CHAPTER 2

LITERATURE REVIEW

The following chapter includes a review of the pertinent literature pertaining to this research. In this chapter, a few other researches dealing with location based AR on Android mobile phone have been reviewed.

2.1. Previous Research

Presently, mobile location based AR has become more popular and interesting field in recent advanced technology and it has been used for developing systems with various purposes. With the growing popularity of smartphones, mobile location based AR applications have started to play a significant role in the tourism industry. These applications help tourists to access context aware information on locations that can improve their knowledge about the area. Mobile location based AR applications allow users to explore the world by adding new layers of location based information to their reality and to create list of their favorite point of interests (POIs) using this information (Kounavis, Kasimati, & Zamani, 2012).

Many researches of location based AR have increasingly been studied and implemented in recent year. The previous research which is conducted by (Brata, Liang, & Pramono, 2015) has developed a mobile AR application about the bus stops in Taipei. This application name is BusAR. The feature of the BusAR is to find location of the nearest bus stop and the route path to get there. The bus stop is assigned as augmented reality entities, called Point of Interest (POI). The POI provides the detail of information like bus stop name, distance from user to the bus

stop, route name, upcoming bus name and bus type, and also estimated time when bus will arrive in particular bus stop. Moreover, this application can guide user to the nearest bus stop by informing him when to turn left or turn right without changing his application screen.

According to the research conducted by (Hui, Hung, Chien, Tsai, & Shie, 2014), has developed a location based mobile augmented reality application of hot springs tourism in Yilan county. This application is divided into two modules. Those modules are augmented reality module and map module. The AR module utilizes the POI with two-dimensional virtual image in real view that allows user to find the location of hot springs. Whereas the map module utilizes the Google map service to provide the corresponding position and used for display the hot springs information and route guidance. In addition, this application also provides the Quick Response code (QR code) for each of the POI, which help users to link to the website of Yilan hot spring through scanning the QR code. It also provides the camera function to take photos and record videos immediately without exiting the application when using the camera module.

Table 2.1. Related Research Summary

Research	*Objective*	*Method*	*Tool*	*Result*
Location-Based Augmented Reality Information for Bus Route Planning System (Brata et al., 2015)	Developed an android based AR application for searching and providing information of the nearest bus stop locations and give the instruction assistant that lead the user way to that bus stop in Taipei.	POI data is parsed by web service, then POI information is overlaid on the mobile screen in AR form. Besides, the instruction assistant works based on Taipei Bus database, Map and POI.	Android Studio, Android SDK, Taipei Bus API, Google Direction API.	Android based MAR application for presenting information of the nearest bust stop locations and also providing instruction assistant to the users in Taipei.
Mobile Augmented Reality of Tourism-Yilan Hot Spring (Hui et al., 2014)	Developed a Mobile Augmented Reality application for presenting the information of Hot Spring location in Yilan County	Presented POI locations with AR two-dimensional virtual image. In addition, Google Map is also used to define the location of Hot Spring. QR code is used to get information from Yilan Hot Spring website through scanning.	Android Studio, Android SDK, Google Map API, Google SketchUp, QR code Generator,	Mobile Augmented Reality application for providing information of the nearest hot spring locations in Yilan County.

CAMTOUR AR: A Location-Based Augmented Reality Mobile Application for searching tourist attractions and culinary places in Phnom Penh, Cambodia (Phearith, 2016)	Develops a location based mobile augmented reality application for searching or finding the tourist attractions and culinary places in Phnom Penh, Cambodia.	Presents POI locations with two-dimensional virtual image based on Android mobile. Besides, POI location is also displayed on the user interface application by using Google Map service.	Android Studio, Android SDK, Wikitude SDK, Google Map API, Web Hosting (phpMyAdmin and File Manager)	Mobile Augmented Reality application for providing information of tourist attractions and culinary places accurately in Phnom Penh, Cambodia

2.2. Theoretical Background

In this chapter, we will provide a general overview of Augmented Reality, Location Based Services, Global Positioning System , Android and Software Development Kit.

2.2.1. Augmented Reality

Augmented Reality (AR) is a technology where users are enabled to see the real world, with virtual objects superimposed upon or composited with the real world (Azuma, 1997). The virtual objects are computer-generated renders, such as text, graphics, sound, video and GPS data. Generally, the real-world view is captured by the camera of a computer, mobile phone or other electronic devices. The superimposition of the computer-generated data on the view captured by the camera in AR improves a user's perception of and interaction with the real world (Azuma et al., 2001).

Currently, AR mostly has been used and carried out in mobile platform environement. In addition, AR technology has been explored and implemented in variety of fields. One of the current challenges for AR technology is to implement effective AR on mobile platforms. Mobile AR has become a most recent development in location based services and interactive graphic applications that allow users to experience visualization and interaction with 3D models or media contents on mobile devices. Presently, mobile AR has also been carried out efficiently in various innovative applications such as gaming, shopping guides, advertising,

edutainment, travel guides, museum guides and medical visualization (G. Papagiannakis, G. Singh & Magnenat-Thalmann, 2008). Research conducted by De La Nube Aguirre Brito demonstrated that AR is really beneficial and helpful in tourism field and also improve tourist on-site experience in a new way in the real life (De, 2015).

2.2.2. Location Based Services

The term Location Based Services (LBS) are information service accessible with mobile devices via mobile network and using the ability to make use of location of the mobile device (Virrantaus et al., 2001). On the other side, LBS is a service which is based on the geographical location. For instance, the nearby information, fleet management, children tracking, and etc. LBS provides service according to the user's location. LBS architecture consist of five basic components: Mobile Devices (User), Positioning Component, Communication Network, Service and Application Providers and Data and Content Providers (Steiniger, Neun, & Edwardes, 2006). LBS applications integrate its user or device location with other information to provide an added value to the user. Nowadays, LBS are used in many applications: navigation and routing, entertainment, information services, military or emergency solutions and commerce (Shek, 2010).

2.2.3. Global Positioning System

Global Positioning System (GPS) is a system that is composed of an array of over 30 satellites in low earth orbit that provide signals that can be detected by a receiver on the earth's surface. The system is developed and

administered by the Department of Defence of the United States of America (Milner, 2016). The system allows any device that has a GPS sensor and can receive a particular signal from at least 4 satellites, to determine an accurate location of the user, in real time, all over the world. With the utilization of the satellites' signal, the receiver can triangulate its location accurately. The system utilizes the standard coordinate system (longitude and latitude) that can be used on any application or physical map.

2.2.4. Android

Google purchased Android from Android Inc. in 2005, which was established in 2003 by Rubin and they handled software development for mobile devices. Afterwards, Open Handset Alliance (OHA) composed of 79 companies together with Google developed their new mobile platform for mobile devices. This alliance was set up so as to develop open technologies for mobile devices and easily make those applications available in the market. This new open source technology was named as Android (Conti, 2008).

Android is an open source architecture which is utilized for developing applications for mobile devices. Android works on Linux Kernel. It has an operating system, middleware and core applications. Android declares its code under the license of free software/open source in 2008. Android goes up with an API (Application Programming Interface) for mobile devices. This Linux Kernel supports Java Virtual Machine (JVM) which helps Java to be the most suitable programming language for

libraries, debugger and a handset emulator in Eclipse IDE (Shu, Du, & Chen, 2009), (Whipple, Arensman, & Boler, 2009). The application which is developed in Android can be tested using this emulator which performs similar to a mobile phone.

2.2.5. Software Development Kit

With numerous benefit of software development kit (SDK), lots of developers have utilized it to develop many applications in diversity of purposes. Nowadays, many Augmented Reality (AR) SDKs have been used and implemented by developers for developing various mobile applications. There are some popular AR SDKs that is used to develop a location based applications such as Metaio, Vuforia, Wikitude, D'Fusion, ARToolKit, and ARmedia. Those SDKs can be used to develop applications that run on Android, iOS platforms and some SDKs also run on Windows platform.

Augmented Reality SDK is a set of tools and libraries that provided to developers for developing AR applications. With the use of AR SDK, it makes the development of AR applications easier and fast. Additionally, it also enhance the existing mobile applications with AR technology which run Android or iOS platform. It facilitates many components within the AR application such as object recognition, object tracking, location based AR, content rendering and visualization (Rattanarungrot, White, Patoli, & Pascu, 2014). Amin and Govilkar have researched about the comparison of Augmented Reality SDKs (Amin & Govilkar, 2015). The features of Augmented Reality SDKs will be described in Table 2.2.

Table 2.2. Comparison of Augmented Reality SDKs

AR SDKs	Features						
	Marker	GPS	IMU Sensors	Natural Feature	3D object Tracking	Face Tracking	3D content
Metaio	✓	✓	✓	✓	✓	✓	✓
Vuforia	✓	×	×	✓	✓	×	✓
Wikitude	✓	✓	✓	✓	✓	×	✓
D'Fusion	✓	✓	✓	✓	✓	✓	✓
ARToolKit	✓	×	×	✓	×	×	✓
ARmedia	✓	✓	✓	✓	✓	×	✓

The Wikitude SDK is a powerful software developer kit which allows the open development of marker-less AR experiences, providing developers with the tools to either create their own augmented reality applications, or enhance their existing applications with an AR camera-view engine. This SDK comprises of or covers with some features such as image recognition & tracking, 3D model rendering, video overlay, location based AR and many more. Wikitude API browser combines every sub system into the browser application, including POI data and channel publishing information. The browser application is a representation of standalone architecture. This architecture has benefit that the application does not rely on the wide area network (WAN) connection (Butchart, 2011). For the development of location based AR with the Wikitude SDK, the object position which overlay on the mobile screen is known through the user position. The user position is obtained either by the mobile communication

network or GPS. The user direction is determined by the digital compass and accelerometer sensor is used to detect the orientation of the phone.