Features and Techniques for Advance Business Card System Based on Android Mobile Augmented Reality

W. K. Obeidy, H. Arshad, and B. Parhizkar

Abstract— Due to advancements in the mobile world and the presence of various strong mobile platforms (Android, IOS, Symbian), it is now possible to make use of the revolutionizing Augmented Reality (AR) technology in mobile devices. This paper presents a short review of concepts of augmented reality and different features and techniques used in previous researches in the field of mobile augmented reality such as tracking, rendering of graphics and the visualization of data required in order to develop an advance business card system. It was found that few simpler AR and Quick Response (QR) code systems exist independently for business cards but do not co-exist together. The core concept of the research is to successfully combine the QR code and the AR and to visualize the virtual 2D & 3D information which in turn displays on mobile phone screen by using AR technology. This work will present us an opportunity to understand and discuss how systems using these advanced technologies can shape today's business and communication systems.

Index Terms— Business Card, Mobile Augmented Reality, QR Code, Android OS.

1 INTRODUCTION

A relatively new term in the field of technology is Augmented Reality (AR) which is somehow can be considered as an extension or a variation of virtual reality. It lets users to experience a new world where the real world is composited or superimposed with the virtual objects upon it and therefore it acts so as to supplement the reality, rather than completely replacing it [1]. AR requires Head Mounted Displays (HMD) and tangible interface objects which has the ability for Six Degree of Freedom (6DOF) pose tracking to assure that there is inexpensive pose tracking, stability in robust and time varying environmental conditions [2]. However, in recent times the popularity of AR devices has switched from the early mobile augmented reality systems; Backpack with HMD's to various small and low cost devices in the form of different smart phones and digital tablets(Fig. 1 a-d) [3].

According to [4], a smart phone is a tiny, networked computer in the form of a cell phone which usually provides the user with mobile and wireless communication capabilities and Personal Information Management (PIM) applications.

Smart phones are developed for a comparatively larger consumer base which is mobile. They are surprisingly robust and powerful although their appearance is very fragile. Almost all of the smart phones today include a built in camera which automatically serves for computer vision approaches. In mobile devices, generally the quality of AR is lower than AR in PC platforms because the computer vision's quality is based on camera and image sensor characteristics [5]. Unlike the earlier smart phones, these days smart phones are being used by the users as a complete gadget which serves almost all their electronic media needs such as playing interactive games, checking emails, reading news, watching TV, managing and interacting with their social online/offline contacts and vCards in ways other than just calling and sending text messages.

Business cards are widely used small cards that help one in giving great information and impression to strangers in perceiving ones personality and work. Typical business cards standard size and measurements are unable to allocate greater information than their sizes due to the limitation of space. Many a times, the information of a business card is unclear and incomplete, which creates a lot of confusion in its viewer's mind [6].

With the task in hand, this research is to design and digitize an advance business card system using mobile phone Quick Response (QR) & AR technology which could combine both these technologies along with some advanced features such as calling, emailing, networking, navigation etc. in order to enhance the functions of traditional business card and visualize detailed information about the person. The objective of this work is to display a large amount of clear information by understanding and using QR and AR technology and to tackle some of the previous research problems such as the tracking, poor graphics and visualization of data in a physical business card.

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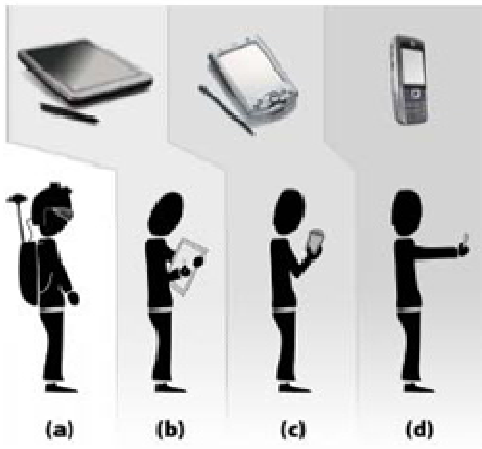

Fig. 1. Symbolic evolution of Mobile AR: (a) HMD Backpacks, (b) UMPC's, (c) Handhelds, (d) Mobile phones.

2 MOBILE AUGMENTED REALITY

The concept of AR tec**hnology can be described as the** superimposition of graphics, audios and other objects in real-time over a real world environment [7]. By implementing the real world with 3D virtual objects, AR technology aims at enhancing the user's imagination and interaction with the real world. The virtual objects seem to co-exist in the same space as the real world. As described by [5] successful implementation of AR requires HMD's and tangible interface objects which has the ability for 6DOF pose tracking. This is because they are capable of offering an environment where the pose tracking is inexpensive and the system works in real time, changing environmental conditions and in a robust manner. Many potential applications are offered by AR technology in various fields including instant information, gaming, advertising, maintenance and construction, military, etc. There are hundreds of potential applications for such a technology, the most obvious ones being advertising, gaming and entertainment [8].

In normal circumstances a pair of sunglasses combined with high-resolution 3D graphics capabilities, accurate DOF tracking and built-in computer with wireless network support is all we need to setup an ideal mobile AR system. No other equipment is required to carry or wear by a mobile user to experience mobile AR environment [9, 10]. The Columbia Touring Machine (CTM) was introduced as the first outdoor mobile augmented reality system which included true mobility. According to [7], user must not feel any conflict and discrepancies between the augmented environment and the real world when AR reaches nearer to its maturity level. It is because of this that the goal of AR technology is to create an environment where user cannot differentiate the real world and augmented elements. Therefore, it is clear that AR focuses on changing those graphics to accommodate the user's head and eyes movements to assure that the graphics always fit the perspective of the user.

Recently, the smart phones have gained tremendous attention for their use in augmented reality technology. It was predicted two years ago that the number of mobile phones sold in 2012 will be around 1.8 billion, and 80% of them were estimated to be from the smart phone category [3]. Unknown marketing strategists introduced the term smart phones to refer to a new category of the mobile phones which could allow data access and processing with greater computing power at that time [4]. Generally it is said that, augmented reality has become practicable on high-end mobile handsets only in 2009. This was because of the availability of superior technology and five key facilities within the handsets other than the mobile operating system which augmented reality supports which are; camera, GPS, Broadband connectivity, tilt sensors and digital compasses [11].

Normally, most smart phones come with one or more built-in cameras, and this allows the device to serve itself for computer vision approaches. Nevertheless, camera and image sensor characteristics like frame size, update rate etc. greatly influences the quality of computer tracking [12]. Thus, in order to achieve the required performance of AR applications, careful selection of algorithms is needed. This is because PC's which acts as a high end device have greater computing capabilities than the smart phones. For instance, heavy use of template C++ and Java code ends up in a negative increment in the code size which in turns slows down the complete process [3]. This limits such devices to application of simple algorithms to solve complex issues such as tracking registration and rendering of augmented reality contents.

3 TRACKING

The three main processes for successful implementation of any AR system are tracking, registration and rendering. AR demands very precise position and orientation tracking so that it can register and align the virtual information with the real elements. To cheat the human sense in order to accept that artificial virtual objects and the physical objects co-exist in the same physical space, is almost impossible without the accuracy and precision achieved by these processes. A number of surveys done by Azuma et al [1], Azuma et al [10] and Hollerer [13] describes in detail a number of visual & non-visual tracking technologies that have been applied to AR such as magnetic and ultrasound.

Generally the latest tracking methods are classified based on their accuracy, resolution, degrees of freedom, delay, update rate, portability and electrical power consumption, infrastructure and operating range cost. Reference [14] explained that tiny devices like mobile phones have attracted a lot of research in the usage of video cameras as a mean for tracking purposes because of the lower costs and the advanced video capturing capabilities of the new video cameras.

For complex augmented reality applications, a very popular approach is the use of fiducials. Fiducial markers are patterns which can be identified easily like concentric

circles located in defined positions. They can be like a passive printed marker or an active light-emitting diode. Both of the two types of markers have already been experimented in different AR applications in previous researches. The clutter resulting from the markers is sometimes undesirable but the use of black and- white printed markers is considerably inexpensive. It is also considered faster and quicker than many accurate off-line surveying of the open spaces and other borderless markers. To efficiently tag a huge number of different locations and objects, unique identifiers are encoded into the marker [12]. Although there are many existing fiducial-based tracking systems available today but none can reach the heights of the ARToolkit system. Tamura et al [15], Billinghurst et al [11], Wagner et al [2], Cheok et al [16], Barakonyi et al [17] presents examples where they have implemented different versions of ARToolkit in mobile devices. Moreover, various tracking algorithms discussed in [14] also provides realistic real-time camera tracking. These techniques follow approaches like natural feature detection, edge detection, planar methods etc. The disadvantage of such techniques and approaches is that they demand a huge amount of processing power creating difficulties on other AR tasks such as rendering.

In simple AR terminology, rendering refers to the drawing of the contents onto the screen for the users to witness. The majority of the existing AR systems use standard computer graphics algorithms for displaying virtual objects in an augmented reality environment. Popular software libraries such as OpenGL, OpenCV, their hybrid versions like OpenGLES and high level scene graphs based on them (e.g., OpenSG PLUS) are often utilized for real-time rendering in AR [6,18]. The most challenging part for creating 3D models in mobile phones is that the devices have limited computational resources. Another major challenge is the lack of feasible programming interfaces because recently only few interface like OpenGL ES and JSR-184 have emerged. These proven technologies are easy to apply in an augmented reality systems and are apparently fast enough for generating robust interactive AR displays.

4 QUICK RESPONSE CODE

QR codes are two dimensional barcodes which were introduced by Denso Wave in Japan. QR Codes gained rapid popularity and were adopted all over the world, especially in Japan because of its ability to encode the Kanji symbols. They are widely used in storing URLs, addresses and various forms of data on posters, signs, public transport vehicles, and business cards. QR codes have already become more popular than the classical barcode in many places. This is due to the fact that typical barcodes only store a maximum of 20 digits; however QR Codes can save up to 7,089 characters [19].

QR Codes do not need to be scanned from one particular angle which makes them more flexible. The information is stored in both vertical and horizontal directions. A QR code can be read even it is somewhat distorted by either being tilted or on a curved surface by alignment patterns and timing patterns. The right way to decode the image based on the three squares that are positioned in the corners of the symbol and their alignment is determined by different QR code scanners [20]. Different areas are reserved inside the QR Code for performing different tasks (Fig. 2).

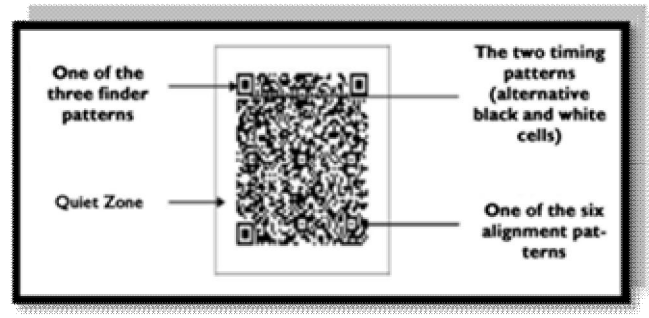

Fig. 2. A QR code sample showing its different areas

A QR code can withhold 7,089 numeric characters, 4,296 alphanumeric characters, 2,953 binary bytes, 1,817 Kanji characters or a mixture of them. The data capacity compared to other 2D codes such as PDF417, DataMatrix and Maxi Code is much higher [21, 32]. The QR codes are extensively used on business cards these days (Fig. 3). By placing the QR codes on a business card, people can digitally pass on their contact details, direct the viewer to a website, send them to a Flickr photo set or Facebook fan page etc. A number of QR code applications are available in different mobile platforms and have specially gained a lot of popularity after the evolution of android OS.

5 ANDROID OS

The Android platform is composed of the operating system, middleware, user interface and application software and is the first software platform and operating system built for complete mobile devices [18].

Fig. 3. QR codes implementation on Business Cards

Android application development is a hot topic since the introduction of Android by Google and hundreds and thousands of applications are being developed and shared in the Android market every now and then. Even until now, the charge to be a registered developer of the

Android Market is USD 25. Phones embedded with Android OS are widely available in the market for prices even as low as USD 200 which encourages the developers to experiment with Android applications [22].

Android supports a wide range of input/output devices, sensors and communication media. Through its massive complex of more than 100,000 Linux servers Google revealed the power of "Open Source" in 2008. This has allowed it to use the power of web and its search engine to revolutionize the mobile computing technologies with its open source Android platform[23]. In May 2010, Android's first quarter U.S. sales surpassed that of the rival iPhone platform. Analysts pointed many advantages and said that Android has as a multi-channel, multi-carrier OS, which allowed it to duplicate the quick success of Microsoft's Windows Mobile and even more. Several hardware manufacturers have already announced Android enabled smartphones and netbooks, even companies like Dell and Acer that normally are known for ordinary PC hardware[24]. Fig. 4 shows the latest 2012 data of the popularity of android from World Wide Smartphones Sales based on Gartner data. Reference [25] have successfully used android OS as the platform for their research Science Expedition and are felt satisfied with the robustness and flexibility of the platform.

6 BUSINESS CARDS

Business cards are one of the important communication media among people. They are printed with business information about a company or an individual. A typical business card includes the giver's name, company affiliation and contact information such as addresses, contact numbers, e-mail addresses and etc. (Fig. 5). The aspect ratios range of business cards is from 1.43 to 1.8. This is because different countries have different standard for the size of business cards [26,27].

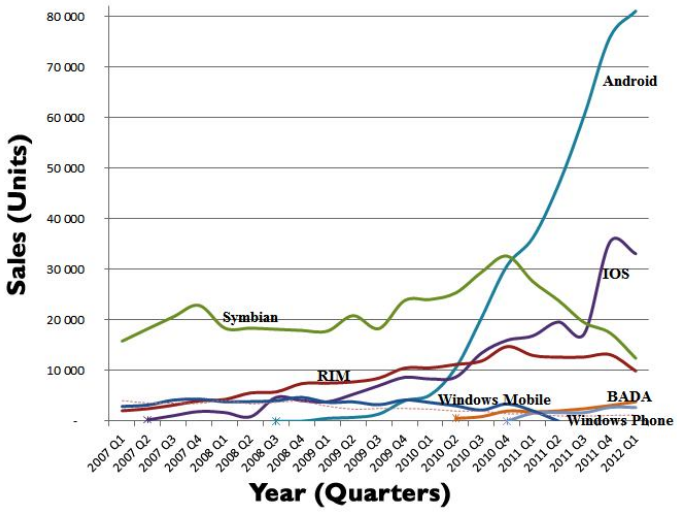

Fig. 4. Popularity of Android from World Wide Smartphones Sales based on Gartner data (16th May 2012)

Fig. 5. A typical business card

Augmented Business Card is a business card that comes with marker for AR technology tracking. In simple words, this business card is exactly like a typical business card with the implementation of AR technology in it. An experimental business card recognition system was proposed by [28] that recognizes Japanese business cards of a wide variety both in formats and fonts.

In order to use the information effectively, [29] extracted the information from the cards automatically to build a data base. Hua & Liu [30] presented a system which can automatically extract, rectify and enhance business card images and used extensive experiments to demonstrate the efficacy and robustness of their system. One more example of such research is found in Toxin Labs' research where AR technology is used in business card to display status of social networks, show personal portfolio, calling or direct contact through the application and etc. [31].

Meanwhile, Wagner & Schmalstieg [2, 12] have also performed such research where they track a marker on a business card with AR technology (Fig. 6). According to them the marker is usually expected to be surrounded by black borders and containing a black and white pattern or image. However, the marker's border can be made very thin (down to zero) if the image inside the marker is darker. Another similar research done by Weng et.al [6] introduces the technology of Mobile Phone AR and develop an application for business card and shows a successful rendering of a 3d map of the university upon the detection of the marker on the business card.

Fig. 6. Left - A virtual avatar on a business card by using mobile-phone-based augmented reality (Wagner & Schmalstieg, 2009) Right - Virtual map and building displayed on mobile phone's screen (Weng et al, 2011)

Along with the fundamental problems of the augmented reality such as tracking efficiency, robustness, registration and rendering of high quality graphics some other issues were also raised through the detailed review of earlier researches on business card augmented reality

systems. The main problems recorded in the earlier researches and their prototypes were that much of the focus was not on the information augmented and its relativity and that very less information has been augmented with very limited interactivity options available for the users.

7 PROPOSED WORK

The proposed work section will give a brief description of the methodologies that will be implemented to develop the Advance Business Card System. After our review, we realized that along with the fundamental problems in the areas of tracking, registration and rendering of AR materials which are normally dealt with the help of image processing and computer vision techniques, the lack of processing power of the handheld devices and growing need of the implementation of new technologies to cater the needs of the business contacts also required solutions. Due to the lower capabilities of the smart phones as compared to the computers, algorithms and techniques will be chosen very carefully in order to successfully combine the QR code, augmented reality (tracking, registration and rendering) and visualisation techniques in order to come up with an advance more visual, interactive and exciting business system. The 6DOF pose tracking of devices would prove as an inexpensive pose tracking, workable in robust and time changing environmental conditions. Fiducial markers developed using the ARToolkit will provide realistic real-time camera tracking stability and robustness. This is to ease the rendering process of complex models and 3D objects. Different approaches such as natural feature detection, edge detection, planar methods etc. will also be tested in order to analyze the differences in the performance and efficiency of the system. This will require large amounts of processing power posing difficulties on the additional AR rendering tasks. OpenGLES will be used extensively for the development of 3D Models to assist successful rendering of complex models on the Android OS. However different techniques other than the OpenGL development will also be conducted for the analysis purposes only. A special attention will be focused upon the relativity of the information and the amount of the data augmented in the form of visuals by understanding the different concepts of visualization and combining it with the main concepts of the research, namely; QR code, Augmented Reality and the Business Card. Shneiderman's Visual Information Seeking Mantra provides design guidelines for dynamic exploration of large information collections. This mantra will be used as a starting point in the understanding of how to design effective visualizations after the comparative review of typical techniques used in the marker development.

8 CONCLUSION

A literature review of the topics such as QR technology, mobile augmented reality, business cards and the latest platforms have enabled us to understand the basic concepts of these technologies and provided us with a deep analysis of the research work going on in these areas. During the course of the literature search we found some major problems which exist in these fields. It was clearly identified that even though there exist some systems which either supports the AR or QR technologies in the business cards, it would be beneficial to have a system which could combine both these technologies along with some advanced features such as calling, emailing, networking, navigation etc. We have named this system as an Advance Business Card System.

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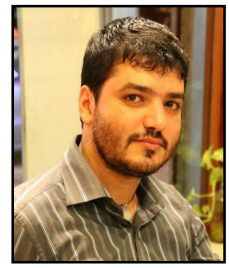

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