

# *Augmented Reality and its effect on our life*

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**Abstract –** Augmented Reality is a combination of a real and a computer-generated or virtual world. It is achieved by augmenting computer-generated images on real world. It is of four types namely marker based, marker less, projection based and superimposition based augmented reality. It has many applications in the real world. AR is used in various fields such as medical, education, manufacturing, robotics and entertainment. Augmented reality comes under the field of mixed reality. It can be considered as an inverse reflection of Virtual Reality. They both have certain similarities and differences. This paper gives information about Augmented Reality and how it started. It analyses various types of augmented reality, its applications and its advantages and disadvantages. This paper also gives us knowledge regarding those major threats that augmented reality will face in the near future and about its current and future applications. It gives us a comparison between the two related topics, Augmented reality and Virtual reality. The following paper also helps us know about the effect of Augmented Reality on the human life.

**Keywords –** Augmented Reality, Virtual reality, Mixed Reality, Real World, Virtual World

## I. INTRODUCTION

Augmented Reality has its origin from the word ‘Augment’ meaning to add or enhance. The term Augmented Reality was given by Boeing Researcher, Tom Caudell. Augmented Reality (AR) is overlapping or augmenting of digital images on real world objects using various AR apps. AR intensifies one’s understanding of the real world. AR can be defined as the system in which real and virtual worlds have been combined, there is real time interaction, [2] and the device is registered in 3D. Here, the augmentation is being done in real time. One can say that AR is a technology in between the real reality and the virtual reality.



AR includes graphics, sounds and touch feedback which are then added to the real world. This creates an enriched user experience. All in all, AR helps improve user experience, helps in spreading knowledge, education and health. AR includes the concepts of Computer Vision and Computer Graphics. It needs vision to get a clear understanding of the real world and needs graphics to create false elements to augment it.

Firstly, the real world is captured. The real world is the target. Then, the virtual world is modelled. Finally, the digital information or the virtual world is augmented or projected on the target. This is how AR is achieved.

Augmented Reality is not a concept of yesterday. It has come a long way. It started its journey from the year 1968. Table I shows the evolution of Augmented Reality.

There are four types of Augmented Reality (AR) observed namely,

- Marker based AR

- Marker less AR
- Projection Based AR
- Superimposition Based AR

TABLE I. EVOLUTION OF AUGMENTED REALITY

1968	First head-mounted display was developed by Ivan Sutherland. It showed simple wireframed drawings. [1]
1974	An ‘Artificial Reality’ laboratory known as Videoplace [1] was built by Myron Krueger. Onscreen silhouettes were emitted by combining projectors with video cameras.
1990	Boeing Researcher Tom Caudell coined the term ‘Augmented Reality’. [1]
1992	Virtual Fixtures were developed by Louis Rosenberg. It was the earliest AR functioning system that was built for Air Force. [1]
1994	The first AR theatre production “Dancing in Cyberspace” [1] was created by Julie Martin. Acrobats danced within and around virtual objects on real stage.
1999	Naval Researchers started working on Battlefield Augmented Reality System (BARS). It was an original model of early wearable units for soldiers. Also, NASA X-38 used AR to overlay map data so as to get enhanced visual navigation during flight. [1]
2000	An open-source software library, that uses video tracking to superimpose visual graphics on a video camera, called AR Toolkit was created by Hirokazu Kato. [1]
2009	AR Toolkit brings augmented reality to web browsers. [1]
2013	Car manufacturers began using augmented reality for getting technical assistance. Volkswagen developed an app named MARTA (Mobile Augmented Reality Technical Assistance) which helped technicians get real life technical assistance. [1]
2014	Google launched the Google Glass devices and started shipping the devices for consumers. The trend of wearable AR started. [1]
2016	Microsoft introduces HoloLens.
2017	Snapchat launches its AR Lenses that places imaginary 3D creatures [5] in our real life photos and videos. Apple launches its ARKit and Google launches its ARCore.

#### A. Marker Based Augmented Reality

This type of reality is also known as Image Recognition [2]. A camera and a visual marker such as a QR code or a 2D code is used. First the marker is sensed by the reader and then the output is given. Apps based on this type uses a camera to differentiate a marker from any other real world object. Markers can be anything which are unique yet simple (e.g. QR Code) and should be detectable by the camera. Calculations of position and orientation is done. Marker Detection Algorithm [3] includes (1) Dividing images in regions, (2) Detecting images in the region, (3) Finding segments in the region, (4) Merging segments into lines, (5) Extending lines along the edges, (6) Keeping lines with corners and finally, (7) Finding the markers.

#### B. Marker Less Augmented Reality

This type of reality is also known as Location-based reality [2] or GPS. Data which is provided is based on our location and is provided with the help of a digital compass, accelerometer, velocity meter or GPS. All these are inserted in our devices. This type of reality is possible because of the location detection features available on our smartphones these days. It recognizes things that were not directly provided [4] to the application in advance, unlike Marker Based AR. Here, the algorithm only has to identify [4] the patterns, the colors, and the other features in order to provide results.

#### C. Projection Based Augmented Reality

As the name suggests, artificial light is projected onto real-world objects [2]. This allows for human interaction by sensing the touch of that projected light. User's touch is detected by distinguishing between an expected projection and an altered projection. A digital operating canvas is created on virtually any work surface. Projection based AR is used to project a 3D interactive hologram.

#### D. Superimposition Based Augmented Reality

In this type of reality, the original view of an object is either partially or fully replaced with a newly augmented view of that same object [2]. Here, object recognition plays an important role. E.g. IKEA – Augmented Reality Furniture catalogue. It is a virtual furniture app that augments furniture onto real floor.

## II. ADVANTAGES & DISADVANTAGES OF AUGMENTED REALITY

Augmented Reality is a platform that helps us blend real and virtual worlds while giving equal space to both. It is like a double-edged sword. It is useful and positive at one place but

has many disadvantages too. Table II shows the advantages and disadvantages of Augmented Reality.

## III. APPLICATIONS OF AUGMENTED REALITY

Augmented Reality allows us to interact with the real and virtual worlds at the same time. It is an example of Intelligence Amplification (IA), as told by Fred Brooks, which means using computer as a tool so as to make it easier for a human to perform a task [7]. Thus, this technology has been applied in many fields some of which have been mentioned below.

#### A. Medical

Augmented Reality will be far-reaching in the near future. It is being widely used in healthcare sector (as shown in figure 1) where there is a need of visualizing the medical information and the patient within the same physical space [7]. Augmented Reality can be used to perform surgeries and can help surgeons perform real time surgeries without being physically present near the patient [8]. Some of the real life examples where AR is being used in medical field are:

- EyeDecide : This is a medical app which simulates the impact of specific conditions or medicines on a person's vision using a camera. E.g. EyeDecide can demonstrate the impact of cataract.
- AccuVein : This app uses a handheld camera which projects over the skin. Thus nurses and doctors get to know where the veins are in the patients' bodies.

#### B. Entertainment and Games

Augmented Reality can be proved to be a game-changer for entertainment and games. Here, it is possible to interact with the real world and reel world using this technology. AR can be used in Television Broadcasting. Many sports channels use AR thus allowing audience to view graphic overlays [9] (as shown in figure 2). AR is widely used in Gaming too. Apps such as Ingress and Pokéémon Go use augmented reality to let gamers play with virtual characters in real world.

#### C. Manufacturing

Augmented reality has helped in improving the understanding of the product assembly tasks to be carried out. Information overload and the training required for assembly operation can be reduced using the AR approach [7]. In manufacturing, AR can help in complex assembly of machinery, in maintenance of parts and in providing expert support [10]. (shown in figure 3)

TABLE II. ADVANTAGES AND DISADVANTAGES

ADVANTAGES	DISADVANTAGES
AR can be used to increase the knowledge bars of people.	AR's availability is improper in social situations.
AR can help people share experiences over long distances.	There are no strong security features in this technology.
AR has a form of escapism[6].	AR has a feature of spam [6].
A life-like experience can be established by AR games.	There are various issues like that of performance, alignment and interaction.

#### D. Robotics

In this field, AR makes it easier for robots for communicating complex information to humans. Moreover, this technology can help robots perform surgeries by combining AR with surgical robot system for performing head surgeries. In a nutshell, AR is a platform that has made human-robot collaboration possible [7].

#### E. Education

Augmented reality in education has been proved to be very fruitful. The young learners can now visualize complex spatial relationships [7] and abstract concepts. This technology helps students to engage in phenomena that are not possible in real world. Moreover, the invisible concepts [7] like magnetic field can now be visualized easily using AR. Augmented Reality can open additional ways and methods of making the learning

process easier and interesting. Classrooms and books become interactive [11]. There are some AR student apps also. Some of them have been mentioned below.

- *AugThat*: This app helps boost education process [11] with 360° virtual photos and 3D lessons.
- *Elements 4D*: This app is for exploring chemistry. It allows students to see how different elements react in reality [11].
- *Zookazam*: It is an app which allows us to do oral explanations [11] in 3D models. It has a large content including insects, birds, animals, fishes and reptiles.



Fig. 1. Applications of AR in Medical : (a) EyeDecide App, (b) AccuVein App



Fig. 2. Using AR in Television Broadcasting

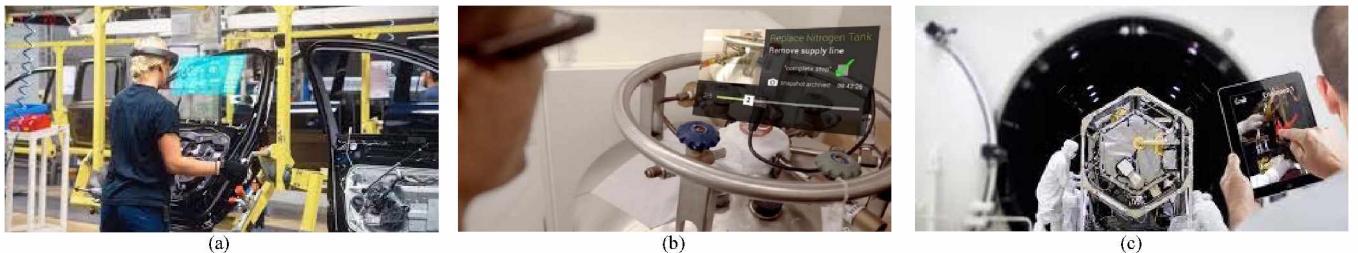


Fig. 3. Using AR in Manufacturing: (a) In complex assembly, (b) In maintenance, and (c) in providing expert support

#### IV. TOP THREATS TO AUGMENTED REALITY

Along with the success comes necessary threats and challenges. Augmented Reality also has some of the threats that may risk its success in the near future. Some of the top threats to AR's success in the near future have been described below.

##### A. Lack of Use Cases

AR is fun for gaming [12] but it has no actual purpose. None could find a reason to pay so much money for a device which has no useful purpose.

##### B. Legal

There are various privacy concerns related to AR. People are being filmed unknowingly. This technology hasn't even reached that headset form properly and there are already things like Pokémon Go Death Tracker [12]. This tracker tells us about the number of deaths that happened while playing the famous AR game Pokémon Go. The AR companies are not able to navigate the legal issues presented when operating at scale.

##### C. Digital Fatigue

In this digital world, we are already hooked up to our screens all the time. And if we use AR headsets then we'll be constantly having virtual information [12]. This can be very exhausting. This leads to a conclusion that technology may prove to be a destruction to the society.

##### D. Miniaturization Issues

AR headsets have a reasonably large size which could be just worn on the head but not like normal eyeglasses. Everyone want their headsets to be AR functional [12] but at the same time wants it to be of the size of eyeglasses.

##### E. Poor Experience

The technology of augmented reality has been a dull experience because of technical deficiencies [12] like poor resolution and inaccurate computer vision.

##### F. Social Rejection

Because the normal public fears change, no one wants to accept AR as a part of his life. They find AR as weird and socially awkward. They don't want [12] to wear a computer sized headset on their faces every time. This leads to social rejection of the technology. This has been the major threat to AR's success because it is not easy to convince people.

##### • How to overcome these threats?

One can conquer such problems because AR has the ability to increase the manufacturing productivity by 30%. Moreover, when the masses are introduced to some new technics, they fail to predict its power. In the coming years, AR will have a stronger potential. Nowadays, we spend most of our time in our virtual worlds inside our laptops and smartphones. But this time is not beneficial. Whereas through AR, the time we would be spending in our virtual worlds may become efficient and will make us more connected to the real world. Augmented reality gives us a chance to be a part of digital world while experiencing the real world. The AR which is being developed today is not the AR of today but the AR of 10 years from now which will be reforming the world.

#### V. AUGMENTED REALITY AND VIRTUAL REALITY

As we know that Augmented Reality is a fusion between the real world and the digital world. On the other hand, there is Virtual Reality. It is an artificial, computer generated recreation [13] of a real world situation. One can say that AR and VR are inverse reflections of one another in terms of what they want to achieve and deliver to the user. (figure 4) And because both of the technologies are interconnected with one another there are some of the similarities and differences between them which have been described below.

##### • Similarities:

- (a) *Technology:* Similar type of technology is being used by both AR and VR. They both occur to serve the society with an intensified experience.
- (b) *Entertainment:* With AR and VR, the user has a control on the artificial or virtual worlds. The user can interact deeply with the reality.
- (c) *Science and Medicine:* Both AR and VR have the capacity to change the aspects of medical field [13] i.e. by making remote surgeries possible. These technologies have already been used to treat diseases such as PTSD (Post Traumatic Stress Disorder).

##### • Differences:

- (a) *Purpose:* Both the technologies have different purposes. AR magnifies user experience by adding virtual components [13] such as graphic overlays as a new layer of interaction with the real world. Whereas VR shapes its whole new reality which is purely computer-based.
- (b) *Delivery Method:* AR is generally used in mobile devices such as laptops, smartphones, and tablets. It is used in such a way so as to change the way real world and digital images interact and intersect [13]. While VR uses HMDs i.e. head-mounted displays or hand-held controllers.

#### MICROSOFT HOLOLENS

It is a technology that has brought AR and VR together [14]. HoloLens doesn't take us to a completely different simulated world. Through HoloLens, we can stay in our same environment but can have access to various digital elements augmented on the top of the physical object around us. Through HoloLens, we can even interact with the digital images layered in the real reality. (Figure 5)

#### VI. NEGATIVE IMPACTS OF AR

We have known many applications of Augmented Reality in many fields such as medical, manufacturing, education and robotics. But like a coin has two sides, Augmented Reality can harm our lives to the same extent at which it can ease our lives. It can destroy us both physically and mentally. One cannot ignore the number of lives that Pokémon Go (an AR game) has taken. By using AR it means that we are constantly looking at our screens. This may lead to several eye diseases, mental illnesses and may destroy our posture. AR can even threaten our privacy . While traveling it may increase distractions when using AR navigation techniques. Augmented reality can lead us to



Fig. 4. AR vs VR



Fig. 5. Microsoft HoloLens



Fig. 6. Layar app



Fig. 7. Porsche technician using AR glasses to repair car

misinterpret the speed of oncoming cars, underestimate our reaction time, and unintentionally ignore the dangers of navigating in the real world. "Until something bad happens, you won't know you're at greater risk of harm" [19].

## VII. CONCLUSION

Aforementioned, we have studied about Augmented Reality and its various application in the field of medical, manufacturing, entertainment & games, robotics and education. We acquired knowledge about some apps such as EyeDecide, AugThat, Zookazam, etc. that use this technology of AR. We also concluded how the use of Augmented Reality can be beneficial in our day to day lives. This term paper gives information regarding different types of AR such Marker Based AR, Marker less AR, Projection Based AR and Superimposition Based AR. The technology of AR still under research and development and is emerging day by day. Many things have been developed recently using this technology. It has entered the world of car repair again after 5 years. In a nutshell, it can be said that AR has a very bright and promising future in spite of having many threats to its success in the near future.

AR is not limited to wearable devices [18]. AR makes passive objects interactive. It is the future of product design.

There is an app named *Layar* (figure 6) which connects digital information [15] with the real world. It scans the printed material enriched with Layar through which we can view digital experiences related to that material. This could help the industries because instead of producing various unconnected products, industries will now have to produce only one single product. Digital layers of information would be printed on that one product which could then be viewed through the Layar app. Users can get richer reading experience and a product team could work in a united manner. Recently, Augmented Reality has entered the world of car repair yet again. *Porsche* dealerships are using the technic of AR (figure 7) to diagnose and repair cars [16][17]. This helps in saving the technician's time and helps avoid tiresome on-site visits of the expert. By using AR, the car service time has been reduced by 40%.

In a nutshell, it can be said that AR has a very bright and promising future in spite of having many threats to its success in the near future.

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