

# Augmented Reality Technology: Current Applications, Challenges and its Future

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**Abstract**—The term augmented reality (AR) refers to a technology that unites virtual things with the actual environment and communicate directly with one another. Nowadays, augmented reality is receiving a lot of study attention. It is one of the few ideas that, though formerly deemed impractical and unattainable and can today be used quite successfully. Research and development on the AR are still in their early stages at many colleges and high-tech enterprises. Like our smart phones and laptops, many researchers predict that it will be one of the most popular technologies in the future. This paper provides a comprehensive study of AR including its working, applications, current challenges and future trends. Although augmented reality applications are used in many areas, the most important areas are focused in this paper. In the light of all these, this study is a compilation study and in the context attention is drawn to usage of augmented reality in current life scenario.

**Index Terms**—Augmented Reality, Applications of Augmented Reality, Challenges of Augmented Reality, Future of Augmented Reality

## I. INTRODUCTION

Augmented Reality (AR) is a leading-edge technique used to improve the users experience perceptions of engagement with real-world environments which includes virtual things, or it is the more natural way to connect in regards to digital environment. Consider a world in which turn around and see a graphical perspective that gives information to explain everything, all thanks to augmented reality. AR (Augmented Reality) and Mixed Reality (Mixed Reality) were formerly considered science fiction before becoming a scientific reality in recent years [1] [2]. Its goal is to enrich your actual environment by adding 3D virtual items to it, rather than removing you from it and transporting you to another realm. As the term augmented implies, to add or to increase, As a result, AR acts as a digital enhancement to the user's environment. However Augmented Reality (AR) has only been around for a little above a decade, it has seen tremendous development and improvement in recent years [3] [4]. There is a shortage of study on the impacts and consequences of AR in the education field, and research on AR implementations in academic is still at an early level. AR says that technology can develop next Generation, reality based on interference. Although the



Fig. 1. Technology of Augmented Reality (AR) [3]

area of augmented reality has only been around for a few years, the growth in the last few years has been quite inventive. To accomplish and use AR technology, three elements are required: a display that can mix virtual 3D objects with the actual environment, and a computer. Trackers are being used to determine your location using gesture motions, as well as the third element is software and hardware used mostly for interactivity. Think of a world where you walk around and see a graphical perspective that gives framework to clarify everything, and that world is made possible via augmented reality [5]. The purpose behind any invention is to enhance the lives of everyone as you can show in figure 1.

## II. WORKING OF AUGMENTED REALITY TECHNOLOGY

Identification, Monitoring, and Mixing are the three fundamental phases of the AR system. Any picture, item, face, figure, or place is identified in identification, where a virtual item would be projected. While tracking, a picture, objects expression, figure, or environment is actual localized in location, and then information as in the form of video, 3-dimensional, 2-dimensional, textual, and so on is overlaid over it. Sensor AR Technologies overlays computer images onto external signs as a bench mark. The target item is continually snapped

by the sensor in this device, and the picture is processed to predict the location, direction, and motion of the visualization displays in relation towards the target item. A two-dimensional printable indicator, for instance, is put beside a camera. The system then analyzes this sign to create an on-screen visual that seems to be perfectly on above of the markers in real life. The effectiveness of AR services utilizing this technology is limited by lighting and fixation issues. Marker-less AR Technologies determines a device's positioning in the actual environment, where it's really oriented, upon which plane it is functioning using a mixture of the accelerator, compasses, and location information (GPS). That data then analyzed to a database hence to figure out which one the gadget is looking at, allowing computing information to be shown on-screen. The term mobile augmented reality was used to describe the application of the technologies with electronics such as smartphones and tablets [6].

### III. APPLICATIONS OF AUGMENTED REALITY

Previously, AR was thought to be limited to games, but current advancements in the technology have expanded its application to include defense, health sciences, educational, manufacturing and supply chain sectors, robotics of course, enjoyment and gaming. Augmented reality is a very fruitful breakthrough since it may be used in a variety of sectors. The sub-areas that follow show the newest studies and comprise every application to date [7].

#### A. Marketing and Advertisement

According to the worldwide COVID-19 epidemic, customers have shifted their buying habits from conventional businesses to online stores. This pandemic has had a significant impact on the worldwide business scene, which has seen a significant increase in the usage of technology devices such as mobile apps for online purchasing. For the reason of the significant advantages, smartphone augmented reality applications are an evolving technique that is influencing a variety of industries. For its advanced features, such technology has becoming increasingly popular. Customers may trial on or explore interactive virtual items, then assess whichever products are most suited to their needs before selecting the best alternative [8]. The notion of augmented reality may also be used as a narrative medium for selling your items, since just the desire will buyers & find it easier to grasp and also have a better user service [6], such as discussing product characteristics. In 2014, Timberland launched a virtual dressing room based on the AR idea, in which customers may view a representation of their profile on a model's body and try on several clothing to determine which one looks best [9] as shown in figure 2.

#### B. Education

The Covid-19 epidemic has wreaked havoc on higher education throughout the world. This medical problem imposes travel limitations and social isolation, as well as a slew of concerns and difficulties for postsecondary education, the most



Fig. 2. Virtual Fitting Room [9]



Fig. 3. AR in Educational Field [11]

significant of which is the move from traditional to online and mixed forms, techniques, and technologies. And this is why higher education institutions throughout the globe are embracing and utilizing online technologies to boost teaching activities and assignments. Education has become more dynamic and exciting thanks to AR as well as VR, which bring theoretical ideas to life in much more fascinating contexts and help students acquire specialized skills [10]. The use of a mounted display can assist students in more efficiently grabbing, processing, and learning information. It also made schooling more fascinating, stimulating, and enjoyable. Modeling tasks, 3D graphics, and layouts are included in the Augmented Education app to assist students in creating models to better comprehend and study animation and architecture. As the old adage goes, "a picture is worth a thousand words," & AR is clearly value over a thousand words [11]. The Figure 3 illustrates AR in education field which includes 3-D graphics.

#### C. Health Sciences

AR in the type of advancement in medical research that is bringing it closer to greater safety and efficiency. The



Fig. 4. Microsoft Holo Lens [12]



Fig. 5. Pokémon Go game [14]

Microsoft HoloLens, that is used for spine surgery and displays an overlaying on the body of patients, is one of the greatest demonstrations of health care AR technology as shown in figure 4. Surgeons employ these overlays to carry out their procedures. AR essentially provides doctors and surgeons with instructions on how to conduct their duties more successfully and efficiently while reducing risk. It allows the two medics who are thousands of miles apart to communicate and discuss procedures [11] [12]. It is also beneficial to patients in terms of obtaining knowledge for their treatment & preventative measures [13].

#### D. Gaming and Entertainment

How can we miss the famous game Pokémon Go (as shown in figure 5) while discussing the importance of AR in animating and gaming. And it is because of this well-known game that augmented reality has resurfaced in the public eye. In the gaming business, augmented reality (AR) has risen to the top because it allows gamers to immerse themselves in a fictitious environment, such as fighting zombies, aliens, or capturing fictional creators. Temple Treasures Hunt, Army of Robots, Beer Pong AR, and many other AR games are available [14]. Gamers would like to be a part of a game when augmented reality is used in the on-line gaming sector, and this desire to become a part of a game enhances the game experience.

### IV. CHALLENGES OF AUGMENTED REALITY

#### A. Public Acceptability

While augmented reality has been progressively growing and evolving over the last several years, there is always a barrier to acceptance whenever it comes to this technology from individuals all over the world. The public has a skewed perception of AR since the technology is not thought to be long-term helpful due to poor quality and low-standard AR application designs [15].

#### B. Poor Content Quality

With the exception of the gaming industry, AR apps do not have particularly effective content, instead having stuff that is difficult to understand. Poor quality is a major cause why AR is having difficulty gaining acceptance among people all around the world. The reason for this might be a lack of competence and experts in the AR industry who can give a higher quality experience [15].

#### C. Devices Used in AR

AR gadgets include cameras, screen movements, sensor, visuals, high web access, CPUs, and others, all of which work together to provide us with an augmented reality experience. However, there are many more gadgets, such as HoloLens, Google Glass, and AR headsets, that may provide an exciting experience, but these devices are expensive and not widely accessible to the general population. As a result, it's also one among the most difficult feature of augmented reality [14].

#### D. Technical Challenges

Many technological issues exist, such as technology, a lack of knowledge, lack of education and awareness among the general public, and inadequate content, all of which make AR challenging to use and culturally acceptable [16].

#### E. Unsatisfactory Experience

Following virtual reality, augmented reality has created such a buzz everybody is expecting so much from it, resulting in a lack of experience. Even good augmented reality applications fall short of providing a more immersive and engaging experience for the user [17].

#### F. Agriculture

In agriculture, object detection can be used to observe or track the movement of various farm animals to avoid anything that can be dangerous [18]. It can also serve the purpose of

counting them. Additionally, we can apply some algorithms that can help us in verifying the products that are damaged.

## V. SOLUTION TO AR CHALLENGES

We can increase machinery abilities by using a progressively smoothing process, enhance camera interference by using 2D QR & scanning tag markers, and overcome GPS difficulties by setting large goals until better solutions arise.

- Increased the reality is a method for debunking the notion of limiting the interfaces of substance by providing a road to a more intuitive, pulling into or out of the containers (really) experience. Currently, your whole surroundings can function as a drug keeper, resulting in a novel experience with its use [19] [20].
- Create a kind of AR governing authority that society access, discuss, and then disseminate criteria to be followed by developer. Create an integrated advanced administrative AR that separates communal, individual, and commercial spaces [21] [22].
- Recognizing threats to customer privacy and safety is simply the beginning in addressing long-term issues which quickly evolves modern tools such as augmented reality creates [23].

## VI. FUTURE OF AUGMENTED REALITY

As augmented reality is remains at its initial stage, the list of possible applications is endless. Advanced re-search in AR takes into consideration suggestions for a future in which people and information interact in a single direction without the need of any intermediary devices. The MIT Media Lab Sixth Sense project provides the perfect pattern of AR investigation or Parviz's eye lens design setting [24], as seen in Figure 6, where data could only the user can be seen. Furthermore, for certain disabled persons, augmented reality gives a possibility to replacement or repair senses that are absent, i.e., AR might be utilized as an alternate for sense device. Visual message should be supplied to those who are deaf or hard of hearing in order to assist them in detecting missing audio signals, or aural signals might to be transmitted to blind persons to assist them in finding their way i.e., unfamiliar visual events. Furthermore, certain AR applications are likely to face societal acceptability difficulties, privacy issues, and ethical implications in the future [25].

## VII. DIGITAL TWIN

The multidimensional, multiphase, and deterministic modelling projection of certain advanced components in real and virtual reality is referred to as a digital twin, and its purpose is to represent the usage state of its related items [26]. The development of digital twins needs to be highly focused on application, such that, connection, cooperation, and covariation among physical items and its digital representations, in order to facilitate more informed, accelerated, and inventive systems design. The implementation of digital twin, which uses many different sensors, seems to have a wide range of applications, including satellites, manufacturing, and smart homes. This



Fig. 6. Example of Futuristic Augmented Reality [21]

digital twin would establish a virtual world able to supervise physical objects and being administered through the IoT when combining massive sensors with diverse functionality placed across the actual scene. As a result, the development of numerous sensors is critical for the digital twin's eventual implementation [27].

## CONCLUSION

It is thought that augmented reality is a skill that has been around for a while. Since augmented reality is still in its early stages, the potential applications for the future are infinite. Applications for augmented reality technology will proliferate during the next few years. In the future, augmented reality technology will change human life to a great extent, which is an inevitable trend of scientific and technological development. In context of this paper; increasing use of augmented reality environments and applications has been determined and content presented related to AR is the most important suggestions for the future researchers in utilizing the AR technology effectively.

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