An ethical code for commercial VR/AR applications

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Abstract: The commercial VR/AR marketplace is gaining ground and is becoming an ever larger and more significant component of the global economy. While much attention has been paid to the commercial promise of VR/AR, comparatively little attention has been given to the ethical issues that VR/AR technologies introduce. We here examine existing codes of ethics proposed by the ACM and IEEE and apply them to the unique ethical facets that VR/AR introduces. We propose a VR/AR code of ethics for developers and apply this code to several commercial applications.

Keywords: ACM, IEEE, Applied Ethics, Augmented Reality, Professional Ethics, Technology Ethics, Virtual Reality

Virtual reality technologies have rapidly emerged into the consumer marketplace since the 2016 release of the HTC Vive and Oculus Rift systems. In 2019, aVR application, the motion game _Beat Saber_, was the first to sell over 1 million copies ("Virtual Reality 2019"). Late in 2019, Mark Zuckerberg announced that sales of VR content for the Oculus family of VR hardware had surpassed $100 million dollars ("Oculus" 2019).

With well over 1 million VR headsets connected monthly on the Steam platform alone, the VR marketplace is on a pace to expand radically as next generation hardware becomes wireless, more mobile, and more cost-effective. While we're not yet at the point where most households have access to VR and AR hardware, game and software developers are hoping that a day comes when this will be true. As a result, the need for deeper discussions on the ethics of VR and AR is imperative.

While significant attention has been given to its commercial potential, much less attention has been devoted to an examination of the potential ethical issues arising from VR and AR development. We examine these issues here and propose a new code of ethics for commercial VR and AR applications. This code draws upon existing frameworks provided by the IEEE and ACM professional codes and extends its applicability towards ethical issues surrounding unique features of VR/AR.

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1. Existing Codes of Ethics

Both the Association for Computing Machinery ACM) and Institute of Electrical and Electronics Engineers (IEEE) have developed codes of ethics to guide the members of their respective professional organizations (see Tables 1 and 2). We begin with these organizations in part because they are the largest international professional organizations which developers of VR and AR applications are likely to belong and thus they wield influence over how ethics gets incorporated into the project workflows of developers large and small.

Both codes of ethics stress professional duties to protect and promote public welfare, build public trust, and work toward the common good. The ACM code of ethics goes on to helpfully distinguish between ethical duties owed to consumers and the public from those developers owe themselves. The duty to be a good developer, in other words, extends beyond the duty to minimize harm, design for compliance, or to enhance social welfare. Being a good developer is, in itself, a moral virtue all developers should aim for.

In this section, we highlight what we believe are the most relevant aspects of each organization's code of ethics. In particular we will later draw upon both professional codes in order to create a code of ethics specifically aimed at developers of VR/AR applications. While there's significant overlap between being an ethical developer of traditional software platforms and that of VR applications, the unique features of VR/AR require we call specific attention to the virtues of good VR/AR design

These codes of ethics include:

Table 1 IEEE Code of Ethics[5]
- To hold paramount the safety, health, and welfare of the public   - To improve the understanding by individuals and society of the capabilities and societal implications of conventional and emerging technologies   - To seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others   - To avoid injuring others, their property, reputation, or employment by false or malicious action   - To assist colleagues and co-workers in their professional development and to support them in following this code of ethics

Table 2 ACM Code of Ethics[6]
- Avoid harm   - Be honest and trustworthy   - Be fair and take action not to discriminate   - Respect privacy   - Ensure that the public good is the central concern during all professional computing work   - Recognize when a computer system is becoming integrated into the infrastructure of society and adopt an appropriate standard of care for that system and its users

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[5] Retrieved from: https://www.ieee.org/about/corporate/governance/p7-8.html
[6] Retrieved from: https://ethics.acm.org/code-of-ethics/code-2018/

One limitation of both the ACM and the IEEE codes is that, while both speak somewhat generally about harm avoidance and designing with the public good in mind, they do not make distinctions on methods by which different technologies can impact (and harm) individuals. Although some material harms (e.g., data privacy, physical safety) are easy enough to identify and to build protections around, emerging technologies are likely to bring with them new forms of harm that are especially important to protect consumers from *in advance* of launching a product.[7]

Virtual reality introduces several new variables into the equation of ethical game design that are unprecedented and require proactive attention. We must consider beforehand the potential harms of virtual reality to ensure that such technologies are neither intentionally nor accidentally misused. Accounting for these new forms of harm protects both the users and developers of VR/AR, who are both fundamental to the progression of good VR and AR technology.

In an effort to integrate VR/AR in a way that reflects the spirit of the ethical codes currently in play, as well as tailoring it to the unique features of the VR/AR landscape, we must look at the way people experience a virtually real environment. While there exist guidelines for the responsible creation of media like film and television, VR and AR are less researched, and they have more capacity to create psychologically real experiences. The interactivity, immersion, and the fact that VR and AR experiences are not screen-bound (experienced as being contained by a screen within the larger field of view of the user), means that events that occur in these virtual spaces will be more 'real' than in TV or film. As such, there is more responsibility to consider these impacts and mitigate any potential harms, especially because of a higher degree of similarity to real life experiences than in these more ubiquitous mediums.

One benefit of the ACM code is that it includes a special set of ethical considerations aimed at those technologies which are, or are poised to become, integrated into the infrastructure of society. We believe virtual reality hardware will be one of these technologies and thus should be subject to a higher level of ethical scrutiny. For example, in 2019, the Facebook Corporation (the parent company of the Oculus Corporation) announced a multimillion dollar effort to create *Horizon*, a VR social media environment, that it plans to roll out sometime in 2020 (Kaser 2019). We believe that the hardware and software investments being made by companies like Facebook are strong indicators that VR and AR technologies are likely to become a part of the social media infrastructure of the 21st century and thus such technologies require an especially careful level of ethical assessment.

2. Ethical Issues in VR/AR

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[7] Most commercial developers (Oculus, HTC, etc) have their own internal codes for employees and other codes have been proposed (Madary & Metzer 2018). We aim to incorporate and synthesize these codes into our own proposal here which builds on what we argue are unique psychological aspects of simulation design that are unique to VR/AR.

As the IEEE and ACM codes help us see, VR and AR technologies will inherit many ethical issues already familiar to those of us concerned with ethics and technology. In this section we briefly survey these issues before extending our analysis to ethical issues that are unique to emerging VR technologies and our research on the moral psychology of user experience.

2.1 Data Collection and Privacy

Virtual Reality devices are capable of collecting a great deal of personalized data that must be safeguarded. For example, VRand AR technologies are capable of collecting information about a user's location, the media they experience, hours spent in virtual space, virtual wallets, and other relevant data typically associated with virtual economies. AR technologies have the additional ability to track a user's location as they move about both virtual and real spaces.

Additionally, VR and AR devices are able to collect information about user height, motion, interaction choices, and avatar design choices. These devices are also able to track user gaze, record facial expressions, and store user audio input using the built-in cameras and microphones on newer generations of VR HMDs such as the Oculus Rift-S, the Vive Cosmos, and the Valve Index. Many developers in these spaces allow users to upload photos to allow their avatars to more closely resemble themselves (or others). These data could lead to a new, and more insidious, form of identity theft in which physical and audio avatar profiles can be cloned and used to deceive unsuspecting users (Slater et al. 2020).

Not only is the volume of data generated by virtual reality technologies larger than that provided by traditional consumer computing platforms, the haptic systems that make virtual reality technologies so immersive allows that data to be of a more intimate nature. Though data collection is used to enhance user experience, it introduces a potential invasion of privacy that players may not have explicitly consented to. Ethical commercial applications must make clear to users not only that such data *can* be collected but also take great pains to carefully encrypt collected data. Equally importantly, developers should aim not to collect more data than is absolutely necessary for particular applications. Furthermore, care must be taken to delete such data at the earliest possible time (minimizing the harm of a data breach). Users must also, to the degree allowed by the application, be empowered to opt out of data collection.[8]

2.2 Content

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[8] Although different in terms of their "opt-in" vs. "opt-out" structure, both the state of California's Consumer Privacy Act (CCPS) enacted in 2020 and the European Union's General Data Protection Regulation (GDPR) enacted in 2018 provide consumers with such a right and both serve as good models for ethical data collection.

Like all media, some individuals may have concerns about VR and AR based on content that they may personally find objectionable. While this has been a concern raised about all forms of media, the interactive and especially immersive nature of VR and AR technologies, and the degree to which they more greatly affect user emotion, makes such concerns especially important.

Although content warnings, game ratings, and other advisories are now common in the industry, there may be instances in which the nature of immersion can add a new ethical dimension that should inform how developers, and rating agencies, respond to these content concerns. We address the special nature of content in section D below. The very same content should, we believe, often receive more conservative ratings (e.g., more adult ratings) when made for VR and AR than other forms of media. These ratings should explicitly convey that virtual reality may result in more severe psychological reactions to content that a player may otherwise find acceptable in less immersive mediums.

2.3 Nudges

Cambridge Analytica's approach to targeted advertising made the ethics of nudging salient in 2016. Nudges are intentional manipulations of a user's (real or virtual) environment that are meant to influence users (Sunstein 2015). As Cambridge Analytica's example helps demonstrate, nudges are sometimes morally problematic to design and use.

Because VR and AR technologies can be immersive, highly convincing, and emotionally engaging, they are an especially good tool for nudges. Already, such applications have been developed for the purpose of nudging users into being less racist, more sympathetic to homelessness, more caring about the environment, and to eating less meat. However, an ethical analysis of the design and development of such nudges has not followed suit. Tech ethicists have argued that a nudge is permissible so long as it avoids manipulating users (by deception or lack of transparency) and works to benefit users and social welfare whenever possible. VR and AR nudges can also be ethically appropriate ways of helping users develop good skills and habits (Sunstein 2015, Herrerra et al. 2018).

Because experiences involving these technologies can blur the distinction between reality and simulation, developers should be especially cautious about developing nudges that leave users with the false impression that they understand what it's like to live the life of a different person (Ramirez 2018b).

2.4 User Experience / Harm

One of the unique features of virtual reality technologies is their ability to convince their users that they're physically located inside the virtual worlds instead of wherever they happen to be in reality.

Psychologists refer to this phenomenon as the feeling of "presence" (Cummings & Bailenson 2016). While many forms of media can instill feelings of presence in their users, virtual reality technologies are capable of generating especially intense forms of presence known as "virtually real" experiences (Ramirez 2018a). Because virtual reality is capable of generating virtually real experiences (i.e., experiences that are treated by users, in the moment, *as if* they were real) developers of VR and AR applications should pay special care, in line with the ACM and IEEE codes, to avoid causing unintended harm to users.

Scott Stephan, director of games at FoxNext VR Studio (makers of TheBlu: Encounter), makes the same point when he cautions that he

> ...find[s] that scary experiences, horror experiences need to be really finely calibrated. If you see a horror movie on a screen, you have the abstraction. It's not so frightening, and you know you're there for fun... I found that, in room-scale VR, things that might be fun on a TV screen, like jump scares...We actually have a rule that no creature should be larger than the size of a small dog. Anything above that and you get this primal, lizard-brain thing of, 'Oh, this isn't a fun scare. It's a survival scare. ("On Immersive Virtual Reality" 2018)

Commercial VR and AR applications need to be sensitive to the hardware's ability to generate virtually real experiences and need to think carefully about how to design simulations with them in mind. Specific design elements of simulations are known to affect the probability that a simulation will give its users virtually real experiences. An ethics for VR and AR applications requires that designers become sensitive to how these elements can be modified to decrease the risk of virtual trauma while increasing user engagement and enjoyment (see Fig. 1).

Less Virtually Real   More Virtually Real

3rd Person Perspective	1st Person Perspective
Non-Diegetic Sound	Only Diegetic Sound
Unrealistic Settings	Contemporary Settings
Impossible Physics	Naturalistic Physics
Poor NPC A.I.	Human-Like NPC A.I.

Fig. 1. A selection of features demonstrating the dimensional nature of virtually real experiences. Developers of VR/AR applications should adjust these parameters to tailor their simulations so as to avoid harmful or undesirable user experiences.

The success of virtual reality exposure therapies (VRET) support this point (Rizzo et al. 2017). VRET environments are created to simulate, as realistically as possible, real-world exposure therapy treatments for phobias and post-traumatic stress disorders. To date they show positive results, comparable to traditional treatments, demonstrating the power of virtually real experiences.

Best practice should focus on avoiding user harm through all phases of an application's design and development. We suggest that these practices should be aimed at following The Equivalence Principle (TEP) when it comes to ethical simulation design:

> **TEP:** If it would be wrong to allow a person to have an experience of something in the real world, then it would be wrong to allow a person to a *virtually real* analogue of that experience. As a simulation's likelihood of inducing virtually-real experiences in its subject increases, so too should the justification for the use of the simulation (Bliznyuk 2019; Ramirez 2018a; Ffiske 2020; Ramirez & LaBarge 2018)

Ethical developers of VR and AR content should take care to fine-tune their application's parameters, in line with TEP, to enhance user experience and minimize user harm. Because these applications are more likely to give users virtually real experiences they should be subject to greater ethical scrutiny. For example, although virtually unreal simulations of murder or torture are common features of games, virtually real simulations of the same actions have the potential to harm users and, in rare cases, can affect real-world user behavior (Ramirez 2020). For this reason, developers of virtual reality simulations that include actions that would be bad for us to do in the real world need to be developed with special ethical care to avoid harming users. Also because of this, developers of applications for VR and AR should not use comparisons of violent content in non-VR/AR games to justify violent content in their own applications. These new media are psychologically unique and require their own ethical frameworks.

2.5 Dissociation / Derealization

Michael Madary and Thomas Metzinger (2016) have cautioned that prolonged use of VR can affect a user's perception of reality. Dissociation (separating yourself from your experiences) and derealization (loss of a sense of reality) are concerns about long-term use of virtual reality technologies. There's evidence that supports Madary and Metzinger's concerns about the effects that VR and AR may have on our perception of reality and our ability to keep track of real and virtual experience (Aardema et al. 2010).

Madary and Metzinger (2016) also worry that long-term use of virtual reality technologies can have negative personal and social consequences if users neglect their real-world health, nutrition, home-life, and social obligations because they prefer to spend time in virtual worlds.

Ethical developers of commercial VR and AR applications should thus take care to prompt their users to exit or suspend use to minimize these problems. Such prompts have become more and more common in traditional media. Little research has been done, to date, on the severity of this problem and it's likely, given the immersive experiences that these technologies offer, that stronger nudges will be necessary to avoid the dangers of prolonged use.

2.6 The Special Case of Children

The Oculus Rift owner's manual recognizes that children raise a special set of ethical issues when it comes to VR. They caution owners that:

> [t]his product is not a toy and should not be used by children under the age of 13, as the headset is not sized for children and improper sizing can lead to discomfort or adverse health effects, and younger children are in a critical period in visual development…Adults should monitor children age 13 and older who are using or have used the headset for any of the symptoms described in these health and safety warnings …and should limit the time children spend using the headset and ensure they take breaks during use. Prolonged use should be avoided, as this could negatively impact hand-eye coordination, balance, and multi-tasking ability. Adults should monitor children closely during and after use of the headset for any decrease in these abilities. (Oculus Health and Safety Manual)

VR and AR hardware and applications are likely to become deeply integrated into the future structure of society, and in line with the ACM code of ethics, special care and precaution need to be exercised when designing applications that may be attractive to children. Because very young children are especially likely to develop issues with derealization and depersonalization as a result of time spent in virtual environments, we believe that it would be wrong to develop VR/AR applications directly (or indirectly) for children. As we learn more about the effects of these technologies on developing brains and minds, such precautions may become less (or even more) necessary.

3. A Code of Ethics for VR/AR: Designing for the Common Good

Table 3 VR/AR Code of Ethics
● Design simulations to avoid being more virtually real than necessary
● The Equivalence Principle sets an upper limit on ethically acceptable virtual and augmented

reality applications

- Take special care when designing VR and AR applications used by children 13 years or older and do not develop applications for children younger than 13 years

- Incorporate design elements into VR applications to avoid prolonged and sustained use

- Applications intended to change (nudge) user behavior must be transparent, avoid manipulation, and serve both the user and public goods

- Be mindful of the fact that content that may not be problematic if experienced using traditional media may *become* problematic if experienced as virtually real

- User data should only be collected as-needed for application functionality and should be encrypted and deleted as soon as is feasible to protect user privacy and identity-theft

- Simulated environments (social, educational, governmental) that aim to be integrated into the infrastructure of society should receive the highest level of ethical scrutiny

The code of ethics that we propose in Table 3 above draws from the decades of experience enshrined in the codes of both the ACM, the IEEE, and our own research on user responses to simulated environments. Developers of commercial VR and AR applications have ethical duties to avoid unnecessary harm to users and to consider the massive impact on basic social structures that these technologies are likely to have in the 21st century. Ethical VR and AR engineers (both software and hardware) must be mindful of both their impacts on users and society. The more axes in our code that a potential commercial application makes contact with (e.g., a VR app aimed at nudging teenagers toward healthy habits), the more ethical scrutiny such applications should be subjected to both internally, by development teams, and externally by government regulatory bodies. Understanding not only the role of virtually real experiences in the ethics of VR and AR but also how such experiences can be made more or less likely by concrete design choices, is essential to ethical VR and AR development.

To illustate a proper application of this code, we briefly look at one case of ethical virtual reality development, Sisu VR's sexual harassment VR training simulations. Sisu VR's simulations are aimed at both the user and public good. Sexual harassment not only harms individuals but also creates a workplace (and social) culture that, overall, generates negtive utility. Harnessing the perspective-taking and immersive capacities of VR, Sisu VR's simulations provide users with different points of view about how to confront, pacify, intervene, or even keep silent in those viewpoints helps ingrain ethical habits into the user. The simulations themselves aim to be virtually real enough (e.g., first-person, realistic settings, etc) so that they engage users emotionally but not so virtually real that they traumatize them (e.g., text-box prompts artificially limit user choice as many VRET simulations do).

The objective of Sisu VR's product is to empower users to make morally civil decisions through "passive and active involvement…where the user is required to "hammer" home the activity or action" (Kenwright 2019). For example, the user is prompted to speak a variety of dialogue responses out loud to in-game characters. To complete the training, one has to select and speak a set of phrases containing both professional and ethical language. Practicing morally civil dialogue in a VR context may empower the user to eventually manifest such actions in a real life context.

4. Conclusion

Virtual reality technologies have been in development throughout the 20th century and are only now becoming widely available commercially. As consumers and developers explore the new spaces and possibilities opened up by VR and AR hardware, we must work proactively to avoid creating unethical applications of these technologies. As these technologies become more deeply integrated into the everyday fabric of our social, political, and educational institutions and as they become a part of the work-environment, we must make sure that such new developments are met with equally new and important ethical constraints. The code contained here represents one early attempt to express the most critical ethical considerations that VR and AR developers should build into all levels of their project workflows.

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