Augmented Reality: A Growing Technology with

Risks and Rewards

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

According to the World Health Organization (WHO) there are 21 million people worldwide that are affected by Schizophrenia, and one in every two schizophrenia-afflicted subjects does not receive care for the disease (WHO 2022). Schizophrenia is one of many mental illnesses that influences an individual's day to day life. The issue of mental health has become a commonplace issue within American society and solutions to mental health are scarce. Not to mention the treatments that do exist for schizophrenia still have side effects such as medications with serious side effects. Schizophrenia is one of many psychological disorders that plague many people while having few options.

As of late, there has become a greater demand for augmented reality due to a "gravitation toward non-pharmacological approaches" to those with mental issues such as dementia (Zhu et al, 2021). Augmented reality has also been brought up numerous times for therapeutic purposes as an alternative option in treating mental illnesses (Freeman et al, 2019). This therapy uses immersive VR environments to expose individuals to their specific triggers and fears, allowing them to confront and overcome them in a controlled and safe environment. This can be particularly helpful for individuals with schizophrenia who experience hallucinations or delusions, as it allows them to practice coping skills and build resilience in a safe and controlled environment.

However, the biggest challenge with augmented reality as a therapy method is the implementation of such a technology into our current system. With technology that can affect the mind, there must be proper regulations or safety measure in place to ensure that the patient's lives would not be negatively affected and that doctors are aware of their responsibility. On the other hand, simply ignoring or not implementing AR as a non-invasive method of therapy in our

health system would be neglecting the many people who are suffering from mental illness and/or disorders. I will use Martin and Schinzinger's engineering as a social experimentation framework to better understand how augmented reality can be better integrated into our current healthcare system, and I will also use Hughes' technological momentum framework to better understand why augmented reality hasn't been popularized and what it needs to become adopted by society.

The current influence of AR in Medical Practice and challenges

Mental illnesses and disorders are difficult to treat and often result in patients having to take medication as treatment. However, these come with side effects that negatively affect the user. Therefore, the major consequence of not having a harmless method of treatment for those suffering from mental disorders such as Schizophrenia creates an issue where those that want to be treated with medication suffer from the side effects, or simply suffer untreated to not deal with the side effects. However, with current AR technology it is capable of solving these problems in a non-invasive manner.

The challenges and concerns that AR is trying to address in the medical field is to provide an alternative method for treating psychological disorders or illnesses that are not invasive or harmful to the patient. As of late, the use of augmented reality in the medical field has become more accepted in treating various mental illnesses. Srivastava, a qualified individual on the topic with a PhD with a peer reviewed journal, is one such researcher who found that in various preliminary studies and studies that there are a lot of applications of augmented reality in healthcare such as treating mental illnesses such as PTSD, various phobias, eating disorders, and more (Srivastava, 2014). Her study reveals that augmented reality in the medical field could be

beneficial and has already seen positive outcomes for its users since doctors are better equipped to help them through the use of augmented reality.

In a recent study done by Yeung and his team, they found that the number of studies dedicated to augmented reality is exponentially increasing each year with a large foci on rehabilitation and simulation as shown below.(Yeung et al. 2021).

Figure 1. Density map showing author keywords of the publications in virtual reality research in medicine (Created by Yeung)

Indeed, the popularity of augmented reality has greatly increased in recent years as a solution towards mental disorders and illnesses.

Schizophrenic treatments with AR

There has been a lot of research done between augmented reality and various mental disorders and illnesses. Two randomized controlled trials have been conducted on the treatment for delusions and paranoia in schizophrenia patients. The first trial, by Freeman et al. , on comparing VR exposure therapy to VR exposure modified with cognitive therapy elements across six VR scenarios, on a group of 30 patients affected by persecutory delusions found that

virtual reality-controlled exposure therapy combined with cognitive therapy elements was effective in reducing delusions for both techniques (Freeman 2019). The second trial, by Pot-Kolder et al., found that virtual reality cognitive behavior therapy was effective in reducing paranoid ideation in schizophrenia patients (Pot-Kolder et al., 2018) . Both trials found that the effects of the virtual reality therapy were maintained in real-world situations. The trials support the effectiveness of virtual reality cognitive behavior therapy and virtual reality exposure therapy in the treatment of delusions and paranoia in schizophrenia patients.

Another study done by du Sert et al. focused on AR therapy on auditory verbal hallucinations. He and his team used virtual reality Avatar therapy for the treatment of auditory verbal hallucinations (AVH) in schizophrenia patients. Avatar therapy was originally a conventional means of a non-pharmacological intervention for AVH treatment where the patient has a conversation with a digital representation (avatar) of their presumed persecutor, voiced by the therapist so that the avatar deescalates himself/herself as not a threat throughout the session. The results of this study were significant improvements in AVH severity, depressive symptoms, and quality of life compared to the control group receiving standard treatment.

The general consensus on the benefits of the medical benefits brought by AR can be summed up quite well by a quote from Bisso et al. who said, " first, it allows effective and brief interventions without the use of drugs and, therefore, the pharmacological side effects; second, it is highly customizable on the needs of the individual patient; third in some cases, it allows treatments of pharmacological resistance psychotic symptoms, too." (Bisso et al., 2020). The customizable and non-invasive nature of augmented reality has therefore become an alternative to the typical drug treatments for these sorts of mental illnesses and disorders.

There are some concerns with augmented reality in terms of safety and cost. Augmented reality has concerns with privacy and according to Frost he says that "Doctors worry about Health Insurance Portability and Accountability Act (HIPAA) compliance because data transmitted to AR devices is not encrypted, making confidential patient information vulnerable."(Frost 2017). Augmented reality usage could include minor side effects such as eye soreness, reduced limb control, reduced postural control, and more to the patient. However, there is still a possible issue with the cost that arises from widespread use of augmented reality. Currently, AR systems could cost from 40,000 – 200,000 USD for app development alone which doesn't even include hardware costs at healthcare facilities. This does raise concerns with regards to the cost of augmented reality, who would pay for the development of the software, and how accessible it would for patients to acquire the hardware to run such applications. There also hasn't been an implementation of augmented reality at a large scale which results in the technology being confined to only infrequent use cases. However, with the right methodology this effective technology could become widespread under the right circumstances and by starting small in implementation and working up.

Augmented Reality's issues with implementation as a system

A Framework for understanding how a Technology becomes prevalent in society

Thomas P. Hughes coined the term technological momentum to describe a theory of the relationship between society and technology that draws upon two other frameworks: technological determinism and social construction. Hughes states that technology does not determine society, which is also known as tech determinism, nor does society determine the outcome of how technology is form (Hughes 2011). Rather that technology and society coexist with each other and influence each other. In other words, technology and society are time

dependent with a dynamic and ever-changing relationship depending on how each party evolves. Over time society and technology will change with each other depending on the evolving circumstances that arises. For instance, the development of phones was an amazing accomplishment that changed the way people communicated. However, it wasn't as revolutionary when it first emerged since very few people had phones due to its cost and lack of infrastructure. It only became ingrained in society once the proper infrastructure such as landlines were placed, and your common man could afford a phone. Society's communication at that point had evolved, and over time the dial phone quickly became replaced with the modern smart phone caused by the need for society to have an even more convenient means for communicating on the fly. In other words, technology and society evolved together but were codependent on each other in order to improve each other.

For societies to accept a technological system, it must first align with social context and goals. Typical stages of development include invention and local application, transfer to other places, development of supportive infrastructure, and finally becoming the standard accepted system that has become a permanent fixture in society, or in other words the momentum of this technology is perpetuated indefinitely for the foreseeable future.
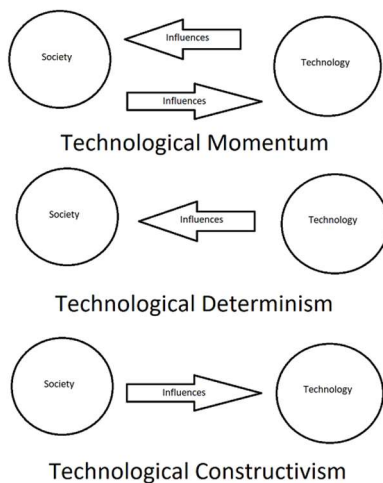

Figure 2. Technological Momentum (created by Author)

Augmented reality in the context of technological momentum

        I feel that Augmented reality fits technological momentum well in the sense that it is still a relatively new technology, but with enough influence from society it could evolve and influence society as well with the benefits that would entail such an evolution. For instance, Riva, a researcher in the VEPSY project for treating mental illness through augmented reality, found a way to lower the cost of augmented reality by PCs that will execute clinical modules that will receive user feedback on its work. Her project helps to provide a possible solution to accessibility issues with augmented reality (Riva et al, 2004). This project is very reminiscent of phones under the scope of technological momentum. This is because augmented reality is still in its infancy and is currently not as prevalent due to its high cost, but as the costs of augmented reality equipment decreases it should tear down a possible barrier to augmented reality and help it gain momentum with society. Then, once augmented reality has gained momentum in the medical field through widespread access, it should be able to evolve and adapt with society based on its need for certain medical treatments that it is currently being used for such as

        Technological momentum allows society to better understand its relationship with technology in the sense that a new technology that may seem underwhelming or useless may become something that is deeply ingrained in society once the right conditions have been met. Currently augmented reality is not commonly used in society despite having its benefits in the medical and recreational fields, but with the right circumstances under the framework of technological momentum could become a powerhouse that is widely used as a way to improve the psychological health of society through its evolution. However, this raises a valid question on whether augmented reality will be able to find these right circumstances and whether augmented reality can step up to becoming the common solution to psychological issues in society, or will

augmented reality be replaced by a different developing technology or simply fade into obscurity.

A Framework for how technology becomes implemented into society from the ground up

Martin and Schinzinger created a framework called "Engineering as a Social Experiment" (ESE) that focuses on virtue ethics. They state that a system having all these 4 things is what makes it an ethical system: a primary obligation to protect the safety of and respect the right of consent of human subjects, a constant awareness of the experimental nature of any project by obtaining and assessing relevant information to determine and monitor any possible dangers, autonomous and personal involvement in all steps of a project, Accepting accountability for the results of a project. It is important for engineers to understand that their role under this framework is to understand the context of their technology in the context of building sustainable and beneficial systems while also being conscientious of the people involved in this system.

In the context of augmented reality, it is important to understand that augmented reality is going to be shaped by society and lies within a larger system. In this case, engineers must understand under the context of ESE that augmented reality should apply virtue ethics in order to ensure that we are conscientious, maintain moral autonomy, and foreseeing consequences in our implementation of augmented reality into a larger scale.

Actions to take in order to make augmented reality a prevalent medical tool

Currently, augmented reality isn't widely used in clinics across the states and is still in its infancy for clinical use. Using frameworks listed in the previous section I recommend a certain course of action that will help implement augmented reality as a staple in the medical field to

help those with psychological illnesses and/or disorders while also making sure the systems are implemented in a way to incorporate virtue ethics.

In order to implement augmented reality to a large scale, we must first apply the concepts from Martin and Schinzinger's framework of ESE to make sure that the system has virtue ethics in mind. I believe that in order to begin implementing augmented reality at a larger scale we must first test it a smaller scale, so in this case we would do further research in a handful of clinics. During this small scale test we will adhere to guidelines that all medical practitioners must follow and also ensure that the proper safety protocols are in place to ensure that both patients and doctors are safe. Some of these safety protocols are possibly to ensure that the patient's privacy and security are well maintained, to ensure that the trained practitioner is well aware of their position and to not abuse their power, and to ensure that moral autonomy is maintained by observing the possible problems that may arise in this "experiment". It is imperative that the observers remain conscientious by actively monitoring how the small-scale experiment is going. It is also important to start small since a large-scale implementation would have no previous model to go off of and would result in a poorly implemented system that only had predictions to go off of rather than what has been done and proven.

Certain groups such as the American Psychology Association (APA) will probably be the most invested in this social experiment and should also be heavily involved in the implementation and monitoring during this experiment. In addition, consulting professionals in the field to help aid in the implementation of such a system would not only be detrimental to the technical side of things but would also ensure that professional workers are aware of the responsibilities and moral obligations while being in this position of power (but not authority).

Technological determinism has acted as a framework for past technologies in order for us to better understand the relationship between society and technology and how each side helps the other side evolve as time progresses (Hughes 2011). Through this lens we analyzed augmented reality and how the potential and signs that it could become ingrained as a staple medical tool becomes apparent. I believe that through various studies I have looked through that augmented reality has the potential to become a deeply ingrained technology in society with a few propositions. Once an established plan for the implementation of such a system is in place it is possible to

I propose that in the context of technological momentum that augmented reality should have more infrastructure available to it in order to give the medical implications for augmented reality I believe will become ingrained in the medical field due to the unique properties that augmented reality has in that it can help treat specific phobias, mental disorders, or PTSD. I feel as though that with an increasing wave of mental health issues in society that augmented reality might find itself to be a solid solution to this problem based on these societal circumstances. Based on the results of some experiments with augmented reality and psychosis, such as Srivastava's study revealed that augmented reality in the medical field could be beneficial and has already seen positive outcomes for its users since doctors are better equipped to help them through the use of augmented reality (Srivastava 2014). Medical developments in augmented reality could help to alleviate the demand that is caused by the current mental health crisis in society.

Conclusion

Augmented reality has shown to be a great tool in the medical field but currently lacks the infrastructure and support needed to become prevalent. In addition, augmented reality is in

dire need of a proper model to scale up to be implemented in many clinics. However, such a model must adhere to virtue ethics to ensure that a certain level of moral obligation to patients is maintained. By adhering to virtue ethics in the development of AR in the medical field, it allows professionals such as doctors, members of the APA, and other medical officials to realize their roles as those in power with responsibility to help facilitate these changes in order to help those that are dealing with psychological disorders and/or illnesses. In my research I have given an approach that emphasizes observing the issues that will or have come up at a small scale in order to ensure that a larger scale implementation will be able to help those suffering from these illnesses in a tested and controlled environment.

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