

A Review on Augmented Reality Technology

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Abstract—

Nowadays, there is new technology such as augmented reality and virtual reality that starting to get attention from many parties especially in mobile gaming industry. This technology brings elements of the virtual world into the real world by enhancing what users see, hear and feel. All these elements are augmented by computer generated sensory input such as, sound, video, graphics or GPS data. Augmented and virtual reality also supported in many fields for example, education, design, reconnaissance, maintenance and etc. This paper review the field of Augmented Reality, including a brief definition, the problems, the inventing technologies and their characteristics. Besides, it will also discuss some recent application of as well as the limitations in the use of these technology

Keywords— *Virtual Reality, Augmented Reality, Ar User Interface, Tracking and Registration, Displaying and Rendering.*

I. INTRODUCTION

Augmented reality (AR) is a live, direct or indirect, view of a physical, real-world environment whose elements are augmented by computer-generated sensory input such as sound, video, graphics or GPS data. It is related to a more general concept called mediated reality, in which a view of reality is modified (possibly even diminished rather than augmented), by a computer. As a result, the technology functions by enhancing one's current perception of reality. By contrast, virtual reality replaces the real world with a simulated one. Augmentation is conventionally in real-time and in semantic context with environmental elements, such as sports scores on TV during a match. With the help of advanced AR technology (e.g. adding computer vision and object recognition) the information about the surrounding real world of the user becomes interactive and digitally manipulable. Artificial information about the environment and its objects can be overlaid on the real world. [2]

Until recently, augmented reality (AR) applications were mostly available for powerful workstations and high-power personal computers. The introduction of augmented reality applications to smart phones enabled new and mobile AR experiences for everyday users. Because of the increasing pervasiveness of smart phones, AR is set to become a ubiquitous commodity for leisure and mobile learning. With this ubiquitous availability, mobile AR allows us to devise and design innovative learning scenarios in real world settings. This carries much promise for enhanced learning experiences in situated learning. [3]

Augmented Reality 3D viewers, like Augment, allow users to place life-size 3D models in your environment with or without the use of trackers. Trackers are simple images that 3D models can be attached to in Augmented Reality. Augmented Reality browsers enrich your camera display with contextual information. For example, you can point your smartphone at a building to display its history or estimated value. Through mobile devices like smartphones and tablets, Augmented Reality acts like a magic window; through the viewer you can see holograms and manipulate 3D models. Hundreds of Augmented Reality apps are available on iPhone, iPad, and Android. On PC and connected TV player, Augmented Reality works through a webcam and relayed through the screen. This can be quite cumbersome when you have to manipulate a tracker in front of your screen. On head mounted displays, glasses, and lenses, Augmented Reality becomes a part of your entire field of view, making for more life-like AR experiences. It almost feels like Ironman with the help of Jarvis. [4]

The main goal of this research is to study the issues related to the augmented reality. The objectives are:

- To study more about augmented reality such as history, functions and others.
- To compare between augmented reality and virtual reality.
- To measure the effectiveness of augmented reality in mobile phones, PC, laptop
- To observe whether people nowadays using augmented reality in their life more than the past.
- To suggest people to use augmented reality more efficiently and frequently in their daily life.

II. BACKGROUND OF PROBLEMS

Nowadays, augmented reality is a technology that enhances our perception and interaction with the real world. This technology presents the information in form of images, 3d models and video in a real environment. Even though AR is a hot topic in recent technological news, for the majority of people, AR is still not so well known field.

In this part we will discuss some problems and misconceptions about augmented reality.

A. The similarity between augmented reality and virtual reality

- The biggest confusions here are the similarity between the augmented reality and virtual reality. Augmented reality is a combination of elements and information from the virtual environment with the real world environment which has been augmented by computer generated sensor input for example video, sound, graphic and etc.
- Virtual reality is the computer generated simulation of a real life environment. It immerses the user to make them feel like they are experiencing the environment.

B. Difficult to use

- Over the year, AR is getting easy to use because there is no special hardware or special skills required to apply it. In addition, anyone who has a mobile phone or laptop with built in capability can augment and extend their reality with easy to use applications. Otherwise people can just downloading the mobile application off the app store.

C. Augmented Reality requires a special headset

- Of course AR is actually has been popular with the use of headset glasses and head mounted display due to the Microsoft and Google. However, it is not necessary to use headset for AR. Nowadays, there are the most common method have been use such as by using mobile and tablet devices to access augmented reality content. For example, Pokemon Go game which is it is not require headset device to play the game. [5]

D. Augmented Reality is not well known field

- Based on the author of this book, he has received unexpected comment about the mobile augmented reality application that they have been experimenting which is situated simulations. It its surprising because over the last few years they have never received any comment like that. It says that until now there is still no exposure about the augmented reality and it was not given a proper attention in their research. [6]

E. Augmented Reality need to be exposed in educational field

- As we know, AR is not really well known in this field. In learning process student can actually more understanding the lesson if the teacher can deliver what they want to teach through visual display. It is proven that learning processes are estimated 80 percent of visual content is retained by short term memory compared to an estimated 25 percent for spoken content. AR technology has the potential to bring a lesson plan to life. [10]

III. DISPLAYING AND RENDERING

There are many classification of AR technologies can be made focusing on some sections. There are three sections such as displays, tracking and user interface. [7]

Displays

First, it is not only preferred to display technologies such as a head-mounted display (HMD). Second, this technology is limited to the sense of sight, as AR technology it should be able to include all senses such as hearing, touch and smell. Third, there is also about mediated or diminished reality where this approaches is about remove the real object by overlaying virtual ones and it is considered as AR.

Visual Display

Visual display is basically having many ways to show the AR. There are see through, optical see through, projective, etc. Video see through consists of a pair of stereo cameras mounted on the HMD and a standard graphic work station. Besides, the brightness and contrast of virtual object are matched easily with the real environment. The bad part is about the camera positioning and the human eyes are not parallax. Optical see through are actually applied in head worn display and hand held display. Then, for projective are not required a special eye wear and can cover large surface.



Fig. 1 Example of Head-Mounted [8]



Fig. 2 Example of AR Technology [9]

Table 1 Characteristics of Surveyed Visual AR Displays

Positioning	Head-worn				Hand-held	Spatial		
	Retinal	Optical	Video	Projective		All	Video	Optical
Technology	+	+	+	+	+	-	-	-
Mobile	+	±	±	+	±	-	-	-
Outdoor use	+	+	+	+	+	Remote	-	-
Interaction	+	+	+	+	+	+	Limited	Limited
Multi-user	+	-	+	+	Limited	+	Limited	Limited
Brightness	+	-	+	+	Limited	+	Limited	Limited
Contrast	+	-	+	+	Limited	+	Limited	Limited
Resolution	Growing	Growing	Growing	Growing	Limited	Limited	+	+
Field-of-view	Growing	Limited	Limited	Growing	Limited	Limited	+	+
Full-colour	+	+	+	+	+	+	+	+
Stereoscopic	+	+	+	+	-	-	+	+
Dynamic refocus (eye strain)	+	-	-	+	-	-	+	+
Occlusion	±	±	+	Limited	±	+	Limited	Limited
Power economy	+	-	-	-	-	-	-	-
Opportunities	Future dominance	Current dominance			Realistic, mass-market	Cheap, off-the-shelf	Tuning, ergonomics	
Drawback		Tuning, tracking	Delays	Retro-reflective material	Processor, Memory limits	No see-through metaphor	Clipping	Clipping, shadows

IV. USER INTERFACES

Augmented Reality Interfaces

One of the most important aspects of augmented reality is to create appropriate techniques for intuitive interaction between user and the virtual content of AR applications. There are three main ways of interaction in AR applications such as tangible AR interfaces, collaborative AR interfaces and hybrid AR interfaces. [10]

A. Tangible AR Interfaces

Tangible interfaces support direct interaction with the real world by exploiting the use of real, physical objects and tools.



Fig. 3 Example of Tangible User Interface [8]

B. Collaborative AR Interfaces

Collaborative AR interfaces include the use of multiple displays to support remote and co-located activities. Co-located uses 3D interfaces to improve physical collaborative workspace. In remote sharing, AR is able to effortlessly integrate multiple devices with multiple locations to enhance teleconferences. Such interfaces can be integrated with medical applications for performing diagnostics, surgery or even maintenance routine.



Fig. 4 Example of Collaborative User Interface

C. Hybrid AR Interfaces

Hybrid interfaces combine an assortment of different, but complementary interfaces as well as the possibility to interact through a wide range of interaction devices. They provide a flexible platform for unplanned, everyday interaction where it is not known in advance which type of interaction display or devices will be used. All paragraphs must be indented. All paragraphs must be justified, i.e. both left-justified and right-justified.



Fig. 5 Example of Hybrid User Interface

V. TRACKING AND REGISTRATION

To present and evaluate a method to use a user's bare outstretched hand in the same way a cardboard AR marker would be used, we present a method of tracking the fingertip configuration of a single hand posture, and use it for camera pose estimation. [13]

Adaptive Hand Segmentation

An adaptive skin color-based method is used to segment the hand region. In order to adapt the skin color model to the illumination change, a color histogram of the hand region is learned for each frame and accumulated with the ones from the previous n frames ($n = 5$ works well in practice). The histogram is learned only when the hand is in view and its fingertips are detected.

Accurate Fingertip Detection

Fingertips are detected from the contour of a hand using a curvature-based algorithm. And then curvature points will fit to ellipses in order to increase the accuracy. The fingertips are then ordered based on the index of the thumb, which can be determined as the farthest fingertip from the mean position of all fingertips.

Fingertip Tracking

The fingertip trajectory is tracked by a matching algorithm that minimizes the displacement of pairs of fingertips over two frames. While matching the fingertips in two frames, the order of fingertips on the contour is used to constrain the possible cases of combinations, determining the ordering (front or back) by the position of the thumb.

In order to estimate the camera pose from the tracked fingertips, we measure the size of the hand by calculating the position of the fingertips in a one-time initialization process. Using the hand model and the extrinsic camera parameter estimation, a 6DOF camera pose can be estimated.

VI. COMPARISON BETWEEN AR AND VR

What is Virtual Reality?

Virtual reality is all about the creation of a virtual world that users can interact with. This virtual world should be designed in such a way that users would find it difficult to tell difference from what is real and what is not. Furthermore, VR is usually achieved by the wearing of VR helmets or goggles. [9]

Difference and similarities

Both virtual reality and augmented reality are similar in the goal of immersing the user, though both systems to this in different ways. With AR users continue to be in touch with the real world while interacting with virtual objects around them. With VR, the user is isolated from the real world while immersed in a world that is completely fabricated. As it stands, VR might work better for video games and social networking in a virtual environment such as PlayStation.

VII. DISCUSSION AND CONCLUSIONS

Augmented reality technology become more important in our daily life especially in this 21st century. When the computers become common, there is no strange feeling to use it and to interacting with. We have splits into three methods in doing this literature review.

1. Displaying and rendering
2. User interface and interaction
3. Tracking and registration

Augmented reality systems require the use of specialized display devices. Basically optical see through or video see through display are used. And most display devices for augmented reality applications are most easily categorised as head mounted and non head mounted. However, the difficulties in building augmented reality systems equally large even at the level of the display.

Nowadays, people use smartphone to use the applications and software. User interface plays important role for user to choose whether the applications such as games, gps, notes are interesting to use for their daily life. Simple and understandable user interface attract people to use the applications. There are many principles that have to be follow to make UI attractive and idealistic for the use of user or customer.

For tracking and registration, various approaches had been introduced. As smartphone technology growing rapidly, new technology are bringing into smartphone development. It helps to solve limitation of development of augmented reality in mobile. In order in adopting this new development environment, previous approaches way has been modified and new approaches introduced to make this augmented reality development easier, efficient and fast.

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