A Peek into Augmented Reality and Its Future

Tanya Rawat & Megha Gupta
Department of Computer Science
Mata Sundri College for Women, University of Delhi, Delhi

Abstract: *Augmented Reality is the view of the real world that has been enhanced by adding computer-generated information. Augmented reality combines the virtual and real world. It is very close to the real world. Recent technological development has proved that augmented reality can be of many uses and can be used in different fields, whether it is education, gaming or health. But there are still many security and privacy issues with augmented reality. These issues can be solved and augmented reality can become a casual part of our society.*

I.   Introduction

"Augmented Reality" (AR) is a way of seeing reality that incorporates computer-generated virtual information into the actual physical environment in real time. Interactivity and closeness to the actual environment are hallmarks of Augmented Reality. Augmented reality is a kind of virtual reality that incorporates interactive elements into the actual world. Screens, glasses, and mobile devices may all be used to show augmented reality. Users may interact with computer-generated 3D images in the actual environment by using augmented reality technology. While VR immerses us in a virtual realm, augmented reality allows us to maintain contact with the actual world aroundus.

Virtual reality (VR) is not tied to a certain form of display technology such as a head- mounted display (HMD), nor is it limited to the sense of sight, according to Azuma et al. [1]. Smells, touch, and hearing might also benefit from augmented reality (AR). Enhancing or substituting users' missing senses, such as augmenting vision for blind or visually impaired users by using audio cues, and augmenting hearing for deaf users by using visual hints. Many fields, including education, health, business, and physical fitness may benefit from the usage of augmented reality (AR).

Any new technology comes with new potential for data to be lost, stolen or misused. There are some security issues with the use of augmented reality. For AR to work, it creates a 3D model of the real world which means there is a lot of information that it is taking as input from us and our surroundings. AR/VR devices and applications collect a large amount of user data, which makes user privacy to be at risk. It makes AR a threat to our rights. In order to secure AR, we must consider both hardware and software both. Recognition of customer safety and privacy must be considered by the AR technology providers.

II.   History

It could be easily inferred from Fig 1, the term augmented reality appeared for the first time in the 1950s when Morton Heilig, a motion-picture cameraman, believed that cinema as an art should be capable of drawing the watcher into the on-screen activity. In 1968, Ivan Sutherland developed a working prototype of the first AR system. After that Myron Krueger 1975 established an artificial reality laboratory called video place. It is an area which enables users to easily deal with the virtual elements for the first time. In 1997, Ronald Azuma conducted the first survey on AR and he introduced a broadly accepted definition of AR. He defined it as assembling real and virtual environments together while both of them are being recorded in 3D and interactive in real-time. In 2000, Bruce Thomas invented the first mobile AR game and displayed it during the International Symposium on Wearable Computers. In 2007 new medical applications were developed. After that, more AR applications are designed particularly for mobile applications e.g., Google Lens, YouCam Makeup, GIPHY world and many more. In addition, there are a number of augmenting reality applications that have been created and have been expanding since then. There are games, social networking applications, healthcare applications and many such applications that use augmented reality.
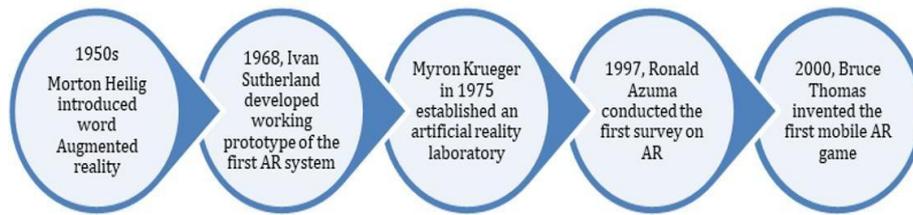
Figure 1: History of Augmented Reality.

III.   How does it work?

Augmented reality uses mapping, depth tracking and computer vision to show content to the user. This application of augmented reality makes it easy to collect and process data to show contents appropriate for the user. In augmented reality, the user's environment is enhanced with the computer-generated content which is relevant to the user. Augmented reality can be experienced using a smart device or special hardware such as optical projection systems.

AR is being used in the mainstream market:

●   Interactive gaming - Pokémon Go, an interactive game launched in 2016, shown in Fig 2. The game set players on the path of becoming Pokémon Masters by capturing all kinds of digital monsters hidden throughout locations in the real world.

●   Snapchat –The app is usually used for its filters. The app first scans your face and then applies the filter using Artificial intelligence.

Figure 2: Examples of Augmented reality[2]

IV.   Augmented Reality Devices

Devices used for experiencing augmented reality are smartphones, displays, computers, optical projection systems, Smart glasses, and AR headsets.

There are three major types of displays used in AR –

●   Head-mounted displays (HMD): HMD is a device which looks like a helmet and is worn on the head, it has a small display optics in front (monocular) or on each eye(binocular) as shown in Fig. 3. HMD can be of two types: video-see-through or optical see-through.

Figure 3: HMD[3]

●   Handheld Displays: Handheld displays are small devices that the user can hold in their hands and use anywhere as shown in Fig. 4. They include the technologies like portable flat screen monitors or mobile phones. These are the most widespread devices.

Figure 4: Handheld device for Augmented reality display[4]

●   Spatial Augmented Reality: (SAR) makes use of video projectors, optical elements, holograms, radio frequency tags, and other tracking technologies to display graphical information directly onto physical objects. It does not require the user to wear any displaydevice as reflected in Fig. 5.

Figure 5: An example of spatial content viewed in the SAR setup [5].

There are many benefits of AR as shown in Fig 6. Also, there are lots of possibilities for using augmented reality in an innovative way. AR is, at present, one of the most promising digital health technologies. There are applications which can be used to study history by visiting the historical places virtually. And the relation between AR and education domain is becoming strong.

V. AR & Education

Augmented reality is widely used in educational fields. It is used to display 3D images, making learning easier and more exciting for students. Students can use AR to see and manipulate 3D geometric forms, in healthcare education. AR also provides an effective and interesting way of teaching. The teachers can use AR devices to teach more efficiently. The AR devices can be used to teach graphically and interactively which makes the teaching process more effective and exciting. The students may get attracted and interested in studying with the new technology which makes teaching interactive. This may also inspire students' minds and help the students explore their interests.

Figure 6: Benefits of AR

AR can have a significant impact on the learning environment.

● Phtotmath: A Smartphone AR app that allows students to scan a math problem and see the virtual animated solution for the problem. The application displays the steps of the solution virtually in an animated manner.

● MergeCube: AR apps can also help students understand mathematical concepts through interactive 3D models. It enables students to hold, view, and rotate a virtual cube. Students can visualize and learn geometry and other mathematical concepts in an interactive way.

● Chem101: It helps students to understand complex compounds such as acids and oxides. It provides valuable visualization and scaffolding. Using this science can be interactive and interesting. Dimensional analysis and organic structure drawing make chemistry easy to learn.

● Teachers can take advantage of AR tools to help students experience history interactively. Tools such as 360Cities and Timelooper lets the student virtually visit the sites and learn the historical and cultural perspectives.

● The AR technology allows students to work collaboratively with the teachers in developing the lesson plan. Teachers can use AR technology platforms to develop lesson plans for coding. Tynker provides teachers with tools to teach coding for video games.

● Human Anatomy Atlas: It can be used to better understand the human body as shown in Fig 7. It has models which make it easier to understand how the human body looks and how it works.

Security & Privacy issues of AR

● Augmented reality devices can see a lot of user information and even the user's surroundings and environment. Which makes the user's privacy to be at risk? AR devices can collect user information to a greater extent

● The risk from hackers is also huge. If Hackers gain access to a device, they can use the control for their benefit.

● Man-in-the-middle-attacks: The Network attackers may be able to access the communication between the AR providers and users. This can result in "man in the middle attacks".

● Sophisticated cybercriminals could steal a customer's or a retailer's information and hold it hostage until a ransom is paid. Or they could capture AR and VR images, manipulate them and use them to steal identities or spread false information to unsuspecting customers.

● Criminals can easily steal the network credentials and Hacking could be a cyber threat for the users of augmented reality applications users.

● Durability: Physical damage may happen while using wearable AR devices. Devices may have some physical vulnerabilities which may harm the user of the device.
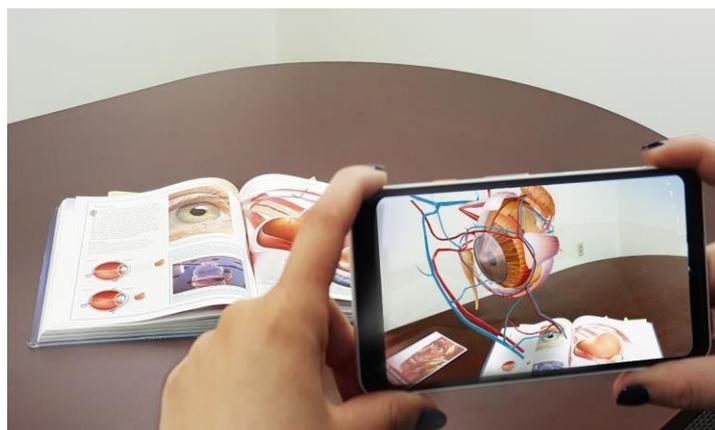

Figure 7: Human Anatomy Atlas app[6]

VI. Discussion & Analysis

Augmented reality provides unique entertainment options that are not available with common types of digital media. With the advancement of technology and continuous research, AR can become one of the big industries. AR has the potential to bring evolution in many fields: gaming, education, business, advertisement and entertainment. AR is providing us with an experience like never before. Ten years ago, AR was unstable and disappointing. The AR technologies now can prove the improvement in AR. Augmented reality faces a large number of challenges and it needs to overcome them to thrive in the future. Security and privacy are also major concerns in the AR industry. But the growing industry will definitely overcome these challenges with research and development.

Augmented reality can make our lives easier and hassle-free. In my opinion, in a decade AR will become a necessity for many of us. AR will be helpful for disabled people in many ways. AR will be a part of education, health, advertising and fitness. Researchers are already finding new ways to use AR in training and teaching. Augmented reality can be used in many efficient ways when combined with Machine learning and Artificial Intelligence. It can be used for disease detection and other medical purposes. AR technology can be used with vehicles. Tesla Motors has shown the possibilities of using AR for the road. They haven't implemented it but it can be made possible with the current augmented devices and technology available. It is quite visible that it is being used for many other purposes than gaming. It is now used in many different industries. Gaming will continue to stay an important driver of augmented reality but, practical uses like in healthcare, engineering, and sales will also grow.

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