

Application of Augmented reality (AR) for Surgery and Patient Care

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Abstract- Digital technologies and computer driven technologies have become an integral part of the surgeries and patient care, as within the entire healthcare system. Augmented reality (AR) is one such technology that has been around for a while but the utilization in healthcare has not been at par with its potential. This Review focuses on breaking down the technology and discussing its specific applications in detail, as well as the limitations and methods to overcome them.

Keywords: Augmented reality, surgery, patient, care, healthcare, digital health, education

1. INTRODUCTION

Augmented reality, or AR, is a 3D immersive interface that incorporates real-time views of the real world with computer-generated elements. AR is an enhanced interactive experience of real-life environment that is heightened by perceptual data produced by a computer. The AR technology uses various modes of sensory abilities like vision, auditory perception, touch, pressure among others in doing so. Augmented reality can be used in the form of making additions to the existing environment in order to enhance it or hiding things from the existing environment. Augmented Reality provides for mixing of the world created by technology to that of the reality. Use of Augmented reality for research or security reasons has been in place for the past two to three decades, but the commercial use has been comparatively recent. It is been tried extensively in the gaming industry currently. The augmented reality game application Pokemon Go which utilizes an Image linked map (ILM) and geotagged locations with approvals show on the maps became a favorite worldwide due to its flawless ability to integrate the Pokemon characters with the real-world locations of the users [1]. These abilities can be very much used in the vast field of healthcare- in surgery and patient care and with its numerous versatile applications

2. AUGMENTED REALITY & VIRTUAL REALITY

Since both Augmented Reality (AR) and Virtual Reality (VR) have been utilized only in the recent decades in terms of their commercial application, it is easy to confuse them to be the same or use the terms interchangeably. Augmented reality (AR) adds or hides objects or other parts of what is an existing real world [2]. In this way AR, true to its name "augments" or "enhances" the perception of that which is already present around in real time. It does so by mixing putting in additional digital information. In addition, AR also allows for registration and tracking between that which is added and the real world. Virtual Reality (VR) on the other hand is a technology that creates an enhanced experience for the user by replacing the real world by a simulated one [3]. It is as the name suggests "virtual" and the entire user perception is basically not real, but more a mirage.

3. APPLICATION IN SURGERY PREPARATION & TREATMENT MODALITIES

Augmented reality (AR) has been recently used by surgeons and medical professionals to enhance the accuracy and ease of the procedures successfully. Surgeons when operating on a certain area of the patient's body can see the underlying tissues and organs using augmented reality. The precise location of surgical action like incisions or implant placement can be made more accurate by being able to see using AR what the surgeon would otherwise visualize. At the same time using supplementary technology like Head-up display (HUD), the surgeon can see within their frame of sight the patient's vitals and dynamic statistics, example- heart beat, oxygen saturation etc., that are critical during surgery and the surgeon would normally have to lift, move their head to look at the monitors in the operation theatre to see them [4]. Another commonly used AR modality is in finding subcutaneous veins and projecting them directly on the patient's skin for accurate location of the veins.

Augmented reality is not just useful for surgery per se, but also other treatment modalities. AR has been shown to be useful in patients with disorders like macular degeneration [5]. A virtual retinal display technology that uses the concepts of Augmented reality superimposes or displays scanned images of the reality on the patient's retina. The patient sees things like they normally would, except that the images are more clear, brighter and with a better definition. More and more companies

are developing AR platforms to use patients gestures, and visual inputs to help relieve them of pain. Likewise AR can be used to improve vision in patients other patients with visual handicap.

4. AUGMENTED REALITY FOR PATIENT EDUCATION

Augmented reality in itself is a powerful tool for education and its use in the healthcare field goes beyond the time of surgery. It can also be very useful in educating the patient as well as patient care. Medical professionals can leverage AR technology to display to the patients a 3D image of their body and organs that the doctor is trying to explain about. For example, being able to actually display a tumor underlying organs a patient in a 3 dimensional view is far more effective in educating the patient about their condition or what a surgery might entail. Medical professionals can use AR to show the patient a before-after like display of what a certain surgical procedure or treatment might do to them in real time or how it may look post surgery. In Reconstructive treatments or procedures, the patients can see using AR what is hard to imagine or visualize before the procedure. AR technology can also be used to nudge the patient in real time for health habits or for medication adherence in them. The audio-visual impact of educating the patients using AR is of another level as compared to the traditional methods.

5. TRAINING HEALTHCARE WORKERS THROUGH AR

Healthcare workers can benefit immensely when trained using Augmented reality right from the beginning. AR can be used to learn about the human anatomy and biological system using a 3D display of the human body. The technology of Projection mapping can be used to show the students organs and their placement on their own body in real time. AR products like ProMIS have been developed to train the medical professionals in laparoscopic surgeries. Various AR products for real time viewing for neurological procedures has been used for training of doctors, for example for thoracic pedicle screw placement. AR simulators have also been shown to be affective for training the medical professionals for echocardiography. Most of these technologies have shown to have a good face validity and the students tend to favor training with the AR modalities as compared to the traditional methods.[6], [7]

6. APPLICATION OF AR IN PHARMACEUTICAL INDUSTRY & RESEARCH

Augmented reality has the ability to produce rich, enhanced and immersive experience to the viewer. The Pharmaceutical industry, medical device industry and the cumulative research in the Healthcare industry can benefit largely from AR. The mode of action of a drug is a complex process in itself and even more difficult to put it in words. Augmented reality can be used to simplify this. The researchers can also use AR to predict the direction of the process or make visual examinations of how a medical device might fit in and the expected problems around the surrounding anatomy.[8],[9] The chemical processes surrounding the action of a drug or the interactions it has with the body are as complex as the mechanism of action of the drugs in the first place. Being able to explain it by projecting the process on your body in real time is a fantastic way of putting across a group of complex concepts and processes. [10],[11]

7. DISCUSSION

Applications of Augmented reality (AR) wherein a larger than life effect can be given to the existing “reality” or the what you see and how you perceive it can be enhanced multiple times over is a promising technology for various sectors, but especially for public sector. The education aspect especially has been shown to benefit immensely from use of AR in training. That being said, the implementation of AR or any new technology is no small feat. Especially in the low resource setting. Although AR has the benefit that it can be used in AR enabled mobile devices or tablets, which in the current day, most of these devices are, the effort and investment in the infrastructure is considerable. Especially, when attempting to do it on commercial level. AR benefits can be reaped best when the users are well educated or have a technical understanding of how the technology works [12], [13]. If the users or staff is not as well versed, a lot of the benefit may be lost to that. That being said with proper training of the users and well strategized implementations, these hurdles can be overcome and the AR technology can be utilized to its full potential safely.

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