

**Guidelines to Responsible Virtual Reality Development
(Technical Topic)**

**Exploring Industry Applications to Ethical and Responsible VR Development
(STS Topic)**

A Thesis Prospectus
In STS 4500
Presented to
The Faculty of the
School of Engineering and Applied Science
University of Virginia
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Computer Science

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November 4, 2022

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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Prospectus

Introduction

Virtual reality (VR) is one of the most promising emerging technologies, providing users with access to a virtual space far more immersive than the traditional two-dimensional computer screen can provide. The advent of VR is projected to significantly shift, if not upend, established practices in various key industries such as healthcare, education, and workforce development (Blangojevic, 2022), and the VR industry is currently experiencing a monumental increase in the number of products being developed. However, since the experience of using VR technology differs so drastically from that of using widespread two-dimensional devices such as computers or phones, creating responsible VR applications carries with it significant ethical concerns, such as user health, data privacy, and protecting vulnerable users. These concerns cannot be addressed simply by porting existing methods of ethical development employed in two-dimensional computer applications into VR development (Slater et al., 2020). As such, this project seeks to create a comprehensive framework to be used by VR developers, which focuses on issues and roadblocks specific to VR development. Furthermore, it will detail how to ensure that their new VR applications are constructed with the maximum attention given to the safety and well-being of future users.

Although the majority of research into the applications of VR technology remains within the scope of the field of computer science, the potential impacts have inspired VR research from professionals in a rapidly increasing variety of fields (Barnard, 2019). The overarching questions answered by much of this research focus on how VR technology advancements can impact practices and address problems in select industries. However, since VR development is a novel and rapidly emerging field with limited established development practices (Slater et al., 2020),

this research can be employed in reverse to help formulate such practices in VR development. This project seeks to explore what lessons can be taken from industries that have a stake in improvements in VR technology to ensure that finished VR products are ethically responsible and respect the needs of diverse user bases for various purposes.

While the framework for responsible VR development focuses on ethical considerations that must be made in the VR development process, research into other industries' applications to VR development provides valuable insight into the needs and ethical concerns of groups who are likely to make use of VR for their ends. Together, they will provide VR developers with the knowledge to develop their applications holistically, with both developers' and users' perspectives considered.

Guidelines to Responsible Virtual Reality Development

In keeping with its name, the nature of virtual reality experiences are that of an immersive environment, one designed to provide the experience of being in an entirely different world from the one that a user's physical body is in, as well as to interact with other users in that space. With the potential that VR technology brings to digitally manufacture the very world around a user, significant ethical issues arise if those worlds are not created to conform to high standards.

As an example of one such ethical issue, one of the burgeoning uses of VR technology is in the treatment of mental health disorders. In one study on VR treatment of PTSD, researchers found that none of the participants exposed to VR treatment terminated their treatment before completion, as opposed to medical industry standard which can see as much as 40% of patients cease treatment before completion (Freedman et al., 2022). In another study on free VR

applications available to consumers, researchers found that a mere 22% of 50 applications identified as possible tools for therapeutic purposes and meeting study criteria were judged to have *any* mental care potential upon trial (Bell, 2021). This information points to two key conclusions. Firstly, VR applications capture heavy attention and interest from users, and secondly, the existing standards for these types of applications are sorely lacking in quality. Together, these points highlight the necessity of establishing guidelines for development of such experiences, as the combination of how immersive and attention-grabbing experiences can be for users with a poorly designed experience may exacerbate its negative impacts on vulnerable populations, such as those seeking treatment for mental health conditions (Boeldt et al., 2019).

While protecting patients is more than enough reason on its own to pursue research into ensuring publicly released VR experiences are developed responsibly, there exist many further ethical concerns that still stand to be addressed, such as ensuring experiences are not overstimulating for users, protecting users from bad actors in a realistic virtual world that may seek to harm or exploit them, and securing their data (Slater et al., 2020). To comprehensively address this issue, this project will first compile all of the VR ethical concerns obtained from research to paint a complete picture of what a VR application must do in order to be considered ethical and responsible. Then, having acquired an accurate assessment of the VR development lifecycle with the assistance of research and VR development groups such as UVA Immersive, it will combine the two into a framework for VR development that informs VR developers how they can construct their applications from the ground up with ethics and the protections of their users in mind.

Exploring Industry Applications to Ethical and Responsible VR Development

Virtual reality is attracting investment and interest from a wide variety of companies and the public as a whole, eliciting a wide range of research from industry professionals on the applications of VR into their specific fields (Cipresso et al., 2018). Much of this research remains focused on how VR advancements will change the main methods of operation for the industries from which said professionals originate. However, the fact that this research is conducted on VR's potential effects on given fields means that, if enough research is collected, it can be generalized across the most relevant fields of interest for VR research, and then be used in reverse to provide an external, industry perspective on ethical VR development. Given the projections of VR's exponentially increasing integration into a wide variety of industries as well as the relative infancy of VR technology itself, any lessons that can be applied to VR from how other, more established industries operate, or their own concerns and ethical dilemmas, are currently at their most useful in the formative stages of VR as its own industry, and this should be done to make sure that VR development is conducted as ethically as possible. This concept is illustrated when viewing the advent of VR technology through the lens of technological momentum.

Under the theory of technological momentum (Hughes, 1969), new technologies start under the control of, and are formed by, societal pressures. However, as technologies evolve and become intertwined with the societies that created them, they become more difficult to control, and eventually become entrenched within that society. At this stage, they are resistant to attempts to modify them on any kind of scale. This theory is applicable to the field upon which VR technology is currently based, that of computer science. Key components of computer science (the Internet, accepted principles of operating systems, data transfer protocols, etc.) have been

developed for nearly half a century, and changing these fundamentals would be nigh impossible given the technology's global reach. VR, on the other hand, is currently limited in its scope. Due to this, it is still possible to root out unethical or poor VR development practices, and to ensure that the technology propagates in the most ethical and responsible manner possible.

A variety of research into VR industry applications can be used in reverse to promote the development of ethical VR experiences. For example, a study on the impacts of VR in the field of kinesiology, attempting to make athletes feel their virtual body was actually theirs for training purposes, revealed that only 40% of participants felt a sense of ownership of their virtual body, let alone dissociation from their real one (Pratviel et al., 2022, pp. 1). In applications into VR development, this suggests that VR technology has not reached a point where users would feel disconnected from their real bodies, and therefore, further increasing the realism of such an experience is not yet unethical. Another such research article, designed to measure the efficacy of VR as a means of remote house-showing to prospective homebuyers, revealed significant differences in preferences of ceiling heights and floor plans across differing genders and personalities (Lee, S.-Y, 2022), which can be applied to VR development as a need for users to be able to edit the physical attributes of the spaces they are in to obtain maximum comfort. Another study on the effectiveness of VR training for police officers in de-escalation training, was designed to show if it could be effective in comparison to standard training methods (Kent, J. A., & Hughes, C. E., 2022), was effective in doing so. Its findings can be applied to VR development to pose the ethical concern of whether programs can accurately simulate the behavior of real-life individuals in life-or-death scenarios.

Making primary use of the Documentary Research method by using published research on VR applications into other industries, this project will comprehensively highlight ethical

concerns and issues from the lens of industries that hold great interest in advances in the field of VR. These concerns would be difficult to uncover from a developer's perspective, as these are taken and generalized from a variety of industry perspectives, rather than considerations made from a developer's standpoint for the safety and well-being of the wider user base, which are the ethical concerns that are the focus of the VR development framework.

Conclusion

When construction of a framework for how responsible VR development should be conducted in all cases is completed, and it is integrated with further research on wider industry perspectives on ethical virtual reality applications, VR developers will be able to make use of this research to ensure that their applications are responsible, ethical, well-rounded, and made with diverse groups in mind. Whether or not this research is widely adopted, VR is going to change the world. However, through their adherence to these guidelines, VR developers will be part of making virtual reality realize its potential as one of the most groundbreaking technologies of our time, while making sure that their creations do no inadvertent harm along the way.

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