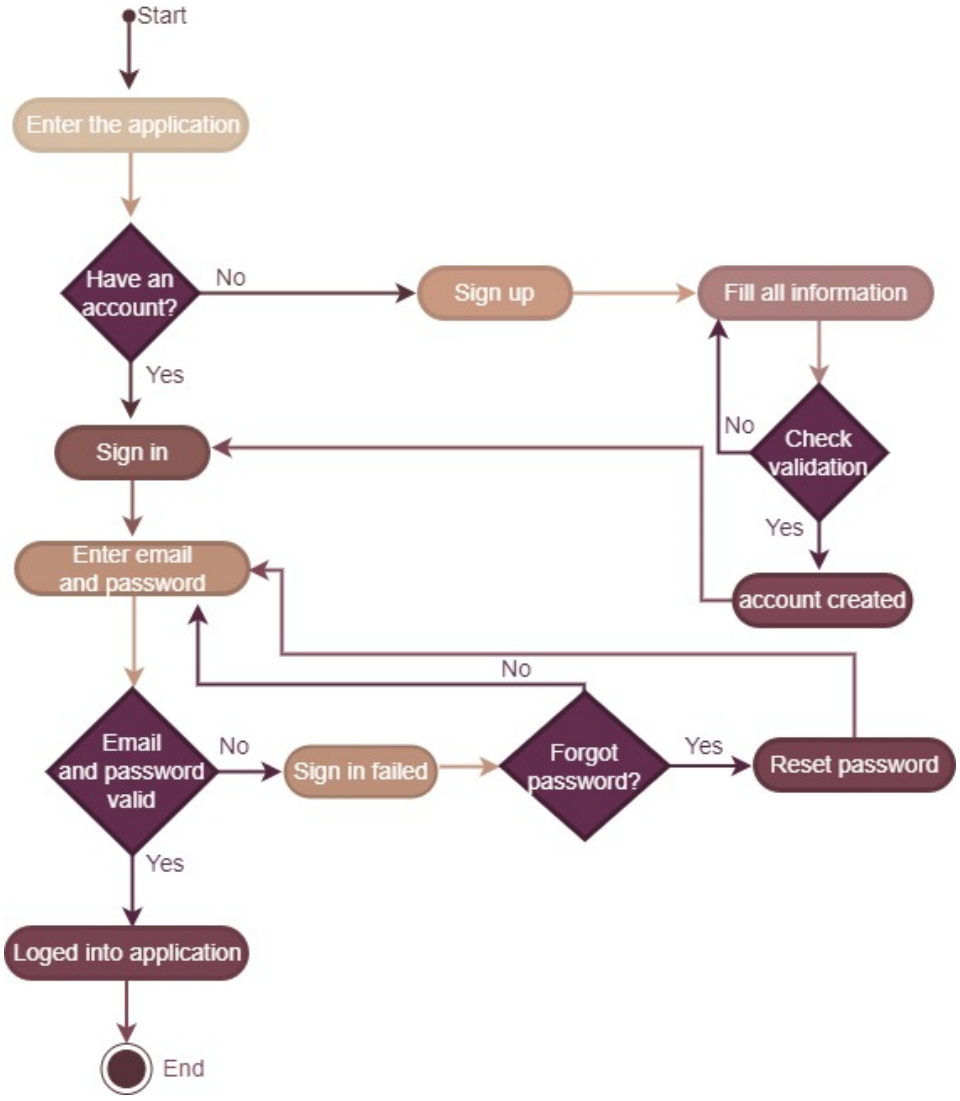

Figure 3.8: A registration flowchart.

3.3.3.3 Data Flow Diagram

A Data Flow Diagram (DFD) maps the information flow for any process or system. DFD can range from simple process overviews to in-depth multi-level DFD which progressively deepen the way data is processed [52].

DFDs have four key symbols: (1) External entity: an external system that sends or receives data, communicating with the system in the being diagrammed. This may be an outside organization or person, a computer system or a business system. These are generally drawn around the edges of the diagram. (2) Process: any process that modifies data and produces an outcome. It can perform calculations, or sort data by logic, or direct the data flow by business rules. (3) Data store: files or repositories with information for further use, such as a database table. (4) Data flow: the path the data follows between external entities, processes and data stores. It represents the interface between the other components and is shown as an arrow [52]. Figure 3.9, Figure 3.10 and Figure 3.11 below shows the context level, level 0 and level 1 of DFD.

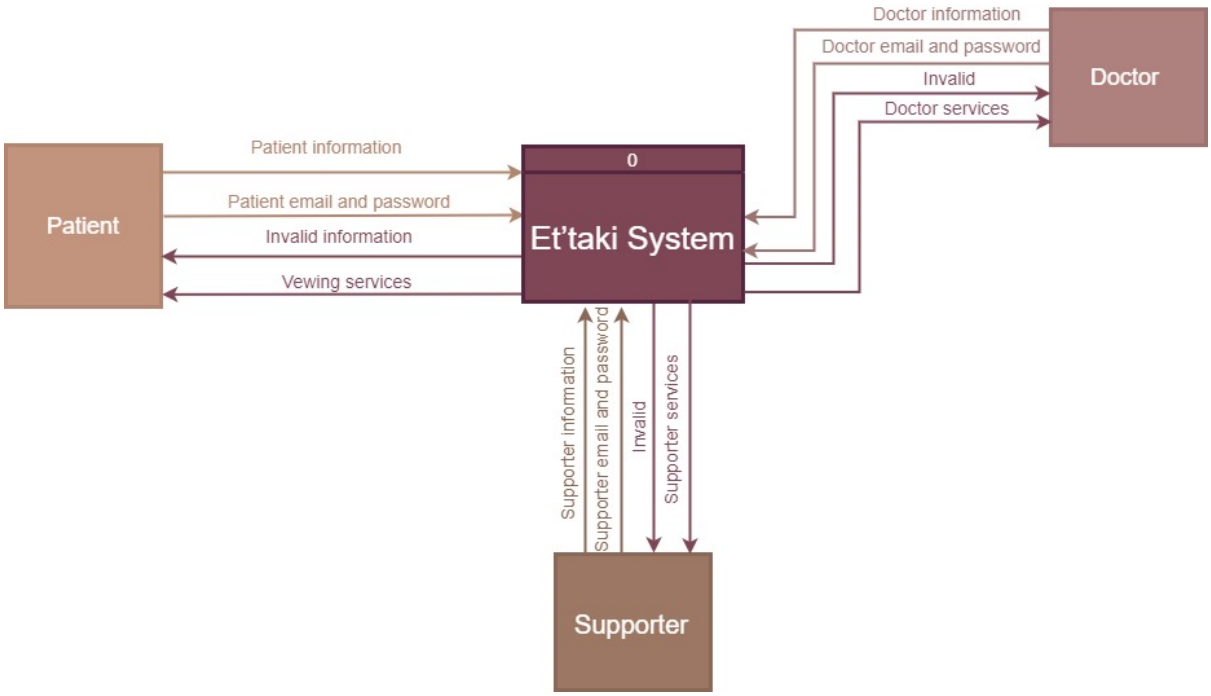

Figure 3.9: Context level DFD.

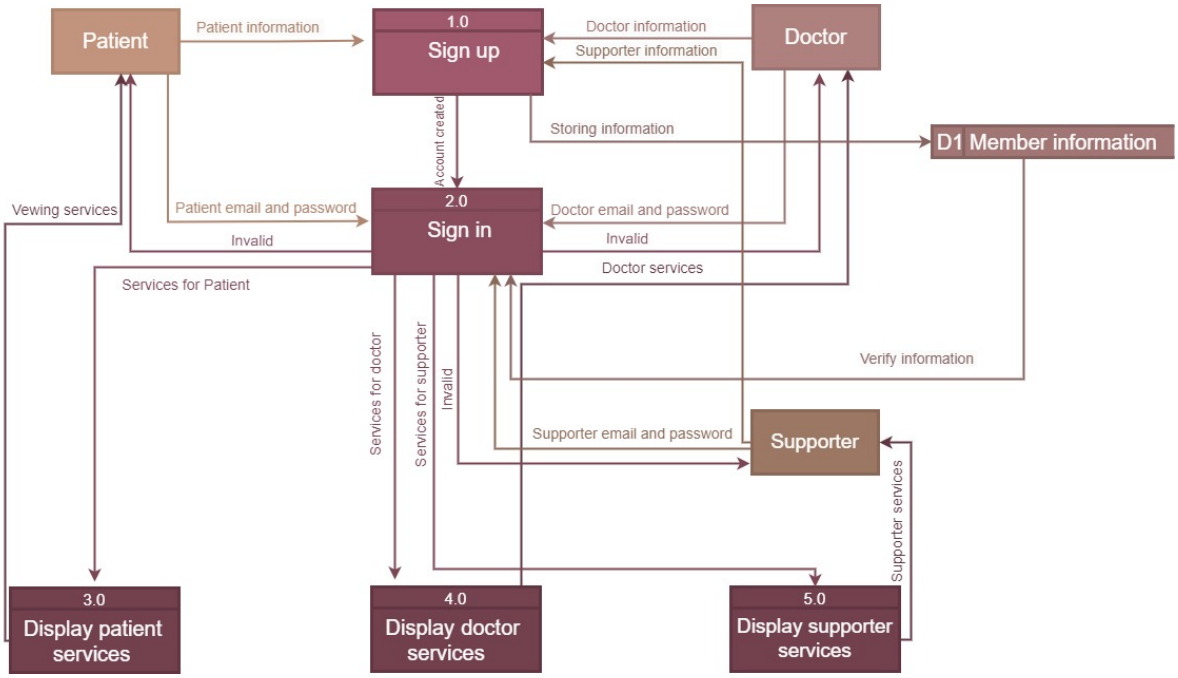

Figure 3.10: Level 0 of DFD.

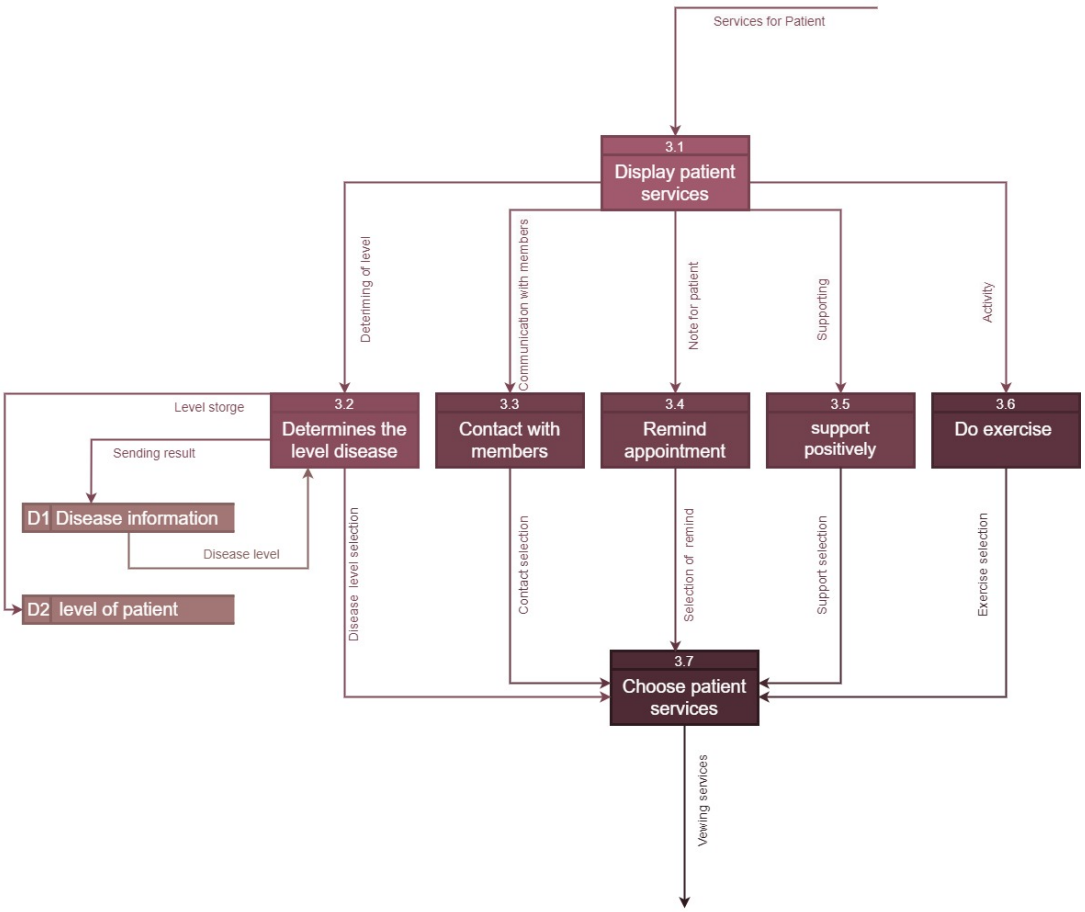

Figure 3.11: Level 1 of DFD.

3.3.4 Implementation

Implementation phase indicates the period of time when the project is developed or carried out. where the design of a system is transformed into a functional prototype. As soon as the developer receives the design document, implementation begins [53].

3.3.5 Testing

Before releasing an application, it undergoes a thorough testing process to ensure that the application works the way it was designed. Software testing is an integral part of the software development industry. Specialty testers and software developers use software tests to ensure their work is functional and of high quality. In the next chapter, we'll go into details about the types of tests used [54].

3.3.6 Maintenance

The maintenance phase of the SDLC follows the complete operation of the product. Its primary purpose is to modify and update the software application after delivery to fix errors and improve performance. Software applications often require upgrading or integration with new systems deployed by the client [55].

3.4 Summary

In this chapter, we discussed the SDLC phases to present our application with effective, high quality that would meet client requirements, which include planning, analysis and system design by using different types of diagrams to illustrate the idea of the system and how it works.

Chapter 4

IMPLEMENTATION AND TESTING

IMPLEMENTATION AND TESTING

4.1 Introduction

In chapter 3, the methodology of the system has been discussed. Also, the project's framework, and application requirements have been clarified. This chapter will be a development of the app begins in the implementation and testing phase. The purpose of implementation is to turn a suggested concept into a functional structure; the project takes shape during this step. The developed product is tested to see if it fits the user's requirements. And software flaws are reported, tracked, corrected, and retested during the testing process.

4.2 Implementation steps

The implementation phase is where software development begins. This section includes descriptions of both the implementation procedure and the sampling procedure.

4.2.1 Implementation Procedures

In this project, we set up the development environment by downloading the android studio library which is the official Built-in Integrated Development Environment (IDE) for the development of Android applications. It is based on IntelliJ IDEA, an integrated Java development environment for software, and incorporates its code publishing and development tools. It employs a Gradle-based build system, an Android emulator, code templates, and GitHub integration to assist application development for the Android OS. In Android Studio, every project contains one or more modalities that include source code and resource files. These formats include Google App Engine modules, Library modules, and modules for Android apps. The Android Package Kit (APK) file is then created from applications created in Android Studio and submitted to the Google Play Store. Android Studio is available for Mac OS, Windows, and Linux desktops. And uses Firebase to build a database that is housed in the cloud [56]. Data is synchronized in real-time to every connected client and stored as JavaScript Object Notation (JSON). When you create cross-platform apps using our Software Development kit (SDKs) for JavaScript, Android, and Apple platforms, all of your clients share a single Realtime Database instance and receive updates with the most recent data immediately [57].

4.2.2 Sampling Procedure

Here, the application interfaces are explained. While designing the application, the following points were taken into consideration:

1. We made the app's interfaces respond to all kinds of Android devices by designing them to be fast-reactive.
2. The interfaces that house the services were designed to make it simple and easy to understand for the user and ensure that they have no trouble utilizing the application.
3. Consistency and flexibility in interfaces.
4. Interact with the user efficiently.
5. Easy to navigate between interfaces.

- Application interface:

  When the application is opened, the user will be shown a splash page containing the application's logo as shown in Figure 4.1.

Figure 4.1: Splash page for the Et'taki application logo.

- Application overview:

  This interface appears to the new user to show an overview of the application and the services provided by the Et'taki application as shown in Figure 4.2 .

Figure 4.2: Application services overview.

- Sign up interface:

  All users must provide general information such as a First name, Last name, Gender Determination: Female or Male, Email, Password, and membership identification: Patient, Doctor or Supporter as shown in Figure 4.3.

Figure 4.3: Registration for the Et'taki Application.

- Sign in interface:

  The sign in interface is the same for all types of users. Once they enter their email address and password and click the Sign in button as seen in Figure 4.4, they will be taken to their home screen. If the password is forgotten, the user can click on retrieve the password below button to sign in.

Figure 4.4: Login to the Et'taki Application

- Password recovery interface:

  The password recovery page enables the user to retrieve the password when they forgot it by entering the email, and the system will send them a link that enables them to reset the password as shown in Figure 4.5.

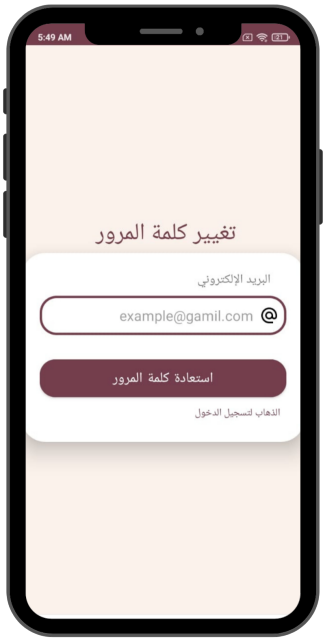

Figure 4.5: Password recovery page.

- Home interface:

  Home interface Includes all the services offered by the app such as: About Et'taki App, Chat with members, Exercises, Reminders of the most important appointments, Determining the patient's level of disease, and Be Positive as shown in Figure 4.6.

Figure 4.6: Home page.

- About us interface:

  It includes an illustration of the App, its purpose and target category as shown in Figure 4.7.

Figure 4.7: About us page.

- User profile interface:

  It shows the first and last name of the user as well as email, sex, user type and patient level of disease with the possibility of adding user view image as shown in Figure 4.8.

Figure 4.8: User profile page.

- Level determine interface:

  This page shows to the user the type of EDSS technique that has used in eliciting questions and the functions based on it. When the user presses the start test icon, the questions will be displayed for them as shown in Figure 4.9.

Figure 4.9: Level determine page.

- Exercise interface:

  This page includes a collection of videos that present some exercises which may help improve the patient's physical health. The videos have been divided into four sections: bottom part of the body, top part of the body, core stability, and foam roller part as shown in Figure 4.10.

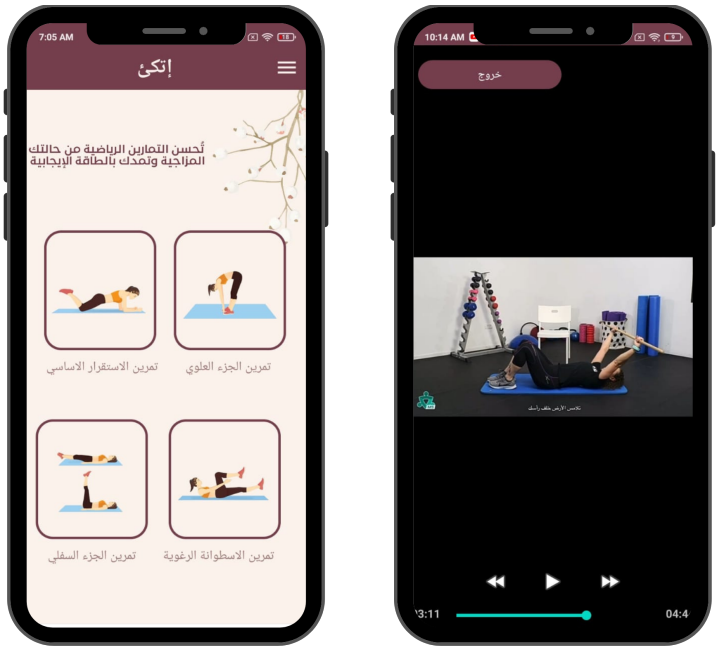

Figure 4.10: Exercise page.

- Be a positive interface:

  This page contains some podcasts and interviews that help improve the patient's psychological health. In addition, it show cases the experiences of people with the disease and how they can live and adapt with the disease as shown in Figure 4.11.

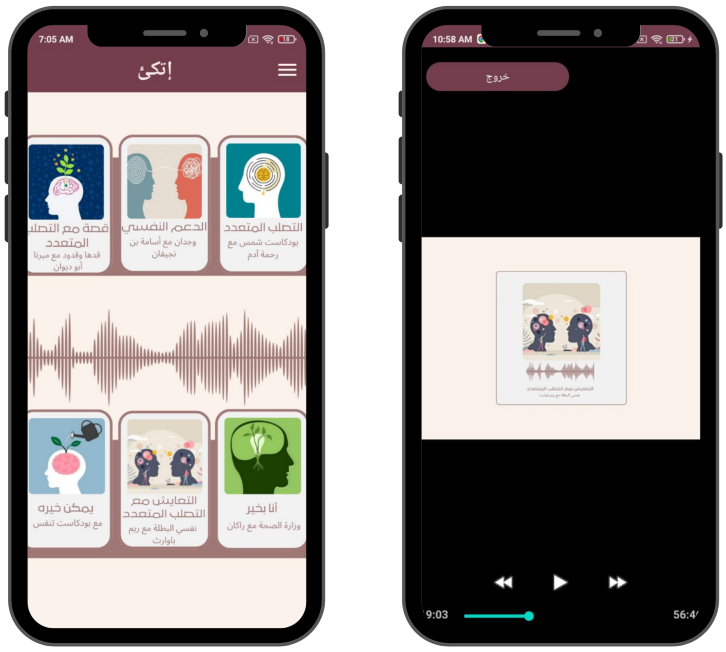

Figure 4.11: Be a positive page.

- Communication interface:

  This page enables the user to choose the person that they want to communicate with, either some supporters, a patient, or doctors. After that, the user can start a chat by clicking on one of the members of Et'taki app. All live chats will be saved in the messages page. Also, the user can know which of the members are online as shown in Figure 4.12.

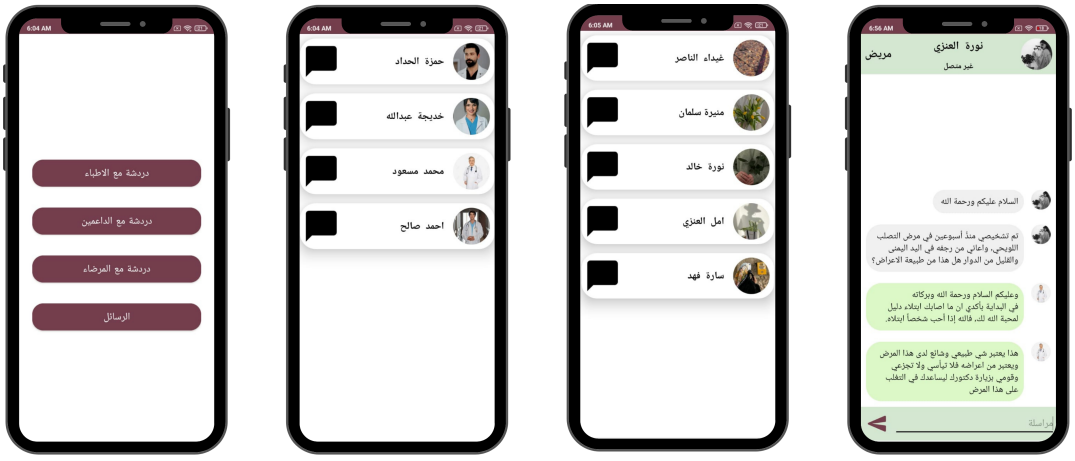

Figure 4.12: Communication pages.

- Reminders interface:

  By pressing the plus button, the user can enter their notes and write titles for their notes, description, time, date, and they can then save this note. Not only that, but they can also edit or delete their previous notes as shown in Figure 4.13.

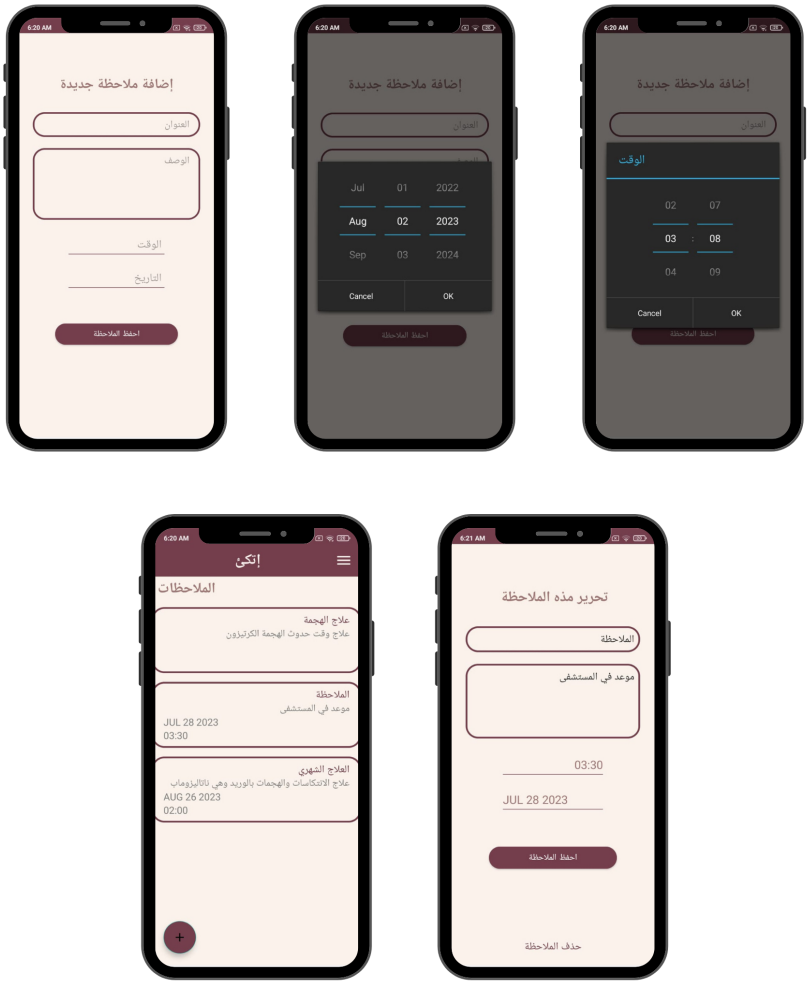

Figure 4.13: Reminders pages.

4.3 Testing procedure

Testing makes sure that the entire program is implemented correctly and that everything functions as intended. The completed program is put through various checks to see if the actual software meets the expectations. A number of test operations are performed for each part and for the integration of these elements because the entire system frequently consists of numerous components [58]. Now the two types of testing are: white-box and black-box testing.

- **White-box testing:**

  White box testing is a type of application testing where the tester has access to the source code and design documentation as well as complete knowledge of the application being tested. White box testing is able to find problems that are hidden from black box testing because of this extensive visibility. Input is given to a system during white box testing,

and it is then observed how the system interprets the input to produce the expected output [59]. At the integration, unit, and system levels of the software testing process, white-box testing can be applied.

Unit Testing:

Unit testing is the process of testing the smallest, most discrete components of a system. Unit testing is intended to make sure that each part or feature of an application operates as intended. Through the development phase, this helps confirm that the application complies with design criteria [59].

– Make sure the data is filled and entered correctly as shown in Figure 4.14.

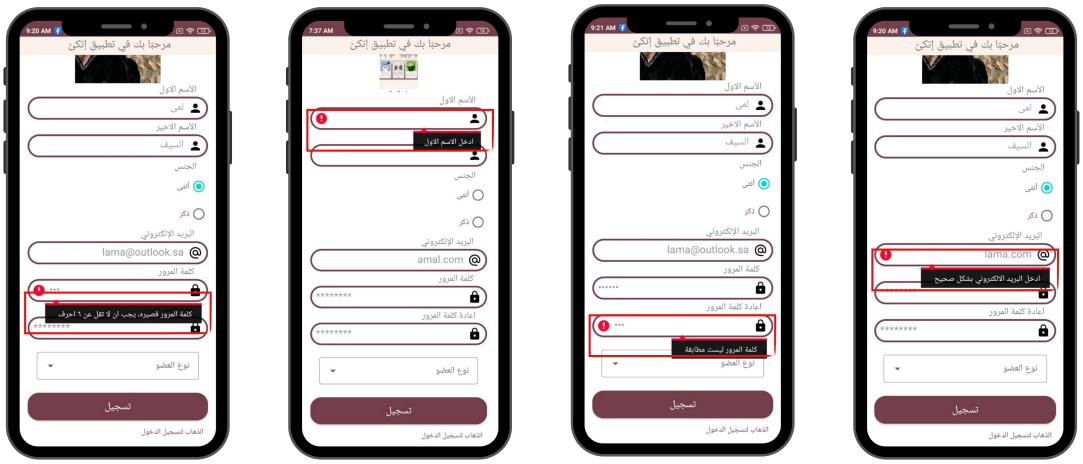

Figure 4.14: Data validation.

– In the communication page, messages are saved between users so that they can refer to them at any time as shown in the figure 4.15.

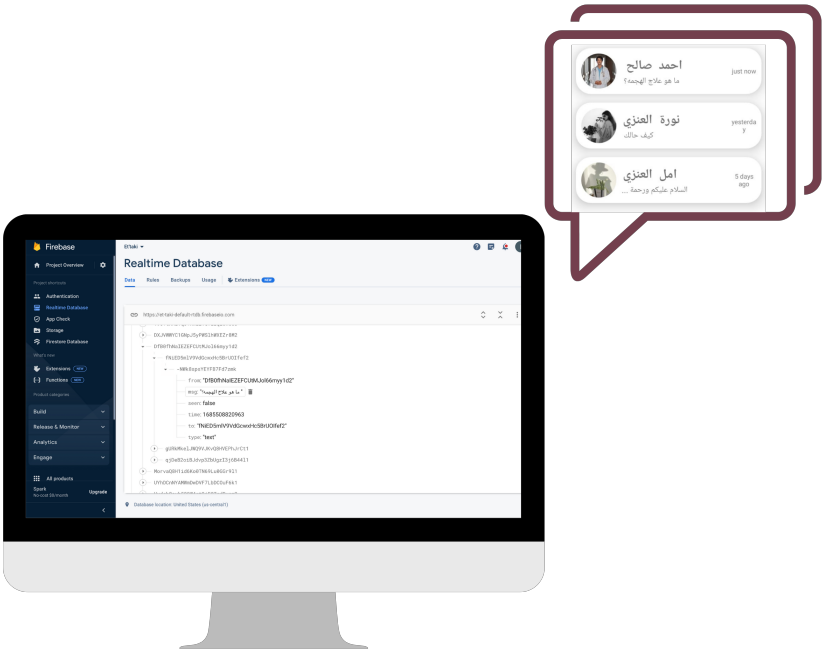

Figure 4.15: Save conversations between members.

– When the patient performs a placement test the result will be saved in the database and displayed in the profile page as shown in the figure 4.16.

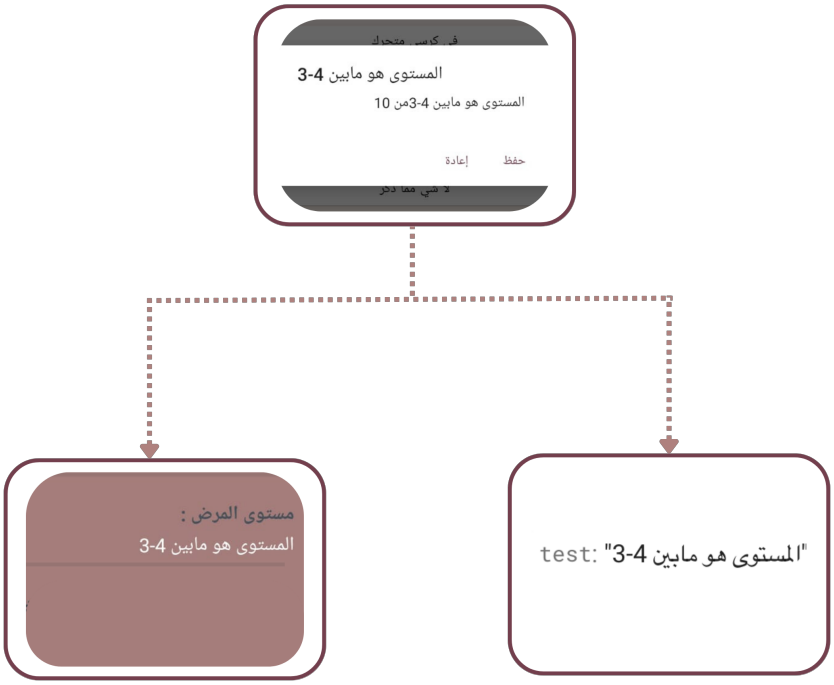

Figure 4.16: Test result.

Integration Testing:

Integration tests concentrate on the interfaces between the different components of an application. Performed after unit testing, it not only ensures that each component works well alone, but also that they can work together effectively [59].

– Ensure that the Firebase database is linked to the app, that when the user creates a new account and enters its data will be added to the Firebase automatically as shown in the figure 4.17.

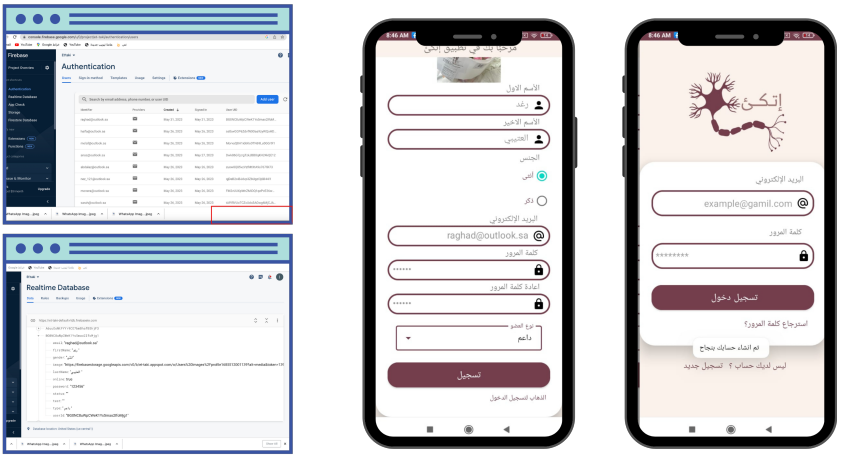

Figure 4.17: Test connection of the application to the Firebase.

– Reset password by sending a link to the email and then the new password is set and updated in the database as shown in the figure 4.18.

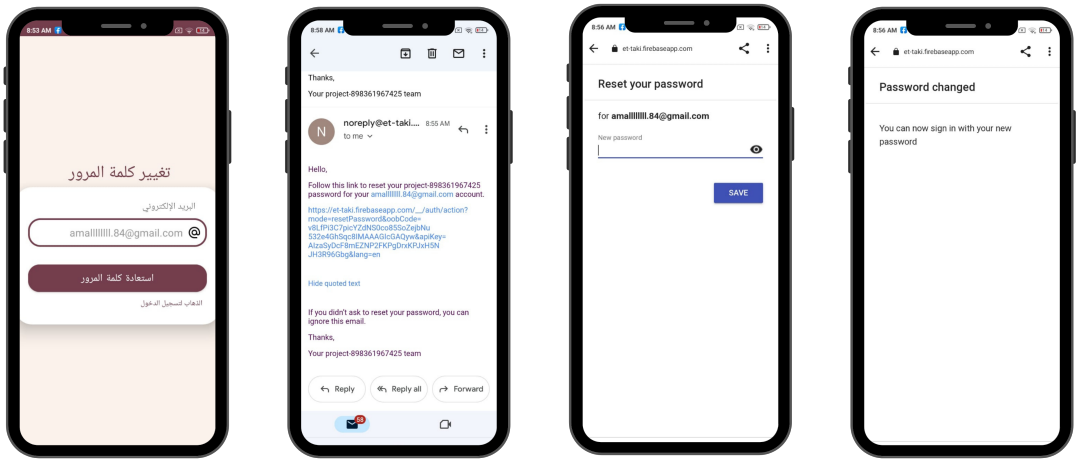

Figure 4.18: Password reset test.

– When you log in, email and password are confirmed in Firebase as shown in the figure 4.19.

Figure 4.19: Check data from Firebase.

– In the event that the user pre-logged in and closed the app, when the app opens after the period, they will not be asked to register again provided that he has not logged out of his account.

- **Black-box testing:**

  Black box testing (also called behavioral testing) is a technique for testing software applications' functionalities without having access to their underlying code structure, implementation specifics, or internal routes. Black Box Testing is totally based on software requirements and standards and primarily concentrates on the input and output of software programs [60].

  System testing :

  System testing, also referred to as system-level testing or system integration testing, is a type of black box testing that focuses on the functionality of an application rather than

the inner workings of a system. System tests fall under the category of black box tests and therefore should not require an understanding of the internal operation of the code. System testing is a series of tests, the primary purpose of which is to test a computerized system. While each test has a different purpose, it is intended to ensure that the system components have been properly integrated and fulfill their assigned roles [61].

- Install the app on a real Android device, test the app for the end user and make sure that all the services work as shown in the figure 4.20.

Figure 4.20: Install the app on a real Android device.

- Play all the added passages through the app fully and clearly.

Acceptance Testing:

User Acceptance Testing (UAT) is a type of test performed by the end user or the client to verify/accept the software system before moving the software application to the production environment. Validation tests, final tests and application tests are different terms used in describing acceptance tests. User acceptance testing is done in the final phase of testing after functional, integration and system testing [62].

- Color consistency, size ratio and easy and clear interfaces.

4.4 Summary

The implementation phase and the application interfaces are described in detail in this chapter, and the app was thoroughly tested to ensure that it complied with the desired requirements.

Chapter 5

RESULTS AND DISCUSSIONS

RESULTS AND DISCUSSIONS

5.1 Introduction

The findings and conclusions of the system are presented and discussed in this chapter on the study's goal of creating a mobile app to help multiple sclerosis patients. The primary objective is to provide psychological and physical care to Multiple Sclerosis patients, by providing some services that contribute to alleviating their feeling of illness and looking positively to improve their mental health and some exercises that may help to improve some muscle weakness. Using an Et'taki app to overcome one of the main problems of Multiple Sclerosis patients is transportation whether going to medical and psychological appointments, by providing communication service with the competent doctor or even a patient or supporter and contributing to saving time and effort of the patient and promoting his mental and physical health.

5.2 Major Findings

Particularly recently, there has been a noticeable rise in reliance on technology and applications. Additionally, it is crucial for making daily and practical living easier. So, a mobile app is created to help patients with Multiple Sclerosis. The application of "Et'taki" will help a large number of people with multiple sclerosis; Help doctors provide their services and consultations to patients with Multiple Sclerosis. The application will make it easier for people suffering from the disease to communicate with doctors at any time and contribute to saving the patient's time and effort, as well as some exercises and podcasts that improve the patient's mental and physical health. The app also allows supportive people from the community to communicate with and mitigate the patient.

5.3 Discussion Related to Proposed Work

The proposed application was developed in java programming language using android Studio in this work. For these applications, the database is an important part of data storage. In this project, we used a firebase. The following section will discuss the objectives based on this work.

5.3.1 Discussion related to study objectives

This section will cover the project's key goals, which were described in section 1.3. The objectives in section 1.3 have all been completed and carried out. Theoretically, goals were accomplished in phase one, while phase two saw the implementation's completion. And that was done by an application for Et'taki to create a communication environment between doctors and Patients.

5.4 Summary

This chapter reviewed the rationale for the study presenting the main findings of the suggested application, as well as a discussion related proposed work.

Chapter 6

CONCLUSIONS AND FUTURE WORK

CONCLUSIONS AND FUTURE WORK

6.1 Conclusion

Multiple Sclerosis patients have difficulty moving and communicating with the world around them or even the outside world.
Today, there is a request for assistance in determining their level of illness and assisting them in terms of health, psychological and physical health through their ability to communicate with specialized doctors, or to chat with supportive people who do not have competence in this area and are not associated with it. They can also write important reminders such as appointments to visit a doctor or treatment appointments etc. We have been keen to offer some exercises that help them improve their mobility, and thought to offer some podcasts and meetings related to this disease to help them live with it.
The application was built using Android Studio, java library, using Firebase server to create a database. The application is designed in Arabic to suit members of the target community. Finally, we hope that this project will achieve great success and to help improve society.

6.2 Contributions and implications of the study

The project helps the ability to live with this disease. Et'taki application aims to facilitate will and coexistence with Multiple Sclerosis, we aim to promote self-care and a healthy life with the disease and build communities that support and care for the people with MS. This lowered the amount of time and effort required by allowing the patients to communicate with and consult doctors about their health status or make an appointment and offer them some services such as scheduling time or treatment . Supportive people are also allowed to reach, talk to and support patients.

6.3 Limitations of the study

The following are some of the constraints and obstacles that were faced during the project:

- Difficulty running the application on some operating systems.
- Due to the importance of the database on the chat page, the data base for the chat was placed as a priority from the database Determine the level of disease page.
- Most of the resources that provided designs were not free.
- Lack of time during the implementation of the project and therefore some requirements were not applied, such as the question of sharing the level of disease in the patient.
- We had difficulty accessing the data in real-time when applying the database to MySQL, the data was transferred to Firebase.
- The lack of sources in the Arabic language that provide clips and exercises that may help the multiple sclerosis patient, and therefore the clips of the exercises were translated by us.
- Due to time constraints, the implementation of the project was focused on patients only.
- Program-related challenges Android Studio:
  - It takes some time to run the app.

- The emulator is running slowly.
- Modifications do not appear on the page.
- Slow response of the program to modifications related to Firebase.

6.4 Future Work

In the future, some application features will be developed, such as:

- Provides versions for all operating systems.
- Expand the system to include all countries of the world.
- Adding the feature of the patient's medical file to facilitate the explanation of the patient's case.
- Adding more services to help the patient cover all their needs.
- We provide a service where the patient can order their medication from some pharmacies by attaching a prescription before ordering.
- Facilitate means of registration, such as using Google accounts or Meta (formerly Facebook).
- When registering as a doctor, their professional certificate must be verified and approved before granting them the authority to enter as a doctor.
- Add videos and voice calls to facilitate communication between members.
- Developing the application to cover the services of the supporter and the doctor.

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