Virtualization of Arm

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***Abstract*—A sense of embodiment, which can be an effective learning aid, is created when one feels they own their body. By observing a person's movement and employing human-computer interfaces such as XR, embodied learning can take place. Medical students can learn about the anatomy of the arm by using the human muscular arm. XR can support educators in a way that students can improve the learning outcomes acquired during the lecture in the classroom. Anatomy educators, however, have been looking for engaging and interactive teaching approaches based on cutting-edge technologies due to the constrained curriculum for medical students. It is useful because XR technology may combine clinical imaging data and information to create a mixed-reality anatomical environment.**

***Index Terms*—Anatomy learning, augmented reality (AR), data visualization and learning, digital learning tools, embodied cognition, embodied learning, usability study, virtual reality (VR).**

I. Introduction

"Augmented reality" or "AR" signifies broadened or advanced reality. The client actually sees their genuine climate, yet virtual articles or logical data are carefully superimposed or outwardly incorporated. Internal data processing and virtual content visualization are the only two aspects of augmented reality that matter. That happens all the while, so clients don't detect delays. This guarantees that the AR software can be used in real time.

AR offers a wide range of visual presentation options. Either a transparent screen that displays the viewing image as if the user were not wearing a device at all, such as with smart glasses, or a display mounted to headgear that does not take up the entirety of the user's view must allow the user to still see their environment.

Virtual reality, also known as "VR", is frequently referred to as a "virtual environment" or "virtual surrounding." In virtual reality, the user only sees virtual things; There is nothing visible from the outside. Head-mounted displays (HMDs) that encircle the user's head frequently serve as the means by which virtual environments are depicted. An image fills the user's field of view on these closed HMDs. It sends the user's head movement to a computer using built-in and external sensors so they can move naturally in the virtual world.

Virtual reality can be used in the workplace during the design or prototyping processes so that employees can see the finished product before it is made. Naturally, virtual reality is already being used for gaming and other forms of entertainment.

II. GENERAL BACKGROUND

We use the term "mixed reality" literally in the industrial setting, frequently referring to the physical mixing of realities. The device used for MR must be capable of scanning its surroundings and offer spatial tracking. The Microsoft HoloLens, for instance, makes use of inside-out tracking and spatial mapping. A mixed reality application then creates and displays virtual 3D models of real-world objects using this technology. You can interact with the world physically and virtually with these tools.

This may mean that with augmented reality remote support tools like Team Viewer Assist AR, you can put a virtual "sticky" annotation on a real object and have it stay with the object in the MR tool regardless of how you move. MR is also known as "spatial augmented reality" or "spatial AR" in some circles.

It is evident that the definitions of virtual reality and augmented reality are constantly evolving in tandem with the technology. In the most fundamental sense, they mean something very similar (the collaboration among people and machines utilizing perception and actual development as opposed to mouses and consoles), however they vary and can cause misconceptions. While virtual reality (VR) tries to replace it, augmented reality (AR) still uses the real world to make it easier. Alternative forms of virtuality continue to be added as software and technology are continuously developed. They must eventually be named and explained.

Humans will continue to find new ways to use data to improve the analog world for work and play, regardless of what we call this technology. When AR, VR, and/or MR become commonplace in the workplace, there will be less of a knowledge gap because of the earlier exploration of these technologies.

III. WORKING PROCEDURE

One of the most widely used game engines currently available is Unity. It lets you make games in any format—3D, 2D, augmented reality (AR), virtual reality (VR), mobile, console—for any platform you can think of. With Solidarity being so flexible, there's a lot of documentation and help accessible on the web. ARKit for iOS and ARCore for Android. An API called AR Foundation enables developers to seamlessly develop augmented reality applications for both platforms. Designers don't have to make separate activities for Android and iOS, or have much more tangled code. It's totally bundled into one with AR Establishment.

Augmented reality is not just for gaming (AR). The healthcare sector is being greatly impacted by the technologies. Yes, you did hear correctly. The use of AR in the medical field has created an ultimate fate with countless possible consequences. The world of augmented reality is prepared to revolutionise patient medical experiences, complete with silly headgear and sci-fi-themed side trips. As the upcoming generation makes more significant strides, we should expect augmented reality excursions to become more meaningful.

What occurs when medical students make errors while performing a surgery in the real world? You're right. That would not go well. But both practical methods and those used in the dissection lab must be learned. In this context, augmented reality (AR) has the promise of revolutionising both healthcare and education. Medical institutions are starting to integrate augmented reality (AR) into their curricula to give students useful hands-on learning experiences. Using augmented reality in the classroom would make it simple for students to practise simulating interactions with patients and surgeons. Medical students might be able to use augmented reality tools during their training to see and apply theories. Scenario: Students can examine the overlay anatomy data on a 3D human skeleton using augmented reality apps. They would gain a better understanding of the human body's functions through the visualization.

IV. LITERATURE SURVEY

The article describes the creation and use of a novel virtual reality learning aid for studying human anatomy, particularly the muscles of the arm and hand. The Human Muscular Arm Avatar (HMAA), a learning aid, was evaluated with medical students to determine its efficacy. The findings revealed that a significant portion of students found the tool to be very helpful and that it improved their engagement with the subject matter, their peers, and their peers. Additionally, some students claimed that the HMAA offered an embodied learning experience, which is when learning is improved by experiencing things physically.The findings imply that tools that foster a sense of body ownership may be helpful for teaching anatomy, but more research is required to evaluate their efficacy to that of alternative techniques. [1]

It discusses describing ScoolAR, a cutting-edge educational platform. Using ScoolAR, one may create AR/VR applications without any programming knowledge. There is presently no evidence of a pedagogical tool that makes it possible to create AR/VR applications without knowing programming. Using these assumptions as a foundation, ScoolAR was developed to break free of these limitations, enabling an autonomous content production system and raising awareness of the usage of AR and VR applications in conventional educational situations. This report presents the architecture of the proposed platform and describes the results of tests conducted in a real didactic environment. The test's findings demonstrated that the first group outperformed the second one across all evaluation criteria. Common pedagogic practises and technological innovation must collaborate in order to achieve superior results in terms of knowledge and capabilities, especially for those fields where transversal learning is crucial. The results of the survey, which was used to gauge comprehension of the topics covered, showed that the themes were well grasped. The query implied a positive attitude towards the platform. This element highlights the experience character of the research by enhancing both the teaching process and the connections of collaboration between the students. [2]

When compared to traditional teaching methods, ARLE seems to have a major impact on students' ability to comprehend and think clearly.Students used ARLE to interact with 3D virtual goods that visualized various Physics principles. It also aids the students in easily recognizing middle principles, improving understanding retention skill sets and realistically gaining knowledge of skills. ARLE provided students with an immersive experience in which they were able to visualize summary principles that are difficult to imagine in traditional training, which causes students to lose interest in class. AR allows the scholar to visualize and interact with 3d digital lively information, which increases the scholar's interest, interaction, and Motivation. [3]

Virtual Reality (VR), Mixed Reality (MR), and Augmented Reality (AR) have gained popularity in recent years and have a wide range of applications, including in the field of education. In a study, it was found that learning in virtual and mixed reality environments produced results comparable to traditional learning, but with higher levels of positive emotions and engagement among participants. Both VR and MR were found to have high levels of usability and acceptance among users, and did not cause simulator sickness. However, MR did not produce a greater sense of presence compared to VR. These findings suggest that using VR and MR for education may have some advantages.This paper discusses the results of empirical research on the use of mixed reality technology for educational purposes. The research examined the potential benefits and drawbacks of using MR in educational settings, as well as comparing mixed reality to virtual reality technology. The results suggest that both MR and VR are suitable and safe technologies for learning, with the potential to enhance traditional teaching methods and be adapted for use in both classroom-based and distance learning courses. The paper also notes the potential for mixed reality technology to provide access to learning materials and experiences that may not be otherwise available, such as simulations of dangerous environments or the use of expensive equipment. As the technology continues to improve, it is expected that some of the current limitations, such as headset comfort, will be reduced. [4]

The purpose of this research was to demonstrate the effectiveness and strength of advanced simulation laboratories on the realistic coaching of dental practitioners. A specially built "AR-Demonstrator-App" was used during orthodontic technical training. Students in a required technical course were able to view each individual step with tutorials on how to create a detachable orthodontic tool using this application. Following those lessons, the students were asked to fill out an anonymous televised survey with 12 questions about the app's development. To activate the 3d viewer, a mat indicator that encased the form of a plaster prototype foundation in the core was required. The physical plaster solid can be identified, and a single stage of the detachable tool's production can be displayed in a three-dimensional digital world. Another important aspect of this software is the credible unification with the digital depiction (augmented reality) of the individual activities within the manufacturing process. According to the results of this poll, the majority of people favor computer-assisted simulation systems, which enable students to acquire theories and concepts and practical knowledge in a multimedia environment. [5]

The goal of this study was to evaluate the effectiveness of learning when a similar lecture was presented using augmented reality using a smartphone or tablet device, such as the Microsoft HoloLens. A lesson on the architecture and physiology of the brain was completed by 38 preclinical undergraduate participants. To evaluate acquired knowledge, initial as well as final tests were provided.After the session, participants were required to complete a Likert-style assessment to assess any detrimental effects on their health as well as how they perceived the module. Test results showed no discernible differences between HoloLens and mobile-based augmented reality lessons. However, when using the HoloLens, there was a significant increase in dizziness. No other notable health issues, such as nausea, confusion, or weariness, were noticed. The learning outcomes from both delivery methods provided evidence to support educators' and developers' usage of augmented reality in the health and medical domains. [6]

The paper shows that about Global home quarantines due to COVID-19 have raised people's desire for indoor physical activity to reduce stress and anxiety and learn prevention-related information. In this article, a prototype for an indoor augmented reality (AR) exercise game using a Lomachenkos headgear speedball for the moving target striking task is constructed. The effectiveness of engagement and the variations between AR and virtual reality modes (using HTC Vive Pro) are then tested in a comparison experiment, which also examines the effect of the exercise game on reducing anxiety. Results from 28 individuals reveal that after utilising the exercise game, participants' levels of anxiety dramatically decreased.Although there is a little variation in flow feeling, there is a slightly significant difference in nausea level, a motion sickness symptom. The two modes' interaction efficiency is also very different from one another. AR mode did better at preventing motion sickness and enhancing interaction performance when hitting moving targets. [7]

Gesture recognition is becoming more and more popular in the field of human-computer interaction research as a result of the development of AR/VR technology and the miniaturization of mobile devices. There have been some innovative ultrasound-based gesture recognition systems proposed. However, they mostly rely on the low-resolution Doppler Effect, concentrating on whole-hand motion and ignoring minute finger motions. This study introduces UltraGesture, a method for recognising and perceiving ultrasonic finger motion based on channel impulse response (CIR). For recognising little finger motions, CIR measurements' 7 mm resolution is sufficient. In order to categorize these images into different groups that correspond to various actions, UltraGesture incorporates CIR measures into the images.In addition, we employ a sliding-window based technique to enhance precision and decrease response latency. Most mobile devices' existing commercial speakers and microphones can run UltraGesture without requiring any hardware modifications. Our findings show that for 12 gestures, including finger click and rotation, UltraGesture can reach an average accuracy of more than 99 %. [8]

Over the past decade, 3D visualization technologies including virtual reality (VR), augmented reality (AR), and mixed reality (MR) have been increasingly popular. Due to their accessibility and cost, digital extended reality (XR) techniques have been applied in a variety of fields, from entertainment to education. By removing the limitations of the conventional 2D display and offering an immersive experience, XR approaches enable 3D visualization of the material. Here, we give an overview of XR in modern biomedical applications and present case studies that make use of ideas from cell biology, photos from multiplexed proteomics, information from heart surgery, and cardiac 3D models. Emerging issues with XR technology are looked at in terms of negative health impacts and a price comparison of various platforms. To improve trainees' and students' learning, the accuracy of medical procedures, and the comprehension of complicated biological systems, the offered XR platforms will be helpful for biomedical education, medical expertise, surgical supervision, and molecular data visualization. [9]

The ability of AR/VR technology to combine clinical imaging data and knowledge into a virtual and real anatomical environment helps to increase medical students' interest in learning and their own initiative to learn, which in turn enhances the effectiveness of clinical education. This research examines the use of VR/AR technology in teaching human anatomy surgery and its impact on student learning. This paper initially illustrates the VR/AR system's learning environment and platform, then describes how it works and analyzes the teaching environment. In this paper, the learning impact on 41 students in our hospital is assessed using the VR/AR operation simulation system of an Irish company as an example.According to research, adding a feature reweighting module to a VR/AR surgery simulation system boosts the accuracy of segmenting the bone structure. For actual human ultrasound imaging data, the feature reweighting module causes the IOU value to rise from 80.21 %to 82.23 %. As a result, the feature reweighting and dense convolution modules substantially enhance bone structure segmentation performance by enhancing the network's capacity to learn about the characteristics of bone structure in ultrasound pictures from the perspectives of feature connection and significance. [10]

Every area of education has been severely affected by new technologies like mobile phones, social media, and artificial intelligence since digital connectedness is the basis for how people learn. Distance/virtual learning is made possible by the ability of the entire Internet and pre-5G wireless communication networks to provide visual and audio data. A crucial component of a new educational paradigm, known as Education 4.0, involving remote physical interactions among students and educational institutions, is still lacking. The 5G mobile network's excellent latency and reliability capabilities will allow students to feel actual objects and remotely control them. This article identifies and explores the unique benefits that 5G networks can bring to education 4.0, as well as any technological challenges they can provide and potential fixes. [11]

The simultaneous merging of the virtual and physical worlds is known as extended reality (XR). The framework, learning strategies, and conclusions of an expert usability survey are all covered in this study for an XR basic life support model. The XR-BLS simulator was developed using BLS education data that aligns with the 2020 American Heart Association criteria and a half-torso mannequin in a virtual reality scenario. In a virtual environment, cardiopulmonary resuscitation, ventilation, and the use of an automated external defibrillator were carried out using a head mounted display (HMD) and hand-tracking equipment. Additionally, the XR-BLS simulator's usefulness was tested using a qualified survey. The research includes eight issues, comprising three each about the usability of XR, way BLS delivers training, and theIn the simulator, an AI instructor. Results: The BLS training was successfully completed, the XR model was constructed, and an expert survey revealed that it was easy to use. It also demonstrated that communications with the AI tutor were clear and impartial. Discussion/Conclusion: The XR-BLS simulator is useful since it enables BLS training without requiring teachers and students to be gathered in one place. [12]

Major cities throughout the world are introducing 5G. Even though new 5G interconnect will be very beneficial, 5G is much more than a radio technology innovation. New concepts will open the door for brand-new, vertically-focused services, some of which might indeed be effective to help save more lives. Examples include adding network softwarization and highly configurable frameworks to the overall network design, relying on edge computing to guarantee decreased latency, or considering network slicing.This article talks about how an eHealth service was created and validated exclusively for the Madrid Municipality's Emergency Services. This creative vertical application, which makes use of the cutting-edge capabilities of 5G, enables a federation of domains, the installation of realistic ar technology on the field of play, and flexible network instantiation at the edges. The use case design, actual implementation, and demonstration done in conjunction with the Madrid disaster response team are all covered in the paper. Genuine solid evidence of such a system, which can attend to a mishap in minutes and undertake more efficient triage, improving the likelihood of lifesaving, is the major result of this effort. [13]

Augmented Reality (AR) has been used in education for a range of subjects, however research on combining pedagogical approaches with AR in language acquisition is still in its infancy compared to AR in STEM education. This study examines the effects of a Chinese character learning game enhanced by augmented reality on students' cognitive engagement in traditional classroom instruction. A Singapore government primary school with 53 grade 2 pupils and two teachers participated in the study. The results show that students' levels of cognitive engagement in the AR-supported activities have significantly improved. Additionally, students are more consistently engaged in the educational process produced to support self-generated contexts than they are when learning content information created by experts.This study makes recommendations for future system design and pedagogical methods of utilising augmented reality to engage young learners in language learning. The study also sheds some light on how learning process analysis may be used to assess cognitive effects of AR assisted learning designs. [14]

A. Abbreviations and Acronyms

AR - Augmented Reality
VR - Virtual Reality
XR - Extended Reality
MR - Mixed Reality
ARLE - AR based Learning Environment
HMAA - Human Muscular Arm Avatar
STEM - Science, Technology, Engineering and Mathematics

CIR - Channel Impulse Response
EMB - Eye Movement Biometrics

B. Figures and Tables

Table 1: COMPARISON

Paper	Technique used	Advantages	Remarks
A framework utilizing augmented reality to improve critical thinking ability and learning gain of the students in Physics	Conventional methods of teaching. An AR based learning environment	Enhanced knowledge retention capabilities and practical learning abilities. Raised the attention,interaction and motivation of the students.	AR enhanced knowledge,attention, and practical skills of students.
HoloLens and mobile augmented reality in medical and health science education: A randomised controlled trial	Unity 3D 3D modelling hololens	Improve the student experience Enhance learning in physiology and anatomy increase productivity Reduces teachers load	HoloLens become an important addition to the health sciences and medical educator's choice of teaching modes in physiology and anatomy
UltraGesture: Fine-Grained Gesture Sensing and Recognition	CIR, CNN, FMCW	The direct interface of hand gestures provides us a new way for communicating with the virtual environment	UltraGesture achieves an average accuracy greater than 99
The Human Muscular Arm Avatar as an Interactive Visualization Tool in Learning Anatomy	AR Embodical Learning Human Anatomy 3D Modelling	Easy to Learn. Better Understanding and Limitation.	Have to improve on the controlling systems and the graphics should be of high quality
VR/AR Technology in Human Anatomy Teaching and Training	VR, Original Surgery Tool, Teaching Experience.	Use of Joysticks help to experience more realistic surgery.	Use of Joysticks and its control need to be improved and the Originality has to be improved.

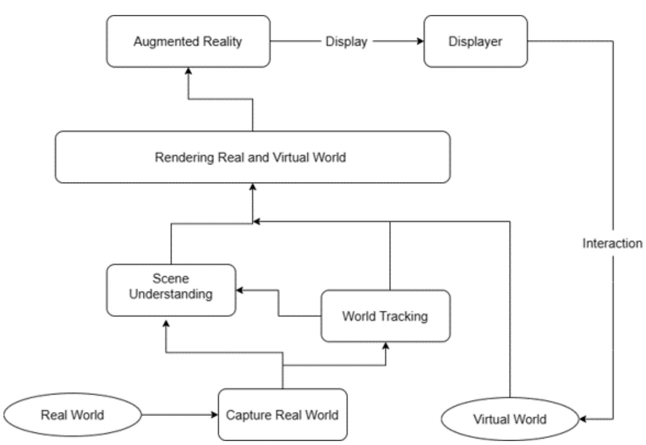

Fig. 1. Architecture diagram

V. CONCLUSION

Most of the instructional programs of VR and AR appear to have assemble and predictive validity, with the received capabilities to be transferable to actual situations. However, the credibility of numerous of those studied is probably questionable. First of all, a lot of them aren't randomized research, with cohorts of various traits and insufficient range of participants (much less than 30 in maximum research). Moreover, there are few research for every simulator, and there aren't anyt any comparable requirements of their layout, in order that they will be summarized and immediately in comparison. In addition, a number of the research regarding particular simulators grow to be quick previous as they do now no longer remember the simulators' non-stop upgrades. More randomized manipulate trials, evaluating the impact of VR education in opposition to no education, different simulation-primarily based totally education, or extraordinary VR education systems, are needed. The samples ought to be large to bolster the consequences and the designs of various research comparable. Moreover, the volume of the decay of the capabilities over the years ought to be elucidated. When those properties, at the side of the fee factors, are clarified, then we will take a look at the manner that VR and AR may be formally integrated in clinical schooling curricula.

However, the posted literature shows a fine instructional effect. VR/AR education shows sure blessings closer to different simulation techniques. Although costly to buy, VR/AR simulators offer a tremendously costless possibility for reproducible education beneathneath numerous environments and trouble levels. Moreover, they do now no longer enhance moral issues, in comparison with different animal and dwelling tissue simulation models. They offer immersion for the person and the capacity to carry out whole procedures, in comparison with partial challenge running shoes. Multiple research have proven a positive effect of VR/AR running shoes on green trainees, and we will intuitively anticipate that they're technically evolving in excessive tempo because the era progresses. Future enhancements may want to consist of the mixing of olfactory stimuli. Odors may be used as diagnostic gear or maybe to recreate annoying conditions (e.g., in a fight or withinside the running room) with more realism. Medical informatics is likewise an evolving field. Medical statistics can be visualized extra definitely and impressively with VR/AR era. Users can be capable of dive into statistical plots and reports, watch them in 4D (in 3-D area and time), control them, and "wander" round them. Although tremendous development has been made, there's nevertheless a want for extra processing power, better resolution, higher layout of the scenarios, and extra superior haptic gadgets a good way to reap surprisingly practical environments.

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