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PERSONAL DIGITAL MUTAWWIF: A MULTI-MODAL MOBILE HAJJ ASSISTANCE USING THE LOCATION BASED SERVICES

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Graphical abstract

Personal Digital Mutawwif (PDM)
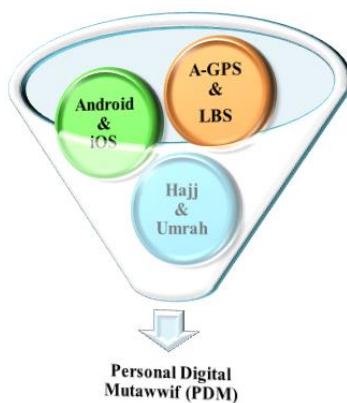
Abstract

Many efforts have been initiated and many techniques and approaches have been developed to facilitate the difficulties faced by pilgrims. However, those studies focus on acquiring initial perspective and background knowledge about Hajj before going to Makkah. In conjunction to that, this study utilizes A-GPS in mobile phone to assist the pilgrims during Hajj. The main aim of this paper is to discuss about the development of a multi-modal mobile application called the Personal Digital Mutawwif (PDM), using location based services to assist pilgrims while performing all the rituals of Hajj. Android platform has been chosen due to the dramatic increased in the Android mobile phone users worldwide. PDM displays the Arabic text, the translation in Malay and also the Arabic audio files of the dua and zikr, which has been gathered, compiled, and verified before the development using Java 2 Platform, Micro Edition (J2ME). The application has been proven to be useful in helping the pilgrims to easily and conveniently recite the dua and zikr towards achieving Hajj Mabrur.

Keywords: Mobile assistance, Hajj, Multi-Modal, A-GPS, Location-Based Services

Abstrak

Pelbagai inisiatif telah dijalankan dan pelbagai teknik dan pendekatan telah dibangunkan bagi menangani permasalahan yang dialami oleh peserta Haji. Walau bagaimanapun, kajian-kajian tersebut memberi fokus kepada pemahaman awal dan pengetahuan asas mengenai Haji sebelum mereka menunaikan Haji di Mekah. Sehubungan itu, kajian ini menggunapakai A-GPS dalam telefon mudah alih dalam membantu peserta Haji semasa melaksanakan ibadah Haji. Matlamat utama kertas kerja ini adalah bagi membincangkan tentang reka bentuk dan pembangunan sebuah aplikasi pelbagai platform yang dinamakan Personal Digital Mutawwif (PDM), menggunakan perkhidmatan berasaskan lokasi bagi membantu peserta Haji semasa melaksanakan ibadat haji di Mekah. Android merupakan platform yang digunakan kerana penggunaannya meningkat dengan mendadak di seluruh dunia. PDM memaparkan teks dalam Bahasa Arab, dan terjemahannya dalam Bahasa Melayu serta audio bagi doa dan zikir yang dikumpul dan disahkan sebelum dibangunkan menggunakan Java 2 Platform, Micro Edition (J2ME). Aplikasi tersebut telah terbukti berguna kerana ianya mudah dan senang dalam membantu peserta Haji dalam membaca doa dan zikir bagi mencapai Haji Mabrur.

Kata kunci: Alat bantu boleh ubah, Haji, Pelbagai kaedah, A-GPS, perkhidmatan berasaskan lokasi

1.0 INTRODUCTION

Hajj is the pilgrimage to Makkah and must be carried out at least once in a lifetime by every able bodied Muslim. It is the fifth pillar of Islam [1], which involves several rituals including Ihram, Tawaf, Sa'ie, Staying in Mina, Staying in Muzdalifah, Wuquf in Arafah, and Stoning of the Jamarat. The Hajj procedures are complex with many information, rules, tasks, practical steps, and dua and zikr and Al-Quran verses that must be memorized. All these rituals are accompanied with dua and zikr that have to be recited by the pilgrims. Since there are so many dua, many pilgrims (out of 3 millions) are not able to memorize all of them. Thus, several methods have been introduced to help the pilgrims to recite the dua while performing the Hajj rituals [2] including book, booklet, and pamphlet. Even though these approaches have been the most popular and widely used approaches, there are some limitations including difficulties in finding pages of any specific dua and zikr especially while performing ritual such as Tawaf, which involves large crowd. Besides, electronic gadgets have been introduced to cater for the reciting of dua and zikr for Hajj such as the Hajj Player. It is a mobile device similar to an MP3 Player containing only audio of dua and zikr for Hajj. Using this device, pilgrims have to listen to the audio while reading the text provided in a separated booklet. This device is useful to those who cannot read the dua and zikr in Arabic [2].

Today, mobile technology is applied in a wide range of our daily activities [3]. It is rare to get a person who does not have a cell phone [4]. In addition, the mobile devices are regarded as very flexible devices because they are easy to handle and to be used everywhere by the users [5]. According to Nusca [6], mobile phones have become powerful useful devices that can carry out professional services and applications such as Global Positioning System (GPS) functionalities, E-Banking, email clients, and web browser besides the typical functions like contacts, calendar, diary, notepad, and voice recorder [7]. With such utilities, more than 3.3 billion mobile connections have been in place worldwide, and the number is increasing daily [3]. By employing the mobile applications, different interests can be gained in various domains such as health [8], tourism [9], education [10], transportation [11], logistics [12], disaster [13], and management activities as well as monitoring projects [14, 15]. Since mobile applications support the requirements of various users, it is essential that the mobile applications are useful as well as usable in order to be successful [3]. Mobile applications that are able to enhance knowledge and taking full advantage of improved capabilities that include applications related to dua and zikr for Hajj are still limited [2]. In such context, this study believes that it could be equipped with Location-Based Services (LBS).

Recently, LBS applications have become very popular. Those kind of mobile applications can easily track user location and may offer additional services such as locating amenities nearby, as well as offering suggestions for route planning. Of course, one of the key ingredients in an LBS application is map, which represents a visual representation of certain location [16]. LBS can be defined as applications that take advantage of the information of the physical location of a mobile device for the purpose of providing services based on available information [15]. Therefore, this paper focuses on the utilization of LBS in a multi-modal mobile application called Personal Digital Mutawwif (PDM) that can assist pilgrims to recite the supplications of Hajj rituals (dua and zikr) based on their current location. Believing that Allah SWT needs no specific language to understand the believers' supplications, all the texts and audios for the dua and zikr are conveyed in Arabic. This is because the Muslims want to follow what has been done by Prophet Muhammad SAW. Since this study has been conducted in Malaysia, in which Malay is the nationwide language, the translation of the supplications is conveyed in Malay. In addition, PDM is developed to work on Android and iOS platforms, since the development language is Java and both platforms have the Java Virtual Machine.

After a brief introduction on the importance of Hajj and the problems faced by the pilgrims while performing the rituals, this paper reviews some of the current approaches which have been developed to facilitate those problems. The rest of this paper is organized as follows; section 2 reviews some of the related studies in the field. Section 3 gives a brief background about LBS and A-GPS, while the development methodology was described in section 4. Finally, the conclusion was discussed in section 5.

2.0 PREVIOUS STUDIES AND RELATED WORKS

In previous studies, several tools and devices have been developed to facilitate the pilgrims in performing the Hajj. Three studies have been carried out to develop an android application to help the pilgrims in the recitation of supplications associated with pilgrimage rituals. The first study explains the development process of the application called Mobile Dua and Zikr for Hajj (MDZ4H). The study shows how the contents of MDZ4H has been prepared and validated and how the experts and users evaluated MDZ4H [2]. While the second study focuses on the users' perceptions and usability of MDZ4H. The results prove that MDZ4H has won the attention of users and their satisfaction [17]. Finally the third study investigates the possible modalities that can be incorporated in MDZ4H [18]. One of the suggestions and future work of this study is to incorporate the GPS and LBS technologies in MDZ4H, which enables the application to automatically select appropriate dua according to the pilgrim's location. As a response to that, this study aimed to design and develop a multi-modal mobile application called the PDM based on the LBS to assist pilgrims during Hajj.

Other than that, researchers at the Universiti Utara Malaysia have developed Virtual Hajj (V-Hajj), a

courseware for learning to perform Hajj, Umrah, and Ziarah. V-Hajj encompasses all the requirements, steps, and procedures in performing Hajj and Umrah. It incorporates interactive multimedia and virtual environments which enable users to learn and understand the Hajj and Umrah procedures step-by-step as well as participate in 3D environments in enhancing user experience in performing the Tawaf, Sa'ie and stoning of the Jamarat [19].

Another group of researchers [20] from Faculty of Informatics and Computing at University of Sultan Zainal Abidin in Malaysia developed Virtual Umrah application that aimed to be implemented as guidelines for developing another virtual environment products. This interactive application have been developed based on five components which are contents, user profile, modalities, Virtual Reality (VR), and usability evaluation. Therefore, this application is very close to the proposed prototype in this study. The usage VR technology in this software allows presenting a realistic experience for Muslims in performing Umrah. In this application, modalities such as texts, images, animations, audios, and videos have been utilized to representing the contents. These modalities facilitate the information capturing for users in an efficient way effectively, which leads to high usability earned the users' satisfaction.

3.0 LOCATION-BASED SERVICES (LBS) AND ASSISTED GPS (A-GPS)

LBS can be defined as applications that take advantage of the information of the physical location of a mobile device for the purpose of providing services based on available information [15]. It provides personalized services to the mobile users according to their current physical location. In addition, LBS give the opportunity to the mobile phone operators, developers, and service providers to extend their services to assist users in reaching their targeted places as well as tracing stolen phones [21]. It can be classified into many categories depending on the purpose of use and the service. Meanwhile, many methods can be used to locate the mobile phone user such as GPS-based LBS and GSM localization [22].

GPS consists of 24 satellites distributed accurately around the earth. The GPS device (such as mobile phone with GPS receiver) needs to receive the signal of 3 satellites only in order to locate it. Then the GPS device is located according to latitude, longitude, and altitude by a special mathematical formula based on the satellites broadcasted absolute positions and relative time delays of the received signals [23]. Nowadays, mobile phones have been equipped with A-GPS technology which consumes less battery power and requires fewer satellites. A-GPS can identify the current location accurately of the mobile phone within seconds indoor and outdoor, by integrating GPS with the mobile network. There is no information need to be downloaded via satellite, because the A-GPS acquires information of the satellites location via the cellular

network. On the other hand, A-GPS uses the nearest cellular towers to calculate and determine the location of mobile phone in the case of weakness or lack of satellite signals. Figure 1 shows the architecture of A-GPS system.

The mobile phone needs an internet connection via General Packet Radio Service (GPRS) or Wi-Fi to establish a connection with the A-GPS assistance server, which some might consider it as one of the service's flaws. In contrast, GPS provides real-time solutions, but A-GPS does not require the integration of a lot of hardware resources in the mobile phone in order to locate the mobile device with high accurately and quality, which reduces the battery's energy consumption and keeps the mobile's simplicity [15]. Meanwhile, there is no user privacy in A-GPS and GPS, because the mobile's location accurately known by the assistance server.
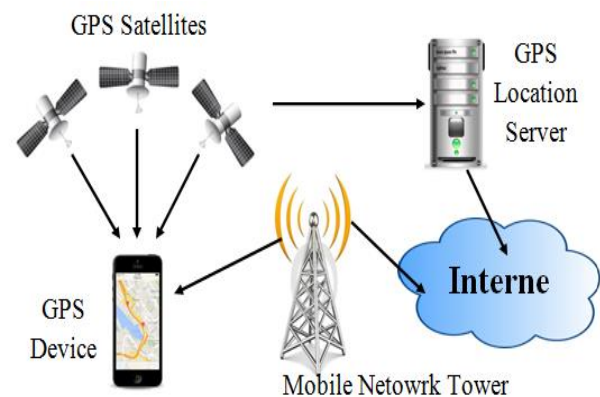

Figure 1 The Architecture of A-GPS

4.0 IMPLEMENTATION AND METHODOLOGY

LBS in android can be provided via tow Application Programming Interfaces (APIs), Android Location API and Google Places API. Both APIs that supported by android provide many classes and services which allow to find out the mobile current location, request periodic updates to get information about the current location of the device, or even it can be used to gives a alerts when the mobile is entering or existing from an area of given longitude, latitude and radius. Figure 2 shows an example of the areas of the rituals in Hajj.
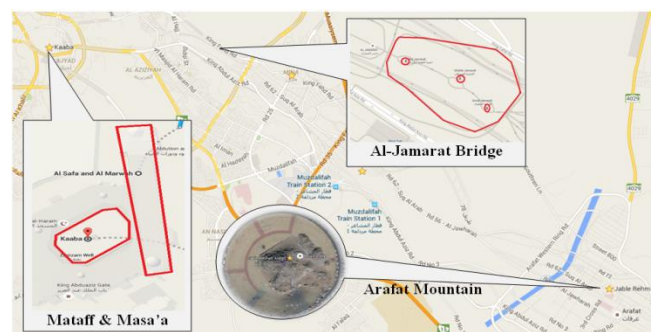

Figure 2 Examples of the Rituals Areas in Hajj

4.1 Android Location API

Location API package in android provides many classes to retrieve the mobile location information. Table 1 lists some of the important classes provided by Android Location API.

On the other hand, Android provides another API to access the Google maps. This means the user's exact location and the targeted place can be shown on the map, with the help of the Google maps and the location APIs. This study used the *LocationListener* class in tracking the Pilgrims whereas the *LocationProvider* class used to get the exact geographical location. Therefore, any changes in the pilgrim's location the *LocationListener* will callback to retrieve the new pilgrim's location. Thus, once the pilgrim enters in the geographical area of any of the Hajj rituals, PDM immediately gives the appropriate instructions to that ritual. This immediate response also depends on the Google Places API, which became available to everyone after the announcement at the Google I/O developer conference in 2011 [23].

Table 1 The Classes in Location API Package

Class Name	Description
LocationManager	The class provides access to the location service. It also provides facility to get the best Location Provider as per the criteria
LocationProvider	It's an abstract super class for location providers. A location provider provides periodic reports on the geographical location of the device.
LocationListener	This class provides callback methods which are called when location gets changed. The listener object has to be registered with the location manager
Criteria	The class provides the application to choose suitable Location Provider by providing access to set of required properties of the *LocationProvider*

4.2 Google Places API

The Google Places API is a service that returns places' data, previously defined within the Web Service as a preferred points or spatial locations by using HTTP requests. According to Walde *et al.* [23], Google Places API provides four types of places requests, which represent the fundamental place services:

*Place Searches:* Provides a list of nearby Places based on the current user location.

Place Details: Provides more specific data about the targeted Place.

Place Check-ins: It allows the request that a user has entered in to a Place.

Place Reports: It allows the users to delete or add new locations to the Place service.

4.3 Methodology and the Development Process

The development process of this project was based on the prototyping approach (see Figure 3). This approach involves three steps which include; developing initial prototype, using the prototype, and revising and enhancing the prototype. Each step of the prototyping approach involved sub steps or rules and results. The results of the first step are passed to the next step. The second and third steps can be repeated till achieving a satisfied prototype.
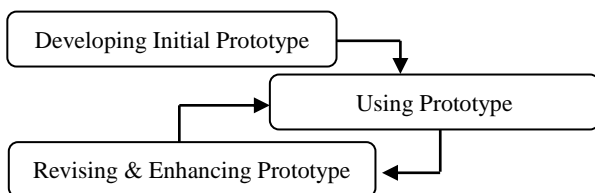
Figure 3 The Prototyping Approach

Developing Initial Prototype: This step involves three activities: information gathering, content preparation and programming. In information gathering the required information like the prototype contents were gathered, compiled and verified before they were used in the prototype. After that, those contents have been prepared and organized carefully to be easy to access. Finally the programming activity involved developing the prototype using two programming languages Extensible Markup Language (XML2.0) and Java. Java programming has been used to develop the logical body of the application, while the interface of the system was created by using XML 2.0. As a result of this step the Android Application Package (APK) file was created.

Using Prototype: The developed prototype has been installed in a mobile phone. During the prototype testing, some notes were taken to further improve and enhance in the next version. *Revising and Enhancing Prototype:* In this step the notes that have been taken in the previous steps were considered and applied in the second version of the prototype. After that the APK file was created again to install and test it again until the prototype is fully satisfied.

4.4 The Developed Prototype

The prototype is divided into several sections. Figure 4 (a) depicts the Logo Screen. It shows the system name and logo with background sound. This screen is displayed in a few seconds only, and then it automatically disappears to show the main menu (Figure 4(b)). It allows users to navigate the PDM by clicking on the required dua to be displayed. The user can only exit from the system through the main menu. The third screen is the Information screen

(Figure 4(c)). This screen contains information and instructions, which are expected by the users. It informs users about the time and place where the dua is most acceptable (mustajab).

There are three buttons at the bottom of each screen, which allow users to navigate the system and go through the system screens. The user can proceed to the next screen by clicking the forward button or return to the previous screen by clicking the back button. The user can also go to the main menu by clicking the home button. The last screen contains dua in Arabic with Malay translation at the bottom plus audio of the dua recitation (Figure 4(d)). The user can play or pausing the audio at any time by clicking the speaker icon on the top of the screen. The back, home, and forward buttons are also provided in this screen.
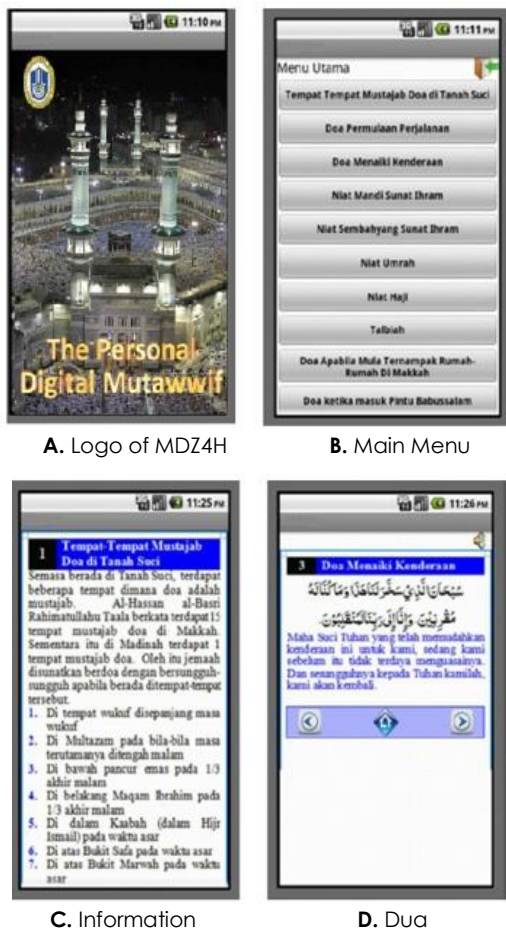

A. Logo of MDZ4H   **B.** Main Menu

C. Information   **D.** Dua

Figure 4 Screenshots of the Personal Digital Mutawwif (PDM)

5.0 CONCLUSION

The development of the PDM and the opportunity of utilizing the A-GPS in mobile phone to assist the pilgrims during Hajj have been elaborated in this paper. The application has been developed in more than one mode to assist pilgrims during Hajj by providing the appropriate instructions as well as reciting the required dua and zikr based on their current location. Briefly,

this application simulate the job of the human mutawwif to provide on time assistance as well as it is able to assist them make dua and zikr recitation easier regardless of their competency in reading the dua and zikr in Arabic. This application is not intended to replace the human mutawwif or the existing approaches of reciting the dua and zikr, instead to complement them through the utilization of A-GPS functionalities and smartphone technology.

Hence, it is hoped that the findings of this study will encourage more researchers to involve in finding new ways and methods to improve and assist pilgrims to perform the rituals easily and conveniently. It is also hoped that Hajj agencies of any country would be interested to incorporate PMD into their existing services in order to improve and enhance the pilgrims' Hajj performance. Finally, the authors hoped that one day PMD is widely used by all the Hajj pilgrims in helping them to achieve Hajj mabrur.

Acknowledgement

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