# A Study on Augmented Reality

**Pranoti Mane[1] Ekta Paraswani[2] Darshan Jawandhiya[3]**
[1,2,3]Institute of JD Polytechnic, Nagpur, India

*Abstract*— Imagine a world with a technology that creates the 3- dimensional (3D) images of a virtual object around you, with which you can interact, see, hear, smell, and even touch it. Technologies such as computer graphics, virtual reality, and augmented reality together can be used to implement this in real world. Augmented reality actually superimposes virtual objects into the real environment with the real objects for enriching the viewer's experience. Augmented reality with virtual reality in virtual space also enhances the audience perception by displaying additional information. This paper surveys the field of Augmented Reality, in which 3-D virtual objects are integrated into a 3-D real environment in real time. It describes the medical, manufacturing, visualization, path planning, entertainment and military applications that have been explored. This paper describes the characteristics of Augmented Reality systems, including a detailed discussion of the trade-offs between optical and video blending approaches. Future directions and areas requiring further research are discussed. It describes the main fields inwhich AR is applied nowadays and important AR devices. Some characteristics of Augmented Reality systems will be discussed and this paper will provide an overview of them.
***Keywords:*** Augmented Reality (AR), Virtual Reality, Scientific Visualization, Mixed reality (MR), Telepresence

## I. INTRODUCTION

The process of superimposing digitally rendered images onto our real-world surroundings, giving a sense of an illusion or virtual reality is called as Augmented Reality. Recent developments have made this technology accessible using a Smartphone. It is a new technology that involves the overlay of computer graphic on the real world.

To understand today's types of Augmented Reality (AR), we need to first understand where this technology came from. AR has existed in laboratory settings since the 1960s, but made impressive technical and cultural progress in the last few years.

AR made a leap into public spaces a few decades ago, when it was featured in rides at amusement parks or in 4D movie theatres that use water, air, sound, lights, or movement to create immersion.

AR is much similar to virtual reality, in which we aim to achieve the illusion of presence within a computer simulation; telepresence aims to achieve the illusion of presence at a remote location.

Virtual Reality is a term used for computer generated 3D environments that allow the user to enter and interact with synthetic environments. The users are able to "immerse" themselves to varying degrees in the computers artificial world which may either be a simulation of some form of reality or the simulation of a complex phenomenon.

AR can be considered a technology between VR and telepresence. While in VR the environment is completely synthetic and in telepresence it is completely real, in

AR the user sees the real world augmented with virtual objects.

Fig. 1: AR example with virtual chairs and a virtual lamp

When designing an AR system, three aspects must be in mind:

1) Combination of real and virtual worlds.
2) Interactivity in real time.
3) Registration in 3D.

## II. TYPES OF AUGMENTED REALITY:

Augmented Reality is categorized into four main types: -

1) Marker-Based Augmented Reality
2) Marker-less Augmented Reality
3) Projection Augmented Reality
4) Superimposition Based Augmented Reality

### A. *Marker-Based AR:*

Markers are distinct patterns that cameras can easily recognize and process. Markers are visually unique from the environment around them. Software, usually in the form of an app, enables users to scan markers from their device using its camera feed. Scanning a marker triggers an augmented experience, whether it be an object, text, or animation, to appear on the device. Tracking plays an important part in this type of AR, meaning that either the marker or camera can be moved slightly without distorting or stopping the augmented effects.

### B. *Marker-Less AR:*

This style of AR is more versatile than marker-based AR; it does not need an image cue to deploy. Instead, it relies on positional information gathered from a device's camera, GPS, digital compass and accelerometer.

These data inputs build an understanding of 3D space in a process known as Simultaneous Localization and Mapping – or SLAM for short. SLAM places content directly into your view of the world and 'sticks' it to the environment. The programming behind marker-less AR is more complicated but delivers pretty stunning results.

### C. *Projection AR:*

This is one of the simplest types of AR which is the projection of light on a surface. Projection-based AR is appealing and interactive where light is blown onto a surface and the interaction is done by touching the projected surface with hand. The widespread uses of projection-based AR techniques can be used to create deception about the position, orientation, and depth of an object. In such a case this allows the user to take different objects into consideration and its structure in order to study in-depth. This technology offers a whole lot more in every sense. This piece of tech is used for creating a virtual object for much larger deployments for experiencing Augmented Reality.

*D. Superimposition Based AR:*

As the word it explains the superimposition of the objects. This AR provides a replacement view of the object in focus. This is done by replacing the entire or partial view with an augmented view of the object. Here object recognition plays a vital role where replacing a view of an object with an augmented view is done.

## III. AR DEVICES

The technology for AR is still in development and solutions depend on design decisions. Most of the Displays devices for AR are HMD (Head Mounted Display), but other solutions can be found.

Fig. 2: Optical See- through HMD Five major classes of AR can be distinguished by their display type:

1) Optical See Through
2) Virtual Retinal Systems,
3) Video See- Through
4) Monitor Based AR
5) Projector Based AR.

*A. Optical See through HMD:*

Optical See-Through AR uses a transparent Head Mounted Display to show the virtual environment directly over the real world (Figure 2). It works by placing optical combiners in front of the user's eyes. These combiners are partially trans missive, so that the user can look directly through them to see the real world. The combiners are also partially would be to instrument the adjustments, so the system could auto magically compensate for the motion. Such devices are not reported in the literature.

Fig. 3: Latest Eyeglass display with holographic element

*B. Virtual Retinal Systems HMD:*

The VRD (Virtual Retinal Display) was invented at the University of Washington in the Human Interface Technology Lab (HIT) in 1991. The aim was to produce a colorful, wide field-of- view, high resolution, high brightness, low cost virtual display. Micro- vision Inc. has the exclusive license to commercialize the VRD technology (Fig.4)

Fig. 4: Virtual Retinal System HMD

*C. Video see-through HMD*

Video See-Through AR uses an opaque HMD to display merged video of the VE and view from cameras on the HMD (Figure 5).

This approach is a bit more complex than optical see-through AR, requiring proper location of the cameras. However, video composition of the real and virtual worlds is much easier. There are a variety of solutions available including chroma-key and depth mapping

Fig. 5: Video See- Through HMD

*D. Monitor Based:*

Monitor Based AR also uses merged video streams but the display is a more conventional desktop monitor or a hand held display. It is perhaps the least difficult AR setup, as it eliminates HMD issues. Princeton Video Image, Inc. has developed a technique for merging graphics into real time video streams. Their work is regularly seen as the first down line in American football games. It is also used for placing advertising logos into various broadcasts.

 

Fig. 6: Monitor Based Example.

### E. Projection Displays:

Projector Based AR uses real world objects as the projection surface for the virtual environment. It has applications in industrial assembly, product visualization, etc. Projector based AR is also well suited to multiple user situations. Alignment of projectors and the projection surfaces is critical for successful applications.

Fig. 7: Projector Based AR.

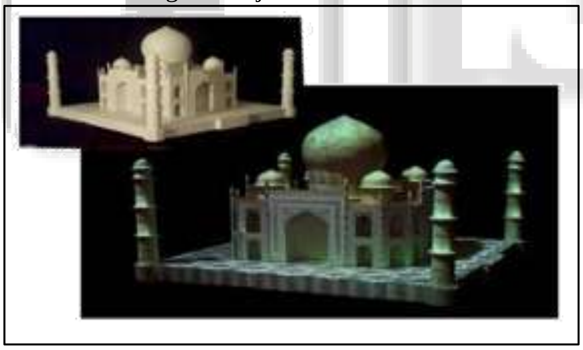

Fig. 8: Projector Based AR

## IV. Applications

1) Medical
2) Manufacturing and repair
3) Annotation and visualization
4) Robot path planning
5) Entertainment
6) Military aircraft

## V. Implementation Framework

### A. Hardware

The main components of our system are a computer (with 3D graphics acceleration), a GPS system originally differential GPS, and now real-time kinematic GPS+GLONASS, a see-through head-worn display with orientation tracker, and a wireless network all attached to the backpack. The user also holds a small stylus- operated computer that can talk to the backpack computer via the spread spectrum radio channel. Thus we can control the material presented on the head worm display from the handheld screen.

We also provide a more direct control mechanism of a cursor in the head worn display by mounting a track pad on the back of the handheld display where it can easily be manipulated (we inverted the horizontal axis) while holding the display upright.

To make the system to be as lightweight and comfortable as possible, off-the-shelf hardware can be used to avoid the expense, effort, and time involved in building our own.

Over the years, lighter and faster battery-powered computers with 3D graphics cards, and finally graduated to laptops with 3D graphics processors.

### B. Software

Software infrastructure Coterie, a prototyping environment that provided language-level support for distributed virtual environments. The main mobile AR application ran on the backpack computer and received continuous input from the GPS system, the orientation head tracker, and the track pad (mounted on the back of the handheld computer). It generated and displayed at an interactive frame rate the overlaid 3D graphics and user interface components on the head worn display.

In the handheld computer we ran arbitrary applications that talked to the main backpack application via Coterie/Repo object communications. In our first prototype, we simply ran a custom HTTP server and a web browser on the handheld computer, intercepted all URL requests and link selections, and thus established a two-way communication channel between the backpack and the handheld.

## VI. Future Scope

Though augmented reality exists from a long period of time but it is an evolving technology. There are many areas in this field that still are undiscovered or requires large amount of work to be done.

Many AR demonstrations generates environment which have very accurate pixel registration, but this is limited to a certain area which is carefully prepared. So, the challenge in this is the advancement in the tracking system in such a way that it supports accurate registration in any unprepared area, indoors or outdoors. There is a need of new visualization algorithm to handle issues such as density, general situational awareness and occlusion. This will give a much better and realistic AR experience.

In future the real time interaction with the virtual world need to be evolved. There should be advancements in the input.

## VII. Conclusion

Augmented reality is another step further into the digital age as we will soon see our environments change dynamically either through a Smartphone, glasses, car windshields and even windows in the near future to display enhanced content and media right in front of us. This has amazing applications that can very well allow us to live our lives more productively, more safely, and more informatively.

Maybe in the future, we will see our environments become augmented to display information based on our own interests through built-in RFID tags and augmentations being implemented through holographic projections surrounding the environments without a use of an enabling technology. It would be incredible to no longer wonder where to eat, where to go, or what to do; our environment will facilitate our interactions seamlessly. We will no longer be able to discern what is real and what is virtual, our world will become a convergence of digital and physical media.

## REFERENCES

[1] K. Ahlers and A. Kramer. Distributed augmented reality for collaborative design applications. European Computer Industry Research Centre, 3-14, 1995.
[2] S. Andrei, D. Chen, C. Tector, A. Brandt, H. Chen, R. Ohbuchi, M. Bajura, and H. Fuchs. Case study: Observing a volume rendered fetus within a pregnant patient. Proceedings of IEEE Visualization, 17-21, 1993.
[3] R. Azuma. Tracking requirements for augmented reality. Communications of the ACM, 36(7):50-51, 1993.
[4] R. Azuma. A survey of augmented reality. ACM SIGGRAPH, 1-38, 1997.
[5] M. Billinghurst, S. Baldis, E. Miller, and S. Weghorst. Shared space: Collaborative information spaces. Proc. of HCI International, 7-10, 1997.
[6] M. Billinghurst and H. Kato. Mixed reality - merging real and virtual worlds. Proc. International Symposium on Mixed Reality (ISMR '99), 261-284, 1999.
[7] S. Boivin and A. Gagalowicz. Imagebased rendering for industrial applications. ERCIM News, 2001.
[8] Cobzas, K. Yerex, and M. Jagersand. Editing real world scenes: Augmented reality with image-based rendering. Proc. of IEEE Virtual Reality, 291292, 2003.
[9] A. Van Dam, A. Forsberg, D. Laidlaw, J. LaViola, and R. Simpson. Immersive VR for scientific visualization: A progress report. IEEE Computer Graphics and Applications, 20(6): 2652, 2000.
[10] P. du Pont. Building complex virtual worlds without programming. EUROGRAPHICS'95 State of The Art Reports, 61–70, 1995.