ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijareeie.com

Vol. 6, Issue 4, April 2017

Review Paper on Augmented Reality

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ABSTRACT: The word Augmented Reality (AR) is used to define a combination of technologies that allow the combination of computer-generated content with live video display in real time. AR is based on technology developed in VR and not only interacts with a virtual world; it also has some degree of interdependence with the real world. Augmented reality, where virtual content is deeply integrated with visuals of real-world scenes, is a growing area of digital design. With the emergence of personal mobile devices capable of producing exciting augmented reality experiences, AR has begun to explore its vast potential. This paper looks into the current state of the art in Augmented Reality. It describes work done in different application domains and explains the exiting problems encountered when building Augmented Reality applications taking into account the ergonomic and technical limitations of mobile devices. This presents and addresses future directions and areas which involve further study.

KEYWORDS*:* Augmented Reality, Scientific Visualization, Virtual Reality, Technology, Real time video.

I.INTRODUCTION

Augmented Reality (AR) is a technology that involves overlaying the real-world computer graphics. One of the technology's best overviews is, that defined the field, described a lot of issues, and summarized developments to date. AR is called Mixed Reality (MR) within a more general context, referring to a multi-axis spectrum of areas covering Virtual Reality (VR), AR, tele-presence, and other related technologies [1]. Virtual Reality is a term used for 3D environments created by computers that allow the user to enter and interact with virtual environments. Users can "immerse" themselves in the computer artificial world to varying degrees, which can be either a simulation of some form of reality or a simulation of a complex phenomenon [2].

Fig. 1: Example of AR with Virtual Chairs and a Virtual Lamp.

The fundamental purpose of telepresence is to extend the sensory-motor facilities of the operator and the problem-solving capabilities to a remote environment [3]. In this way, telepresence can be described as a human / machine system in which sufficient information about the teleoperator and the task environment is received by the human

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operator, presented in a fully natural manner that the operator truly feels present at remote site. Quite close to virtual reality, where they strive to achieve the illusion of presence in a computer simulation, telepresence aims at achieving the illusion of presence in a distant location. AR can be considered a VR-to-telepresence device. While the environment is fully digital in VR and is completely real in telepresence, the user sees the real world that with virtual objects in AR [4].

II.AUGMENTED REALITY COMPONENTS

Scene Generator:
The scene generator is the device or software responsible for the rendering of scene. Rendering is not actually one of the major problems in AR, because a few virtual objects need to be created and often do not really have to be accurately made in order to serve the function of the application [5].

Tracking System:
The tracking system on AR systems is one of the most important problems mainly due to the issue of registration. The items in the real and virtual worlds should be perfectly aligned with each other or undermine the illusion that the two worlds coexist. Some applications in the industry require precise registration, especially on medical systems [6].

Display:
The AR technology is still being developed, and solutions are dependent on design decisions.
The bulk of AR Displays are HMD (Head Mounted Display). There are two simple choices available when integrating the physical and the virtual world: optical and video technology. Each of them has some tradeoffs depending among others on factors such as resolution, versatility, field of view, registration strategies. Display technology remains a limiting factor in AR systems growth. There are still no see-through displays with sufficient brightness, resolution, field of view and contrast to integrate a wide range of real and virtual images seamlessly. Moreover, many technologies that are beginning to approach these goals are not yet small, lightweight and low-cost enough. Nevertheless, as we shall see next, the last few years have seen a number of advances in see-through display technology.

III.AR DEVICES

Optical See-Through HMD:
Optical See-Through AR requires a transparent Head Mounted Monitor to clearly monitor the virtual environment in the real world. It works by putting optical combiners before the user's eyes. Such combiners are partly transmissive, so the user can see the real world directly through them. The combiners are also partly transparent, so that the user can see simulated images reflected off head-mounted displays from the combiners. The various augmented medical systems are prime examples of an Optical See-through AR system. The MIT Image Guided Operation focused on brain surgery. UNC experimented with an AR improved ultrasound system and other methods of superimposing a patient's radiographic images [7]. There are many other Optical See-through systems, as the main direction for AR seems to be this. Despite these specific examples, there is still a shortage of general purpose see-through HMDs. The synchronization of the HMD optics with the real world is one problem for Optical See-through AR. A decent HMD allows for adjustments to fit the individual users ' eye position and comfort. As well, pushing it out of the way should be easy when not needed. Such changes, however, will alter VE's registration over the real world and involve machine re-calibration.

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Fig. 2: Optical See-Through HMD

Virtual Retinal Systems:

In 1991 the VRD (Virtual Retinal Display) was developed in the Human Interface Technology Lab (HIT) at the University of Washington. The goal was to produce a full color, wide field of view, high resolution, high brightness, virtual display at low cost. Microvision Inc. has the exclusive license to sell the VRD technology. This device has many potential applications, from head-mounted displays (HMDs) to medical applications for military / aerospace applications.

The VRD directs a modulated light beam (from an electronic source) directly onto the eye's retina and produces a rasterized image. The spectator has the impression that he / she is standing two feet away in front of a 14-inch display, seeing the source image. In fact, the image is on his eye's retina and not on a screen. The image quality he / she see is outstanding with stereo vision, full color, wide field of view and no flickering features [8].

Fig. 3: Virtual Retinal System HMD

Monitor Based:

Monitor Based AR also uses combined video streams but display is a more traditional screen display or display that is held by hand. It may be the least difficult setup for AR, because it eliminates HMD issues. Princeton Video Image, Inc. has developed a method to merge graphics into video streams in real time. Their job is routinely presented as the first down line in football games in America. It is also used to insert commercial logos into various broadcasts.

Projection Displays:

Projector Based AR uses objects of the real world as the surface of projection for the virtual environment. It has industrial assembly tools, product simulation, etc.. AR-based projector is also well suited for multiple user situations. Projector alignment and the projection surfaces are critical to successful applications.

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IV.APPLICATIONS OF AR

Augmented Reality improves a user's understanding of the real world and its interaction. The virtual objects display information which the user cannot detect with his senses directly. The knowledge that the virtual objects convey lets a user perform tasks in the real world. AR is a particular example on what Fred Brooks considered Intelligence Amplification (IA): using the machine as a tool to make it easier for a person to carry out a mission [9].

Medical:
Augmented medical technology takes its primary motivation from the need to imagine medical data and the patient in same physical space. This would involve in-situ real-time visualization of co-registered fragmented data and was possibly the target of many of the medical augmented reality solutions. In 1968, Sutherland proposed a tracked head-mounted screen as a novel human-computer interface for view-dependent visualization of virtual objects.

Fig. 4: Image Guided Surgery

Another use in the medical sector for augmented reality is ultrasound imaging. The ultrasonic technician will show a volumetric rendered image of the fetus overlaid on the pregnant woman's abdomen using an optical see through monitor. The picture appears as if it was within the stomach and is rendered correctly as the user moves sielhorst2008. In addition, a researcher explain the first steps towards a Superman-like X-ray vision in which a brain-computer interface (BCI) system and a gaze sensor are used to enable the user to monitor AR simulation.
Military:
The military used screens in cockpits that show data to the pilot on the cockpit windshield or flight helmet viewfinder (Fig. 5). It is a type of augmented reality. It is possible to imagine the activities of other units involved in the exercise by equipping the military personnel with helmet mounted visor displays or a special purpose rangefinder. For example, while looking at the horizon, the display-equipped soldier could see a simulated aircraft rising above the tree line, during a training section. Another person could be flying the helicopter in simulation. During combat, the view of the real battlefield scene could be improved with annotation details or focus on concealed enemy units.

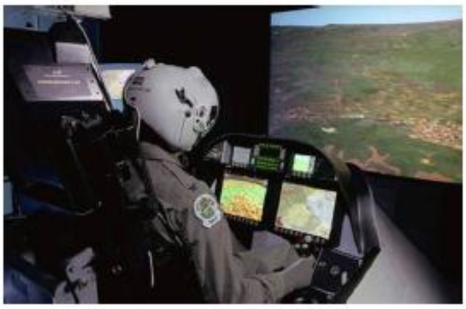

Fig. 5: Military Training.

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Entertainment and Games:
In the entertainment industry, augmented reality has been applied to create games but also to increase the visibility of important aspects of the game in the broadcast of life sports. AR can also serve advertisers to show virtual ads and product placements in those cases where a large public is reached. Swimming pools, football stadiums, race tracks and many other sports environments are well recognized and easily prepared, which easily feeds video viewing via expansion tracked camera. Another example is Fox-Trax system, used to illustrate the position of a hard-to-see hockey puck as it moves quickly across the ice, but AR is also used to annotate racing cars, snooker ball trajectories, life swimmer results, etc. The annotations are shown on the ground and not on the players thanks to predictable conditions (uniformed players on a green, white, and brown surface) and Chroma-keying techniques.

Fig. 6: Virtual Surgery Using Robot Arms

Robotics and Telerobotics:
The robot is directed by a tele-robotic operator using a visual image of the remote workspace. Annotation of the view would be helpful, as is the case when the scene is in front of the operator.
In addition, the augmentation of structures with wireframe drawings in the view will allow visualization of the remote 3D geometry. If the user attempts a move it can be performed on a simulated robot which is visualized as an increase to the real scene. After seeing the results the operator may decide to proceed with the motion. The robot action can then be directly performed which would remove any oscillations caused to the remote site by long delays in a telero-botic program. The use of robotics and AR is for remote medical service.

V.CHALLENGES

Despite increasing interest in AR and the large body of advancements and studies, a number of challenges and concerns still remain and need to be addressed. In this part, they define the boundaries characterizing AR's current state of the art based on the following aspects: technology, social acceptance, usability. Significant advances made in each of the fields outlined in this article. Nevertheless, the technology that needs to be surmounted still has limitations. In fact, AR system has to interact with vast amounts of information. The hardware used should be thin, lightweight and easily portable and quick enough to display graphics. The battery life utilized by these complicated AR devices is also another limitation for the uses of AR. In addition, AR tracking requires some device hardware such as GPS to provide accurate markers, requiring them to be both precise and reliable. For realistic use of AR these technological problems need to be overcome [10]. Typically, AR systems collect a lot of information, and need software to sort the information, maintain useful information, delete useless data and display it conveniently.

VI.CONCLUSION

Among several recent advances in AR there is still a lot of work to be done. Using the available libraries can help with application innovations. One of them is ARToolkit, which offers computer vision techniques for measuring the location and orientation of a camera relative to the marked cards so that virtual 3D objects can be precisely overlaid on the

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markers. All wearable equipment needs to be developed to be lighter, smaller, and more user-friendly. AR system researchers also need to consider other challenges such as AR system response time delays, hardware failures, or software failures. AR system limitation is registration error.

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