Chapter 7
Massively Multi-user Online Social Virtual Reality Systems: Ethical Issues and Risks for Long-Term Use

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Abstract This chapter covers the convergence of Social Media Networks and Virtual Reality Systems, labeled as Social Virtual Reality. It reviews the evolution of the World Wide Web from a single user, static experience into the futuristic 3D multi user interactive experience. This is followed by a review of bulk data collection in Virtual Reality, and the ethical risks and threats to privacy that this could create for Social Virtual Reality users. The chapter ends with recommendations to mitigate the ethical risks and threats to privacy for adult VR users, parents of VR users, psychologists, VR software and hardware manufacturers, governments and other regulatory institutions and VR researchers.

Keywords Social VR · Web VR · MMOGs · Metaverse · Web 5.0

7.1 Introduction

The year 2017 will go down in history as the year Social Media Networks (SMNs) and Virtual Reality (VR) converged, although not everyone will be aware of the significance of this convergence. Facebook opened their Virtual Reality world called

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"Spaces" (April 18, public launch of the Beta version).[1] Within a few months, Microsoft bought the Social VR application called "*AltspaceVR*" (October 3),[2] after it had to briefly shut down due to lack of funding (July 28 August 16).[3,4,5,6] Alongside this, Microsoft has launched a major update for Windows 10 (October, 17, 2017),[7] which includes full support for Windows Mixed Reality (named after the continuum of shared functionalities between Reality, Augmented Reality (AR) and VR,[8] that runs on headsets from Acer, Dell, HP, Lenovo, new Samsung VR headset, with competitive features and price.

Users of Social Media Networks (SMNs) share information about their lives and their interests, and the number of users and the frequency with which they share information is on the increase. They share this information with others as a means to communicate with those they identify as friends, family and like-minded others, such as members of their online special interests groups. Online user conversations, user searches and literally everything users do and look at on the Internet and on an SMN are automatically stored and can then be analyzed for purposes such as mass-surveillance and marketing. This is current standard practice, which culminates in massive databases of personal information or Bulk Personal Datasets (BPDs), which are collected, traded, and sold by all kinds of parties with different kinds of intentions from personalized targeted marketing to fighting serious crime.

Multi-user Virtual Reality (*also known as Social VR*) systems provide huge potential to give users similar social networking opportunities, because multi-user VR systems allow users to see a virtual representation of other users, talk to each other, and collaborate on something together, such as a game or building something together - all within a shared 3D computer generated virtual environment. These types of VR systems can be divided into applications for serious long-distance work: Collaborative Virtual Environments (CVEs) and fun games: Massively Multiplayer Online Games (*MMOGs or MMO for short*), depending on the purpose for which the VR system was developed. CVEs can be used for long-distance meetings, replacing or adding to the existing video-conferencing and audio-conferencing applications. At minimum a CVE will have a blackboard or presentation-screen, and other types of meeting tools that facilitate long-distance collaboration, see Fig. 7.1 for an impression of a CVE and the different levels of design: architectural layout of the shared spaces, semantic layout of the functional objects for collaboration, social layout of the users in the virtual-world, which continuously change configuration based on

[1] https://newsroom.fb.com/news/2017/04/facebook-spaces/.

[2] https://altvr.com/joining-microsoft/.

[3] https://altvr.com/good-bye/.

[4] https://vrscout.com/news/altspacevr-is-closing-down/.

[5] https://www.theverge.com/2017/7/28/16055222/altspacevr-virtual-reality-social-network-shutdown-funding.

[6] https://www.theverge.com/2017/8/16/16156806/altspacevr-vr-social-network-not-shutting-down.

[7] https://developer.microsoft.com/en-us/windows/mixed-reality.

[8] https://en.wikipedia.org/wiki/Reality%E2%80%93virtuality_continuum.

Fig. 7.1 Collaborative Virtual Environment with functional layers: architectural, semantic and social

interactions of users with objects and other users within the virtual, thus changing the virtual world over time, adding a 4th functional level, the space-time continuum [15, 16]. MMOs are online games which can be used by large numbers of players (*ranging from hundreds to thousands*) who are simultaneously in the same virtual world, consisting of one persistent space or of multiple connected spaces, depending on the purpose and design of the game. However, Social VR systems can also simply be just that: a space to meet and talk, or collaborate on a building or viewing shared virtual 3D objects in the virtual world. Users can access these virtual worlds via their Desktop PC, Smartphone, Tablet and Head-Mounted Display. These types of Head-Mounted Displays range from affordable low-end to high-end devices, such as Google Cardboard (~$5) to the Oculus Rift (~$500) and the HTC Vive (~$600). In fact, both Oculus and HTC dropped the price of their VR headsets with $200 during summer 2017, in a bid to obtain a larger share of the market. Facebook, who owns Oculus, ran an ad during the summer of 2017, calling the price drop part of the "*Summer of VR*". Facebook has announced (October, 2017) new additional social tools for Spaces, to enhance social creative collaboration, such as live-video streaming in Spaces and a stylized drawing tool called Quill.[9]

The convergence of Social Networks and VR is taking place, and due to the size and magnitude of the user-base of Facebook and Microsoft, the number of users for these new 3D Computer Graphics based Social Networks can increase at a rapid rate, which brings with it an exponential increase of ethical and privacy risks. The ethical issues are not necessarily all new. They are similar to the risks in Social Networks, but the potential anticipated increase in the number of users of VR for non-gaming

[9] https://www.theverge.com/2017/10/11/16460080/facebook-spaces-live-360-degree-video-3d-posts.

purposes, means that these ethical concerns are more all-pervasive. It can be predicted that there will be an exponential growth in the number of Social VR users, based on the popularity and number of users of Facebook and Microsoft software. This increase in the number of users of Social VR would mean that the ethical problems and risks potentially also become more widespread and all-encompassing. In this chapter we analyze the historic growth of Social Media usage and bulk surveillance, the World Wide Web and the evolution it is going through, illustrating how these systems converge and grow into a World Wide 3D social VR-based browsing experience. Next the ethical problems and risks are reviewed and discussed. The chapter ends with concrete suggestions on how to manage these risks for:

- VR users,
- VR software and hardware companies,
- the government,
- psychologists and
- researchers.

7.1.1 Historical Growth of Social Media Networks

According to the Pew Research Center in 2005 only 5% of American adults used at least one SMN and by end of 2016 this had risen to 69%. By July 2016, 86% of the youngest adult age group 18–29 was reported to use at least one SMN, and for the older groups 30–49 80%, 50–64 64% and 65+ 34%. See Fig. 7.2 [10] for an illustration of the growth curve of Social Media users and Table 7.1 [11] for an overview of the number of users per Social Media Network (SMN), based on data from September, 2017.

Reference [6] studied Social Media user perceptions of their own frequency of use, usefulness, and enjoyment of Facebook, Twitter and Pinterest, analyzed against their actual use of the different features of these SMNs. The study found that for males and females, most often used features were contact with friends, posting information about themselves and finding information about others and these were highly correlated with the users' perceived usefulness for all three Social Media Networks. Some correlations were also found for perceived usefulness of these SMNs for finding information about products and stores. What is remarkable is that low ease-of-use had little impact on perceived usefulness, which suggests that even when SMNs are perceived as not easy to use, persist in using it because of the inherent value they reported getting from it.

[10] http://www.statisticbrain.com/social-networking-statistics.

[11] http://www.statisticbrain.com/social-networking-statistics/.

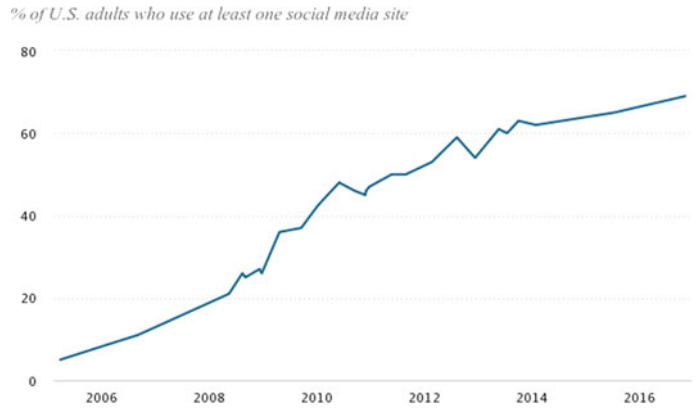

Fig. 7.2 Growth curve of social media users. http://www.statisticbrain.com/social-networking-statistics.

7.1.2 Historical Developments of Social Virtual Reality

Earlier multi-user VR applications that received world-wide active user groups are ActiveWorlds (*June 28, 1995, called AlphaWorld in the early days*),[12] blaxxun Interactive (August 1995),[13] notable because it was one of the first companies to use VRML (Virtual Reality Markup Language (now called X3D[14,15]) an extension of HTML, the language that is used to construct webpages for the WWW). Amongst a list of other ones, some mostly focused on some form of gaming, rather than socializing,[16] the Social VR's which captured some form of world-wide attention are "*SecondLife*" (June 23, 2003),[17] and their next versions "*High Fidelity*" (April, 2013) and Sansar (public launch of the Beta version, June 23, 2017).[18,19] Interestingly, Google also opened a Social VR world called "*Google Lively*", but closed it again very quickly (July 8 December 31, 2008).[20]

A distinction is often made between Massively Multiplayer Online Games (MMOGs or MMOs) and Social VR applications that are part of a much bigger future vision for the Internet, called "*the Metaverse*"[21] [8], a term coined by Cyber-

[12] https://en.wikipedia.org/wiki/Active_Worlds.

[13] https://en.wikipedia.org/wiki/Blaxxun.

[14] https://en.wikipedia.org/wiki/X3D.

[15] https://en.wikipedia.org/wiki/Web3D.

[16] https://en.wikipedia.org/wiki/Metaverse#Timeline_of_virtual_environments_inspired_by_the_concept.

[17] https://en.wikipedia.org/wiki/Second_Life.

[18] https://www.sansar.com/.

[19] https://singularityhub.com/2017/06/23/new-virtual-world-sansar-is-ready-to-pick-up-where-second-life-left-off/.

[20] https://en.wikipedia.org/wiki/Google_Lively.

[21] https://web.archive.org/web/20140608135859/.

Table 7.1 Number of users per Social Media Network. http://www.statisticbrain.com/social-networking-statistics/.

Percent of people who use social networks	Percent yes
Do you ever use / have a profile on	
Any social network	58%
Facebook	56%
LinkedIn	14%
Twitter	11%
Google+	9%
Largest socials networks in the world	Number of users
Facebook	1,374,000,000
QZone	635,000,000
Google+	347,000,000
LinkedIn	336,000,000
Instagram	302,000,000
Twitter	289,000,000
Tumblr	237,000,000
Sina weibo	162,000,000
Snapchat	113,000,000
Pinterest	73,500,000
Top reasons for using social networking sites	Percent yes
Percent who said the following was a MAJOR reason for using social networking sites	
Staying in touch with current friends	67%
Staying in touch with family members	64%
Connecting with old friends you've lost touch with	50%
Connecting with others with shared hobbies or interests	14%
Making new friends	9%
Reading comments by celebrities, athletes or politicians	5%
Finding potential romantic or dating partners	3%

punk writer Neal Stephenson in his novel "*Snowcrash*" (1992).[22] The Metaverse is envisioned by Stephenson as a collective virtual shared space, created by the convergence of virtually enhanced physical reality and physically persistent virtual space [8], including the sum of all virtual worlds, augmented reality, and the internet, it is used to describe the concept of a future iteration of the internet, made up of persistent, shared, 3D virtual spaces linked into a computer generated virtual universe.[23]

[22] https://en.wikipedia.org/wiki/Snow_Crash.

[23] https://en.wikipedia.org/wiki/Metaverse.

7.1.3 Historical Developments of the Three-Dimensional World Wide Web

The first version of the WWW (*publicly available January 1991*), was a "*Read-Only*" collection of interconnected websites and webpages, that the user could browse by clicking on "*hyperlinks*", but creating one's own website was generally something only experts in the HTML code with access to a server were capable of. This led to the dot.com boom, which turned into a "*bubble that burst*" (1999–2001) due to over-inflated expectations, and perpetuated by the far-reaching repercussions of the financial crisis. It was the beginning of the Web-browser development efforts, and the e-commerce and e-marketing efforts. The next version (beginning of 2002[24]), now referred to as Web 2.0, was a "*Read-Write*" version, that allowed non-programming users to create their own websites and Social Media sites like MySpace, Facebook, Twitter and Flickr started and quickly gained popularity, especially amongst the younger Internet users [3]. Web 2.0 allowed many new service-oriented startups to boom, including Ebay, Amazon, YouTube and Google Search engine. Web 3.0 was intended as a Read-Write-Executable and to this end HTML was extended with semantic-markup. It was intended to bridge the communication gap between human web users and computerized applications. The "*execute*" part of the Web 3.0 functionality refers to formatting data in such a way that it can be understood by automated "*software agents*". By combining a semantic markup and web services, Web 3.0 applications can communicate with each other directly, and this allowed "*automatic contextual search*"; i.e. broader searches for information through simpler interfaces. In order for the search function to understand the context of the user, the system has to collect user search behaviour and user interests through monitoring and collecting "*cookies*" (*small data files, saved within the web browser on the user's computer or other device, as they view a website*) and the clicks the user makes and it is possible to analyze where and how long a user spends reading or looking on a page. This led to the development of Google Analytics and the debate about privacy.[25,26]

The numbering of the next versions of the Web become less clear cut and some predicted developments took longer than expected (*for instance the semantic web and the symbiotic web*) while others progressed faster than expected (*for instance social networking via the smartphone*) and yet other developments are taking place that were not really expected at all (*for instance Augmented Reality applications for the smartphone*). The general consensus seems that Web 4.0 was about the transition to mobile devices, allowing all devices to be connected at all times, creating an Internet of Things (IoT) and people, connecting the real world and the digital domain or "*virtual world*" anywhere and everywhere. The Internet of Things is the network of all physical devices, vehicles, and other items that have built-in electronics, software, sensors, actuators, and network connectivity which enable these objects to collect

[24] https://en.wikipedia.org/wiki/History_of_the_World_Wide_Web.

[25] http://freespeechdebate.com/cookies/.

[26] https://searchengineland.com/its-not-about-cookies-privacy-debate-happening-at-wrong-level-77980.

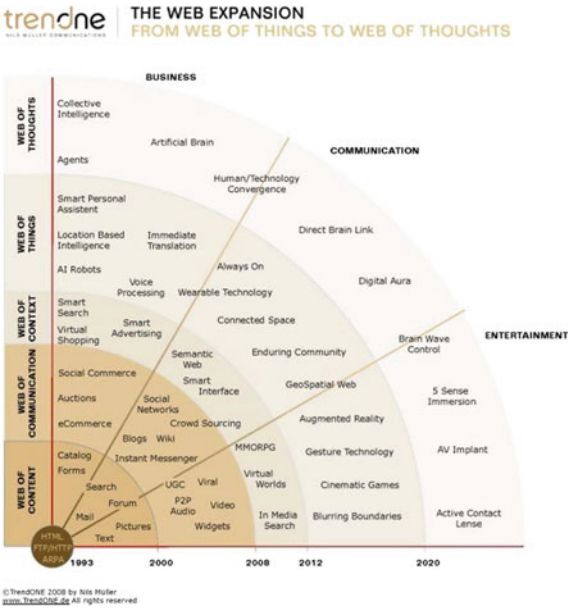

Fig. 7.3 Overview of the evolution of Web 1.0 to Web 5.0 (by TrendOne, 2008)

and exchange data.[27] Each device has a unique identifier and devices are capable of communicating with each other. The IoT is predicted to consist of 30 billion objects by 2020. For instance, with the GPS tracker built into smartphones, user's mobile location, orientation, speed and altitude can be tracked in realtime, allowing the collection of this data on web servers, for analysis and viewing of location worldwide, historical trails, battery life, signal strength, etc. This led to the rise of location based services and apps, such as Google maps, Uber, Foursquare, Tripadvisor, Instagram, Pokemon Go, etc., allowing users to find relevant information near them, such as a restaurant or individuals, where location, time, personal interests and keywords from searches can be used as triggers to push information at a smartphone user.

Web 5.0, a Read-Write-Execution-Concurrency web (2009), was aiming to be a sensory emotive web; a linked web which communicates with users like they communicate with each other (*akin a personal assistant*), also known as the Symbiotic web and the Ubiquitous web. This has led to the rise of personal voice assistants like Google's Echo, Amazon's Alexa, Echo, Echo Dot, and the portable device Amazon Tap.[28] Many large companies, for instance Ford,Whirlpool and Lenovo announced they are going to build Amazon's voice-activated personal assistant into their devices and research firm Gartner[29] predicts that by 2019, 20 % of all smartphone interactions will take place through personal assistants, and by 2020 most gadgets will be designed to work with "zero or minimal touch. In order for these devices to work,

[27] https://en.wikipedia.org/wiki/Internet_of_things.

[28] http://time.com/4624067/amazon-echo-alexa-ces-2017/.

[29] https://www.gartner.com/newsroom/id/3551217.

they have to continuously record what is being said in their surroundings so that they can respond adequately to requests from the user. Consumers are raising questions about privacy and security,[30] for instance: What are Google or Amazon doing with the information and how secure is this information from third parties? The magnitude of information that will be gathered through these devices is currently beyond prediction.

Further predictions for Web 5.0, are that it will be a 3D Virtual web, rather than the current 2.5D webpages. This is now quite feasible in principle with the release of WebVR,[31] an open application that makes it possible to experience VR from the web browser and supports VR hardware, such as the Oculus Rift, HTC Vive and Google cardboard. Other predictions are that this 3D Virtual web will be viewed through Active Contact Lenses rather than the large cumbersome VR headsets. Additionally, predictions are that all this will be integrated with Artificial Intelligence (*IBM Watson*[32] *is a forerunner for this*) providing intelligent self-learning virtual assistants, and a Brain-Human-Machine interface, making the use of keyboard and mouse redundant. See Fig. 7.3 for an overview of these different versions of the WWW.

7.2 Digital Footprint Collections from Internet, Social Media and Virtual Reality

A study (2016)[32] for the United Nations by special rapporteur on counter-terrorism and human rights lawyer Emmerson, concluded that while the internet is composed of many layers of private as well as social and public realms, bulk access technologies are indiscriminately corrosive of online privacy and pose a direct and ongoing challenge to established norms of international privacy laws. However, at the same time rules governing privacy and the use of these bulk personal datasets, are currently legislated very differently in different countries.[33]

One of the most common forms of mass surveillance is carried out by commercial organizations. For instance, when a person joins a shop's loyalty card program, they essentially agree to share their personal data and shopping data in exchange for small discounts on the purchases made in that shop. The aggregated data from all customers shopping behaviours can provide valuable insights for the shop owners to help in planning which and how many products will be needed and to anticipate customer needs and trends. This kind of market-analysis can be performed for online shops, without a loyalty-card system, because customers of online shops need to make an

[30] http://komonews.com/news/consumer/personal-assistant-devices-are-always-listening-at-what-cost.

[31] https://en.wikipedia.org/wiki/WebVR.

[32] https://www.theguardian.com/world/2014/oct/15/internet-surveillance-report-edward-snowden-leaks.

[33] https://en.wikipedia.org/wiki/Mass_surveillance.

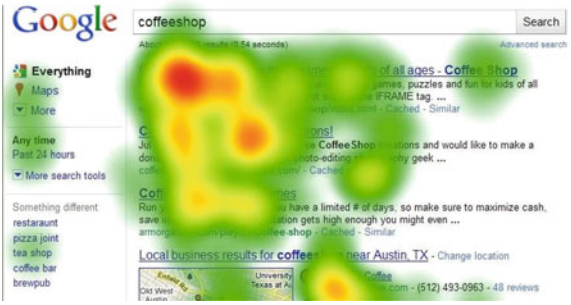

Fig. 7.4 Example *"heatmap"* visualization of where the user looked and for how long

account in order to have their purchases delivered to their address. This allows the shopping platform to collect data about their buying behaviours.

In addition to online shopping behaviours, many web sites are collecting user information about the sites users visited, how long they stayed on the site and each page, and where they looked on the page, who they chat with and the words they used, see Fig. 7.4[34] for an example of this type of "heatmap" data visualisation. This information can all be collected via the web browser. This data is valuable for authorities, marketeers and anyone interested in profiling user behaviours, trends and the performance analysis of the effectiveness of a website in converting a curious visitor into a buying and returning customer. As the number of users they collect data from increases, their "reach" increases and the aggregated data becomes increasingly more all-inclusive, which makes it more valuable.

Google, Facebook, Microsoft, etc., are increasingly more critically questioned by users about this data collection process. This is illustrated with a recent article[35] by Facebook that made the global news, in which they attempt to defuse a rumour that the Facebook app collects audio data from users. Facebook declared that businesses are able to push relevant ads to users, based on the analysis of user interests, demographic data and location information, but that they were not doing this through the collection of audio data from the Facebook app.

With mobile computing devices, geolocation - where users are physically located - can be tracked and data about users' physical movements can be collected without any need for user involvement. This data can be used for location-based advertising, which can benefit the user, because it allows them to do searches like: "*restaurants near me*" with high quality and quantity results. Organizations like the Electronic Frontier Foundation (EFF) are constantly informing users on the importance of privacy, and considerations about technologies like geolocation, etc.[36]

[34] http://line6.ca/wp-content/uploads/2017/03/heat-map.jpg.

[35] http://newsroom.fb.com/news/h/facebook-does-not-use-your-phones-microphone-for-ads-or-news-feed-stories/.

[36] https://en.wikipedia.org/wiki/Electronic_Frontier_Foundation.

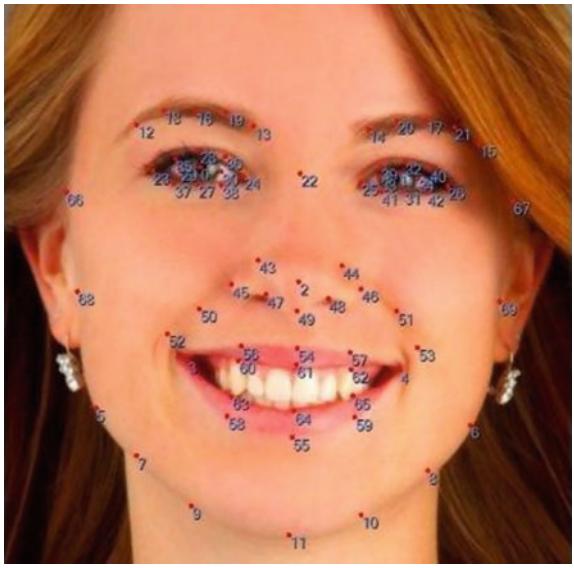

Fig. 7.5 Facial expression analysis markers

More detailed personal information collection is also taking place via advances in other new technologies, such as face-recognition, for instance Windows Hello, Google Vision, Blink!, AMD Face Login, and facial expression analysis software, such as for instance FaceReader and Affectiva, which can combine demographic data, with emotion recognition and eye-tracking, see Fig. 7.5.[37] To illustrate the power of these combined new technologies, consider the following example: researchers reported being able to automatically recognize sheep facial expressions, based on techniques for human face recognition. "Our multi-level approach starts with detection of sheep faces, localisation of facial landmarks, normalisation and then extraction of facial features." They reported that their computer system was able to classify 9 different sheep faces and consequently estimate their pain levels with an overall accuracy was 67%.[38]

Emotion recognition and gaze direction is also being built into Virtual Reality headsets, for instance Tobii EyeCore. The advantages of this are multitude.[39,40] It allows for the representation of computer generated realistic reproduction of non-verbal communication cues in the virtual world, based on data collected from eye-contact between users and virtual agents. It can also make following moving objects and aiming at objects easier, because the computer system can help improve the aim. Additionally it can add new interface functionality, by making gaze directed selec-

[37] http://cdn.windowsreport.com/wp-content/uploads/2017/08/Blink-face-logon.jpg.

[38] https://www.engadget.com/2017/06/02/facial-recognition-software-sheep-pain/.

[39] https://www.tobii.com/siteassets/tobii-tech/vr/tobii-vr-infografic.pdf/?v=1.

[40] https://www.tobii.com/siteassets/tobii-tech/vr/tobii-whitepaper-eye-tracking-next-natural-step-for-vr.pdf/?v=1.

tions from menus possible. Finally, it can help computational constraints of visual fidelity to be lower, by only rendering in full detail what is in the direct gaze of the user in an instant. In order for facial, emotional and gaze direction recognition to work, the system has to record and analyse this data. A user watching something on a screen, will show changing facial expressions, their pupils will react, and their bodily systems will respond to the stimuli in numerous, unconscious ways and it is possible to show the relation of these physical reactions to the exact online stimuli. This means that data can be gathered about a person such as the length of time they look at something and more importantly their physical reaction to it. This kind of tracking and recording of personal emotions, movements and social interactions creates data collections that were never possible before and are as detailed and predictive as any forensic scientist could wish for [2].

This digital footprint then, provides a wealth of information about individuals, their preferences and that of their network of work-colleagues, acquaintances, as well as their friends and family. The information becomes a valuable commodity in both commercial, social and political sense, as it is used by companies to target advertisements and analyze trends and behaviours. Recently the first VR, in-world advertisement was made feasible via the Unity ads platform.[41] Companies that own the data collected via these new technologies, especially those that collect data from combinations and convergences of social network and virtual reality systems, have enormously influential positions, because they can collect data from all users and analyze their behaviours. This makes them the gatekeepers to key elements of individual and social life e.g. fulfilment of informational needs, social environments, and entertainment [5]. Already, questions and concerns are raised about advertising in VR.[42] Both Facebook and Microsoft already have large user-groups. Add to this the "*killer-app*" functionality of VR to connect geographically distributed users, which makes meeting on a regular basis so much easier, an exponential growth of the number of users and the use of VR can be expected in the near future. This means that, potentially ever more detailed information about each individual can potentially be aggregated and available, certainly more than ever before.

7.3 Ethical and Psychological Risks of Personal Data Collection with Social VR

The awareness that the Internet and Social Media can have a strong effect on a user's self-perception and social self-esteem, is becoming more mainstream. This effect, known as the Proteus Effect, has also been studied in relation to VR use [17]. The long-term consequences of how this influences and shapes user's psychological makeup are not that well known yet. If the trend of Social Networks converging with

[41] https://blogs.unity3d.com/2017/10/20/vr-advertising-experience-lionsgates-jigsaw-in-vr-with-a-virtual-room-ad/.

[42] https://venturebeat.com/2017/10/25/the-vr-industry-must-avoid-intrusive-ads-for-as-long-as-possible/amp/.

Virtual Reality technology continues, in the not too distant future large parts of the human population will be immersed in virtual environments, while we actually do not fully know what the psychological impact of long-term immersion will be. It is clear that this is particularly important to understand better, when we consider that the majority of VR headsets are being purchased by younger Internet users, whose minds and brains are not fully matured.

Users of VR systems are represented in the virtual world, by a personal virtual embodiment, also known as "Avatar", and they can interact with other users' Avatars, in real-time, either via audio, text or a combination of both and to a certain degree they can move and virtually touch other avatar's with their own avatar. An avatar is a computer generated representation of a user, and in many VR systems users can chose from a number of different types of embodiments, in terms of shape, colours and outfits, depending on what is available in the system. There is an ongoing trend in terms of the realism of avatars, both in terms of movement and appearance. A high degree of realism can be achieved by using 3D 360° photo's of the physique of a real user, made with 360 camera. The avatar is controlled via the user interface to the virtual world and the avatar, which means that control of the avatar is always mediated by technology. While the user interacts with the virtual environments via the avatar, they build up a representation of the virtual self and the virtual world, that temporarily replaces the awareness of their, real self and their real body and the real world around them. They enter a state of absorbed attention and identification with the VB in the VE, which has been compared to mystical experiences and can take first-time VR users by pleasant surprise, making them seek out further VR experiences [14], see Fig. 7.6 for a diagram that depicts this effect. This is not to say that the user loses touch with their real self, but in order to concentrate on the avatar their awareness is focused on this immersive experience at the expense of their ability to pay attention to the real world around them.

The psychological effects of immersion in a VR world have been researched by quite a few researchers in one form or another since the early days of VR. A recent

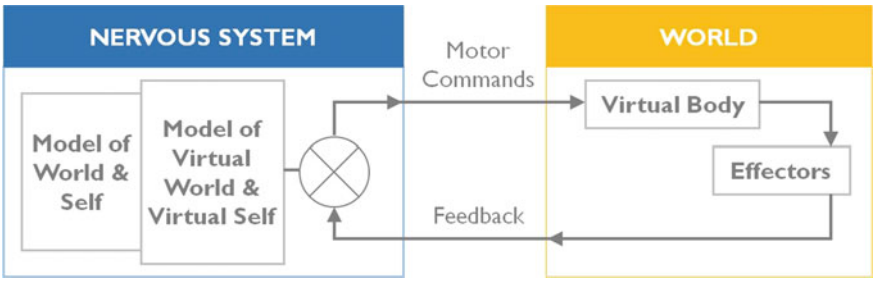

Fig. 7.6 Interaction in a virtual world through a virtual body representation temporarily replaces awareness of one's usual self [14]

review of the research results has been reported by the VERE Project [4]. The authors see a number of risks involved with long-term immersion in VR:

1. *Additiction*: it is not unheard of that users get addicted to being their avatar and prefer this over being themselves, finding it hard to deal with the real world and stuggle to take breaks from the VR world. This can lead to neglect of their real body and their immediate real family, friends, work colleagues and job in the real world.
2. *Manipulation of agency*: users control their avatar via the interface to the VR world. This means that their avatar can be manipulated in subtle ways outside of their immediate awareness and the user might think they are in control, but actually their avatar is directed in certain ways and exposed to manipulated imagery and experiences, rather than the users picking and choosing these. This is related to a concept called "*nudging*" in which for instance marketing agencies present information in a certain way or in a limited way, so that citizens' thinking, behaviour and expectations spontaniously follow a desired direction.
3. *Unnoticed psychological change*: it is not unusual for new users and long-term users to feel a certain euphoria when being immersed in the virtual world, because it is vivid and attractive. They might feel a sense of power and control over their virtual world and virtual self that they lack in the real world, thus giving them a false sense of their own abilities when the power and control does not translate to the real world, the so called Proteus Effect. This can be more difficult to understand and handle for some users than for others, and could lead to Depersonalization or other types of mental illness for some users [1].
4. *Privacy*: as described in previous sections, VR of the future can record user's physical and psychological responses, which can be analyzed automatically and use for targeted advertising, a new method called "*neuromarketing*". This could be argued to be a breach of someones privacy and autonomy. These two concepts are further explored below.

According to [5] there are two central ethical concerns, that are broken down into three subcategories each, which in turn are further broken down into actual threaths to end-users: Privacy (subcategories: *Informational Privacy, Physical Privacy and Associational Privacy)* and Autonomy (subcategories: *Freedom, Knowledge, and Authenticity*). Consider what would happen if a large part of the Internet users is using VR for business and daily social interactions, this might erode societal norms to a status-quo in which privacy and autonomy are deminished in undesirable ways.

People develop themselves and explore their ideas, by making mistakes, experimenting, and exploring different aspects of themselves. They require a certain degree of privacy in which to feel free to do this. Life in a world of diminished privacy will affect the development of individuals' moral characters. Without privacy, the ability of governments *and companies* to influence individual and group behaviour will be extensive. Three types of privacy and their associated threats are distinguished (O'Brolchain, et al, ibid; [11]): Informational privacy, Physical Privacy, Associational Privacy. These concepts are further explained below.

- *Informational Privacy*: protection against third party access to all kinds of information about an individual including an individual's thoughts, utterances, correspondence, and financial, medical and educational records. Threats to Informational Privacy are increased vulnerability of data; misuse of data from virtual meetings with supervisors, doctors, accountants, partners etc. In VR that means information about work performance, health, financial status and sexual preferences is captured and no longer private, and people might face discrimination as a result of what is known about them.
- *Physical Privacy*: shelter against third party sensory access to an individual's body and actions. Thus it concerns modesty, separateness, bodily integrity and the like. Threats to Physical Privacy are recordings of people's faces, emotional states, bodily movements. Three types are distinguished: losing control over being observed in our physical environment; unintended revelation of physical information; loss of anonimity.
- *Associational Privacy*: an individual's control over excluding and including third parties in certain specific experiences. It thus guarantees the intimacy of certain social situations that an individual wishes to be intimate. Threats to Associational Privacy refer to the ability to include or exclude people from certain events and has two aspects: Online socialising, which means that it will be harder to control who attends a virtual event, and more difficult to control who knows about it, and the Global Village problem, which refers to the fact that when we socialize online with realistic avatars, many of our real-time reactions and conversations about trivial and important matters are recorded and potentially available to third parties.
- *Autonomy defines an important quality of human beings*: the ability to independently make plans and form goals. It is intertwined with privacy because we need a certain amount of privacy to think through our options in order to be able to come to our indepdent decisions. Autonomy requires three components (O'Brolchain, ibid): Knowledge, Freedom and Authenticity. These concepts are briefly described below. Knowledge: people need access to relevant information in order to make choices. Threats to Knowledge come from filter bubbles, cyberbalkanization, and from gatekeepers. If VR users primarily access news and information about the world based on what the Virtual Environment shows them or recommends, then they are at risk of the "*Filter Bubble*" [9]. This refers to information being filtered based on the preferences of the user as analyzed from their searches and time spend looking at information, The analysis means that they can then be provided with targeted information based on their appearent interests, giving them a personalised online experience. This could be intensified by the social aspect of VR, where the VR system could help them find only information that confirms their views (*also called Cyberbalkanization or Gatekeeping*) and virtually meet only like minded other's, thus creating their own filter bubble. Virtual worlds might become ever more appealing to users if their beliefs and perspectives are prevalent in the VR bubble they inhabit. And finally, a company could use artificial intelligence (AI) or a chatbot in a virtual world, that presents information in a certain way, with the aim of influencing public opinion, effectively making the AI chatbots the new gatekeepers. Freedom: people need a certain lack of constraints

so that their autonomy is not hollow. Threats to Freedom are based on addiction, manipulation, the Big Brother scenario, and self-censorship. Authenticity or being one's own person: people need to be able to choose for themselves according to their own ideas and values. Threats to Authenticity are based on being exposed to a virtual environment that creates a false sense of autonomic agency, where in fact the user is presented with information that is selected for them outside of their awareness.

7.4 Recommendation to Mitigate Ethical and Psychological Risks of Social VR

People will increasingly more use VR for their daily tasks and activities, leaving an increasingly more detailed digital record of their likes and dislikes and their daily needs and routines. For instance, in the near future VR users might not just meet their friends or family in a virtual environment, but they might also virtually meet their supervisor, their doctor, their accountant, their teachers via VR, rather than physically travelling to meet them. It has been found that people are likely to reveal more intimate and personal information in online scenarios, placing them at an even higher risk than ordinary Social Media users. A virtual environment can give the illusion of greater anonimity and privacy, and a VR user may temporarily forget that their actions can be recorded and replayed, both within and outside of the VR system, because the recording devices may be not be so obvious, embedded in the virtual spaces they visit or the VR hardware or software they are using. There are a number of recommendations for mitigating the possible and currently unknown risks of large-scale (*many users*) and or long-term (*many hours*) in social VR. Separate recommendations are made for Psychologists, adult VR users and parents of VR users, Regulatory Agencies, VR Software and Hardware developer companies and VR researchers.

7.4.1 Recommendations for Psychologists, Adult VR Users and Parents of VR Users

Similar to Internet Use Disorder and Gaming Addiction and this may now have to include addiction to VR. Psychologists need to establish diagnostic criteria for addiction to VR and how these differ from the criteria for Internet Use Disorder and Gaming Addiction. The neurophysiological underpinnings of VR addiction may differ from that of internet use disorder due to the prolonged illusion of embodiment created by VR technology, and because it implies causal interaction with the low-level mechanisms constituting the UI [4]. Psychologist also need to establish if the treatments for Internet Use Disorder and Gaming Addiction will help VR addiction

sufferers. Adult VR users and parents of young VR users need to be aware that Psychologists are not fully versed in how to treat VR addition yet.

7.4.2 Recommendations for VR Software and Hardware Companies

The fact that there may be risks associated with long-term use, and that those risks are not known yet, needs to be directly and clearly communicated to users, preferably at the beginning and as part of the VR experience itself. Additionally, any devices that record user behaviours should clearly state this and make it very obvious how to switch this feature off.

7.4.3 Recommendation for Regulatory Institutions

Citizens need to be made aware that long-term VR exposure may have lasting psychological effects and that there is no clear information about the effects of long-term use of VR and that not much is known about the long-term effects so far. Citizens also need to be made aware that their freedom and autonomy in choosing what information they are exposed to in a VR world is manipulated in the same way as via Internet, TV and radio advertizing. Furthermore citizens need to be made aware that their behaviours and responses in VR may be recorded and analyzed to a much finer degree than is already happening via Internet user behaviour monitoring.

7.4.4 Recommendations for Researchers

In order to better understand the risks of the psychological and physical effects of long-term immersion, longitudinal studies of actual users are necessary, conducted according to the principles of informed consent, non-maleficence, and beneficence, for which the VERE Project develop a Code of Ethics ("*The Research Ethics of VR.*"), to help raise awareness and provide guidance to achieve this (Madary and Metzinger, ibid).

7.5 Conclusions

The goal of this chapter was to focus on the risks and challenges of Social VR and how these impact our society. However, there are also many potential advantages for mainstream daily use of Social VR. Firstly, having a system that is capable of analyzing whether we are bored or inspired will have tremendous potential for

education. To have a virtual AI driven teacher in a virtual classroom that can be attended by anyone regardless of their physical location and abilities, will allow education to be customized to suit each individual's needs [7]. Secondly, Social VR is a green technology, because it makes the need to physically travel to meetings less frequently necessary, and this will save on fuel, time and financial resources. VR makes the world subjectively smaller as more groups connect individuals with each other. Thirdly, Social VR has an added value over other teleconferening technologies, because it allows multiple users to look at and collaboratively interact with 3D objects in the shared virtual space, even co-designing in real-time. This means that Social VR is very suitable as a tool to make the new Digital Silk Road feasible, because discussions about a design and checking dimensions of a design in relation to other objects, or the space in which they need to be utilized, can be pre-assessed by the team in the Social VR world, thus potentially saving time and manufacturing resources. Numerous theorists have argued that these new technology changes mean that we live in a cognitive, or informational, or immaterial, or knowledge economy, where collective cooperation and knowledge become a source of value [10].

VR has been put forward as game-changer in every human domain, including but not limited to love, war, worship, and learning [2]. It has been hypothesized that Social VR will impact all social institutions, bringing people together in new ways, changing the nature of activities and institutions. Recent Nobel prize winner in economics, Professor Thaler, systematically describes how human beings all succumb to biases in their thinking and make decisions that deviate from the standards of rationality. He is a proponent of the "*nudge for good*" concept, where positive social norms are reinforced through selective presentation of personalized information towards a certain societally desirable point of view, making a distinction between the nanny-state concept and libertarian paternalism [13]. Social VR provides the means to show citizens what the world would look like from all kinds of different perspectives, making it in a manner of speaking an empathy machine.

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