Augmented Reality: Current and Future Application Areas

Remya.S.P
Lecturer, Department of Computer Science, N.S.S.College, Ottapalam
University of Calicut, Kerala, India.

Abstract : Augmented Reality (AR) is regarded as one of the most world-changing technologies of 21st Century. Augmented reality is a technology that superimposes computer-generated images onto a live environment, helping the user to analyze the real-world situation in more detail. AR is used often with laptops, smartphones, and tablets, where digital images and graphics intersect and interact with the real world to enhance the experience. AR is an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, and haptic. After capturing the input from the devices, the AR application recognizes the target, processes the image, and augments it with pictures, video, and audio to create an illusion that can effectively engage users in a virtual world.AR Technology can change the way we look at the world. Augmented Reality is a perfect blend of the digital world and the physical elements to create an artificial environment. The aim of this research paper is to highlight top technologies and applications of Augmented Reality technology

Keywords – **Augmented Reality (AR), Virtual Reality (VR), Technology, Networking, Types of AR.**

I. INTRODUCTION

AR is an integration of the real world and the virtual world, with the aim of providing additional information about something in the real world with information displayed in the virtual world. AR can be defined as a system that incorporates three basic features: a combination of real and virtual worlds, real-time interaction, and accurate 3D registration of virtual and real objects. The overlaid sensory information can be constructive (i.e. additive to the natural environment), or destructive (i.e. masking of the natural environment). This experience is seamlessly interwoven with the physical world such that it is perceived as an immersive aspect of the real environment. In this way, augmented reality alters one's ongoing perception of a real-world environment, whereas virtual reality completely replaces the user's real-world environment with a simulated one. Augmented reality is related to two largely synonymous terms: mixed reality and computer-mediated reality.The primary value of augmented reality is the manner in which components of the digital world blend into a person's perception of the real world, not as a simple display of data, but through the integration of immersive sensations, which are perceived as natural parts of an environment. The earliest functional AR systems that provided immersive mixed reality experiences for users were invented in the early 1990s, starting with the Virtual Fixtures system developed at the U.S. Air Force's Armstrong Laboratory in 1992. Commercial augmented reality experiences were first introduced in entertainment and gaming businesses. Subsequently, augmented reality applications have spanned commercial industries such as education, communications, medicine, and entertainment. In education, content may be accessed by scanning or viewing an image with a mobile device or by using markerless AR techniques.

Augmented reality is used to enhance natural environments or situations and offer perceptually enriched experiences. With the help of advanced AR technologies (e.g. adding computer vision, incorporating AR cameras into smartphone applications and object recognition) the information about the surrounding real world of the user becomes interactive and digitally manipulated. Information about the environment and its objects is overlaid on the real world. This information can be virtual. Augmented Reality is any experience which is artificial and which adds to the already existing reality. or real, e.g. seeing other real sensed or measured information such as electromagnetic radio waves overlaid in exact alignment with where they actually are in space. AR let us see the real-life environment right in front of us—trees swaying in the park, dogs chasing balls, kids playing soccer—with a digital augmentation overlaid on it. For example, the dogs could be mingling with their cartoon counterparts, and the kids could be seen kicking past an alien spacecraft on their way to score a goal. The most famous example of AR technology is the mobile app Pokemon Go, which was released in 2016 and quickly became an inescapable sensation. In the game, players locate and capture Pokemon characters that pop up in the real world—on your sidewalk, in a fountain, even in your own bathroom.

There are as many uses for AR in our everyday life.Here are just a few examples:

- Enhanced navigation systems use augmented reality to superimpose a route over the live view of the road.
- During football games, broadcasters use AR to draw lines on the field to illustrate and analyze plays.
- Furniture and housewares giant IKEA offers an AR app (called IKEA Place) that lets you see how a piece of furniture will look and fit in your space.
- Military fighter pilots see an AR projection of their altitude, speed, and other data on their helmet visor, which means they don't need to waste focus by glancing down to see them.
- Neurosurgeons sometimes use an AR projection of a 3-D brain to aid them in surgeries.

Augmented reality also has a lot of potential in the gathering and sharing of tacit knowledge. Augmentation techniques are typically performed in real time and in semantic contexts with environmental elements. Immersive perceptual information is sometimes combined with supplemental information like scores over a live video feed of a sporting event. This combines the benefits of both augmented reality technology and heads up display technology hud.

II. DIFFERNCE BETWEEN AR,VR,MR,XR

Augmented reality,Virtual reality, Mixed Reality and Extended Reality are different ways that technology can change the way you look at the world.

2.1 Augmented Reality(AR)

Augmented reality is defined as "an enhanced version of reality created by the use of technology to add digital information on an image of something."AR is used in apps for smartphones and tablets. AR apps use your phone's camera to show you a view of the real world in front of you, then put a layer of information, including text and/or images, on top of that view.Apps can use AR for fun, such as the games, or for information. It takes some sophisticated technology to create Augmented Reality (AR) experiences. AR images can be displayed on a multitude of devices including eyeglasses and goggles, headsets, and heads-up displays like helmet visors, but the most common way to use AR these days is on a smartphone, in a variety of apps and games.

2.2 Virtual Reality (VR)

Virtual Reality is defined as "the use of computer technology to create a simulated environment."When you view VR, you are viewing a completely different reality than the one in front of you.Virtual reality may be artificial, such as an animated scene, or an actual place that has been photographed and included in a virtual reality app.With virtual reality, you can move around and look in every direction -- up, down, sideways and behind you, as if you were physically there.You can view virtual reality through a special VR viewer, such as the Oculus Rift. Other virtual reality viewers use your phone and VR apps, such as Google Cardboard or Daydream View. AR augments the real-world scene whereas VR creates completely immersive virtual environments.AR is 25% virtual and 75% real while VR is 75% virtual and 25% real.

2.3 Mixed Reality (MR)

Mixed Reality combines elements of both AR and VR, real-world and digital objects interact. Mixed reality technology is just now starting to take off with Microsoft's HoloLens one of the most notable early mixed reality apparatuses.

2.4 Extended Reality (XR)

Extended Reality is an umbrella term that covers all of the various technologies that enhance our senses, whether they're providing additional information about the actual world or creating totally unreal, simulated worlds for us to experience. It includes Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) technologies.

III. TYPES OF AUGMENTED REALITY

AR uses computer vision, mapping as well as depth tracking in order to show appropriate content to the user. This functionality allows cameras to collect, send, and process data to show digital content appropriate to what any user is looking at. In Augmented reality, the user's physical environment is enhanced with contextually relevant digital content in real-time. We can experience (AR) augmented reality with a smartphone or with special hardwareAR is enabled by new technical features such as computer vision, object recognition, miniature accelerometers, a Global Positing System (GPS) and the solid state compass. The AR display technologies that are essential to create the AR experience are briefly described below:

3.1. Marker-Based AR: the marker based AR relies on the image recognition technique that takes help of a camera and certain types of visual markers like QR/2D code , that gives result only when sensed by a reader. The marker based apps with the use of camera can differentiate between the marker and other real world objects. Markers are generally based on simple patterns, easily recognizable, requiring comparative low processing power for reading. Here the orientation and the position is also calculated where certain content and/or information is then overlaid on location of marker.

3.2. Markerless AR: (also known as location-based, positionbased, or GPS-based AR) uses miniature versions of a GPS, a digital compass, and a velocity meter, or accelerometer, which are embedded in the device, to provide data based on the exact location and orientation of the device. A strong force behind popularization of the Marker-less AR technology solution is the availability of smartphones everywhere with the location detection features. They are mostly used for mapping directions, finding nearby businesses, or other location-centric mobile applications.

3.3 Projection-Based AR: Projection-based AR works by projecting artificial light onto real world surfaces. Projection-based AR applications allow for human interaction by sending light onto a real-world surface and then sensing the human interaction (i.e. touch) of that projected light. Detecting the user's interaction is done by differentiating between an expected (or known) projection and the altered projection (caused by the user's interaction). Projection-based AR can utilize laser plasma technology to project a 3D interactive hologram into mid-air, and although early demonstrators have come out in 2014, consumer version applications are still in the early stages of development.

3.4. Superimposition-Based AR: Superimposition-based AR partially or fully replaces the original view of the object with an augmented view of that object. Computer vision and object recognition play a vital role, because the original view has to be recognized before it can be replaced with the correct augmented version. It is very suitable for the low-end consumer, who can use their smartphone or tablet to experience an augmented version International Journal of Engineering & Technology 159 of their view, in for instance a museum or cultural heritage location.

IV. TECHNOLOGY USED IN AR

Augmented reality(AR) can be experienced with a smartphone or with special hardware. AR is enabled by new technical features such as computer vision, object recognition, miniature accelerometers, a Global Positing System (GPS) and the solid state compass. The AR display technologies that are essential to create the AR experience are briefly described below:

4.1.Hardware

Hardware components for augmented reality are: a processor, display, sensors and input devices. Modern mobile computing devices like smartphones and tablet computers contain these elements, which often include a camera and microelectromechanical systems (MEMS) sensors such as an accelerometer, GPS, and solid state compass, making them suitable AR platform. There are two technologies used in augmented reality: diffractive waveguides and reflective waveguides.

4.2.Display

Various technologies are used in augmented reality rendering, including optical projection systems, monitors, handheld devices, and display systems, which are worn on the human body.A head-mounted display (HMD) is a display device worn on the forehead, such as a harness or helmet-mounted. HMDs place images of both the physical world and virtual objects over the user's field of view. Modern HMDs often employ sensors for six degrees of freedom monitoring that allow the system to align virtual information to the physical world and adjust accordingly with the user's head movements. HMDs can provide VR users with mobile and collaborative experiences Specific providers, such as uSens and Gestigon, include gesture controls for full virtual immersion.

4.3.Eyeglasses

AR displays can be rendered on devices resembling eyeglasses. Versions include eyewear that employs cameras to intercept the real world view and re-display its augmented view through the eyepieces and devices in which the AR imagery is projected through or reflected off the surfaces of the eyewear lens pieces.

4.4.HUD

A head-up display (HUD) is a transparent display that presents data without requiring users to look away from their usual viewpoints. A precursor technology to augmented reality, heads-up displays were first developed for pilots in the 1950s, projecting simple flight data into their line of sight, thereby enabling them to keep their "heads up" and not look down at the instruments. Near-eye augmented reality devices can be used as portable head-up displays as they can show data, information, and images while the user views the real world. Many definitions of augmented reality only define it as overlaying the information. This is basically what a head-up display does; however, practically speaking, augmented reality is expected to include registration and tracking between the superimposed perceptions, sensations, information, data, and images and some portion of the real world.

4.5.Contact lenses

Contact lenses that display AR imaging are in development. These bionic contact lenses might contain the elements for display embedded into the lens including integrated circuitry, LEDs and an antenna for wireless communication. The first contact lens display was patented in 1999 by Steve Mann and was intended to work in combination with AR spectacles, but the project was abandoned, then 11 years later in 2010–2011. Another version of contact lenses, in development for the U.S. military, is designed to function with AR spectacles, allowing soldiers to focus on close-to-the-eye AR images on the spectacles and distant real world objects at the same time. Many scientists have been working on contact lenses capable of different technological feats. A patent filed by Samsung describes an AR contact lens, that, when finished, will include a built-in camera on the lens itself. The design is intended to control its interface by blinking an eye. It is also intended to be linked with the user's smartphone to review footage, and control it separately. When successful, the lens would feature a camera, or sensor inside of it. It is said that it could be anything from a light sensor, to a temperature sensor.The first publicly unveiled working prototype of an AR contact lens not requiring the use of glasses in conjunction was developed by Mojo Vision and announced and shown off at CES 2020.

4.6.Virtual retinal display

Human Interface Technology Laboratory. With this technology, a display is scanned directly onto the retina of a viewer's eye. This results in bright images with high resolution and high contrast. The viewer sees what appears to be a conventional display floating in space.Several of tests were done to analyze the safety of the VRD. In one test, patients with partial loss of vision—having either macular degeneration (a disease that degenerates the retina) or keratoconus—were selected to view images using the technology. In the macular degeneration group, five out of eight subjects preferred the VRD images to the cathode-ray tube (CRT) or paper images and thought they were better and brighter and were able to see equal or better resolution levels. The Keratoconus patients could all resolve smaller lines in several line tests using the VRD as opposed to their own correction. They also found the VRD images to be easier to view and sharper. As a result of these several tests, virtual retinal display is considered safe technology.Virtual retinal display creates images that can be seen in ambient daylight and ambient room light. The VRD is considered a preferred candidate to use in a surgical display due to its combination of high resolution and high contrast and brightness. Additional tests show high potential for VRD to be used as a display technology for patients that have low vision.

4.7.EyeTap

The EyeTap (also known as Generation-2 Glass[) captures rays of light that would otherwise pass through the center of the lens of the wearer's eye, and substitutes synthetic computer-controlled light for each ray of real light.The Generation-4 Glass (Laser EyeTap) is similar to the VRD (i.e. it uses a computer-controlled laser light source) except that it also has infinite depth of focus and causes the eye itself to, in effect, function as both a camera and a display by way of exact alignment with the eye and resynthesis (in laser light) of rays of light entering the eye.

4.8.Handheld

A Handheld display employs a small display that fits in a user's hand. All handheld AR solutions to date opt for video see-through. Initially handheld AR employed fiducial markers,[and later GPS units and MEMS sensors such as digital compasses and six degrees of freedom accelerometer–gyroscope. Today simultaneous localization and mapping (SLAM) markerless trackers such as PTAM (parallel tracking and mapping) are starting to come into use. Handheld display AR promises to be the first commercial success for AR technologies. The two main advantages of handheld AR are the portable nature of handheld devices and the ubiquitous nature of camera phones. The disadvantages are the physical constraints of the user having to hold the handheld device out in front of them at all times, as well as the distorting effect of classically wide-angled mobile phone cameras when compared to the real world as viewed through the eye.

4.9.Projection mapping

Projection mapping augments real-world objects and scenes, without the use of special displays such as monitors, head-mounted displays or hand-held devices. Projection mapping makes use of digital projectors to display graphical information onto physical objects. The key difference in projection mapping is that the display is separated from the users of the system. Since the displays are not associated with each user, projection mapping scales naturally up to groups of users, allowing for collocated collaboration between users.Examples include shader lamps, mobile projectors, virtual tables, and smart projectors. Shader lamps mimic and augment reality by projecting imagery onto neutral objects. This provides the opportunity to enhance the object's appearance with materials of a simple unit—a projector, camera, and sensor.A projection mapping system can display on any number of surfaces in an indoor setting at once. Projection mapping supports both a graphical visualization and passive haptic sensation for the end users. Users are able to touch physical objects in a process that provides passive haptic sensation.

4.10.Networking

Mobile augmented reality applications are gaining popularity because of the wide adoption of mobile and especially wearable devices. However, they often rely on computationally intensive computer vision algorithms with extreme latency requirements. To compensate for the lack of computing power, offloading data processing to a distant machine is often desired. Computation offloading introduces new constraints in applications, especially in terms of latency and bandwidth. Although there are a plethora of real-time multimedia transport protocols, there is a need for support from network infrastructure as well.

4.11.Input devices

Techniques include speech recognition systems that translate a user's spoken words into computer instructions, and gesture recognition systems that interpret a user's body movements by visual detection or from sensors embedded in a peripheral device such as a wand, stylus, pointer, glove or other body wear. Products which are trying to serve as a controller of AR headsets include Wave by Seebright Inc. and Nimble by Intugine Technologies.

4.12.Computer

The computer analyzes the sensed visual and other data to synthesize and position augmentations. Computers are responsible for the graphics that go with augmented reality. Augmented reality uses a computer-generated image which has a striking effect on the way the real world is shown. With the improvement of technology and computers, augmented reality is going to lead to a drastic change on ones perspective of the real world. According to Time, in about 15–20 years it is predicted that augmented reality and virtual reality are going to become the primary use for computer interactions. Computers are improving at a very fast rate, leading to new ways to improve other technology. The more that computers progress, augmented reality will become more flexible and more common in society. Computers are the core of augmented reality. The computer receives data from the sensors which determine the relative position of an objects' surface. This translates to an input to the computer which then outputs to the users by adding something that would otherwise not be there. The computer comprises memory and a processor. The computer takes the scanned environment then generates images or a video and puts it on the receiver for the observer to see. The fixed marks on an object's surface are stored in the memory of a computer. The computer also withdraws from its memory to present images realistically to the onlooker.

4.13.Projector

Projectors can also be used to display AR contents. The projector can throw a virtual object on a projection screen and the viewer can interact with this virtual object. Projection surfaces can be many objects such as walls or glass panes.

V. APPLICATIONS OF AR TECHNOLOGY

Augmented reality technology is becoming more widely available to consumers. At the end of 2021 it was estimated there were a total of 598 million AR active devices and this is projected to increase to 1.73 billion by 2024, according to research by ARtillery Intelligence.As more consumers adopt augmented reality technology, AR will move into the mainstream and cease to be viewed as a niche technology. 2020 marked a significant period of growth for AR, with 2021 set to further expand on this. Augmented reality has been explored for many applications, from gaming and entertainment to medicine, education and business.

Here is a list of top trends and applications of what to expect from the world of AR in 2021.

5.1. Archaeology

AR has been used to aid archaeological research. By augmenting archaeological features onto the modern landscape, AR allows archaeologists to formulate possible site configurations from extant structures. Computer generated models of ruins, buildings, landscapes or even ancient people have been recycled into early archaeological AR applications. For example, implementing a system like, VITA (Visual Interaction Tool for Archaeology) will allow users to imagine and investigate instant excavation results without leaving their home. Each user can collaborate by mutually "navigating, searching, and viewing data".

5.2. Architecture

AR can aid in visualizing building projects. Computer-generated images of a structure can be superimposed onto a real-life local view of a property before the physical building is constructed there; this was demonstrated publicly by Trimble Navigation in 2004. AR can also be employed within an architect's workspace, rendering animated 3D visualizations of their 2D drawings. Architecture sight-seeing can be enhanced with AR applications, allowing users viewing a building's exterior to virtually see through its walls, viewing its interior objects and layout. With continual improvements to GPS accuracy, businesses are able to use augmented reality to visualize georeferenced models of construction sites, underground structures, cables and pipes using mobile devices. Augmented reality is applied to present new projects, to solve on-site construction challenges, and to enhance promotional materials. Examples include the Daqri Smart Helmet, an Android-powered hard hat used to create augmented reality for the industrial worker, including visual instructions, real-time alerts, and 3D mapping.

5.3. STEM education

In educational settings, AR has been used to complement a standard curriculum. Text, graphics, video, and audio may be superimposed into a student's real-time environment. Textbooks, flashcards and other educational reading material may contain embedded "markers" or triggers that, when scanned by an AR device, produced supplementary information to the student rendered in a multimedia format. The 2015 Virtual, Augmented and Mixed Reality: 7th International Conference mentioned Google Glass as an example of augmented reality that can replace the physical classroom. First, AR technologies help learners engage in authentic exploration in the real world, and virtual objects such as texts, videos, and pictures are supplementary elements for learners to conduct investigations of the real-world surroundings. As AR evolves, students can participate interactively and interact with knowledge more authentically. Instead of remaining passive recipients, students can become active learners, able to interact with their learning environment. Computer-generated simulations of historical events allow students to explore and learning details of each significant area of the event site.

In higher education, Construct3D, a Studierstube system, allows students to learn mechanical engineering concepts, math or geometry. Chemistry AR apps allow students to visualize and interact with the spatial structure of a molecule using a marker object held in the hand. Others have used HP Reveal, a free app, to create AR notecards for studying organic chemistry mechanisms or to create virtual demonstrations of how to use laboratory instrumentation. Anatomy students can visualize different systems of the human body in three dimensions. Using AR as a tool to learn anatomical structures has been shown to increase the learner knowledge and provide intrinsic benefits, such as increased engagement and learner immersion.

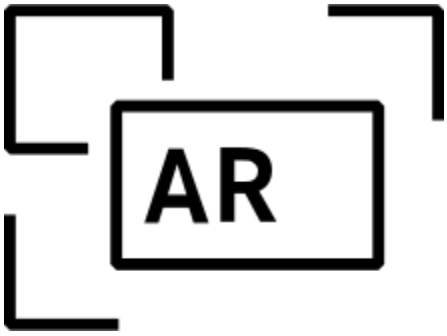
5.4. Industrial manufacturing

AR is used to substitute paper manuals with digital instructions which are overlaid on the manufacturing operator's field of view, reducing mental effort required to operate. AR makes machine maintenance efficient because it gives operators direct access to a machine's maintenance history.[123] Virtual manuals help manufacturers adapt to rapidly-changing product designs, as digital instructions are more easily edited and distributed compared to physical manuals.

Digital instructions increase operator safety by removing the need for operators to look at a screen or manual away from the working area, which can be hazardous. Instead, the instructions are overlaid on the working area. The use of AR can increase operators' feeling of safety when working near high-load industrial machinery by giving operators additional information on a machine's status and safety functions, as well as hazardous areas of the workspace.

5,5. Commerce

The AR-Icon can be used as a marker on print as well as on online media. It signals the viewer that digital content is behind it. The content can be viewed with a smartphone or tablet.



AR is used to integrate print and video marketing. Printed marketing material can be designed with certain "trigger" images that, when scanned by an AR-enabled device using image recognition, activate a video version of the promotional material. A major difference between augmented reality and straightforward image recognition is that one can overlay multiple media at the same time in the view screen, such as social media share buttons, the in-page video even audio and 3D objects. Traditional print-only publications are using augmented reality to connect different types of media. AR can enhance product previews such as allowing a customer to view what's inside a product's packaging without opening it.AR can also be used as an aid in selecting products

from a catalog or through a kiosk. Scanned images of products can activate views of additional content such as customization options and additional images of the product in its use.

Augmented reality is becoming more frequently used for online advertising. Retailers offer the ability to upload a picture on their website and "try on" various clothes which are overlaid on the picture. Even further, companies such as Bodymetrics install dressing booths in department stores that offer full-body scanning. These booths render a 3-D model of the user, allowing the consumers to view different outfits on themselves without the need of physically changing clothes.

5,6. Human Computer Interaction

Human Computer Interaction is an interdisciplinary area of computing that deals with design and implementation of systems that interact with people. Researchers in HCI come from a number of disciplines, including computer science, engineering, design, human factor, and social science, with a shared goal to solve problems in the design and the use of technology so that it can be used more easily, effectively, efficiently, safely, and with satisfaction. Primary school children learn easily from interactive experiences. As an example, astronomical constellations and the movements of objects in the solar system were oriented in 3D and overlaid in the direction the device was held, and expanded with supplemental video information. Paper-based science book illustrations could seem to come alive as video without requiring the child to navigate to web-based materials.

AR would also be a way for parents and teachers to achieve their goals for modern education, which might include providing more individualized and flexible learning, making closer connections between what is taught at school and the real world, and helping students to become more engaged in their own learning.

5.7. Emergency management/search and rescue

Augmented reality systems are used in public safety situations, from super storms to suspects at large. An example was a search aircraft looking for a lost hiker in rugged mountain terrain. Augmented reality systems provided aerial camera operators with a geographic awareness of forest road names and locations blended with the camera video. The camera operator was better able to search for the hiker knowing the geographic context of the camera image. Once located, the operator could more efficiently direct rescuers to the hiker's location because the geographic position and reference landmarks were clearly labeled.

5.8. Education

As education continues to be affected by the Covid-19 pandemic and the reliance on distance learning continues, we're going to see an increase in AR technology being optimised to enhance the education experience of students in 2021.Augmented reality in education allows students of all ages to learn immersively. Educational institutions have been some of the hardest hit by social distancing policies in the face of the 2020 COVID-19 pandemic. However, augmented reality has a number of applications that can help improve the learning experience for e-learning students. Wikitude has created an app called Ai.R-Cord. This app is aimed at helping elementary school students learn concepts by using augmented reality experiences.

The potential of augmented reality to increase student focus on course content while at home cannot be understated. The technology also makes learning modes at home more diverse by expanding visual content for more visual-focused learners. This can help break up monotonous video conferencing and recorded lecture note-taking to improve student engagement.One of the primary advantages of augmented reality in the educational space is the ability for a student to inspect a model from many different angles on their own. By moving around a virtual object or rotating it in space, they can better examine and understand certain concepts. Most importantly, it allows students the benefit of at-home experiential learning. This kind of learning is more likely to be remembered and understood by students compared to other methods.

5.9. Healthcare

One of the first applications of augmented reality was in healthcare, particularly to support the planning, practice, and training of surgical procedures. AR provides surgeons with patient monitoring data in the style of a fighter pilot's heads-up display, and allows patient imaging records, including functional videos, to be accessed and overlaid. Examples include a virtual X-ray view based on prior tomography or on real-time images from ultrasound and confocal microscopy probes, visualizing the position of a tumor in the video of an endoscope,[185] or radiation exposure risks from X-ray imaging devices. AR can enhance viewing a fetus inside a mother's womb. Siemens, Karl Storz and IRCAD have developed a system for laparoscopic liver surgery that uses AR to view sub-surface tumors and vessels. AR has been used for cockroach phobia treatment. Patients wearing augmented reality glasses can be reminded to take medications. Augmented reality can be very helpful in the medical field. It could be used to provide crucial information to a doctor or surgeon without having them take their eyes off the patient. On 30 April 2015 Microsoft announced the Microsoft HoloLens, their first attempt at augmented reality. The HoloLens has advanced through the years and is capable of projecting holograms for near infrared fluorescence based image guided surgery. As augmented reality advances, it finds increasing applications in healthcare. Augmented reality and similar computer based-utilities are being used to train medical professionals In healthcare, AR can be used to provide guidance during diagnostic and therapeutic interventions e.g. during surgery. Magee et al. for instance describe the use of augmented reality for medical training in simulating ultrasound guided needle placement. A very recent study by Akçayır, Akçayır, Pektaş, and Ocak (2016) revealed that AR technology both improves university students' laboratory skills and helps them to build positive attitudes relating to physics laboratory work. Recently, augmented reality began seeing adoption in neurosurgery, a field that requires heavy amounts of imaging before procedures.

5.10. Broadcast and live events

Weather visualizations were the first application of augmented reality in television. It has now become common in weather casting to display full motion video of images captured in real-time from multiple cameras and other imaging devices. Coupled

with 3D graphics symbols and mapped to a common virtual geospatial model, these animated visualizations constitute the first true application of AR to TV.

AR has become common in sports telecasting. Sports and entertainment venues are provided with see-through and overlay augmentation through tracked camera feeds for enhanced viewing by the audience. Examples include the yellow "first down" line seen in television broadcasts of American football games showing the line the offensive team must cross to receive a first down. AR is also used in association with football and other sporting events to show commercial advertisements overlaid onto the view of the playing area. Sections of rugby fields and cricket pitches also display sponsored images. Swimming telecasts often add a line across the lanes to indicate the position of the current record holder as a race proceeds to allow viewers to compare the current race to the best performance. Other examples include hockey puck tracking and annotations of racing car performance and snooker ball trajectories. AR has been used to enhance concert and theater performances. For example, artists allow listeners to augment their listening experience by adding their performance to that of other bands/groups of users.

5.11.Tourism and sightseeing

Travelers may use AR to access real-time informational displays regarding a location, its features, and comments or content provided by previous visitors. Advanced AR applications include simulations of historical events, places, and objects rendered into the landscape. AR applications linked to geographic locations present location information by audio, announcing features of interest at a particular site as they become visible to the user.

5.12.Video games

An AR mobile game using a trigger image as fiducial marker.The gaming industry embraced AR technology. A number of games were developed for prepared indoor environments, such as AR air hockey, Titans of Space, collaborative combat against virtual enemies, and AR-enhanced pool table games. Augmented reality allowed video game players to experience digital game play in a real-world environment. Niantic released the augmented reality mobile game Pokémon Go. Disney has partnered with Lenovo to create the augmented reality game Star Wars: Jedi Challenges that works with a Lenovo Mirage AR headset, a tracking sensor and a Lightsaber controller, scheduled to launch in December 2017. Augmented reality gaming (ARG) is also used to market film and television entertainment properties. On 16 March 2011, BitTorrent promoted an open licensed version of the feature film Zenith in the United States. Users who downloaded the BitTorrent client software were also encouraged to download and share Part One of three parts of the film. On 4 May 2011, Part Two of the film was made available on VODO. The episodic release of the film, supplemented by an ARG transmedia marketing campaign, created a viral effect and over a million users downloaded the movie.

VI. CHALLENGES IN AR

Augmented reality (AR), bring many benefits to us as consumers, and to the industries that adopt them. But we can't ignore the fact that there are many risks that come with AR.

6.1. Reality modifications - AR creates the risk that the wearers of augmented reality glasses may become unaware of surrounding dangers. Consumers want to use augmented reality glasses to change their surroundings into something that reflects their own personal opinions. Around two in five want to change the way their surroundings look and even how people appear to them. For the development of new AR-related products, this implies that the user-interface should follow certain guidelines as not to overload the user with information while also preventing the user from over-relying on the AR system such that important cues from the environment are missed. This is called the virtually-augmented key. Once the key is ignored, people might not desire the real world anymore.

6.2. Lack of Privacy - The concept of modern augmented reality depends on the ability of the device to record and analyze the environment in real time. Because of this, there are potential legal concerns over privacy. Legal complications would be found in areas where a right to a certain amount of privacy is expected or where copyrighted media are displayed. In terms of individual privacy, there exists the ease of access to information that one should not readily possess about a given person. This is accomplished through facial recognition technology. Assuming that AR automatically passes information about persons that the user sees, there could be anything seen from social media, criminal record, and marital status.

6.3. Expensive - It is very expensive to implement and develop AR technology-based projects and to maintain it.

6.4. Low-performance - The low-performance level of AR devices is a major drawback that can arise during the testing phase.

6.5. Health issues - Extreme engagement with AR technology can lead to major healthcare issues such as eye problems and obesity etc.Augmented reality can also cause mental health issues.

6.6. Lack of security - Lack of security may affect the overall augmented reality principle.

VII. CONCLUSION

Augmented reality (AR) is one of the biggest technology trends right now, and it's only going to get bigger as AR ready smartphones and other devices become more accessible around the world. It's worth exploring the different avenues and trends that drive the surging augmented reality market. Augmented Reality and Virtual Reality are blended together to generate an

improved engaging experience when these technologies are merged together to transport the user to the fictitious world by giving a new dimension of interaction between real and virtual world.

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