



# Extended Reality and it's Variant

Maaz Mahmood<sup>#1</sup>, Mohd. Sharique Alam<sup>#2</sup>, Ayush Kumar<sup>#3</sup>, Shubham Verma<sup>#4</sup>, Paramanand Sharma<sup>#5</sup>

<sup>#</sup>ECE Department, KIET Group of Institutions

NH-58 Muradnagar, Ghaziabad

<sup>1</sup>maaz.2024ec1127@kiet.edu

<sup>2</sup>mohd.2024ec1193@kiet.edu

<sup>3</sup>ayush.2024ec1090@kiet.edu

<sup>4</sup>[shubham.2024ec1121@kiet.edu](mailto:shubham.2024ec1121@kiet.edu)

<sup>5</sup>paramanand.sharma@kiet.edu

**Abstract**— This paper surveys the growing trend, recent developments, and innovative use of Augmented Reality in formal and informal way to make the real-life problems easier. It describes about the different works performed by researchers in the field of Augmented Reality and mentioned about the reason for which new technologies came into existence. It covers and discusses about Augmented Reality technologies with Computer Vision methods, AR devices, and vast use of HMDs (Head Mounted Display) and many more tools and technologies. It also focuses on how humans make use of AR apps in their day-to-day life marketing, manufacturing, and visualization. Further we described about the XR and IoT technologies and how it helps in making of sensor-based AR devices and what were the challenges that were faced during the making of this. This paper also comprises about different safety measures that can be taken using AR like in US construction industry and talks about different areas where AR is bringing revolution like education system.

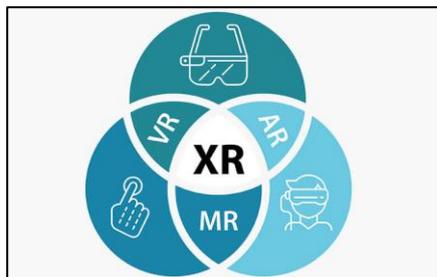
**Keywords**— AR: Augmented Reality, VR: Virtual Reality, HMD: Head Mounted Display, AR Core, AR Kit, Vuforia PTC, AR Foundation

## I. INTRODUCTION

The term AR stands for Augmented Reality. It means when we bring the animated, imaginary, or computer-generated objects or images in a real-life world, it is termed as AR. Augmented Reality is an interactive experience of an environment in a real world where the objects that are placed in real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, acoustic, tactile, somatosensory and olfactive. Augmented reality (AR) differs from virtual reality (VR) in the sense that in AR part of the surrounding environment is actually 'real' and just adding layers of virtual objects to the real environment. AR is both interactive and registered in 3D as well as combines real and virtual objects. Milgram's Reality-Virtuality Continuum is defined by Paul Milgram and Fumio Kishino as a continuum that spans between the real

environment and the virtual environment comprise Augmented Reality and Augmented Virtuality (AV) in between, where AR is closer to the real world and AV is closer to a pure virtual environment, as seen in Fig [1]. Augmented Reality aims at simplifying the user's life by bringing virtual information not only to his immediate surroundings, but also to any indirect view of the real-world environment, such as live-video stream. As stated in (Minjuan Wang, et al.), Implementation of AR in education is following a trajectory like mobile learning (mLearning). While initially heralded as becoming mainstream in the classroom, mLearning has become much more of a supplementary tool than an indispensable component of teaching. Connecting the AR technology with smartphones we discovered that Smartphones and other mobile technologies have become a necessary and fundamental component of modern consumption and life (Braun et al., 2016). Recent developments suggest a future where augmented reality (AR) will be similarly indispensable to both consumption and marketing. Augmented Reality represents an innovative media format that integrates virtual information into a user's perception of the real-world. The 'Pokémon Go' mobile app is a well-known example where users catch virtual creatures projected over the real-world as viewed through a smartphone (Rauschnabel et al., 2017). Apart from AR, we also got familiar with XR, i.e., Extended Reality. VR, AR and Mixed Reality (MR) are building new experiences in entertainment [5] and education. The intersection between these technologies is something that hasn't been fully explored, but pioneering projects are leading the way to show the potential of bringing IoT and XR technologies together. Augmented reality (AR) has captured the attention of both the public and corporations with its ability to seamlessly integrate digital content with the real-world environment. AR devices like the Microsoft HoloLens and Magic Leap One allow users to see the real physical world but superimpose a layer of digital content such that users see virtual models mixed in with the actual world around them. Typically, the digital objects—which can be anything ranging from a simple shape to a realistic model of a person—are rendered in stereo (i.e., with

separate images projected into each eye) to give the illusion of depth when situated next to real objects.



## AUGMENTED REALITY TECHNOLOGIES

### Extended Reality

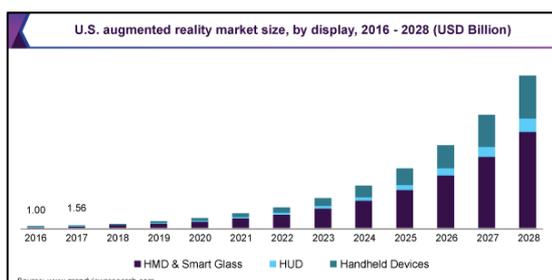
Extended Reality (XR) is a domain which encases AR, VR and MR all as a single domain.[6] it is a term referring to all real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables, where the 'X' represents a variable for any current or future spatial computing technologies.[7] [8]

### Augmented Reality (AR)

Augmented Reality technology is gaining popularity within society and becoming more ubiquitous in nature (Johnson, Smith, Levine, & Haywood, 2010) [1]. Augmented Reality, a technology that superimposes a computer-generated image on a user's view of the real world. In Augmented Reality, virtual content is superimposed into the real world using various methods like image detection, ground plane detection, etc.

While the general interest in AR may be recent and growing, academic researchers have been building and testing the technology for decades. Many experiments focus on the technical and design aspects of AR, but less is known about how social interactions are affected by the technology.

Gordon Allport defined the field of social psychology as “an attempt to understand and explain how the thoughts, feelings, and behaviour of individuals are influenced by the actual, imagined, or implied presence of others”. This well-accepted definition is broad enough to include virtual people rendered in AR. Allport's foresight in extending social psychology to imagined and implied others is quite prescient, given the new types of social interactions which will become possible in AR [9][10]



### Uses of AR

The use of Augmented Reality systems has been investigated in a range of industries since the early 1990's, including medicine, manufacturing, aeronautics, robotics, entertainment, tourism and more recently, social networking and education (Azuma, 1997; Billingshurst, 2002; Hincapie, Caponio, Rios, & Mendivil, 2011; Shelton, 2002; Shin, et al., 2010; Shuhaiber, 2004). By overlaying media elements into the users' real-world context Augmented Reality can provide cognitive support for difficult tasks [1].

In NFT techniques, some characteristic points from the image are detected in real-time by the AR system and the virtual objects pose are calculated based on these points (Fraga-Lamas et al., 2018) [10].

#### 1-AR Healthcare

More sciences groups are using augmented reality (AR) to carry out new treatment plans to lifestyle through combining digital and bodily worlds. AR facilitates creating rich & interactive studies that display how new pills and clinical gadgets interact with the body. Surgeons can get entry to real-time, lifesaving affected person information. They can now use these during complicated or straightforward procedures. By using a handheld scanner in Augmented Reality, nurses can determine where the veins are.



An open MRI is a feasible option for perioperative imaging. however, a single surgery requires  $40 \pm 9.4$  minutes of scanning in average and the use of specialized MRI-compatible instruments. Automatic medical reconstructions tend to include many different structures, which make the orientation difficult, especially in abdominal surgery [11][12].

#### 2-AR Education

Augmented Reality can replace textbooks, physical forms, posters, and printed brochures. his mode of mobile learning also reduces the cost of learning materials and makes it easy for everyone to access. This can assist college students in implementing ideas in an immersive environment, so one can simplify ideas and make studying easy. Moreover, schools

will also grasp huge attention from students through an excellent learning experience delivered via technology.

### 3-AR E-Commerce

Create digital showrooms and permit clients to discover showrooms from the comfort of their homes without having to visit a retail store. Provide virtual landscapes of products and enable customers to experience all the features and capabilities first-hand. Customers can not only shop for products online via real life interfaces but also try products virtually. Retailers can overcome physical limitations and offer access to every product feature, in the long run drawing extra clients into the income funnel for better conversions. [13]



### 4-AR Tourism

AR is the future of travel app development, and it has immense potential to transform each one of these aspects. Google Maps announced its new development in April 2018 using Augmented Reality to facilitate spatial orientation. Tourists can learn more with Augmented Reality. They can view the current architectural artifacts in detail. For instance, some hotels have an interactive wall map in rooms through which guests can explore pertinent information regarding local travel destinations with much ease. [14]



### 5-AR Gaming and Entertainment

Pokémon GO has rightfully earned its popularity and opened the world of AR games to us. By turning the AR concept

inside out placing actual objects in a virtual world – augmented reality game creation is reaching new heights. Interactive TV could utilize AR to provide information on top of what the viewer is already seeing. Augmented reality can turn listening to music into unusual activity. [15]



## II. TOOLS IN AR

Augmented reality is a way in which a human can bring a virtual world into our real world. Dealing with augmented reality requires several technologies. [16] These devices generally include displays, input devices, tracking and computers.

### Displays

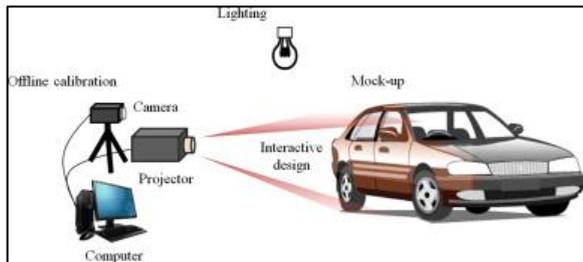
Augmented reality generally include three main types of displays they are: head mounted display (HMD), handheld displays and spatial displays. HMD is a device worn on the head or as a part of a helmet through which one see the real world integrated with the virtual one. HMD can either be video-see-through or optical see-through and can have a monocular or binocular display optic. The HMD helmet can either have a small display optic in front of one or each eye. [17]



Handheld devices consist of those devices which can be held into the palms of humans. These devices generally come to use while working with the marker AR. These small computing devices use video see through technique to overlay the graphics onto the real world which can be seen

through the display of these devices. the devices generally come in three classes: smart-phones, PDAs, and tablets.

Spatial augmented reality (SAR) is another variant of augmented reality that uses Holograms, projectors, optical elements, etc.in order to overlay the graphical information. SAR is unique type of Augmented Reality that uses Projection as a source in order to overlay its Information. SAR produces immersive contents by overlapping virtuality and real-world environment using three ways: video-see-through, optical-see-through and direct augmentation.[18]



### Input Devices

The input device used in AR can be of many types. These devices can either be a normal Smartphone, Pc, digital Wristbands etc. These devices are mainly used to gather information from the environment so that the virtual overlay can be applied on the real environment. In case of marker AR the devices can be used to scan the marker and augment the object .

### Tracking

Tracking devices in AR mainly consist of digital cameras and optical sensor. Devices such as Camera are heavily used in devices like HMD to gather info from the outside world. The gather info help in near perfect augmentation of the subject into the real world.

### References Links

1. [https://www.researchgate.net/figure/Paul-Milgrams-Reality-Virtuality-RV-Continuum\\_fig1\\_290010171](https://www.researchgate.net/figure/Paul-Milgrams-Reality-Virtuality-RV-Continuum_fig1_290010171)
2. <https://link.springer.com/article/10.1007/s12652-017-0547-8>
3. [How Does a Product Gain the Status of a Necessity? An Analysis of Necessitation Narratives - Braun - 2016 - Psychology & Marketing - Wiley Online Library](#)
4. [An adoption framework for mobile augmented reality games: The case of Pokémon Go - ScienceDirect](#)
5. The Void VR Experience Start-up Is Worth Paying Attention To, Yahoo Finance. Available:

6. <https://finance.yahoo.com/news/void-vr-experience-startup-worth-020600309.html>
7. Augmented Reality in Education-Cases Places, And Potentials
8. Social interaction in augmented reality
9. [https://www.google.com/url?sa=i&url=https%3A%2F%2Fvciba.springeropen.com%2Farticles%2F10.1186%2F42492-020-00057-7&psig=AOvVaw1ty3dxUk\\_X2Lg-fWWWa6Aj&ust=1640094305237000&source=images&cd=vfe&ved=0CA5QjRxqFwoTCJCf57rE8vOCFOAAAAADAAAAABAD](https://www.google.com/url?sa=i&url=https%3A%2F%2Fvciba.springeropen.com%2Farticles%2F10.1186%2F42492-020-00057-7&psig=AOvVaw1ty3dxUk_X2Lg-fWWWa6Aj&ust=1640094305237000&source=images&cd=vfe&ved=0CA5QjRxqFwoTCJCf57rE8vOCFOAAAAADAAAAABAD)
10. A Survey of industrial Augmented Reality
11. <https://www.zumoko.com/industries/cultural-tourism-ar/>
12. Recent Development of Augmented Reality in Surgery
13. <https://www.geekwire.com/2020/xr-experts-see-health-care-killer-app-vr-ar-mr-whatever-call/>
14. <https://www.threkit.com/blog/6-brands-using-augmented-reality-in-ecommerce>
15. <https://mobidev.biz/blog/augmented-reality-future-trends-2018-2020>
16. <https://www.grandviewresearch.com/industry-analysis/augmented-reality-market>
17. <https://link.springer.com/article/10.1007/s11042-010-0660-6>
18. <https://api.time.com/wp-content/uploads/2016/03/gettyimages-494459120.jpg?w=800&quality=85>
19. [1-s2.0-S2288430014000050-gr2.jpg \(386x172\) \(els-cdn.com\)](https://en.wikipedia.org/wiki/Extended_reality)
20. Reitmayr G, Schmalstieg D (2003) Location based applications for mobile augmented reality. AUIIC2003

### III. CONCLUSIONS

Augmented Reality is developing very fast in today's world. Whatever filters we are using in snapchat, Instagram, etc all are based on AR. Augmented Reality has the potential to supplant the Internet in terms of size and application. But as often noted in the educational domain, utilisation of technology is by no means a guarantee of success. On the contrary, poor use of emerging technology can result in inferior learning outcomes. The challenge for educators is to harness the power of Augmented Reality in ways that contribute to the ultimate growth of students, and that means supporting the development of students' higher order thinking capabilities. We also got to know that how we can use these

kinds of immersive technologies in helping and solving our real-life problems.

#### ACKNOWLEDGMENT

This research paper review would not have been possible without the exceptional support of my supervisor, Mr. Paramanand Sharma. His enthusiasm, knowledge and exacting attention to detail have been an inspiration and kept our work on track. The main contributions towards this review report were done by four authors who are pursuing their undergraduate courses from KIET Group of Institutions. The authors would like to thank the college for providing this opportunity.

#### REFERENCES

- 1) Wang, Minjuan, et al. "Augmented reality in education and training: pedagogical approaches and illustrative case studies." *Journal of ambient intelligence and humanized computing* 9.5 (2018):1391-1402.
- 2) Wang, M., Callaghan, V., Bernhardt, J., White, K., & Peña-Rios, A. (2018). Augmented reality in education and training: pedagogical approaches and illustrative case studies. *Journal of ambient intelligence and humanized computing*, 9(5), 1391-1402.
- 3) Wang, Minjuan, Vic Callaghan, Jodi Bernhardt, Kevin White, and Anasol Peña-Rios. "Augmented reality in education and training: pedagogical approaches and illustrative case studies." *Journal of ambient intelligence and humanized computing* 9, no. 5 (2018): 1391-1402.
- 4) Wang, M., Callaghan, V., Bernhardt, J., White, K. and Peña-Rios, A., 2018. Augmented reality in education and training: pedagogical approaches and illustrative case studies. *Journal of ambient intelligence and humanized computing*, 9(5), pp.1391-1402.
- 5) Wang M, Callaghan V, Bernhardt J, White K, Peña-Rios A. Augmented reality in education and training: pedagogical approaches and illustrative case studies. *Journal of ambient intelligence and humanized computing*. 2018 Oct;9(5):1391-402.
- 6) Rauschnabel, Philipp A., Reto Felix, and Chris Hinsch. "Augmented reality marketing: How mobile AR-apps can improve brands through inspiration." *Journal of Retailing and Consumer Services* 49 (2019): 43-53.
- 7) Rauschnabel, P. A., Felix, R., & Hinsch, C. (2019). Augmented reality marketing: How mobile AR-apps can improve brands through inspiration. *Journal of Retailing and Consumer Services*, 49, 43-53.
- 8) Miller, Mark Roman, et al. "Social interaction in augmented reality." *PloS one* 14.5 (2019): e0216290.
- 9) Miller, Mark Roman, Hanseul Jun, Fernanda Herrera, Jacob Yu Villa, Greg Welch, and Jeremy N. Bailenson. "Social interaction in augmented reality." *PloS one* 14, no. 5 (2019): e0216290.
- 10) Miller MR, Jun H, Herrera F, Yu Villa J, Welch G, Bailenson JN. Social interaction in augmented reality. *PloS one*. 2019 May 14;14(5):e0216290.