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“I certify that this assignment is my own work.”



Security Aspects of Virtual Reality

# Abstract

Virtual Reality (VR) and Augmented Reality (AR) technology have evolved in the last decade and become commercially successful. The technology uses cameras and sensors to project a simulation to users. That same technology tracks and collects more information than any other technology sold today. Due to the lack of specific regulations and policies regarding these devices and low commitment from businesses to protect information, the technology is a risk to users’ privacy and security.

# Introduction

Virtual Reality (VR) has been described as the technology of the future; however, VR as a product has been around since the late 1960s. It was initially developed as a possible training application for pilots in the military. The original model was a large heavy headset connected to the elementary computers of that age. At the time, the idea was so limited by technology it wasn’t considered a revolutionary breakthrough. The headset they created was so impractical due to its weight that users could not wear the device for extended periods (Barnard 2023). In the last decade, the technology has expanded to be used within military, educational, commercial, and daily life. However, the technology presents an unexplored territory of data collection; users need to be conscious of what data is collected by VR technology and how that data could be manipulated and sold.

# Background

### What is Virtual Reality?

Virtual reality as the name suggests is a technology that allows a user to access a virtual environment generated by a computer. Through a headset or similar device, the user can see and interact within the three-dimensional space. As mentioned, it was developed to create simulations for pilots within the military, allowing pilots to experience flying without operating real equipment. Its current uses are limitless, and with the invention of a 3D camera, it can even show images and videos of our real world.

### What is Augmented Reality?

On the other hand, augmented reality (AR) is a subtype of VR. AR allows the user to interact within a three-dimensional virtual environment overlayed by the user’s physical environment. This is accomplished with cameras and sensors in a headset or other devices. Until recent times, AR technology has been limited by even our best technology. It takes advanced cameras and sensors to project images within the established dimensional plane. Although the two technologies are used interchangeably, as described there are key differences.

### Why does mixed reality technology matter?

While the technology has now just started to make headlines, certain industries have already employed and used the technology. Businesses have started to use it for communication, simulations/training, and even tech support applications. Schools have started to use it to help engage students within lessons. Even in the healthcare industry, hospitals have been testing uses within surgery, therapy, and patient care. Within the next few years to decades, mixed reality technology is expected to be more common in daily life.

### Widespread Commercial Success of VR and AR

Commercially, the VR headset market is relatively new and has been dominated by a few companies. One of the very first widespread commercial VR technologies was produced and sold by Oculus. Through Oculus hardware, you could connect a headset to the program on a computer and access different simulations. In 2014, Oculus was bought out by Meta (previously known as Facebook) so its headsets are now sold and marketed under the Meta Quest name. Another well-known competitor is Sony through their release of a VR headset that could connect to their gaming consoles. Some other competitors include Apple, HTC, and Valve Index. They offer similar technologies within gaming and commercial use.

The subset AR market has commercially been less successful than VR has. AR technology was limited and expensive due to the intricate technology. Additionally, not many companies have marketed the technology toward a more general audience. Products like AR glasses were a small market that didn’t gain significant traction due to limited functionality and design flaws. Overall, until 2024, the market has been relatively stagnant.

In 2024, Apple entered the market by releasing its product the Apple Vision Pro. With a retail price of $3,299.00, it raised eyebrows with its substantial price tag. It was a huge leap in innovation for AR in the commercial market. It was the first commercial VR headset to have both VR and AR technologies. Since its release, it has made waves in the news and media for its futuristic look. Even within the first version of the technology people are imagining the widespread use it could have.

### VR/AR in Popular Media

While VR/AR headsets are a newer technology, the concept of VR headsets has been a part of pop culture for years. It was first shown off in the novel, Ready Player One, by Orison Scott Card. In the book, it depicts a dystopian future where VR technology has taken over daily life. A VR headset combined with futuristic technology like an omni-directional treadmill, and a haptic suit allowed the user to forget reality. Every aspect of daily life has been replaced by digital simulations. Whenever mixed reality technology grows, it gets compared to the not-so-distant possibility of the world depicted within the book.

# Research Process

My rationale behind researching the security aspects of mixed reality stemmed from the commercial success of the Apple Vision Pro headset. I was amazed by how advanced the technology had become but as with new technology there are always drawbacks. This has been seen with the invention of recent technologies. When the internet became widespread, issues like hacking, phishing, and cybercrime were uncharted territory. Only within recent years have policies and technology risen to combat these issues. If this technology becomes as common as a smartphone, buyers need to be aware of the lack of information and security in these products.

My research methods were limited by the nature of the topic. Until now there hasn’t been interest or need to research the subject. My research focused on understanding what data? is currently being collected within mixed reality technology. I compared this to what data is currently collected by smartphones, computers, and other technologies. Mixed reality collects significantly more data through its cameras and sensors than any other established technology. I then investigated current regulations and policies regarding the data collected.

# Data Collection

Data collection has been a heavily debated topic within current events and lawsuits. In the 21st century, tracking and data collection has made huge leaps. Websites track browsing data to show relevant ads through cookies. Apps like Instagram and Facebook track how long you look and interact with certain products to sell you ads. Data has become the newest commodity within advertising and business. Even in recent events, the US government has worked to ban the popular app TikTok due to allegations of foreign tracking. However, data collection has positive and negative aspects.

Some positive aspects of data collection are being able to improve shopping, customer experiences, and healthcare solutions. Data can improve shopping by showing relevant products and rewards. Cookies and other site data allow commerce websites to advertise items calculated to pique your interest. Another way is through customer experiences. Spotify, one of the largest music streaming platforms, collects music listening data to show users their listening habits in Spotify Wrapped and suggest music they may like. Lastly, data collected by smartphones and other technology can be used in the healthcare industry. Smartwatches and some smartphones collect biometric information that could be helpful within healthcare (Invisibly 2023). However, there are also ways data collection can be dangerous.

The main arguments against data collection are privacy and security aspects. Data including sensitive information like customer records is collected and stored within servers. This data is in danger of being stolen or leaked to the public. Additionally, users don’t appreciate companies having certain information about their online habits. Finger tracking, eye tracking, and other data tracking sources can show companies sensitive information about users (Smith 2019). In recent years, companies have had to limit and announce what they collect and what they do with it. However, it is still a topic of debate within the news.

# Data Privacy

Data privacy has become a larger issue within the last decade. Data privacy first made major headlines when a scandal involving Facebook (now Meta) reached the public. For a while, Facebook made major revenue from collecting and selling user’s data and information. In 2015, an investigation uncovered that 50 million Facebook users had their data leaked online without their permission. In 2023, Facebook was forced to pay 725 million dollars to the affected users. However, Meta hasn’t been the only company to face major leaks and scandals (Martichoux 2023).

           Major companies like Yahoo, Google, Microsoft, and LinkedIn face constant attacks and cyber threats. Although we now have national guidelines on how data needs to be protected and secured, it doesn’t stop hackers and foreign threats from gaining access and stealing data. In fact, in 2023 alone there were 353 million victims of data leakage around the world (TNS 2024). Government agencies are constantly working to create stricter standards and policies for companies. Fortunately, in the last 10 years, protection has improved despite more attacks.

Government regulations in the United States that apply to data collection in any device also apply to VR/AR technology. These regulations/policies protect sensitive user information but are not specific to mixed reality. However, as mentioned before, these policies are basic and not comprehensive enough. In the European Union, specific policies for mixed reality have made a foundation for further regulations (Law Office of Salar Atrizadeh 2024).

# Specific Security Aspects of VR/AR

Why is data collection with mixed reality different from any other technology? Overall, the data it collects is remarkably similar but it additionally contains much more sensitive information than many realize. Mixed reality technology has cameras and sensors to detect your surroundings and map out the environment for the user. This is an issue of concern found especially within AR technology; if you are using it throughout your day, the device is recording your actions and experiences. Many haven’t stopped to think about what is done with that data, and how protected it is by policies and regulations.

# When laptops and computers gained webcams and front-facing cameras there were worries of privacy concerns. Many feared businesses watching them through their devices, or hackers gaining access to these devices. It became common for users to cover their webcams with tape or plastic to make them feel secure that they were not being watched (Afolabi 2019). Ironically, many users don’t realize mixed reality technology commonly uses four cameras and other sensors to collect even more information than a small webcam.

# Current Regulations on Mixed Reality

Oculus, the pioneers of VR technology, was purchased by Facebook in 2014. Facebook/Meta has a questionable history of data leakage and selling to third-party sources. The privacy policy for the Quest devices lacks important information for users. They state they collect personal information, geolocation information, biometric/health data, interaction and behavior analytics, and sensitive data automatically through the device. In that same policy, they admit to getting information from users from third parties and sharing their data with third-party sources as well. They do state they protect and do not sell sensitive information, but their past doesn’t give users confidence (Common Sense Privacy Report 2023).

           Apple has a much more sophisticated and user-centric privacy policy. In their policy, they show every way data is collected by their device and what it is used for. Additionally, where the data is stored, and what apps and processes use that data. Apple has a history of protecting user data even when government bodies request information. In 2016, the US government requested Apple’s help with unlocking a terrorist’s iPhone. They notably fought the request, stating that if they worked with the US government on this issue, no user was safe (Nakashima 2021). Apple, like any other business, is vulnerable to attack and leakage, but their approach to their policy was more user friendly than Oculus’s.

# Discussions

In my research, I discovered the lack of information and research into mixed reality to be concerning. The amount of data collected by these devices is immense compared to what is currently being collected by other devices. The lack of policies and regulations for mixed reality technology is also profound. Until proper regulations are made, using these devices is a risk for buyers. Consumers and users need to be made aware of the risks they accept by just using the technology.

# Conclusion

I learned a lot about mixed reality through this assignment. In the past, I had always considered buying a VR headset. Then when the Apple Vision Pro was released, I was even more interested in buying the device. After doing this research I would wait to buy until the future. I already have so much data collected by my current devices, and I don’t want to further risk my privacy and security by buying these devices. Also, after reading about Facebook’s past in data leakage and even more current drama, I wouldn’t buy a Facebook device; I am even wary of Facebook/Instagram for the same reason.

           I enjoyed this assignment because I was able to choose my topic. Although it’s been troubling to find information, I think I learned a lot and put together some important information. I plan to use this information to guide myself in tech purchases in the future.

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