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AUGMENTED REALITY TECHNOLOGY FOR HUMAN COMPUTER INTERACTION CONNECTION AND MODELLED BASED TRACKING

Mahiima M. Bartere, Aman B. Vyas

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Abstract

In spite of the fact that personal computers may be found in a wide variety of sizes and shapes, their core components have not changed throughout the years. If we look at the history of personal computers from the perspective of their users, we might be surprised to discover that the information-gathering machine was the primary force behind the expansion of commercial development. To put it another way, human-computer interaction was the driving force behind the development of personal computer history. HCI has gone through three distinct stages, the most important of which is determined by the information required to establish a connection with a computer, with the keyboard serving as the primary input device. The second phase is the graphical user interface (GUI), and it receives input from the mouse. The next stage is the touch screen, which is included into each and every mobile device. The forefinger is the primary connection used at this stage. Because people need to fully utilise all five of their senses to experience the world, the development of virtual reality and augmented reality has become an intriguing issue. The primary thrust of technological advancement is to broaden people's access to more opportunities and to make information gathering a process that is more analogous to the natural world. This chapter will provide you with information on AR/VR Technology and its use in HCI.

Keywords: AR/VR Technology, Human Computer Interaction, AI.

1. INTRODUCTION

It makes reference to the expertise by which Real-time convergence of interactive content with accessible real-world skill is provided. Easy link in the real time globe to latent data linked to scope is enabled using augmented reality. Enhancement of by enriching what we see, sound and hear in the natural habitat, our experience of the real world is done using augmented reality. AR refers to "Augmented Reality", it is the promising skill that performs the present combining of information coming from the real world with the information processed by a processor, and suitable computer interfaces helps to perform this task. AI, DIP, CG and other computational technologies are combined under the shed of comprehensive information technology called augmented reality. For providing extra level of facts and to encourage comprehension and contact with real world around you.AR uses computer-aided graphics. It produces a virtual image on over head of a real image, enabling real time experiences, combining simulated 3D or 2D objects with physical objects are the features of AR. Explicit is made implicit; by augmented reality; completely linked information with a background can be made openly reachable by way of the AR interfaces. AR combines real & virtual objects also it is interactive and registered in 3D environment.

AR is the cycle in where a live perspective on the physical world is expanded by PC produced tactile info, for example, illustrations, video or sound. It has been effectively applied in territories, for example, diversion, instruction, recovery and military to give some examples. There are two particular periods of activity of AR. The main stage recognizes intrigue focuses (common highlights or markers) in the camera pictures. The subsequent stage builds up a genuine co-ordinate framework from the information got in the main stage. Through these two stages an AR framework would then be able to overlay whatever PC created content is wanted over the information pictures [1].

In today's era people has plenty of information, It is not an easy task to present these data to the user, care must be taken to not to overpower him with them. AR is the proposed technology to mix information with the genuine condition world by utilizing various strategies. For example, a live view of the real-world data on blending with certain information can be made to feel more natural to the user. By using a Smartphone and its camera information can be embedded into the real environment. Anyway, this is just a single chance. Different situations may have variety of intends to show data. AR systems are categorized as portable and inactive AR systems. Devices used for mobile systems, are worn or hand held. Stationary

School of Engineering & Technology, G H Raisoni University, Amravati, Maharashtra, India.

*Corresponding author email- snehab30@gmail.com

systems generally have surfaces as, “table” to interact with them [2].

AR is a peculiar tool having sound potential for novel applications in the field of education. An efficient way is provided by AR to speak to a model that needs representation. For consistent cooperation between the genuine and virtual conditions AR supports tremendously and for object manipulation it allows a tangible interface metaphor. Impact of this technology in the field of education is noticeable that indicate a positive effect on learning and educating styles. Exercises upheld by AR are prompting more creative types of educating and learning. The reason for it is that technology involves the utilization of genuine issues, reenactments of ideas, most recent instructive assets, and ongoing correspondence with experts in the field. Supplement to the conventional types of instructing and learning will be, getting the hang of utilizing innovation. Enlarged reality (AR) is found to have potential for making the learning cycle more clients benevolent, dynamic, viable and important. This is on the grounds that it empowers clients to interface with virtual and ongoing applications at the same time and carries the common encounters to the client [3].

Working of AR system can be understood in three steps namely “Recognition”, “Tracking”, and “Mixing”. Recognition involves recognizing, images, like objects, face or space. During tracking, on these recognized entities, it can superimpose virtual object and then real-time localization in the image space, the face of the target, a body or space will be conducted. Lastly step involves superimposition of media in the appearance of video, 3D, 2D, text, over it. Physical-world symbols are used by Marker-based AR Systems, as an allusion end for computer graphics to be ofaced. To appraise the position, direction and development of the representation show concerning the objective item, camera continuously snapshots the target object and process the image in this system. Suppose in front of a webcam if we place a 2-dimensional printed marker then the computer will interpret it as a symbol directly overlay on top of the marker. This is accomplished as on-screen graphic as if it were in the physical world. Threat to the performance of AR services is lighting and focus related problems using this system.

To ascertain the status of the real universe Marker-less AR Systems are used. Electronic devices, accelerometer, compass and location data (GPS) are simultaneously used by marker less AR systems in order to verify the site of an object in the corporal globe. Such a system decides the pointing direction and axis of operation of the device. This acquired data is compared to the already available database, then the decision is taken for “what the computer is looking for is”, this helps the PC to display on-screen all data and graphics appropriately. The mobile augmented reality has been developed due to such technological approach by using devices like Smartphone and tablets [4].

2. TYPES OF AR TRACKING

Fiducial Marker Based Tracking

The frequently used practice for AR is Fiducial marker-based tracking. In the field of view for quick identification and for having elevated contrast, this technique is used. We can relate to point in space and also calculate distance, angle of sight by using this technique. Black and white squares with geometric figures are used as markers in AR. On background environment if we use black and white squares, it gives high contrast and can thus be quickly recognized. Fiducially markers technology has the drawback that, during the augmentation they cannot be obscured by other objects. Remembering the location of the marker and refreshing its location continuously according to the device movement, this problem can be solved to some extent. [5].

Hybrid Based Tracking

To compute genuine position and direction, this kind of tracking is used. Information sources, for example, GPS, compass, accelerometer is combined for hybrid-based tracking. The Global Positioning System helps to pinpoint the current location of the devices; this can help to discover objects in a specific territory that need to be expanded. To find out the direction in which the device is pointing we can use the compass, and then it can be find out that regardless of whether the way has any items to be expanded or not. Using gravitation concept, the accelerometer can be to calculate orientation of the device. When all this information is combined, it can be determined that, what is should have been increased in the view field without the necessity of real preparing of the genuine picture. Genuine picture is utilized here for putting the layer of growth [5].

Modelled Based Tracking

Prior knowledge of 3D objects is required for model-based approach in the environment along with their appearance. For manipulating position and orientation of objects and for matching them to their partners in the field of view, mathematical portrayal of 3D objects can be utilized. For construction of 3D models, model approach can work using edge detection. The model is utilized to follow likeness comparable to its article in nature for example following a moving ball on a green grass of ground; more processing power is required by this approach [5].

Natural Feature Tracking

Utilizing objects in genuine world as markers, by acknowledgment of their regular attributes is the idea driving characteristic component following for accomplishing AR. For the pictures that are exceptionally recognizable we find "fascinating highlights" that depend on numerical calculations. For additional acknowledgment, highlight descriptor of a specific picture is spared. A similar picture can be perceived from various separations, direction, and light levels dependent on this list of capabilities, even with some impediment as the descriptor is invariant to those changes. The two closures of this continuum called blended reality in with the center area are this present reality and an absolutely virtual condition. Close to this present reality end of the range, Augmented reality lies with the prevail discernment being

this present reality enlarged by PC created information. Milgram made the term Augmented virtuality to distinguish frameworks that are generally manufactured with some true symbolism included, for example, surface planning video on virtual items. As clarified by Milgram, augmented reality totally submerges the clients in a virtual situation wherein an individual can't see this present reality around him. This could resemble; the client would by and large wear a glass and once the applications begin an individual could feel like he is in a pixie world, so it can't be detected by him that what really is circumventing him in all actuality. While AR on other hand, despite the fact that the client would require some showing gadget like PC, advanced cell, unique glasses or Head mounted showcases, he could see the virtual world being overlaid on this present reality. So, the individual could know about both the world [5].

3. AUGMENTED AND MIXED REALITY

By implies of Augmented Reality (AR) our perception of the surroundings is improved and enhances by combining sensing, computing and display technologies. Visual frameworks are equally the concentration in this contour, however it is noteworthy that further boosts, for illustration, input from here-able, material or olfactory presentations, might be similarly or considerably further significant, dependent upon the specific circumstance and individual. The qualities of these frameworks can be additionally perceived from three traditional and generally utilized rules for AR frameworks clarified as beneath [5].

Blend virtual and real: AR requires show innovation that permits the client to at the same time observe virtual and genuine data in a consolidated view. Conventional presentations can show just PC created pictures and are along these lines lacking for AR.

Registered in 3-D

Augmented Reality hangs on a cozy coupling sandwiched between the virtual and the genuine that depends on their mathematical correlation. This makes it conceivable to deliver the virtual substance with the correct arrangement and 3D viewpoint regarding the genuine.

Interactive in real time

The AR framework must run at intelligent edge rates, with the end goal that it can superimpose data continuously and permit client communication. The principal thought of AR is to join, or blend, the perspective on the genuine condition with extra, virtual substance that is introduced through PC designs. Its persuading impact is accomplished by guaranteeing that the virtual substance is adjusted and enrolled with the genuine articles. As an individual moves in a situation and their viewpoint perspective on genuine items changes, the virtual substance ought to likewise be introduced from a similar point of view.

The Reality-Virtuality Continuum traverses the space between the real world, where everything is physical and augmented reality, where virtual and incorporated PC designs supplant the physical environmental factors. Blended the truth is situated among them, and incorporates AR and expanded virtuality. AR adds virtual substance to an overwhelmingly genuine condition, though increased virtuality adds genuine substance to a transcendently virtual condition. Albeit both AR and expanded virtuality are subsets of blended reality by definition, the majority of the exploration in the zone centers around AR, and this term is subsequently frequently utilized conversely with blended reality. AR methods abuse the spatial connections between the client, the computerized data, and the genuine condition, to empower natural and intelligent introductions of information [5].

4. HOW AR IS DIFFERENT FROM VR

The term augmented reality is characterized as "PC produced, intelligent, three-dimensional condition in which an individual is submerged". Expanded reality permits the constant mixing of the advanced data prepared by a PC with data originating from this present reality by methods for appropriate PC interfaces. There is an away from between the idea of computer-generated reality and increased reality that can be clarified with the assistance of figure 8.1[4].

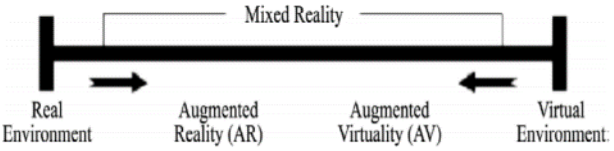

Figure 1 Milgram's Reality- Virtuality Continuum [4]

5. VIRTUAL REALITY (VR)

It is characterized as the employ of interactive mechanics to provide real-time multimodal display and interaction of information, allowing a computer-generated world to be occupied, navigated and controlled by a user or users. Virtual reality (VR) refers to digital technologies that create realistic images, sounds and other stimuli that reflect an immersive world and simulate the physical presence of a user in this world using software. With the assistance of digital technology, mixed reality (MR) refers to the combination of real and virtual content. Augmented reality (i.e., simulated 3D objects in interactive reality) and augmented virtuality (i.e., recorded reality elements in immersive 3D virtual environments) are seen as mixed reality [6].

This technology enables a client, regardless of whether that condition is a reproduction of this present reality or an envisioned world, to interact with a computer-simulated environment. It is the gateway to the past, present and future being witnessed, felt and touched. It is the tool for building our own universe, a personalised truth of our own. It might series from making a computer game to taking a virtual stroll across the world, from strolling through our very own fantasy place to walking on an alien planet. With virtual reality, by playing healthy and with a learning perspective, we can explore the most challenging and exhausting scenarios. For an absorbing, interactive, computer-mediated experience in which a person perceives a synthetic (simulated) world through special human computer interface equipment, Virtual Reality (VR) is a common term. In that environment, it interacts with virtual objects as if they were real. In a shared synthetic environment such as the battlefield, many

people can see each other and communicate. Computer generated Reality is a term used to portray a virtual world made by a machine that a client can go around and control continuously. On a head-mounted presentation, a PC screen, or a wide projection screen, a reenacted world can be seen. To permit the client to watch, move around and control the virtual world, head and hand global positioning frameworks are utilized [7].

Virtual Reality

It is a concept that has been used several times by all of us. Movies such as the Matrix took augmented reality into the consciousness of the public and out of science fiction. All things considered, from military pilot training programs to basic mobile apps. Virtual reality consists of an immersive computer simulation that senses the state and function of the user and replaces or increases one or more senses with sensory feedback information in such a way that the user gets a sense of being immersed in the simulation (virtual world). In this manner, four key components of augmented reality can be distinguished: the virtual condition, virtual presence, tangible criticism [8].

Virtual Environment

Descriptions of objects and the rules and relationships that govern these objects within the simulation are generated by a virtual environment created by a machine. It is a plan that presentations protest and permits the virtual world to be observed by interaction, offering a virtual presence. The virtual world is decided by its material (items and typeset). In a virtual environment, the material is exhibit in diverse forms (visual, auditory and haptic) what's more, seen by the client through vision, hearing and contact. Items also have characteristics for example, shape, weight, shading, surface, thickness and temperature, much like articles in reality. These properties can be detected using different senses. For example, only in the visual domain is the colour of an object perceived, whereas both the visual and haptic domains may perceive its texture. The material of the virtual world can be segmented into categories. The topology of the atmosphere determines the surface structure, areas and features. Usually, activities are confined to a particular region in which the user in a virtual environment can move. Articles are three-dimensional structures that consume space in the virtual universe. They are elements which the client can screen and control. Go-betweens are styles that the UIs or symbols themselves handle. UI segments speak to parts of the interface inside the virtual world. These include virtual force components, including virtual keys, switches, and sliders. [8].

Virtual Presence

You can separate virtual presence into physical (tangible) and mental presence, roughly. It speaks to in reality the sentiment of being in a situation; this can be either a completely mental condition or accomplished through any physical medium. The genuine virtual presence is the characterizing normal for augmented reality and truly speaks to the client's body utilizing the medium. Synthetic upgrades are made misleadingly and applied to the individual, yet there is no compelling reason to impact or include all faculties and the entire human body. The psychological virtual presence is a condition of 'daze': duty, aspirations and the sentiment of being essential for the virtual world. Aside from physical and mental presence, a few authors additionally depict telepresence, the importance of virtual presence in a geologically inaccessible location. Digital presence is hard to summon from other media since they don't have genuine tactile and physical submersion in the globe. The idea of nonappearance has likewise been made, yet evoked by other media, as a thought like presence. Allies of the hypothesis guarantee that knowing the plot of a novel, for instance, requires a separation from the earth wherein a book is perused by the individual. To some degree, so the writer can be submerged in the substance of the novel, ecological data must be disregarded, so the pursuer must be missing from the nearby world. In augmented reality, the individual is available in an (in fact virtual) condition, so he/she ought to likewise see it as genuine and respond to it as real.[8]

Physical (sensory) Virtual Presence

It is portrayed by a virtual presence that is perceptible and isolated simultaneously from other media. It is accomplished by offering a client because of the client's position and activities with a combination of improvements to at least one faculty in the virtual world. Typically, a computer-generated simulation interface makes the virtual world through sight, sound, and contact (haptics). As the client moves, the visual, sound and haptic upgrades move, as the virtual scene additionally moves. It becomes bigger, stronger, and can even be contacted at a fitting separation as it moves towards an article. Turning the head uncovers the world to one side and right of the purchaser. Manufactured improvements frequently overwhelm boosts of the physical world, along these lines bringing down this present reality's mental presence. How much genuine upgrades are supplanted by engineered improvements and the measure of 'deceived' faculties influence the degree of physical presence, which thusly decides the degree of mental presence [8].

Mental Virtual Presence

The degree of wanted virtual mental presence depends on the objective utilizations of augmented reality. In the event that the virtual experience is proposed for amusement, a serious extent of mental presence is required. Nonetheless, a serious extent of mental inundation is frequently not anticipated, conceivable or even alluring. Thus, a medium won't be avoided from being augmented reality by the nonattendance of mental virtual presence. A client's psychological virtual presence can have fluctuating degrees of power: clients can feel a connation to a PC; clients can disregard this present reality and spotlight on interfacing with the virtual world while as yet understanding the contrast among genuine and virtual universes; or clients can even be so inundated in the virtual condition that they overlook that it's virtual. A reasonable presentation including sight, sound and contact can altogether influence the level of mental virtual presence. As even little blunders in such a picture occupy the client from the experience, a mimicked photorealistic picture is extreme and once in a while undesirable. The

equivalent applies to other sensible components, for example, three- dimensional perspectives or echoes, while they are frequently required for the protection of mental virtual presence, they may occupy them in different applications. Computer generated reality must ensure at any rate a base physical standard for virtual presence. The hypothesis of mental virtual presence implies that individuals are so occupied with virtual encounters that they quit questioning what they are experiencing. The degree of mental virtual presence is influenced by components, for example, the recreated situation, the picture quality and graphical portrayal and the quantity of faculties empowered by the augmented experience system. The fantasy of mental drenching can be lost if the deferral is excessively long (being too long relies upon the visual, aural or haptic kind of the presentation). The apparent authenticity of individual items and the whole virtual world can be improved utilizing tactile exchange. At the point when an article seems sensible, we trust it will likewise act all things considered. The authenticity of the entire universe can be essentially improved by focusing these components on the faculties. [8]

Sensory Feedback

Tactile input is an essential capacity of augmented reality. Fixated on their physical area, the computer-generated simulation plot gives clients direct tangible input. Visual data normally gives a significant part of the criticism, albeit certain settings utilize just haptic data. Obviously, it is important to control the area of the client so as to give exact input. Accordingly, the PC must have the option to consequently decide the position and direction of articles in reality. [8]

Interactivity

Augmented reality, in the event that it is to be reasonable, must react to the client's activities; as it were, it must be intelligent. The client's capacity to control PC produced situations is one method of communication. Another decision is to change the area and edge from which the client sees the globe. A multi-client condition is an intuitiveness expansion that incorporates countless clients working simultaneously in a similar reenacted condition or simulation. This condition will likewise permit different client encounters, yet computer generated reality isn't really important for it. In a similar situation, it is important to follow their activities, motions, lead, bearing of consideration, voice, heading while communicating with others. The word symbol (a Hindi word for the indication of a god) is commonly used to distinguish an anecdotal item that speaks to a client or genuine article inside the virtual world. [8].

Augmented Reality Verses Virtual Reality

AR is a cutting-edge innovation that incorporates this present reality superposition of PC illustrations. Probably the best outline of the innovation is that the zone was set up, a few issues were distinguished and the advancements were summed up to that point. AR is called Mixed Reality (MR) in a broader sense, alluding to a multi-hub continuum of territories crossing Virtual Reality (VR), AR, telepresence, and other related technologies. Virtual Reality is a term utilized for 3D situations made by PCs that permit the client to enter recreated conditions and connect with them. Clients can "inundate" themselves in the fake universe of PCs to different degrees, either reproducing a type of the real world or mimicking a complex phenomenon. The fundamental point of telepresence is to grow the tactile engine offices of the client and critical thinking aptitudes to a distant situation. In this sense, telepresence can be portrayed as a human machine framework where the human administrator gets adequate data, introduced in an adequately normal way,

about the teleoperator and the assignment condition, that the administrator feels truly present at the far-off site. Telepresence looks to accomplish the hallucination of quality in a far-off area in a to some degree comparable approach to augmented reality, wherein we mean to accomplish the fantasy of essence inside a PC reenactment. AR can be known as a VR-telepresence innovation. Despite the fact that nature is completely sensible in VR and totally genuine in telepresence, the client sees the physical world joined with virtual articles in AR. [9].

Figure 2 AR example with virtual chairs and a virtual lamp [9]

Human Computer Interaction (HCI)

It alludes to the investigation and instrument by which PCs are managed by humans. Very essential HCI is something as basic as a console and mouse while progressed HCI could be thought-controlled cooperation between an individual and a PC. "Haptics" alludes to the capacity, by contact, to feel a characteristic or manufactured mechanical environment. Haptics can include kinesthesia, the capacity to detect the area, development and weight of one's body. Force contribution to clients about the physical properties and offers of virtual articles portrayed by a gadget is created by Haptics technologies. For model, a haptic joystick gives dynamic protection from the client dependent on a computer game 's activities. Haptics consolidates both touch components (material) and movement components (sensation). For applications that reproduce genuine physical properties, for example, weight, force, grating, surface, or opposition haptics imparts those properties through interfaces that let clients "feel" what's going on the screen [7]. Although this field is being studied for a longer period of time, AR is not yet a mature area. Each year, we have new technologies that allow us to better integrate virtual objects with real environments. New sensors and their miniaturization will help a great deal to enhance the experience of the user. It seems like the most important thing is to have an impression as similar as possible to the reality, to provide a normal way of communicating with the system. For that,

several input categories are available; we can use our hands to control a machine, but also our voice or eyes. New inputs activate new applications and make the use of augmented reality easier. Using a depth sensor can be a new paradigm; the hand of the user can communicate freely behind his screen, which can easily identify his 3D gesture. The screen is also fully transparent to the user as behind the screen the gesture is made. Another point is the Haptic feedback of getting a more normal feeling. We can touch them while communicating with objects in real life. We may replicate this sensation by using haptic devices or tactile surfaces to support the experience of the user. Other options, such as providing a rear touch-panel and using it instead of the front touch- screen, will partly fix those issues. Visual assistance, Touch 3D and Homer-S are a low-cost alternative to costly hardware specifications as well.

6. CHALLENGES IN VR/AR

Virtual Reality is described as a real or simulated environment in which the user experiences telepresence [10] Whereas AR is described as a technology that maps a computer-generated image to an individual's view of the surrounding world [11]. Technology plays a key role in Augmented and Virtual Reality. Augmented Reality (AR) can be accessed through various devices like tablets, smartphones or head mounted device (HMD) while to access Virtual Reality (VR) one needs exclusive virtual reality gadgets.

AR/VR has applications is various sectors including education, entertainment,medical, retail, business logistics, repair & maintenance, tourism industry, public safety [38]

Figure 3 Major Hurdles of VR Industry

Challenges of AR/VR in Educational Sector

In a survey done by authors in [12], it was suggested that use of VR may be more suitable for students of upper primary classes but students of lower primary classes may face difficulties in using such gadgets. Also, use of VR enabled gadgets will be a matter of ease for students who are compatible in using computer systems, for non – compatible students it can be cumbersome.

Another important challenge in the use of VR enabled gadgets in educational sector was its ability to allow user to access any information using internet. But in some situations, students should not be allowed to access unconcerned topics [12]. Without a well-designed framework and guidelines for students, AR technology can be too difficult for students to use [13]. In a survey, [14] stated that Students find AR challenging and often encounter technical glitches while using AR. In [15], authors commented that AR technologies such as HMDs are not only voluminous in size but also tough to handle. They suggested AR technologies should be developed to be smaller, lighter, more flexible and faster [15].

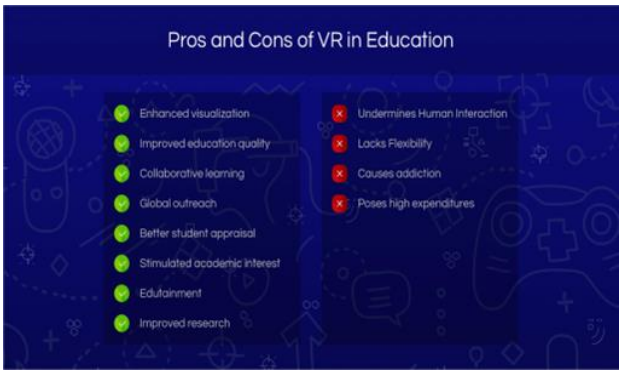

Figure 4 Pro & Cons of VR in Education

Apart from these technical limitations, it is also observed that an additional amount of time must be dedicated in teaching the students the use of AR/VR technologies [16] .Moreover, even the visual explanation of any topic is more interesting to understand, Indian education system requires students to read the textbook as well .Survey has also validated that many parents are reluctant in allowing their wards to use smartphones while others were found financially in-competent to buy individual smartphone for every child studying in school [12].

Challenges of AR/VR in Industrial Applications

Augmented Reality (AR) is generally referred as an imminent interface for communication and collaboration among man and machine. [17]

Along with the prominent use of Computer Aided Design (CAD) to stimulate and advance the process of growth, technologies of virtual and mixed reality are also being applied to these sectors [18]. Industrial Augmented Reality (IAR) can be considered as the application of AR to aid an industrial process [23]. AR and VR basically change the way in which technical information is presented to the user [21].

Each industrial sector is special and the prerequisites of the organization are not the same as each other. This differentiation in prerequisites prompts another challenge that makes it possible for each industry to specialize in technical answers. [20]. The major hurdles identified were: hardware and software issues, weight, ergonomics issues, limited user acceptance, visual fatigue and concentration performance issues, data transfer, integration and security issues, content authoring, adaptive instructions, marker tracking reliability and cost [19].

Challenges of AR/VR in Tourism

By acting as the distribution technology of enticing digital content and mobile applications, AR will help tourism agencies to meet a broader audience with finely tuned different expertise levels. [22].

AR applications used in tourism sector often require stable Internet connection which is possible only with the use of either Wi-Fi or 3G, 4G or more advanced generations of communication network. Since not all cities or locations are equipped with Wi-Fi or internet connection, therefore the interoperability is hampered due to unstable connection.

Challenges of AR/VRin Medical& Healthcare

Three main problems must be overcome by AR in medicine: tracking of precision, Misperception and synthetic data interaction. Since the precision required for medical /surgical operations is in sub millimeter order, there is challenge to place all assets accurately. Medical AR, on the other hand, generally involves very limited and controlled indoor volumes of work and current tracking systems are capable of providing the requisite accuracy under these conditions.

The misperception is significantly related to an incorrect perception of depth (although assets are properly aligned, they are perceived in the wrong position by the user), but this problem can be mitigated by using stereoscopic visualization devices. The problem of interaction relates more generally to the user interface, design issues; for example, a surgeon can't fully interact with assets by using touch, so it is necessary to implement natural and multimodal user interfaces. The user can choose between different input modes through multimodal interfaces: gesture / pose recognition and speech recognition can be two alternatives for interacting naturally with computer-generated content. Unfortunately, these alternative input modes can introduce problems with robustness, that must be taken into account when designing safety-critical systems such as medical ones.[38]

Figure 5 Use of AR in Healthcare Domain

Challenges of AR/VR in Maintenance & Repair

Despite the fact that AR has demonstrated preferences and undiscussed potential over a wide scope of businesses, challenges stay to be addressed. Hardware instability describes the AR market as new equipment rises. Banding together with a supplier that follows an equipment freethinker approach will permit business to send AR applications on the right now utilized gadgets immediately. Lots of computerized content is needed to capitalize on AR's maximum capacity. The ideal item has simple to-creator work processes getting to information and substance from existing incorporated frameworks, just as simple to-tune directions for video direction as well as distant guide support. It catches the metadata related with the execution of the work process, for example, the expert who played out a stage, when the progression was performed and its length, making this data accessible to Analytics and to quantify consistence with the execution [42]

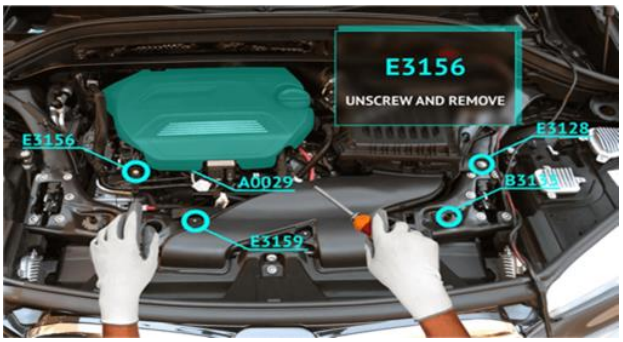

Figure 6 Application of AR in Maintenance& Repair

Challenges of AR/VR in Entertainment, Sports & Games

Even after huge success of AR enabled game like PokemonGo, development of AR based solutions for entertainment faces major challenges. One of the major hurdles is hardware requirement. Although, users are willing to buy additional VR set required but if this challenge is not taken into consideration, the development of cross platform products may become useless if most potential customers haven't the devices to enjoy them - here and now, not in the future. Another challenge is to offer new wow-effect with every new application. Also, the distribution of the AR/VR applications needs more attention in order to reach to proper audience. Since the users of such applications are majorly kids/teens, issue of healthcare must be taken into consideration [43].

Figure 7 AR based PokemonGo Game

Challenges of AR/VR in Architecture & Construction

With AR/VR in real estate, visualizing dream house has become very interesting. But major challenge is that serving the user with these visuals sounds very expensive. Also, the real estste agents, do not promote the use of such application to users as they want prospective buyers to contact them, ask questions about a property, and come to an open home. So, there is need to find a midway from this issue [44].

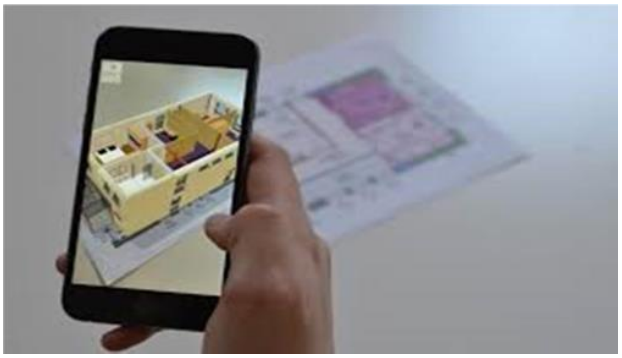

Figure 8 AR based application for construction assistant

Application of Virtual and Augmented Reality to Human Computer Interaction

Human-computer interaction (abbreviated as HCI) is a Computer Science domain that focuses on designing interfaces underpinning the relationship between humans and the computer. In a lighter sense, HCI helps how the machine can easily understand humans and vice versa. Virtual reality and augmented reality blur the demarcation line between real life and computer-generated human experiences. These emerging technologies are gaining much popularity not only for the gaming industry but to other sectors as well.

There is an overlapping yet clear difference between AVR and AR. Virtual reality provides total immersion of computer-generated experience, thus shutting out the physical environment. Devices such as Google Cardboard, HTC Vive, and Oculus Rift can transport users to real-world and simulated environments. On the other hand, augmented reality supplements a real-world environment with digital views using assistive tools like smartphones. Notable examples of AR applications are Snapchat lenses and PokemonGo [24].

There is a wide array of studies on the applications of AR and VR concerning human-computer interaction to various fields like Engineering, Medicine, Education, and Business to name a few. Sato and Koike [25] designed a system that represents the user's hand gestures into 3D with the use of multiple cameras. Utilizing a pre-trained artificial neural network, these hand gestures were able to augment desktop activities and detect hand motions in real-time. With the same fashion, Hu's recent study focuses on eye movement. Using the so-called gaze, positioning in the virtual environment is determined with the use of Artificial Neural Networks. The collected data about head movements help in determining object focus and shifting of scenes in the virtual spectrum [26].

The business and industry sectors benefit a lot from virtual and augmented reality. From virtual shopping to virtual product evaluation, organizations formulate strategies in improving their product offering based on customer feedback and experiences. Falcão and Soares [27] proposed a conceptual framework endeavoring to increase user product experience and achieve efficient usability evaluation of products. The proposal involved a graphical user interface wherein customers can have a virtual experience of the product before being released into the market. Using a graphical user interface, they can provide feedback and additional requirements. Similarly, Speicher [28] proposed a Virtual Reality Shopping Experience (VRSE) mode combing the experience of e-commerce and conventional brick-and- mortar shops. Users can navigate the shopping center and view products offered. Moreover, customers can pay the commodities using the integrated e-commerce payment system.

Virtual and augmented reality applications are now getting much attention from the Medical Sector. For an instance, a VAALID European funded project of Jiménez-Mixco[29] utilized virtual reality simulating tools in designing prototypes for elderly and physically challenged people. The prototype named Ambient Assisted Living assist them in bridging the gap between technology and physical capabilities. Also, the study of Wrzesien et al. [30] recognizes the roles of Virtual Reality (VR) and Augmented Reality (AR) with therapists and patients. The authors found out that human-computer interactions involving these two technologies significantly improved the process of treating specific phobias. Similarly, a group of medical practitioners published in Computational Science and Engineering Research Magazine their findings on the effectiveness of augmented and virtual reality applications in simulating surgery. The said applications introduce a three-dimensional environment for both patient and practitioner's experience. The results of each simulation improved the spatial awareness and cognition of surgeon-trainees, thus minimizing errors and time spent on the surgery [31].

As people become health-conscious, various researches introduce various exercise and diet regimens. Park and Park [32] introduce an augmented reality environment for athletes training like rough terrains for runners. Also, people doing exercises at home utilized exercise routines and gym simulations embedded in the application. For sports enthusiasts, specifically for target shooters, the study of Basu and Johnsen [33] provides a virtual venue for inside warehouse and urban shooting environment. The prototype includes a custom wireless 3D printed head-mounted display with the smartphone as the primary display and a body-worn electromagnetic tracker on a utility belt design.

With the COVID 19 outbreak, academic institutions restructure ways of delivering academic programs. Most of these institutions resorted to either blended or distance learning methods as a viable solution. E-learning and virtual tours have become famous nowadays because students cannot attend physically in their classes. Long before the pandemic, simulations using either or both virtual and augmented reality applications were in place to replace environments that pose risks to students or too expensive. For instance, flying airplanes, performing surgeries, and underground mining are both dangerous and expensive for students and universities alike. Augmenting e-learning experience for students is the subject of Bednarz [34] and his team in their proposed immersive virtual reality prototype. Using a four-meter hemispherical dome projection screen that simulates underground mining and an iPhone, users can interact directly with an application. This virtualization simulates an environment that is risky for students to explore in real life. With the same goal, researchers from Chung Yuan Christian University [35] developed a web-based

infrastructure melding both virtual and physical Physics laboratory. Before going to actual experiments, students can practice with the simulated environment. This setup avoids dangers for students who will do the experiments for the first time and without prior knowledge of the use of laboratory equipment. The Nanyang Technological University in Singapore had introduced a virtual campus tour for prospective and current students developed using advanced modeling software systems, MultiGen-Paradigm's MultiGen and Vega. Using their personal computers and while at home, students were capable of doing VR walkthroughs in shared virtual worlds using a three-dimensional Web visualization [36].

Following are the applications of AR/VR

1. Crisis Management: Much as the ascent of information perception has upgraded situational mindfulness during crisis circumstances, Augumented Reality can advance responders' information on their environmental factors so as to protect inhabitants out of luck. Occupants could plan their areas on an intelligent guide conveyed to responders, which would then show EMS laborers the most secure salvage courses and distinguish especially unsafe regions.
2. Resource Management: Armed with shows featuring the state of city resources and the existence of any risky conditions, laborers would have the option to finish fixes and development extends all the more proficiently and securely. Information about their environmental factors
3. Emotional wellness Services: Recent examination has shown that AR and VR have colossal potential for dealing with psychological well-being issues like uneasiness and posttraumatic stress disorder, making open doors for clients to stand up to their apprehensions in introduction treatments. Furthermore, VR reproductions can likewise assist inhabitants with posttraumatic stress disorder practice prospective employee meet-ups, figuring out how to deal with their indications in high-stress situations. By outfitting social specialists with these devices, urban communities can improve their emotional wellness treatment.
4. Training: Enlarged and computer-generated reality can possibly carry more understudies into the homeroom and make all the more captivating and energizing study hall encounters. Utilizing VR, understudies in medical care offices or immature provincial territories could partake in the study hall practically in a substantially fuller and richer route than in customary online classes. Utilizing AR and VR, instructors could make a vivid learning condition, permitting understudies to investigate the sea depths or new pieces of the globe. By subsidizing these sorts of innovations in state funded schools, urban areas can make schools more comprehensive and locks in.

Figure 9 Application of AR in Training

E-commerce and Retail

AR application improvement is going to reshape on-and disconnected shopping. AR applications let customers interface with items and help in making customized shopping encounters. Envision yourself strolling around a store with a cell phone. On its screen, you'll see the costs, exceptional offers or limits yet additionally the highlights and any extra subtleties you wish to think about an item. In 2019, design and excellence marks especially are relied upon to push the limits with AR and VR for customers who visit their stores.

Figure 10 Benefits of AR/VR in Ecommerce

Real Estate

The Web is the primary spot were purchasers and tenants search for properties. AR can assist clients with encountering homes contrastingly and spare time. For planned speculators, AR lets feature properties before they have been constructed or transform 2D outlines into intuitive 3D representations. VR glasses and 3D shots of properties additionally make a decent effect. Land dealings can be debilitating both for real estate agents and customers. VR can limit the driving and strolling to see various properties, the need to recall various insights regarding every one, the pressure of decision, and different disappointments. VR features of properties guarantee great presentation, can accumulate a large number of perspectives, connect with global purchasers, and significantly diminish an opportunity to bring a deal to a close. A real estate professional can lead a visit through a property distantly and even observe where the customer is looking, tending to issues continuously. Investigating 3D designs through VR additionally overcomes any barrier between a modeler's or fashioner's creative mind and this present reality.

Figure 11 Application of AR in Real Estate

Advertising & Marketing

Creative use of AR can strengthen customer relationships while increasing the propensity to purchase. Delightful content motivates customers to use a brand's mobile application regularly. Unique and fresh AR experiences offers a chance to surprise customers and competitors that don't do anything like that yet.

Figure 12 Application of AR in Advertise

Assembling and Occupational Safety

AR innovation can encourage and quicken measures at manufacturing plants. It empowers architects to show models, building destinations, and so forth., and offer their vision. AR markers on gear help to screen the work in progress. Computerized guides and plans spare time and advance comprehension. AR glasses can give assembling and field laborers ongoing information that assists with decreasing blunders and improve precision, wellbeing, and superiority.

Computer generated reality emulates genuine situations short the danger. Subsequently, it is turning into a standard preparing instrument for workers who need to manage physical threat. Mining organizations can utilize VR to prepare representatives without sending them underground.

Utilizing VR for perception or displaying limits the requirement for 3D printer demonstrating and further encourages the work. Ventures are as of now joining AR, VR, and live IoT tangible information to make a computerized imitation of a physical resource. Such 'advanced twins' will change the best approach to do numerous positions and manage numerous issues. They'll permit examining the articles in VR without visiting distant or hazardous locales. For instance, a specialist found aground can utilize a computerized twin of a failing breeze turbine to recognize and fix the issue continuously.

Figure 13 Application of AR in Assembly

Metropolitan plan and arranging

AR frameworks are being utilized as synergistic apparatuses for plan and arranging in the constructed condition. For instance, it can be utilized to make increased reality guides, structures and information takes care of extended onto tabletops for shared survey by assembled condition professionals. Outdoor AR guarantees that plan and plans can be superimposed on this present reality, rethinking the dispatch of these callings to acquire situ plan into their cycle. Plan choices can be explained nearby, and show up nearer to reality than customary work area components, for example, 2D guides and 3d models.

Figure 14 Application of AR in Metropolitan planning

Visual Art

It is applied in the visual articulations licenses things or spots to trigger innovative multidimensional experiences and understandings of this present reality. Amplified reality can help in the development of visual craftsmanship n chronicled focuses by allowing show lobby visitors to compelling artwork in shows in a multidimensional way through their phone screens. The Museum of Modern Art in New York has made a presentation in their art chronicled focus showing AR incorporates that watcher a see using an application on their phone. The verifiable ocus has developed their own application, called MoMAR Gallery, that show lobby guests can download and use in the Augmented Reality explicit presentation in order to see the display corridor's syntheses in a substitute way. This grants individuals to see covered viewpoints and information about the masterpieces, and to have the choice to have an instinctive inventive association in craftsmanship moreover.

Figure 15 Application of AR in Visual Art

Social Cooperation

AR can be utilized to encourage social communication. An expanded reality interpersonal organization structure called Talk2Me empowers individuals to disperse data and view others' publicized data in an enlarged reality way. The convenient and dynamic data sharing and survey functionalities of Talk2Me help start discussions and make companions for clients with individuals in physical proximity. However, utilization of an AR headset can hinder the nature of a communication between two individuals in the event that one isn't wearing one if the headset turns into an interruption.

Increased reality likewise enables clients to rehearse various types of social associations with others in a sheltered, hazard free condition. Hannes Kauffman, Associate Professor for Virtual Reality at TU Vienna, says: "In community oriented Augmented Reality various clients may get to a mutual space populated by virtual items, while remaining grounded in reality. This strategy is especially ground-breaking for instructive purposes when clients are assembled and can utilize regular methods for correspondence (discourse, motions, and so forth.), yet can likewise be blended effectively with vivid VR or far off collaboration.

Figure 16 Application of AR in Social Communication

Flight Preparation

Expanding on many years of perceptual-engine research in exploratory brain science, analysts at the Aviation Research Laboratory of the University of Illinois at Urbana–Champaign utilized increased reality as a flight way in the sky to show flight understudies how to set down a plane utilizing a pilot training program. A versatile enlarged timetable where understudies were indicated the growth just when they left from the flight way end up being a more successful preparing intercession than a consistent timetable. Flight understudies educated to land in the test system with the versatile growth figured out how to set down a light airplane more rapidly than understudies with a similar measure of landing preparing in the test system yet with steady expansion or with no enlargement.

Figure 17 Application of AR in Flight Preparation

Military

A captivating early usage of AR happened when Rockwell International made video map overlays of satellite and orbital trash tracks to help in space recognitions at Air Force Maui Optical System. In their 1993 paper "Trash Correlation Using the Rockwell WorldView System" the makers depict the use of guide overlays applied to video from space perception telescopes. The guide overlays showed the headings of various articles in geographic ways. This allowed telescope directors to recognize satellites, and besides to perceive and list conceivably dangerous space flotsam and jetsam.

Figure 18 Application of AR in Military

Beginning in 2003 the US Army incorporated the SmartCam3D expanded reality framework into the Shadow Unmanned Aerial System to help sensor administrators utilizing adaptive cameras to find individuals or focal points. The framework consolidated fixed geographic data including road names, focal points, air terminals, and railways with live video from the camera framework. The framework offered an "image in picture" mode that permits it to show an engineered perspective on the region encompassing the camera's field of view. This takes care of an issue in which the field of view is tight to such an extent that it bars significant setting, as though "glancing through a soft drink straw". The framework shows constant companion/enemy/nonpartisan area markers mixed with live video, giving the administrator improved situational mindfulness.

Broadcast and live occasions

Climate representations were the principal use of expanded reality in TV. It has now gotten basic in climate projecting to show full movement video of pictures caught continuously from various cameras and other imaging

gadgets. Combined with 3D illustrations images and planned to a typical virtual geospatial model, these energized perceptions establish the main genuine use of AR to TV.

AR has gotten essential in sports broadcasting. Sports and delight scenes are outfitted with straightforward and overlay expansion through followed camera deals with for improved review by the group. Models consolidate the yellow "first down" line found in transmissions of American football coordinate ups demonstrating the line the unfriendly gathering must cross to get a first down. AR is in like manner used in relationship with football and different games to the big-time advertisements overlaid onto the viewpoint on the playing district. Territories of rugby fields and cricket pitches moreover show upheld pictures. Swimming transmissions regularly incorporate a line over the ways to exhibit the circumstance of the current record holder as a race keeps on allowing watchers to balance the current race with the best introduction. Various models fuse hockey puck following and clarifications of running vehicle execution and snooker ball bearings

Figure 19 Application of AR in Broadcasting

7. SUMMARY

By cultivating a positive attitude among teachers, students profit from learning, thereby encouraging the use of AR /VR technology in the classroom. There are, however, few issues regarding these technologies in terms of lack of features to promote the expertise of students, which may not provide an adequate forum to accommodate different skills. The limitation in vailability of learning materials available does not necessarily match the learning objectives of students in accordance with the norm about the local syllabus [12].

Based on the above discussed factors, we define the limits of the AR/VR as: technology, social acceptance, usability. In fact, the AR system has to deal with huge amounts of information. The hardware used should therefore be small, lightweight and easily portable, and quick enough to display graphics. Another drawback for AR uses is also the battery life used by these complex AR devices. AR tracking often requires certain device hardware, such as GPS, to provide precise markers, to ask them to be precise and accurate enough. For realistic AR use, these hardware barriers need to be overcome. Typically, AR systems receive a lot of information and need software to analyze the data, preserve useful information, discard and view useless data in a convenient way. [37].

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