College of Computer and Information Sciences
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LETECH

A Mobile Application to Review the Medicine Leaflet Information
CSC 496– Final Report

Software project for the degree of Bachelor in Computer Science
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I.English Abstract

Most people do not read the side effects in the medicine information leaflet which is a big mistake could lead to a serious damage for the patient's health, and most of this because that sometimes, medicine leaflet have a bad user experience (UX), bad user interface (UI) of the medicine leaflet [1], and sort of user negligence. For instance, about a bad UI/UX, they are often printed on high transparency paper which may lead to interference between the back, and the front content of the leaflet paper [1], [2]. In addition to, putting small letters and with many lines [1], which makes the users subconsciously underestimate its importance. Thus, health, and financial losses may be produced. To address these shortcomings, our application is going to allow the users to review the important information of the leaflet such as the side effects and usage instructions by scanning the barcode of the medicine packages with a good user experience.

II.Arabic Abstract

معظم الناس لا يقرؤون المعلومات المذكور في نشرة معلومات الدواء وهو خطأ كبير يمكن أن يؤدي إلى ضرر جسيم لصحة المريض، ومعظم هذا بسبب أنه في بعض الأحيان تُقدم نشرة الدواء مع تجربة مستخدم سيئة (UX) ، واجهة مستخدم سيئة (UI) ، وأحيانًا أخرى يكون السبب، إهمال المستخدم. بالنسبة لواجهة وتجربة المستخدم السيئتين، على سبيل المثال، غالبًا ما يتم طباعة النشرة الدوائية على ورق عالي الشفافية مما قد يؤدي إلى تداخل الجزء الخلفي والمحتوى الأمامي لورقة المنشور [١] ، [٢]. بالإضافة إلى وضع حروف صغيرة في سطور متتالية وشديدة التقارب [١] ، مما يجعل المستخدمين لا شعوريًا يقللون من أهميتها. وبالتالي، يمكن أن تنتج الخسائر الصحية والمالية. لمعالجة أوجه القصور هذه، سيسمح تطبيقنا للمستخدمين بمراجعة المعلومات المهمة للنشرة مثل الآثار الجانبية وتعليمات الاستخدام عن طريق مسح الرمز الشريطي لحزم الأدوية مع تجربة مستخدم جيدة.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

In recent years, technology has gotten to be a expansive portion of our lives and has entered numerous areas. Where it begun within the 1970s and spread into the twenty-first century. It given us with numerous services that made a difference us spare exertion, time, and rearrange our lives. Smartphones and their applications have become one of the foremost vital innovations nowadays, as they are accessible to everybody anyplace and at any time on different types of devices. In addition, Smart phone applications are effective and reliable in dealing with many important tasks and services such as online payment, government and health transactions and many other services.

The Medicine information leaflets, or patient package insert (PIs) are essential part of medicine which helps people to know about the side effects of medicine. Since of Poor of communication between people, pharmacist and register medical practitioner regarding the use of medication, the leaflet plays a crucial part in filling of the lacunae of communication, and It is part of the Food and Drug Administration (FDA)-approved drug fact labelling [4].

Medicine leaflet contains instructions on the safe and effective use of and an explanation of the purpose, benefits, and risks of the prescribed medicine and when to use the medicine [2]. Despite wide availability, Patient Information leaflets are rarely used by patients. Leaflets are usually only read if side effects appear or the medicine is new [5]. Furthermore, according to [2], analyzed PIs were defective in many aspects. Particularly of concern were unclear dosage instructions, lack of measures to be taken when an administrative error was made, inappropriate presentation of side effects, and lack of measures to be taken if serious side effects occurred. On the other hand, technology facilitates addressing such shortcomings in an intelligent and quick way by Harnessing appropriate technologies to make sophisticated healthcare applications which leads to more aware and healthy community.

Relatively, in the recent period, many health applications have appeared that allow users to search for a specific drug in different ways, commensurate with the user's situation, such as phonetic search, dedicated search for pregnant women, search by identifying the medicine or scanning the barcode of its package, and displaying the medicine leaflet information details clearly and comfortably. In addition to, providing the advantage of comparing medicines, revealing inconsistencies between them, providing lists of nearby pharmacies, and comparing their prices, as it brought the user closer to the doctor or pharmacist, where it began to provide communication channels between these parties. In LETECH application, which we were inspired its name from the combination of the Medicine Leaflet and Technology, we will address the shortcoming of the paper medicine leaflet such as, the poor quality of the medicine

leaflet, the difficulty reading for some patients and the difficulty of understating a foreign language.

1.1 Problem Statement

Patient usually do not read medicine leaflet paper that enclosed in the medicine leading to in danger their life and could cause death since it may include harmful side effects that the consumer is not aware about due to the bad user experience (UX), bad user interface (UI) of the medicine leaflet and the user negligence. In this project, we aim to create an application that allow patents to review the leaflet information of a specific medicine such as, the side effects, and usage instructions by scanning the barcode of the medicine package or searching by generic name or brand name.

1.2 Goals and Objectives

The Goal of our project is to create an application that help users to review the medicine leaflet information such as side effects and usage instructions by scanning the barcode of its package. To achieve this goal, we have the following objectives:

1. Create a dataset for Medicines side effects and usage instructions.
2. Design an application prototype with good UI to allow patients to read the medicine information leaflet easily.
3. Incorporate additional features in the application, such as:
    a) Convert the text in the leaflet information to speech.
    b) Translate the application from English to Arabic and vice versa.
4. Implement the application using the Android studio platform.
5. Test the application.

1.3 Proposed Solution

Consumers typically do not read the drug leaflet paper which is dangerous and may cause death because it could have adverse side effects that the consumer is not informed of. Due to the poor user interface (UX), we provide an application mobile to help the users to read the information leaflet paper easily and we are going to develop it using Android studio. Our application provides many serves with a good user interface to the patients such as, search by text and by barcode scanning. Also, it provides Text-to-Speech feature for those who cannot read probably, in addition to translation, favorite and history features. Also, we will use tools like MI Kit to scan a barcode[6], Text-to-Speech tool [7] to read the text, and use the Google Translate API to translate the text [8].

1.4 Research Scope

The main goal is to create an application that reviews the medicine leaflet information specifically, the side effects and the usage instructions. Our application is specific for the Android mobile operating system. The application is used for people within Saudi Arabia 's local scope where they may be patients or not. The Application will be available in Arabic and English language. It will not interest about the price details of medicines. Also, it does not cover other areas out of Saudi Arabia.

1.5 Research Significance

Our motivation is to create a smart mobile application that fuse health with technology which improve the health awareness of the community by easing the reviewing of the important information about consumers' medicines or any medicine else, especially for Illiterate, elderly and visually impaired. We will be able to implement this application by collecting a very powerful medical dataset and using group of Google APIs, Android studio and Firebase SDK for barcode scanner.

1.6 Ethical and Social Implications

Our application is an ethical and legal since it doesn't violate any rules and doesn't have any implications in society and religions, it doesn't share any information about users to a third parity also all the information are reliable. In addition, all medicines data will be collected from publish servers.

1.7 Table of Terms

Terms	Definition
UI	The user interface (UI) is just the scope in which human and machine interactions take place [9].
UX	User experience includes all aspects of the relationship of the end-user with both the business, its facilities, and its goods [10].
API	A collection of procedures and functions that facilitate the development of applications that access the operating system, server, or other service features or information [11].
Google translate API	Google translate API used to translate the leaflet of the drug.
PI	package insert (PIs) are essential part of medicine which helps people to know about the side effects of medicine [4].

FDA	Food and Drug Administration it is the duty of the Food and Drug Administration to protect public health by ensuring the safety, effectiveness, and protection of human and veterinary, biological products and medical devices, and by make sure the safety of the food, cosmetics, and radiation-emitting products of our country [12].
PILs	Paper Medicine leaflet is a medication information leaflet is a technical document that the manufacturer includes in each package of medicinal products following a standard template composed of the same types of information for each medication [9].
EMA	The European Medicines Agency (EMA) is a European Union (EU) agency responsible for the assessment and regulation of medical products [13].
QRD	Quality Review of Documentation (QRD) provides solutions to the technical committees of the European Medicines Agency and to businesses with regard to the linguistic dimensions of product knowledge for medicines. This includes summaries, labelling and box leaflets with product characteristics [14].
OTC	Over-the-counter (OTC) refers to the method of exchanging shares for firms which are not listed on a formal exchange [15].
Text-to-Speech engine	Text-to-Speech It is a screen reading application created for the Android operating system through, Google that works to convert text into audible speech [8] .
Google ML Kit for Firebase	ML Kit is a smartphone SDK that puts the machine learning experience of Google into a strong and easy-to-use package for Android and iOS applications [16].
Android Studio	Android Studio is Google's official integrated development environment (IDE) for Android, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development [17].
IOS	iOS is an operating system manufactured by Apple Inc , used for mobile devices [11].
IDE	The Integrated Development Environment (IDE) is a software application that offers extensive software development services for software developers [18].

1.8   Report Organization

Chapter 1 contained the introduction and detailed description of the project idea, objectives, and problem and solution statement. Chapter 2 will be the Background that is provide Detailed description of Paper Medicine leaflet, Medical terms, Drug classes, Contraindications meaning and Tools used in our project Chapter 3 will contain Related Work that contain Compare medical applications and their features and Discussion about it. Chapter 4 will be the System Analysis that contain the functional and non-functional requirements, show the Use Case Diagram and Use Case Description followed by the Interaction Diagram. Chapter 5 we will go through the details of system design and implementation, we will review the System Architecture, Class Diagram, Database Design including Entity Relationship Diagram and Database Schema. Chapter 6 will be the conclusion.

Chapter 2: Background

In this project we are going to develop an Android mobile Application that help consumers to be more aware about their heath by facilitating gain and understand all the needed information for any medicine they want. In this background chapter, We will provide the reader with some information on the following topics : Information of Medicine Leaflet, design and content of medicine leaflet, Medical Terms ,Barcode ,Android Studio, Ml kit Firebase: Barcode scanner, Text-speech engine, Google Api.

2.1 Paper Medicine leaflet

As mentioned in [9], a medication information leaflet is a technical document that the manufacturer includes in each package of medicinal products following a standard template composed of the same types of information for each medication. Their main aim is to tell patients about the administration, safety measures, and possible side effects of their medication. The content of PILs should, as required by Article 11 of Directive 2001/83 / EC, be impartial, evidence-based and presented in a clear, coherent, and well-readable manner to suit laypeople. Figure 2.1 shows the recent medication information leaflet text structure according to the structure of the European Medicines Agency's (EMA) Quality Review of Documents (QRD) working group[6] .Since of Poor of communication between people, pharmacist and register medical practitioner regarding the use of medication, the leaflet plays a crucial part in filling of the lacunae of communication, and It is part of the Food and Drug Administration (FDA)-approved drug fact labelling [4].

Table 2.1 The current text structure of a PIL

1.	What X is and what it is used for

2. What you need to know before you <take> <use> X
- Do not <take> <use> X <:>
- Warnings and precautions
- Children <and adolescents>
- Other medicines and X
- X with <food> <and> <,> <drink> <and> <alcohol>
- Pregnancy <and> <,> breast-feeding <and fertility>
- Driving and using machines
- <X contains {name the excipient(s)}>

3. How to <take> <use> X
- <Use in children <and adolescents>>
- <If you <take> <use> more X than you should>
- <If you forget to <take> <use> X>
- <If you stop <taking> <using> X>

4. Possible side effects
- <Additional side effects in children <and adolescents>>

5. How to store X

6. Contents of the pack and other information
- What X contains
- What X looks like and contents of the pack
- Marketing Authorization Holder and Manufacturer

Figure.2.1 Recent medication information leaflet text structure

2.1.1 Medical terms in Medicine leaflet

2.1.1.1 Handling the medicine

Medicine and Frequency

The patient takes medications to treat or prevent illnesses, it has many different forms, and the patient can take it in distinct ways. However, medications can be harmful, even though they are intended to improve our health. The risks can be minimized by taking them properly and knowing the best way to administer them [19].

Routes of medication administration

There are many different methods of delivering medications. The most popular are injections and pills. But we can deliver the medications with other ways such as: Via drops, gel, or ointment, ophthalmic injection into the eye, Enteral, Inhalable, intrathecal, Nasal administered. The patient may self-take a drug, or it may be administered by a healthcare provider [19].

Dosage and timing

Only the dose specified in the prescription label or other guidance is important to take. The dosage is carefully measured by the doctor and can be influenced by age, weight, and other health cases. To be effective, many drugs need to reach a certain level in the bloodstream, at specific times, such as every morning, they need to be administered to retain the amount of medication in the system. Missing a dose or waiting too long between doses may reduce your body's amount of medication and prevent it from working properly. And taking a dose too soon can cause drug levels to be too high [19].

2.1.1.2 Over the counter and prescription medicines

As known, there are two kinds of drugs, over the counter (OTC) and prescription only. prescription drugs are available when its written by a valid prescriber. These medicines are so controlled and have to include a prescriber visit, a diagnosis and supervising by a prescriber to make sure that the medication works and that it works securely. Prescription drugs are designed to be used by an individual patient for the treatment of a specific condition, so each patient is legally entitled to talk about the drug with a pharmacist when going to begin the medication. Prescription drugs have to be approved by the Food and Drug Administration (FDA) and supervised for security and side effects even it already on the market, through several clinical trial phases. While over-the-counter medicines are available to buy without even a prescription and it can be bought at a store right off the shelves-without a prescriber visit or pharmacist consultation. OTC medications, even if it is dependent on the medication, such as nasal sprays, eye drops or

creams, weren't designed for a specific person. The FDA monitors OTC drugs, and it is not as rigorous as the procedure of the prescription drugs will have to go through. Manufacturers are have to be produce drugs only on the basis of a particular recipe with respect to the strength of the drug, and in order to be on the market, they have to get the FDA specific dosage and approved labelling . regard OTC drugs are available with no consultation with a pharmacist or prescriber, there is also a risk for the patient to be conscious of such drugs. Some OTC drugs may be the reason to get drug interactions or cause more side effects with prescription medications. It is necessary to refer all the OTC drugs has been used to a pharmacist or prescriber and to obey the advised dosing instructions upon the label [20].

2.1.1.3 Drug classes with regards to control

A controlled substance is a medicine or other substance that the government is strictly controlled since it may be misused or lead to addiction. The control relates to the way the material is produced, utilized, handled, preserved, and circulated. Substances regulated include Depressants, hallucinogens, opioids, stimulants, and anabolic steroids [21]. And they have classified into Three types [22]: The most dangerous are Class A drugs. This group contains opium, cocaine, and methadone. The harshest punishments would be levied on the owner of it. While Class B medications are less dangerous and contain amphetamines and barbiturates. and Class C drugs are the least dangerous of the controlled drugs considered by Parliament. Benzodiazepines and steroids are among them.

2.1.1.4 Medicine safety guide for pregnancy

During pregnancy, some medicines are considered safe and other medicines are not safe., when taken during the first three months of pregnancy, If the pregnant woman took prescription medicines before becoming pregnant, the health care provider should ask about the safety of continuing these medicines as soon as she finds out that she is pregnant . The healthcare provider will weigh the benefit to you and the risk to the baby when making his or her recommendation on a particular medicine. The risk that some medicines will not be taken may be more serious than the potential risk associated with taking them [23].

2.1.1.5 Medicine contraindications types

A contraindication is a specific situation in which because it can be harmful to the person, a drug, procedure or surgery should not be used. There are two types of contraindications [24]:
- Relative: Contraindication means that when two drugs or procedures are used together, caution should be used.

- Absolute: Contraindication means that an occurrence or substance may trigger a situation that is life-threatening. A procedure or medicine falling within this category must be avoided.

2.1.1.6 Medicine side effects

Effects arise when an issue is caused by a treatment. The effect can range from minor to severe and life-threatening. An adverse effect means a side effect that is unwanted. The therapy may be a surgical procedure or a medication. Depending on their general health, the state of their illness, age, weight, and gender for each patient, the adverse effects may differ. There are different reasons for side effects associated with drugs, for example, dosage which may require adjustment, and drug interactions. A drug interaction occurs when a drug's activity is affected by another substance. This could be a food, another drug, or a vitamin. [25].

2.1.1.7 Medicine black box warning

The most stringent labeling requirements that the FDA can mandate for prescription drugs are black box warnings. First introduced in 1979, within the labeling of products for prescription drugs warnings in the black box highlight severe and sometimes life-threatening drug adverse reactions. Through the FDA Reporting System for adverse events and the Surveillance and epidemiology office, evaluating postmarked safety data. In general, these safety concerns are defined. However, sometimes, right at the time when the approval of a new drug, a warning from a black box is handed down. Although alerts from the black box, when treat the patients and recommending doctors، All pharmacists should be conscious of these concerns safety. Also, the following black box warnings should be familiar to every pharmacy [26].

2.1.1.8 The administration route of medicines

The route under which a medicine, liquid, toxin, or other substance is going to be stored into the body is a route of administration in toxicology and pharmacology. We can say that it is a representation for the delivery of drugs. in general, routes of administration are categorized by the place where the substance is implemented. Oral and intravenous administration are popular uses [27].

2.1.2 Drawbacks of paper Medicine Leaflet

An open-ended questionnaire was used to query the reasons why a leaflet was read or not read. The conclusions of the present investigation revealed that two key drawbacks of the leaflet were complicated material and small print, which may discourage consumer from reading the leaflet [5]. There were additional explanations for not reading the leaflet: illiteracy or foreign language, ignorance or laziness, package information availability [1]. In general, medical leaflets are lengthy and feature a lot of details and complex language. They often printed on high transparency paper which causes the contents of the front and back of the paper to interfere which lead to decrease the readability [1],[4]. Furthermore, they usually minimally treated, printing the contents as a (Black/blue/Red) color plain text [2] and do not make the most of headings and sectioning, which keeps people from quickly finding the information they need .In addition, to fit into the drug box, leaflet paper is folded several times. So, when the leaflet is unfolded the paper crease marks influence the readability of the text too [4].

2.2 Tools used in this application

2.2.1 Translation API

Translation API Basic translates texts for your website and apps instantly into more than one hundred languages. Translation API Advanced provides the same quick, dynamic results you get with Basic and additional customization features [8]. Translation APIs may also detect input language programmatically. Statistical machine translation and machine learning are based on these APIs .In addition, some of the software have exposed their Application Programming Interfaces (APIs) to allow developers to integrate their features and integrate translation capabilities into their own apps without creating them from scratch. The Google Translate API offers a simple programming interface to translate a random string using the new Neural Machine Translation into any compatible language. It is responsive so that the translation API can be combined with websites and applications to obtain a fast and dynamic translation of the source text from the source language to the target language (such as French to English).In cases where the source language is unknown, language detection will be available. In order to include updates from Google's search teams, the core code is continuously updated, resulting in improved translations, new languages and language pairs. The Google Translate API enables you to automatically translate texts between languages using Google's powerful cloud-based machine learning technology.

API features:

You can easily translate an arbitrary string of text from one language to the other with the Google Translate API. In addition, the API will detect the given language when the source language is not known. Languages Supported: More than 100 languages are supported by the API Ease of use: With plenty of integration examples, the Translate API is well documented, just like other Google products, making it easy to use [28].

2.2.2 Text-to-Speech engine

Text-to-Speech It is a screen reading application created for the Android operating system through, Google that works to convert text into audible speech. It helps applications to read (speak) aloud the text that appears on the screen and supports many languages. We can use the text-to-speech feature through applications such as read books loudly, and through Google Translate to read translations loudly which is useful for pronouncing words and other applications based on access to spoken comments, . Users have to install audio data for each language [8] Google Cloud Text-to-Speech empowers designers to synthesize natural-sounding discourse with 100+ voices, accessible in different dialects and variations. As an easy-to-use API, We can create interactions with users across multiple apps and devices, as Cloud Text-to-Speech is supported by WaveNet [7]. Individuals with visual and inability were the early adopters of TTS. And others who suffer from learning difficulties by eliminating reading pressure and providing information optimally. Also, TTS can make life easier and make you more efficient Too.

2.2.3 Google ML Kit for Firebase

ML Kit is a smartphone SDK that puts the machine learning experience of Google into a strong and easy-to-use package for Android and iOS applications. Through putting Google's ML techniques such as TensorFlow Lite, the Google Cloud Vision API, and the Android Neural Networks API together in a single SDK, the ML Package makes it easier to incorporate ML techniques the your applications, and one of most powerful tools of ML kit is the Barcode Scanner [16]. Barcodes are a simple way to transfer real-world information to any smartphone as a developer can read data encoded using most common barcode formats with the ML Kit barcode scanning API. Barcode scanning occurs on the computer and developer can encrypt structured data such as contact information or WiFi network passwords by using 2D formats such as QR code. Since this data can be automatically recognized and parsed by the ML Package, when a user scans a barcode, his software can respond intelligently [6].

2.2.4 Android Studio

Android Studio was declared on May 16, 2013 at the Google I/O conference. The Early Access Preview phase, starting with version 0.1, was in May 2013 [17]. The first official stable release was released in December 2014, starting with version 1.0 [29]. Android Studio is Google's official integrated development environment (IDE) for Android, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux-based operating systems. It also provides the fastest tools for creating applications on every type of Android device [17]. It provides real-time previews of code changes so developers can always see what their modifications do for the final application [30]. The most important features of Android Studio are Android rebuilds, quick fixes and a rich formatting editor that allows you to drag and drop UI components, preview layouts on multiple screen configurations plus developers can download what they need to translate and then choose from a range of diverse translation services [30].

Chapter 3: Related Work

In this chapter, we will present some similar and related mobile applications to our project idea. First, we will give a brief description for each application. Then we will compare them together based on their features. Our aim is to analysis and explores their functionalities in addition to showing how our application would contribute and differs from the existing ones.

3.1 An Overview of the Existing Similar Applications

3.1.1 Drugs.com/ Medication Guide

Medication Guide application was developed by drugs.com on 7 July 2015. It enables the users to Fast search of drug information available online. Interactions Checker provides a list of interactions that may occur when a medicine that is taken with any other medicines at the same time. set up user personal medication records. it also enables the user to search for drug using phonetic search[31],[32].
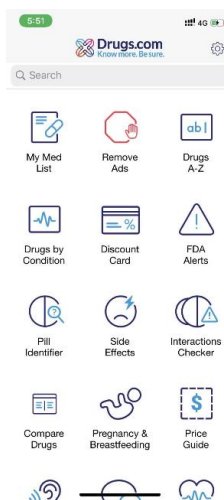
Figure.3.1 Drugs.com/ Medication Guide application.

3.1.2 Medisafe Medication Management

It is provided by Medisafe Inc Team on 9-10-2012. The main idea of the application is to provide a reminder to take medicines and show alerts if any vital interaction appears. Also, it gives the user the ability to add their medicines, dosage, warning when conflict occurs, edit the profile, sign in, sign out and add dairy entry such as Allergy, emergency, mood, general and side effects. So, this application is a useful application and will impact in the patients and society health [33]
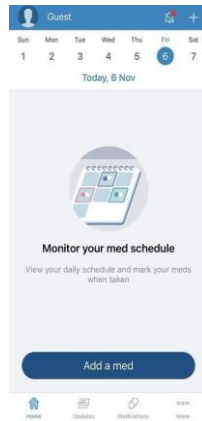
Figure.3.2 Medisafe Medication Management application

3.1.3 WebMD: symptoms, rx, & doctors

It is provided by WebMD Health Corporation on 6-5-2011. The main idea of the application is to know about drugs and conditions and check symptoms. Also, it provides a reminder to take medicines and give the users to add a dosage and time , the user has the ability to add two or more medicines in the interaction checker , find lowest price of the required medicine , near doctors , Search about conditions, drugs, news, doctors and Q&A , show and edit profile , sign in and sign up. Since it's have all of these fluence features it will impact in the patients' lives and health [34].
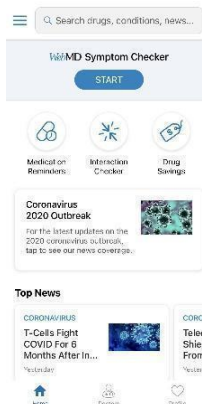
Figure.3.3 WebMD: symptoms, rx, & doctors' application.

3.1.4 Tammeny

Tammeny app was developed by the Saudi Food and Drug Authority on November 11, 2019. Tammany app will provide accurate information to consumers about the products supervised by the Food and Drug Authority to enhance their health. The application provides other services such as: searching by name of the product or scanning its barcode. The application will provide all the information that can be viewed and of interest to the consumer - users can communicate with the authority via e-mail, phone [35].
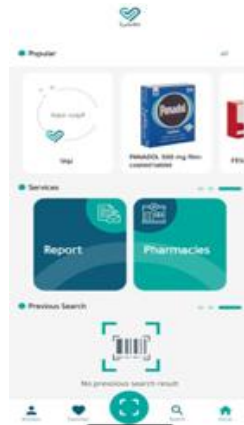
Figure.3.4 Tammeny Application.

3.1.5 CVS Pharmacy

The application of CVS pharmacy was developed by the WebMD LLC on 6 May 2011 .It provides the user with the easiest way to search for drug information, identify tablets, check interactions and prepare your personal drug records. The application provides other services such as : pill Identifier, Discount card, Drug interaction [36].
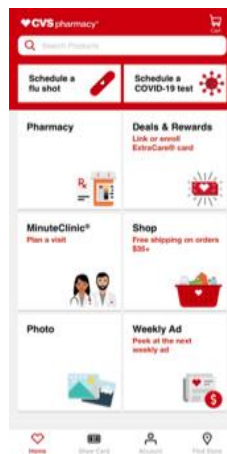
Figure.3.5 CVS Pharmacy Application.

3.1.6　KSA Drugs

6.KSA Drugs application was developed by Abduallah Hussein on January 24, 2016. It allows the users to operate drug name searches, the Application guesses the correct name, and allows the users to compare prices of identical drugs[37].
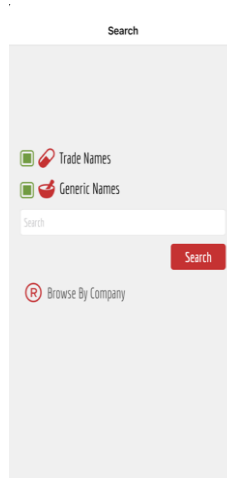
Figure.3.6 KSA Drugs Application.

3.1.7 Medscape

Medscape was developed by Medscape.com on 24 December 2018. The application Medscape is the central online destination for practitioner and healthcare professionals all over the world, provides step-by-step procedural videos for illustration. Also user can access the largest network for practitioner and medical students [38].

Figure.3.7 Medscape application.

3.1.8 Drugs Dictionary Offline

Drug Dictionary app was developed by Smart Training on 14 December 2018. it is providing all information about the medicines: uses, dosage, how to take them, side effects, precautions, drug interactions, missed dose and storage. It makes it easy for the user to search for any medicine[39]
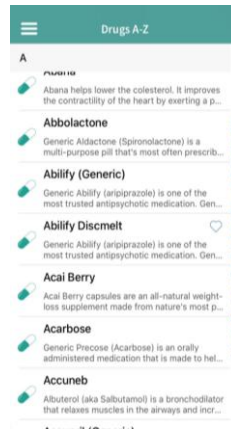
Figure.3.8 Drugs Dictionary Offline application.

3.1.9 Medical Dictionary

medical dictionary was developed by appspouch on 4 April 2015. it is Dictionary for you to quickly find Detailed definitions of all diseases as it facilitates search for it Including Clear, in-depth definitions of direct medical terms and abbreviations. No internet connection required[40].

Figure.3.9 Medical Dictionary application.

3.1.10 Learn Drug, medical Dictionary

The application was developed by Parth Pandya in 2016, it allows to students, nurses, medical practitioners to search for definitions. Addition to Medical Terms and Dictionary with common and uncommon words. Also, it can be used to look up symptoms, diseases and treatment. It provides all information about drugs for example: how to take, drug interactions and side effects [41].

Figure.3.10 Learn Drug, medical Dictionary Application.

3.1.11 GoodRx Application

GoodRx Application was developed by GoodRx in 2011. The application allows the user to search for the prescription. Also, it allows the users to find pharmacies that have a nearby location, in addition to pharmacies that have the lowest prices. When the user finds suitable prices, he can add them to the favorite list and review the other users' opinions. Moreover, it allows users to search about thousands of pharmacies and compare between them. And, it provides reminders to refill medication [42].
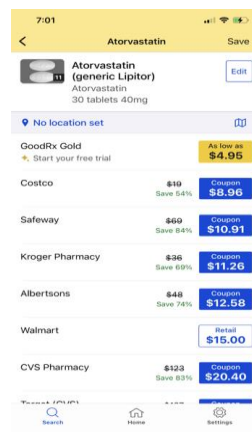
Figure.3.11 GoodRx Application

3.1.12 Dalil Al'adwi

Dalil Al'adwia (means Medicines Guide in English) is an Arabic application was developed by 3rb Apps on 09/02/2014. it contains detailed and extensive information about the medicines available in the medical field, and it is divided into four chapters: general information, detailed explanation, special warnings, and side effects. To find a drug in the directory, they offer search by trade name, generic name and alphabetically. This program is providing a large list of medicines divided into categories, an explanation about the medicine in four different sections. General information, a detailed explanation, special warnings, and side effects, in addition to the ability to search in Arabic or English, and the ability to display medicines according to the Arabic or English alphabet [43].
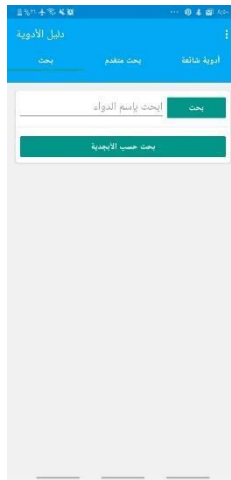
Figure.3.12 Dalil Al'adwia application

3.2 Discussion

	Function	Drugs.com	Dalilal, adwia	KSADrugs	LearnDrug, medical Dictionary	GoodRx	WebMD: symptoms, rx, & doctors	Medisafe medication management	Medscape	Drug Dictionary offline	MEDICAL DICTIOnARy	cvspharmacy	tammeny
Registration	Enter the Phone number												✓
	Enter the email	✓					✓		✓			✓	
	Password	✓					✓		✓			✓	
Sign in	Username/Email/Phone number	✓				✓	✓	✓	✓			✓	
	Password	✓					✓	✓	✓			✓	
Patient profile	Set a list of medicines	✓											
	Informs the patient if there is a conflict between the medications the patient is taking	✓											
	Reminder	✓											
	Notes	✓											
Search about Medicine by	Generic name	✓	✓	✓	✓	✓			✓		✓	✓	✓
	Trade name	✓	✓	✓		✓			✓		✓	✓	
	Alphabetically	✓	✓		✓					✓	✓		

	Wildcard	✓		✓	✓	✓						✓
	Scanning barcode										✓	✓
	Suggestions and tendencies										✓	
	The nearest site					✓					✓	
	Conditions/Disease	✓				✓		✓				
Offer medicine information	Instructions	✓	✓		✓				✓			
	Warnings	✓	✓		✓				✓			
	Side effects	✓	✓		✓				✓			
	Another trade names	✓	✓	✓								
Search about	Dosage for specific medicine	✓		✓	✓	✓	✓					
	Conditions/Diseases	✓				✓	✓	✓			✓	
	Doctor	✓				✓						
	Side effect of specific medicine	✓						✓	✓			
	News	✓				✓		✓				
	medical terms				✓					✓		
Search about Medicines for Pregnant women		✓										
Pill Identifier	by pill imprint	✓						✓			✓	
	by color	✓						✓			✓	
	by shape	✓						✓			✓	
	by form							✓				
	by Scoring							✓				
Interaction checker	Check between 1 medicine with the entire database	✓										
	Check between 2 specific medicines or more	✓				✓		✓				
Compare between Medicines	Compare between 1 medicine and all similar medicines in the entire database	✓										
	Compare between 2 medicines or more	✓				✓						
	Shows consumer comments on the compared medicines	✓				✓						
Symptom Checker		✓										
Reminder	Add /choose medicine	✓				✓	✓	✓				
	Add time						✓	✓				
	Add date	✓				✓	✓	✓				
	Add dosage						✓	✓				
	Frequency	✓										
	Message	✓										
	Email – to deliver the reminder	✓										

Category	Feature												
Diary	Categorized diary	✓					✓						
	General diary	✓											
	Set Date	✓											
	Set Time	✓											
Settings	Show profile	✓			✓		✓					✓	✓
	Change Language			✓			✓						✓
	Support	✓			✓		✓	✓				✓	✓
	feedback	✓										✓	✓
	Report	✓					✓						✓
Find Pharmacy by	Current location	✓			✓							✓	
	Zip Code	✓											
Find Doctor by	Current location	✓				✓							
	Zip Code	✓				✓							
News	Top news	✓			✓	✓		✓					
Prices	Find lowest price of the required medicine				✓	✓							
	Show price of the drugs		✓		✓							✓	✓
	Giving a discount Card for medicines	✓											
History		✓				✓			✓				✓
Bookmark		✓		✓				✓	✓			✓	✓
Favorite									✓				

Table.3.1 Comparation between all applications

we show that in 5 applications, they provide registration section but many of the applications does not provide it since it is not important and doesn't effect on the main goal which is to show useful information about health and provide many useful functions. In addition, there are 6 applications provide sign in section which is allow the users to sign in from different devices. However, our application will include the registration and sign in section to let the users capable to access their data whenever they want. Also, there is 1 application that allow the users to create a medical profile to keep tracking with his health state. For example, in Drugs.com application a user can set the list of his medicine and put a reminder for each.

Most of the applications provide search about medicine which is an important feature to any application including ours. For instance, 7 out of 12 applications provide generic search. Meanwhile, 6 out of 12 applications provide trade search. While the alphabetically is used in 5 out of 12 applications, the condition is used in 3 out of 12of them , same number of applications have used the searching by wildcard or the nearest site and 1 application has used searching by suggestions and tendencies. Furthermore, 5 application provide search about dosage for a specific medicine and about condition or diseases. And 3 applications provide search about the side effect of specific medicine and the medical news.

At the same time, 2 out of 12 applications provide search about medical terms, 1 application provide searching about doctors. However, only 1 application provide dedicated search for pregnant women. Furthermore, 3 applications provide a pill identifier by imprint, color and shape. Meanwhile one of them offers more identifying options such as identify by form and scoring. In our application, we will include search about medicines by the default search, and barcode scanner.

Moreover, 4 out of 12 applications are concerned with making patients more aware of the medications they take by providing clear instructions, side effects and warnings to reduce the chances of the patient being harmed unintentionally. Among them, 3 applications provide another trade name for the medicine. In addition to 2 applications provide interaction checker and 10 applications does not provide it although it is an important function to reduce conflict between medicines and only 1 application provide Symptom checker form 12 applications. There are 4 out of 12 applications provide editable reminder that let user set the date and the medicines. 2 of them let user set the time and dosage, and one of the other two let the users set the frequency of taking the medicine, message and the email which will receive the reminding. 2 out of 12 applications provide diary that help the user to keep tracking with his health state. Both of them allow to user to write a general diary, the first one allows the user to categorize his diary under following types (emergency, mood, general and side effect). while the other one let the user to set date and time. In our application, we are not including this feature since it is not supporting our goal. However, there are 7 applications out of 12 provide settings features. In our application, we will include change language section, show profile, edit profile, and log out. In addition, there are 3 applications provide find pharmacy by current location and 1 application allow it by zip code. In parallel, there are 2 applications that allows to find the doctor by current location and zip code, and 4 out of 12 applications provide top news feature.. Also, as shown in the bottom of table 1, there are 2 application provide finding the lowest price of the required medicine and 4 applications only show the price of the medicine. in our application, we are not going to include any of these features since that it is not supporting our recent goal.

Finally, there are 4 out of 12 applications provide history feature and 6 applications allow the user to favorite/bookmark the medicines. In our application, we will include these features.

Chapter 4: System Analysis

In this chapter, we will provide the details of System Analysis. We will review the functional and non-functional requirements, show the Use Case Diagram and Use Case Description followed by the Interaction Diagram.

4.1 Functional Requirements

1. **Registration and Logging in**

   1.1 The system shall view the Log in/Register options in the main page.
   1.2 The user shall be able to register by typing his/her (E-mail, username, password, the confirmation of the password).
   1.3 The user shall be able to login to the system by typing the email or username and password.
   1.4 The system shall provide the forgot password option.
       1.4.1 The user shall be able to type his/hers email for verification
       1.4.2 The system shall send a verification link to the user's email.
       1.4.3 The link shall direct the user to restoration password page.
       1.4.4 The user shall be able to type his/her new password and confirm it.
       1.4.5 The system shall be able to show the user a confirmation message
       1.4.6 The system shall be able to direct the user to the homepage after Registering or after Logging in.
     1.5 The system shall view the user a Home page that contain (the user information if he was a registered user, update profile option, search bar, barcode scanner button, favorite list button, history list button, switch language button, log out button).

2. **Updating profile**

The user shall be capable to update username, password, email.

3. **Switching language**

The system shall provide a switch language option to the user to change the language of labels within the application from English to Arabic and vice versa.

4. Translating

The system shall translate the content of the medicines leaflet information from English to Arabic and vice versa.

5. Search by text

   5.1 The user shall be able to search about the medicine by typing the Trade / Generic name in the search bar.

      5.1.1   The system shall view a list of matched medicines.

      5.1.2   The system shall direct the user to the medicine leaflet information page after clicking on its name in the result list.

      5.1.3   The system shall view the required medicine leaflet   information (Generic name, Trade names, Form, Dose, Side effect, Warnings, Instructions).

      5.1.4   The user shall be able to view the required part of medicine leaflet information by clicking on its title.

6. Search by Barcode Scanning

   6.1 The user shall be able to search about the medicine by scanning its barcode.

      6.1.1   The system shall direct the user to the require medicines leaflet information.

      6.1.2   The system shall view the required medicine leaflet   information (Generic name, Trade names, Form, Dose, Side effect, warnings, Instructions).

      6.1.3   The user shall be able to view the required part of medicine leaflet information by clicking on its title.

      6.1.4   The system shall be able to view the expiration date of the scanned medicines.

7. Add to Favorite

   7.1 The user shall be able to view the favorite list in Home page.

      7.1.1   The user shall be capable to add to favorites list

      7.1.2   The user shall be capable to remove from the favorites list

8. Save at History

    8.1 The system shall keep all searched or visited drugs in a history list.

        8.1.1 The user shall be capable to view the history list.

9. Convert Text to Speech

    9.1 The system shall provide a text to speech option which can convert the required part of the medicine leaflet information from text to speech.

        9.1.1 The user shall be able to convert from text to speech by clicking on the text to speech icon.

4.2 Non-Functional Requirements

The table 4.1 below shows the Non-Functional requirements considered in the system.

Main Functions	Description of the Functions
Availability	The system shall be able to do a required function.
	The system shall be able to gives the user good results for any action.
	the system shall has least possible time when any error occurs.
Usability	The system shall be use Arabic and English languages.
	The system shall have a good interface, the colors and font should be clear.
	The system shall have a Graphical User Interface.
Reliability	The time of system failure shall be at least as possible.
	The system shall perform the required function for a specified period of time.
	for Every action that happened shall give the system a correct result for it.
Maintainability	The system shall allow to the user to modify.
Security	The system shall require email and password for register.
	The system shall be able to maintain the privacy of personal information.
Intelligence	The system shall be able to search for the user request.

Table.4.1 Non-Functional Requirement.

4.3 System use-cases

In this section, we provide a Use case Diagram and a description of this use cases for our app. There is Four actors in the current version of our app, the role of the mobile end user, Database, Google API, Text-to-Speech Engine. The following figure 4.1 displays the system use case diagram.
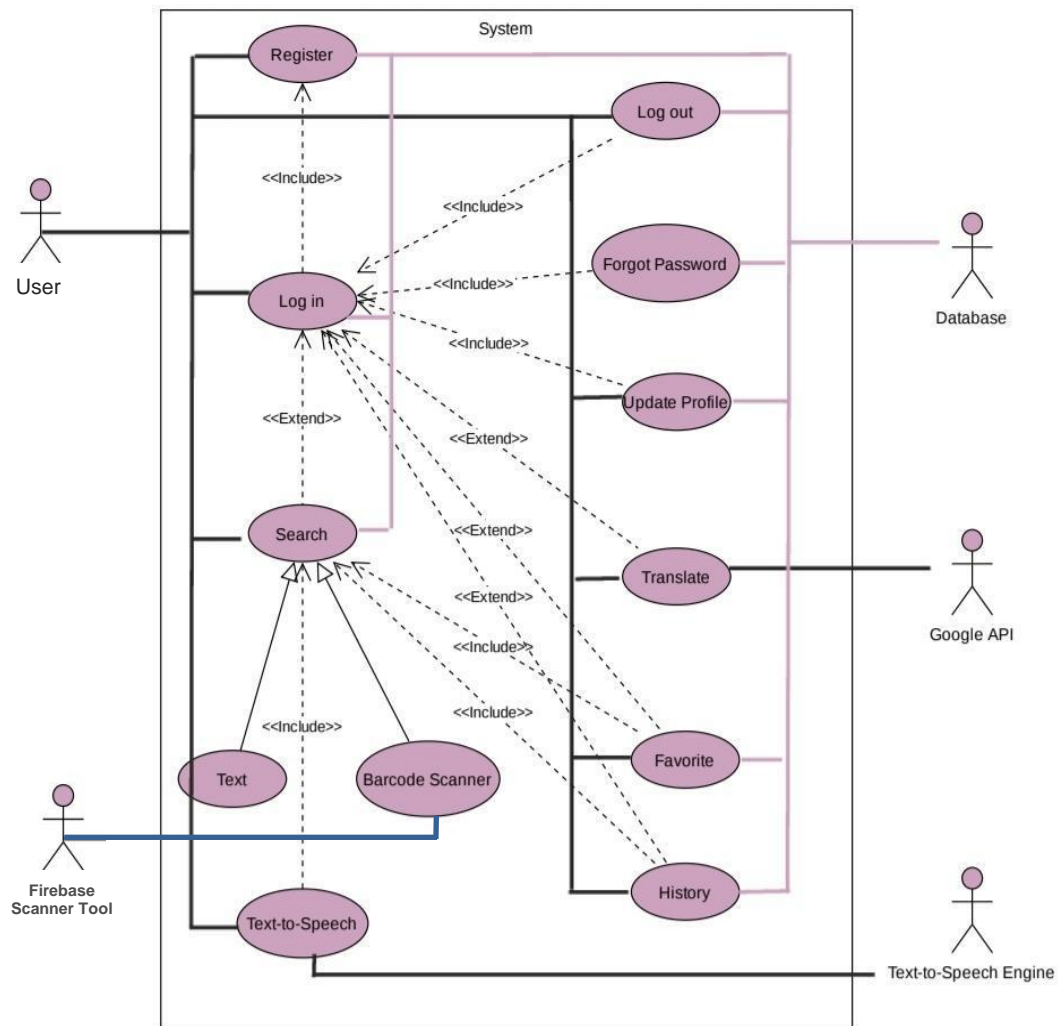
Figure 4.1. Use Case Diagram

Use Case 1: Register	
Initialing Actor: User	
Participating Actor: Database	
Purpose: A user Register to the System.	
Brief Description: This use case allows a new user to register into the system by entering his/her username, email, password.	
Pre-condition: None	
Post-condition: If the registration process done successfully the system will direct him the user into home page as a logged in user.	
Flow of Events	1. The user selects registration option. 2. The System asks the user for registration information, Username, email, and password. 3. The user enters the required information. 4. The user clicks on Register button. 5. The system verifies the information and creates a new account and direct the user to home page

Alternative flow	**Invalid Information Entered**
	  3a. The user entered invalid username/E-mail/password.
	  3b. The system displays a message tells the user that the entered information is invalid.
	  3c. The user re-enters information.

	Cancel the registration operation
	  4a. The user clicks on cancel button.
	  4b. The system asks the user to confirm his cancelation.
	  4c. The user confirms the cancellation operation.
	  4d. The system directs the user into the Log in page.

Use Case 2: Add to History	
Initialing Actor: User	
Participating Actor: Database	
Purpose: Save the visited medicines to an easy-to-access list.	
Brief Description: It allows the system to store the names of the visited drugs in the database at the History list, so a user can reach these drugs faster later.	
Pre-condition: 1- The user searched for a specific medicine and the medicine exists in the database.	
Post-condition: The names of the visited drugs are added to the History list.	
Flow of Events	1. The user searches for a drug by text or Barcode scanning. 2. The system directs the user into the drug page. 3. The system adds the drug name to the History list.
Alternative Flow	1a. The searching process did not complete successfully. 1b. The system displays an error message tells the user that the searching process is failed.

Use Case 3: Log in	
Initialing Actor: User	
Participating Actor: Database	
Purpose: A user logs in to the System.	
Brief Description: This use case allows a user to loge in into the system by entering his/her username or email and password to save his information, so he can access to them from another device or keep them saved even after uninstalling the app.	
Pre-condition: None	
Post-condition: If the logging in done successful, the system directs the user into home page as logged in user.	
Flow of Events	1. The system requests that the user to enter his/her name/ email and password. 2. The user enters his/her name/ email and password. 3. The system validates the entered name/ email and password. 4. The system logs the user into the system and directs him to home page.
Alternative Flow	2a. The user enters an invalid name /email or password. 2b. The system displays an error message tells the user about the invalid entered information. 2c. The user re-enter his information.

Use Case 4: Log out	
Initialing Actor: User	
Participating Actor: Database	
Purpose: A user logs out from the System.	
Brief Description: This use case allows a user to loge out from the app.	
Pre-condition: The user must be logged in the system.	
Post-condition: The user is logged out successfully from the system and all his information saved in database.	
Flow of Events	1. The user clicks the Logout button after done using the app. 2. The system logs the user out from the system. **Note**: Saving users information in the database done automatically while using the app.
Alternative flow:	1- If the user does not click the logout button, the user will remain on the home page.

Use Case 5: Search by text	
Initialing Actor: user	
Participating Actor: Database	
Purpose: Search by text allows the user to search about a drug by typing its Generic or Trade name.	
Brief Description It allows the user to search for a drug by typing the drug Generic/Trade name in the search bar.	
Pre-condition: The user is a guest or logged in user.	
Post-condition: The name and information of the drug they searched for is shown to the user.	
Flow of Events	1. The user clicks on the search field. 2. The user writes the name of the drug he wants to search about. 3. User clicks the search button. 4. The system sends a request to database. 5. The system displays results.
Alternative Flow	**Invalid Drug Name** 2a. The user writes wrong drug name. 2b. The system displays an error message "Wrong drug name ". **Not Existing Drug** 4a. The drug is not existing in the database. 4b. The system displays an error message "no results ".

Use Case 6: Text to speech	
Initialing Actor: user	
Participating Actor: Database and Text to speech Engen.	
Purpose: Converting the text of the leaflet to a sound in order to facilitate getting the information.	
Brief Description: The user is allowed to Convert the text of the leaflet to a sound in order to facilitate getting the information.	
Pre-condition: The user searches for the drug by text or barcode scanning.	
Post-condition: reading leaflet for User by Voice engine.	
Flow of Events:	1. The user searches about a drug by text or Barcode scanning. 2. The user clicks on the read button that appears beside each section in the drug page. 3. The system sends a request to Android Text -to- Speech engine to read text in a spoken language. 4. The system starts reading the selected section of the leaflet till the end.
Alternative flow:	4a. The user clicks on the read button in the middle of the reading process. 4b. The system stops reading.

Use Case 7: Add to Favorite	
Initialing Actor: User	
Participating Actor: Database	
Purpose: Allows the user to save his wanted medicines in an easy to access list to review them later.	
Brief description: This use case describes how a user save his wanted medicine in favorite list.	
Pre-condition: The user must search for a specific medicine by text or barcode scanning .	
Post-condition: The favored medicine will be saved in the database.	
Flow of Events:	1. The user clicks on favorite button for a specific medicine. 2. The system send request to the database to link the property that has been favored from the property list to the favorite list 3. The system will fill the star button indicating that the property is stored in the database.
Alternative flow:	2a. The database fails to link the property from the property list to the favorite list. 2b. The star button remains unfilled indicating that the property has not been stored in the database

Use Case 8: Forgot password	
Initialing Actor: User	
Participating Actor: Database	
Purpose: Allows the user to restore his password.	
Brief description: This use case describes how a user can restore his password in the system.	
Pre-condition: The user must have an exist account.	
Post-condition: If the restoration succussed, the system would update the old password.	
Flow of Events:	1- The user clicks on forgot the password option. 2- The system asks the user to enter his email. 3- The system sends a timed validation email. 4- The user clicks on the received email from the system. 5- The system asks the user to enter the new password and re-enter it. 6- The system sends the new password to the database. 7- The database updates the password. 8- The system shows the log in page to the user.
Alternative flow:	3. If the user entered an invalid email, the system would display an error message. 5. If the user did not click on the email within a specific time, it will be expired. 6. If the user entered a different password in the second entry, the system would show an error message.

Use Case 9: Change language	
Initialing Actor: User	
Participating Actor: Google API, Database.	
Purpose: Allows the user to change the interface language from English to Arabic and vice versa .	
Brief description: This use case describes how a user can change the language of the application.	
Pre-condition: None.	
Post-condition: If the translation succussed, the system would change the interface language.	
Flow of Events:	1- The user clicks on translate icon. 2- The system changes the labels' language into the desired one. 3- The system sends a request to Google API translation to translate the content. 4- The system displays the labels and content in the desired language.
Alternative flow:	3. I f the Google API could not translate the content successfully, the system would show a notification message.

Use Case 10: Search by Scanning	
Initialing Actor: User	
Participating Actor: Firebase Barcode Scanner, Database.	
Purpose: Allows the user to search about medicine by scanning its barcode.	
Brief description: This use case describes how a user can search about medicine by scanning its barcode.	
Pre-condition: None.	
Post-condition: If the scanning done successfully, the system would direct the user to the desired medicines' page.	
Flow of Events:	1- The user clicks on the scanner button. 2- The system opens the scanner tool. 3- The user scans the desired medicine's barcode. 4- The scanner tool converts the barcode inro a numeric code. 5- The system sends a request to database to match the desired medicines' numeric code. 6- The system displays the medicine page.
Alternative flow:	3- If the scanner tool did not work, the system would display an error message. 6-If the desired medicine did not exist in the database, the system would display an error message.

Use Case 11: Update profile	
Initialing Actor: User	
Participating Actor: Database.	
Purpose: Allows the user to update his profile information.	
Brief description: This use case describes how a user update his profile.	
Pre-condition: The use must be logged in.	
Post-condition: If the updating done successfully, the information will be updated in the database.	
Flow of Events:	1- The user clicks on the profile icon. 2- The system displays the user's profile page. 3- The user updates the desired field (Username, E-mail, Password). 4- The system sends a request to database to update the user's information. 5- The system displays the updated user's profile page.
Alternative flow:	3- If the user entered invalid information, the system would show an error message. 4- If the database could not update the user's information, the system would show an error message.

4.4 Interaction Diagrams

In this section, we are going to show the normal flow and alternative flow in the interaction diagram in detail.

1) Log out.
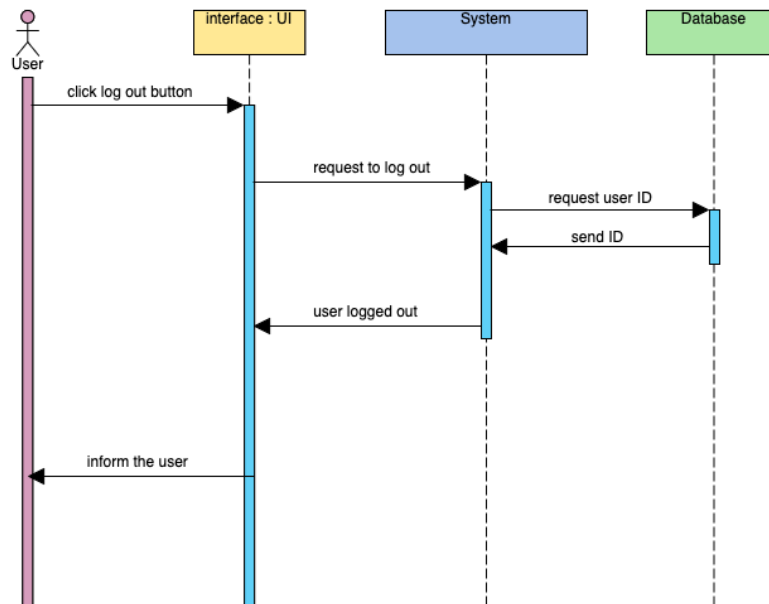
Figure 4.2. Log out

2) Log in.
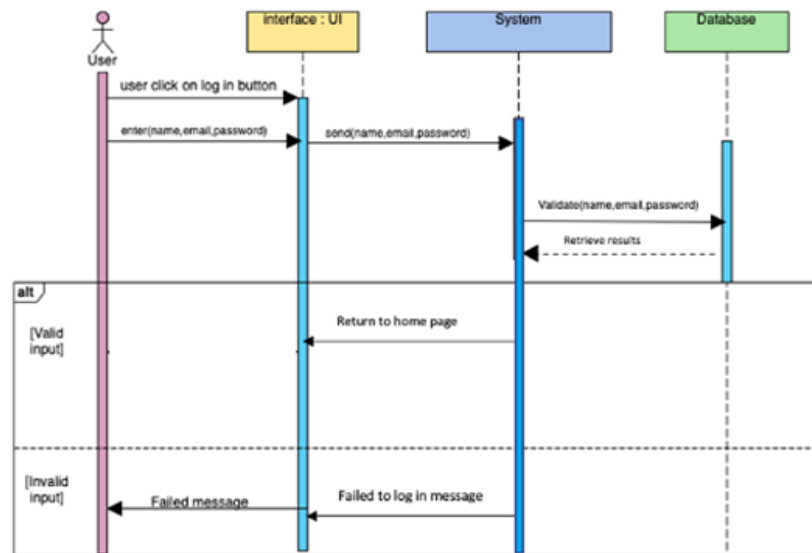
Figure 4.3. Log in

3) Add to favorite.

.
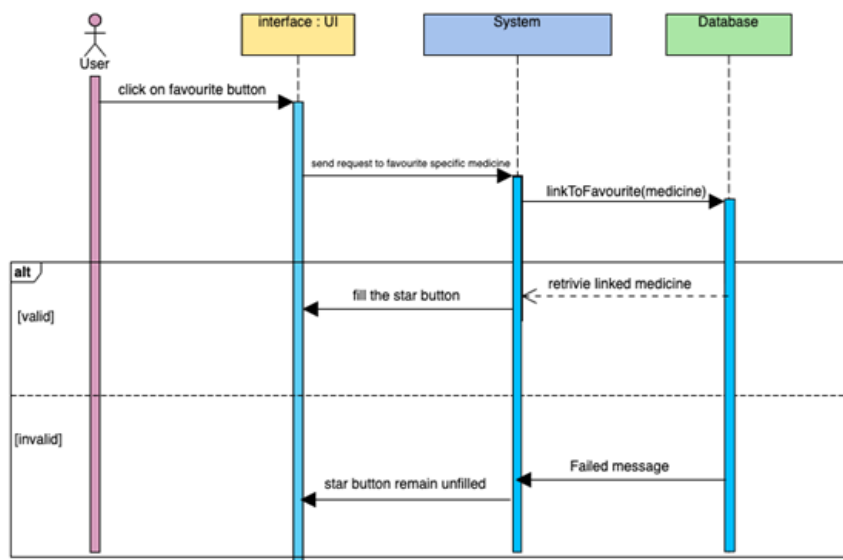
Figure 4.4. Add to Favorite

4) Forgot password
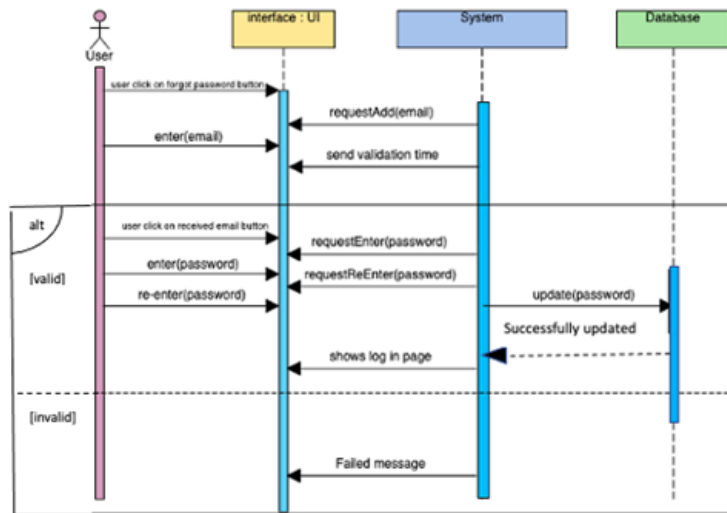
Figure 4.5. Forgot password

5) Text to speech
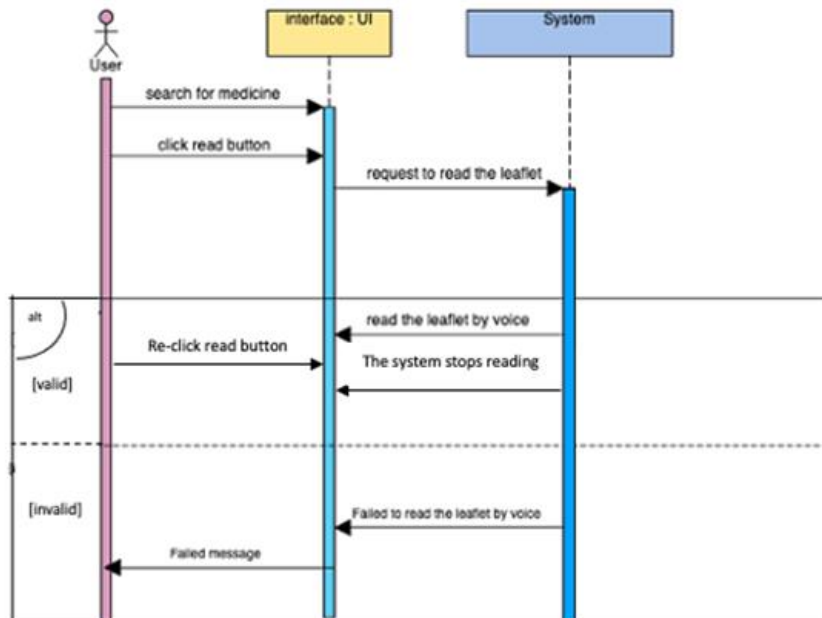
Figure 4.6. Text to Speech

6) Registration
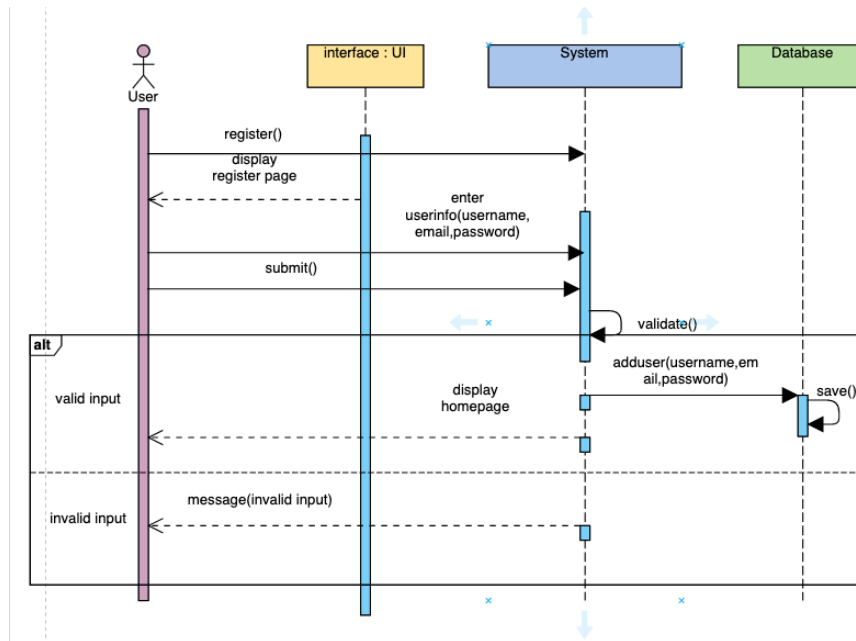
Figure 4.7. Registration

7) Update profile
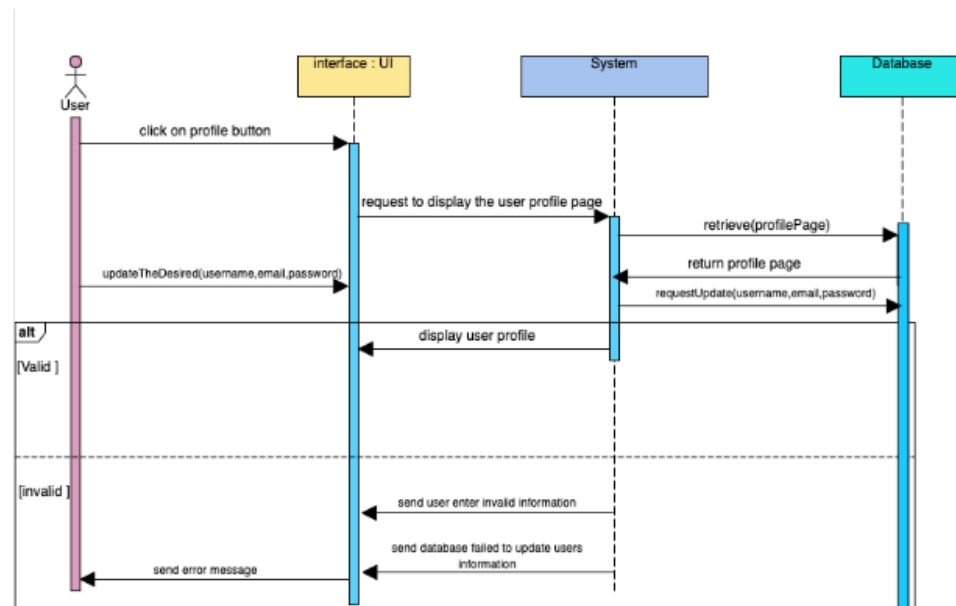
Figure 4.8. Update profil

8) Add to the history
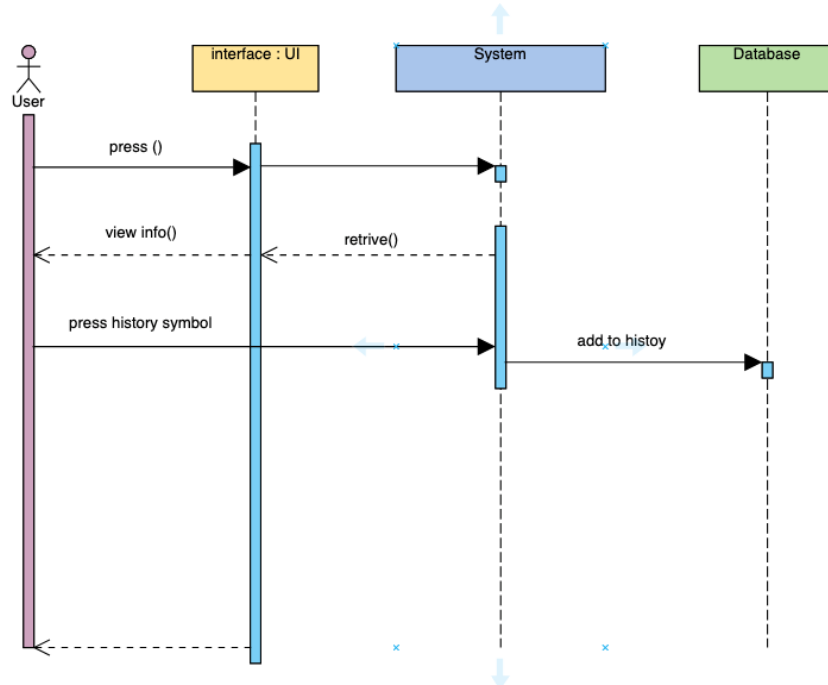
Figure 4.9. Add to the History

9) Search by text
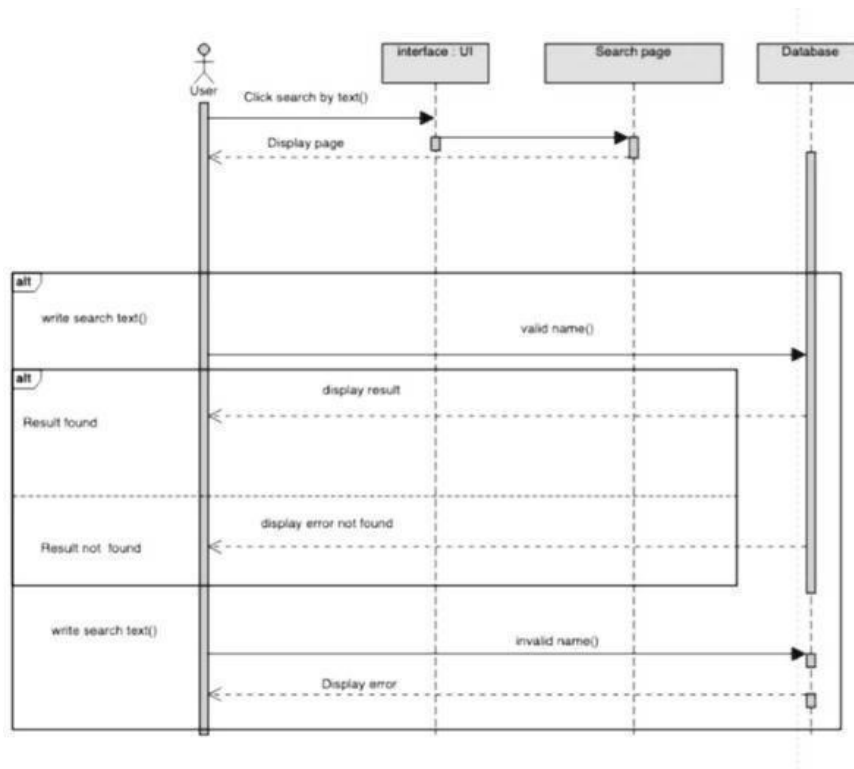
Figure 4.10. Search by text

10) Search by scanning
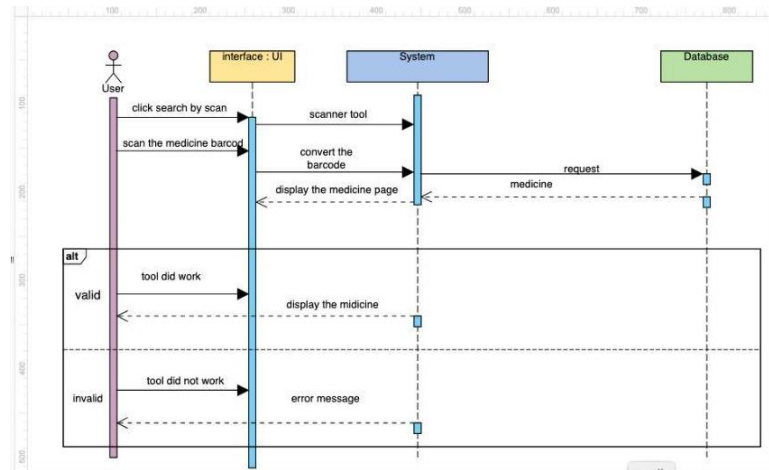
Figure 4.11. Search by Scanning

11) Translate Leaflet content by using Google API
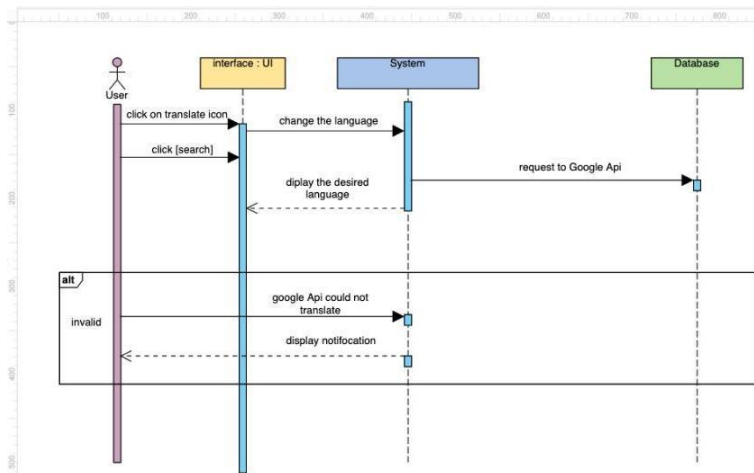
Figure 4.12. Translate Leaflet content by using Google API

Chapter 5 System Design & Implementation

In this chapter, we will go through the details of system design and implementation, we will review the System Architecture, Class Diagram, Database Design including Entity Relationship Diagram and Database Schema. Also, we will present the Algorithm of the system and pseudocode. In addition to the User Interface Prototype at the end of this chapter.

5.1 System Architecture

The most relevant architecture style for our application is microservices design. us to divide our framework into microservices, and each one has its own independent responsibility and can be developed, maintained, and implemented independently by our team members. In addition, since microservices are smaller and less related to other parts, it is easy to rewrite the application. Also, because we can scale the microservices that we need to be scaled, the less commonly used parts of the program do not need to be scalable. However, communication is the only dependency between each microservice and the other.
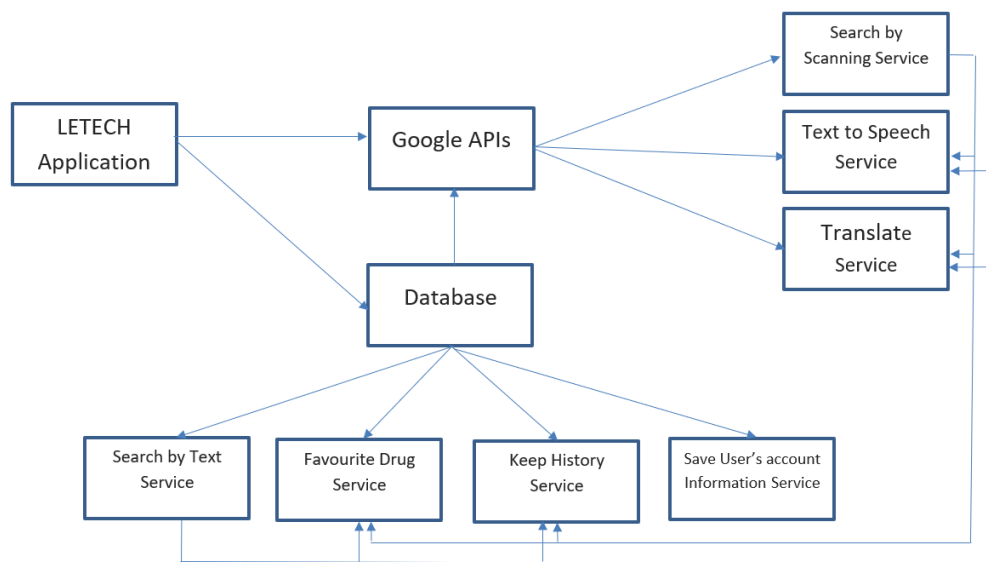
Figure 5.1. System Architecture.

5.2 Class Diagram

The below figure 5.2 shows detailed of class diagram "Software Artifact". Which described classes and linked between them.
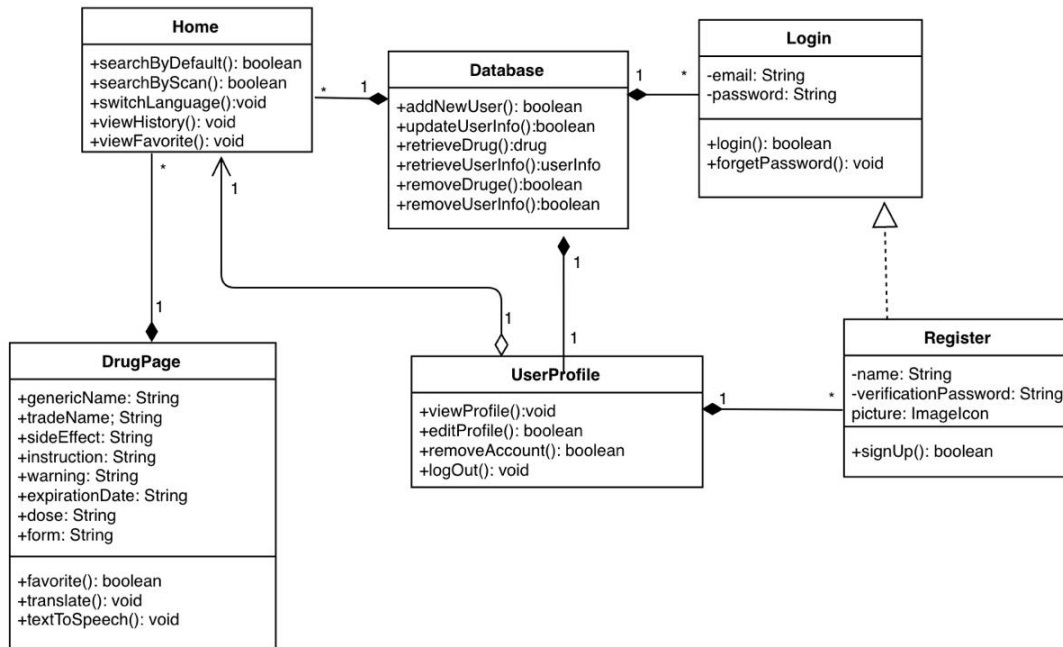
Figure 5.2: Class Diagram

5.3 Database Design

The below figures 5.3 and 5.4 show the entity relationship diagram. Which clarifies entities and its attributes and relationship between them.

5.3.1 Entity-Relationship Diagram
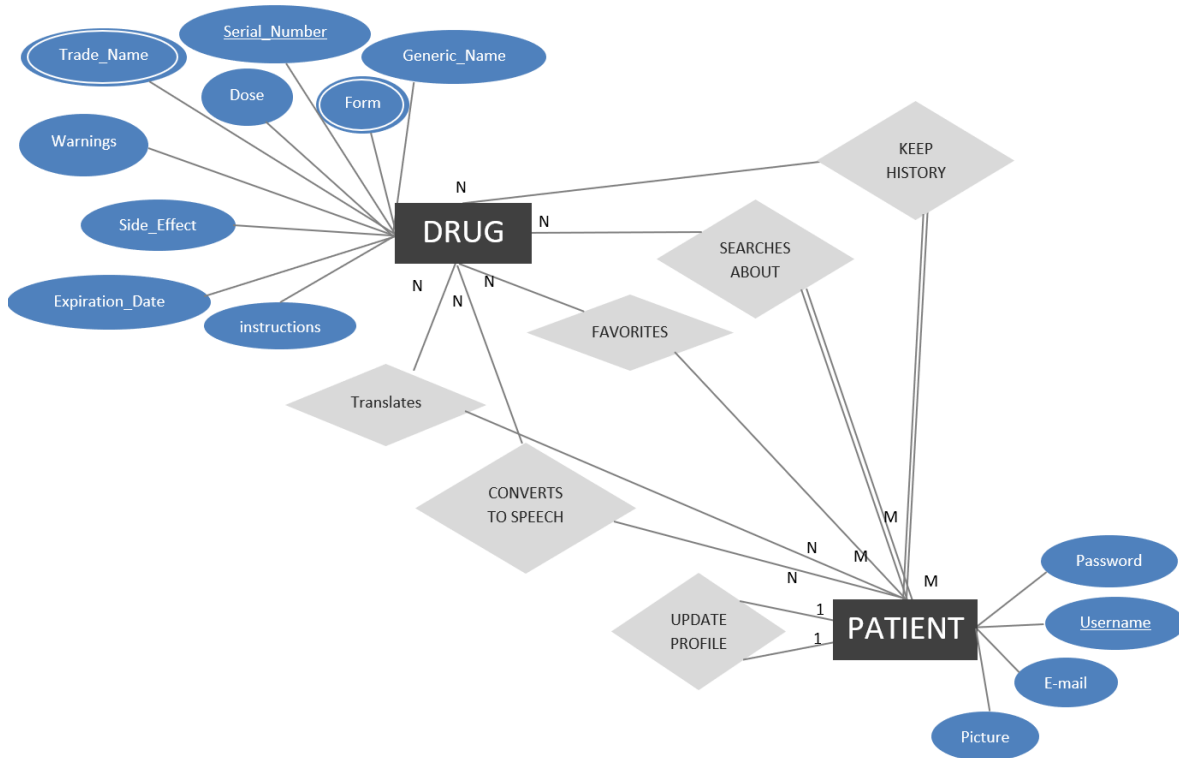
Figure 5.3. Database Entity-Relationship Diagram

5.3.2 Relational Database Schema

Drug

Generic Name	Serial_Number	Form	Dose	Side effects	Warnings	instructions	Expiration Date

Drug_trade_name

Trade_name	Dserial_number

Converts to speech

Pusername	Dserial Number

Patient

Username	Password	E-mail	Dserial_number	Picture

Favourites

Pusername	Dserial Number

History

Dserial_number	Pusername

Drug_form

Form	Dserial_number

Searches about

Pusername	Dserial_number

Translates

Pusername	Dserial_number

Figure 5.4. Relational database schema

5.4 Algorithms

5.4.1 Flow Chart

1) Add to Favorite.
   describes how a user save his wanted medicine in favorite list .

```
                          ┌─────────────┐
                          │    Start     │
                          └─────────────┘
                                 │
                          ┌─────────────┐
                          │ Click on star button │
                          └─────────────┘
                                 │
                                 ▼
                          ◇ Star filled ? ◇
         no                      │
┌──────────────────┐            │ yes
│ Show failed      │◄───────────┘
│ message to the user │
└──────────────────┘
         │
         ▼
┌──────────────────┐
│ Star remain      │
│ unfilled         │
└──────────────────┘
         │
         ▼
                          ┌─────────────┐
                          │    End       │
                          └─────────────┘
```
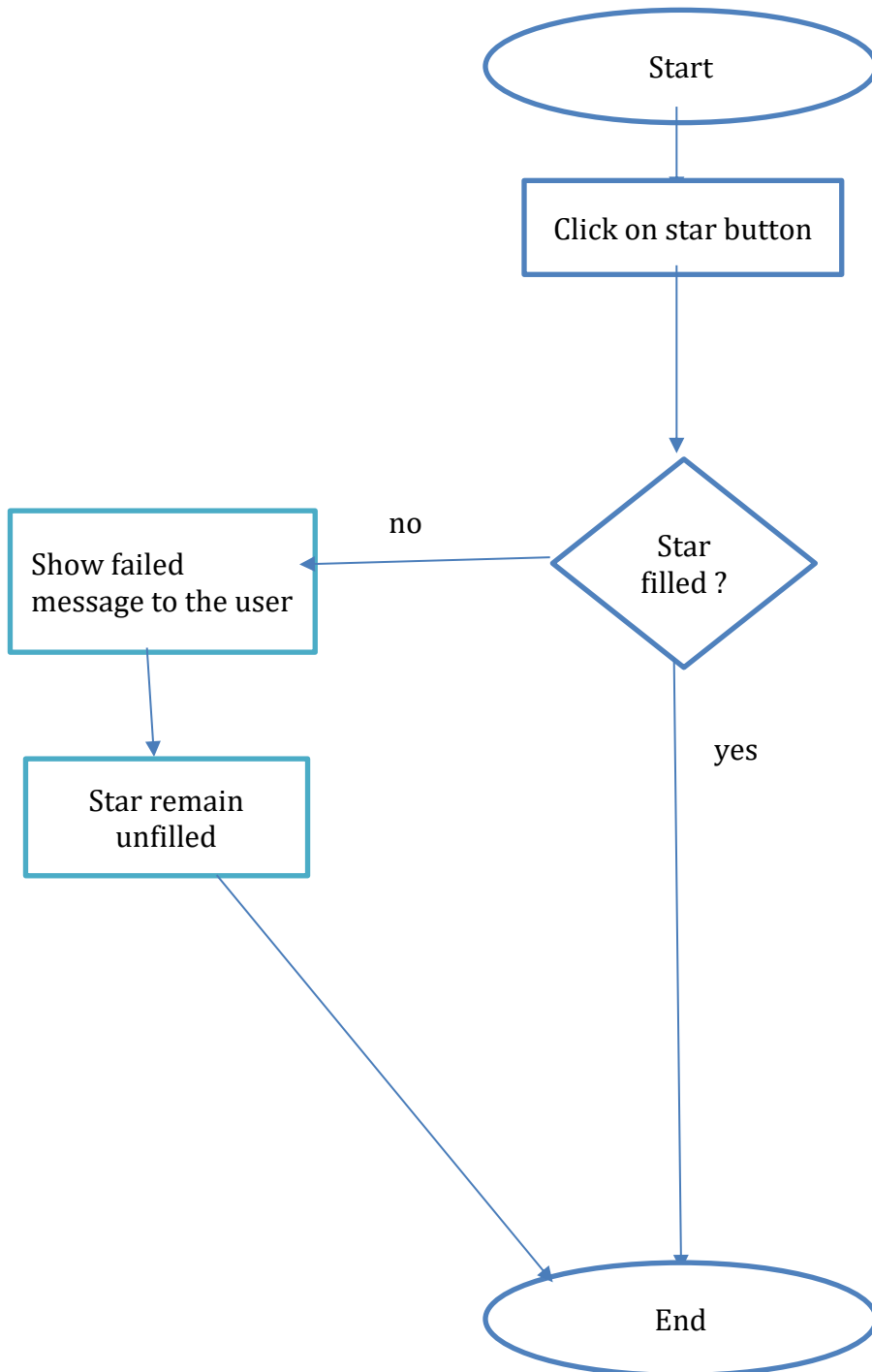
2) Search by default search
searching for a drug by typing the drug's name in the search field.

```
                    ┌─────────────┐
                    │    Start    │
                    └─────────────┘
                           │
                           ▼
                  ┌──────────────────┐
                  │ Click on search  │
                  │      field       │
                  └──────────────────┘
                           │
                           ▼
                 ╱────────────────────╲
                 │  User enter name of │
                 │    the medicine     │
                 ╲────────────────────╱
                           │
                           ▼
                  ┌──────────────────┐
                  │ Click on search  │
                  │      button      │
                  └──────────────────┘
                           │
                           ▼
                        ╱─────╲
         no           ╱  Found? ╲
  ┌──────────────┐ ──╱           ╲
  │ Show no      │   ╲           ╱
  │ results      │    ╲─────────╱
  │ message      │         │
  └──────────────┘         │ yes
         │                 ▼
         │        ┌──────────────────┐
         │        │ Show the results │
         │        └──────────────────┘
         │                 │
         └────────►┌─────────────┐◄──┘
                   │     End     │
                   └─────────────┘
```
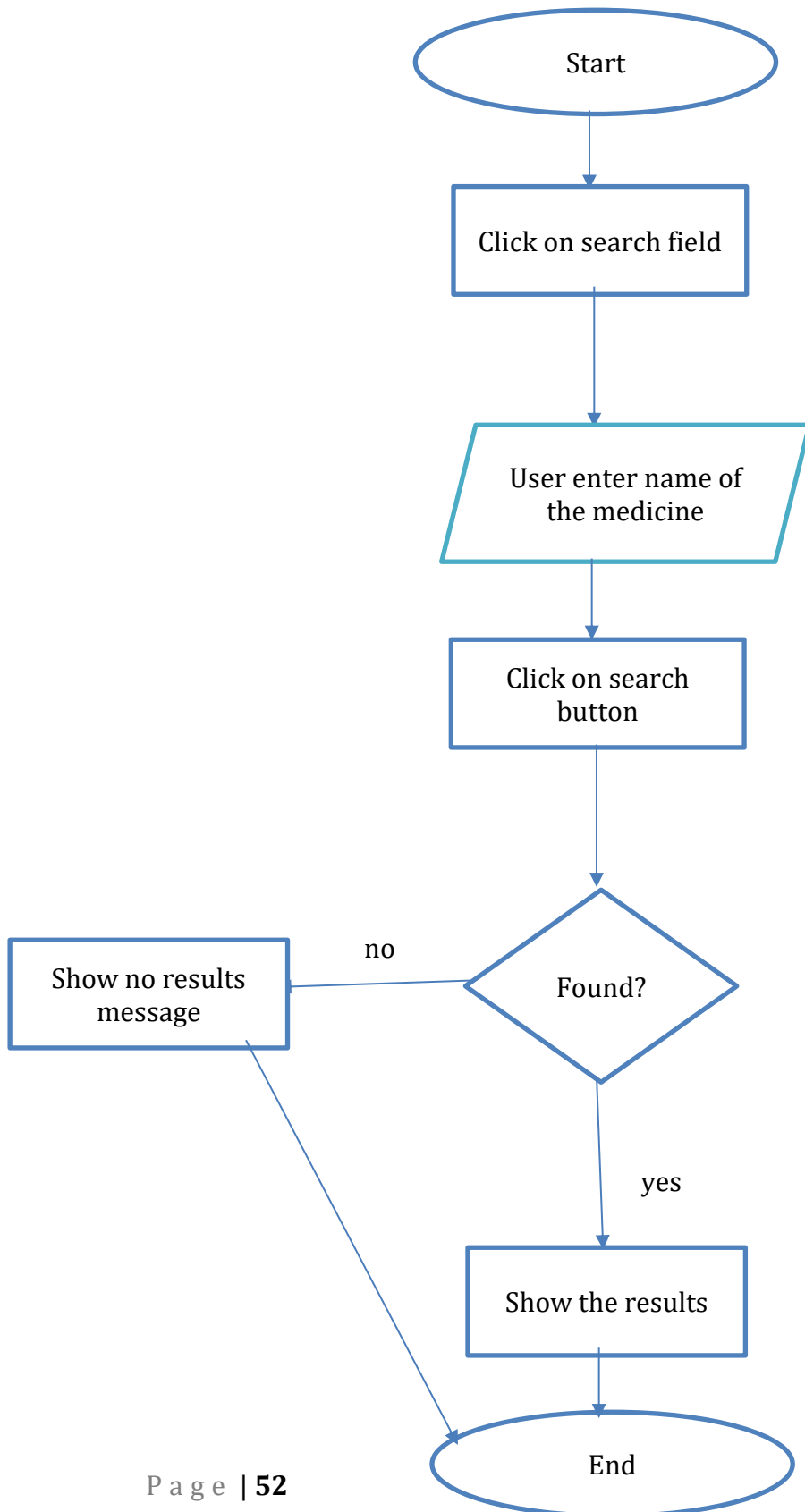
4) Translate the application.
   describes how a user can change the language of the application.

Start

Click on translate button

Page translated?

no

Show Failed message

yes

End
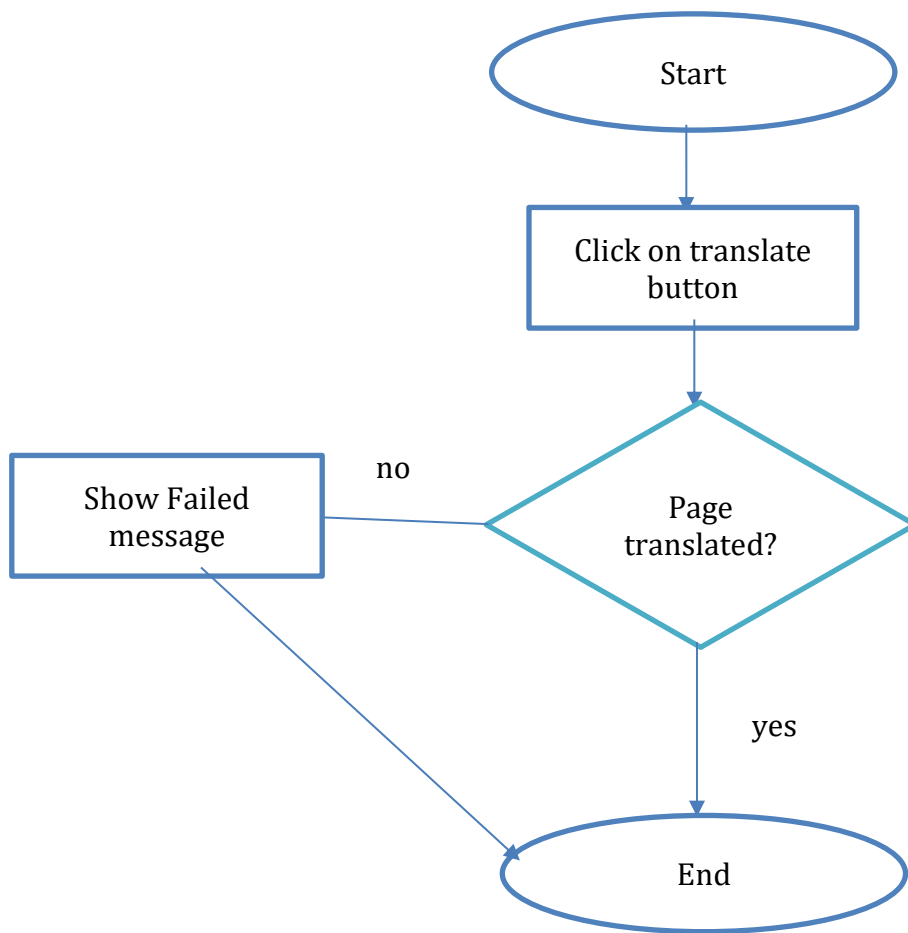
5) Add to the History
   store the names of the searched drugs in the database as History list.

```
                        ┌───────────────┐
                        │     Start      │
                        └───────┬───────┘
                                │
                                ▼
                        ┌───────────────┐
                        │ searching for the │
                        │ name of the drug │
                        └───────┬───────┘
                                │
                                ▼
                             ╱Found?╲
      ┌────────────┐    no  ╱        ╲
      │ Show error  │◄─────╱          ╲
      │  message    │      ╲          ╱
      └─────┬──────┘        ╲        ╱
            │                ╲Found?╱
            │                   │
            │                 yes│
            │                    ▼
            │            ┌───────────────┐
            │            │ Add name of the │
            │            │ drug to history list │
            │            └───────┬───────┘
            │                    │
            │                    ▼
            │            ┌───────────────┐
            └───────────►│      End       │
                         └───────────────┘
```
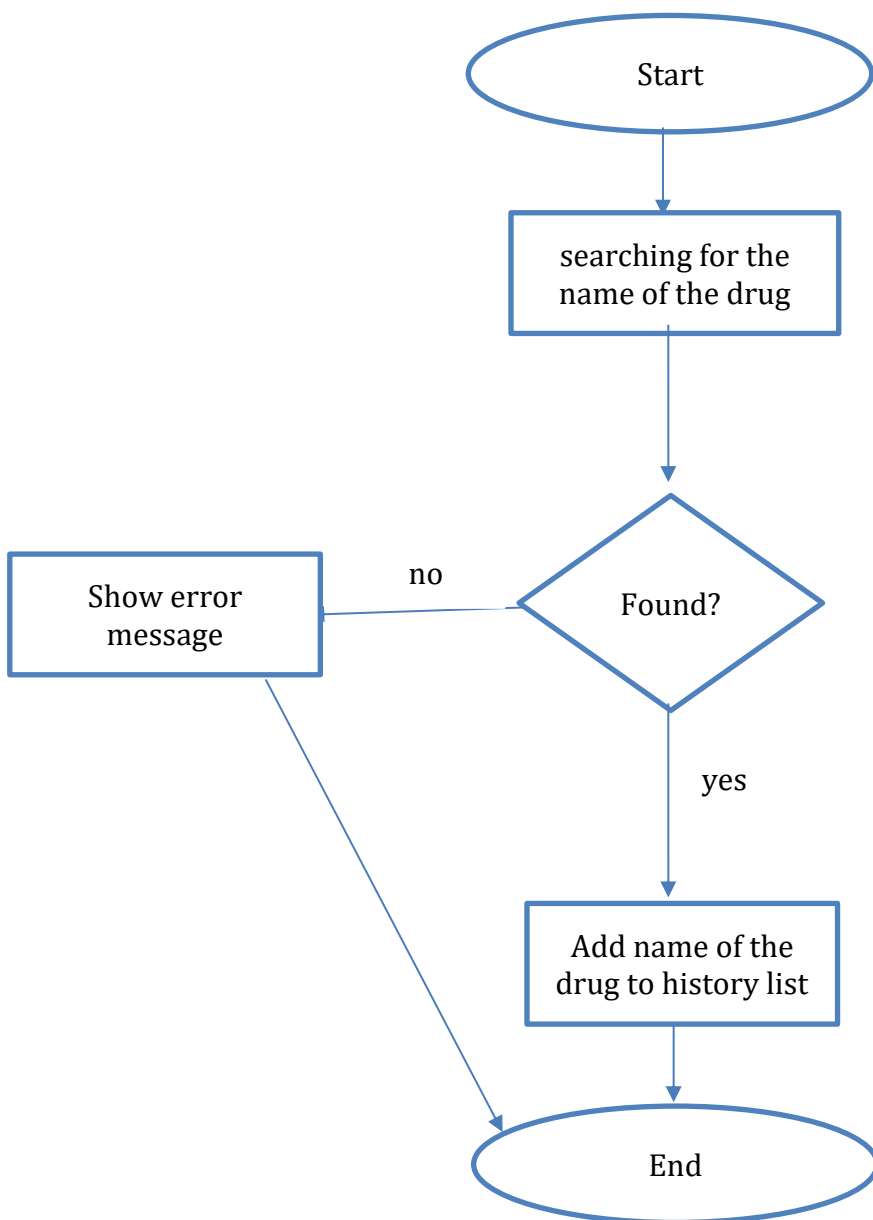
6) Search by scanning search.
   describes how a user can search about medicine by scanning its barcode.

```
                    ┌─────────────┐
                   (    Start     )
                    └─────────────┘
                          │
                          ▼
                   ┌──────────────┐
                   │ Click on scanner │
                   │    button    │
                   └──────────────┘
                          │
                          ▼
                 ╱─────────────────╲
                 │ User scans desired │
                 │ medicine's barcode │
                 ╲─────────────────╱
                          │
                          ▼
                       ◇ Found? ◇
```

no

Show error
message

Found?

yes

Show the results

End
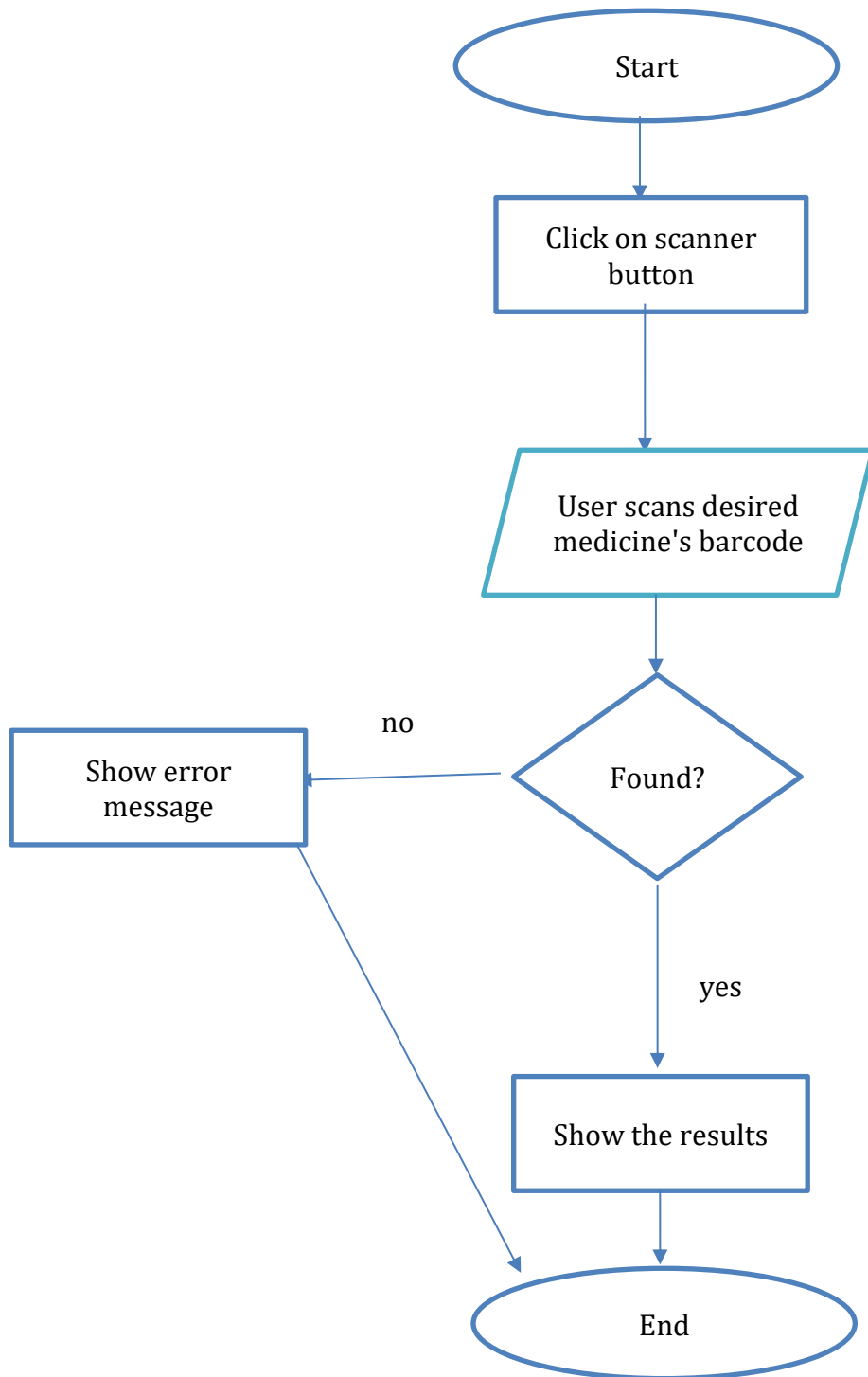
7) Text to speech.
   Convert the text of the leaflet to a sound in order to facilitate getting to information

Start

Click on read button

reading the leaflet

Click on read button to stop read?

yes

Stop reading

no

End
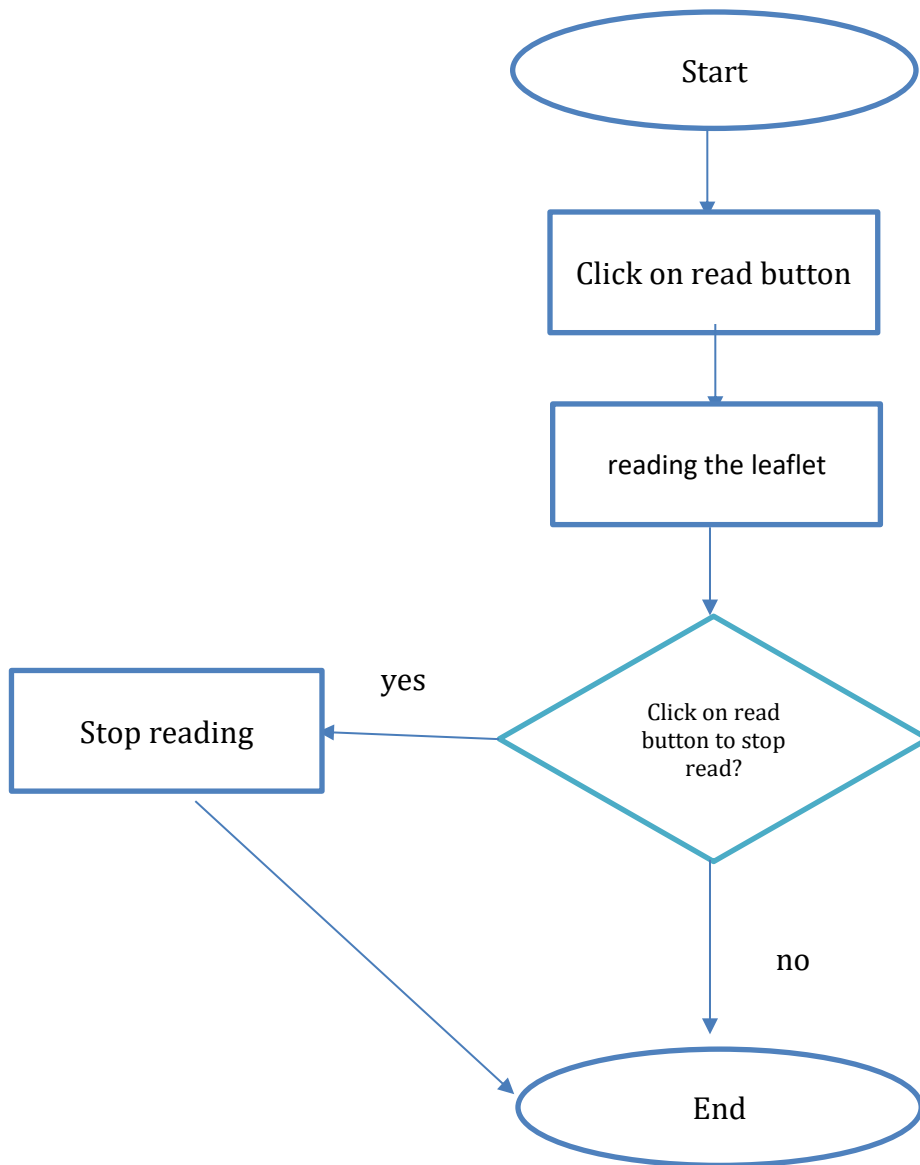
5.4.2 Pseudocode

1) AddToFavorite (DrugName)

BEGIN
  IF DrugName **NOT NULL**
    IF FindDrugName(DrugName)
    THEN STORE IT IN FAVORITE LIST AND FILL THE STAR BUTTON
   ELSE IF !FindDrugName(DrugName)
   THEN SHOW "Drug Name Not Found"
END

2) SearchByDefault(DrugName)
 BEGIN
   IF DrugName **NOT NULL**
     IF FindDrugName(DrugName)
     THEN SHOW IT IN SEARCH LIST AND AddToHistory(DrugName)
   ELSE IF !FindDrugName(DrugName)
   THEN SHOW "Drug Name Not Found"
END

3) TranslateLeaflet(GenericName, TradeName, Instructions, Form, Dose, SideEffects, Warnings, ExpirationDate)
BEGIN
   Translate_status ← CALL GOOGLE API TO TRANSLATE the LEAFLET ATTRIBUTES
    IF ! Translate_status
   THEN SHOW " page failed to translate"
END

4) AddToHistory(DrugName)

 BEGIN

  IF DrugName **NOT NULL**

   IF FindDrugName(DrugName)

   THEN STORE IT IN HISTORY LIST

  ELSE IF ! FindDrugName(DrugName)

  THEN SHOW "Drug Name Not Found"

END

5) SearchByScanning(Numeric_code)

 BEGIN

  IF FindDrugNameByScanner(Numeric_code)

   THEN drugName ← getDrugName(Numeric_code)

   AND SHOW THE RESULTS AND AddToHistory(drugName)

  ELSE IF ! FindDrugNameByScanner(Numeric_code)

  THEN SHOW "Drug Name Not Found"

END

6) TextToSpeech(leaflet_subtitle)

 BEGIN

  CALL TEXT TO SPEECH API

  IF PressPauseButton

  THEN STOP READING

END

5.5 Prototype Design

The prototype for LETECH was made with Justinmind [44] prototyping tool to design the mobile application .It is designed in a way where the positions of the pages are clear and the icons used leave no room for ambiguity, therefore increasing the usability and ease of use of the program.

1. Application Page

Figure 5.5.1 it displays the login/Register page, the user can login by enter the email and password. Also the user can log as a Guest without register.

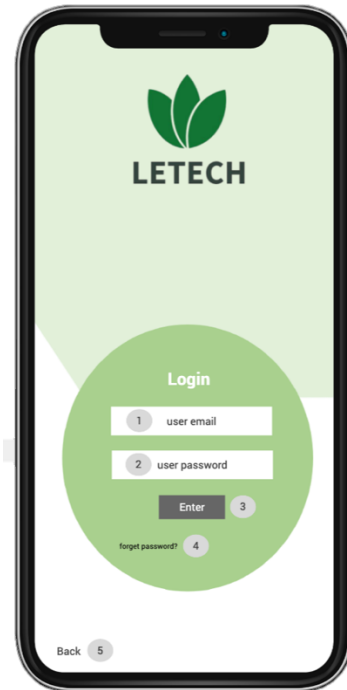| #	Description
1	Login "button": the system will transfer the user to the login page.
2	Guest "button": the system will transfer the user to home page of the application.
3	Register "button": the system will transfer the user to register page.

2. Registration Page

Figure 5.5.2, displays registration page, the user can create a new account by enter the required information which are: username, email and password.
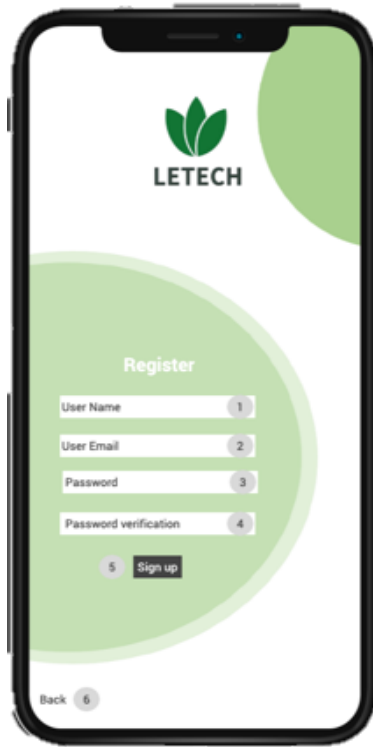
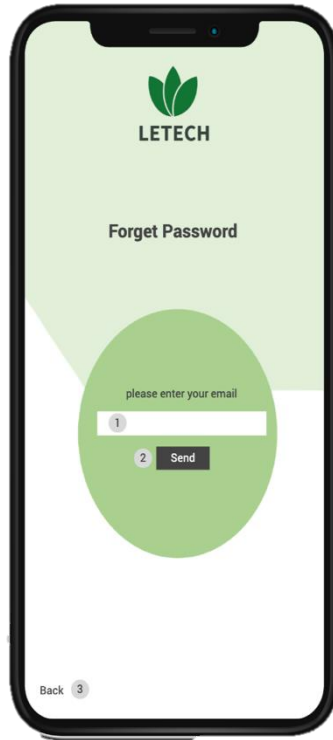| #	Description
1	Name "Input field": enter the user's name.
2	Email "Input field": enter the user's email.
3	Password "Input field": enter the user's password.
	Password verification "Input field": enter the user's password.
4	Sign up "button": the system will register as a new user then transfer the user to login page.
5	Back "movement": the system will back to application page.

4. Login Page

In the figure below, the system displays the login page, the user can login by enter the email and password. Also, the user can restore the password by clicking on "Forgot Password" button.

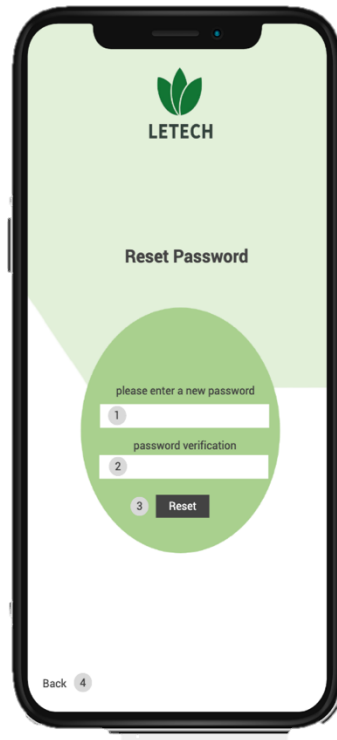| #	Description
1	User email "Input field": enter the user's email.
2	User password "Input field": enter the user's password.
3	Enter "button": the system will transfer the user to home page.
4	Forget password "button": the system will transfer the user to forget password page.
5	Back "movement": the system will back to application page.

5. Forget Password Page

In the figure below, the system allows to the user to reset password by email.

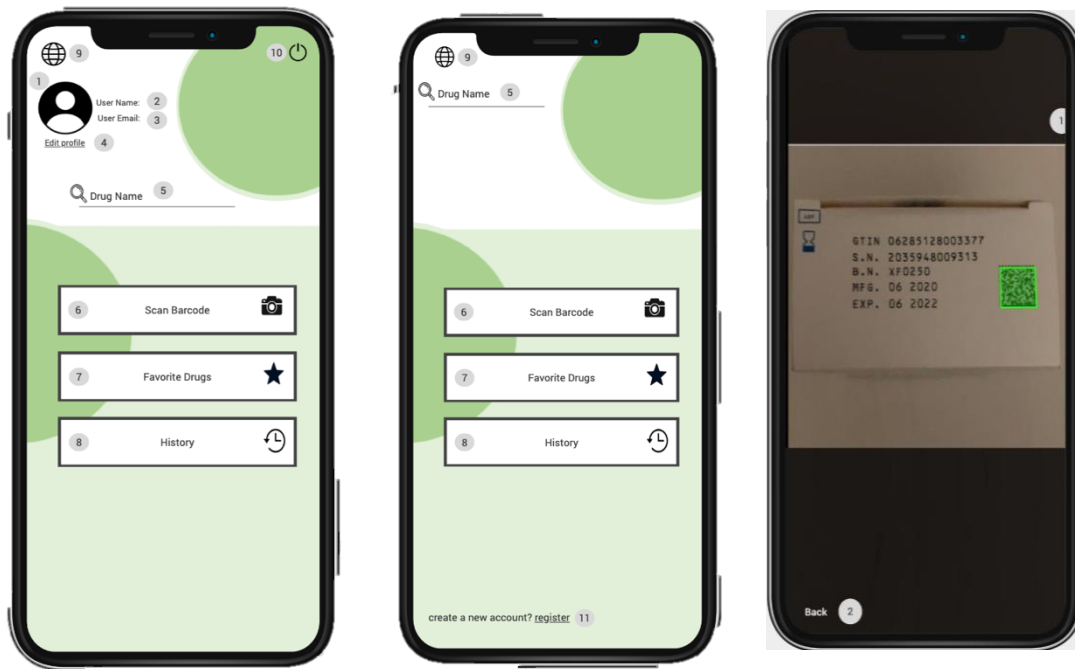| #	Description
1	User email "Input field": enter the user's email
2	Send "button": the system will send a link on user email, then the user click on the link for transfer to reset password page.
3	Back "movement": the system will back to login page.

6. Reset Password Page

In the figure below, the system allows to the user to reset password by email.

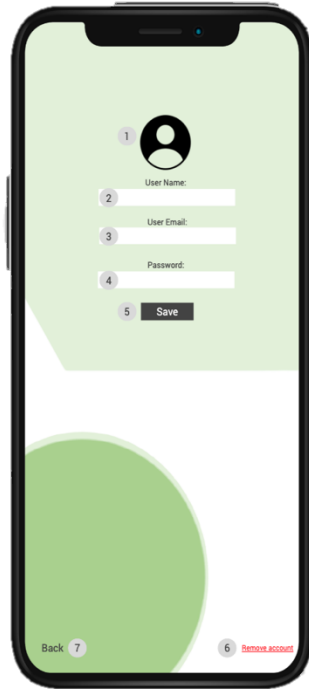| #	Description
1	Password "Input field": enter the user's password
2	Password verification "Input field": enter the user's password.
3	Reset "button": the system will do reset the password.
4	Back "movement": the system will back to login page.

7. Home Page

In the figure below, it displays the home page. It includes user's profile. Also, it allows to the user to do some operation like search about the drug, favorite drug and history of search. Addition to the user can change the current language from the home page. In the left figure it has same as the right figure, but this page will display if the user does not have an acco

#	Description
1	Picture: " picture view": display the user profile photo.
2	User name "text view": display the user name.
3	User email "text view": display the user email.
4	Edit profile "button": the system will transfer the user to edit profile page.
5	Drug name " Input field ": the user can search about the drug by name, then will display drug page.
6	Scan Barcode "button": the user can search about the drug by scanning barcode then will display drug page.
7	Favorite Drugs "button": the system will transfer the user to favorite page.
8	History "button": the system will transfer the user to history page.
9	Translate "button": the system will translate the current language.
10	Logout "button": the system will log out of the user's account and go to the application page.
11	Register "button": the system will give an option to the guest if want to create an account.

8. Edit Profile Page

The figure below displays the edit profile page. It is allows to edit the user photo, name, email and password.

#	Description
1	Picture "click button": edit the user's profile photo.
2	Name "Input field": edit the user's name.
3	Email "Input field": edit the user's email.
4	Password "Input field": edit the user's password.
5	Save "button": the system will save all the user updates
6	Remove account "button": The system will delete the user account and go to the application page.
7	Back "movement" the system will back to home page.

9. Drug Page

#	Description
1	Drug name:" text view" The user can display the information of drug.
2	Generic_name:"button" The active ingredient's name.
3	Trade_name: "button" the name given by the company that manufactured the treatmen.
4	Instructions: "button"The user can display the Instructions.
5	Side_Effect :"button" The user can display the side effects of drug.
6	Warnings:"button" The user can display the warning of drug.
7	Dose:"button" The user can display the dose of drug.
8	Form:"button" The user can display the form of drug.
9	Expiration_Date :"button" The user can display the Expiration_Date of drug.
10	Text to speech:"button" The user can convert text to speech.
11	Google translate API :"button" translation of the drug leaflet content.
12	Arrow "movement" back to home page.

10. Drug Page

#	Description
1	Drug name:" text view" The user can display the information of drug.
2	Generic_name:"button" The active ingredient's name.
3	Trade_name: "button" the name given by the company that manufactured the treatmen.
4	Instructions: "button"The user can display the Instructions.
5	Side Effect :"button" The user can display the side effects of drug.
6	Warnings:"button" The user can display the warning of drug.
7	Dose:"button" The user can display the dose of drug.
8	Form:"button" The user can display the form of drug.
9	Expiration_Date :"button" The user can display the Expiration_Date of drug.
10	Text to speech:"button" The user can convert text to speech.
11	Google translate API :"button" translation of the drug leaflet content.
12	Arrow "movement" back to home page.

11. Favorite Page

#	Description
1	Favorites:" text view" The user reviews the most important medicines he prefers.
2	Medicine name:" text view": display the information of drug.
3	Star sign: "button": the user can delete a specific drug from favorites.
4	Delete All: "button": the user can delete all the drug from favorites.
5	Arrow "movement" back to home page.

12. History Page

#	Description
1	History:" text view" The user can view history.
2	Medicine name:" text view": display the information of drug.
3	Trash sign: "button": the user can delete a specific drug from history
4	Delete All: "button": the user can delete all the drug from history
5	Arrow "movement" back to home page.

Chapter 6: Conclusion

In this document, we provide an application mobile to help the users to read the information leaflet paper easily and it's called LETECH for our graduation project and we are going to develop it using Android studio. Our application will provide to the patients many serves with a good user interface such as a default search and scanning barcode to look for specific medicines easily. Also, it will provide translate option to the user and favorite option, so users can keep their medicine in nearby as well as history feature.

In the background and literature review, we have mentioned the relevant concepts of our project. For instance, we went through the definition, usage, design and content of information leaflet. Also, we went through each tool and API deeply such as MI KIT tool to scan the barcode and Text-to-Speech engine to read the text and Google Translate API to translate the text. Finally, when we compared between applications in the literature review, we didn't find any application with all significant features as we mentioned that we will provide so we want to combine all of these features in one application.

In chapter 4, we have provided the details of System Analysis. We reviewed the functional and non-functional requirements, showed the Use Case Diagram and Use Case Description followed by the Interaction Diagram.

In chapter 5, we have gone through the details of system design and implementation, we reviewed the System Architecture, Class Diagram, Database Design including Entity Relationship Diagram and Database Schema. Also, we presented the Algorithm of the system and pseudocode. In addition to the User Interface Prototype at the end.

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