Mobile Augmented Reality of Tourism-Yilan Hot Spring

Lin Hui*
*Dept. of Innovative Information & Technology
Tamkang University, Taiwan
121678@mail.tku.edu.tw

Fu-Yi Hung
Dept. of Innovative Information & Technology
Tamkang University, Taiwan
fuyihung@mail.tku.edu.tw

Yu-Ling Chien
Dept. of Innovative Information & Technology
Tamkang University, Taiwan
Betty101712@hotmail.com

Wan-Ting Tsai
Dept. of Innovative Information & Technology
Tamkang University, Taiwan
lovecatus@gmail.com

Jeng-jia Shie
Dept. of Innovative Information & Technology
Tamkang University, Taiwan
pamelashie@gmail.com

***Abstract*—This research focuses on a concept of location-based service (LBS) and further extend to design a set of smart phone application (APP) with mobile augmented reality about Yilan hot spring. The APP is divided into two parts: map module and augmented reality (AR) module. The map module enables people to search the hot springs' information and their corresponding positions by combining the application with the use of Google Map. The AR module uses the point of interest (POI) with two-dimensional virtual image in the real scene that allows people find the location. In addition, we provide the Quick Response code (QR code) for each of the POI, which assists the users to link to the original website of Yilan hot spring by scanning the QR code. The APP also provides the function of camera that allows its users to capture the photos and record the videos in this APP. By using this Mobile AR APP, people can search the information about Yilan hot spring anywhere and anytime.**

Keywords—AR, LBS, Mobile AR, POI, Navegation

I. INTRODUCTION

The tool used during a tour these days is quite different with the old time because of the change of culture and the advancement of technology. It is understandable that people prefer to use the most cost-effective and time-saving methods in searching for the information for self-touring. Therefore, we expect to use mobile devices (smart phone, Tablet etc.) along with the technology of AR to present the characteristics of Yilan hot spring.

This APP enables the tourism information to become more portable, it provides high accuracy of locating graphical location for the users and shows the characteristics of the Yilan hot spring effectively.

We design a set of APP with MAR about Yilan hot spring and divide into two parts: map module and AR module. In map module, we combine it with the Google Map which let people feel user-friendly and comfortable when searching the graphical location about Yilan hot spring. On the other hand, AR module puts the virtual technology information to the screen of reality. Both map module and AR module allow the users to get the corresponding information and add the sufficient information of the environment in time. Last, not only we add the QR code for the POI (which allows the users to search the website for the hot spring information), but also provides the users the camera function that let this APP functions become more interesting and fun to use with.

II. RELATED WORK

A. Location Base Service(LBS)

Location Base Service provides a variety of communication device locations as a basic concept of position service, mobile positioning service, and location service by using Global Positioning System and Geographic Information System. It is a radio communication network which works through the mobile operators such as Global System for Mobile Communications and Code Division Multiple Access. On the other hand, it also can be used as an outside positioning method such as GPS to get the location information from the moving end users. It is a value-added service which provides the users with the support of GIS platform.

Location Base Service could exert its value because of the increase of popularity of smart phones and the wide application of 3G mobile networks. It has a high mobility, instantaneity, and no space constraint. Unlike the traditional way of searching on website or presenting information on papers, it adds the advantage of instantaneity and diversity. The increase of popularity in mobile network has extended many applications. The mutuality of the LBS makes the integration of real and virtual worlds possible.

LBS provides many positioning function, information, social networking and other forms of navigation system by combining the GPS positioning function [1]. Through the development of LBS, it starts from the basic personal navigation, POI and connects the social networking system and further develops to commercial tradeoff. All these applications are everywhere, and it creates tones of business opportunity. The inconvenience experiences by the users when they are moving, was solved at the birth of LBS. [2]

978-1-4799-4266-4/14 $31.00 © 2014 IEEE
DOI 10.1109/U-MEDIA.2014.46

LBS combines the information with POI, position, to telecommunication providers and it could be divided into six categories: positioning tracking/security, transportation/travel, POI information, community/friends, push advertisements, and LBS games.

Although these applications also rely on high technological smart phones, the accuracy of positioning varies when the function of the application varies. In order to provides the users a good service based on their needs, we must find out how to eliminate the waiting time, provides instant information and with the appropriate positioning technique. [3]

B. Introduction to AR

Augmented Reality is a mechanism that calculates the location and angle of a camera view and adds corresponding virtual image to the view. The concept of AR is similar with Virtual Reality (VR). The only thing that AR differentiates from VR is that it replaces the real-world image with the virtual image, changing to the real world by producing virtual objects while AR adds the virtual image to the real world to strengthen the insufficient information of the reality and convenient life (Figure 1). AR combines the virtual object with the real world, connects the line between the real and virtual worlds, it also provides interaction between the virtual and real world on the screen. This strategy of AR can also get the required information in time and provide the information which is insufficient in the reality. AR is used in many mobile platforms such as iPhone, Windows Phone and Android smart phone.

Fig. 1. Comparison of real and virtual

C. Navigation Technology

Users can get the latitude and longitude position through GPS to receive the current location because the GPS satellite signal reception belongs to the time series and receives the location signal per second, GPS guide system can receive the signal from the GPS receivers when the users move the location.

The traditional GPS guiding system cannot integrate the information and provide the correct direction for the users because it only uses the inner graphics system to process the route plan. Therefore, our research provides the MAR guide system.

OmniGuider GPS Navigation System is developed by Department of Computer Science and Information Engineering (NTPU). OmniGuider GPS Navigation System presents the technology of location-based awareness, orientation sensor and walking intention of prediction to induce the direction relationship between users and places.

D. Android

Android platform is the use of Google Open Handset Alliance. This platform is built in the core of Linux and used in the open source mobile handset operating platform. Android application is used in JAVA language, providing the opening environment of windows, Mac and Linux. It also provides the simulator and Android software development kit (SDK) for the user. Both of the Android application program and the inner system are put in a set of program which allows the program to interact easily. This is called Application framework. For the developers, it is easy to make more basic Libraries function through JAVA to provide the Application Programming Interface (API). In addition, to enables more users to participate in the Android application program, Google opens the Android SDK free download version. This version can be installed in Windows, Linux and Mac operating system environment. Android SDK can provide not only Android API but also Android Debug Bridge (ADB) and Android Emulator.

We choose the top ten Yilan hot spring locations and introduce their information, types, and price. We use Google SketchUp software to draw a 3D picture that was created based on the appearance of each hotel and switch to 2D pictures with AR in the Android mobile tools. In the same time, we create a QR code for each hotel that allows people scan the 2D code to link to the detail information about each hotel and hot spring.

E. AR Navegation Application

AR Navigation technology lets its users get visual effect by using computer image strategy and combine the real and virtual objects. It integrates many different video equipment and display the said equipment in AR technology, such as display systems and video cameras. Our object is to design a set of APP with MAR for Yilan hot spring for the user interface that allows the users to get more direct and accurate route guidance method.

We use OmniGuider GPS Navigation System as our tool to get a more accurate direction and position. We will integrate the AR technology with actual road image as instant guide to provide the users more instinctive guide experience. Our research focuses on the AR interface and integrates it with the technology to provide the users more directive method of route guidance.

Our research uses the GPS receiver to get the location information during traveling and provides a set of Community outdoor MAR Navigation to let users to have the full direction and distance information, solving the problems that traditional GPS guide system has.

III. SYSTEM ANALYSIS AND DESIGN

A. System Architecture

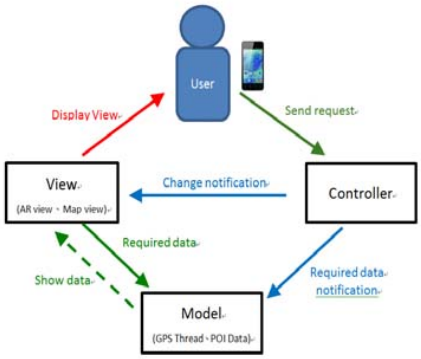

Fig. 2. MVC Structure

Our research goal is to build up a system, similar to an Augmented GPS Navigation system, which processes a guide of Yilan tourism, and reduce expense and enhance the effect. Our MVC structure of the system has three parts as shown in Figure 2. In View module, our research provides two kinds of screens for the users: one uses POI information with virtual 2D image to show in Google Map so that users can find the corresponding location and direction. The other one uses AR to display the front position. In Controller module, controller service receives the current graphical location and sends the information for the Model module and View module. In Model module, model service primary receives the GPS and Orientation information from the Controller module and calculates the POI information which needs to display the AR module and Map module in View module. In order to calculate the distance between the user and POI, our research uses the Ingo Harre Formula. [4](Figure 3)

A（λ_a,φ_a）,B（λ_b,φ_b）,λ is Longitude,φ is Latitude

the distance between A and B is

$$\sqrt{((\varphi_b-\varphi_a)\times 60\times 1852)^2+((\lambda_b-\lambda_a)\times 60\times 1852\times\cos(\varphi_a\times\pi)/180)^2}$$

Fig. 3. Ingo Harre Formula

In order to get the correct information of the location and direction, our system uses Position-aware Service and Orientation-aware Service. However, both of the services produce errors easily in any case. As a system of Yilan tourism, it needs to be revised so that it can provide correct location and direction for the users.

In Position-aware Server, our research uses a GPS-aware system-OmniGuider GPS-aware system. OmniGuider system uses the method of Context-aware and divides into four parts: feature extraction, state classification, behavior learning, and perception and amendment. These four parts primary get the basic positioning signal from the GPS and calculate the displacement difference from time to time, speed difference, and azimuth difference as the characteristics of the user habits. Then, using behavior classification, and learning behavior mode to process behavior prediction and information correction to get the correct location values.

In Orientation-aware Service, it is primary used in electronic compass to get the information of direction. Although electronic compass could be assisted through GPS, the directional accuracy of GPS will decrease when reducing the rate of object movement. OmniGuider uses Complementary Metal-Oxide Semiconductor (CMOS) Sensor as optical flow image technology to provide information such as relative displacement, direction information mutual authentication of electronic compass, and technology about speculate user direction information. Therefore, the method of combining GPS, electronic compass and CMOS Sensor becomes a good method in providing correct direction for the users.

B. Display method of Mobile Augmented Reality(MAR)

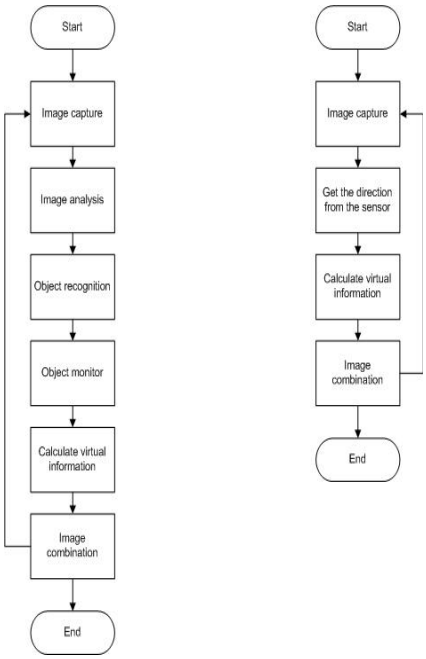

Fig. 4. Display Method of Traditional AR and MAR

Figure 4 shows the comparison of Traditional AR and MAR. Traditional AR uses the Web cam to capture the real location and Marker, as well as make some image analysis, object recognition, object monitoring and calculates the virtual information. Last, combing with the real location and displays those in front of the users.

On the other hand, MAR is used primary in mobile tools. When the camera (CMOS) captures the real location, the system will search the current location and information, and use the OmniGuider system to modify the position and direction. The advantage of MAR we use is that it does not have the limitation of Marker and the information can also be shown in the screen in hand.

C. System Working Flow Chart

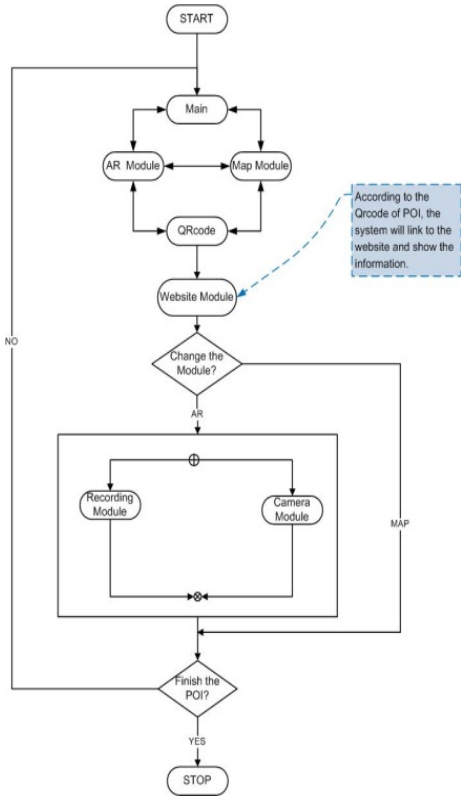

Fig. 5. Working Flow Chart

Instead of using the traditional tour guide, we design a set of APP with AR that is more convenient for the uses. This APP consists of two parts: AR module and map module. Users can scan the QR code then link to the website of POI from both of modules (Figure 5). In addition, we provide a camera function in the AR module so that the users can take photos or record videos without leaving this APP. We will introduce more details about the flow charts in the next part.

IV. MPLEMENTATION

A. The Main Flow Chart

When users turn on this APP (Figure 6), first, the system will start the frame setting such as the brightness of the screen, removing the main title and so on. Second, the system will get into the user interface then shows the buttons of AR and map module after the frame setting. Third, it will start the network setting. System will check whether the network is connected or not. If the network does work, the system will get the location service. Otherwise, the system will move to GPS setting for getting the location service [5]. When system finishes the above-mentioned settings, users can start the tour guide with AR module or map module. After the activity running, system will update and save the data of Trusted Platform Module (TPM) and alpha. (Alpha is the value of transparency about background and pictures.)

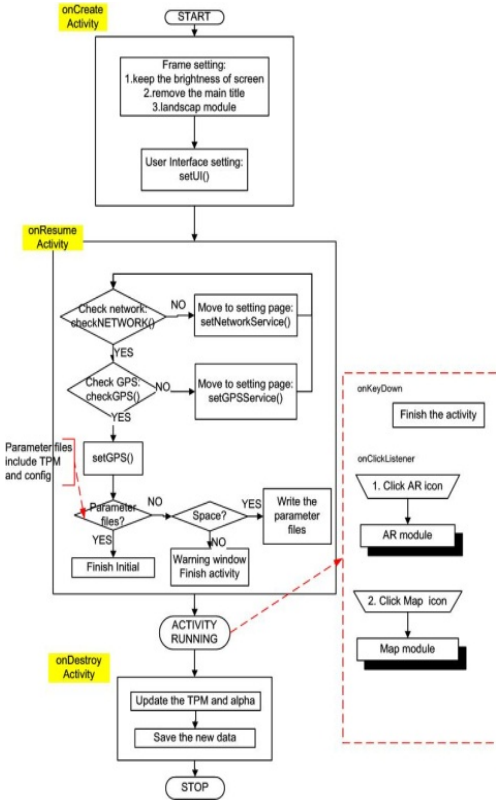

Fig. 6. Main Flow Chart

B. The Flow Chart of AR module

For AR module (Figure 7), system will do the frame setting and user interface setting. Then, it will get the information of POI and check the connection of network. After the system is done with the background setting, it will compute the distance and bearing between two different points [6]. At first, the system has to load the latitude and longitude data of two points. Through those data, the system gets the arccosine value from the sine value and cosine value, and then times the radius of earth so that it will compute the distance between two points on earth. Also, the system can compute the bearing in degrees between two points on earth [7]. In

addition, the view of the POI will change with the angle of camera.

Besides, there are four buttons on the lower left corner: map module, main module, QR code and camera button. When users click the QR code button, the view will turn to QR code scan page [8]. According to the QR code of POI, the user interface will link to the website and the result will store in "la.droid.qr.result". This function let people search the hot spring information more quickly. Also, the system will catch the camera tool from the Android system when users click the camera button [9]. After turning on the camera, user can switch to the video recording. The data of photos and videos will be saved in the camera folder.

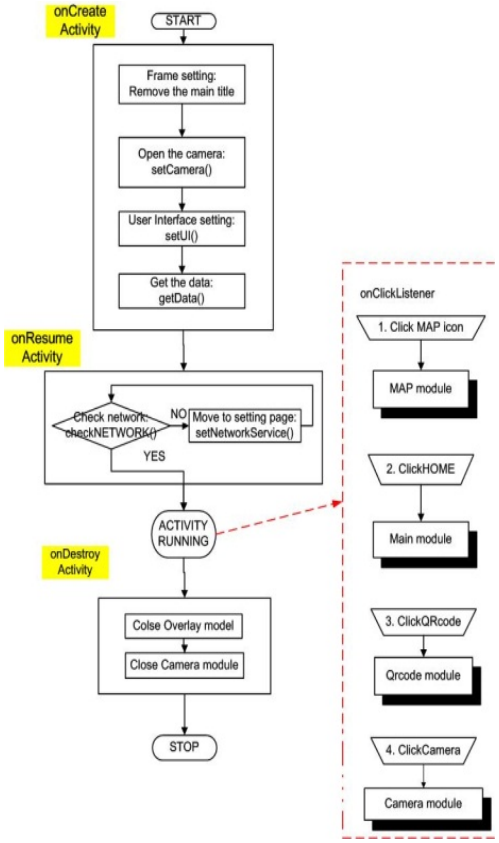

Fig. 7. AR module flow chart

C. The Flow Chart of AR module- Activity Runnung

According to the GPS setting, the system will change the location service when executing the AR module. If GPS does work, the system will have the location service and update the data from GPS. Otherwise, the system will update the data of POI from network (Figure 8).

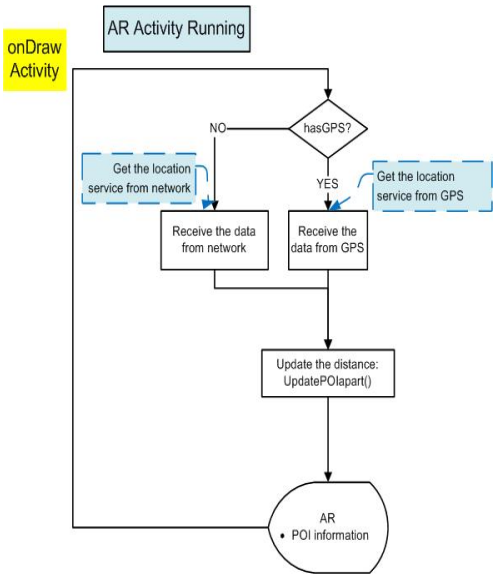

Fig. 8. Activity running flow chart

D. The Flow Chart of Map module

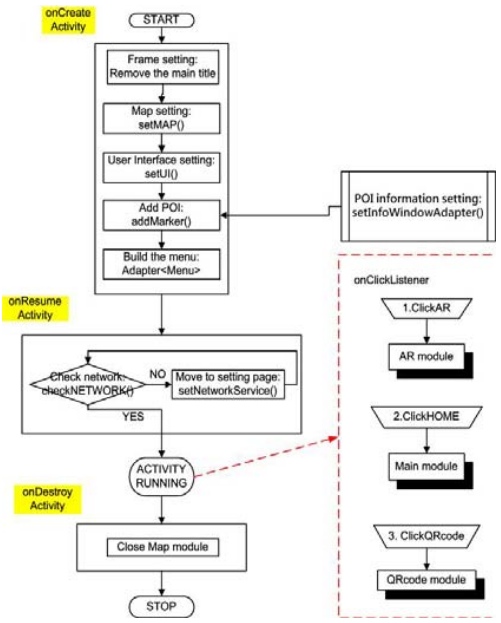

Fig. 9. Map module flow chart

For map module (Figure 9), system will do the frame setting, user interface setting and put it in the frame of Google Map [10]. Then, it will get the information of POI and check the connection of network. After the system is done with the background setting, it will establish the position in the user interface [11]. In addition, this system will add the content and the image of POI. Last, we will add the POI list then we complete build work.

From the user interface, there are three buttons on the lower left corner: AR module, main module and QR code. When users click AR module and main module, the view will change to AR system and main screen. Otherwise, the view will change to QR code scan page when users click the QR code button. Also, when it scans the QR code of POI, it will connect to the webpage of the POI [12]. This function allows people to search the information of Hot Spring more quickly.

V. Conclusion & Future Work

According to the location-based service, this research completes the MAR of tourism for Yilan hot spring. The user interface of AR module and the user interface of Map module are shown in Figure 10 and Figure 11. The traditional AR has to recognize and track the object by using the marker. This research uses the position and direction to modify this limitation. In addition, it adjusts the data of position and direction more accurately through the Omniguider.

This research gets the information of geographic location by computing the distance and angle between two points [13]. For users, they can obtain detailed information from the website faster when they are using the QR code module. Besides, it has the camera function for users to take photos and record videos immediately. Also, they do not have to exit this APP when using the camera module. After the users acquire the data of POI, they can record those data at the same time.

Apart from the AR for Yilan hot spring, this research can be applied to other different types of tourism or community systems in the future work. Besides, it also can be applied to educational purpose. For example, it increases the users' interests in local cultural education.

Fig. 10. The user interface of AR module

Fig. 11. The user interface of Map module

References

[1] Cin-Hong Jheng (2010)，" The Influence of Attitude and Trust on Consumers' Acceptance on Location-Based Services: An Explorative Study in Taiwan Market ", Department of Business Administration, National Chung Hsing University, master's degree thesis.

[2] GAO SHAO SYUAN and WUN YAN RU(2008), "Android LBS application platform unstoppable waves".

[3] SHEN BO HAN(2011), "LBS and Future Action Learning", The Institute for the number of teaching and learning digital archive of Industrial Development and Promotion Plan.

[4] Ingo Harre http://www.mar-it.de/GPSDataParser/Spreadsheet.htm[Accessed online at 01/21/2009]

[5] Gu Jieguang, and Linze Sheng "RFID applications in museums." Journal of Library and Information Science 59 (2006): 57-65. http://www.myerstone.com.tw/E-guide.aspx

[6] How to calculate the distance of two coordinates http://mobile.dotblogs.com.tw/shadow/archive/2012/06/08/72682.aspx

[7] Mathematical Functions Math. Operators use (P.8) http://eportfolio.lib.ksu.edu.tw/user/T/0/T093000174/repository/Java%20%E7%A8%8B%E5%BC%8F%E8%A8%AD%E8%A8%88-Applet%E7%AF%87%20%E9%9B%BB%E5%AD%90%E6%9B%B8/chap13%20%E8%A8%88%E7%AE%97.pdf

[8] How to read QR code http://elviselle.blogspot.tw/2013/06/android-app-qr-code.html

[9] How to join AR camera module http://fecbob.pixnet.net/blog/post/34704805-%5Bandroid%5D%E7%9B%B8%E6%A9%9F%E7%9A%84%E5%AF%AB%E6%B3%95

[10] How to get API key and build a base map http://www.moke.tw/wordpress/computer/advanced/410

[11] Screen positioning method http://epaper.gotop.com.tw/pdf/AEL012331.pdf

[12] Build POI listing Configuration http://www.cnblogs.com/tefcricul/p/3486936.html

[13] Huangjun Yao, Caizong Xian, Li Yi-fan, Chen Ching Lai, Gao Hong security, "GPS mobile phone navigation system design," 2009 computer and network technology applications in education seminar, 26-27 November 2009.