THE IMPACT OF VIRTUAL REALITY ON LEARNING AND THE ETHICAL CONSIDERATIONS INVOLVED

INTRODUCTION: THE ETHICAL CONCERNS OF USING VIRTUAL REALITY AS A TEACHING TOOL

Engineers are on the forefront of technology, building and inventing things that ordinary people would never dream of. One of these advanced technologies brought to life by engineers is virtual reality. Virtual reality, or VR, which is defined as “an artificial environment which is experienced through sensory stimuli (as sights and sounds) provided by a computer and in which one’s actions partially determine what happens in the environment” [1], is a relatively new and increasingly powerful tool used to simulate the real world, different worlds, or specific scenarios for the purpose of training and teaching the subjects more effectively and with less risk. The technology has already shown evidence of its benefits in the education of health professions [2], especially in those with a surgical focus, as well as in engineering design, like in a course called “Simulation of Production Systems” at Chalmers University [3]. While VR may often be viewed as a totally positive and uncontroversial technology, this is not the case.

As previously mentioned, engineers are on the forefront of technology, meaning they are the ones who create not only the beneficial technologies of tomorrow, but also the unethical, dangerous, and harmful ones as well. Engineers must always consider the ethics and consequences of the new technologies they create, lest it be harmful to others. As a new technology, virtual reality is no exception to this rule. While in professional and academic settings, VR is an effective tool and rarely is used unethically, the controversial and ethical concern is when VR is used to plan out and train to do violent and criminal acts. Using virtual reality for military training [4], while certainly not illegal, is still a good example of this ethical question: should engineers create virtual reality systems that train humans to kill other humans more effectively?

The controversial nature of virtual reality’s ethics is further questioned when expanded into the realm of violent videogames and their effects on the children that play them. Although not composed of the same hardware as the virtual reality systems usually used in academia and in military training, many video games, especially those like in the popular Call of Duty™ franchise, are still realistic simulations of real world activities in simulated environments mirroring real world places, and thus coinciding with the definition of virtual reality. With school shootings and mass shootings by children and teenagers appearing to occur more often (six have happened since 2007 alone [5]), the issue arises on whether violent video games (of which nearly all of the young shooters shared a common obsession) are dehumanizing the children who play them?

When approaching these ethically charged scenarios, engineers must follow with various and often times multiple engineering codes of ethics, usually with one code representing the profession of engineering as a whole and with another code representing the engineer’s branch of engineering (for example electrical engineering or mechanical engineering). In the case of VR’s ethical considerations, the most applicable section between the various codes of ethics (most specifically the NSPE, IEEE, and IEEE-CS codes of ethics, which pertain most to the fields involved in the development of virtual reality) is the section (specifically Section II, subsection 1, part a in the NSPE code of ethics) stating “If engineers’ judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client and such other authority as may be appropriate” [6]. Unfortunately, however, the codes of ethics that pertain to the kinds of engineers that are involved in the creation of virtual reality systems are ineffective in addressing the specific ethical issues related to it (especially that of video game violence, which is already a commonplace and generally-accepted part of American society).

This paper will address the topic of ethics in virtual reality with the creation of an ethically questionable scenario involving VR that will then be related to the many aspects of VR itself and its various uses in an effort to make a clear ethical decision regarding that scenario.

SECTION 1: INITIAL ESTABLISHMENT OF THE ETHICAL SCENARIO

For this scenario I will pretend that I am a software engineer working for a prestigious software company. Recently, my employer assigned me a new project in which I am to create a virtual reality military simulation program that uses highly realistic 3D models of real world cities for the purpose of training soldiers for urban combat, in ANY country. Your employer has also expressed interest to you about later turning the simulator into a videogame for the public, and has asked for your input. Two ethical issues arise in this scenario, such as whether this project will end up being harmful to the public? What effect will turning this program into a videogame have on the children that end up...
playing it? To sufficiently examine this scenario and to make ethical decisions, the intricacies of virtual reality, its role in teaching people new things, and the concepts of engineering ethics must be further explored.

SECTION 2: THE DEFINITION OF VIRTUAL REALITY AND HOW IT WORKS

To begin to understand the scenario, it must first be explained what exactly virtual reality is and how it works. As previously stated, virtual reality is “an artificial environment which is experienced through sensory stimuli (as sights and sounds) provided by a computer and in which one’s actions partially determine what happens in the environment,” [1] which can be more basically defined as a simulation inside of which the subject can control events and actions. In a simpler sense, VR is defined by what can be termed as the “3 I’s,” which stand for Immersion, Interaction, and Imagination [7]. Immersion is the feeling of being present or being part of the virtual world. Interaction is the means of communicating with the system (but with 3D means like a head-mounted device, or HMD, or stereo display monitors), and Imagination can best be described as “the thought of the system designer to execute a particular goal” [7]. These features are what determine the quality of the VR system. It is also important to state that there are multiple types of VR systems: non-immersive (videogames would generally fit into this type of system), semi-immersive, and immersive, which respectively go from the cheapest to the most expensive [7]. At its most basic level, A VR system can be divided into two major subsystems: hardware and software [7]. The hardware components include the computer/VR Engine (which in itself includes the processor and the GPU) and I/O devices (see figure 1), while the software includes the database and application software [7]. The whole system works by taking the input signals from input devices such as position sensors, bio-controllers, or a voice device [2], and sending them to the modeling application software. The software then takes the data and uses the computer/VR engine to run calculations (approximately one every 33ms [7]) to determine what to render in real time through the output devices, such as the HMD or stereo display monitor [7]. Virtual reality systems that are currently on the market and used in educational settings include the Oculus system (used mostly entertainment) [8], the full room Mechdyne CAVE™ system (used in fields that range from design to research) [9], and the VIRTALIS system (used in many of the world’s leading research and academic bodies) [10], among many others. More controversially, and more relevant to the earlier defined scenario, a system called the “Dismounted Soldier” system is currently being designed and implemented by the U.S. Army [4].

SECTION 3: VIRTUAL REALITY’S POSITIVE EFFECTS ON EDUCATION

One of the greatest benefits of using virtual reality systems, like those described in the earlier section, is the boosted efficiency and quality of education. As stated in an article called “Mitigating Challenges of Using Virtual Reality in Online Courses: A Case Study,” the “primary benefit of using VR as a learning tool is the ability to engage learners in multiple ways” [11] (this is especially important in military training programs, where the soldier has to be aware of multiple factors in his or her environment). Further examples of VR’s positive effects on education include a Motorola, Inc. study comparing outcomes of using “VR and a traditional lab (face to face) setting to train employees in managing flexible robotic assembly lines” [11]. The results were in favor of virtual reality, with the VR participants showing fewer errors and comparable to better mastery scores than the lab setting participants [11]. In a separate study, a “test of chemical engineering student reactions to a virtual chemical reaction module… found that 80% of students reported higher perceived learning scores and higher satisfaction in using VR” [11]. The most commonly used application of virtual reality in training is the use of interactive scenarios. These scenarios can involve low risk simulations of high risk activities, like surgery, that are used to train students to avoid fatal errors and/or disastrous consequences [2]. Another common application of simulations directly correlates to a previously mentioned ethical concern, the use of VR to train soldiers. One form of this application that is ethically sound is to train soldiers through a simulation game, in which they learn “how to pronounce and use regional… expressions correctly,” and how to interact with the local populace from where they are stationed [11]. Undoubtedly, VR has positive effects on teaching; however it is what is being taught through the use of virtual reality that becomes the ethical concern.
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SECTION 4: THE USE OF VIRTUAL REALITY TO TEACH HOW TO COMMIT VIOLENT ACTS AND THE ETHICS CONCERNED

Where virtual reality comes in conflict with ethics, specifically in the field of training and education, is when it is designed and used to teach unethical or ethically questionable things. A controversial ethical question is whether virtual reality should be used to train soldiers to become better killers. While that concern may be dismissed for militaries of countries that follow international rules, it becomes a far greater concern if it should get in the hands of the military of a country that is hostile to most of the world, such as Iran or North Korea. A greater concern is if these virtual reality programs get into the hands of terrorist organizations. In an article on the use of VR for the U.S. Army, it is described that “you can mold the situation, and you can do it as many times as you want” in regards to virtual reality simulations [4]. The article later says that “with a wide variety of environments, and the ability to insert specific entities into the scenarios, the options for training opportunities are virtually limitless [4]. Imagine the devastation that could be caused by a terrorist group that has been extensively trained to execute an attack on New York, or even to assassinate the president? In the design of a virtual reality system, especially the one as described in the scenario, it must be considered exactly what the system is being used to teach or train, who is receiving the system, and what are the risks that the system will harm the general public in the future? However, it must be mentioned that violent forms of virtual reality are not just specific to the military; they are ingrained into civilian society as violent video games.

SECTION 4: CONNECTED ETHICAL ISSUE- VIRTUAL REALITY IN THE FORM OF VIOLENT VIDEOGAMES AND THE EFFECTS IT HAS ON THE CHILDREN WHO PLAY THEM

Regarding the topic of using virtual reality to teach how to commit violent acts, it seems appropriate and necessary to mention the ethical issue of the effects on violent video games on the children that play them. While the focus on virtual reality’s effects on education, specifically on the ethical issue of using to teach violent and harmful acts, may seem off-topic concerning video games, it is actually well placed, as it is the connection between virtual reality, video game violence, and the ethics involved. As defined by Dictionary.com, education is, “the act or process of imparting or acquiring general knowledge, developing the powers of reasoning and judgment, and generally of preparing oneself or others intellectually…” [12]. While video games, especially violent ones, generally don’t impart general knowledge or prepare somebody intellectually, it does, in fact, have a strong connection with reasoning and judgment. In a Fox News article, it is mentioned that school shooter Evan Ramsey “described how playing videogames warped his sense of reality” after his attack on his Alaska school [13]. He also said that he “did not understand that if [he]… pulled out gun and shot [somebody], there’s a good chance [they’re] not getting back up” [13]. The same article later mentions how in some cases the young murderers “appear to have been reenacting specific video game episodes when they killed in real life” [13]. Another article specifically mentions how “the army uses [the] same video games to break down recruits’ inhibition to kill enemies in war” [14]. All the evidence points toward the simple fact that violent video games teach the children who play them morally wrong reasoning and judgment. In the scenario built in this paper, it is mentioned that my employer expressed interest in eventually turning the combat simulator into a video game for public use. As supported by the evidence above, I as an engineer must consider the ethics surrounding transforming a military program into a civilian one, and existing impact violent games have on children.

SECTION 5: ENGINEERING CODES OF ETHICS AND THEIR VALUE IN ETHICAL SCENARIOS

Before revisiting and discussing the initial scenario in depth, various engineering codes of ethics and their value in ethical scenarios must be examined. The codes of ethics that pertain most to the topic of virtual reality are the National Society of Professional Engineers (NSPE), the Institute of Electrical and Electronics Engineers (IEEE), and the IEEE-CS (computer science section of the IEEE) codes of ethics. These codes are often consulted when ethical issues arise, such as in the Challenger explosion on January 28, 1986. In this case, the design engineers knew of a design flaw in the shuttle in the earliest days of the program [15]. Despite the objections of the engineers, the NASA executives voted to launch anyway [15]. The result was loss of life. This is a classic example of an engineering ethics scenario on what the project engineers should have done. According to NSPE code of ethics, Section I, subsection 1, part a, “if engineers’ judgment is overruled under circumstances that endanger life or property, they shall notify their employer or client and such other authority as may be appropriate” [6]. In such a case as the Challenger launch, the engineers should have contacted a higher authority, perhaps even the government itself, in an effort to prevent the disaster.

Many other examples of such ethical dilemmas exist, though very few relate to the same field as virtual reality. One of such examples is the case of the Bay Area Transit
(BART) system. Despite being a significantly older example (occurring in the late 60s), it is still a very relevant example of ethics in the same fields (electrical and computer engineering) as virtual reality. The BART system intended to use an Automatic Train Control (ATC) system for its currently high-tech rail system [16]. The engineers in charge of the project were concerned about the lack of testing on some of the components of the ATC and the quality of the documentation that the company designing the system (Westinghouse) was providing. Unable to have their concerns acted on by management, they went over management to the board of BART. This was against the policies of the company, and the engineers were dismissed [16]. The ethical issue in this (which is very closely related to the one in this paper’s scenario) is that the engineers actually did act in compliance of the first fundamental cannon of the safety of the public, of the NSPE code of ethics, to “hold paramount the safety, health, and welfare of the public” [6], a cannon that is very similarly reflected in the IEEE code of ethics [17].

Aside from that first fundamental cannon of engineering ethics (involving the safety of the public), the other canons are useless in this paper’s scenario involving virtual reality. Most of the other canons and rules involve personal conduct and behavior, more so than any specific technology (such as VR). As for this reason, most of the codes, rules, and canons of engineering ethics will not be applied in the decisions made in the scenario.

SECTION 6: THE INITIAL SCENARIO REVISITED AND REEXAMINED

Now that all of the major components of the initial scenario have been explored in depth, decisions regarding the ethics of the situation and the thought processes behind those decisions can be examined. In this scenario, there are two ethical issues that need to be discussed. The first ethical issue to be addressed in the scenario is potentially how much damage might the program do to the public? In the hands of a military bound by international rules, the damage done by such a program would be minimal. However, the employer never specified whether the contract for the program was for the U.S. military, or a foreign military. If it is for a foreign military, especially one in an area that has constant conflicts (such as Israel), there runs the risk of the program getting into dangerous hands. One way for me to approach this specific ethical issue is to bring my concerns about this to my employer, and discuss it with them. Another possibility would be to create the program in a way that users must buy the 3D environments separate from the company, so that more control can be given over what can be done with the system.

The second ethical issue to be addressed is the desire of my employer to possibly turn the military combat simulation system into a video game for civilian use. Because of the connection between violence and violent video games, and poor judgment learned from them, I would be ethically required (through the first fundamental cannon of the NSPE code of ethics and similar codes) to notify my employer of the risks involved and to discourage the action. Examples like the Sandy Hook shooting in Connecticut [14] or of the shooting committed by Evan Ramsey should sufficiently show how the teaching of violence in virtual settings has a dangerous and profound effect on the public.

CONCLUSION: WHY ETHICS MUST BE CONSIDERED WHEN VIRTUAL REALITY IS USED TO TEACH

Virtual reality has been shown to be a powerful tool in education, one on the forefront of technology. Like any technology that is on the leading edge of innovation, however, there are ethical considerations to think about. While VR is proven to be effective in education, the education provided by this technology could prove to be negative to the public good. The use of VR to teach violence and poor judgment in video games and to train killers in the military is ethically questionable. Because of the multiple encounters with ethical situations by engineers, there are multiple codes of ethics for them to follow by organizations like the NSPE and IEEE. Though not always directly helpful in every situation, they provide a good guiding point for the decisions that are made. Perhaps the best tool in an engineer’s arsenal for making ethical decisions, however, is ethical scenarios and mistakes of the past. Virtual reality is a ethically a tough subject to make decisions on, but like any ethical decision the right one is the one that minimizes the harm it does to others.

REFERENCES


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