# Deep Dive into Augmented Reality

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**Abstract -** *Although Augmented Reality technology was first developed over forty years ago, there has been little survey work giving an overview of recent research in the field. This paper reviews how one can "Augment Reality" and use this technology to invent new machines. The tools used for Augment Reality. It explains the advantages and disadvantages of AR. Where AR is used and its applications. It also explains how augmented reality is changing activism and is becoming a boon for the people using AR technology. It provides a roadmap for future augmented reality research which will be of great value to this relatively young field.*

## 1. INTRODUCTION

Augmented Reality (AR) is a technology which allows computer-generated virtual imagery to exactly overlay physical objects in real-time. Unlike virtual reality (VR), where the user is completely immersed in a virtual environment, AR allows the user to interact with the virtual images seamlessly using real objects.

Augmented Reality (AR) combines virtual world objects with real environments. Over the years, augmented reality has been used in many domains for a multitude of purposes. In most fields, AR is used as an assistive system for performing human tasks. AR has proven to be useful in increasing the efficiency and accuracy of the tasks especially in the domains related to surgery and aeroplane manufacturing. In the case of surgery, it can be used as a tool to render 3D models of the patient's operated area/organ that can help doctors perform surgeries with minimum risk and complications. In aeroplane manufacturing, AR can be used as a tool to assist wiring the electrical harness of a plane which is a long and tedious task and is still done manually.

### 1.1 How to "Augment Reality"

1. **Augment the user**

   Beginning with the earliest head-mounted display by Sutherland in 1968 [1], researchers have developed a variety of devices for users to wear, letting them see, hear and touch artificially-created objects and become immersed in virtual computer environments that range from sophisticated flight simulators to highly imaginative games. Some augmented reality researchers have borrowed this "virtual reality" technology to augment the user's interactions with the real-world. Charade [2] involves wearing a data glove to control the projection of slides and video for a formal presentation. Charade distinguishes between the natural gestures a user makes when just talking or describing something and a set of specialized gestures that can be recognized by the system, such as "show the next slide" or "start the video".

2. **Augment the object**

   Another approach involves augmenting physical objects directly. In the early 1970s, Papert [3] created a "floor turtle", actually a small robot, that could be controlled by a child with a computer language called Logo. LEGO/Logo [4] is a direct descendant, allowing children to use Logo to control constructions made with LEGO bricks, motors and gears. Electronic bricks contain simple electronic devices such as sensors (light, sound, touch, proximity), logic devices (and-gates, flip-flops, timers) and action bricks (motors, lights). A child can add a sound sensor to the motor drive of a toy car and use a flip-flop brick to make the car alternately start or stop at any loud noise. Children (and their teachers) have created a variety of whimsical and useful constructions, ranging from an "alarm clock bed" that detects the light in the morning and rattles a toy bed to a "smart" cage that tracks the behaviour of the hamster inside.

3. **Augment the environment**

   Neither the user nor the object is affected directly. Instead, independent devices provide and collect information from the surrounding environment, displaying information onto objects and capturing information about the user's interactions with them.

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## 1.2 Tools for Augmented Reality

1. **Vuforia**

   Vuforia is an augmented reality software development kit (SDK) for mobile devices that enables the creation of augmented reality application. It uses computer vision technology to recognize and track planar images and simple 3D objects. Vuforia provides Application Programming Interface (API) in C++, Java, Objective-C++ (a language utilizing a combination of C++ and Objective-C syntax), and the .NET languages through an extension to the Unity game engine. In this way, the SDK supports both native development for iOS and Android while it also enables the development of AR applications in Unity that are easily portable to both platforms.

2. **Kudan**

   The Augmented Reality technology uses the existing real environment and overlays a piece of new digital information on top of it. There are many AR application developed in many aspects of life e.g. health, education, military, industry, entertainment, etc. It explores the location-based AR technology to develop a game named Monster Buster. This game is an Android platform. This game uses the information of latitude and longitude used to generate the position of the monster. This research is expected to develop an innovative game application that can give another user's experience by using location-based AR technology. The Unity 3D is the game engine that is used in this research, and the Kudan SDK is used to provide the AR technology.

3. **ARKit**

   ARKit (Apple ARKit) is Apple's Augmented Reality (AR) development platform for iOS mobile devices. ARKit allows developers to build high-detail AR experiences for iPad and iPhone. With iPhone X, ARKit can perform real-time face scanning and use this data to drive facial expressions of 3D characters.

4. **ARCore**

   ARCore is a software development kit developed by Google that allows for augmented reality applications to be built. ARCore uses three key technologies to integrate virtual content with the real world as seen through your phone's camera:

   a. Motion tracking allows the phone to understand and track its position relative to the world.
   b. Environmental understanding allows the phone to detect the size and location of flat horizontal surfaces like the ground or a coffee table.

   c. Light estimation allows the phone to estimate the environment's current lighting conditions.

## 1.3 Advantages of Augmented Reality

The central advantage of augmented reality is that it enables more interactive and richer human-to-computer and computer-mediated human-to-human interactions than conventional interfacing. One of the specific advantages of AR is that it expands the features and capabilities of computers and other consumer electronic devices such as smartphones, etc. Some of the advantages are as follows:

1. **Learning and Instruction**
   Augmented Reality can improve the learning environment by making the entire learning experience more immersive, thus encouraging better participation and collaboration between learners and instructors. Learners can become active participants rather than merely passive recipients of instruction. Examples of AR applications in the learning environment include driving and flight simulation training, visualization of anatomy for biology and medical classes, laboratory exercises and experimentations, and design activities in engineering and architecture, among others. Compared to virtual reality, another specific advantage of augmented reality is that it does not replace the natural environment with a simulated one.

2. **Communication and Interaction**
   The primary benefit of augmented reality is that it introduces a new way for computer-mediated human interaction. Instead of merely calling one another or sending text messages via SMS or chat apps, Augmented Reality makes communication more interactive. As an example, remote collaboration becomes more immersive through the addition

of digital elements. Distanced communication can be supplemented by graphic images overlaid in front of the participants to aid verbal communication. Social networking sites like Instagram and Snapchat have used AR for sharing videos and photos more visually appealing.

3. **Business Improvements**

    Augmented Reality has several beneficial applications in business settings like it allows product developers to see and experience the mockup design of a product before its completion. Because of the applications in instruction and interaction, it can also be used to improve workplace environments. For example, Augmented Reality can be used to promote remote work and collaboration between distanced team members. Retailers can also benefit from AR. For example, clothing retailers using AR can allow their customers to try on various clothes or accessories, which creates a visual dressing room. The furniture retailers can also overlay a piece of furnishing in a real home or office space to help a consumer decide if he or she wants to buy the product or not.

4. **Navigation and Tourism**

    The ability of AR to place digital elements on real environments can supplement navigation, as well as tourism. In vehicles, information such as map data, traffic status, weather, and terrain can be displayed on the windshields of cars. Government tourism agencies and companies can use AR to promote a particular spot. At an actual location, travellers can be presented with sensory information that can simulate historical events or render objects to improve their overall experience. Tourists in a foreign country can use apps on their smartphones that can translate the texts in their language in real-time.

5. **Immersive Video Gaming**

    Another advantage of augmented reality is that it provides enables more interactive and richer human-to-computer. AR simply provides additional input-output features to video games, thus making the gameplay more immersive and interactive. Games such as Pokémon Go and Star Wars: Jedi Challenges have demonstrated how AR allows video game players to experience digital gameplay in a real-world environment. This technology mixes the virtual world of games with the natural world, thus providing a more realistic gaming experience.

## 1.4 Disadvantages of Augmented Reality

The fact is that augmented reality distorts the real-world while it also depends on the generation and distribution of data in the form of computer-generated perceptual information.

1. **Issues about privacy**

    One of the drawbacks of augmented reality is that it is based on the collection, analysis and redistribution of different types of data, through the application of Big Data, which raises concerns over privacy and security like, some AR devices record the environment in real-time which can create potential legal concerns. AR systems also collect and analyze information about their users such as biometric data, etc.

2. **Dangers of Reality Modification**

    Another drawback of augmented reality centres on possible dangers that come from reality modification as AR blurs the line between the real world and the digital world. For example, the introduction of Pokémon Go game created controversy due to associated accidents and even deaths.

3. **Implementation Requirements**

    Although business organizations, learning institutions, and other organizations can benefit from using augmented reality due to its numerous advantages or beneficial applications, developing and implementing an AR system is both costly and technologically taxing. Not everyone can do so. In the context of business, smaller firms can be at a disadvantage because of their lack of resources.

## 1.5 Applications of Augmented Reality

Augmented Reality has applications in almost every field; from healthcare to real estate there is room to implement AR. It can be used with patients to display their anatomy, or doctors can use it to have guides during surgeries that require immense accuracy. The most important innovation, smart glasses that display answers while you write a test or exam. Some of the applications are:

1. **Mobile applications**

   With advances in tracking and increased computing power, researchers are developing mobile AR systems. These may enable a host of new applications in navigation, situational awareness, and geolocated information retrieval. Researchers have been investigating mobile AR research systems operating in a well-prepared indoor environment for some time. NaviCam augments the video stream collected by a handled video camera [5]. The Touring Machine [6] was developed at Columbia University, which is a self-contained system that includes tracking (a compass, inclinometer and differential GPS), a mobile computer with a 3D graphics board, and a see-through HMD. Mobile AR systems must be worn, which should challenge the system designers to minimize weight and bulk. With the current technology, one approach is to move some of the computation load to remote servers, reducing the equipment the user must wear [7] [8].

2. **Collaborative applications**

   Many Augmented Reality applications can benefit from having multiple people simultaneously view, discuss, and interact with the virtual 3D models. As Billinghurst and Kato discussed [9], AR addresses two major issues with collaboration:

   a. Seamless integration with existing tools and practices.
   b. Enhancing practice by supporting remote and collocated activities that would otherwise be impossible.

   A significant problem with collocated, collaborative AR systems is that it ensures the users a shared understanding of the virtual space, analogous to their understanding of the physical space. In the Emmie system, Butz and his colleagues discuss the notion of privacy management in collaborative AR systems and present an approach to managing the visibility of information using the familiar metaphors of lamps and mirrors [13]. Another form of collaborative AR is in entertainment applications. Researchers have demonstrated several AR games, including AR air hockey [10], collaborative combat against virtual enemies [11], and an AR-enhanced pool game [12].

3. **Commercial applications**

   Augmented Reality has been used for real-time augmentation of broadcast video, primarily to enhance sporting events and to insert or replace advertisements in a scene. An early example is the FoxTrax system, which highlights the location of a hard-to-see hockey puck as it moves rapidly across the ice [14].

## 2. How augmented reality is changing activism

Glenn Cantave uses technology to highlight the narratives of the oppressed. In a tour of immersive visual projects, he shares his work with the team at Movers and Shakers NYC, a coalition that executes direct action and advocacy campaigns for marginalized communities using virtual reality, augmented reality and the creative arts. Movers and Shakers are a group of activists, artists, educators and engineers focused on using immersive technology to highlight the narratives of the oppressed. Glenn Cantave created an augmented reality installation on the true story of Christopher Columbus and used it to host teach-ins in Columbus Circle and Times Square. He realised that with augmented reality you don't need permission from the government to put up a monument or to make a statement. So, he decided, why not just put up a bunch of AR monuments of women and people of colour throughout New York City? Typically, monuments are created to commemorate the achievements of the deceased, but with augmented reality, we can route the rules. With augmented reality, we have the power to tell stories in public spaces that need to be told. Augmented Reality can also be used as a tool to support organizations that are fighting against systematic oppression. Soon they will release our free smartphone app with augmented reality monuments and content. One can take their smartphone and hold it over any one-dollar bill and see a scene in augmented reality that illustrates the injustice of cash bail. You can then click on the screen and be directed to the donation page of The Bail Project, a fund that raises money for people who cannot afford bail. With augmented reality, we the people have the power to highlight the narratives of the oppressed when institutes refuse to do so. We can use this tool to highlight the systematic implications of erasing someone's history. And more concretely, we can use this technology as a way to support initiatives that are fighting against systemic racism. With AR, we have the power to reimagine a world that prioritizes justice over oppression.

## 3. CONCLUSION

AR or augmented reality has gone from pipe dream to reality in just over a century. There are many AR applications in use or under development today, however – the concept will only take off universally when UX designers think about how they can integrate AR with daily life to improve productivity, efficiency or quality of experiences. Jessica Lowry, a UX Designer, writing for the Next Web says that AR is the future of design and we tend to agree. Already mobile phones are such an integral part of our lives that they might as well be extensions of our bodies; as technology can be further integrated into our lives without

being intrusive (a la Google Glass) – it is a certainty that augmented reality provides opportunities to enhance user experiences beyond measure. The future will belong to AR when it improves task efficiency or the quality of the output of an experience for the user. This is the key challenge of the 21st century UX profession.

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