An Implementation of Augmented Reality and Location Awareness Services in Mobile Devices

Pei-Jung Lin[1], Sheng-Chang Chen[2], Yi-Hsung Li[3], Meng-Syue Wu[1], and Shih-Yue Chen[1]

[1] Department of Computer Science and Information Engineering, Hungkuang University, Taiwan
[2] Ursa Pictor Design Co., Taiwan
[3] Institute for Information Industry, Taiwan

Abstract. The popularization of smartphones and advances in location-based technology have led to the creation of many applications and diverse mobile cloud technologies. Augmented reality (AR), which integrates virtual reality with the real world, is one of the mobile service technologies that have been receiving considerable attention in recent years. This study focuses on AR technology, which in conjunction with point of interest (POI) information established in a cloud database, enables users to instantly obtain services with the camera lenses of their mobile devices. The developed system allows users to quickly share AR images and information with others in their social networks from their current locations. This work includes social communities, photographing, radar detection, and GPS positioning that facilitate various human-machine interactions and information searches.

Keywords: Location-based Services, Mobile Social Network, Augmented Reality, Clouding Computing.

1 Introduction

With the increasingly wide application of mobile devices, smartphones and tablet computers are rapidly becoming integrated into every aspect of life, encompassing commercial marketing, scientific and technological industries, car navigation, interactive education, and game development. The scope of application is considerably vast and offers many advantages. In recent years, a number of technologies associated with augmented reality (AR) have extended to mobile devices. This technology is incorporated real-world elements into virtual reality. In AR, computer text and image information superimposed on images of the real-world environment provide accurate sensory information when users require it. Users can roam through a given space using mobile devices, integrating interaction between the virtual and the physical. AR is eye-catching in that it emphasizes the interaction between objects and real space. The applications and commercial opportunities for this technology are considerable. In this study, we developed a cloud database system integrating AR technology and social networking. The purpose of this system is to provide users with a location-based

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service (LBS) platform that supplies employment information. When users aim the camera lenses of their mobile devices at their surroundings, photographs are sent to the server site using cloud computing. The server site then retrieves and sends back data from the database, which is presented on the screens of users' smartphones or tablet computers, enabling them to access point of interest (POI) information corresponding to their GPS locations. Subsequently, the screens display job openings within their vicinities, presenting the information in AR message boxes. This is an extremely convenient system for those seeking employment.

According to a smartphone market-forecasting report released by the international research advisory firm, Gartner, 1.83 billion users are expected to be using their smartphones for internet access by 2013. For the first time, exceed that of users accessing the internet by computer (1.78 billion). The report also predicted that by 2014, over 70 billion downloads of mobile applications from App stores will be conducted yearly. In the same year, 20% of sales agents will be communicating through social networking services instead of through email, and personal cloud services will replace personal computers, forming the core of the digital industry. By 2015, approximately half of all online sales will originate from social networks and smartphone applications, and the data storage demands of consumers will be satisfied by free social network sites. At present, users are already accustomed to uploading a large number of photographs to Facebook. Smartphone usage is growing exponentially, of which Android and iOS hold a total market share of over 68%. With the development potential of this significant trend in mind, we developed a cross-platform mobile employment system using AR technology. This system can be installed in mobile devices using the two major operating systems mentioned above. We also integrated the social network Facebook, enabling users to share screen information. The popularization and convenience of mobile devices and the integration of AR [5, 8] in this study enable users to effectively satisfy their job-hunting needs. During the process of job-hunting, people generally utilize the internet to seek for job vacancies, by searching employment websites for example. However, it is hard to provide the job-hunting service according to users' location. We hope that the vast community of mobile device users can benefit from the convenience of our proposed mobile job-hunting system integrated with AR, and have access to employment information at any time.

2 Related Works

AR was developed from virtual reality technology, the concept of which originates from the "ultimate display" proposed by Professor Ivan E. Sutherland in the 1960s. In the following decades, virtual reality has been extended in the form of computer graphics, computer simulation, artificial intelligence, and sensing technology. Virtual reality uses virtual three-dimensional (3D) images generated by computer graphics to create a virtual environment that integrates the visual, auditory, and tactile sensory information. Although derived from physical reality, virtual reality does not allow users to perceive their physical surroundings. AR was thus created. It enables the virtual and the physical to co-exist in the same space. AR does not replace the real world; it augments it with virtual images and allows users to perceive the virtual world and the real world at the same time. AR [4, 6] comprises computer-generated virtual images that use real-world objects as location coordinates. The images overlap or are merged to create a mediated reality that resides between the virtual and the real. Using the newly created mediated images, images of the real world can be augmented (or modified or diminished). Users can obtain corresponding sensory information [4, 9] through related devices (head-mounted displays, retina displays, or smartphones).

There are currently a number of existing platform systems for AR. Junaio [12], for example, displays AR images in the form of message boxes and uses radar detectors to conduct radar searches. This system is primarily used to plan transportation routes. Smartphone pictures and videos can also be stored in databases or uploaded and shared with social communities. Layar [11] enables software engineers to create various functions; users can see AR images with automatic message box displays, make phone calls, send e-mail, and plan routes. The Sekai Camera system [14] enables users to design their own AR; the customized functions allow users to input POI information to their current locations in the form of text or self-designed images. Other systems are designed for specific subjects. Wikitude [13], for instance, is designed for backpackers and enables users to search for recreation information and geological information on Wikipedia. Libre Geo Social [15] locates landmarks near the location of the user and provides select AR information; if the user selects fast food restaurants, the system will immediately show nearby fast food restaurants. Comparing the above, we found Junaio to be the most suitable application for job-hunting, as it allows users to limit the range of their search by distance. When in map mode, Junaio displays the locations of companies. Keywords can also be used to search for other subjects. Location-based job-hunting is thus enabled, and through the AR images, users can contact companies in which they are interested via phone or e-mail.

3 System Overview

Figure 1 displays the four major functions of the system: (1) AR Presentation: the opening screen of the system shows an introduction to the system with a reality virtual image, (2) Tagged Info: users can detect their own locations on maps, and in conjunction with multi-point positioning functions, they can plan routes on foot, by car, or by public transportation, (3) Social Network Sharing: using their smartphones, users can upload their photographs to social network sites and share them with friends, and (4) Radar Detection: a radar map displays nearby POI markers and message boxes containing distance-related information. These are the four core functions of the proposed system, which supports two major platforms, Android and iOS.

The developed system uses GPS to provide location-based information. In this case, the information involves job vacancies in the near vicinity. When users aim the lenses of their smartphone camera at the POI, virtual message boxes are displayed containing the marker information on companies or stores sent from the cloud database to the server site. POIs are locations of interest marked by users with appropriate information corresponding to the coordinates.

The information may include advertisements, URLs, or company contact details. The server site then returns the information to the mobile devices through Internet, enabling users to perform GPS tracking [1]. Job vacancies are displayed in AR message boxes based on the location of the users, thereby fully utilizing the characteristics of virtual images and integrating them with employment information. The POI information in this study was obtained from employment websites, providing users with up-to-date information. Furthermore, mobile device users can download the system from Android Market or App stores.

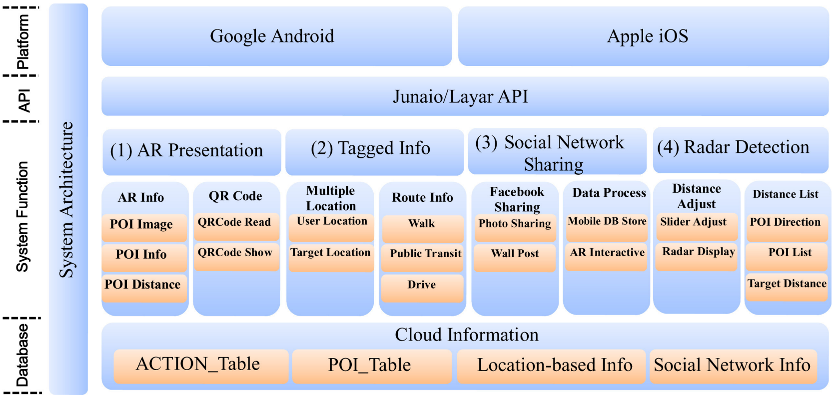


Fig. 1. Overview of system functions

3.1 AR Images

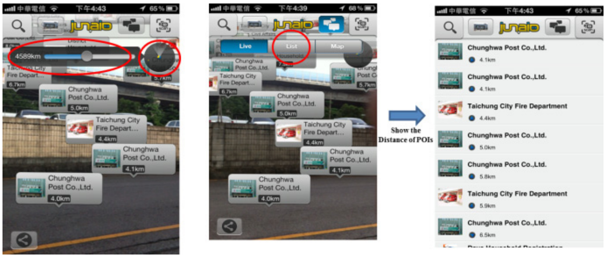
In the augmented virtual images on a smartphone, two relevant functions can be seen, as shown in Figure 2. The screen shows the virtual image provided by AR; the image presented by GPS positioning and the lenses merges the virtual with reality, making the message boxes more real [10]. Users can enter the developed employment system by simply scanning a QR Code with the mobile device, as seen in Figure 2 (a). Upon entering AR mode, the content of each message box is displayed using AR virtual images. When users select a message box, an information window will pop out, containing a brief introduction for users to browse. Other functions such as making a phone call, sending e-mail, playing videos, and planning routes are also shown. Users can also link to the URLs of company websites for further information, and share the information or screenshot with friends so that while integrating the information that user's need [2], the AR also enhances interaction with other users.

(a) (b)

Fig. 2. (a) QR Code scanning; (b) Actual screenshot

3.2 Radar Detection

This function displays all of the POI information in the near vicinity of users on radar maps on the mobile devices with the locations of the users in the center. This allows users to see their relative positions with each POI marker in addition to the pertaining information. The smartphone screenshots clearly indicate the markers nearest the users. As shown in the upper right hand corner of the screen in Figure 3(a), the radar map displays the POI markers as dots. Densely distributed dots show where POIs are high in number.



(a) (b)

Fig. 3. (a) Distance adjustment function; (b) List mode

As shown in Figure 3(a), the distance in the radar map is calculated in kilometers. When users take photographs, they can set a distance limit by selecting the radar map. This displays a scroll which shows the number of kilometers and with which users can adjust the distance range. When there is a greater number of AR message boxes, users can narrow the range to reduce the number of overlapping message boxes on their screen, thereby giving them a clearer screen image. By adjusting the distance on the screen, the message boxes will also change accordingly to demonstrate the distance between the POI and the users, as will the number of message boxes.

Figure 3(b) shows the list mode that users can select. The list mode lists the markers nearest the users and their distance from the users. In the event that the AR message boxes are very dense, users can switch to this mode. As users move, the content of each marker will change accordingly [7]. Using the distance adjustment function, users can control the amount of information in the list. The system also has a gyrocompass function that provides further accuracy in navigation.

4 Conclusions

The applications of AR are becoming increasingly diverse. In particular, the use of AR virtual images in smart mobile devices is rapidly growing in popularity. Our developed system combines four major functions: augmented reality, map search, social networks, and radar detection. Route planning for multiple means of transportation is also provided. To satisfy the needs of individuals seeking employment, the system uses the current location of users to provide POI information with LBS. This allows users access to employment information anytime, anywhere. We tested the developed system on two major operating systems: Apple iOS and Android. The AR screenshots can uploaded to social network sites and shared with friends instantly. As the number of individuals using mobile devices such as smartphones and tablet computers increase, an AR job-hunting application with LBS can enhance the efficiency of searching for this kind of information.

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