KAMALUDEENBATURE SHEHU

DEVELOPING A MOBILE APPLICATION FOR TOURISTS IN THE TURKISH REPUBLIC OF NORTHERN CYPRUS

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A THESIS SUBMITTED TO THE GRADUATE SCHOOL OF APPLIED SCIENCE OF NEAR EAST UNIVERSITY

By

KAMALUDEEN BATURE SHEHU

In Partial Fulfilment of the Requirements for the Degree of Master of Science in Computer Information Systems

NICOSIA, 2018

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conducts, I have fully cited and referenced all materials and results that are not original to this work.

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To my parents….

ABSTRACT

The Turkish Republic of Northern Cyprus (TRNC) is a well-known tourist destination that welcomes a considerable large number of tourists yearly. The tourists are usually given tour booklets, pamphlets or then taken around on a tour in groups, as part of an official tour. Also, due to lack of updated information and navigation/path-finding capabilities,privately, tourists are usually not able to visit all the areas that are of interest to them. After much research, this thesis aims to provide a solution that will helpthe tourists to overcome the inconveniences stated in line with the latest trends in information technology. Therefore, this thesis presents aGPS-based Androidmobile application named “Tour TRNC”that aims to solve the issues stated. The main features of the application are user current locationidentifier, emergency SMS to police and ambulance, multiple language text-to-speech audio history for historical places, navigation/path-finding features, weather information, and touristic exchange rates. The application was developed using Android Studio and it is tobe used on Android mobile devices. The main objective of this thesis is to provide tourists with a mobile application that can enable them to travel and explore different places individually whenever they so desire as well as incorporate emergency features should the need arise. The developed application can also be fully utilized by students as well because the TRNC welcomes a large number of new students each year.

Keywords:Mobile application development;tourism;global positioning system GPS;path finding; XML; emergency SMS

ÖZET

Kuzey Kıbrıs Türk Cumhuriyeti (KKTC) çok iyi bilinen bir turistik ülke olup her yıl oldukça çok miktarda turist adaya gelmektedir. Turistler genellikle gruplar halinde gezdirilirler ve kendilerine yapacakları geziler ve turlar hakkında broşürler ve küçük kitapcıklar dağıtılır. Kendi başlarına gelen turistler ise gerekli bilgi, harita, ve yerbulum sistemleri olamamasından dolayı arzu ettikleri ve beğendikleri yerleri gezmekte zorlanırlar. Arastirmacinin esas amacı en son enformasyon teknolojilerini kullanarak turistlere yardımcı olmak için sistem geliştirilmistir. Bu tezde Android mobil telefon uygulamalı ve 'Tour TRNC' isimli yerbulum (GPS) sistemi kullanan ve yukarıdaki problemleri çözecek bir uygulama geliştirmektir. Geliştirilmiş olan uygulamanın esas özellikleri bulunan yeri tanımak, polis ve ambulans ile SMS yoluyla irtibata geçerek yardım istemek, çeşitli tarihi yerler hakkında çeşitli lisanlarda yazıyı konuşmaya çeviren uygulamalar kullanmak, hava raporu bilgileri vermek, ve turistik para kurlarını anında vermektir.Bu uygulama Android mobil telefon cihazlarında kullanılmak üzere geliştirilmiştir. Tezin esas amacı, turistlere değişik yerleri gezip tanımalarında kolaylık sağlayacak olan ve anında gerekirse acil yardım isteyebilecekleri mobil bir uygulama geliştirmektir. KKTC'ye her yıl oldukça çok miktarda yeni öğrenci geldiği için bu uygulama turistlere ilaveten KKTC'ye yeni gelen öğenciler de yardımcı olacaltır.

Anahtar Kelimeler:Mobil uygulama geliştirmek;turizm;küresel yerbulum sistemi GPS;yer bulumu; XML; acil SMS.

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LIST OF ABBREVIATIONS

TRNC	Turkish Republic of Northern Cyprus
ICE	In Case of Emergency
POI	Places of Interest
MCC	Mobile Cloud Computing
MAPPER	Map Personalization
GPS	Global Positioning System
GIS	Geographic Information Systems
LBS	Location Based System
PSiS	Personalized Sightseeing Tour Recommendation System
ICT	Information and Communication Technology
OS	Operating System
GUI	Graphical User Interface
SDK	Software Development Kit
API	Application Programming Interface
RAD	Rapid Application Design
CSS	Cascading Style Sheet
XML	Extensible Mark-up Language
HTML	Hypertext Mark-up Language
TMI	Text Messaging Intervention
SMS	Short Messaging Language
PC	Personal Computers
JDK	Java Development Kit
IDE	Integrated Development Environment
UML	Unified Modelling Language
JVM	Java Virtual Machine
DVM	Dalvik Virtual Machine
PLMTA	Personalized Location-based Mobile Tourism Application
ISSM	Information System Success Model
TAM	Technology Acceptance Model
ACO	Ant Colony Optimization
SDLC	Software Development Life Cycle

CHAPTER 1
INTRODUCTION

This chapter gives the introduction to the topic of research. It also gives a detailed explanation of the problem statement, the objectives of study, importance of study, the limitations and the overview of the entire thesis.

1.1 Introduction

Ever since smart phones became popular, a very large number of mobile applications have been developed for human use (Bicen & Sadikoglu, 2016). Mobile applications are developed to carry out different purposes all aimed to make human life easier. The dependency on smartphones, mobile devices and Internet Technology in general has given birth to the digitalization of every single piece of information that is required to carry out daily activities, which ultimately aims to make human life easier (Chen & Tsai, 2017). This has resulted in the development of mobile applications for health (Wu et al., 2013), tourism (Rodrigues-Sanchez et al., 2013), governance (Asongu & Nwachukwu, 2016), education (Alqahtani & Fayyoumi, 2015; Ham, Dirin& Laine, 2015)and other businesses (Ehrenhard et al., 2017).The average mobile applications user is thought of to be mobile, social and local (Tarute, Nikou & Gatautis, 2017). The most common mobile platform used in the development of mobile applications is the Android operating system (Dunn, 2016). Android operating system is the most affordable and the most common operating system. This is because Android operating system is an open source operating system that supports java and is based on Linux (Bhattacharya & Pambu, 2013).The tourism sector is one sector that is continuously being implemented for use technologically on mobile applications.

Tourism is without a doubt one of the most lucrative businesssectors of economy that is increasingly implemented for use on mobile devices/computers all around the world (Rodrigues-Sanchez et al., 2013). Tourism is one of the leading sectors of the economy that always embraces new technological innovations (Gretzel, 2011).It is an important cultural, economic and social phenomenon that involves the movement of a large number of people around the world, which has a big impact on the economy of

the countries visited (Cenamor et al., 2016).There is a significant increase in the use of technology and mobile devices in the last couple of years (Rodriguez-Sanchez et al., 2013). Due to advances in technology, most tourists usually carry their mobile devices on them all the time and this gives them access to accurate information than their personal computers and other electronics (Singh et al., 2014).In the future, tourism will continue to evolve and develop more as technology and smart devices are further applied to the sector (Koo et al., 2013).

Most mobile applications for tourism arebased on Location Based Services (LBS) and Geographical Information Systems (GIS) (Gugapriya, Vaitheki & Kaviyarasi, 2013).This is because it enables tourists to know their current location, conduct a search and generate way-paths from one location to anothereasily, using Global Positioning System (GPS) (Bhatia & Halil, 2013). This is because GPS is the most accurate location tracker used. GPS uses latitude and longitude coordinates when tracking the current location of a user/device.

This study aims to develop a mobile application for tourists, which will enable tourists visiting the Turkish Republic of Northern Cyprus because it records a high number of tourist coming in all year round. The application will enable usersto know their current location, get current information on POIs, navigate/find-paths to different locations, offer text-to-speech audio about the brief history of historical placesin multiple languages and also provideemergency SMS services; a platform for users to reach the emergency service providers in the time they are needed.

1.1 Problem Statement

Tourism is one of the most important economic sectors that generates revenue and a in the Turkish Republic of Northern Cyprus (TRNC). This is because each year, TRNC welcomes a large number of tourists from other countries every year, which generates revenue for the TRNC in return.

Due to the influx of tourists in the TRNC, there is a need to develop a platform that will enable the tourists to seek help in case there is an emergency situation. Relevant researches have pointed to this need, indicating that there is a need to provide such a platform for tourists to seek help immediately in cases of emergency or distress.

1.2 Objective of Study

The study aims to develop a mobile application for tourists visiting the TRNC. The application will aim to display theuser's current, provide up to dateaccurate information on various POIs.However, the major objective of the study is to develop a tourism mobile application with emergency SMSfunctionality, which will enable tourists to send an automatic SMS message of their current location and the emergency situation toemergency service providers, that is the Police andAmbulance services instantly, should there be need. The emergency SMS feature will aim to be a one-button SMS feature, where the tourists can automatically send an SMS by simply pressing a button, which corresponds to the type of emergency situation.

1.3 Importance of Study

This study is of outmost importance because it aims to develop aGPS-based mobile application for tourists visiting the Turkish Republic of Northern Cyprus (TRNC). The proposed mobile application will be very important to the tourists because the emergency SMS feature will make them feel safer, secured and more interested in the visiting the TRNC. It will give them a platform to seek help from the relevant service providers in case of emergency.

1.4 Limitations of Study

During the course of this study, there were some limitations that were encountered. These are:

- The application is developed only for Android Operating System Presently.
- The application is developed in English language only.
- The multiple language text and audio history is only implemented for the five historical places listed below. They are;
    - Ermeni Kilisesi
    - Bedesten/Bedestan Old St. Nicolas Church
    - Arab Ahmet Mosque
    - Selimiye Mosque
    - Sarayonu Camii

The multiple language audio and text history is implemented for these five historical places because they are among the most visited historical places in Lefkosa, TRNC. Tourist are always interested in these sites because of their immense and long histories. Their history goes beyond ancient Cyprus alone, as they all have historical links to either the ancient Roman Empire, Greek Empire, Spanish Empire and Constantinople (Present day Istanbul).

This fact makes tourists from different countries to be interested in these historical places because it gives them an idea of the history in general.

1.5 Thesis Overview

The main chapters of the thesis are explained below:

Chapter 1: This chapter introduces the thesis as well as describes the problems, objectives of the study, the importance of the study and lastly, the limitations.

Chapter 2: This chapter explains some of the previous works carried out by researchers in the field of mobile application for tourism in different locations.

Chapter 3: This chapter provides the theoretical framework for tourism mobile applications. It points out the concepts of mobile application development, tourism information, GPS features and how they are utilized in tourism mobile applications.

Chapter 4: This chapter gives a detailed explanation of the software and tools to be used in the development of the mobile application. It also shows the proposed system architecture and UML diagrams, which gives a visual representation of the design of the application to be developed.

Chapter 5: This chapter reviews the developed application and gives a vividly explains the application and its functionalities. Also, the screenshots of the developed applications GUI are included in this chapter to further explain to the prospective users how the application fully functions.

Chapter 6: This chapter concludes the thesis. It gives the conclusion as well as offers recommendations and future works to be carried out in order to enhance the application in the future.

CHAPTER 2
RELATED RESEARCH

This chapter explains some of the tourism mobile applications developed, which are previous works carried out by researchers in the field of mobile application for tourism in different locations.

2.1 Related Research

Kabassi (2010) conducted a study on the internet and how it influenced the availability and delivery of goods and services in tourism sector of business. The study focused on the bulkiness of information due to the large number of choices that has made it difficult for tourists to get information on places that are of interest to them. As a result, the study proposed the development of a mobile-based and computer recommendation application for tourism. The proposed application will allow the tourist to customize and also personalize their recommendation according to their personal taste and preference. Also reviews were carried out on the applications previously developed and improvements where recommended, which are based on the requirements of personalized recommendation systems for tourists.

Wilson et al. (2010) researched the interaction difficulties tourists usually face, for example, information overload and usability limitations while using a map-based interactive application. They therefore designed and developed a mobile application called MAPPER (MAP Personalized), which is a Geographic Information System (GIS) based application. The developed system is designed to give the current map-based information based on the user's preferences, therefore eliminating the information overload problems, which it did by presenting the user with information related to the user's preference only while neglecting all other irrelevant information.

Deb et al. (2010) designed and developed software that offers mobile solutions and Leveraging Geo Data and Maps. Also, they developed an application that will allow users to download, install and use the map of a city based on the user's current location. The user can use the downloaded map both while connected to the internet

or not as well as download and use new and updated versions of the map. The user's current location is shown using coverage signals from the cell towers of the network providers on the map, which enables the user to use the application even while offline. As a result of this application, the shortest route to a location selected by the user will be highlighted on the map. Other things that are indicated on the map includes tax stations, bus stops (that are close to the user's current location) and the distance between the user's source and destination.

Kenteris et al. (2010) proposed an approach and design of a multi-platform tourism guide system for the Municipal Council of Mytilene. The tourism guide system is designed to enhance the experience of tourists by integrating a"web-to-mobile" system that will enable the transfer of personalized tourism information from the web to the mobile device of the user. The applications allowed users to browse the contents effectively without Internet connection required. The application was adopted the multiplatform mobile tour guide approach with the sole objective of producing a personalized mobile tour guide application that can be used with or without Internet connection as well as provide other tourism related services related to location-based services and recommendation systems.

Mathkour (2011) developed a mobile applicationbased on GPS functionalities that will helpthe users to find and locate and desired Places of Interest(POIs) while using their mobile devices. The developed application also estimates the distance between the places of interest from the user's current location. Due to the applications extendibility and flexibility, it easily incorporates and uses additional mobile service providers.

Kounavis et al. (2012) researched the useof Augmented Reality (AR) technology used in developing mobile applications for tourism. They discussed the Augmented Reality technologicalfrom its early stages of development to the perfection and commercialization ofAugmented Reality (AR-based)mobile applications. They conducted further analysis and further examined the development of other applications. Havingacknowledged the differences in technological limitations that usually stops the technology from being used, they designed and Augmented Reality AR-Based mobile applications for tourism. The model will aim to unlock the full

potential of Augmented Reality and how it can be implementedwhile developingmobile applications for tourism.

Rodriguez-Sanchez et al. (2013) developed a mobile application for tourism. The developed applicationenables users to generate paths for both indoor and outdoor environments without requiring programming skills. This is achieved by the assistance of an automatic generation system and the updates on points of interest through a web form. The mobile was developed using the GAT platform.

Singh et al. (2014) conducted a research on the challengesfaced by touristswhile visiting Fiji. Parts of the challengesdiscovered includehaving access toinformation on activities, events and places in Fiji, weather information,navigating from one tourist spot to another, booking hotel accommodation and translation from the tourist's languages to the indigenous Fijian language.They however proposed the developed of a centralized web-based and mobile tourist travel guide system specifically designed to tackle the challenges they identified. The result of the developed application helped made tourism in Fiji a lot easier because it enabled the tourists to book hotel reservations and accommodations easier, access information to places and tourist events. As a result of this, the tourism experience in Fiji was greatly enhanced.

Smirnov et al. (2014) presented a category of mobile tourism/travel applications that are readily available to tourists in the application stores of both Android operating systems and Mac OSX operating systems. They concluded that out of all the tourism applications, the most interesting group of applications are the Travel guide application because they combine both Location-Based services and Information Resources. Therefore, they developed a mobile application called "Tourist Assistant – TAIS" which recommends POIs to the tourists and also serves as a travel guide. The originality of the proposed application however is its ability to extract current information from different online sources and in turn, provides the tourist with real time up-to-date information without any need for download.

Anacleto et al. (2014) reviewed some of the best mobile applications for tourism. As a result, they proposed the PSiS Mobile, which is a mobile application that helps tourists to plan their vacation as well as offers recommendations on places to visit. The PSiS mobile application was designed to assist tourists by giving a list of POIs to

be visit. This is usually according to the tourist's preferences. The application was designed to work like a digital diary because it also keeps records of the tourist's movements.

Jana and Chattopadhyay (2015) examined the challenges of new students admitted into the Jaduvpur University, India. They realized that there are no facilities to assist new students to locate places like administrative blocks, departments and libraries. They also realized that new buildings are being built and some departments have relocated all within the campus. They therefore designed a GPS map-based mobile application to solve the challenges and help the new students to locate departments and other places while providing the shortest route to get there. The application also provided information on events and activities that are to hold in the school. The mobile application was developed using Android SDK. The application was found to have significantly reduced the confusion of the newly admitted students in the school.

Kefas (2015) developed a GPS-based mobile application to help tourists visiting Lefkosa. The developed mobile application effectively used a combination of multimedia and cloud-computing platforms to help the tourist to gain information and locate their desired places of interest.

Pereira et al. (2015) conducted a research on tourism from a cultural perspective and how its impact on the economy. They thought that the only wayto improve the appeal and attraction to the tourists, some tourist hotspots and POIs had to use an open-data model because the different cities publish their tourism information in different ways. Therefore, they proposed a design overview, implementation and deployment of City SDK Tourism API that will enable the tourist to gain access to current information on events and their desired POIs. The deployment of the API has been successful cities such as Lisbon, Amsterdam, Rome and Helsinki. Many other tourism companies in different countries have developed and launched their tourisms mobile applications using this same API.

Ismail et al. (2016) studied the challenges faced by tourists in Malaysia. Some of these challenges are the presentation of information and maps on printed materials and how they resulted in more problems like lack of access to information, navigation and a less efficient way of promoting and showcasing the full potential of tourism in

Malaysia. As a result, they aimed to provide a solution by developing a mobile application to cater for the needs of the visiting tourists. The developed the application a simple RAD design process. The result indicated the need to develop a mobile application which can help the users to find their desires POI and also help them navigate there. The application will also enable the tourists to embark on secured journey because they can continually recheck the information of their desired POIs and use other GPS features actively.

Afolalu et al. (2016) suggested the development of a tourism mobile application for the capital city of Abuja in Nigeria. The proposed application will serve as a mobile tourist directoryand it will provide a well-designed user-friendly GUI for easier understanding by the user. This will help remedy the problems of the existing application can function whether it is connected to the Internet or not.

Yang and Hsu (2016) developed a mobile tourism application that uses location-based services, which uses Google maps and also image processing technology for tourists. The application was tested in the archaeological and ancient city of New Taipei City, Taiwan. The application proved to be very useful as it was able to provide tourist with information on popular tourism sites and also has a highly efficient GPS functionality that guides the tourists to their desired destination. A comparison of this application with the other applications developed for New Taipei City showed that this application is far superior to the others in terms of performance, effectiveness and attractiveness.

Zhu (2016) designed a GPS-Based mobile application for campus student's social interaction named "Stick IT" in Nanjing, China. The application was developed to help students identify the location of different places on campus. The application also had a chat room functionality, which was designed to provide the students with a meeting point to socialize, make friends and pass important information within them. The result was very impressive as student were willing to use the application as it enabled them to find relevant places easier and afforded them the chance to make new friends.

Rodriguez-Sanchez and Martinez-Romo (2017) proposed a new way-finding service

system known as ‘GAWA’, which will improve the new SmartCities mechanism (that is smart living, smart mobility etc.) in Spain. Because navigation and steering are a very important activity of everyday life, there is a high degree of importance to practical values such as geo-positioning, urban planning, navigation, environmental design and architectural way finding. Therefore, the proposed applicationaimed to tackle the problem of navigation around the city, especially for visually impaired individuals, as it will enable them to navigate autonomously without any assistance especially in unknown indoor and outdoor environments using a smartphone. The result obtained showed that the GAWA application can help visually impaired individuals to carry out everyday tasks efficiently.

Chen and Tsai (2017) explored the improvements in public transit systems and the installation of the YouBike public bicycle systems in the city of Taichung, in Taiwan, which created a robust and diversified transportation network system that had amassive impact on the tourism industry locally. They therefore developed a Personalized Location-based Mobile Tourism Application (PLMTA), which combined Ant Colony Optimization (ACO) algorithm and hybrid filtering technology. They integrated both Information System Success Model (ISSM) and Technology Accepted Model (TAM) in the study. Questionnaires were used to collect the relevant data and structural equation model (SEM) was used to test the hypothesis. The results indicated that there was more willingness to use the PLMTA application because of its perceived easy usability and information quality.

From the above-related works undertaken by different researchers, we can affirmatively conclude that tourism is an industry that is growing at a very fast rate globally and Information and Communications Technology (ICT) features are integrated into tourism at an even faster rate. One of such ways is by following the latest ICT trend and developing mobile applications that offer tourists with GPS features to help them track their desired Places of Interests.

However, feature that offers security and emergency features in the field of tourism seems to be missing. Therefore, this study aims to feel that gap and as a result, offer further contributions to the tourism field.

CHAPTER 3

THEORETICAL FRAMEWORK

This chapter provides the theoretical framework for tourism mobile applications. It points out the concepts of mobile application development, tourism information, GPS features and how they are utilized in mobile applications for tourism.

3.1 Mobile Application Development

Over the last couple of years, the use of mobile applications has increased tremendously and as a result of this; most people nowadays use the mobile devices to carry out their daily activities. The number of smartphone users increases each year due to the different variety of mobile applications offered to users in App Stores (El-Kassas et al. 2017). This has resulted in less use and dependency on computers all over the world. The recent growth in mobile application development shows the increasingly significant role that mobile applications fulfils in the everyday life of people, which is responsible for the increasing number of smartphone and tablet users (Majchrzycka & Poniszewska-Maranda, 2017).

Some areas in which the use of mobile applications has really progressed are mobile learning (m-learning) (Alqahtani & Fayyoumi, 2015), health/mobile nurse applications (Ham, Dirin & Laine, 2017), business/mbusiness (Ehrenhard et al.2017) and tourism (Rodriguez-Sanchez et al. 2013) etc.

3.1.1 Types of Mobile Applications

There are three types of mobile applications. These are:

- ***Native Applications:***Native applications are developed exclusively for a single mobile operating system, that is, for one particular device or platform. This means that an Android application cannot be used on iOS or any other operating system. The major advantage of native applications is that they ensure high performance, good user experience and are available in the Application Stores for the users to download and use.

- ***Hybrid Applications:***Hybrid applications are developed using a combination of multi-platform web-basedtechnologies (e.g. CSS, JavaScript and HTML 5). They are web applications developed as a native application. An advantage of hybrid applications is that they are fast, easy to develop and have low maintenance cost due to the single code base for all the platforms. However, hybrid applications do not have a high-performance speed and thus, the optimization is low.

- ***Web Application:***Web applications are web-based applications that are developed in CSS, JavaScript, HTML 5 and they use browsers to run. Unlike native and hybrid applications, web applications are actually website that look like, feel and work like native applications.

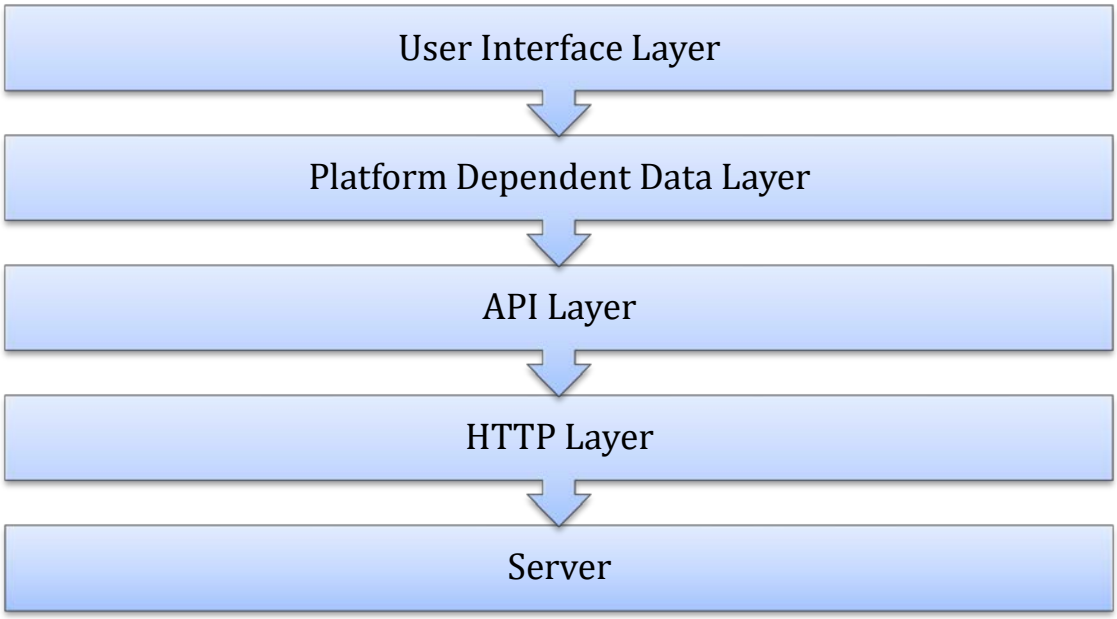

Figure 3.1: Layered architecture of android mobile application development (Holla & Katti, 2012)

3.2 Mobile Cloud Computing

Mobile Cloud Computing refers to the technology that consists of three important and different areas, which are mobile computing, cloud computing and wireless networks (Raei, Yazdani & Shojaee, 2017). It combines mobile computing, clouding computing and wireless communication as a means of providing mobile users with rich, vital information and computational resources. Mobile Cloud Computing aims to reduce

the limitations of mobile applications by providing a centralized source of information to increase and intensify the effectiveness and efficiency of mobile applications and devices (Orsini, Bade & Lamersdorf, 2016).Mobile Cloud Computing services are offered in mobile embedded systems or mobile phone environments (Mollah, Azad & Vasilakos, 2017).

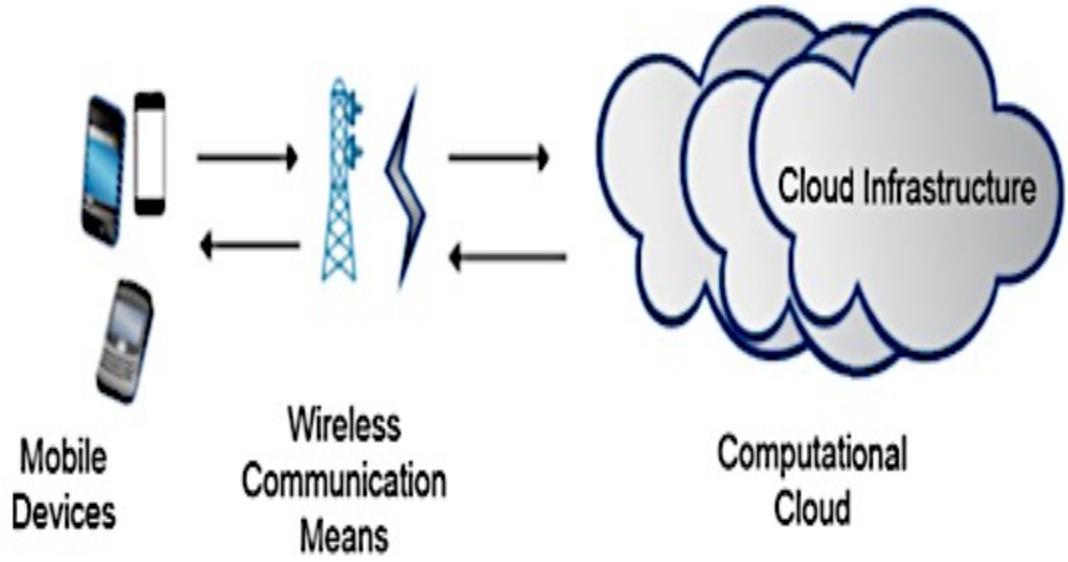

Figure 3.2: Mobile cloud computing (Akherfi, Gerndt &Harroud, 2016)

Also, Mobile Cloud Computing is essential to mobile embedded systems because it provides similar cloud-like characteristics such as resource pooling, on-demand self-service andbroad access networkamongst others (Mollah, Azad & Vasilakos, 2017).

3.2.1 Advantages of Mobile Cloud Computing

The integration of MCC in the mobile device environment has been mainly due to the following advantages.

- ***Multiple Platform Support:***Unlike the normal applications, MCC enables multiple platform support, which means that irrespective of which platform it may be, users can still easily gain access the information stored in the cloud.
- ***Flexibility:***Information stored in the cloud can be accessed from anywhere in the world, irrespective of location and type of mobile device.

- ***Free or Minimal Upfront Cost:*** MCC are usually free. However, in most cases, it offers a pay-as-you-use service to users. This advantage has resulted in the adoption of MCC in businesses, especially Small and Medium Businesses.
- ***Real Time Data Availability:***This provides users with the ability to gain access to real time data at any time and from anywhere. Furthermore, different users can access the data at the same time from different locations.

3.3 Tourism

Tourism has become an emerging target area for interactive mobile applications (Ayala et al. 2017). It is one of the numerous areas of everyday life and business, which is adopted for use via mobile devices. Smart phones have made tremendous impact on human lives, which has led to improved developments in mobile applications. This is because mobile phones these days offer a lot of functionalities and capabilities apart from the conventional making and receiving of phone calls (Kaur & Maheshwari, 2016).For tourists, one of the most important items of use is maps and guidebooks that will help them to navigate and find their way through unfamiliar places. The problem is these maps and guidebook may be too bulky and uncomfortable to carry. The solution to this problem has been the implementation of Global Positioning System (GPS) for use on tourism applications in order to help tourists to find the places they want to visit as well as have all the relevant information easily accessible to them on their mobile phones (Anacleto et al., 2014)

3.4 Global Positioning System (GPS)

Due to the technological improvements, positioning systems have a very unique outstanding prominence and application to reality (Balzano, Formisano & Gaudino, 2017). The Global Positioning System (GPS) is a radio navigation system, which is based in outer space (outside earth). It is a global navigation satellite system, which provides information on both geographical location and time to GPS receptors anywhere on earth as long as there is an uninterrupted line of communication to various GPS sub-stations (Wikipedia, 2017).GPS services are now utilized in mobile applications that are related to health; tracking land-use regression and airpollution

(Minet, Gehr & Hatzopoulou, 2017), education (Hu et al. 2012) and tourism (Yang & Hsu, 2016).Presently, almost all mobile applications make use of GPS functionalities.

3.4.1 Geo-location

Geo-location simply means identifying the geographic location of an individual or a mobile/computing device through different data collection mechanisms, especially through internal GPS devices to determine the exact location (developers.google.com, 2017). Geo-location technology enables individuals to track and locate other individuals or objects at any time regardless of their location, mostly in cases of rescue and emergency (Cheung, 2014).This technology uses the GPS technology embedded in Smartphones to determine the location of the user (Bozzon et al. 2011).
Geo-location technology is very important for location-based tourism mobile applications because it provides tourists with a better tour experience as it readily gives them access to the information they need anywhere and at any time (Shi et al., 2010).

3.5Emergency SMS and Messaging Services

Safety is an essential requirement for the wellbeing of humans because unpredicted and sudden events that present a risk to a person's life, property, health or environment can happen at any time (Cabo et al., 2014).Mobile application technology that supports Text Messaging Interventions (TMI) continue to evolve as mobile technology further develops (Iribarren et al., 2017). The SMS-based active tracking is a lean and non-intrusive approach that can be applied to different mobile network architectures. It is a new technology that is rapidly growing and has a very diverse applicability (Ficek et al., 2013). In the mobile application environment, many mobile applications developers are beginning to adopt this feature to further improve and enhance the usability of their applications in different sectors.

3.6 Navigation (Path Finding)

Mobile applications with street navigation features have recently been introduced for use on mobile phone devices. These applications use integrated Global Positioning System (GPS) as the input for indicating and determining the location (Giang, Hans & Hoilund, 2010). One of the most important aspects of tourism is transportation, i.e. tourists moving and navigating from a particular place of interest to another. In

tourism, navigation involves obtaining the route and transit information, finding out how to reach the desired destination as well as having a visual representation of the route in a user-friendly and easy-to-understand manner (Candra, Soraya & Rudy, 2017).

3.7 GPS Mobile Application for Tourism

The use of mobile applications is becoming more popular especially in fields such as tourism and because they rely on information from multiple inputs such as Compass and GPS (Bernaschina et al., 2017). Transportation is a very important aspect that supports the implementation of some economic activities in tourism(Buana et al., 2016). This makes navigation a key feature in GPS-enabled mobile applications for tourism. Also, they use location-based services to provide tourists with the needed information about places of interests, which also serve a great deal when it comes to tourism.

The combination and implementation of all these aspects into one mobile application will help to develop a very useful mobile application for tourists.Finally, the above stated frameworks will all be implemented to develop a mobile application for tourists visiting the Turkish Republic of Northern Cyprus.

CHAPTER 4
SYSTEM DEVELOPMENT

This chapter gives a detailed explanation of the software and tools to be used in the development of the mobile applications. The development was done in accordance to the Software Development Life Cycle's (SDLC) Waterfall Model.

Software Development Life Cycle (SDLC): SDLC is a conceptual development model that is used to describe the processes/stages involved in the development of projects in information systems and project management. The stages of SDLC waterfall model are shown below.

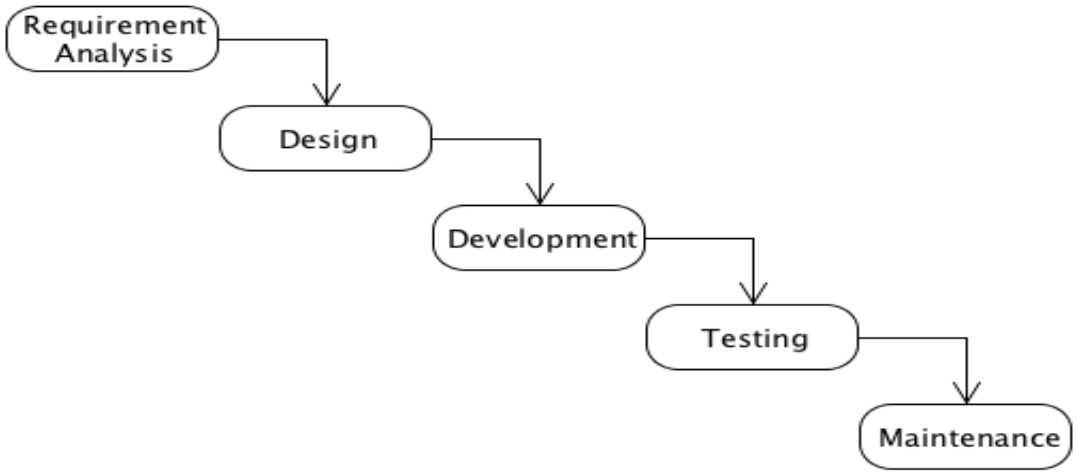

Figure 4.1: SDLC waterfall model(Bernaschina et al., 2017)

4.1 Stage 1: Requirement Analysis

In this stage of the development, the requirements are clearly defined. These are both the user functional and software requirements, which are needed in order to facilitate the development. For this application, both the user functional and software requirements are clearly defined. Feasibility studies are also carried out to determine whether the requirements can be achieved or not. The user functional requirements are presented in the form of a Use-Case diagram for easier understanding.

4.1.1 Functional Requirements

The Use Case diagram above depicts the functionalities that the user of the proposed application can carry out while using the application. Each Use Case in the diagram represents a unique functionality, which the user will be able to execute when using the application.

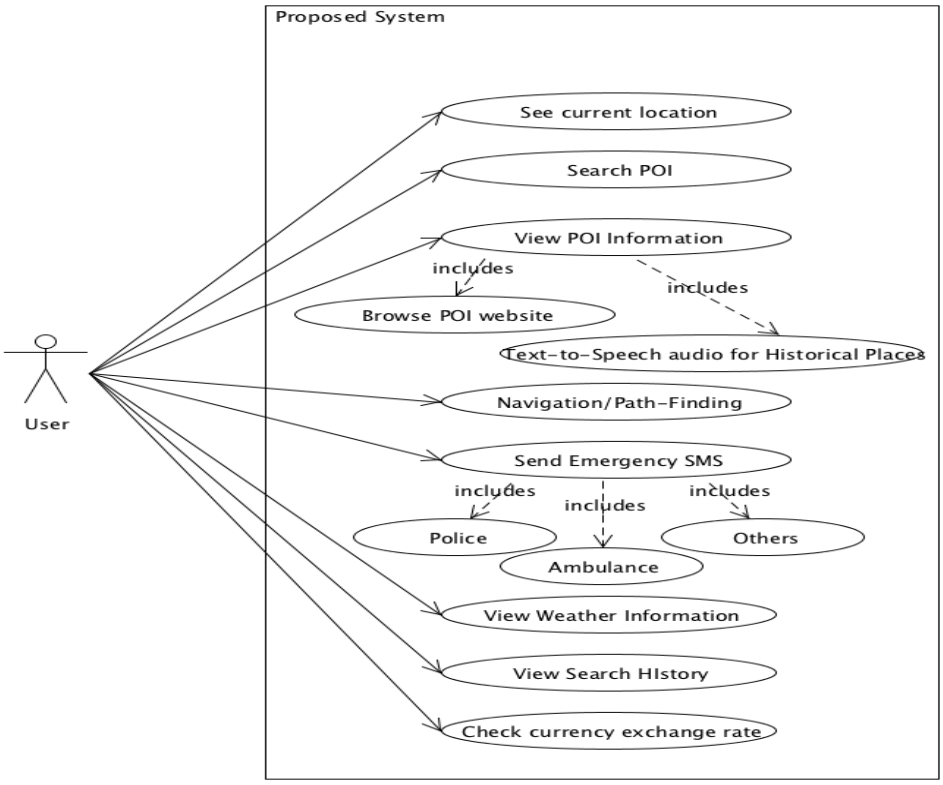

Figure 4.2: Functional requirements of the proposed application

4.1.2 Software Requirements

The following computer software will be used in the development and documentation of this mobile application:

- ***Android Software Development Kit (SDK):*** Used to develop the application. It also includes development tools such as debuggers, libraries and emulators.
- ***Android Studio IDE:*** Computer application used for creating the project codes.
- ***Android Virtual Device:*** A mobile virtual emulator that will be used to preview and show how the developed application runs.
- ***Mac OS X Sierra:*** The operating system that will be used in the development because all the software required for the development are installed in it.

- ***UMLet:*** Used for drawing the UML diagrams and architectural diagrams in the thesis documentation.
- ***SQLite:*** To be used as the embedded database for the application. It will be used to store, retrieve and share information.
- ***Google Maps API:***Used to code the map-based functions of the application.
- ***Google Directions API:***Used to code the path-finding functions of the application.
- ***Google Places API*****:** Used to get information of POIs by the application.
- ***Open Weather API:*** Used to get weather information.
- ***Currency Rates API:*** Used to get the currency exchange rates.
- ***Ivona:*** Used for the text-to-speech audio features of the application.
- ***Microsoft Word 2016:***Used to create and edit thesis documentation document.

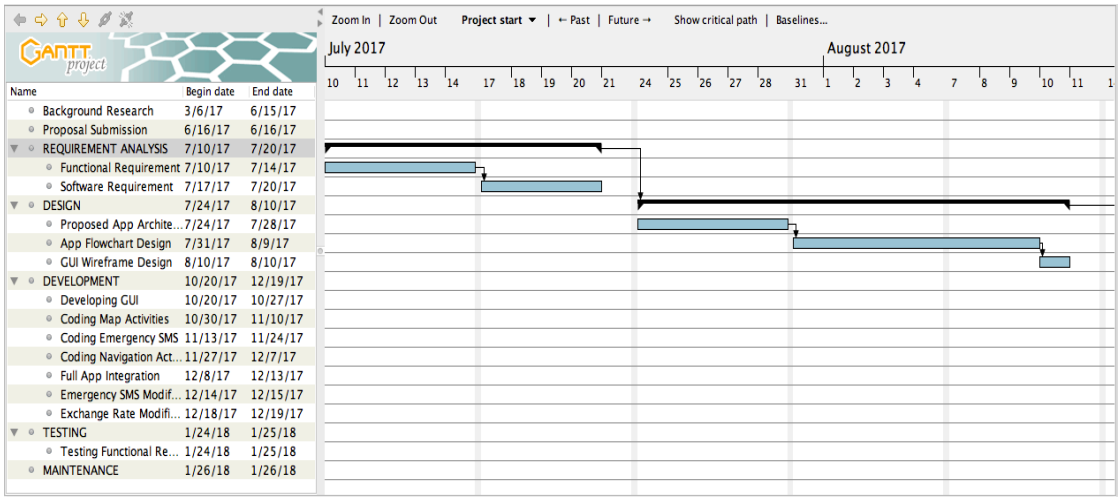

Figure 4.3: Gantt chart for requirement analysis stage

4.2 Stage 2: Design

After the requirements analysis, the next stage is the design stage. In this stage, the design of the proposed system is conceptualized based on the requirements gathered. This is also the stage where the design document of the application is prepared.

4.2.1 Architecture of Android Mobile Applications

The various components of the android mobile applications are described below:

- ***User:***User refers to the individual who installs, runs and uses the proposed mobile application on their android mobile device.

- ***Front End:***Front End refers to the Graphical User Interface (GUI) of the proposed application. This includes GUI design elements such as textboxes, texts and buttons, which the user will use to interact with the application.
- ***Java Logic:*** Java Logic refer to the class files that contain the codes that communicates with the other components of the application, which means that it contains the procedures and methods to meet the functional requirements of the proposed application.
- ***Services:***Services refer to the components that carryout background tasks that do not require human interaction. In the proposed application, this component carries out various tasks such as fetching the location of the device using GPS, searching for requested POIs etc.
- ***Receivers:***Receivers refer to the components that listen and receive the results of long background tasks carried out by the Services components. In the proposed application, this component receives the GPS co-ordinates from the Services and determines the location of the device.
- ***SQLite:*** SQLite is a relational database that is locally available on android devices. Their libraries are provided by Android. In the proposed application, SQLite is used to store information such as the list of places previously searched by the user, that is the 'Search History'
- ***Location Manager:*** Location Manager fetches the location of the device using both network provider information andGPS. GPS usually the most widely used because gives more accurate result when determining a location.
- ***Connectivity Status Manager:***This notifies the application of changes in connectivity, which is from Wi-Fi to network, vice versa.
- ***Google Maps:***This application used Google Maps API v2 for Android and when the API is used, it fetches results from the Google Maps engine as well as place markers on the map to indicate the various locations of the POIs searched.
- ***PHP:***PHP are scripts that perform the task of interacting with the database deployed on the server, thereby generating a result on the app.
- ***Database:***Database refers to the MySQL database deployed on the server. It stores the data of the application, such as search history.

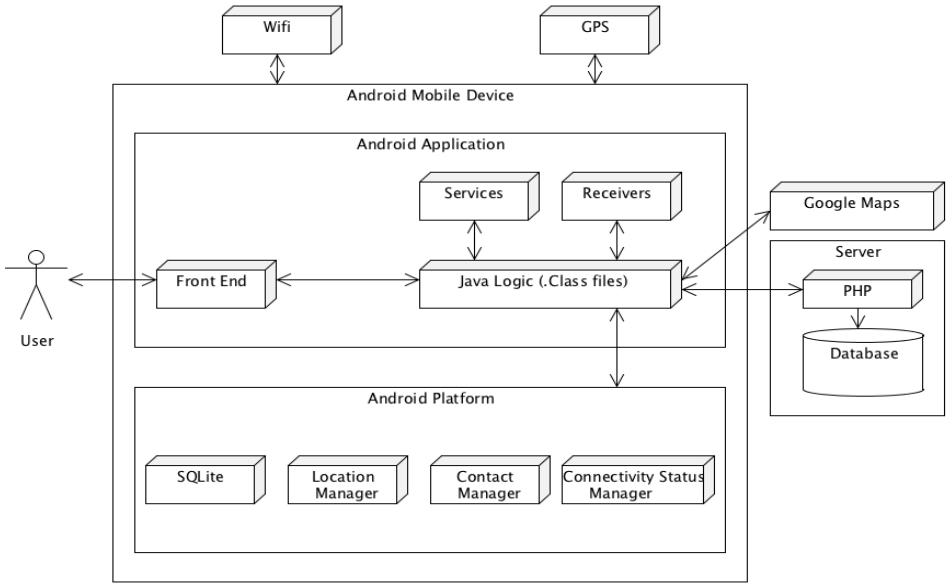

Figure 4.4: Architecture of Android mobile applications

4.2.2 Proposed System Architecture

The architecture of the proposed system is illustrated logically in the image above. The user will interact with the application, which will be installed on the mobile device in order to gain access to the tourism guide information. The Internet helps retrieve the information from the web service. The web services offer accurate and reliable information based on the user's current location or the user's chosen selection. The architecture of the proposed system will provide a platform that will help provide updated and accurate information to the user when using the proposed mobile application.

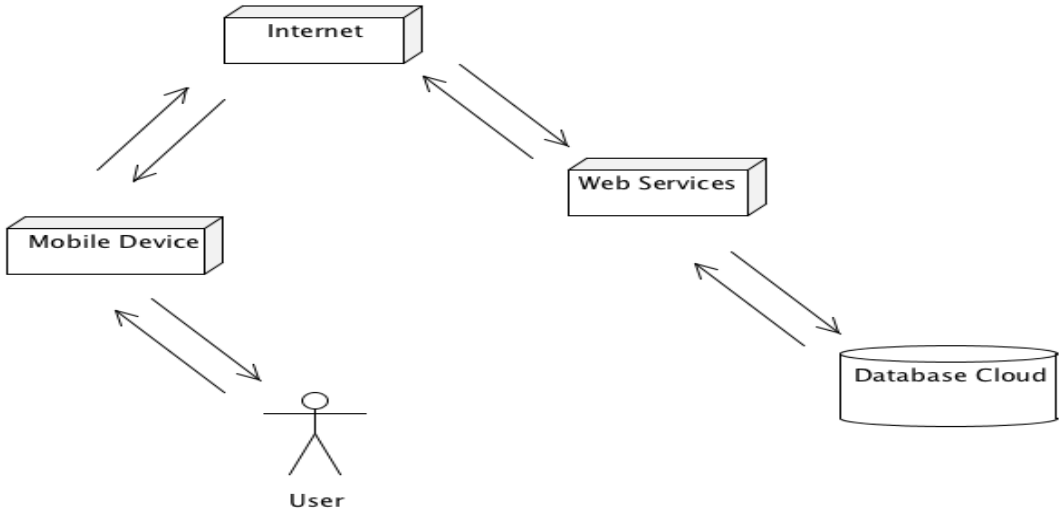

Figure 4.5: Proposed system architecture

4.2.3 Application Flowchart

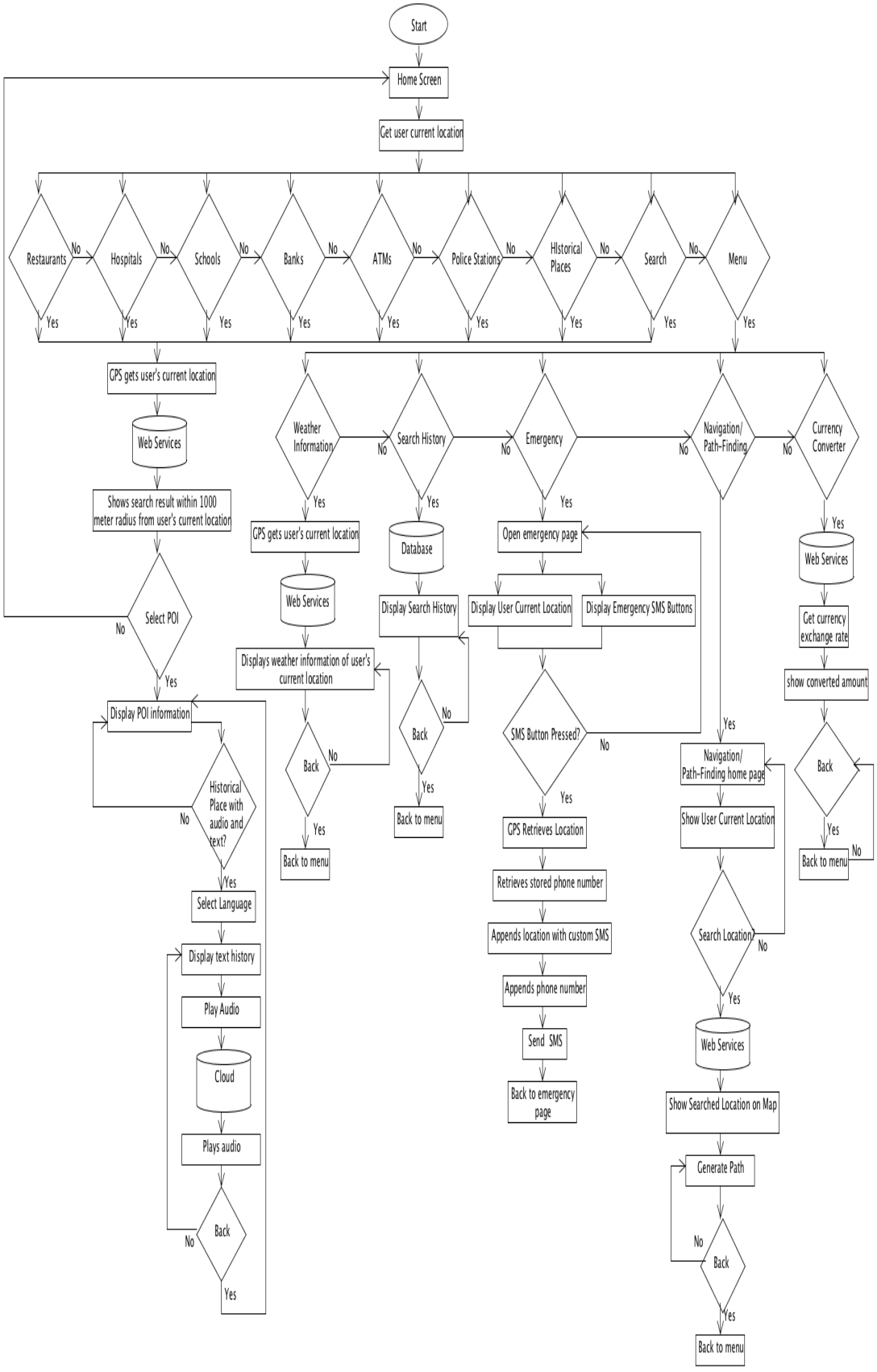

Figure 4.6: Shows the flowchart of the entire application

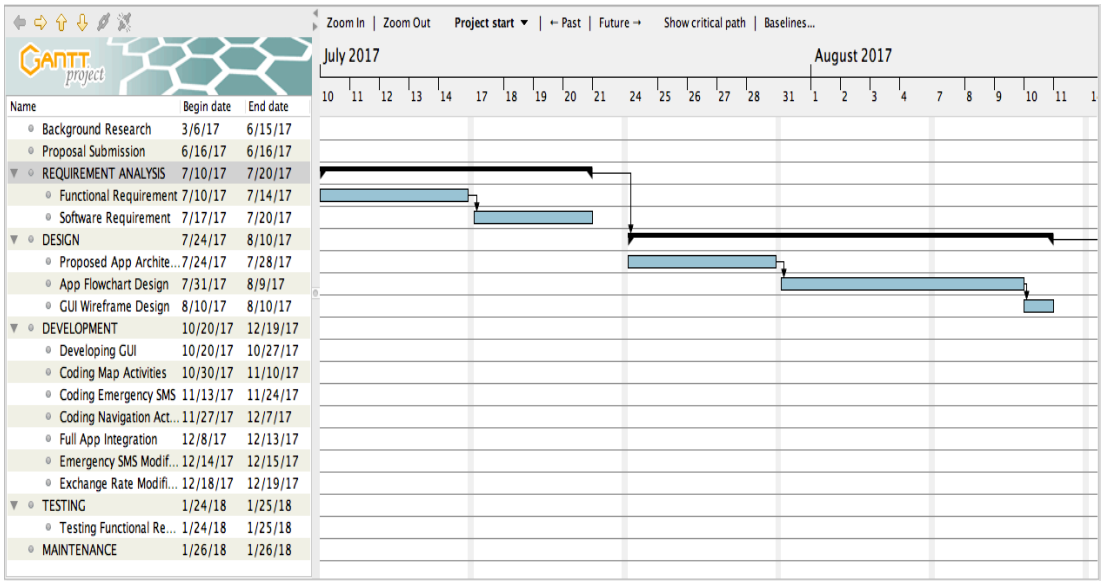

Figure 4.7: Gantt chart for the design stage

4.3 Stage 3:Development

In this stage, the programming and coding of the functionalities and features of the application is performed. Both the coding aspect and the user interface developments are carried out in this stage.

4.3.1 Android Operating System

Android Operating System is an open source mobile operating system developed by an American company called Google. It is based on Linux Kernel. Android Operating System is currently one of the two most used mobile operating systems in the world. Android operating system is designed to run on mobile devices such as smartphones and tablet PCs. The mobile application developed in this study is an Android mobile application.

Over the last couple of years, Android operating system is the most popular and most commonly used mobile operating systems. Figure 4.1 shows that Android operating system has become more popular and the demand for it has increased tremendously from 2009 to 2016 years in market share based on worldwide smartphone sales to end users.

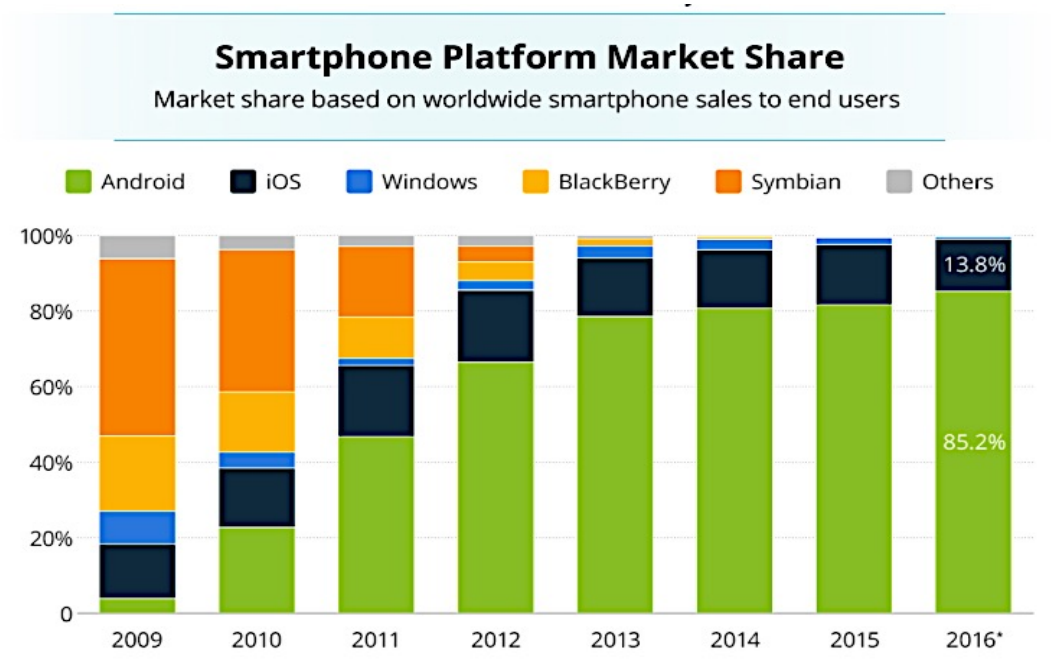

Figure 4.8: Worldwide smartphone operating system market share (Dunn, 2016)

According to the figure above, Android operating system has had a very significant growth compared to the other operating systems. In 2016, Android smartphones accounted for 85.2% of the total sales to end users while iOS smartphone accounted for 13.8% of total sales to end users. The other operating systems namely Windows, Blackberry and Symbian accounted for the remaining 1% combined.

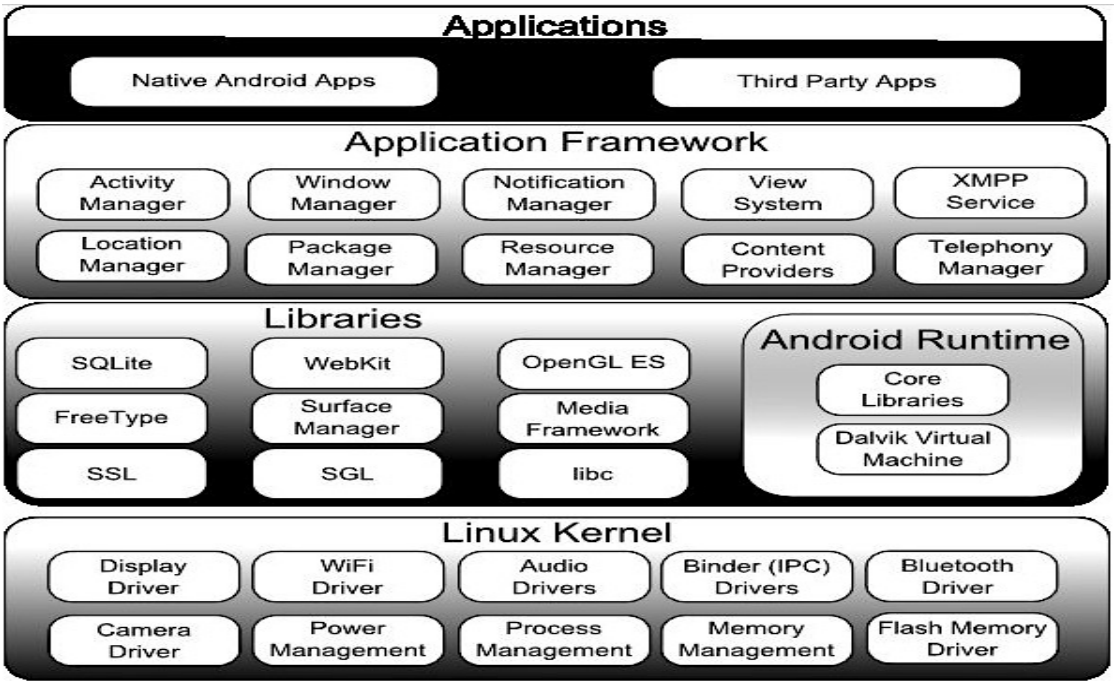

Fig 4.9: Architecture of Android operating system (Vogel, 2016)

As shown in the figure above, Android Operating Systems is divided into four layers and five segments as explained below.

- ***Linux Kernel:***This is the layer at the bottom of the Android OS architecture. The other layers depend on the Linux Kernel layer in order to interact with the hardware. This layer performs the most important functionalities such as Power, Memory and Process Management as well as contains the hardware drivers for features such as display, camera, Wi-Fi and Bluetooth.
- ***Libraries:*** The layer above the Linux Kernel layer. The functionalities of this layer allow the android device to store and retrieve different types of data. This layer contains useful libraries such as (i) SQLite used as a repository for storing and sharing data and is very useful for database management, (ii) WebKit, which is a web browser engine that is used to display contents retrieved from the internet, (iii) OpenGL, which is a Java interface that is used to render 2D and 3D graphic on the display screen.
- ***Android Runtime:*** This is the third segment, also present in the Libraries Layer.It contains the Dalvik Virtual Machine (DVM), which is exactly like JVM and is used to run android applications, provides high performance and consumes less memory. Android Runtime also provides the core libraries that enable developers to develop Android applications using the standard programming language.
- ***Application Framework:***This layer contains the files readily available for a developer to use. It contains APIs such as Resource Manager, Telephony Services and Activity Manager etc. that an application can interact and use directly.
- ***Applications:*** This is the layer at the top of the architecture. Developed android applications are installed in this layer.

However, when developing a mobile application, developers usually work with the top two layers only. As a result of this, the application to be developed in this study will be based on the Android operating system.

4.3.1.1 Advantages of Android Operating System

As illustrated in Figure 4.2 above, Android OS has gained a wide user acceptance all over the world because of its advantages to users in terms of usability. Some of the most notable advantages of Android OS include:

- ***Cost Efficiency:***Android OS is an open source OS, which makes it very cost efficient because it provides highly usability and better performance at a lower cost when compared to other operating systems. There are a lot of free applications in the Google Play Store as well for users.
- ***Supports Customization:*** Android OS supports customization. Because the Android framework is open source, it enables individuals and organizations to customize or tweak different aspects of the OS according to their preferences.
- ***Large Number of Applications:*** Android OS enables anyone to gain access and use of many free applications that are available in the Google Play Store. Another important point here is that the OS gives users the freedom to install and use applications from third party users.
- ***Multitasking:*** Android OS can effectively run different applications at the same time, on a single device.
- ***Supports Additional Hardware:*** Additional external hardware can be easily connected to an android device and it will work perfectly.

4.3.2 System Technology

For the purpose of this study, a set of android development technologies was used. Theseare:

4.3.2.1 Java Development Kit (JDK)

Java Development Kit (JDK) is a development environment for Java only, which is used to develop Java applications. JDK components include Java Runtime Environment (JRE), an archiver (javac), an interpreter (java), and a documentation compiler (javadoc) among others. Furthermore, JDKhas its own Java Virtual Machine (JVM), which is used to run, test and ultimately conclude the development of an application.

4.3.2.2 Android Studio Integrated Development Environment (IDE)

Google developed Android Studio and it is the official Integrated Development Environment (IDE) for Android. Android Studio was specifically built for developing Android applications only and it provides an environment to help build high-performance Android applications of the highest quality for all Android devices. Some key features of Android Studio include the Intelligent Code Editor, Instant Run. Fast Emulator and it is built and optimized for developing applications for all Android devices.

Android Studio IDE gives developers the ability to create new projects, code and run, debug and design the User Interface for the application. It uses Android API framework to add application packages and to export and share the apk file when the application development is complete.

4.3.3 Database

The system will use a database to in order to store and retrieve certain information such as the phone numbers of other family members. In this study, the system will use the following database:

- ***SQLite:***SQLite is a relational database management system that is tightly integrated in the application's end program and it is not a client-server database management tool. SQLite is one of the best database software for local storage within the application and it is the most widely used database engine.

4.3.4 Programming Language

When developing mobile applications, there are different programming languages that are used for the development. For instance, Object C is used to develop iOS mobile applications, Java is used to develop Android mobile applications and C# is used to develop Windows mobile applications.

However, for this study, Java programming language will be used to develop the Android mobile application.

4.3.5Graphical User Interface (GUI)

The proposed application will have a very user-friendly user and intuitive GUI design, which will be very easy for users to understand, thereby increasing the application's

overall usability.The main advantage of a user-friendly GUI is that it increases the popularity of an application/system and also helps derive a greater user satisfaction because it is the platform with which the user interacts and uses the application.

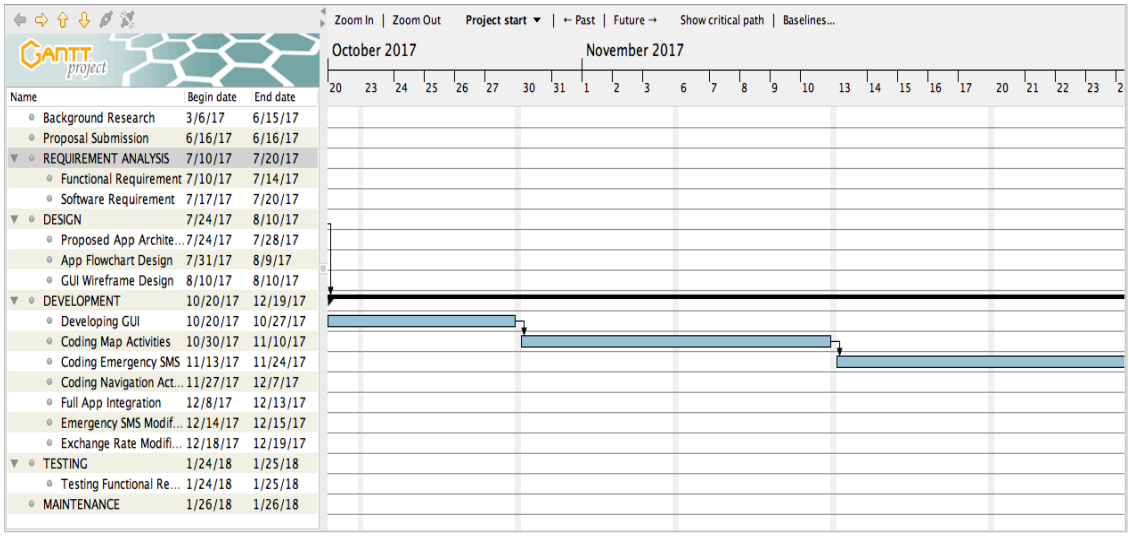

Figure 4.10: Gantt chart for development stage I

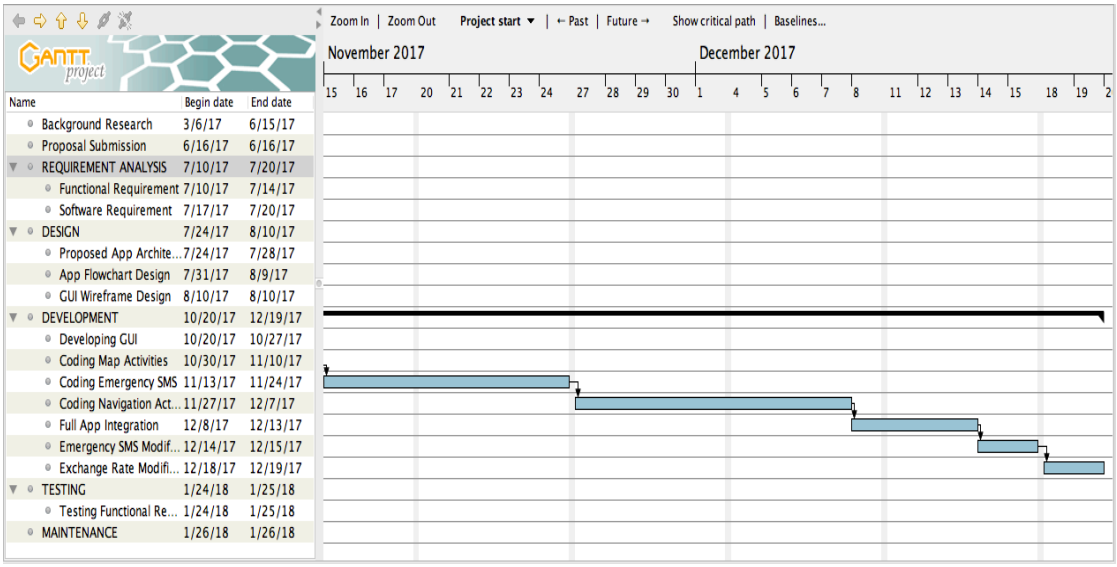

Figure 4.11: Gantt chart for development stage II

4.4 Stage 4: Testing

In this study, Acceptance Testing will be carried out to ensure that the all the components of the developed applications are functioning properly as a whole. Acceptance Testing is defined as:

- ***Acceptance Testing****:* refers to testing done at the end of the development, usually to ensure that the requirements have been achieved. This type of

testing is performed by the proposed users of the application. This will help to further check the functionality and reliability of the developed application.

Acceptance Testing is usually performed by the proposed users of a system/application so as to ensure whether the proposed application has meet all the required functionalities or not.

4.4.1 Testing Process

To carry out the testing phase, 30 students (participants) newly admitted into the Near East University were identified randomly and the volunteered to use the proposed application. They were required to use the developed application, review the performance of the identified functional requirements and give their verdicts on the proposed application, that is, according to the functional requirements of the proposed application.

4.4.2 Testing Results

- The participants were required to test the performance of the application and see whether their current location can be identified successfully and accurately.

Test Unit	**Unit 1:** View User Current Location			
Test Type	**Acceptance Testing**			
Test Objective	Test whether user's current location is displayed successfully.			
Test Action	**Expected Result**	**Result Achieved**	**Successful or Unsuccessful**	**Comment**
Identify and show user's current location	The current location of the user should be identified and displayed	The current location of the user is identified and displayed.	Successful: 28 Unsuccessful: 2	The location of the user was successfully identified and displayed.

Table4.1: User current location (acceptance testing)

- The participants were required to test the performance of the application and see whether they can successfully conduct searches on Places of Interest.

Test Unit	**Unit 2:** Search Places of interest			
Test Type	**Acceptance Testing**			
Test Objective	Test whether user can search places of Interest successfully			
Test Action	**Expected Result**	**Result Achieved**	**Successful or Unsuccessful**	**Comment**
Test whether can search places of interest	User should be able to search place of interest and see the results.	The user was able to successfully search and see the results of the search.	Successful: 30 Unsuccessful: 0	The places of interest search was successful as the results displayed where accurate.

Table 4.2: Search places of interest (acceptance testing)

- The participants were required to test the performance of the application and see whether they can successfully view information on Places of Interest.

Test Unit	**Unit 3:** View Information on Places of Interest			
Test Type	**Acceptance Testing**			
Test Objective	Test whether users can view POI information successfully.			
Test Action	**Expected Result**	**Result Achieved**	**Successful or Unsuccessful**	**Comment**
Test if information on POI can be viewed	User's should be able to view the information of a selected POI.	User was able to view the information of the POI selected.	Successful: 30 Unsuccessful: 0	The information of places of interest are can be viewed successfully.

Table 4.3: View information on places of interest (acceptance testing)

- The participants were required to test the performance of the application and see whether a path can successfully be generated from their current location to a selected destination.

Test Unit	**Unit 4: Navigation/Path-Finding**			
Test Type	**Acceptance Testing**			
Test Objective	Test whether navigation path can be generated successfully.			
Test Action	**Expected Result**	**Result Achieved**	**Successful or unsuccessful**	**Comment**
Whether navigation path can be generated successfully for the user.	Navigation path should be generated for the user.	The navigation/path was generated for the user after a search was conducted.	Successful: 27 Unsuccessful: 3	Navigation/path was successfully generated for the user.

Table 4.4: Navigation/path-finding (acceptance testing)

- The participants were required to test the performance of the application and see whether they can successfully send an Emergency SMS or not.

Test Unit	**Unit 5:** Send Emergency SMS			
Test Type	**Acceptance Testing**			
Test Objective	Test whether user can send Emergency SMS successfully.			
Test Action	**Expected Result**	**Result Achieved**	**Successful or Unsuccessful**	**Comment**
Test whether user can send emergency SMS successfully.	Users are expected to be able to send emergency SMS	The user was able to send Emergency SMS.	Successful: 30 Unsuccessful: 0	The user was able to send emergency SMS successfully.

Table 4.5: Send emergency SMS (acceptance testing)

- The participants were required to test the performance of the application and see whether they can successfully view the current weather information.

Test Unit	**Unit 6:** View Weather Information			
Test Type	**Acceptance Testing**			
Test Objective	Test whether users can check weather information successfully.			
Test Action	**Expected Result**	**Result Achieved**	**Successful or Unsuccessful**	**Comment**
To check if user can check weather information.	User is expected to be able to see the weather information.	The user was able to check weather information successfully	Successful: 30 Unsuccessful: 0	The user was able to check the weather information successfully

Table 4.6: View weather information (acceptance testing)

- The participants were required to test the performance of the application and see whether they can successfully view their search history.

Test Unit	**Unit 7:** View Search History			
Test Type	**Acceptance Testing**			
Test Objective	Test whether users can view stored search history successfully.			
Test Action	**Expected Result**	**Result Achieved**	**Successful or Unsuccessful**	**Comment**
Test if user can view searched history stored	Users is expected to be able to view search history	User was able to view a list of places searched earlier on the application.	Successful: 30 Unsuccessful: 0	User was able to view the search history of places searched on the application

Table 4.7: Viewsearch history(acceptance testing)

- The participants were required to test the performance of the application and see whether they can successfully check the current exchange rate of currencies.

Test Unit	**Unit 8:** Check Currency Exchange Rate			
Test Type	**Acceptance Testing**			
Test Objective	Test whether users can convert currency exchange rate successfully.			
Test Action	**Expected Result**	**Result Achieved**	**Successful or Unsuccessful**	**Comment**
Test if user can check the current exchange rate of foreign currencies	Users is expected to be able to check the exchange rate of currencies	User was able to check the exchange rate of foreign currencies online	Successful: 30 Unsuccessful:0	User was able to check the exchange rate of foreign currencies online successfully.

Table 4.8: Currency exchange rate converter (acceptance testing)

Due to the results obtained after the testing stage was concluded, the developed application is considered to be a success. This is because all the requirements that were tested by the participants functioned successfully except in few cases, which are the View User CurrentLocation which had (successful: 28, unsuccessful: 2) participants and Navigation/Path-Finding which also had (successful: 27, unsuccessful: 3). The high number of success and the insignificant number of unsuccessful result makes the proposed application a success.

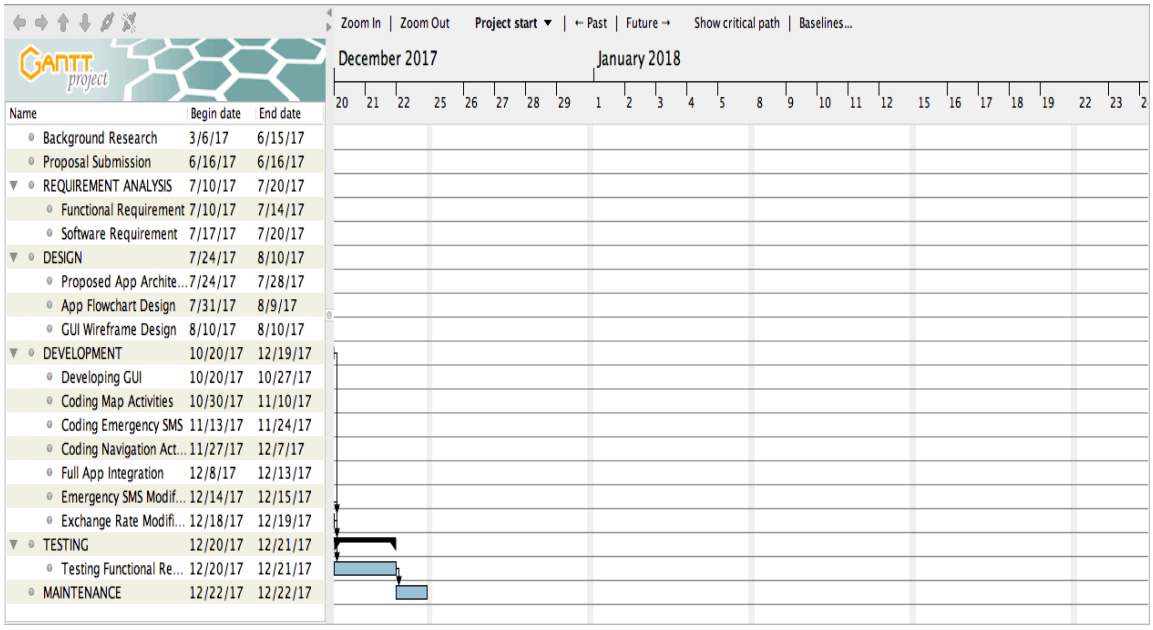

Figure 4.12: Gantt chart for testing stage

4.5 Stage 5: Maintenance

The maintenance of the developed application will have to be carried out periodically. The maintenance to be performed may include updates of features, optimization upgrades etc.

CHAPTER 5
SYSTEM IMPLEMENTATION

This chapter reviews the developed application and gives a vividly explains the application and its functionalities. Also, the screenshots of the developed applications GUI are included in this chapter to further explain to the prospective users how the application fully functions.

5.1 Overviewof Developed Application

The developed application is called “Tour TRNC”. It is a mobile application for tourists. The application has GPS functionalities and is developed to help tourist visiting the TRNC to know their current location, search POIs, see location and information of POIs, navigate/find path to the desired POIs, offers a text-to-speech audio ofthe brief history of historical places for the user and also provides the tourists with SMS functionalities that will enable them to send their location to the relevant authorities in cases of emergency.

5.2 The Developed Application

The GUI of the developed application will be used to explain the features and functionalities of the developed mobile application in details. The workings of the developed application will also be illustrated, so as to give the users a detailed overview of the overall functionalities of the developed application.

5.3 The GUI Screenshots

Upon completing the development of the application, it was installed in a Huawei Enjoy 5s (TAG-AL00) smartphone, which runs on Android Lollipop, version 5.1. After successful installation and running the application on the mobile device, the following screenshots were obtained using the mobile device.

5.3.1 The Splash/Launch Screen

The Splash/Launch Screen is usually the first screen that pops up when the user clicks on the application's icon. It gives the user the impression that the application is getting ready for use while performing some background tasks to fully initialize application for usage by the user.

Figure 5.1: Splash/Launch screen

5.3.2 The Home Screen

After the splash screen has disappeared, the Home Screen appears. The Home Screen shows the current location of the user. The buttons on the screen allows the user to perform a quick search conducted on a 1000 meters radius from the user's current location. The Home Screen also has a search bar at the top, where users can search for specific POIs as well as a menu button on the top left side of the Home Screen.

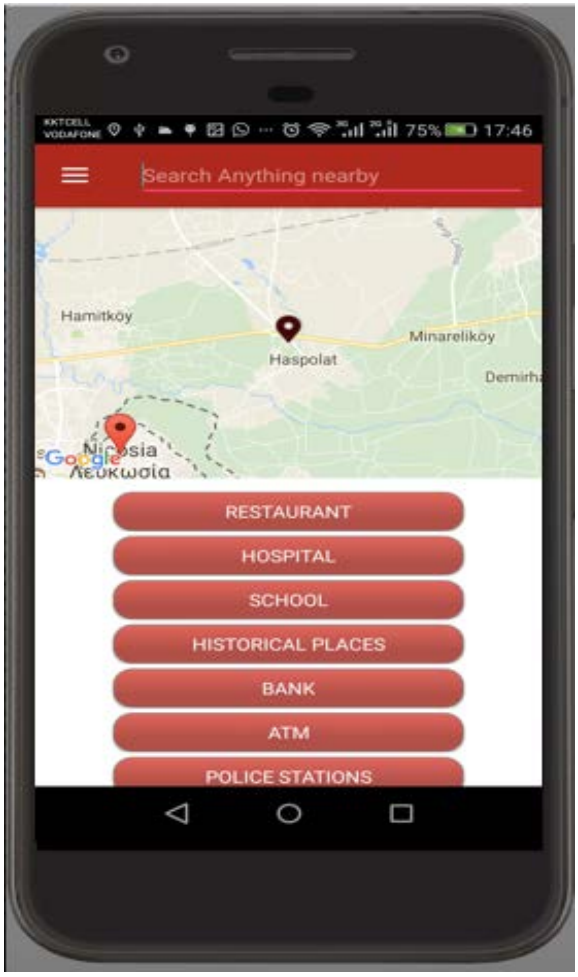

Figure 5.2: Home screen

5.3.2.1 The Menu

When the user clicks the Menu icon located on the top left side of the Home Screen, the Menu list sides in front of the Home Screen from the left-hand side. The Menu presents the user with the additional functionalities that can be performed while using the application.

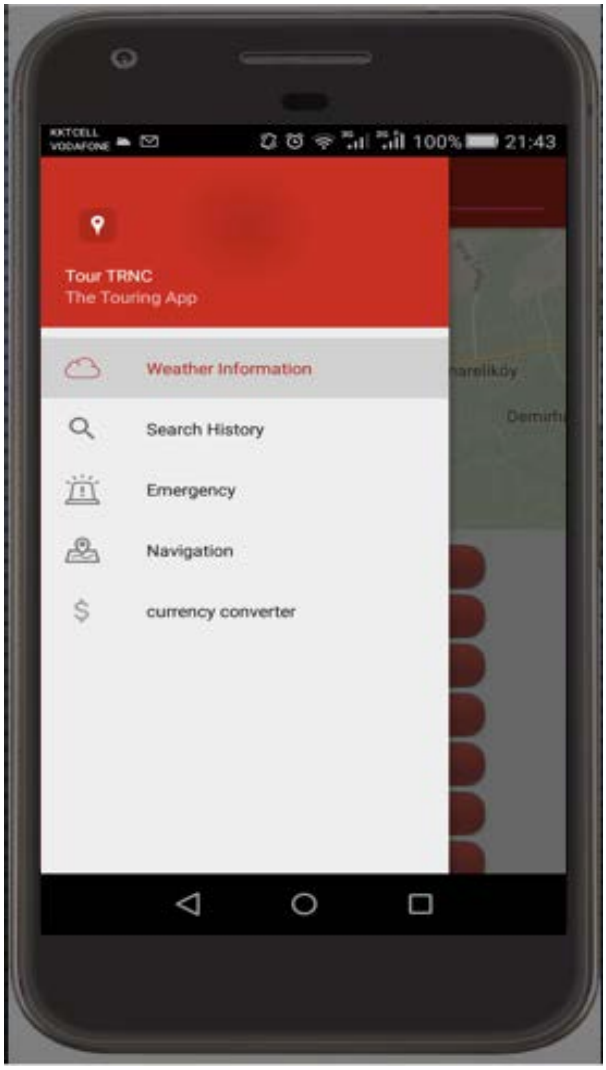

Figure 5.3: Menu

The features in the menu section are:

- ***Weather Information:***The feature gives the user the opportunity to know the weather information (temperature and weather condition) of the user's current location.

- ***Search History:***This feature stores a list of all the previous places searched by the user. Usually, tourists may not be able to recall the names of all the places they have searched due to different reasons e.g. language differences. Therefore, this aims to serve as a reference feature.
- ***Emergency:***This feature gives the user the opportunity to send emergency SMS to emergency service providers (Police and Ambulance). This feature is useful to the user in times of distress, security and when general help is required.
- ***Navigation (Path-Finding):***One important aspect of tourism is transportation. Often times tourists usually prefer to explore locations themselves rather than being on official organized tours. Therefore, this feature gives users the chance to locate different areas and subsequently explore them on their own.
- ***Currency Converter:***This functionality is very important to tourists and tourism in general. The currency converter feature enables the user to check the exchange rate of their home currency against the Turkish Lira (the legal tender in the TRNC). This feature is very important as it will help the users to organize their expenses and make life in the TRNC a lot easier.

5.3.2.2 Search Function

When the Search Bar is clicked on the Home Screen, the keypad appears so that the user can type in the name of a desired POI and search. This functionality gives the user the advantage of searching any POI desires regardless of the category.

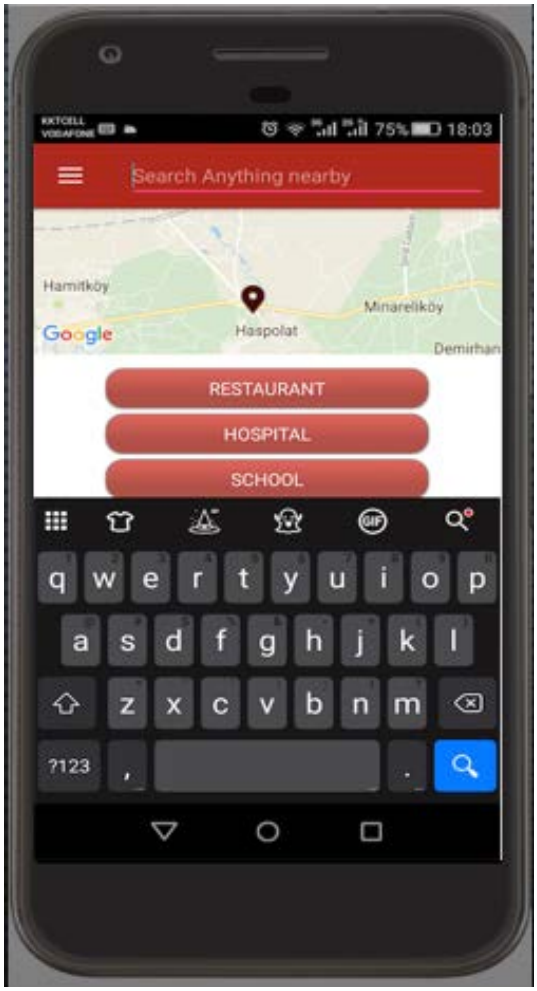

Figure 5.4: Search function on the home screen

.

5.3.3 Search Result

When a search is conducted, the results of the search are presented to the user in the form of a list based on the search category. It presents the user with images and names of the POIs as well as the “View” buttons, which will take the user to the information page of the selected POI. The search result page display mode is the same for all search results regardless of search category.

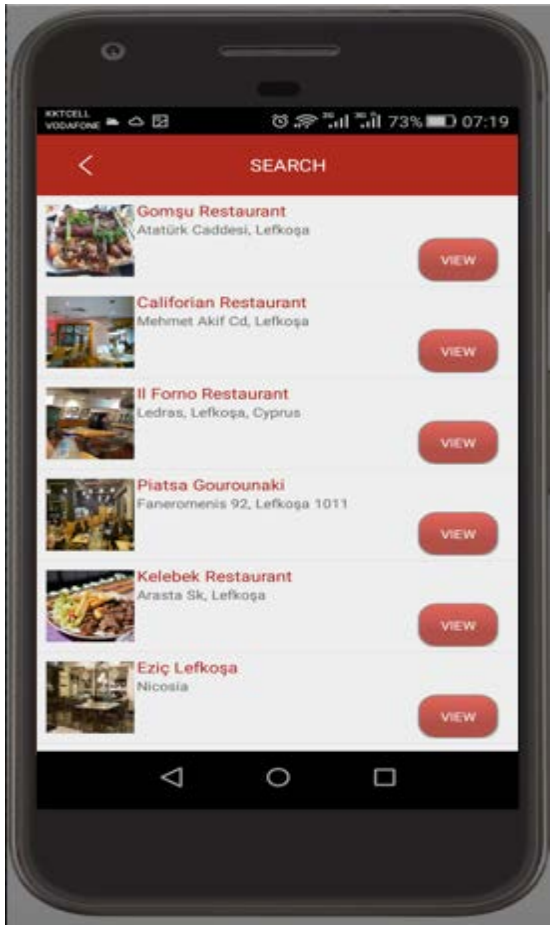

Figure 5.5: Search result page for all the POIs searched

5.3.4 POI Information Page

The page gives the user the necessary information of the POI selected from the Search Result Page. The information given in this page are the address, phone number and website address (if any) of a POI. It enables the user to surf the website of a POI by simply clicking on the website icon, besides the call icon. This POI information page display mode is the same for all POIs, except for historical places with audio and text.

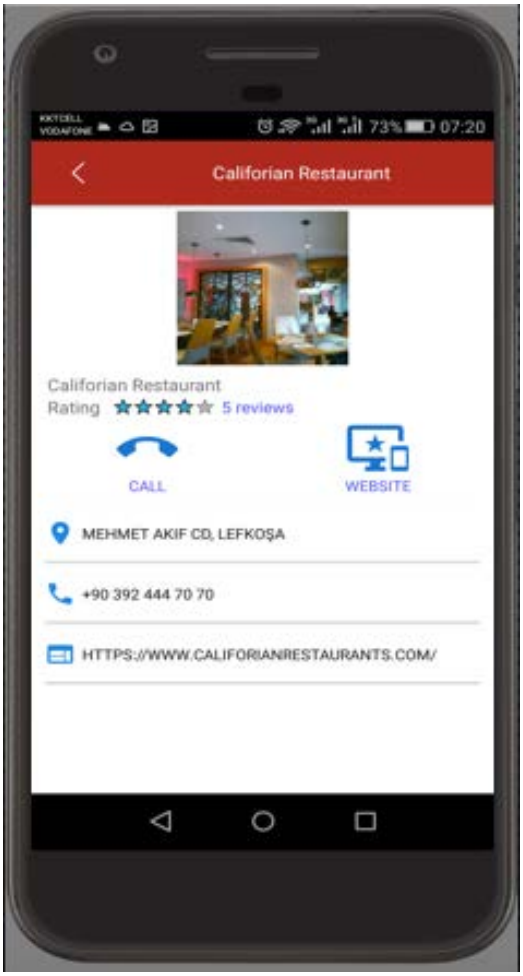

Figure 5.6: POI information page

5.3.5 Information Page for Historical Places without Audio and Text

Historical Places with audio and text history have slightly different information page. It has the same layout and information as all the rest.

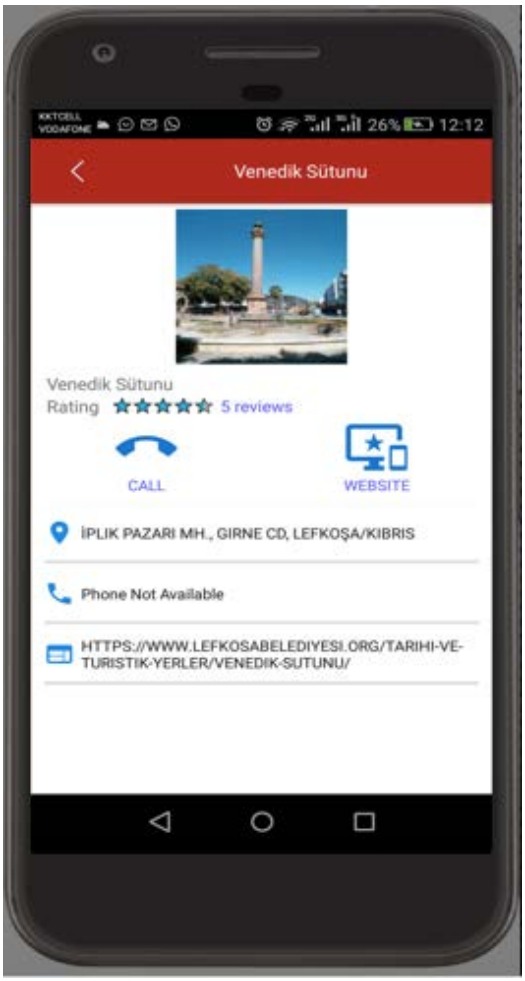

Figure 5.7: Information page for historical places without audio and text

5.3.6InformationPage for Historical Places with Audio and Text

Historical Places with audio and text history have slightly different information page. It has the same layout and information as all the rest. However, there is an added information button. The ‘History Text’ button gives the user a list of language options choose from. Each of the languages when selected enables the user to either read the history of the POI or listen to the text-to-speech audio of the history in the language.

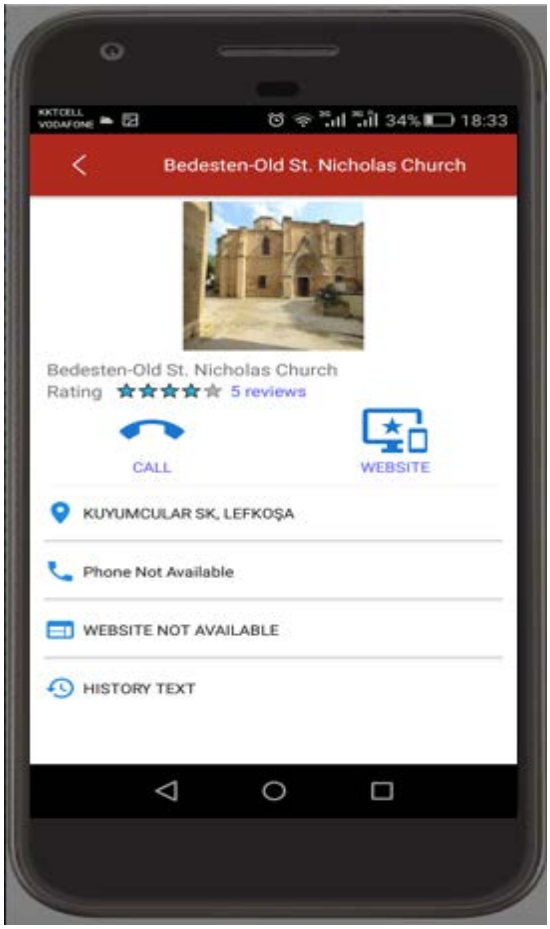

Figure 5.8: Information page for historical places with audio and text

5.3.7 Audio and Text History Language Options (Pop-Up)

When the user clicks the history text button from the information page, a pop-up appears with a list of languages (English, German, Italian and Spanish) for the user to select his/her preferred language, thereby providing an avenue to allow the user to further understand the story behind the historical POI.

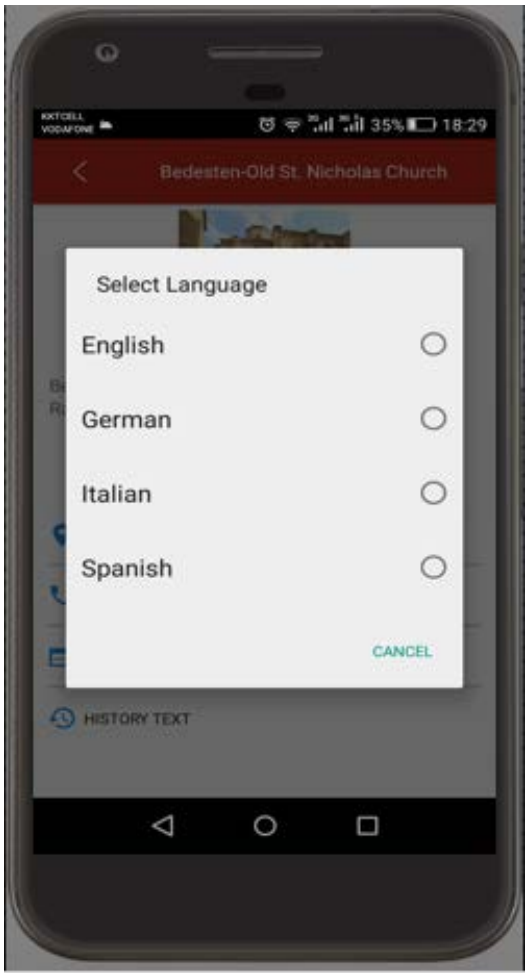

Figure 5.9: Audio and text history language options.

5.3.7.1Audio and TextHistory Page (English)

This is the audio and text history page of historical places. When the user clicks on English from the list of options in the pop-up menu, it takes the user to the English Language text and audio page. The text history for the selected POI is presented to the user as seen in the image above. A play button is available for the user should the user prefer to listen to the history instead of reading the text.

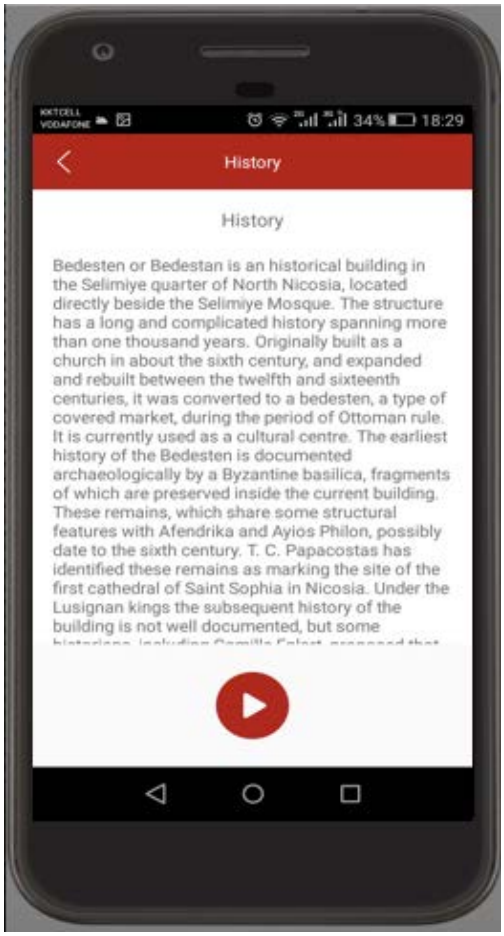

Figure 5.10: Audio and text page (english)

5.3.7.2 Audio and Text History Page (German)

This is the audio and text history page of historical places. When the user clicks on German from the list of options in the pop-up menu, it takes the user to the German Language text and audio page. The text history for the selected POI is presented to the user as seen in the image above. A play button is available for the user should the user prefer to listen to the history instead of reading the text.

Figure 5.11: Audio and text page (german).

5.3.7.3 Audio and Text History Page (Italian)

This is the audio and text history page of historical places. When the user clicks on Italian from the list of options in the pop-up menu, it takes the user to the Italian Language text and audio page. The text history for the selected POI is presented to the user as seen in the image above. A play button is available for the user should the user prefer to listen to the history instead of reading the text.

Figure 5.12: Audio and text page (italian).

5.3.7.4 Audio and Text History Page (Spanish)

This is the audio and text history page of historical places. When the user clicks on Spanish from the list of options in the pop-up menu, it takes the user to the Spanish Language text and audio page. The text history for the selected POI is presented to the user as seen in the image above. A play button is available for the user should the user prefer to listen to the history instead of reading the text.

Figure 5.13: Audio and text page (spanish)

5.3.8Emergency SMS

The Emergency SMS page shows the current location of the user as seen in the image above. Also on the page are 2 buttons that when pressed, automatically send an SMS message of the user's current location and a request for help to the corresponding service providers as stated on the buttons (i.e. Police and Ambulance). The map recalibrates automatically every time the user moves a distance of 20 meters.

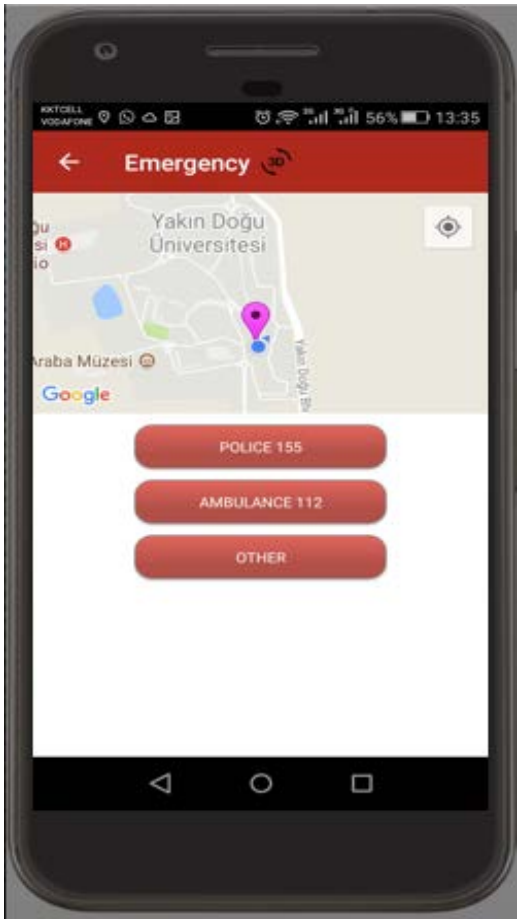

Figure 5.14: Emergency SMS page

5.3.8.1 Emergency SMS (Police)

When the user presses the Police button in Figure 5.14 above, a pop-up menu appears with a list of police (security-related) situations/cases. When the users presses the button that relates to the situation, It automatically sends the SMS together with a brief description of the user's situation, the user's current location (in url form) and the user's contact number.

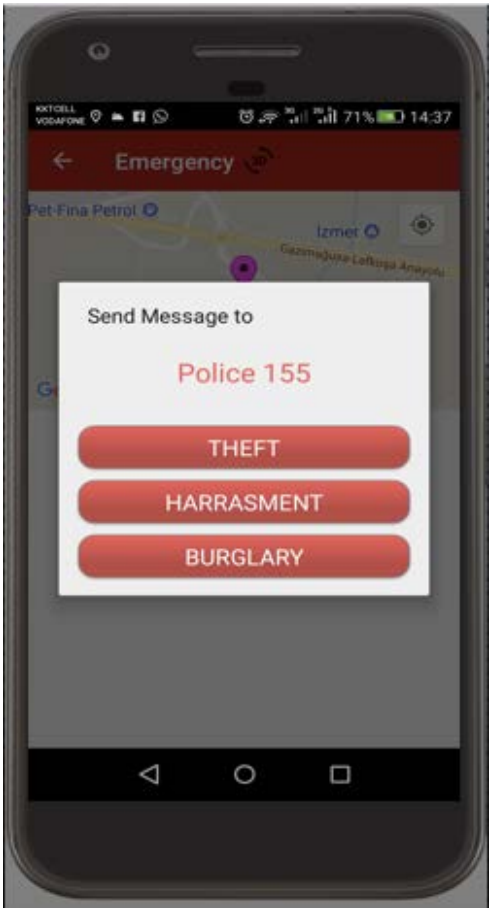

Figure 5.15: Shows theemergency SMS for police

5.3.8.2 Emergency SMS (Ambulance)

When the user presses the Police button in Figure 5.14 above, a pop-up menu appears with a list of ambulance (health- related) situations/cases. When the users presses the button that relates to the situation, It automatically sends the SMS together with a brief description of the user's situation, the user's current location (in URL form) and the user's contact number.

Figure 5.16: Shows the emergency SMS for ambulance

5.3.8.3Emergency SMS (Other)

The “Other Functionality” in the emergency SMS page will enable the user to compose and send an SMS message to either the Police or the Ambulance services directly from the application. The user may choose to use the functionality in case there are added information the emergency service provider may require to know before they arrive at the scene to provide the help needed. The user can use this feature by simple tapping on the text field provided and once the keypads appear, the user can start to compose the message. Once the message is composed, the user can click on any of the buttons above and the message will be sent to automatically to the emergency service providers.

Figure 5.17: Shows the other functionality

5.3.8.4 Sample of Emergency SMS Received

The image below shows a sample of how the Emergency SMS is delivered to the recipient after the user sends the message from the developed application. In the first sentence, the message clearly states the type of emergency situation. This is followed by a URL address, which when clicked, will display the user's current location (the location the user sent the message from) on Google Maps.

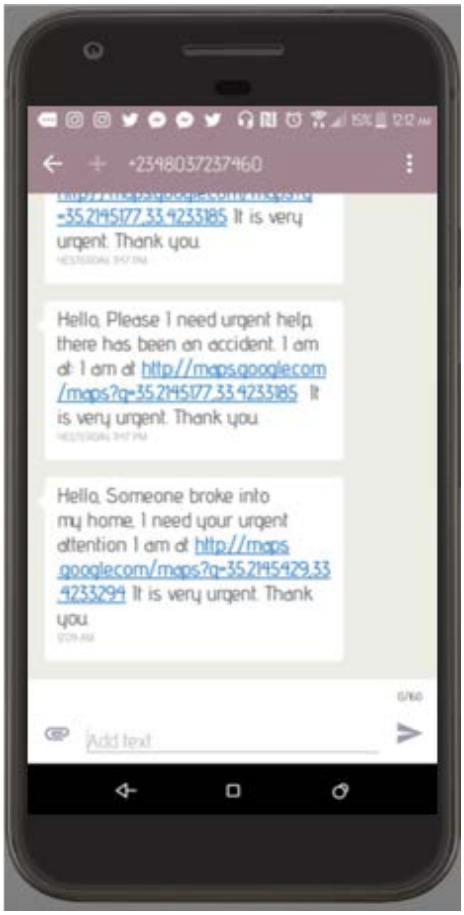

Figure 5.18: Shows a sample of emergency SMS received from the application

5.3.9 Navigation (Path Finding)

The navigation/path-finding feature of the application has a very simple, user-friendly and intuitive design. To use this feature, the user simply has to search for the name of any location they are interested in visiting. Thereafter, the application will automatically generate a path to reach the searched location from the user's current location.

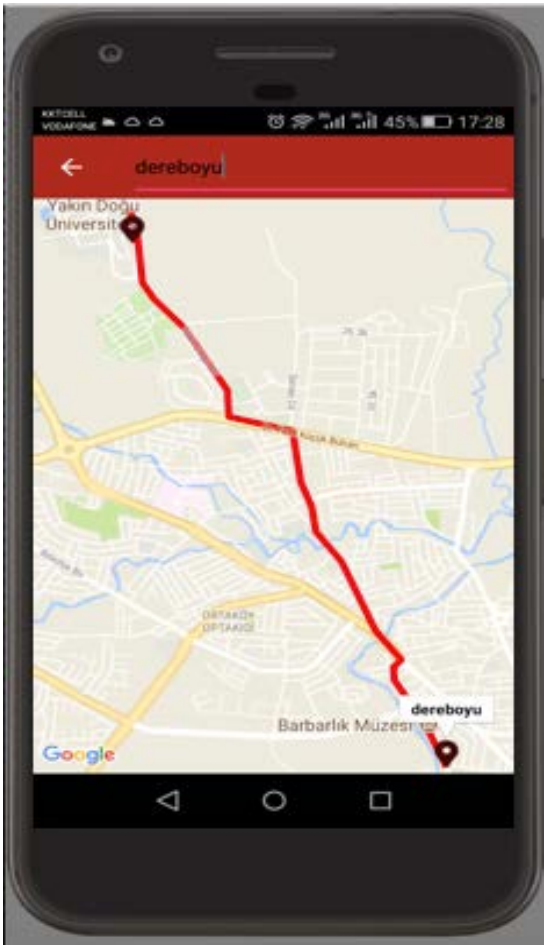

Figure 5.19: Shows the navigation/path-finding page

5.3.10 Weather Information

The weather information page of the application displays the weather information of the user's current location. It also displays a pictorial representation of the present weather condition, the current temperature (in degree centigrade) and a written description of the current information. All this aims to give the user a detailed information about the current weather condition of his current location. The application sources the current weather information by using the open weather API.

Figure 5.20: Shows the weather information page

5.3.11 Search History

The Search History stores the list of POIs searched by the user. The advantage of this feature is that it helps the user to make references and recall certain POIs searched, which the user may not be able to remember the name.

Figure 5.21: The search history

5.3.12 Currency Converter

This functionality is very important to tourists and tourism in general. The currency converter feature enables the user to check the exchange rate of their home currency against the Turkish Lira (the legal tender in the TRNC). This feature is very important as it will help the users to organize their expenses and make life in the TRNC a lot easier. The application sources the current exchange rate of international currencies by using the currency rates API.

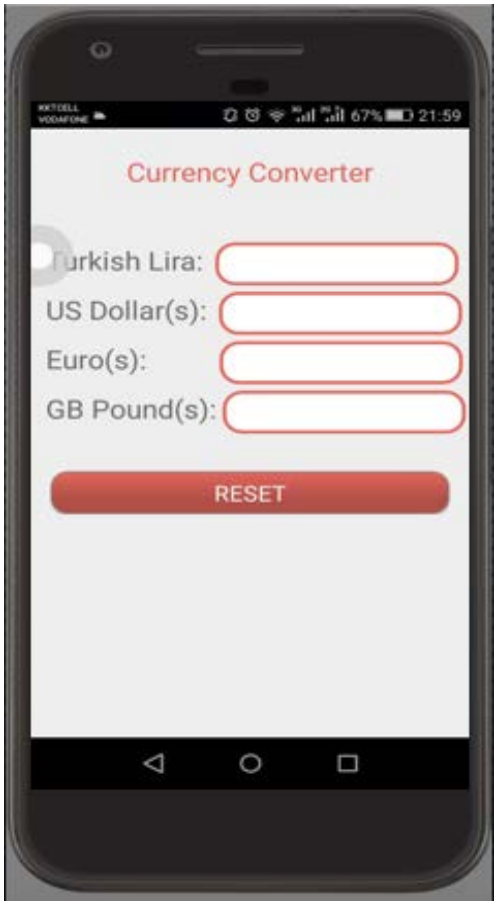

Figure 5.21: Currency converter

5.4 GUI Colour

Mobile applications are developed with specific colours for different reasons, e.g., (Kauppinen-Räisänen, 2014) stated that colours mostly aim to serve three purposes. These are;

- To serve as a source of attraction
- To attract attention and help communicate to the user

During mobile applications development, the decision of the colours to implement is a very important one because it is very important in determining the success of the application (Page et al., 2012), brand recognition and product classification (Van Tilburg et al., 2015). In contrast, a badly chosen mobile application colour can detract and reduce the entire user experience of the application (Kauppinen-Räisänen, 2014). This is why most mobile applications always adopt family-friendly colours that look great and also are also highly visible and usable in both light and dark backgrounds (Mcculloch et al., 2017).

An example of this is the adoption of the colour as the official colour of the social media websites/applications Twitter and Facebook. KISSmetrics (2016) stated blue colour represents the colour of trust, loyalty, order and peace and as a result, gives the user a feeling a serenity and calmness.

For this developed application, the colour red was implemented. This is because red colour represents passion, dynamic, desire and love (Hynes, 2009).This aims to represent the passion and desire that most tourists have towards exploring and learning about different countries, cultures, food and history. Coincidentally, red is also a major colour on the TRNC flag, which can also be taken as a statement to represent the affiliation of the developed mobile application to the TRNC.

CHAPTER 6
CONCLUSION AND FUTURE WORK

This chapter concludes the thesis. It gives the conclusion as well as offers recommendations and future works to be carried out in order to enhance the application in the future.

6.1 Conclusion

In conclusion, an intuitive and user-friendly mobile application called “Tour TRNC” was designed and developed for tourist visiting the Turkish Republic of Northern Cyprus. The application will virtually serve as a digital tour guide and emergency SMS platform fortouristsin the TRNC because they can easily install it in their Android mobile devices. Using the developed application will be much more convenient for touristsrather than using booklets and pamphlets to general information. The emergency SMS feature, which will allow tourists to send their location via SMS to the Police, Hospital/Ambulance emergency and also compose a detailed message to the emergency service providers depending on the situation. This application aims to replace the traditional ways of tourism in the TRNC.

6.2 Future Work

Here are some of the aspects in which the mobile application can be improved in the future:

- ***Multiple Platforms:***The application should be developed for other mobile platforms, that is, iOS and Windows OS.
- ***Location Based Services:*** The features of the application should be upgraded to show the location of POIs on the map using markers.
- ***Multiple Path Suggestions*:**The path-finding feature should suggest multiple paths for the user, thereby offering the user options of which path to follow.
- ***Audio and text for Historical POIs:*** Only a few POIs have the audio and history text feature. This should be upgraded to include all historical POIs.

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APPENDICES

APPENDIX 1

HOW TO LOAD APPLICATION ON AN ANDROID DEVICE

- Import source code files into Android Studio.
- Connect the target android mobile device to the computer using the USB port.
- Enable USB debugging on the target android mobile device.
- In Android Studio, navigate to the Project Window, click on the App module and click Run.
- In the Deployment Target window, Select the target android mobile device and click OK.

APPENDIX 2

SOURCE CODES FOR EMERGENCY SMS

```
public class EmergencyCall extends ParentActivity implements OnMapReadyCallback,
GoogleApiClient.ConnectionCallbacks, GoogleApiClient.OnConnectionFailedListener, LocationListener
{
//region Variables
private GoogleMap mMap;
    Geocoder geocoder;
    List<Address>addresses;
    GoogleApiClient mGoogleApiClient;
    Location mLastLocation;
    Marker mCurrLocationMarker;
    LocationRequest mLocationRequest;
private double latitude;
private double longitude;
    Button sendLocationInSMSBtn;
    EditText phoneEt;
    String phoneNo = "";
    Button updateBtn, deleteBtn;
//endregion
Button emergency_btn;

@Override
protected void onCreate(Bundle savedInstanceState) {
super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_emergency);
        init();
        Toolbar toolbar = (Toolbar) findViewById(R.id.toolbar1);
        setSupportActionBar(toolbar);
        getSupportActionBar().setDisplayHomeAsUpEnabled(true);
        getSupportActionBar().setTitle("My title");
        toolbar.setTitle("Emergency ");

//sending SMS permissions
Ask.on(this)
                .id(333) // in case you are invoking multiple time Ask from same activity or fragment
.forPermissions(Manifest.permission.ACCESS_COARSE_LOCATION
, Manifest.permission.SEND_SMS)
                .withRationales("Location permission need for map to work properly",
"In Order send sms Through Telephony Allow SMS Permissions") //optional
.go();


        Button sendsmspolice = (Button) findViewById(R.id.policebtn);
        sendsmspolice.setOnClickListener(new View.OnClickListener() {
@Override
public void onClick(View v) {
//   phoneNo = "155";
            //   sendLocationInText();
alert();
            }
        });
        Button ambulancesend = (Button) findViewById(R.id.ambulancebtn);
        ambulancesend.setOnClickListener(new View.OnClickListener() {
@Override
public void onClick(View v) {
//  phoneNo = "112";
            //  sendLocationInText();
alertDialogThree();
            }
        });
```

```
geocoder = new Geocoder(this, Locale.getDefault());

// Obtain the SupportMapFragment and get notified when the map is ready to be used.
SupportMapFragment mapFragment = (SupportMapFragment) getSupportFragmentManager()
                .findFragmentById(R.id.map);
        mapFragment.getMapAsync(this);


emergency_btn = (Button) findViewById(R.id.emergency_btn);

emergency_btn.setOnClickListener(new View.OnClickListener() {
@Override
public void onClick(View v) {
                alterDialogTwo();

            }
        });

    }


private void alert() {
        AlertDialog.Builder alert = new AlertDialog.Builder(EmergencyCall.this);
        LayoutInflater inflater = getLayoutInflater();
final View dialogview = inflater.inflate(R.layout.activity_other_emergency, null);
        alert.setView(dialogview);
        alert.setTitle("Send Message to");
//        alert.setMessage(POPUP_LOGIN_TEXT);

Button mssgone_bttn = (Button) dialogview.findViewById(R.id.messge_one);
final Button mssgtwn_bttn = (Button) dialogview.findViewById(R.id.messge_two);
final Button mssgtree_bttn = (Button) dialogview.findViewById(R.id.messge_three);

final String message_One = "Please I need urgent help, I have been robbed";
final String message_Two = "I am being harrassed, I need urgent help";
final String message_Three = "Someone broke into my home, I need your urgent attention";

        mssgone_bttn.setOnClickListener(new View.OnClickListener() {
@Override
public void onClick(View v) {
phoneNo = "+905338595718";
// sendLocationInText();

if (phoneNo.length() == 0) {
                    Toast.makeText(getApplicationContext(), "Invalid Phone Number",
Toast.LENGTH_SHORT).show();
                } else {
// Toast.makeText(getApplicationContext(), "Sending Location in Telephony SMS",
Toast.LENGTH_SHORT).show();
String url = "Hello, "+ message_One + " I am at http://maps.google.com/maps?q=" + latitude + ","
+ longitude + " It is very urgent. Thank you. ";
                    Log.d("response message", url + " ");
                    SmsManager smsManager = SmsManager.getDefault();
                    ArrayList<String> parts = smsManager.divideMessage(url);
                    smsManager.sendMultipartTextMessage(phoneNo, null, parts, null, null);

                    Toast.makeText(EmergencyCall.this, "Notification Message has been sent to the Police
", Toast.LENGTH_SHORT).show();
                }
            }
        });

        mssgtwn_bttn.setOnClickListener(new View.OnClickListener() {
@Override
public void onClick(View v) {
```

```
phoneNo = "+905338595718";
//  sendLocationInText();

if (phoneNo.length() == 0) {
                Toast.makeText(getApplicationContext(), "Invalid Phone Number",
Toast.LENGTH_SHORT).show();
            } else {
// Toast.makeText(getApplicationContext(), "Sending Location in Telephony SMS",
Toast.LENGTH_SHORT).show();
String url = "Hello, "+ message_Two + " I am at http://maps.google.com/maps?q=" + latitude + ","
+ longitude + " It is very urgent. Thank you. ";
                Log.d("response message", url + " ");
                SmsManager smsManager = SmsManager.getDefault();
                ArrayList<String> parts = smsManager.divideMessage(url);
                smsManager.sendMultipartTextMessage(phoneNo, null, parts, null, null);

                Toast.makeText(EmergencyCall.this, "Notification Message has been sent to the Police
", Toast.LENGTH_SHORT).show();
            }
          }
       });

       mssgtree_bttn.setOnClickListener(new View.OnClickListener() {
@Override
public void onClick(View v) {
phoneNo = "+905338595718";
//  sendLocationInText();

if (phoneNo.length() == 0) {
                Toast.makeText(getApplicationContext(), "Invalid Phone Number",
Toast.LENGTH_SHORT).show();
            } else {
// Toast.makeText(getApplicationContext(), "Sending Location in Telephony SMS",
Toast.LENGTH_SHORT).show();
String url = "Hello, "+ message_Three + " I am at http://maps.google.com/maps?q=" + latitude + ","
+ longitude + " It is very urgent. Thank you. ";
                Log.d("response message", url + " ");
                SmsManager smsManager = SmsManager.getDefault();
                ArrayList<String> parts = smsManager.divideMessage(url);
                smsManager.sendMultipartTextMessage(phoneNo, null, parts, null, null);

                Toast.makeText(EmergencyCall.this, "Notification Message has been sent to the Police
", Toast.LENGTH_SHORT).show();
            }
          }
       });

// Set an EditText view to get user input
/*       final EditText email = new EditText(this);
       email.setHint("Enter Phone Number");
       email.setInputType(InputType.TYPE_CLASS_NUMBER);
       email.setSingleLine(true);

       final EditText password = new EditText(this);
       password.setHint("Enter Message");
       password.setInputType(InputType.TYPE_CLASS_TEXT);
       LinearLayout layout = new LinearLayout(getApplicationContext());
       layout.setOrientation(LinearLayout.VERTICAL);
       layout.addView(email);
       layout.addView(password);
       alert.setView(layout);

       alert.setPositiveButton("Send", new DialogInterface.OnClickListener() {
          public void onClick(DialogInterface dialog, int whichButton) {

            //  String number = email.getText().toString();
            //  String message = password.getText().toString();
```

```
            //  sendSMS(number, message);

          }
        });

        alert.setNegativeButton("Cancel", new DialogInterface.OnClickListener() {
           public void onClick(DialogInterface dialog, int whichButton) {
              dialog.cancel();
           }
        });
*/
alert.show();
   }


private void alterDialogTwo(){
final AlertDialog.Builder alert = new AlertDialog.Builder(EmergencyCall.this);
        LayoutInflater inflater = getLayoutInflater();
final View dialogview = inflater.inflate(R.layout.other_emergency_message, null);
        alert.setView(dialogview);
        alert.setTitle("");

final Button pMessageButton = (Button) dialogview.findViewById(R.id.messge_one);
final Button ambMessageButton = (Button) dialogview.findViewById(R.id.messge_amblance);
final Button cancelButton = (Button) dialogview.findViewById(R.id.cancelBttn);

final EditText inputMessage = (EditText) dialogview.findViewById(R.id.message_emergency);


        pMessageButton.setOnClickListener(new View.OnClickListener() {
@Override
public void onClick(View v) {
phoneNo = "+905338595718";
//  sendLocationInText();

if (phoneNo.length() == 0) {
                Toast.makeText(getApplicationContext(), "Invalid Phone Number",
Toast.LENGTH_SHORT).show();
             } else {
// Toast.makeText(getApplicationContext(), "Sending Location in Telephony SMS",
Toast.LENGTH_SHORT).show();
String url = "Hello, "+ inputMessage.getText().toString() + " I am at
http://maps.google.com/maps?q=" + latitude + "," + longitude + " It is very urgent. Thank you. ";
                Log.d("response message", url + " ");
                SmsManager smsManager = SmsManager.getDefault();
                ArrayList<String> parts = smsManager.divideMessage(url);
                smsManager.sendMultipartTextMessage(phoneNo, null, parts, null, null);
inputMessage.setText(null);

                Toast.makeText(EmergencyCall.this, "Notification Message has been sent to the Police
", Toast.LENGTH_SHORT).show();
             }
          }
        });


        ambMessageButton.setOnClickListener(new View.OnClickListener() {
@Override
public void onClick(View v) {
phoneNo = "+905338595718";
//  sendLocationInText();

if (phoneNo.length() == 0) {
                Toast.makeText(getApplicationContext(), "Invalid Phone Number",
Toast.LENGTH_SHORT).show();
```

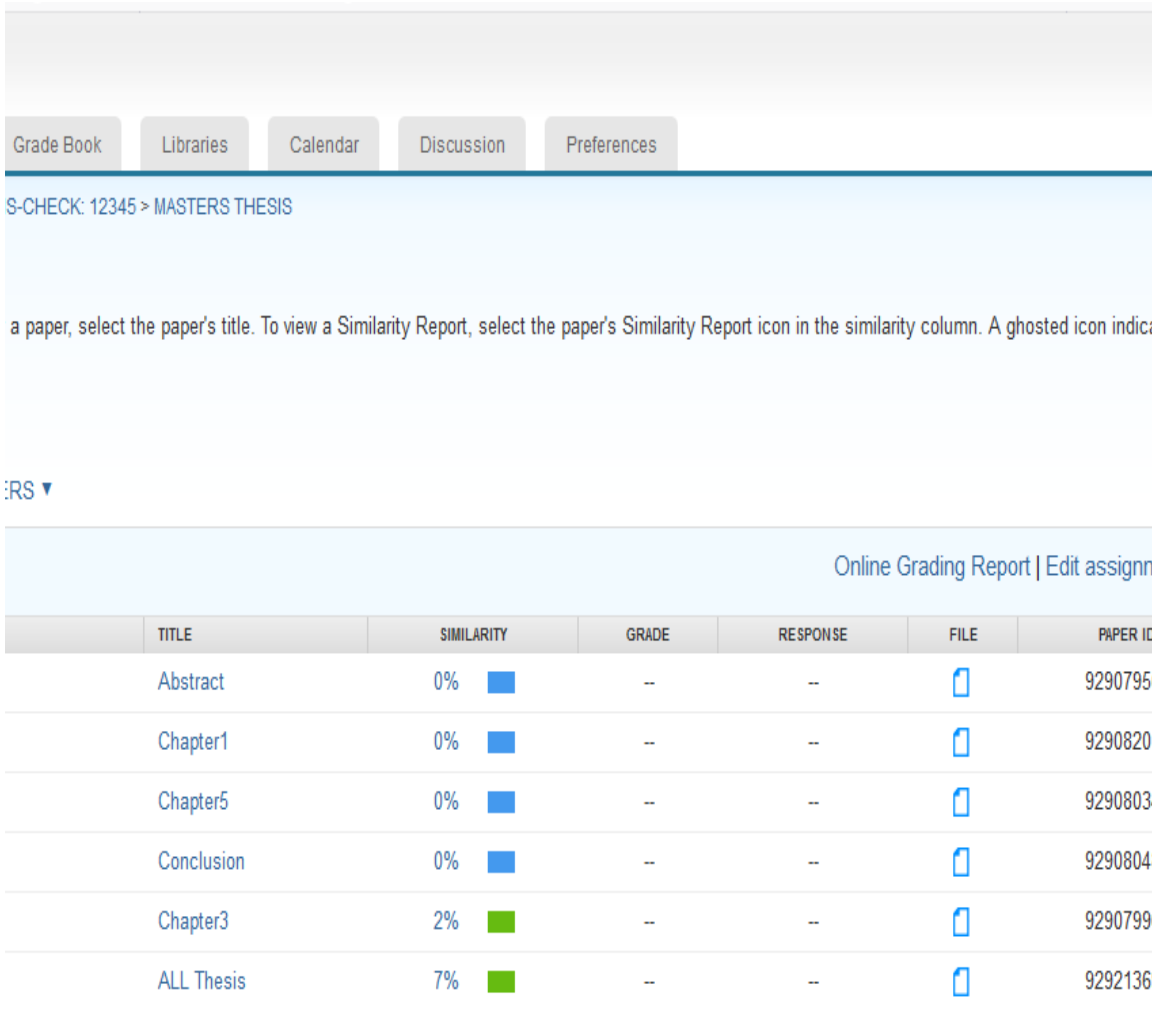
```
            } else {
// Toast.makeText(getApplicationContext(), "Sending Location in Telephony SMS",
Toast.LENGTH_SHORT).show();
String url = "Hello, "+ inputMessage.getText().toString() + " I am at
http://maps.google.com/maps?q=" + latitude + "," + longitude + "  It is very urgent. Thank you. ";
                Log.d("response message", url + " ");
                SmsManager smsManager = SmsManager.getDefault();
                ArrayList<String> parts = smsManager.divideMessage(url);
                smsManager.sendMultipartTextMessage(phoneNo, null, parts, null, null);
inputMessage.setText(null);

                Toast.makeText(EmergencyCall.this, "Notification Message has been sent for
Ambulance Service ", Toast.LENGTH_SHORT).show();
            }
          }
        });


        cancelButton.setOnClickListener(new View.OnClickListener() {
@Override
public void onClick(View v) {

          }
        });

        alert.show();
    }



private void alertDialogThree() {
        AlertDialog.Builder alert = new AlertDialog.Builder(EmergencyCall.this);
        LayoutInflater inflater = getLayoutInflater();
final View dialogview = inflater.inflate(R.layout.amb_emergency, null);
        alert.setView(dialogview);
        alert.setTitle("Send Message to");
//        alert.setMessage(POPUP_LOGIN_TEXT);

Button mssgone_bttn = (Button) dialogview.findViewById(R.id.messge_accident);
final Button mssgtwn_bttn = (Button) dialogview.findViewById(R.id.messge_fracture);
final Button mssgtree_bttn = (Button) dialogview.findViewById(R.id.messge_ailment);

final String message_One = "Please I need urgent help, there has been an accident. I am at:";
final String message_Two = "Please urgent attention needed, there has been a fracture case. I am
at:";
final String message_Three = "Please urgent help needed, there has been a case of ailment
attack. I am at:";

        mssgone_bttn.setOnClickListener(new View.OnClickListener() {
@Override
public void onClick(View v) {
phoneNo = "+905338595718";
// sendLocationInText();

if (phoneNo.length() == 0) {
                Toast.makeText(getApplicationContext(), "Invalid Phone Number",
Toast.LENGTH_SHORT).show();
            } else {
// Toast.makeText(getApplicationContext(), "Sending Location in Telephony SMS",
Toast.LENGTH_SHORT).show();
String url = "Hello, "+ message_One + " I am at http://maps.google.com/maps?q=" + latitude + ","
+ longitude + "  It is very urgent. Thank you. ";
                Log.d("response message", url + " ");
                SmsManager smsManager = SmsManager.getDefault();
                ArrayList<String> parts = smsManager.divideMessage(url);
                smsManager.sendMultipartTextMessage(phoneNo, null, parts, null, null);
```

```
                Toast.makeText(EmergencyCall.this, "Notification Message has been sent for
Ambulance Service ", Toast.LENGTH_SHORT).show();
            }
        }
    });

    mssgtwn_bttn.setOnClickListener(new View.OnClickListener() {
@Override
public void onClick(View v) {
phoneNo = "+905338595718";
//  sendLocationInText();

if (phoneNo.length() == 0) {
                Toast.makeText(getApplicationContext(), "Invalid Phone Number",
Toast.LENGTH_SHORT).show();
            } else {
// Toast.makeText(getApplicationContext(), "Sending Location in Telephony SMS",
Toast.LENGTH_SHORT).show();
String url = "Hello, "+ message_Two + " I am at http://maps.google.com/maps?q=" + latitude + ","
+ longitude + " It is very urgent. Thank you. ";
                Log.d("response message", url + " ");
                SmsManager smsManager = SmsManager.getDefault();
                ArrayList<String> parts = smsManager.divideMessage(url);
                smsManager.sendMultipartTextMessage(phoneNo, null, parts, null, null);

                Toast.makeText(EmergencyCall.this, "Notification Message has been sent for
Ambulance Service ", Toast.LENGTH_SHORT).show();
            }
        }
    });

    mssgtree_bttn.setOnClickListener(new View.OnClickListener() {
@Override
public void onClick(View v) {
phoneNo = "+905338595718";
//  sendLocationInText();

if (phoneNo.length() == 0) {
                Toast.makeText(getApplicationContext(), "Invalid Phone Number",
Toast.LENGTH_SHORT).show();
            } else {
// Toast.makeText(getApplicationContext(), "Sending Location in Telephony SMS",
Toast.LENGTH_SHORT).show();
String url = "Hello, "+ message_Three + " I am at http://maps.google.com/maps?q=" + latitude + ","
+ longitude + "  It is very urgent. Thank you. ";
                Log.d("response message", url + " ");
                SmsManager smsManager = SmsManager.getDefault();
                ArrayList<String> parts = smsManager.divideMessage(url);
                smsManager.sendMultipartTextMessage(phoneNo, null, parts, null, null);

                Toast.makeText(EmergencyCall.this, "Notification Message has been sent for
Ambulance Service ", Toast.LENGTH_SHORT).show();
            }
        }
    });

    alert.show();
  }


        Uri students = Uri.parse(URL);
try {
int count = this.getContentResolver().delete(students, "1", null);
if (count >0) {
            Log.d("response ", "Successfully deleted");
        }
    } catch (Exception e) {
```

```
            e.printStackTrace();
        }
    }


private void sendLocationInText() {
//        phoneNo = phoneEt.getText().toString();
if (phoneNo.length() == 0) {
            Toast.makeText(getApplicationContext(), "Invalid Phone Number",
Toast.LENGTH_SHORT).show();
        } else {
// Toast.makeText(getApplicationContext(), "Sending Location in Telephony SMS",
Toast.LENGTH_SHORT).show();
String url = "Hello, I need urgent help, I am at" + "  http://maps.google.com/maps?q=" + latitude +
"," + longitude + "  It is very urgent. Thank you. ";
            Log.d("response message", url + " ");
            SmsManager smsManager = SmsManager.getDefault();
            ArrayList<String> parts = smsManager.divideMessage(url);
            smsManager.sendMultipartTextMessage(phoneNo, null, parts, null, null);
        }

    }

//Sends an SMS message to another device

private void sendSMS(String phoneNumber, String message) {
        SmsManager sms = SmsManager.getDefault();
        sms.sendTextMessage(phoneNumber, null, message, null, null);
    }

@Override
public void onRequestPermissionsResult(int requestCode,
                                       String permissions[], int[] grantResults) {
switch (requestCode) {
case MY_PERMISSIONS_REQUEST_LOCATION: {
// If request is cancelled, the result arrays are empty.
if (grantResults.length >0
&& grantResults[0] == PackageManager.PERMISSION_GRANTED) {

// Permission was granted.
if (ContextCompat.checkSelfPermission(this,
                        Manifest.permission.ACCESS_FINE_LOCATION)
                        == PackageManager.PERMISSION_GRANTED) {

if (mGoogleApiClient == null) {
                        buildGoogleApiClient();
                    }
mMap.setMyLocationEnabled(true);
                }

            } else {

// Permission denied, Disable the functionality that depends on this permission.
Toast.makeText(this, "permission denied", Toast.LENGTH_LONG).show();
            }
return;
        }

// other 'case' lines to check for other permissions this app might request.
        //You can add here other case statements according to your requirement.
}
    }


@Override
public void onMapReady(GoogleMap googleMap) {
mMap = googleMap;
```

```
mMap.setMapType(GoogleMap.MAP_TYPE_NORMAL);

//Initialize Google Play Services
if (android.os.Build.VERSION.SDK_INT >= Build.VERSION_CODES.M) {
if (ContextCompat.checkSelfPermission(this,
                Manifest.permission.ACCESS_FINE_LOCATION)
                == PackageManager.PERMISSION_GRANTED) {
            buildGoogleApiClient();
mMap.setMyLocationEnabled(true);
        }
    } else {
        buildGoogleApiClient();
mMap.setMyLocationEnabled(true);
    }
  }

protected synchronized void buildGoogleApiClient() {
mGoogleApiClient = new GoogleApiClient.Builder(this)
            .addConnectionCallbacks(this)
            .addOnConnectionFailedListener(this)
            .addApi(LocationServices.API)
            .build();
mGoogleApiClient.connect();
  }

@Override
public void onConnected(@Nullable Bundle bundle) {
mLocationRequest = new LocationRequest();
mLocationRequest.setInterval(1000);
mLocationRequest.setSmallestDisplacement(1);
mLocationRequest.setFastestInterval(1000);
mLocationRequest.setPriority(LocationRequest.PRIORITY_BALANCED_POWER_ACCURACY);
if (ContextCompat.checkSelfPermission(this,
            Manifest.permission.ACCESS_FINE_LOCATION)
            == PackageManager.PERMISSION_GRANTED) {
        LocationServices.FusedLocationApi.requestLocationUpdates(mGoogleApiClient,
mLocationRequest, this);
    }
  }

@Override
public void onConnectionSuspended(int i) {

  }

@Override
public void onConnectionFailed(@NonNull ConnectionResult connectionResult) {

  }

@Override
public void onLocationChanged(Location location) {
mLastLocation = location;
if (mCurrLocationMarker != null) {
mCurrLocationMarker.remove();
    }
    Log.d("response location", location.toString() + " ");
// Toast.makeText(this, "location changed", Toast.LENGTH_LONG).show();
latitude = location.getLatitude();
longitude = location.getLongitude();
//Place current location marker
LatLng latLng = new LatLng(latitude, longitude);

try {
addresses = geocoder.getFromLocation(latitude, longitude, 1); // Here 1 represent max location
result to returned, by documents it recommended 1 to 5
```

```
Log.d("response address ", addresses + " ");
//          String address = addresses.get(0).getAddressLine(0); // If any additional address line present
than only, check with max available address lines by getMaxAddressLineIndex()
//          String city = addresses.get(0).getLocality();
//          String state = addresses.get(0).getAdminArea();
//          String country = addresses.get(0).getCountryName();
//          String postalCode = addresses.get(0).getPostalCode();
//          String knownName = addresses.get(0).getFeatureName();
} catch (IOException e) {
          e.printStackTrace();
      }

      MarkerOptions markerOptions = new MarkerOptions();
      markerOptions.position(latLng);
      markerOptions.title("Current Position");

markerOptions.icon(BitmapDescriptorFactory.defaultMarker(BitmapDescriptorFactory.HUE_MAGENTA)
);
mCurrLocationMarker = mMap.addMarker(markerOptions);

//move map camera
mMap.moveCamera(CameraUpdateFactory.newLatLng(latLng));
mMap.animateCamera(CameraUpdateFactory.zoomTo(15));

//stop location updates
if (mGoogleApiClient != null) {
          LocationServices.FusedLocationApi.removeLocationUpdates(mGoogleApiClient, this);
      }
   }

public static final int MY_PERMISSIONS_REQUEST_LOCATION = 99;

public boolean checkLocationPermission() {
if (ContextCompat.checkSelfPermission(this,
              Manifest.permission.ACCESS_FINE_LOCATION)
              != PackageManager.PERMISSION_GRANTED) {

// Asking user if explanation is needed
if (ActivityCompat.shouldShowRequestPermissionRationale(this,
                  Manifest.permission.ACCESS_FINE_LOCATION)) {

// Show an expanation to the user *asynchronously* -- don't block
              // this thread waiting for the user's response! After the user
              // sees the explanation, try again to request the permission.

              //Prompt the user once explanation has been shown
ActivityCompat.requestPermissions(this,
new String[]{Manifest.permission.ACCESS_FINE_LOCATION},
MY_PERMISSIONS_REQUEST_LOCATION);


          } else {
// No explanation needed, we can request the permission.
ActivityCompat.requestPermissions(this,
new String[]{Manifest.permission.ACCESS_FINE_LOCATION},
MY_PERMISSIONS_REQUEST_LOCATION);
          }
return false;
      } else {
return true;
      }
   }
}
```


Grade Book
Libraries
Calendar
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S-CHECK: 12345 > MASTERS THESIS
a paper, select the paper's title. To view a Similarity Report, select the paper's Similarity Report icon in the similarity column. A ghosted icon indica
ERS ▾
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Abstract 0% -- -- 9290795
Chapter1 0% -- -- 9290820
Chapter5 0% -- -- 9290803
Conclusion 0% -- -- 9290804
Chapter3 2% -- -- 9290799
ALL Thesis 7% -- -- 9292136