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Recent development in Extended Reality technologies

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Abstract

This study discusses the recent trends in Extended Reality (XR) technologies. Extended Reality is a group of three technologies i.e., virtual reality, augmented reality, and mixed reality. It has been used in many high-performance applications like military, gaming and medicine. In general, all immersive technologies increase the sense of realism, by fusing the virtual and real worlds. The same underlying technologies that enable AR and VR also power XR to deliver a wide range of innovative user experiences. According to Qualcomm, the future of XR is to develop sleek headsets to revolutionize user experiences on a daily basis and also in many different market segments, including education, retail, and healthcare. This study summarizes the different types of extended reality technologies, XR standardization work, XR and its multi-interactive technologies, and implementation of XR in real life applications.

Keywords: Extended Reality, Virtual Reality, Augmented Reality, Artificial Intelligence.

1. Introduction

Extended Reality (XR) is now used in all the environments created by computer technology and wearables in both the real world and virtual world. In high-performance settings, extended reality technologies have been used in fields as diverse as military, psychology, marketing, retail, education, industries, medicine and the entertainment [1]. The attraction of XR in these applications is its ability to recreate circumstances that are difficult to imitate and to offer a safer training environment with a lower chance of damage. It is anticipated that, in 2030 and beyond, the XR technologies will influence the way humans live and work. Additional benefits of XR include the capacity to adjust limitations in repeatable and dynamic environments.

Although XR exists today, it is still in its early stages. The evolution of the XR will take years, like that of smartphones. XR has been used in sport as well and there will be a huge opportunity in other fields. The sports sector has lately adopted this technology and are looking into how effective it is at enhancing an athlete performance.

To widely use XR technologies, a number of technical issues must be resolved. To display a rich visual material and to move between the real world and virtual world without any lag, XR needs more technological upgradation in display technology. It is incredibly difficult to make virtual objects in augmented environments that look exactly like real ones, especially in a variety of lighting situations. To that extent, XR needs to establish pervasive and ubiquitous connectivity to the internet and cloud services. The XR market is anticipated to grow to $200 billion by 2024, which is eight times where it is now. This enormous growth might indicate that the realities of human lives in 2030 are incomprehensible now.

Figure 1. Application of XR in varies industries

2.Research Background

Morimoto et al., states that with the quick development and consumerization of XR technology, the XR technology can also be applied to a specified medical application such as spine medicine [2]. According to Jungherr, companies that provide game engines put conventional platform firms' present power dynamics to the test, demonstrating that gaming technologies have evolved into a significant new platform type worthy of academic and public attention [3]. Taylor examined how the XR is used for teaching the human body's anatomy and considers how it may be used in medical education [4]. Because of the Covid19 pandemic, the majority of academic instruction is delivered online and rarely through in-person instruction. Alternative teaching strategies for anatomy have become necessary, so the XR is used for teaching anatomy and considers how it may be used in medical education [4].

According to Cárdenas-Robledo, widespread adoption and significant application development in a variety of industry 4.0 sectors have occurred as a result of the availability and faster growth in technical gadgets that incorporate cutting-edge methods, aesthetic attributes, integrated devices, and sensors [5]. Eye trackers, according to Plopski, are used to investigate innovative spatial human-computer communications, analyse human focus and habits, and evaluate human reactions and intents [6]. Hunde investigated how merging XR, manufacturing, and Artificial Intelligence (AI) might improve CAD advantages. AI can convert complex design processes and create an intelligent graphical user interface. Simulation can take place in a 3D virtual setting with the use of extended reality technology by boosting interaction and analysis [7]. According to Fashimpaur, wrist displacement provides considerable benefits over current XR interaction approaches while also giving a feasible solution for efficient scrolling controls [8].

3.Reality-Creating Technologies

A general word for technology that can generate simulated realities utilising digitally produced pictures, videos, and activities, relates to technologies that use virtual reality, augmented reality, and mixed reality.

• **Augmented reality**

Augmented reality is a fascinating new development in technology that is rapidly integrating into our daily lives. It is a new and developing technology that allows users to interact with a world that has been enhanced with multimedia like photographs, graphics, and other data [10]. The invention of Augmented Reality (AR) is credited to some of the tech behemoths, including Microsoft, Google, and Apple. The experience of augmented reality technology is considerably more thrilling and challenging than its early understanding. The word "augmented" evolved from a Latin word that means "to add." In essence, AR enriches the real-world experience by introducing new components [11]. There are two kinds of augmented reality that are used according to business requirements. One is Marker-based Augmented reality and another one is Markerless Augmented reality.

A natural environment may be visually altered through augmented reality, or it may be improved by the addition of fresh knowledge. It can be applied to many different things, including gaming, object display, advertising efforts, residence and structure design, education, and industrial manufacturing [12]. An interactive experience called augmented reality involves adding artificially produced visuals, audio, and other stimuli to a real-world environment. It can give a person a greater, more immersive experience than they would get otherwise, which heightens their enjoyment or increases their comprehension. From a business standpoint, augmented reality can raise brand recognition and generate revenue [13].

Several different AR categories exist in the literature currently in use, and many of them are inconsistent. As a general rule, more advanced hardware is often found in newer, specialised AR devices, which also enables new types of human-computer interactions. A higher level of embodiment is also often provided by newer AR gadgets by bringing the technology closer to the human body, as opposed to more established approaches that make use of widespread technologies with a broad market reach. The following figure outlines a classification of the properties of AR based on the most popular visual AR devices, enablers, and display types.

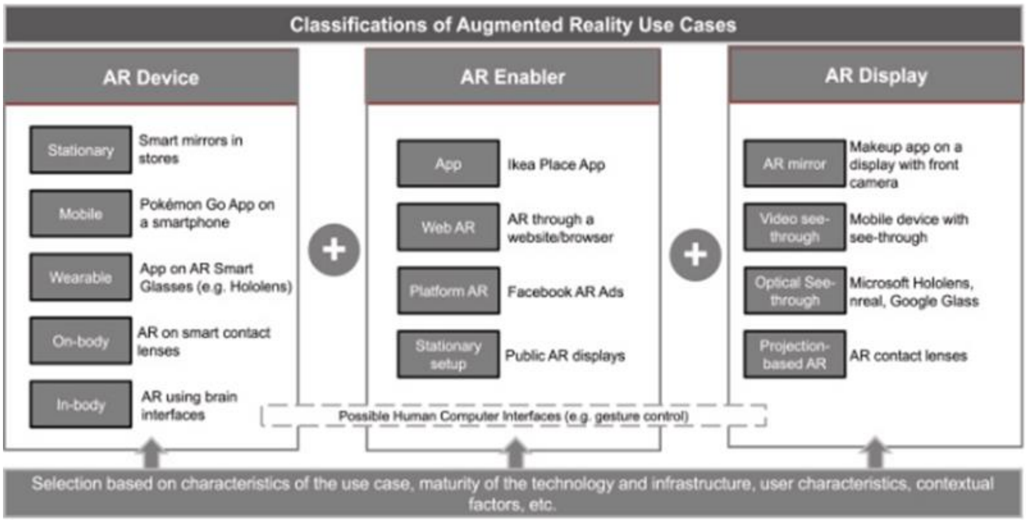

Figure 2. AR application classification

• Virtual reality

The Virtual Reality (VR) allows a person to engage with a manufactured three-dimensional (3-D) visual or other sense of the world. Through the use of interactive, wearable devices such as goggles, headsets, gloves, or body suits that send and receive information, VR applications submerge the user in an artificially created setting that replicates reality. Depending on their function and the technology employed, VR systems can vary greatly from one to the next, but they typically fall into one of the following three categories: Non-immersive, Semi-immersive, Fully immersive. The success of goods like Beat Sabre, Minecraft VR, and Skyrim VR shows that virtual reality is frequently connected with gaming because the sector has been at the forefront of the VR effort [14]. However, there has been a rise in curiosity about VR's possibilities in a variety of other fields like education, health care, trainings, real estate and etc.

4. XR Standards

According to the existing research studies, two key challenges are being addressed in XR standardization efforts: one is constructing XR with interoperability capabilities through a shared environment, XR services and applications are developed by identifying important system and user requirements to create compatible interfaces and data formats. And another one is XR user experience specifications by taking the accessibility and quality into consideration. This section introduces a number of current technical standards and requirements that are pertinent to the development, distribution, and implementation of XR experiences.

• Interoperability

For any new technology, terminology is frequently standardized because it serves as the basis for enabling design interoperability. Instead of using separate lexicons like CTA-2069-A, present research on common terms for XR tends to be more integrated into standards that provide guidance on other subjects covered by XR. Although different meanings are used within this and other standards, terminology appears to converge towards a common level of understanding. There are several applications for XR like Medicine, E-commerce, Education, entertainment, gaming, etc. The ISO/IEC 23000-13 and the ISO/IEC 21794, 23005, and 23090 series make up the collection of data format standards for immersive media that are now accessible. These standards were primarily produced by JPEG and MPEG. The MPEG-V series is complemented by the five-part ISO/IEC 21794 (JPEG Pleno) set, which offers a framework and coding tools to make it easier to express novel image modalities needed to support immersive environments.

i. The currently available works outline the broad structure.

ii. A tool for illumination enables coding.

iii. The program also provides recommendations for conformity testing.

iv. Utilization of reference software.

v. A comparable set of programming devices for holographic imaging is being explored and is now under development.

While research is carried out under the IEEE P2048 series to investigate data formats for immersive music and video, IEEE 1857.9 specifies an effective coding toolset for immersive visual material. The Immersive Technologies Media Format (ITMF) specification from IDEA serves as an umbrella for transferring data formats supporting the end-to-end transmission of immersive media.

• User experience

Usability standards are extremely restricted for XR technologies. For people with special needs, especially those who have sensory challenges or have restricted mobility, this requirement is even more important. It provides more information on the standards that must be met for accessibility in multimedia installations and the possibilities for them. The W3C's working group note on "XR accessibility user requirements" aims to facilitate the delivery of XR experiences that are as accessible as possible. For XR system designers and product developers, ETSI EG 202 848 provides a set of accessibility standards that include accessible user guidelines for design and architectural concerns and also to XR users with restricted mobility, CTA 2095 also provides some considerations.

One of the most important aspects of assessing overall user experience is quality of experience assessment. A number of technical definitions and standards on performing XR QoE evaluation have resulted from activities of the ITU, IEEE, and 3GPP. XR's quality of experience is seen from a different angle by IEEE 3079. It focuses on enhancing VR user experience by offering suggestions for lowering simulator sickness, which some VR users find to be a negative outcome.

5. XR Technologies in Real-Time

With the usage of technology, the "digital twin" that can interact with the physical world is designed to blend with or replicate it. Since imaginations are limitless, new worlds are possible if XR technology is imaginatively combined with them. Nevertheless, a few of XR applications have already made a significant social impact.

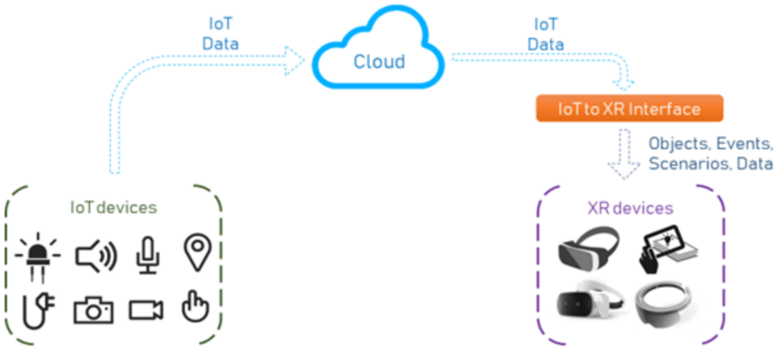

Figure 3. Architecture for data exchange between Internet of Things and XR devices

The most advanced application came from a lift manufacturer who used HoloLens to support their technicians in doing lift servicing and repairs. The lift company started by connecting its lift's sensors and systems to the cloud. The cloud service logs and retains data from lifts, including the temperature of the motor, the alignment of the shaft, as well as the acceleration of the cab and the operation of the doors. Real-time data processing in the cloud access provides immediate failure diagnosis and component identification. The technician is seeing an augmented reality (3D) representation of the lift where specifics regarding the problematic components are highlighted [2]. In another scenario, the technician is inside the lift inspecting the highlighted component and learning about its condition while receiving instruction over a Skype conversation on how to replace it. Microsoft just made instructions for technicians to learn how to input data from the Internet of Things into a holographic app through their IoT Cloud service to establishing the facilities needed to support the future growth of further XR IoT applications.

Another commercial application comes from Eye Create Worlds, an organization that develops AR and VR experiences. A virtual reality experience that allows users to communicate with digital models of Internet of Things (IoT) devices was developed to understand more about their present states [9]. IoT devices are used in reality, to collect, process, and transfer data. Then VR gets the data and works as an intermediary to the user's device and the data. Additionally, real-world sensor data from IoT devices that are really deployed can be activated, displayed, and otherwise modified by the user. The authors constructed two working models with the intent to display data produced in real time by IoT devices. One is location information and another one is data from sensor. Both models were made to understand their surroundings through the added layer of 3D data.

6. Conclusion

This research study has summarized the extended reality (XR) technologies and its types, and also analyzed the standards available in XR. The interaction of XR with other technologies has been discussed initially. Finally, the real-time applications, addressing topics like manufacturing companies and software industries like Eye Create Worlds has been provided. Since Industries and governments will depend on the strength and scope of the virtual world to exchange data, offer services, and work together in ways that aren't currently possible, it can be concluded that, more research studies, academic curriculum and professional training may be offered in virtual 3D environments in the upcoming years to make young researchers and students familiar with the technology and its wide range of applications.

References

[1] Paris, Stefano, Klaus Pedersen, and Qiyang Zhao. "Adaptive Discontinuous Reception in 5G Advanced for Extended Reality Applications." In 2022 IEEE 95th Vehicular Technology Conference: (VTC2022-Spring), pp. 1-6. IEEE, 2022.

[2] Morimoto, Tadatsugu, Takaomi Kobayashi, Hirohito Hirata, Koji Otani, Maki Sugimoto, Masatsugu Tsukamoto, Tomohito Yoshihara, Masaya Ueno, and Masaaki Mawatari. "XR (extended reality: virtual reality, augmented reality, mixed reality) technology in spine medicine: status quo and quo vadis." Journal of Clinical Medicine 11, no. 2 (2022): 470.

[3] Jungherr, Andreas, and Damien B. Schlarb. "The extended reach of game engine companies: How companies like epic games and Unity technologies provide platforms for extended reality applications and the metaverse." Social Media+ Society 8, no. 2 (2022): 20563051221107641.

[4] Taylor, Lucy, Tamsin Dyer, Mohammed Al-Azzawi, Christian Smith, Obi Nzeako, and Zameer Shah. "Extended reality anatomy undergraduate teaching: A literature review on an alternative method of learning." Annals of Anatomy-Anatomischer Anzeiger 239 (2022): 151817.

[5] Cárdenas-Robledo, Leonor Adriana, Óscar Hernández-Uribe, Carolina Reta, and Jose Antonio Cantoral-Ceballos. "Extended reality applications in industry 4.0.-A systematic literature review." Telematics and Informatics (2022): 101863.

[6] Plopski, Alexander, Teresa Hirzle, Nahal Norouzi, Long Qian, Gerd Bruder, and Tobias Langlotz. "The eye in extended reality: A survey on gaze interaction and eye tracking in head-worn extended reality." ACM Computing Surveys (CSUR) 55, no. 3 (2022): 1-39.

[7] Hunde, Bonsa Regassa, and Abraham Debebe Woldeyohannes. "Future prospects of computer-aided design (CAD)–A review from the perspective of artificial intelligence (AI), extended reality, and 3D printing." Results in Engineering (2022): 100478.

[8] Fashimpaur, Jacqui, Amy Karlson, Tanya R. Jonker, Hrvoje Benko, and Aakar Gupta. "Investigating Wrist Deflection Scrolling Techniques for Extended Reality." In Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems, pp. 1-16. 2023.

[9] Burova, Alisa, Viveka Opas, John Mäkelä, Jaakko Hakulinen, Timo Lindqvist, Sanni Siltanen, Roope Raisamo, and Markku Turunen. "Enhancing Remote Industrial Training Experiences with Asymmetric Virtual Reality: Experiences, Tools and Guidelines." Applied Sciences 12, no. 15 (2022): 7745.

[10] Abdulrahaman, M. D., N. Faruk, A. A. Oloyede, N. T. Surajudeen-Bakinde, L. A. Olawoyin, O. V. Mejabi, Y. O. Imam-Fulani, A. O. Fahm, and A. L. Azeez. "Multimedia tools in the teaching and learning processes: A systematic review." Heliyon 6, no. 11 (2020): e05312.

[11] Zhou, Bosen. "Storytelling in extended reality (XR) for spatial experiences.".

[12] Park, Sang-Min, and Young-Gab Kim. "A metaverse: taxonomy, components, applications, and open challenges." IEEE access 10 (2022): 4209-4251.

[13] Ivasciuc, Ioana Simona. "Augmented reality and facial recognition technologies. Building bridges between the hospitality industry and tourists during pandemic." Bulletin of the Transilvania University of Brasov. Series V: Economic Sciences (2020): 75-92.

[14] Xiong, Jianghao, En-Lin Hsiang, Ziqian He, Tao Zhan, and Shin-Tson Wu. "Augmented reality and virtual reality displays: emerging technologies and future perspectives." Light: Science & Applications 10, no. 1 (2021): 216.

[15] https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/awe_2017_-_the_mobile_future_of_extended_reality_-for_pdf_1.pdf

[16] https://www.researchgate.net/profile/Daniel-Bastos-6/publication/336725896_Extended_Reality_in_IoT_scenarios_Concepts_Applications_and_Future_Trends/links/62dc6d6ff3acdd5dc21271dc/Extended-Reality-in-IoT-scenarios-Concepts-Applications-and-Future-Trends.pdf

[17] https://ars.els-cdn.com/content/image/1-s2.0-S074756322200111X-gr1.jpg