MUSLIM-GUIDE: USING AUGMENTED REALITY AND INTUITIVE FEATURES FOR DETERMINING QIBLA DIRECTION AND PRAYER TIMES

NG AH NGAN MIKE CHRISTIAN TIEN TSONG

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DECLARATION

No portion of the work referred to in this report has been submitted in support of an application for another degree or qualification of this or any other university or institution of higher learning.

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ABSTRACT

Everyday, more than a billion of Muslims in the world face the Ka’bah in Mecca five times as they perform their daily prayers. The direction towards the sacred Ka’bah is called qibla. While before, mainly when travelling around the world, people used conventional methods such as stick to see the shadow in order to know the prayer times and qibla direction, nowadays, various mobile and web applications exist to accomplish similar tasks. However, such applications requires huge location databases, requires human intervention to calculate current location, displays relative directions rather than absolute directions or use various geographical notations and terminologies that requires mental effort or reduces users’ learnability. Therefore, this study investigated the potential of using Augmented Reality, which is defined as the latest advancements of Human Computer Interaction technology and context-aware computing environment to improve the mental model design in mobile-based qibla applications. This study offered a new method of visualizing spatial information by overlaying multiple intuitive features onto the live streaming from the mobile’s camera to provide cognitive advantages and enhance perceptual guidance. Finally, a proposed Location-based application called “Muslim Guide” was developed to demonstrate its usability and reliability compared to current qibla applications.
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CHAPTER 1
INTRODUCTION

1.0 Overview

This chapter gives an introduction to the importance of the qibla direction and how Muslims calculates its direction using conventional and modern techniques. The issues regarding current techniques used in mobile and non-mobile application are explained, as well as the objectives and scopes of this research.

1.1 Introduction

The direction to the sacred Ka'bah or towards the city of Mecca is called qibla in all of the languages of the Islamic common-wealth (King, 1999). Everyday, more than a billion of Muslims in the world face the Ka’bah in Mecca as they perform their daily prayers. Attempting to face the qibla during the prayer is one of the conditions for its validity (Balogun, 2009). However, Muslims also face the Ka’bah during other religious obligations such as the slaughtering procedure of an animal for food where its head is aligned to the qibla direction, and when Muslims are buried with their heads rotated right towards the qibla. (King & Lorch, 1992)

Generally, finding the direction to the qibla is not really an issue as in most mosques the direction is correctly identifies. Also, in Islamic countries, indications of the qibla direction can be found in various places such as hotels’ bedrooms. Moreover, most buildings such as shopping malls, hospitals, recreational parks and offices are equipped with prayer rooms that resemble a mosque. However, for Muslims, traveling for studies, pleasure or
business is very common and when one is travelling to a foreign country where mosques are not accessible, determining the correct direction of the qibla as well as knowing the prayer times becomes a challenge (Balogun, 2009).

Before the technological era, people used conventional methods such as a stick to see the shadow casted by it from the sun to determine the time for prayers and the direction of qibla (Ibrahim & Norashikin, 2010). But of course, this method required a certain level of knowledge to execute and was not very accurate. Nowadays, various applications exist in form of websites, mobile applications or portable gadgets (qibla compass) that allows users to determine the qibla direction and prayer times. (Ibrahim & Norashikin, 2009).

The Figure below demonstrates the various ways on how Muslim people find the qibla direction when travelling or when mosques are not accessible.

Figure 1.0: Popular methods to find the qibla direction
From the result from this preliminary research, indicates that most people rely on mobile applications to find the qibla direction when travelling. The main reason is that nowadays, most mobile phones have the capability to accurately pinpoint their own location, which is an essential input in correctly finding the qibla direction. Applications that use this feature are referred as Location-based service application (LBS) as they use the context of the device such as the location to provide certain services (Virrantaus et al., 2001). Most LBS applications providing qibla direction usually display the result using a 2 dimensional view of a virtual compass image. By using the built-in digital compass or magnetometer in the mobile device, the virtual image of a compass rotates to the direction of the qibla based on earth coordinate and north direction. (Ibrahim & Norashikin, 2010).

The second most common used method to find the qibla when travelling is by using web-based qibla applications. In such application, the qibla direction is usually drawn with a straight path from the current position of the user to the location of the qibla onto a 2 dimensional world map. Online viewers can then take one of the objects (trees, building etc) that are located on the path as a reference to be faced when praying (Crattie, 2010).

With that said, understanding the information using a web-based or a compass-based application (LBS) requires mental effort or familiarity with navigational terminologies (Razali et al., 2013). In addition, some applications may not provide accurate data when used in different countries or requires more than one application to provide necessary information to Muslim users seeking for qibla direction and prayer times (Ibrahim & Norashikin, 2010).
Therefore, this research will address the usability issues in web-based and mobile-based applications currently used to find the direction to the qibla and investigate the potential implementation of intuitive features through an Augmented Reality (AR) interface for mobile-based applications to provide extra guidance to mobile users. The main reason of using AR in this research is because it provides a unique combination of visual display properties and interaction with spatial information that offers cognitive advantages for understanding and visualising information compared to traditional 2D interfaces (Shelton & Hedley, 2004).

In addition, the research will address the reliability issues faced by non-location-based applications and map-based applications and on how the various sensors in today’s mobile phones can be beneficial to these issues. Finally, a proposed mobile application will be implemented and compared to current mobile-based qibla applications to evaluate its reliability in finding the qibla direction and prayer times as well as its usability satisfaction.

1.2 History

In the early centuries of Islam, finding the direction to the qibla with precision was practically impossible due to a lack of tools. People had to refer to the shadow casted by a stick during sunny days. Then, as we evolved, scientific approaches such as arithmetic method, trigonometry method, star sphere method, star disc method, and Weris’ cone were introduced to determine the direction of the qibla more accurately (OnIslam.net. 2012).

From the third century mathematical solutions for finding the direction became available. Various Muslim scientists like Al-Khawarizmi, Habash al-Hasib al-Marwazi, Al-Nayrizi, Al-Battani and Abu al-Wafa Buzjani contributed in finding the qibla direction from
any point in the world (Ali, 2011). Their solutions gave rise to charts, maps, instruments, and other cartographic methods providing high degree of accuracy. One popular tool that was used to locate the direction to the Qibla in the medieval ages was the Astrolabe, originally designed for astrology, navigation and surveying (Balogun, 2009).

In the 13th century AD, the process in finding the qibla direction was revolutionised with the introduction of the compass. By combining the compass with the astrolabe, the Ka’bah could be found from anywhere in the world (Winterburn, 2005).

Then the 18th century, the compass was used along with other qibla indicator such as the Sundial and the Persian Qibla indicator. (bbc.co.uk, 2009)

![Figure 1.1: 18th Century Persian Qibla indicator for finding Mecca (bbc.co.uk, 2009)](image)

Afterwards, in the late 20th century, compass-based tools were built to help Muslims in finding the qibla direction more effectively. Some of them were marked and coded for major cities around the world with the Ka’bah designed inside its dial (OnIslam.net. 2012).
Currently, with the technological era and the growth in smart phones and computers users, the issues in finding the qibla from wherever you are around the globe are fading away. Many tools have been developed like web-based application such as “e.qibla.com” (e.qibla.com, 2012), and “qibla direction” (www.qibla.com.br, 2012) as well as mobile applications such as “Qibla Direction” (Qibla Direction, 2012), “Qibla Compass” (Qibla Compass, 2012), “MySolat” and many others.

1.3 Problem statement

Nowadays, the methods for finding the directions of qibla have evolved allowing users to accomplish the task faster. Muslims are able to quickly find the qibla direction using dedicated websites and location-based mobile applications. However, these applications face some reliability and usability issues.

Reliability issues

There are various web-based applications that have been created for the purpose of knowing the qibla direction and the daily prayer times. In these applications, the direction to the qibla is displayed using compass-based or map-based techniques as shown in Figure 1.2. One reliability issue with web-based application is that it requires constant Internet access, which may be difficult to acquire or completely inexistent when one is travelling. Another reliability issue is that most web-based applications require the manual entry of the user’s location to calculate the qibla direction and prayer times. Inaccuracies in the location entered can consequence in significant deviation of the qibla direction or in determining the correct prayer times (Harizah, 2012). This reliability issue also affects the usability of such system. While in some of these applications, the user is required to enter the name of his or her
location in order to view the direction to the qibla (Figure 1.2), in others, user has to enter specific geographical location such as latitude and longitude in order to get the appropriate direction (Razali et al, 2013).

![Figure 1.2: Map based application for determining the location to the qibla.](image)

In addition, in map-based system, the direction is relative rather than absolute. The direction to the qibla is usually shown on a 2d world map using a straight path from the user’s current location to the location of Mecca, whereas in reality, the path follows the spherical shape of the earth. Therefore, while on a 2d map, the direction to the qibla from the US is almost east and many Muslims pray in this direction, due to the spherical shape of the earth, the most direct path from to Mecca points in a Northeast direction (El-Sayed, Greenhill & Westrup, 2011). In order to be able to show geodesics distance which is the shortest path between two points on a sphere onto a 2 dimensional map, huge database containing qibla
direction longitude, latitude, and geodesic distance to Mecca needs to be created (Asiri, 2010).

**Usability issues**

Unlike web-based applications, mobile-based qibla applications offer a more reliable solution. With advancement in mobile technology, most current mobile phones are equipped with Geographical Information System (GIS) and Location-Based Services (LBS) technology, thus making them a convenient platform for effectively and practically locating the qibla (Barkhuus & Dey, 2002). In mobile-based application, the current location of the user is automatically determined using the available wireless technologies such as Global Positioning System (GPS), and the direction to the qibla is shown using a representation of a compass as shown in Figure 4. The built-in digital compass in the mobile phone rotates the compass image to the direction of the qibla (Ibrahim & Norashikin, 2010). In addition, tracking of places precisely can also provide more accurate prayer time (Saleh, 2008).
Figure 1.3: A mobile-based application: using a compass interface to show the direction to the qibla.

Figure 1.4: A mobile-based application: using a compass-representation without geographical notations.