VIRTUAL REALITY AND THE HARMS OF EXCESSIVE DATA COLLECTION: A CASE OF RISK SOCIETY

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By

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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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Imagine a world where one can study Ancient Roman architecture by standing within the walls of the once standing Old St. Peter's Basilica, marvel at the miracles of our solar system by taking a stroll on the rings of Saturn or interact with the founders of the United States by being present at the signing of the Declaration of Independence (Dipippo, 2016; National Archives, 2020). Though these moments and places are unreachable in the real world, all of this is possible with the progression of virtual reality (VR) technology. VR can take one to unfamiliar places and bygone times without stepping foot out of the house. The potential for VR is endless.

This introduction presents the barebones structure of the argument and introduces all the necessary background information. First, an explanation of what VR is, and its all-purpose functionality is declared. Building off that, the thesis addresses the extensive data required for the functionality of VR and briefly discusses its, therefore, intruding nature compared to other technologies. Then, the current regulations and policies regarding this technology are discussed. Finally, the framework used to govern the ethos of the research is established. The rest of the research is devoted to fully expanding on this design using the STS framework to guide the discourse of the argument, briefly explaining potential dangers of excessive data mining using the company Meta as a specific reason for concern, and, ultimately, presenting adjustments to the current data protection policies.

Virtual reality aims to create a completely immersive and interactive digital environment through visual, haptic and auditory outputs, transporting the user away from reality and into a virtual world (Adams et al., 2018). Due to its hyper-realism and fully immersive nature, VR has a tremendous range of applications: education, aviation and maritime training, military preparation, medicine and surgical simulation, mental and physical rehabilitation, gaming, social networking, etc. (Spiegel, 2017). However, according to media theorist and author Neil Postman

(1998), all technological advancement is a trade-off and is what he calls a “Faustian bargain.” Every technological improvement prioritizes some material benefit over personal morals and values. (Postman, 1998) While the applications of VR are numerous and potentially revolutionary, the downsides of the technology can outweigh the benefits without proper oversight and regulation. This idea alights perfectly with Ulrich Beck’s framework “risk society,” which will be used to dictate the thought process throughout the research and will be discussed in more detail later.

David Uberti (2022), a cybersecurity reporter for the Wall Street Journal, writes of the treasure trove of private user information necessary for VR technologies. For just the head-mounted display (HMD) to function, the equipment extracts gaze, three-dimensional-movement, gait and pupil dilation (Uberti, 2022). The remaining hardware and software also require digital communications, associated data such as usernames and IP addresses, biographical data, location data, advertising profiles, biometric identification and other observed data (Dick, 2021). VR and augmented reality (AR) revolutionizes the practice of data acquisition. Instead of relying on smaller amounts of observable data, this technology gathers an immense amount of information. From there it then makes accurate inferences or predictions from it, arriving at hidden conclusions and providing a more complete picture (Dick, 2021).

The amount of raw and unique data collected by VR and AR reveals issues in current data privacy regulations. There is no oversight and VR companies are left to their own devices to establish a status quo in the handling of this extensive private data. In similar industries, the United States government has displayed little effort in interfering to make a meaningful impact (Hunter, 2022). The industry leader, Meta, the parent company of Facebook, has been guilty on

more than one occasion of being irresponsible with user data. Stated concisely, there is no indication that user privacy will be kept safe when it could be in more danger than ever before.

For the technical portion of the capstone, a team of four designed a thermoelectric liquid-cooling station. The project was completed by Computer Engineering majors Pat Baskin, Micah Harris, EJ Patterson and Robin Watkins with Associate Professor of Electrical and Computer Engineering Harry Powell as the technical advisor. Though there seems to be little connection between thermoelectrically cooling stations and virtual reality data privacies, the similarities lie in how awareness for the technology must be raised in order make worthwhile change as opposed to relying on drastic overnight infrastructure changes. There is no one good idea for either technology in how this should be done, but both require a deep and wide-reaching understanding of the long-range effects of the technology.

An undisturbed sprint toward the wide application of this technology can have lasting impacts. Thus, a study to examine the absolute impacts of VR in technology simultaneously requires a wide-ranging and longitudinal approach. Since VR in its application is still in its infancy, a thorough longitudinal impact study cannot produce reliable and secure conclusions. On the other hand, due to the exponential growth of this technology, it is unwise to wait for these delayed conclusions to fully develop. With this in consideration, the scope of this research contains the effects that this technology will have under current regulation using the STS framework "risk society." (Beck, 1992, p. 19) Risk society addresses how the hazards inherently produced by modernization and industrialization can be "prevented, minimized, dramatized, or channeled." (Beck, 1992, p. 19) By being able to identify risks based off Beck's (1992) core propositions and better understanding the risks' origins, society can better address the solutions to these issues. Specifically, the framework evaluates how virtual reality can be used

irresponsibly under current regulations and what changes can be made to eliminate these possibilities.

HISTORY OF VIRTUAL REALITY

Though VR is a seemingly recent technology, the idea of it, particularly as we think of it now, was created for the sake of a science fiction story called Pygmalion's Spectacles by Stanley G. Weinbaum where the user of the goggles experienced a digital world through holograms, taste, touch, and smell (Picard, 2020). Some precursors to VR go back even further. In 1929, Edward Link created the first flight simulator called the Link Trainer. 10,000 of these "blue boxes" were used during World War II to quickly train beginner pilots (Poetker, 2019). In the 1950s a cinematographer named Morton Heilig created the Sensorama, a film-watching experience using all the senses, designed to fully immerse the viewers in the film (Poetker, 2019).

Thereafter virtual reality as we use it now began to take shape. In 1961, the first HMD with head-tracking systems called the Headsight was invented for the remote viewing of dangerous environments in military applications (Barnard, 2019). Seven years later, a brilliant computer scientist named Ivan Sutherland built off that idea by creating the first HMD connected to a digital fabrication. Sutherland would also author a paper a few years earlier that would be a vital outline for the concepts that describe the modern understanding of VR (Hosch, 2022). In 1975, the first interactive VR system was produced (Poetker, 2019). Two years after that, MIT created a virtual experience of Aspen, Colorado (Poetker, 2019). Then, finally, the name "virtual reality" was born and popularized by Jaron Lanier, a pioneer who has aided in bringing about the second generation in the history of VR: the appeal of VR to the general public as well as the government and large enterprises (Poetker, 2019).

VIRTUAL REALITY – THE TREASURE TROVE OF DATA

Through the convoluted and rapidly changing popular standard of internet-based technologies, one trend remains consistent and apparent – with each new and improved agent for interacting with the web comes a new and improved method for harvesting user data (Nair et al., 2022). This point is displayed when evaluating the development of web design, which is eloquently delineated in the anthology *Social Networks Science: Design, Implementation, Security and Challenges* and visualized in Figure 1.

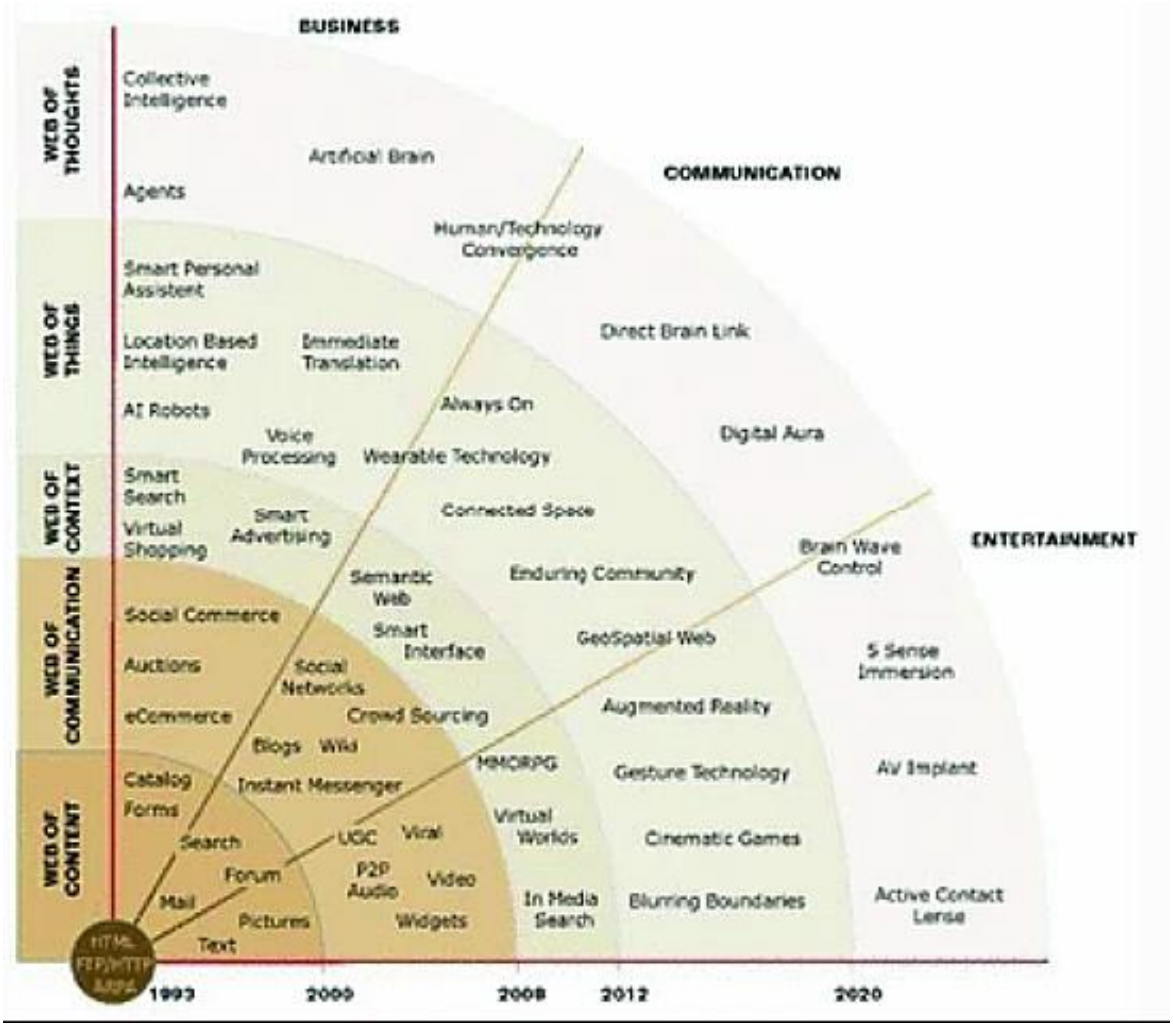

Figure 1: The development of web design and data-mining technologies (Figure 7.3 from Tromp et al., 2018)

In the research article “Massively Multi-user Online Social Virtual Reality Systems: Ethical Issues and Risks for Long-Term Use,” Tromp et al. (2018) eloquently rehearses the progression of web-based technologies and its data-mining tendencies. In the early years of the world wide web (WWW), also known as Web 1.0, the internet was a “Read-Only” collection of webpages that did not allow for many opportunities of data acquisition (Tromp et al.). In the following years, numerous social network platforms including Facebook, MySpace and Twitter gained popularity and initiated the collection of information on users (Tromp et al.). Then Web 3.0 functionality refers to web applications that can communicate with each other directly in order to gain context about what the user is looking for. This came in the form of “cookies” or small data files saved within a web browser to track, personalize and save information about a user’s session. Tromp et al. notes that this would directly lead to the development of Google Analytics and, more broadly, the discussion about privacy. Then came the transition to smartphones, the development of the Internet of Things (IoT) and interconnectivity of all devices. This created a constant link between the real world and the virtual world, digitizing everyday activities and introducing “big data” (Tromp et al.). Finally, Web 5.0 marks the transition to artificial intelligence (AI) personal assistants such as Siri and Alexa, solidifying our reliance on data-mining technologies and their ubiquitous nature in our society (Tromp et al.). Virtual reality is the next step in this process, and it follows the trend of introducing a new and improved methods for harvesting user data.

Though VR has been in existence to some degree since the 1960s, it only recently became commercially available and usable. The first headset with fully realized VR capabilities was the Oculus Rift in 2016, which catalyzed a movement towards improving publicly available VR technology. (Adams et al., 2018) When the Oculus Rift was released, the total revenue in the

United States for VR based technology was approximately 400 million. By 2021, this figure increased to five billion dollars in revenue with experts projecting this annual revenue to triple by 2024.

This technology necessary for the development of a digital environment is already in place. Epic Games recently released Unreal Engine 5, a gaming engine with graphics indiscernible from real life. Maintenance training and flight simulation have been breeding grounds for real-world simulation for decades. Meta is in the beginning stages of constructing a totally enveloping digital world, the metaverse. Considering this technology is knocking at the door, it is time to contemplate what humanity is risking when this immersive technology becomes a staple to society.

META JOINS THE VIRTUAL WORLD

It was only in the last few years, however, that the technology has begun to catch up to the public's interest, providing the reliable hardware and software at a cheap price to everyone. In this time, VR has soared in popularity, interest and applications. Hundreds of companies are making VR products. These include well-known corporations such as Sony, Google and, perhaps most notably, Facebook who purchased Oculus in 2014 and changed their name to Meta to initiate their effort towards a digital frontier.

Facebook has already had their share of data breaching scandals derived from their current popular social media. In 2008, Facebook violated a federal wiretap law by analyzing and publishing the behavior of users without their consent (Guild, 2021). Three years later, a report by Symantec revealed that third parties had access to up to 100,000 applications linked to Facebook accounts (Guild, 2021). Only a year after that, Facebook was caught in a lawsuit that revealed their merchandising of user data (Guild, 2021). Finally, and most prominently,

Facebook infamously divulged the data from over 87 million user profiles to a political consultancy company, Cambridge Analytica. This final breach of public trust revealed the serious dilemma of monetizing user information that Facebook has been guilty of repeatedly. In the past, Meta has had disputes with other major companies whose privacy guidelines they did not agree with such as Google and Apple. By creating their own digital world along with the accompanying hardware separate from all "middlemen," Meta would have unobscured access to all user data, in essence creating a self-sufficient data-mining ecosphere. Through the lobbying against data privacy laws and the acquisition of both Instagram and the data-privacy driven company WhatsApp, Facebook has revealed this to be their true profit-making incentives.

UNDERSTANDING THE POTENTIAL PERILS OF VIRTUAL REALITY USING RISK SOCIETY

Risk society is a broad and far-reaching social theory that is concerned with the industrial advancement of modern society and the unavoidable hazards that follow. The father of the term is the late sociologist Ulrich Beck. Beck (1992) describes his theory as a grand theory of society itself, concerned with the transition from modern industrial society to a new era distinguished much more by technological hazards. Risk society is defined not just by the distribution of goods such as wealth but, more importantly, by the distribution of "bads" (Beck, p. 21).

There are three key factors in Beck's proposition to identifying risks. First, the scale and potential for catastrophe is increasing because of an increasingly complicated sociotechnical structure (Beck). With each new scientific and technological development, society is further occupied with "debating, preventing and managing risks that it itself has produced" (Beck, p. 20). Second, there is a loss of faith in experts to protect society from these technological hazards. Individuals question their own safety in society and question the guiding institutions for their

ability to protect them (Beck). Third, there is no consensus regarding the governance of technology. In other words, the uncertainty of science and technology has reached the minds of the general public, causing disarray, disagreements and discussion. The theory is a system for preemptively attempting to understand and evaluate risk for technologies that have potential negative societal impacts that are not yet fully realized. Using these three factors, one can identify risk before it plagues society and implement regulation improvements to nullify the hazards.

The large-scale adoption of VR comes with many risks, particularly to the collection and inferences of users' data. VR systems collect haptic, audio and visual inputs. Furthermore, in an entirely digital world like Meta is currently developing, behavioral and subconscious habit information is in danger as well. "Big data" is a reference to data that is contains more variety, larger amounts and arrives in higher velocity than traditional methods of data analytics can account for. VR can contribute more to the acquisition of "big data" than any other technology currently in existence, thereby allowing VR companies to maintain an entirely autonomous ecosystem of data.

CURRENT REGULATIONS AND ITS STRUGGLES WITH "BIG DATA"

This gathered information is new in the realm of collected data by technology and, therefore, presents an entirely new collection of risks that current data collection regulations are unprepared for. The General Data Protection Regulation (GDPR) of the European Union holds the standard as the most stringent and influential data privacy law. A key factor of the GDPR is the necessity to obtain the user's "informed consent" whereby users are in absolute control over decisions about their personal data (Kim, 2022). At face value, this sounds like the proper approach to keeping individual data safe. Everyone has total and independent control over his or her data.

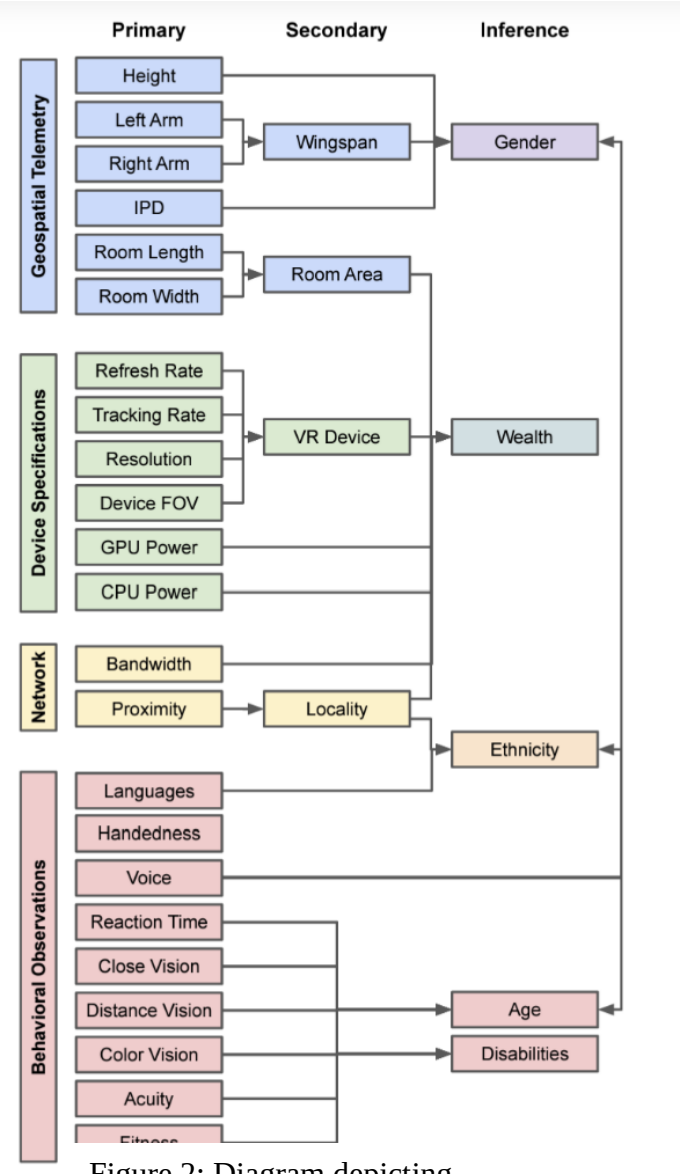

Figure 2: Diagram depicting inferences made by VR technology. (Adapted by Baskin (2022) from Dick (2021)).

However, when vast amounts of "big data" are collected, this notion no longer remains true. For VR to function each of the "three Vs" of big data - variety, veracity and velocity - are used to their full extent. When the accumulation of data can be used to discern physiological and psychological traits of the user as visualized in figure 2, the user is no longer the ideal candidate to determine what data constitutes their confidential information (Kim, 2022). The gap between the user's idea of informed consent and the actual

implication of the informed consent is compounded to a degree further than any other technology is capable. These data breached perils perfectly align with Beck's idea of unforeseen risk.

IMPROVEMENTS TO CURRENT POLICY

In order to minimize risk and abide by Beck's proposals of risk assessment, there are three changes to current policy that must be implemented. First, there must be a transition away from text-based informed consent. This nullifies the gap between what a user believes their data could be used for and the actual data inferences that could be made. This can be achieved by using excessive warning labels, videos and interactive exercises that all educate the user about their data and its usage. The more the user can understand, the less likely their data could be used for nefarious purposes without their knowledge. Second, there must be a standardized rating system for how pervasive and intrusive a certain VR technology can be. This gives a knowledgeable user the ability to draw the line at a particular rating. Finally, the implementation of a "no share" law. This would eliminate the desirability of user data for third-party companies and abolish the ability to sell user data as a profitable commodity.

With these large-scale modifications to current policy, there would be a decreased amount of discussion about user data because by eliminating data as a profitable asset, the sociotechnical structure is vastly simplified. If these conditions were implemented before a vast technological change in society regarding VR, then for once regulation would be ahead of technology growth. Finally, if these regulations became standard, a general consensus could be agreed upon.

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