

Augmented Reality: An Overview

Pallavi Sood

Department of Computer Science, Apeejay College of Fine Arts, Jalandhar, Punjab, India

Abstract- Today's era is technological era, where changes are very frequent. With advancements in technology, Augmented Reality came into existence. Augmented reality provides a way to learn and see the things as they happened in real world with more effects and graphics. It provides a view of physical real-world environment with superimposed computer-generated images. This paper presents an overview of basic aspects and various applications of augmented reality.

Keywords: augmented reality, AR, virtual reality, applications.

I.INTRODUCTION

Augmented Reality is one of the immersive technologies that revolutionizing the present and future. It is the fastest growing and facilitating technology today. Immersive technologies create or extend reality by immersing the user in a digital environment having applications in different domains like healthcare, transportation, construction, gaming etc. This technology is gaining momentum with every passing day and hour and helping us to reimagining the future. AR technology projects computer generated augmentations on top of reality and helping us performing tasks better and efficiently. Augmented reality falls in between reality and virtual reality. It is a method used to render real world data and presented intuitively so that virtual elements resemble the present reality to an extent.[2] Virtual reality is a computer generated environment with scenes and objects that appears to be real and it makes the user feel they are immersed in their surroundings.[5] Virtual reality environment is perceived by a device known as E-virtual reality headset or helmet. It is a computer generated simulation of an environment or 3-dimensional image where people can interact in real or physical way.[3] Augmented reality is advanced version of virtual reality. The revolution does not stop here. Have you ever try to catch Pokemon using Pokemon Go or fit any furniture using the Idea app. This all possible using the technology called augmented reality. The augmented reality has seen raging in popularity over

the past few years and the revolution is not stopping anytime soon. AR is giving brands the power to provide their customers with unique experiences that can prove to be the difference between purchase or drop out. AR is an enhanced version of the physical real world and it is achieved by various digital visual elements. [4]

Examples of augmented reality are Snapchat, Photography and Editing, Pokemon Go, Google Glass, interior Decoration apps, AR maintenance, Google ARCore etc.

II.BASIC AUGMENTED REALITY PROCESS

The process of how augmented reality works can be divided into three basic steps.

- A. *Input-* For input, one or more sensors are used to capture information from the real world.
- B. *Processing-* The processing unit process or interprets the data acquired from the real world through different software and hardware resources.
- C. *Output-* The output unit displays the information in a way that user feels virtual objects are part of the real world. The AR generated displays can be seen on devices such as mobile phones, screens, glasses, handheld devices etc.

III.COMPONENTS OF AN AUGMENTED REALITY SYSTEM

An augmented reality system can be divided into two components: one is hardware and other one is software.

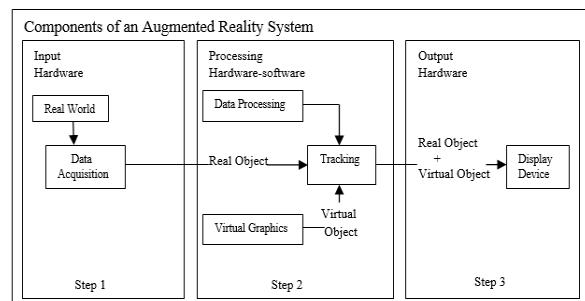


Fig: Components of Augmented reality system

A. Hardware components: The task of the hardware component is divided into two categories. First is to acquire and display the data and information and second is to process the acquired data and information. For acquiring data, input components are used and for displaying data, output components are used.[19] For input, different types of sensors are used that respond to various activities from the real environment and provide the required data for the development of the

system. For output, devices are used to display the information. These devices can be wearable and non-wearable.[7]

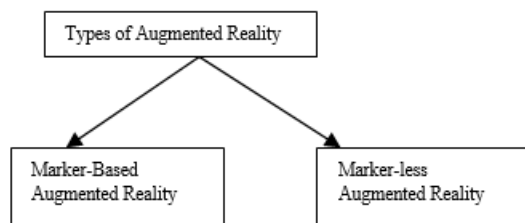
B. Software components are used to interpret the acquired data for transformation and augmentation. Currently various software development kits are used to transform the data such as ARKit, ARCore, ARtoolkit, EasyAR, LayAR etc.

Hardware	System	Type	Example
Input	Sensor	Magnetic	Compasses
		Optical	Cameras, Infrared
		Inertial	Accelerometer, Gyroscope
		Others	Thermo-sensors, GPS, Depth
Output	Wearable	Optical	Helmets, Glasses
	Non-wearable	Video	Head-up Display Smartphone, Tablets, PC
		Projection	Projectors

Table: Types of Hardware Components

V. TYPES OF AUGMENTED REALITY

Augmented Reality is a sub domain of extended reality. AR is an interactive experience of a real world environment where objects that reside in the real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities.



- A. Marker-based Augmented Reality: This type of augmented reality works on the concept of tracking and recognition. In this type of AR, user needs to have a marker through which user can perform augmentation. In general, this augments digital objects upon a marker. Marker based recognition is nothing but the identification of any object/media, such as a barcode, our devices has software to scan and recognize a barcode, similarly recognition of human faces through security systems.
- B. Marker-less Augmented Reality: This type of augmented reality doesn't require any sort of marker. This augmented reality can simply detect

the plane and perform the augmentation of digital objects. For example- IKEA Place.

Types of Marker-less augmented reality

1. Super Imposition Augmented Reality: It is the augmented reality technique which uses object recognition. The augmented image replaces the original image. [12] This replacement is done partially or fully. This kind of AR is used in the medical field. It is used to superimpose an X-Ray onto a patient's body.
2. Location based Augmented Reality: It ties digital content and the experience it creates to a specific place. [23] The objects are mapped out in such a way that when a user's location matches the predetermined spot it is displayed on the screen.
3. Projection based Augmented Reality: It is a little different than the other types of marker-less augmented reality. Namely, the users don't need a mobile device to display the content. Here the light projects the digital graphics onto an object or surface to create an interactive experience for the user. [24] This type of AR is used to create 3D objects that can be interacted with by the user. It can be used to show a prototype of a new product, even disassembling each part of better show its inner workings.
4. Outlining Augmented Reality: It recognizes boundaries and lines to help in situations when the human eye can't. [22] It uses object recognition technique to understand user's immediate

surroundings. Thinking about driving in low light conditions or seeing the structure of a building from the outside.

A. APPLICATIONS OF AUGMENTED REALITY

Augmented Reality in Military and Defense: AR is used in military for situational awareness and survivability in military operations. It helps in supplementing the human perception of and interaction with the bottle space with timely and coherent information to enhance decision making and action implementation. AR is also used to enhance military training programs, potential savings for training, medical-personnel- rapid access to information and reconnaissance information.[17] There are various examples of AR in military and defense. The 'Super Cockpit' are AR headsets used to assist air force pilots. Aspen Movie Map is an early type of interactive computer control of the display of video frames. BARS (Bottle Augmented Reality System) is a program to develop wearable AR headsets for soldiers. C-130 Loadmaster training program is a study by USAF air education and training command to determine if AR headsets should be introduced as a permanent training device. IVAS (Integrated Visual Augmentation System) introduced in 2022. It is based on the Microsoft Hololens and is produced by Microsoft. It is the next stage in AR development. It is a digital display that can provides thermal sensors, low-light sensors, raid target acquisition, aided target identification. All this allows soldiers to make rapid, well-informed decisions.[28]

B. Augmented Reality in Education: Education is one of the industries that is very actively being disrupted by technology and digitalization. New learning techniques generates greater student engagement and It makes the knowledge and skills stay longer. Education can be rather flexible when it concerns the methods of increasing student engagement and interest in learning.[11] The augmented reality provides opportunity to students to inspect a 3D hologram from many different angles. The students can better examine and understand certain concepts by rotating a virtual object in space or moving around. This alone can revolutionize learning in topics like geometry, biology, anatomy, cosmology and many more.[25] It can even revolutionize how augmented reality also enables students to benefit from at-home experiential learning. For example, students can see how certain

modifications affect various organs in human body and they can adjust various physical conditions on a virtual planet to see how those conditions affect its ability to support life. [29]This type0020 of learning is more likely to be remembered and understood by students as compare to other methods.

Many educational apps include printable markers that teachers can use in the classrooms. When the kids point their Smartphone cameras at the markers, something interesting pops out. With augmented reality, educators can recreate 3D models of any object, even that which is impossible to bring to a class and by augmented reality, the models can be dynamic and interactive. An AR app can show a beating heart or the planets rotating around the sun or a hatching hurricane. For example, The Aug That!

Some AR apps for education are- Quiver, 3DBear, SkyView Lite, ARAtom Visualizer for ARCore, Photomath, Catchy Words AR, Google Translate etc.

C.AR in locating appliances, furniture and other Tangible Products: There are already over a dozen Smartphone apps that make this possible. With the help of AR, customers click on a product and instantly see it overlaid wherever they point their mobile device. That means customers can see how appliances and furniture look in their homes. In this scenario, customers could quickly change types of appliances and furniture, colors, sizes and so forth.[13] This is excellent for visualizing room arrangements and color matching before making a purchase. Additionally, customers can view products from every conceivable angle in an interactive 360 degree experience. This gives customers a better idea of the value that a product can offer. For example, IKEA provides augmented reality to place furniture in your home. SHOPIFY AR is a tool that already allows customers to view products in natural environments before buying them.

D.AR in Entertainment: Entertainment industry is always on the lookout for new and innovative ways to engage their audience. AR has provided them an effective way to maximize user engagement and boost their revenue. The immersive AR technologies are transforming the cinematic experiences across the globe.[26] AR elements enable viewers to watch through the eyes of the movie characters, making them experience every scene in an immersive environment.

AR has taken gaming to the next level by providing an immersive environment with real-life simulations.[6] AR techniques enable users to experience the thrill and excitement of a video game in a real-world environment.

For example, AR makes gaming experience so immersive and realistic that gamers feel like they are transported to a whole new world. AR based games eliminate the traditional way of sitting in front of a television screen for hours. With augmented reality, gamers can actually indulge in a game almost as if they are a part of it. Furthermore, AR-based gaming applications allow gamers to interact with technology in a way that energizes them both physically and mentally.[10] Some AR apps for entertainment are- POKEMON Go, SnapChat, Angry Birds AR: Isle of Pigs, YouCam Makeup, PhotoPills, Jurassic World Alive etc.

E.AR to enhance the Shopping experience: AR is giving companies new ways to engage with customers by immersing them in highly informative and engaging experiences. Clothing and Fashion augmented reality simulates in-person shopping experiences online by allowing customers to see how a product might look on them.[16] For example, customers can see how virtual versions of jackets, footwear, jewellery, makeup and sunglasses look on them. Some people call this virtual fitting room technology and its global market is projected to hit \$10 billion by 2027. Smart phones, Smart glasses and other handheld and wearable devices will provide the bulk of these experiences. Smart mirrors are another way to use augmented reality to facilitate these types of experiences.[14] Many large retail chains like Ralph Lauren and H&M are already featuring smart mirrors in their stores. Some apps to enhance the shopping experience are- NIKE to shop shoes, WARBY PARKER to shop glasses, L'OREAL to try on makeup and buy that suits you, WATCH BOX to shop for luxury watches, FACECAKE app to shop jewellery specially earrings etc.

F.AR in Retail Manufacturing sector: AR technology gives a revolution in the retail manufacturing sector. With AR, stores might take a different approach to production. The data captured by augmented reality headsets can be viewed and analyzed in real time. The information is used by stores to improve their

manufacturing decisions, which in turn leads to greater efficiency and cost savings.[1] The creation of a product can be viewed and followed in real time with the use of augmented reality technology. This aids stores in locating production bottlenecks, so they can be eliminated, speeding up delivery times and boosting happy customers.[18] There are further advantages to using augmented reality in production. It makes process more transparent and helps cut down on mistakes. By evaluating and visualizing production data in real time, retailers can make more informed decisions. When used in retail manufacturing operations, augmented reality can increase output while decreasing waste, enhancing customer service and decreasing errors.[30]

G.JARVIS-like Virtual Assistance: A company called Mojo is currently developing AR lenses with micro LED displays that place information inside the wearer's eyes. Its first priority is to help people struggling with poor vision by providing better contrast or the ability to zoom in on objects. But eventually, the lenses will be made available to everyone and could be used to show things like health tracking stats, text messages, weather reports and more.[8] It could also help us enhance our sight in low light conditions or serve as a teleprompter for speaking events. Eventually AR lenses and AR glasses could be used to augment the world around us and even facilitate virtual assistance with the help of sophisticated AI. Depending on what permissions you grant to virtual assistance software, it could listen to all your conversations, read your emails, monitor your blood chemistry and more. With access to all of this data, this AI enabled software would learn your preferences, anticipate your needs and behaviors, shop for you, monitor your health and help you navigate toward your mid-and-long term goals.

H.AR in Healthcare: There are various powerful tools are being developed with potential to redefine disease detection diagnosis and treatment detecting cancer through image recognition. It can help doctors in their patient's diagnosis with real time screening analysis.[27] The results are just as accurate as those performed by trained professionals. For example, an AR microscope with real time AI integration for cancer diagnosis is used, advance AR devices for cardiologists during simple or complex surgical

procedures.[9] AR is also used for vein visualization. An app called acuvein allows nurses to find the vein for injection. For example, simply use the camera of your phone to look at an arm or hand and identify where the veins are, which makes it easy if they needed to inject something or took blood.[15] AR is also used to diagnose mental health. It can be used by the doctors for pre-surgical data. For example, a doctor can even have a holographic visualization of the organs that he/she want to operate on.[20]

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