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A Survey on Augmented Reality Technologies and Applications

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Abstract - *Augmented Reality is the new way of enhancing our perception of the reality with virtual elements so that we can see, hear and feel this new elements. AR is available in various fields such as education, medical, military and a various of other fields. This paper describes AR, its definition, a brief history about it and the various applications that is now in used in the modern trends.*

***Key Words*: Augmented Reality, Technologies, Applications, Virtual Environments, Virtual Reality**

1. INTRODUCTION

A Technology through which we can see, hear or feel and sometimes in the near future maybe taste it. With it we can perceive virtual elements and objects within our real world experience, interact with virtual creatures and entire architectural structures that can help us in our daily activities with input as finger gestures and speech.

Imagine a world where every thoughts and ideas can be projected to the real world where we can perceive it with our eyes and ears and also feel it. Augmented reality is a technology that will bring us closer to that dream. With the advancement of such technology mechanics could see instructions on what to do next, surgeon could see ultrasonic organ while they are operating on the body as opposed to the screen, soldiers could see positions of infantry and enemy snipers spotted by a unmanned drone or aircraft, we can view the food of the restaurant using their menu or the reviews on a particular restaurant, information on a public monuments or buildings.

1.1. Definitions

AR by definition is a part of mixture of both reality and virtual reality. AR systems deviates from a basic VR system as it adds the virtual objects on to the real environment as opposed to the transportation of the user to a virtual world. An AR System follows:

a) Combines real and virtual elements in a real environment.

b) Runs interactively in three dimensions and also in real time

c) Realign virtual and real object with each other using coordinates

One major mistake with the definition of AR is that many people relegates it to the common use of HUD as a visual only component. AR is not limited to Visual senses, it can also refer to the other senses like hearing, feeling also.

1.2. History

AR made its first debut back in 1968 when a computer scientist Evan Sutherland developed the first ever head mounted display system called " The Sword of Damocles". It basically used computer graphics to show wireframe drawings.

Later in 1974, computer artist Myron Krueger established an artificial lab called the "Videoplace". It combined projectors, video camera and different types of hardware to implement an interactive experience.

Sometimes in 1990, the word "Augmented Reality" was first used by Boeing researcher Tom Caudell. He and his colleague David Mizell proposed that the worker configuring the airplane should wear Head mounted Display that would display the airplane schematics.

By the late 1990s, as AR gain its popularity, several conferences on AR began, including the International Workshop and Symposium on Augmented Reality, the International Symposium on Mixed Reality, and the Designing Augmented Reality Environments workshop. Organisations such as the Mixed Reality Systems Laboratory2 (MRLab) in Nottingham and the Arvika consortium3 in Germany were formed. Also, it became possible to rapidly build AR applications thanks to freely available software toolkits like the ARToolKit.

1.3. AR Potentials and Difference from Virtual Reality.

Augmented reality is a system that creates a view of a real scene but with computer constructed virtual models in the view so that when the user of the system moves or try to touch the virtual object, the object would appear at the specific location as if it has always been there.

Augmented reality potential is limitless and the end goal of it is to make such a system that the user will not be able to distinguish between the computer constructed virtual objects from the real objects.

Sometimes people consider augmented reality and virtual reality as the same technology. They cannot be more wrong. Virtual and Augmented Reality are two different but similar technology that is going to make the future more exciting. Virtual Reality is a full immersion into the virtual world whereas augmented reality is the augmentation of the user's view point with virtual elements designed to help the user. Virtual Reality comprises of three point in its definition, Firstly the entire environment is comprised of computer constructed virtual elements, Secondly virtual reality is interactive and the lastly the user is fully immersed in the virtual world with no awareness of the outside real world.

However in contrast to that augmented reality generates a view for the user that is a combination of the real scene being viewed and the computer generated virtual elements. The virtual elements augment the entire environment with additional information. However the virtual elements are all tagged to a specific geolocation on the environment so even if we move towards the virtual element it would show us a different angular view point of the virtual elements.

Later in 1994, Milgram describes a taxonomy on how the two are related. He defines the Reality-Virtuality Continuum as shown in the figure below.

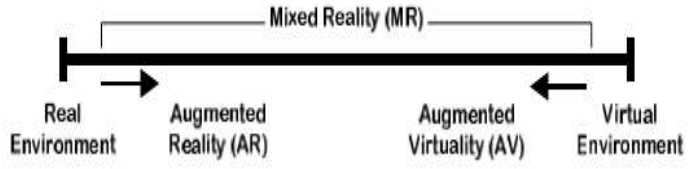

Figure 1: Milgram's Reality-Virtuality Continuum

According to this continuum, the real world and the virtual world are at the two ends of this continuum and in the middle is the Mixed Reality. Augmented reality lies near the real-world end of the spectrum with the predominate perception being the real-world augmented by computer generated data. Augmented virtuality is a term created by Milgram to identify systems that are mostly synthetic with some real world imagery added—such as texture mapping video onto virtual objects.

2. Applications of Augmented Reality

2.1. Medical

In the medical field, imaging technology is very important as most of the medical application uses imaging techniques in various forms. Most of the medical application deals with image guided surgery or post-operative imagery like X-Ray or MRI or CT Scan. Using all these images a surgeon is able to visualize the path through the anatomy of the body to the affected area thus being able to operate on the affected area. But if using augmented reality, surgeon can see the affected area through the body then he will not need to visualize as these will make it much easier thus reducing human error.

Augmented reality will map the entire human anatomy using diagnostic instrument such as X-Ray or CT Scan then mark every organ or anomaly to a coordinate so that when the doctor looks through the augmented glass then he will be able to see the affected area through the body over the exact area where it is affected.

2.2. Entertainment

In the entertainment field, a simple type of augmented reality is already present. Its like when in a weather news forecast, the reporter is standing in front of an ever changing forecast.

But then nowadays, augmented reality is everywhere like the game Pokemon Go, an augmented reality game where the user has to go around real places and catch virtual game character and battle with other player with the virtual character.Also a multitude of movies nowadays uses augmented reality such as in Iron Man, the character uses advance augmented reality to design his iron man suit.

2.3. Military

The Military has also been using a form of augmented reality as they display information at the cockpit of planes and the head up display of the pilot. Using drones and satellites, military personnel can see enemy hiding place or where the nearest land mines are located in wartime. A plethora of information can be displayed in their visor in simulation or real time activities so that they can perform their duties more efficiently.

2.4. Engineering Design

Suppose a group of designer are working on a very complex design but each of them are working on a small parts of it separately but by using augmented reality the design that these different designers are working on can be integrated into a single design using augmented reality so as to show the client what each designer has done in completion of the design.

2.5. Maintenance and Repair

Suppose a technician has to repair a machine that he has never worked on and is totally unfamiliar with, using augmented reality displays instead of rummaging around for the instruction manual, the technician can see the displayed information on the machine and the important information pertinent to the repair, for example the location of the screws and the fastener are highlighted and if the machine is missing a fastener the display points out the missing position and so forth. Aircraft manufacturer are particularly familiar with augmented reality as they mostly used it to repair

boeing aircraft. The technology helps the maintenance by displaying the design schematics of the machine over the real machine.

2.6. Consumer Applications

Various augmented reality system are already in use with the consumer design. There are all sort of programs available like household design that makes you remodel your own home architecture like putting a table on your kitchen to see whether it would fit with the décor, since it is all done on augmented reality no furniture needs to be moved.

In fashion and beauty industry, augmented reality is a major help as you can try out new products whether it is beauty products or fashion products without ever putting on. Thus a lot of resources can be managed using these technology. Suppose you want to change your style, then using these technology you can see yourself in a camera and then after tracking your body size and shape the device will then conjure a 3d model of the clothes over your body so that when you move the clothes also moves with you thus giving the illusion of having wore the product.

2.7. Navigation and Path Planning

Augmented reality in navigation has been tried for some time. Consider a person wants to go to the market from his home, using augmented reality a person can walk from his home without constantly having to look at a map or a map application on the phone but just by simply wearing the augmented reality glass, direction to the desired destination is mapped using the phone GPS system and also a lot of information of the area including the nearest restaurants or bank or ATMs are all marked in the display.

3.6. Education

AR tools can be used to develop application that support education with 3d objects. Construct3D for mathematics and geometry study, MARIE for engineering studies that employ a screen based AR with Web3D. MIT education also employs a large number of games on AR where each game has a well defined character and engaging story designed for the purpose of educating the students.

3.7. Personal Information System

Höllerer and Feiner believed that one of the biggest potential markets for AR could be in personal wearable computing. AR may serve as an advanced, immediate, and more natural UI for wearable and mobile computing in personal, daily use. For instance, AR could integrate phone and email communication as a form of context overlay or manage phonebook, inbox or social network updates, provide navigational guidance without ever having to take your phone out.

3. Challenges

AR even though it is a growing technology, it has garnered a lot of interest in people due to it unique application. It is considered one of the many technologies that is going to be primarily used in future times but it still has a lot of limitation present in it. The goal of AR is such that the user can augment their vision of their real life with the computer constructed virtual elements. In order for this to be possible technology needs to advance further as devices can't run the full extent of these technology on their mobile devices which is the major application of these technology.

4. Conclusion

Augmented reality is progressing at a phenomenal rate and the device needed to further needs to be advanced too. The HMD used nowadays are rather clumsy and a large source of storage and processing power is needed to handle the full load of recognizing every objects in real view and providing information on it.

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