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Integrating Virtual and Augmented Reality in Healthcare : A Comprehensive review of Future Applications

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ABSTRACT

Virtual reality (VR) and augmented reality (AR) are two emerging technologies that could have significant healthcare implications. The increasing advancements in technology have created possibilities for diagnosis and treatment in healthcare. It creates a virtual environment for the user that they believe they are physically present in this virtual space. Virtual characters, also known as avatars, provide the user with a greater sense of reality and facilitate meaningful interaction. The user's observation can be weakened by the single technology, this issue can be overcome by combining the two technologies. This article proposes an interface system between design and development based on AR-VR hybrid technology. This article reviews the application of AR and VR in the healthcare and medical field.

Keywords : Virtual reality, Augmented reality, medical field, treatment, healthcare, and technology.

I. INTRODUCTION

Augmented reality (AR) transforms your surroundings by incorporating digital elements into a live view. Virtual reality (VR) is a fully immersive experience that replaces the real world with a simulated one. This integrated technology presents a three-dimensional effect to the user while enjoying different service methods. It presents a collaborative VR (virtual reality) environment, offers a large field of view, improving depth perceptions and understanding of complex internal structures compared to surgical training from desktop systems. A collaborative VR environment allows multiple users to interact and work together in the same virtual environment, which has many possibilities for medical teaching and increasing communication and teamwork. The VR (virtual reality) interventions are used in various health-related problems such as: treating chronic pain, improving balance of patients in post-stroke, managing symptoms of depression, helps reduce burden in terminal cancer patients, and treatment for psychiatric patients. These interventions if implemented thoroughly, can potentially improve the quality of healthcare.

II. RELATED WORK

The Journal of Healthcare Engineering has retracted an article on virtual reality in human anatomy teaching and operation training. The publisher, Hinda Wi, discovered evidence of systematic manipulation in the publication process, including discrepancies in scope, research description, data availability, inappropriate citations, incoherent content, and peer- review

manipulation. The retraction is due to the publisher's failure to identify these issues before publication and has implemented additional measures to safeguard research integrity. The article presents a collaborative VR environment for advanced surgical training, also known as "virtual teaching hospital", which improves various aspects of planning and training procedures, including patient data analysis and laparoscopic liver surgery training. The environment includes photo-realistic avatars and scenarios, and evaluations by domain experts suggest potential benefits for surgical planning and training, effective communication, and teamwork. Future work aims to study collaboration and team training effectiveness in different virtual rooms, investigate the scalability of group interactions, and conduct real-world use cases involving all user roles.

III. FINDINGS AND ANALYSIS

Virtual Reality and Augmented Reality are innovative technologies that offer different perspectives on the human experience. VR technology improves multiple senses involving vision, hearing and touch, simultaneously. It is low-cost and has a broad development space, but its accuracy in image display may be affected by complex environments. AR accurately superimposes computer-generated virtual objects or information into real scenes, extending the human sensory experience. Increased usage of this is seen in space missions, as they help with medical diagnosis, reduce psychological stress, and improve learning and operation performance [2]. It is more convenient and constantly innovates, combining optical perspective principles with real-world integration.

The field of VR is still new, despite its rapid development [1]. When used properly, virtual reality (VR) interventions can improve the quality of care. The research should concentrate on the application aspect of VR technology which presents a fictional world in real time through devices. To include VR technology in treatment, users must get training and education. Improved knowledge, expertise, and experience are necessary for healthcare providers to feel self-assured and capable when utilizing virtual reality. VR adoption by the healthcare professionals will improve the accuracy of treatment protocols. Collaborative VR has the capacity for better surgery training and planning while also encouraging better communication and collaboration [6]. Surgical training needs more realistic teaching methods and emphasizes positive teamwork.

The visual presentation through the human eye is improved with AR technology as it superimposes holographic images. AR has been applied in clinical medicine and has become a research hotspot. There are various advantages and challenges offered by these technologies, their applications are yet to evolve.

Introducing AR/VR technology brings about better pre-operative planning, surgical path, presentation of visual needle path and so on. [7]. However, introducing them in health and social care may result in the exclusion of certain groups such as accessibility or digital literacy [5].

According to Medical Research Council guidelines, health economic evaluations of more complicated therapies should seek to be done simultaneously with evaluations of broader impact for developing and evaluating complex interventions.

With the evolution of technology, AR/VR can help the medical sector in many ways. There are many implementation strategies for AR/VR technology in treatment, including practical resources like AR/VR equipment, treatment rooms, and healthcare providers' training, with important training and education on VR.

Recommendations for Implementing VR in Healthcare:

- The patient stability, functional limitations such as communication and mobility should be considered by the healthcare workers before recommending VR treatment.
- To improve healthcare providers knowledge and skills in VR use through proper training programs, educational resources and online meetings
- Healthcare providers' engagement with VR can be enhanced by communicating its benefits, using successful case studies, and disseminating evidence of its added value.
- There should be sufficient support staff and mentors in healthcare to promote and encourage the usage of VR in treatments.
- For the better development of the VR in treatment, it is recommended to allow patients to get used to the equipment and software by setting goals and then gradually increasing the difficulty levels.
- The final step is to ensure proper functionality of the user's needs, age, treatment protocols, with the help of VR hardware and software.
- For the more effective implementation of VR in practice, special attention should be given to the staff and patients requirements.

In actual usage, few problems have been observed. Multiple needs of the user, such as lack of human-system interaction, weak immersion and others could not be met. The users want to interact closely with the models and equipment in the scene. The single nature of the virtual medical system makes it inconvenient for the user and increases the operating burden.

This article suggests a hybrid approach of combining virtual and augmented reality technologies into a single virtual medical system. Three dimensional effects created by this approach allow the user to complete multiple tasks more quickly and efficiently. This technique also improves the user experience and engagement, a better immersive environment, and better sensory adaptation and recognition.

This hybrid method can also be utilized on various platforms such as military, education, real estate, video games, entertainment, and many more.

There are many challenges like inconvenience, bad results, hardware processing issues, and speed with these technologies. For these issues, other fields of resolution, high-speed graphics, image processing, and artificial intelligence are required. AR equipment is often intervened from the outside for its shortcomings and the urgent need for improvements.

The virtual medical system is developed to create an interactive space between the virtual and the real world. Vuforia SDK for tracking and augmented reality system is built using Unity3D and 3D Max. This system allows the user to control third- person position movement and change perspectives using a roaming module. This system enables personalized, independent medical knowledge acquisition to the user.

The utilization of VR/AR technologies in the medical field is still in the experimental stage. The developers should face problems regarding convenience and application and discover the perfect combination of technology and apps to create devices for medical usage. People's understanding and application of these technologies are gradually increasing. These technologies focus on improving the quality of users' lives and learning rather than just providing a technical experience [3]. It is important to research the whole process for successful implementation of VR/AR technologies rather than just focusing on a single component that includes identifying obstacles along with creating and carrying out a cogent, multi-level implementation intervention with suitable tactics,

unambiguous implementation objectives, and predetermined outcomes [4].

IV. CONCLUSION

Virtual reality (VR) and augmented reality (AR) are being applied in military training, education, video gaming, and medicine. There is still a need for improvement in areas such as applications, image processing, and user convenience in AR/VR technologies. This technology provides more realistic training experiences which help enhance user immersion and provide better practical benefits. By combining these technologies, the patient engagement and education can be improved. After reviewing different theories and technological applications, suggestions are given to interface system between design and development based on this hybrid technology to improve medical assistance.

V. REFERENCES

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