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Augmented reality in sport and healthcare sciences: A review

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Abstract---The term "augmented reality," refers to the adding of new data to an existing environment. When contrasted to other innovations, augmented reality may provide benefits not previously available. This research aimed to describe and get a better understanding of the advantages that augmented reality may bring to the training of athletes. In this review we propose the findings were evaluated in terms of their significance in athletics in sports and healthcare sectors. According to the findings of our study, a variety of augmented reality methods could be employed for teaching as well as delivering feedback. It may be possible to change some of the rules in order to level the playing field amongst players with varying levels of expertise. The perception of the audience might be enhanced further by the addition of more information. We also investigated the limits of existing augmented reality systems, as well as their usefulness in training, and offered some pointers for the creation of various types of training situations. This paper describes augmented reality techniques and reviews augmented reality tools for sport and health sciences. Current study describes augmented reality tools. Firstly, we explain what the augmented reality stands for. Secondly, we explain application of augmented reality in physical education sphere. Thirdly, we demonstrate augmented reality application in healthcare science.

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Introduction

The traineeship approach, which was based on the pedagogical tenet "see one, do one, teach one," was the norm in universities education up to the turn of last century. The foundation of this concept, created by W. Halsted in 1890, is increasing responsibilities that leads to almost-independence (Kerr & O'leary, 1999; Scott et al., 2008). To put it another way, the student first closely watches the experienced mentor do a technique repeatedly, and then, when the student is competent, he or she copies the teacher's movements while paying close attention to any potential errors so that the patient is protected. The student's early engagement in the healthcare setting, which enables him or her to learn practical knowledge, is clearly a strength of this paradigm. Nevertheless, it is ineffective since it is distinguished by lengthy workdays, ill-defined objectives, and chance encounters (Tan & Sarker, 2011).

A computer technique called augmented reality creates the illusion that digital data is really present in the physical world (Laghari et al., 2021, Omarov et al., 2017). Since it exists and communicates in time and space like reality, this idea differs from virtual reality (VR). Additionally, improvements in science and technology have streamlined user engagement and improved digital content and reality. Research is being done as a consequence, and it is having an impact on society as a whole (Rauschnabel) in areas like gaming and health care. Technology could assist classroom teachers enhance their instruction and develop athletes' skills. In video game contexts, computer systems are becoming more and more important in mimicking sports interactions. The potential of sensing devices to track a wearer's health, activity, and environment has attracted attention during the last several years. Moreover, simulations provide chances to practice sports in far-off locations and may enable the transfer of habits to actual settings (Sánchez Pato & Davis Remilllard, 2018). A perspective of the actual world combined with computer-generated components like voice, video, images, or geolocation is known as augmented reality (AR) tools (Milgram, Takemura, Utsumi, & Kishino, 1995; Sourin, 2017; Altayeva et al. 2016). While AR works in conjunction with the actual world to improve users' view of their surroundings, virtual reality (VR) replaces the real world with computer-generated features (Wiederhold, 2019; Altayeva et al., 2017).

The technological infrastructure of the System that was conceived and built comprises of multiple linked pieces, including augmented reality glasses, a wristwatch, and a cellphone, which allow for a variety of multisensory inputs and outputs choices. Depending on the field of implementation, the Platform can be utilized as a precise positioning and orientation system and synchronize the moves of numerous teams between both the real and virtual environments to assist, for example, the search for geocaches or Wifi beacons with sound recordings signals. Other possible applications include the assistance of the search for geocaches or Wifi beacons with audiovisual signals. In terms of multimodal interaction, the System provides access to more than one output

channel (for example, visual and audio). It makes it possible to employ a variety of input modalities, such as touch control and voice input, amongst other possibilities. The input modalities enable more integrated gameplay than the currently available augmented reality interfaces in gaming scenarios. The user does not need to utilize any extra technological infrastructure such as a smartphone in order to use the interface, since it is present in their field of view and is thus immediately linked to the natural world. One example of this is Pokémon Go. In a similar vein, the wearable interface allows the user to move more fluidly and freely without the need to carry any additional equipment (Unbehaun et al., 2022).

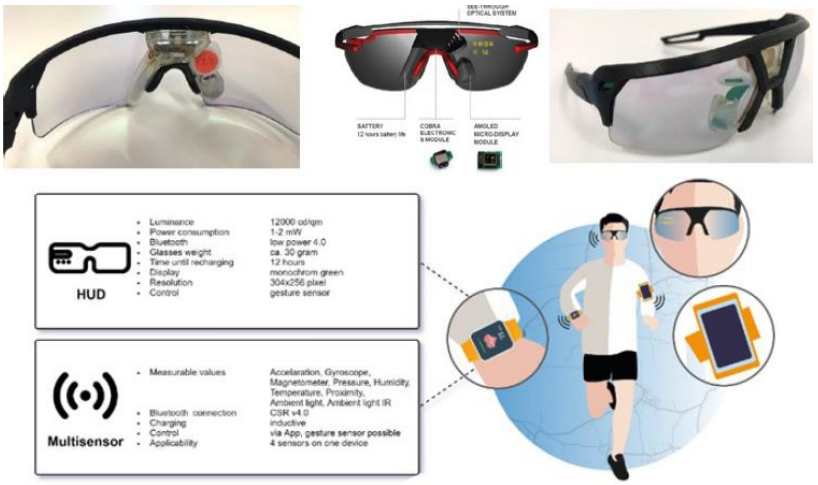

Figure 1. Schematic of some emerging optical technologies applied in AR/VR (Unbehaun et al., 2022)

In order to examine the difficulties and developments in this field, we give a comprehensive assessment of simulation methods based on AR and VR approaches in the context of sport and health sciences. We start by defining AR and VR based methods, after which we look at simulation techniques in terms of how their virtual and physical components are implemented and how accurate the techniques that have been used are. Finally, we assess the simulators' for sport and healthcare applications.

Materials and Methods

According to the findings of Rauschnabel et al., 2022, academic descriptions of new reality formats continue to be disjointed and inconsistent, while also often going against the language used in the business. The "reality-virtuality continuum" developed by Milgram et al. (1995) continues to be the preeminent framework for organizing various digital reality formats. Despite the fact that this continuum has some restrictions, different popular definitions of "reality" were investigated by the researchers. On the reality-virtuality continuum, formats are often classified according to the percentage of actual vs virtual material (rather than the type of content), or according to whether real content is layered with virtual content, or vice versa. On the other hand, customers could not place importance or attention on these components at all. The authors Rauschnabel et

al. (2022) offer a new model that identifies XR as an umbrella word for all different forms of current and new realities. In this model, X represents a placeholder for "any" form of new reality. This model is based on a qualitative investigation conducted by experts (Dwivedi et al., 2021).

The phrase "extended reality" for XR, which is often used in daily conversations, may be deceptive due to the fact that the word "extended" excludes virtual reality (VR) due to the fact that VR replaces reality rather than extending it. Due to the fundamental distinctions between augmented reality and virtual reality, for example as explained in Hilken et al., the two technologies should not be placed on the same continuum (2021). According to Rauschnabel et al. (2022), a differentiation between AR and VR should be established based only on whether or not the user's actual surroundings are made a part of the experience, at the very least visually or not (in the case of VR). More precisely, augmented reality (AR) experiences may be characterized on a telepresence-continuum ranging from atomistic to holistic, while virtual reality (VR) experiences can be represented on a local-presence continuum ranging from assisted reality (AR) to mixed reality (MR). It is also important that high levels of local presence establish the illusion among users that virtual content "is here". Low degrees of local presence point to a virtual content integration that is more "functional," such as the incorporation of textual information. Telepresence in virtual reality, on the other hand, refers to the extent to which users feel as if they are immersed in the virtual world regardless of where they are physically located in the real world. Figure 2 demonstrates schematic of some emerging optical technologies applied in AR/VR (Xiong et al., 2021).

Some of the AR technologies for improving teaching have been identified in state-of-the-art reviews (Akçayr & Akçayr, 2017; Ibáez & Delgado-Kloos, 2018; Omarov et al., 2016), including increased content understanding through AR in comparison to other technologies. While some of these academic subjects relate to sports, some are exclusive to athletic education and training. Learning visual signals might help athletes better understand the mechanics behind sports moves (Fery & Ponserre, 2001; Omarov et al., 2020; Onalbek et al., 2013). Players' sensory modalities might be fed with augmented information via AR devices to better grasp their actual world. The efficiency of such training techniques has been questioned in the past since earlier iterations of sports vision training produced erratic outcomes. For instance, video analysis does not provide artists with immediate feedback, forcing them to repeatedly try out alternative motions. Perceptual learning techniques have been included into recent strategies to provide more precise and effective training. Students are exposed to a variety of circumstances, enabling them to build knowledge across a variety of subjects, which may enable them to make judgments more quickly (Fery & Ponserre, 2001). Although visual displays are the primary means of conveying information to users, they may only be able to provide stimuli linked to objects and activities that are happening in the direction that users are looking. The user may get important data about the surroundings via audio cues. Vibrations, temperature, and other tactile sensory input like texture may also operate as mechanical interfaces between our body and the outside environment.

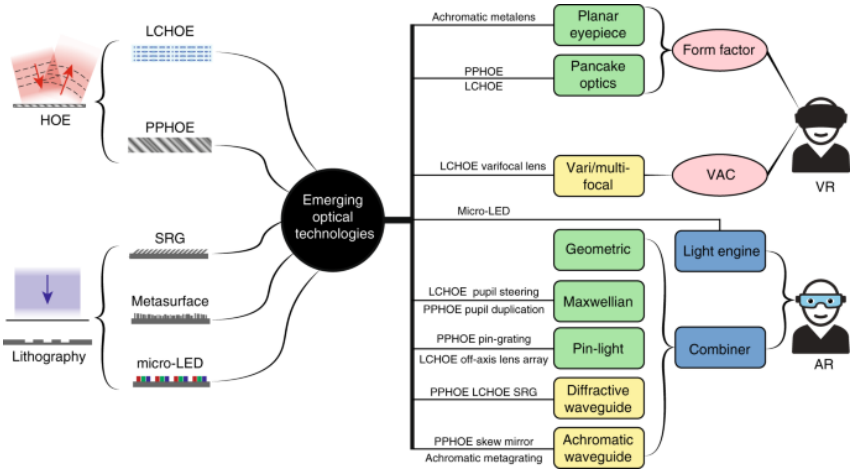

Figure 2. schematic of some emerging optical technologies applied in AR/VR (Xiong et al., 2021)

Results and Discussion

Different subfields of education make use of the AR as a kind of instructional approach (Cadavieco & Vázquez-Cano). This breadth encompasses a wide range of disciplines, some examples of which are listed below: engineering, healthcare, sports among many others. Additionally, it is employed in the fields of entertainment, hospitality, advertising, and transportation (JARAMILLO et al., 2018). Researchers, such as those cited in Reference (Ruiz-Ariza et al., 2018), have demonstrated that incorporating augmented reality (AR) in the form of the game Pokémon GO into a Physical Education class leads to an increase in the amount of students who engage in physical activity on a routine basis and in a way that is fun for them to do so.

The use of virtual and AR technologies is expanding across a variety of industries, including sports broadcasting, conceptual interactive, overall physical activity and educaiton. Chin et al considered that AR technologies have easy throughput, interactive connection, and multiple data digitization, all of which are required to merge the development of current sports and the expansion of technology Lai et al (Lai, 2019). Chang et al outlined the process for integrating AR technologies into schools, digital teaching materials can be blended with the virtual artifacts of 3D-assisted learning resources. The process for integrating AR tools into physical education classes has been detailed (Chang et al., 2020). Learners are given the ability to read digital 3D multimedia applications over the course of their education, which helps them successfully consolidate factual and procedural knowledge while also enriching their experience of differentiated instruction.

Smartphone apps have also played a big role by providing assistance to a variety of parties who are either active in sports or interested in them. The advancement of technology has ushered in the evidence is information, which was previously unimaginable. According to the findings of the study conducted by (Loia & Orciuoli, 2019), the growing prevalence of the use of smartphones is one of the indicators that demonstrate the information revolution has already started. The

usage of mobile apps is one of the variables that reflect the growth of information in the sports industry, which is one of the industries that is embracing the digital evolution. Users located in a variety of geographic areas have been able to connect with their sports team, favorite players, and other fans via the usage of programs designed for smartphones (Loia & Orciuoli, 2019).

The user of a smartphone may also receive any information about their sports team that they choose to have by using programs designed specifically for smartphones. Similar study conducted by Wang (2020) demonstrates that the usage of mobile apps has had a significant impact in physical education. This is due to the fact that the innovation has been endorsed in universities to improve training and keep improving player productivity and make the players get to understand each other better. Consequently, the use of smartphone applications has had a significant impact in sports. The usage of smartphone apps enables coaches to have a far better understanding of their players, and they utilize the knowledge to assist their players in improving. The writers are unanimous in their opinion that smartphone apps have had a substantial impact on the development and public's view of sports in general.

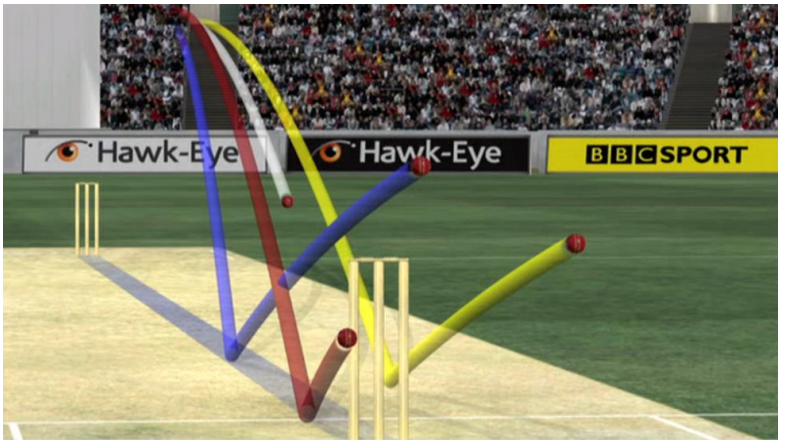

Figure 3. Augmented reality in sports

The physical education and training data for the augmented reality server was generated using the data from the training and sports activities of 6000 learners and trainers. The expansive data center offers increased reliability for the system as well as the opportunity for further data analysis. Figure 4 provides a full breakdown of the infrastructure of the data center that is based on augmented reality and is part of the school's physical education system (Liu et al., 2022).

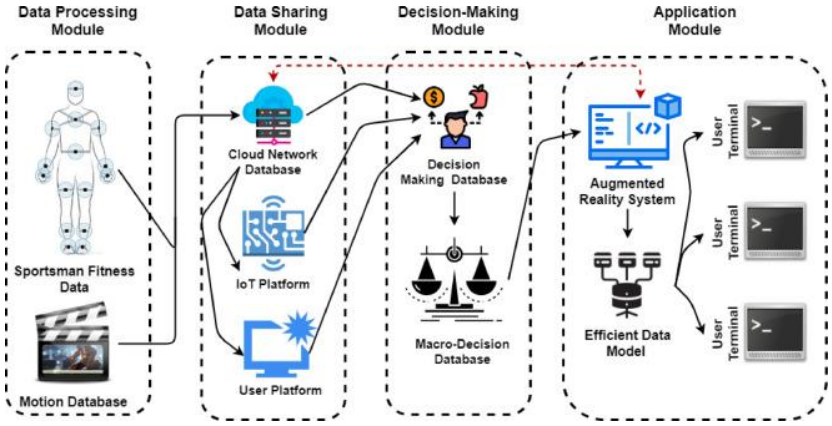

Figure 4. Architecture of the augmented reality-based data center for the school physical education system (Liu et al., 2022)

Although augmented reality has started to be used in the sporting business (Goebert, 2020), the vast bulk of research into the application of AR in sports has been concentrated on the creation of AR technology. The use of augmented reality to monitor players and in-game activity in team sports was examined by Jang et al. in 2018. The research that were discussed earlier focused mostly on the viability of the monitoring platforms and techniques that might be utilized to improve the viewing experience of sporting events; however, they did not investigate how consumers feel about or respond to the technologies. A play-by-play announcer and color analyst accompany a visual broadcast of the action taking place on the court in the conventional broadcast (shown in Figure 5), but augmented reality (AR) enhanced visuals are not used in this kind of broadcast. Both the standard video and the AR-enhanced clips showcase the exact same segment of gameplay taken from the identical games and include the exact identical sound elements.

Figure 5. Traditional NBA broadcast with no AR enhancements (Goebert et al., 2022)

Researchers have conducted a significant amount of study on video analytics and processing over the course of the previous two decades, resulting in the development of a number of useful ideas and methodologies. The structure and

rhythm of sports videos tend to be very consistent. Because the examination and study of sports video have both a high theoretical calculation and a broad practical value, sports video has drawn the attention of a significant number of academics (Adachi & Willoughby, 2016; Roumeliotis et al., 2019). Players and the actual game itself are two extremely significant things to consider while doing research and processing on football videos. In many different applications, such as action recognition, game analysis, automated summary production, and target-based video compression, it is of the utmost importance to recognize and track players as well as the football. Researchers' attention has always been drawn to the problem of detection and tracking since it is such a pressing concern in the field of video and sequence image processing. In recent years, a number of well-known educational organizations and academic institutes both in the United States and elsewhere have conducted in-depth research on soccer computer vision and processing techniques. As a result of this research, they have developed a number of efficient methods for detecting and following football video targets.

Augmented Reality in Healthcare Science

The American Medical Education Association defines clinical training as "the process of teaching, learning, and mentoring of educators with a continuing combination of insight, abilities, qualifications, contribution, and value systems which qualify a human to treat patients." This definition can be found in the definitions of health sciences terms (Wojtczak, 2002, p 36). "With the greater understanding of the circumstances for studying in under clinical care as well as the rising emphasis on the 'lifetime' essence of medical schools, learning process now, more so than it did in the past, requires to encompass 3 components: undergraduate, postgraduate, and the professional development" (Swanwick & Buckley, 2010, p 123). The first term has an emphasis on the process and the results, while the second definition acknowledges education as a continuous endeavor that continues throughout one's life. These two definitions reflect two contemporary recognized viewpoints on medical training.

The development of augmented reality technology in the medical field has recently become very important due to the wide variety of applications that it offers. Computer vision (Urakov et al., 2016; Khor et al., 2016), object detection and classification (Frajhof et al., 2018), image analysis (Ahad et al., 2018), image classification (Wilhelm et al., 2018), and cloud technologies (Jones et al., 2018; Chen et al., 2011; Anand et al., 2022) are all being integrated into AR-based medical systems. AR-based healthcare solutions have made significant strides in a number of important areas, including increased patient privacy and connection (Pereira et al., 2019), increased speed in the delivery of quality diagnosis and therapy, and increased dependability. In addition, wireless services, early treatment, real-time surveillance, online consulting, tumor detection, diagnostic specialty, m-health service, and personalized evaluation are developing prototypes of augmented reality-based healthcare solutions. These prototypes are presented in Figure 6. In a similar vein, the employment of it has led to improvements in both the patient's adherence to medication and their treatment in rehabilitation (Ara et al., 2021). Recently, a contemporary healthcare society adopted an e-health strategy to facilitate the use of progressive augmented technologies, such

as AR headsets and smart glasses. As a consequence of this, the use of augmented reality in the medical industry is seeing a meteoric rise in popularity, and an increasing number of people are proposing that it should be further developed.

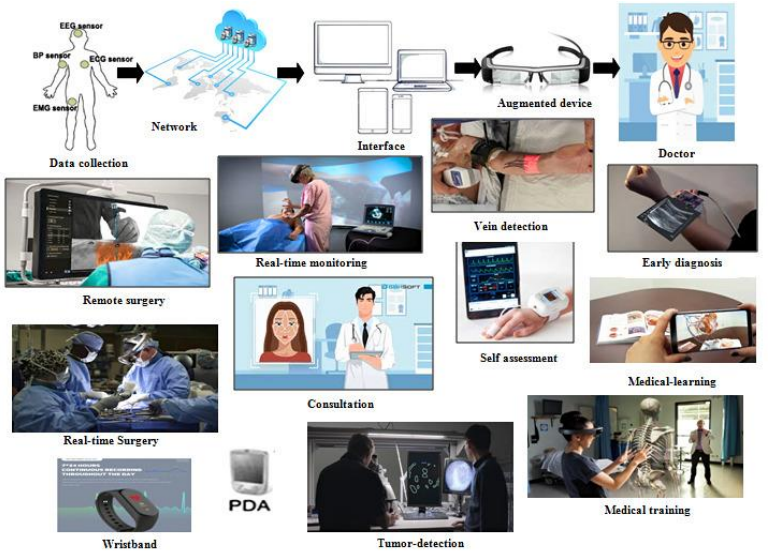

Figure 6. Current Trends of Augmented Reality in Healthcare Platform (Ara et al., 2021)

Conclusion

Scientists are putting in a lot of effort to come up with better technical solutions to improve human life that is in place today all over the globe. The purpose of these innovations is to bring about a significant shift in sport and healthcare industry and to simplify the processes that are now in place. In this article, we have presented a short overview of several augmented reality medical care and apps that are now available. A comprehensive overview of the most recent development plans with relation to the existing medical technology stack as well as data processing methods has been laid out. The purpose of this essay was to, to some degree, help continued development by drawing attention to various unresolved concerns with simultaneous security needs and upcoming difficulties. For future study on augmented reality healthcare apps and services, the discussion that was done in this article on standards, data availability, quality of service, and data privacy may assist in several ways. In addition, this article demonstrated the significance of augmented reality-based applications in sports and healthcare sectors, which were supported by statistics on the current state of the industry. Such applications may encourage the participation of a greater number of stakeholders in the subsequent stages of development.

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