AUGMENTED REALITY

A Technical Seminar Report Submitted to the Faculty of

Computer Science and Engineering

Geethanjali College of Engineering & Technology

(Affiliated to J.N.T.U.H, Approved by AICTE, NEW DELHI)

In partial fulfillment of the requirements

For the award of degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

By

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CERTIFICATE

This is to certify that the Technical seminar report entitled "AUGMENTED REALITY" is a bonafide work done by KAVYA REDDY. V (12R11A05E5) in partial fulfillment of the requirement of the award for the degree of Bachelor of Technology in "Computer Science and Engineering" from Jawaharlal Nehru Technological University, Hyderabad during the year 2015-2016.

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ACKNOWLEDGEMENT

I am greatly indebted to the authorities of Geethanjali College of Engineering and Technology, Cheeryal, R.R Dist, for providing me the necessary facilities to successfully carry put this Technical Seminar work titled "**AUGMENTED REALITY**".

Firstly, I thank and express my solicit gratitude to **Prof. Dr. S. Nagander Kumar,** HOD, CSE department, Geethanjali College of Engineering and technology, for his invaluable help and support which helped me a lot in successfully completing my technical seminar..

Secondly, I express my gratitude to **Assistant Prof. Mrs. Swathi Teja**, Geethanjali College of Engineering and Technology for her suggestions and encouragement which helped me in the successful completion of my technical seminar.

I would like to express my sincere gratitude to our **Principal Dr. Udaya Kumar Susarla** for providing the necessary infrastructure to complete my technical seminar.

Finally, I would like to express my heartfelt thanks to our parents who were very supportive both financially and mentally and for their encouragement to achieve my set goals.

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CONTENTS

ABSTRACT

Most of us love playing video games; it often brings out the child inside from all of us. Over the generations video games have evolved from time to time. If it started with big kiosk type machines which consumed a lot of space and now we have small portable PlayStation from Sony which we can carry anywhere or everywhere we want. Still the consumers are not satisfied as most gaming contents offer only 2-D or 3-D perspective and lacks a real feel to it.

We have currently wireless sticks which we can connect to the gaming consoles in the market which is somewhat close to reality as we can play games like golf and tennis by using this stick as rackets or clubs. The search of a real gaming experience went on and that gave birth to a unique concept called augmented reality or AR.

AR provides a real time world environment and allows the viewers to interact with game live. This happens with the help of various augmented factors such as audio, visual, computer graphics and even global positioning input. Augmented reality synchronizes the environment with the graphical structure to provide an ultimate virtual reality gaming experience. A user has to wear special type of glasses to absorb this technology and as more research is done on this topic in the coming years, we can expect even better results happening

It is a cutting edge technology used to enhance one's current perception of reality.

AR technology mainly works with the help of the sensors and is also a stretched virtual reality technology. The users will be able to experience a real experience while using this technology, for e.g. if we are watching a live telecast of a game, AR will give us the same ambiance of sitting inside that stadium. AR is certainly one technology to look for the future.

Some researchers define AR in a way that requires the use of Head-Mounted Displays (HMDs). To avoid limiting AR to specific technologies, this survey defines AR as systems that have the following three characteristics:

1) combines real and virtual

2) Interactive in real time

3) Registered in 3-D

1.INTRODUCTION

Augmented reality (AR) is a live direct or indirect view of a physical, real-world environment whose elements are augmented (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data. It is related to a more general concept called mediated reality, in which a view of reality is modified (possibly even diminished rather than augmented) by a computer. As a result, the technology functions by enhancing one's current perception of reality. By contrast, virtual reality replaces the real world with a simulated one. Augmentation is conventionally in real-time and in semantic context with environmental elements, such as sports scores on TV during a match. With the help of advanced AR technology (e.g. adding computer vision and object recognition) the information about the surrounding real world of the user becomes interactive and digitally manipulable.

Video games have been entertaining us for nearly 30 years, ever since Pong was introduced to arcades in the early 1970s. Computer graphics have become much more sophisticated since then, and game graphics are pushing the barriers of photorealism. Now, researchers and engineers are pulling graphics out of our television screen or computer display and integrating them into real-world environments. This new technology, called augmented reality, blurs the line between what's real and what's computer-generated by enhancing what we see, hear, feel and smell.

On the spectrum between virtual reality, which creates immersive, computer-generated environments, and the real world, augmented reality is closer to the real world. Augmented reality adds graphics, sounds, haptic feedback and smell to the natural world as it exists. Both video games and cell phones are driving the development of augmented reality. Everyone from tourists, to soldiers, to someone looking for the closest subway stop can now benefit from the ability to place computer-generated graphics in their field of vision.

AUGMENTED REALITY IN VARIOUS FIELDS

Augmented Reality on Cell Phones

While it may be some time before you buy a device like SixthSense, more primitive versions of augmented reality are already here on some cell phones, particularly in applications for the iPhone and phones with the Android operating system. In the Netherlands, cell phone owners can download an application called Layar that uses the phone's camera and GPS capabilities to gather information about the surrounding area. Layar then shows information about restaurants or other sites in the area, overlaying this information on the phone's screen. You can even point the phone at a building, and Layar will tell you if any companies in that building are hiring, or it might be able to find photos of the building on Flickr or to locate its history on Wikipedia.

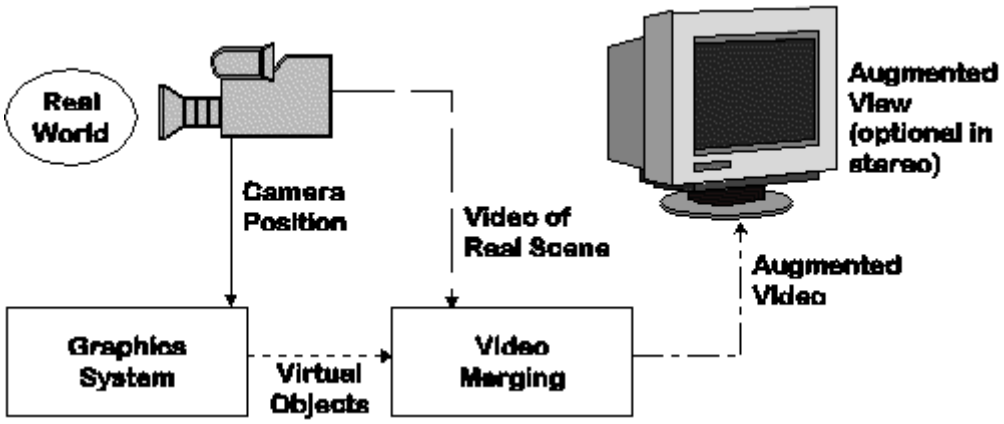
Layar isn't the only application of its type. In August 2009, some iPhone users were surprised to find an augmented-reality "easter egg" hidden within the Yelp application. Yelp is known for its user reviews of restaurants and other businesses, but its hidden augmented-reality component, called Monocle, takes things one step further. Just start up the Yelp app, shake your iPhone 3GS three times and Monocle activates. Using your phone's GPS and compass, Monocle will display information about local restaurants, including ratings and reviews, on your cell phone screen. You can touch one of the listings to find out more about a particular restaurant.

Augmented Reality in Video Games and the Military

Video game companies are quickly hopping aboard the augmented-reality locomotive. A company called Total Immersion makes software that applies augmented reality to baseball cards. Simply go online, download the Total Immersion software and then hold up your baseball card to a webcam. The software recognizes the card (and the player on it) and then displays related video on your computer screen. Move the card in your hands -- make sure to keep it in view of the camera -- and the 3-D figure on your screen will perform actions, such as throwing a ball at a target.

Total Immersion's efforts are just the beginning. In the next couple of years, we'll see games that take augmented reality out into the streets. Consider a scavenger-hunt game that uses virtual objects.

HOW AUGMENTED REALITY WORKS:



AR system track the position and orientation of user's head so that the overlaid material can be aligned with the user's view of the world.Through this process, known as registration, graphics software can place a three dimensional image of a tea cup, for example on top of the real saucer and keep the virtual cup fixed in that position as the user moves about in the room.

TECHNOLOGY

Hardware:

Hardware components for augmented reality are: processor, display, sensors and input devices. Modern mobile computing devices like smartphones and tablet computers contain these elements which often include a camera and MEMS sensors such as accelerometer, GPS, and solid state compass, making them suitable AR platforms

Display:

Various technologies are used in Augmented Reality rendering including optical projection systems, monitors, hand held devices, and display systems worn on the human body.

Head-mounted:A head-mounted display (HMD) is a display device paired to a headset such as a harness or helmet. 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 users immersive, mobile and collaborative AR experiences.

Eyeglasses:

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

Augmented Reality Glasses:

These are the viewing devices that you can wear while you're around the house, in the office and on the go.There is a variety of exciting implementations of augmented reality: devices that give you full-colour "apps" within a supplemental, glanceable screen; helmets that give you driving directions while you zip around on your motorcycle; glasses that provide notifications; and visual systems that can make your science fiction movie dreams a reality.

Augmented reality is still in its infancy, and developers are still striving to optimize them for everyday consumer use. Here's a breakdown of most of the major augmented reality headsets

Microsoft HoloLens

The true augmented reality concept that will, ideally, have wearers waving their arms around to interact with screens and full-colour virtual objects wherever they are.

The Key specifications and features of this device are:

- No dangling cords or wires;
- lightweight and adjustable to fit any adult head size;
- HD holographic images;

Sony Smart Eyeglass

Sony's SmartEyeglass wearable comes with some decently thick rims, and serves as a heads-up display for your Android device. You get information such as directions, Tweets related to your location and real-time voice translations via green text that appears over the lenses.

This device also comes with a wire that connects down to the Smart Eyeglass' control pack, which is where you'll find its touch controls, battery, microphone and speaker.

Key specificaions and features:

- 3MP camera;
- Bluetooth 3.0;
- 802.11 b/g Wi-Fi;
- around 2.5 hours of battery life;
- compass, gyroscope, accelerometer, brightness sensor.

Epson Moverio BT-200

Epson is targeting a more immersive experience with its Moverio Smart Glasses, with two screens that cast a 960 x 540-pixel image over each of your eyes.The interaction is done with the Moverio BT-200 via a special cable-connected control box that comes with a large touch panel.

Epson is using its own app store, instead of the more conventional Google Play for third-party support. There are around 80 apps to pick from at the time of this writing.

Google Glass

With this tiny head-mounted display, you can see a number of superimposed information screens over your daily life: the weather, current events, missed calls, even turn-based navigation based on your smartphone's GPS. Glass works with a variety of Android-friendly third-party apps as well. And, yes, you can even tell the headset to take pictures of what you were looking at.

Key specifications and features:

- 5MP camera with 720p video;
- Bluetooth; 802.11 b/g Wi-Fi;
- 12GB usable memory.

Recon Jet: This augmented reality device is like a sportier version of Google Glass. It uses a similar "screen in front of part of your eye" setup, with a slightly more bulging apparatus housing the glasses' HD camera, touchpad and sensors. The device's camera and high-resolution display are mounted to polarized glasses — the perfect thing to have when you're running or biking in the afternoon sun — and you can pair your glasses to either iOS or Android devices to see calls and messages on-the-fly. You can also use sports-themed apps that track metrics such as speed, pace, distance and heart rate.

Recon Jet doesn't come with voice- activation enable, even though the built-in microphone could certainly handle third-party apps with voice-trigger features.

Key specs and features: "HD" camera; Bluetooth 4.0; ANT+; 802.11 b/g/n Wi-Fi; around 4-6 hours battery life; 8GB internal memory; built-in GPS; accelerometer, gyroscope, magnetometer, pressure sensor and infrared sensor

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.

Virtual retinal display

A virtual retinal display (VRD) is a personal display device under development at the University of Washington's Human Interface Technology Laboratory. With this technology, a display is scanned directly onto the retina of a viewer's eye. The viewer sees what appears to be a conventional display floating in space in front of them.

EyeTap: The EyeTap captures rays of light that would otherwise pass through the center of a lens of an eye of the wearer, and substitutes synthetic computer-controlled light for each ray of real light.

Handheld

Handheld displays employ a small display that fits in a user's hand. All handheld AR solutions to date opt for video see-through. The two main advantages of handheld AR is the portable nature of handheld devices and 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 distorting effect of classically wide-angled mobile phone cameras when compared to the real world as viewed through the eye.

Spatial

Spatial Augmented Reality (SAR) augments real world objects and scenes without the use of special displays such as monitors, head mounted displays or hand-held devices. SAR makes use of digital projectors to display graphical information onto physical objects. The key difference in SAR is that the display is separated from the users of the system. Because the displays are not associated with each user, SAR scales naturally up to groups of users, thus 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, providing the opportunity to enhance the object's appearance with materials of a simple unit-a projector, camera, and sensor.

Other applications include table and wall projections. A SAR system can display on any number of surfaces of an indoor setting at once. SAR supports both a graphical visualisation and passive haptic sensation for the end users. Users are able to touch physical objects in a process that provides passive haptic sensation.

Tracking

Modern mobile augmented reality systems use one or more of the following tracking technologies: digital cameras and/or other optical

sensors, accelerometers, GPS, gyroscopes, solid state compasses,RFID and wireless sensors. These technologies offer varying levels of accuracy and precision. Most important is the position and orientation of the user's head. Tracking the user's hand(s) or a handheld input device can provide a 6DOF interaction technique.

Input devices

Techniques include speech recognition systems that translate a user's spoken words into computer instructions and gesture recognition systems that can 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.

Software and algorithms

A key measure of AR systems is how realistically they integrate augmentations with the real world. The software must derive real world coordinates, independent from the camera, from camera images. That process is called image registration which uses different methods of computer vision, mostly related to video tracking. Many computer vision methods of augmented reality are inherited from visual odometry. Usually those methods consist of two parts.

First detect interest points, or optical flow in the camera images. First stage can use feature detection methods like corner detection, blob detection, edge detection or thresholding and/or other image processing methods. The second stage restores a real world coordinate system from the data obtained in the first stage.

APPLICATIONS OF AUGMENTED REALITY

Augmented reality has many applications, some of which are:

Archaeology

AR can be used to aid archaeological research, by augmenting archaeological features onto the modern landscape, enabling archaeologists to formulate conclusions about site placement and configuration.

Another application given to AR in this field is the possibility for users to rebuild ruins, buildings, landscapes or even ancient characters as they formerly existed.

Architecture

AR can aid in visualizing building projects. Computer-generated images of a structure can be superimposed into 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 work space, rendering into their view 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.

Art

AR technology has helped disabled individuals create art by using eye tracking to translate a user's eye movements into drawings on a screen. An item such as a commemorative coin can be designed so that when scanned by an AR-enabled device it displays additional objects and layers of information that were not visible in a real world view of it.

AR in art opens the possibility of multidimensional experiences and interpretations of reality. Augmenting people, objects, and landscapes is becoming an art form in itself. In 2011, artist Amir Bardaran's Frenchising the Mona Lisa infiltrates Da Vinci's painting using an AR mobile application called Junaio. Aim a Junaio loaded smartphone camera at any image of the Mona Lisa and watch as Leonardo's subject places a scarf made of a French flag around her head. The AR app allows the user to train his or her smartphone on Da Vinci’s Mona Lisa and watch the mysterious Italian lady loosen her hair and wrap a French flag around her in the form a (currently banned) Islamic hijab.

Commerce

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. 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 straight forward image recognition is that you can overlay multiple media at the same time in the view screen, such as social media share buttons, in-page video even audio and 3D objects.

Construction

With the 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.

Education

Augmented reality applications can complement a standard curriculum. Text, graphics, video and audio can be superimposed into a student’s real time environment. Textbooks, flashcards and other educational reading material can contain embedded “markers” that, when scanned

by an AR device, produce supplementary information to the student rendered in a multimedia format. Students can participate interactively with computer generated simulations of historical events, exploring and learning details of each significant area of the event site. On higher education, there are some applications that can be used. For instance, Construct3D, a Studierstube system, allows students to learn mechanical engineering concepts, math or geometry. This is an active learning process in which students learn to learn with technology. AR can aid students in understanding chemistry by allowing them to visualize the spatial structure of a molecule and interact with a virtual model of it that appears, in a camera image, positioned at a marker held in their hand. It can also enable students of physiology to visualize different systems of the human body in three dimensions. Augmented reality technology also permits learning via remote collaboration, in which students and instructors not at the same physical location can share a common virtual learning environment populated by virtual objects and learning materials and interact with another within that setting

This resource could also be of advantage in Primary School. Children can learn through experiences, and visuals can be used to help them learn. For instance, they can learn new knowledge about astronomy, which can be difficult to understand, and children might better understand the solar system when using AR devices and being able to see it in 3D. Further, learners could change the illustrations in their science books by using this resource.
For teaching anatomy, teachers could visualize bones and organs using augmented reality to display them on the body of a person.

Emergency management / search and rescue

Augmented reality systems are used in public safety situations - from super storms to suspects at large.Augmented reality systems provide aerial camera operators with a

geographic awareness of forest road names and locations blended with the camera video. As a result, the camera operator is better able to search for the hiker knowing the geographic context of the camera image. Once found, the operator can more efficiently direct rescuers to the hiker's location.

Gaming

Augmented reality allows gamers to experience digital game play in a real world environment. In the last 10 years there has been a lot of improvements of technology, resulting in better movement detection and the possibility for the Wii to exist, but also direct detection of the player's movements.

Medical

Since 2005, a device that films subcutaneous veins, processes and projects the image of the veins onto the skin has been used to locate veins. This device is called VeinViewer

Augmented Reality can provide the surgeon with information, which are otherwise hidden, such as showing the heartbeat rate, the blood pressure, the state of the patient’s organ, etc. AR can be used to let a doctor look inside a patient by combining one source of images such as an X-ray with another such as video.

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, or radiation exposure risks from X-ray imaging devices. AR can enhance viewing a fetus inside a mother's womb. It has been also used for cockroach phobia treatment. Also, patients wearing augmented reality glasses can be reminded to take medications.

Beauty

In 2014 the company L'Oreal Paris started developing a smartphone and tablet application called "Makeup Genius", which lets users try out make-up and beauty styles utilizing the front-facing camera of the endpoint and its display.

Spatial immersion and interaction

Augmented reality applications, running on handheld devices utilized as virtual reality headsets, can also digitalize human presence in space and provide a computer generated model of them, in a virtual space where they can interact and perform various actions. Such capabilities are demonstrated by "project Anywhere" developed by a post graduate student at ETH Zurich, which was dubbed as an "out-of-body experience"

Military

In combat, AR can serve as a networked communication system that renders useful battlefield data onto a soldier's goggles in real time. From the soldier's viewpoint, people and various objects can be marked with special indicators to warn of potential dangers. Virtual maps and 360° view camera imaging can also be rendered to aid a soldier's navigation and battlefield perspective, and this can be transmitted to military leaders at a remote command center.

The map overlays indicated the trajectories of various objects in geographic coordinates. This allowed telescope operators to identify satellites, and also to identify - and catalog - potentially dangerous space debris.

Navigation

AR can augment the effectiveness of navigation devices. Information can be displayed on an automobile's windshield indicating destination directions and meter, weather, terrain, road

conditions and traffic information as well as alerts to potential hazards in their path. Aboard maritime vessels, AR can allow bridge watch-standers to continuously monitor important information such as a ship's heading and speed while moving throughout the bridge or performing other tasks.

Office workplace

AR can help facilitate collaboration among distributed team members in a work force via conferences with real and virtual participants. AR tasks can include brainstorming and discussion meetings utilizing common visualization via touch screen tables, interactive digital whiteboards, shared design spaces, and distributed control rooms.

Sports and entertainment

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.

AR can enhance concert and theater performances. For example, artists can allow listeners to augment their listening experience by adding their performance to that of other bands/groups of users.

The gaming industry has benefited a lot from the development of this technology. A number of games have been developed for prepared indoor environments. Early AR games also include AR air hockey, collaborative combat against virtual enemies, and an AR-enhanced pool games. A significant number of games incorporate AR in them and the introduction of the smartphone has made a bigger impact.

Television

Weather visualizations were the first application of Augmented Reality to television. It has now become common in weathercasting 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 geo-space model, these animated visualizations constitute the first true application of AR to TV.

Augmented reality is starting to allow Next Generation TV viewers to interact with the programs they are watching. They can place objects into an existing program and interact with these objects, such as moving them around. Avatars of real persons in real time who are also watching the same program.

Tourism and sightseeing

Augmented reality applications can enhance a user's experience when traveling by providing real time informational displays regarding a location and its features, including comments made by previous visitors of the site. AR applications allow tourists to experience simulations of historical events, places and objects by rendering them into their current view of a landscape. AR applications can also present location information by audio, announcing features of interest at a particular site as they become visible to the user.

Translation

AR systems can interpret foreign text on signs and menus and, in a user's augmented view, re-display the text in the user's language. Spoken words of a foreign language can be translated and displayed in a user's view as printed subtitles.

5.Limitations and the Future of Augmented Reality

Augmented reality still has some challenges to overcome. For example, GPS is only accurate to within 30 feet (9 meters) and doesn't work as well indoors, although improved image recognition technology may be able to help.

People may not want to rely on their cell phones, which have small screens on which to superimpose information. For that reason, wearable devices like SixthSense or augmented-reality capable contact lenses and glasses will provide users with more convenient, expansive views of the world around them. Screen real estate will no longer be an issue. In the near future, you may be able to play a real-time strategy game on your computer, or you can invite a friend over, put on your AR glasses, and play on the table top in front of you.

PRIVACY CONCERNS:

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 certain amount of privacy are 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.

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