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The material politics of mobile virtual reality: Oculus, data, and the technics of sensemaking

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Abstract

This paper contributes to an increasing occupation in media studies with Mobile Virtual Reality (MVR) – a form of 'wireless' VR, where all necessary sensing componentry is built into the system's headset and controllers. Our analysis focuses on the Quest series of devices, offered by Facebook-owned VR company Oculus. Through the philosophy of Gilbert Simondon, we argue that the Quest represents a 'concretisation' of VR – of VR becoming internally coherent and synergistic, enabling its mobility and use in varied contexts. We suggest that this process of concretisation is what enables it to generate vast amounts of data with the potential for use by Facebook's advertising arm and in future product development.

Keywords

Data, Facebook, mobile media, Oculus, philosophy of technology, Simondon, technicity, virtual reality

Introduction

Virtual Reality (VR) has long been framed by industry boosters as a class of technology affording experiences that are 'disembodied', cordoning the user off from the corporeal world (see Chesher, 1994). Recent scholarship has pushed back against this common framing, with an eye to the VR medium's material dimensions (see Bollmer, 2020; Saker and Frith, 2020). In this article, we contribute to nascent materialist scholarship on emerging forms of mobile VR (MVR). An increasingly popular form of 'wireless' VR, favoured by market leaders like Facebook-owned Oculus, MVR systems build all necessary hardware componentry into the headset and controllers – using

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inbuilt sensors, outward facing cameras and computer algorithms to generate virtual environments and register movements made by the body (see Saker and Frith, 2019, 2020).

In this article, we examine the case study of the Oculus Quest MVR device. As we have set out in more detail elsewhere, Facebook increasingly frames Oculus' VR (and, more speculatively, augmented and mixed reality – collectively 'XR') as a central part of the platform's future (see Egliston and Carter, 2020), what it now refers to as the 'metaverse'. The company's foray into MVR has proven a success so far. Following the release of the Quest 2 in late 2020, Facebook's fourth quarter (non-advertising) revenue doubled compared to that of its 2019 fourth quarter – which Facebook CFO David Wehner attributed to high sales of the Quest 2. Overall, Oculus' products currently capture a dominant 39% share of the VR hardware market over competitors Sony, HTC and Valve (Freedman, 2020). The device, unlike previous forms of Facebook VR (e.g. the Oculus Rift) does not require a dedicated PC to run software and is entirely self-sufficient beyond the requirement of installing the Oculus smartphone app to set up the console.

Our analysis is driven by two main aims. First, to specify the apparatuses and modalities through which the Quest 'makes sense' of space in ways that are distinct from existing forms of VR. Second, to frame these materially specific sensemaking processes within wider political economic debates surrounding Facebook (Bucher, 2018; Wilken, 2014), particularly with respect to the company's data and surveillance centred business model.

To coordinate our analysis, we draw on ideas from Gilbert Simondon's philosophy of technicity, emerging from his project of 'mechanology' – a wider philosophical intervention that can be described as a phenomenology *for* machines, taking seriously their interior 'lives' in such a way that technics are irreducible to their use or effect. For Simondon technicity can broadly be taken as the way technical objects 'come into being, change and endure' (Mackenzie, 2013: 192). Simondon's account of technicity centres around a process he terms 'concretisation' (see, particularly, Simondon, 2017: 25–29. In Simondon's philosophy, concretisation refers to an inherent tendency of many technological objects, specifically, their dynamic functionality as originating from new forms of synergy, plurifunctionality and internal coherence. It is from this perspective that Simondon studies broader arrangements of interdependent concrete objects (what he calls ensembles), which may exist as part of a wider network of technical objects and human actors (see, e.g. Simondon, 2017: 247–261).

Following Simondon, we understand the Quest as concrete and distinct from previous forms of (non-mobile) VR on the basis of its tightly integrated hardware and software stack. This view of technology's material substrate afforded through Simondon's thought holds great explanatory power. For Simondon, mechanology provides an understanding of technics not in terms of their use or telos, but in terms of degree of concretization. This is part of Simondon's wider aim to take seriously the role of technics in culture as things that are not deterministic of human action, nor something that can be understood purely as socially or culturally constituted. For Simondon, machines are certainly implicated deeply in human life, society, economy – but have their own distinct agency. While Simondon does not frame it as such, this perspective offers much to political economic analyses of technology today (see, e.g. Bardin, 2015; Ash, 2017) – specifically, those focused on the political economy of data – by orienting us toward the materialities that subtend mediated life, and the ways these materialties sustain particular aims, logics and interests. As we show here in thinking through the Quest's concretisation, we argue that the Quest and MVR are distinct from other forms of VR (despite their similar end use, of generating virtual environments) – operating as an arrangement of componentry (such as optical sensors, Inertial Measurement Units and computer vision algorithms comprising the system's navigational stack) that allow it to make sense of the environment around the user. The framework of concretisation, then, allows us to take the Quest for what it really is – a data intensive digital sensor that is increasingly (and uncritically) taken into our homes – and to ask questions about who reaps the benefits of its adoption. Drawing from Simondon's notion of the ensemble (that is, the arrangement of interdependent concrete objects), we argue, with reference to Oculus' EULAs and technical documentation, that the Quest's concretization not only serves phenomenological ends – convening particular modes of attention – but accrues financial benefit to Facebook through their surveillance and data centred business model. Drawing from Facebook's statements in these materials, we track the company's ambitions in its development of Oculus – specifically as they pertain to leveraging Oculus' network effects. We focus on how data from user interactions with space may become variously mobilised by Facebook – for ends of targeted advertising and for future product design (see Egliston and Carter, 2021). In this way, through the Simondonian notion of technicity we develop – as Gerlitz and Helmond have it – a 'platform critique' of Oculus (as a subsidiary of Facebook) that is 'sensitive to technical infrastructure whilst giving attention to the social and economic implications of the platform' (2013:2)

In what follows, we begin with an overview of existing literatures exploring the sensemaking capacities of VR (and MVR) technology. We then introduce the philosophy of Simondon and the concept of concretisation, outlining its utility in thinking about digital media. The remainder of our analysis applies Simondon's thought to think through the case of the Oculus Quest. We first examine the concretization of the Quest, compared to earlier forms of VR (specifically the Oculus Rift CV1). From there, we discuss how a more concrete MVR benefits Facebook's imagined platform future, and moreover fits neatly within the corporate aims of Facebook; operating as a part of Facebook as a technical 'ensemble'. Further, we discuss some approaches for intervening in and limiting the role of Oculus within the Facebook ensemble that build from an understanding of MVR's technicity.

Making sense with VR

Before proceeding, we offer a brief overview of the relationship between VR as a sensory apparatus, and VR as something that generates certain sensory modes. In the literature to date, the sensemaking capacities of VR have largely been conceived in terms of spatiality. By this, we mean that VR is understood as something that occupies a space, produces certain socio-spatial relations, and requires certain spacings and timings of the body in its use.

One popular way of thinking about VR's sensory capacities has been in terms of the body of the VR user. Like other forms of natural user interfaces, VR produces (and requires) certain spacings of the body in its use. As Bailenson writes 'When you experience a VR simulation, you move your body as if you were experiencing an actual event in the real world' (2018: 31). Indeed, the intuitive or natural regimes of embodiment of VR has been a part of the VR imaginary for some time, as Chesher (1994) notes in his analysis of industry discourse around VR in the 1980s and 1990s. He writes that this discourse of a natural, intuitive interface is encapsulated in the language of VR tech pioneers like Lanier, Walser, Gullichsen and Rheingold. On more contemporary VR, specifically focusing on the Oculus Rift, Golding (2019) writes of VR as a medium that is imagined largely around the performance of an embodied spectacle, through the user making a range of bodily gestures. He makes this point with reference to the now famous and widely parodied *Time* magazine cover of (then) Oculus CEO Palmer Luckey suspended in mid-air using the Oculus Rift. Other work has begun to address the politics of embodiment with attention to disability. As Gerling and Spiel (2021) have suggested, while VR is commonly held to offer intuitive or natural embodied experiences, it often takes an ableist and normate view of embodiment.

Beyond the space of the body, we might also think of the material environments in which VR is used as spatial. Scholarship has touched on the socio-spatial relations that emerge from the use of

VR, particularly in the use of VR in public spaces. Focusing on the use of VR in art gallery spaces, Parker and Saker (2020) discuss the qualitative experience of this increasingly popular 'public' use of VR. Inspired by Henri Lefebvre's (1991) account of spatiality, Parker and Saker understand the art museum as both spatial and social – a dynamic that VR-based experiences alter. As they point out, through interviews with gallerygoers, VR created feelings of 'freedom', inasmuch that their view of the virtual space was not visible to others – providing a 'mastery of space and autonomy that is rare in a crowded museum' (2020: 10). Conversely, their participants describe feelings of vulnerability – particularly in being watched using the technology, which Carter et al. (2020) also found in their research into the use of VR videos in the zoo. Museums – as social, public spaces – are inherently characterised by a dynamic of watching others, something that Parker and Saker's (2020) participants also felt to be intensified through VR, where the user's bodily performance of VR became part of the museum experience.

In a piece that is perhaps most relevant to the present work, Saker and Frith (2020) focus on the Quest as a 'mobile' form of VR, not tethered to a stationary PC and set of sensors (as with previous iterations of Oculus hardware). They develop the concept of coextensive space 'as a way of understanding the developing relationship between the physical, digital and concrete reality that is being enacted by current VR systems' (2020: 3). In this way, the 'concrete space' – referring to the users' analogue surroundings – of the world is always and already included in the phenomenological experience of VR (chiming with broader accounts of media and space, particularly mobile media, see Humphreys, 2012). Through their examples of the Oculus' Passthrough or Guardian systems – which allow the player to see, in mediated form, and navigate the analogue space surrounding them without taking off the headset – Saker and Frith argue that 'modern VR systems are forging an altered relationship between the physical, the digital and concrete space, through the mediated inclusion of concrete reality' (2020: 9).

Through Simondon, and by identifying MVR in the form of the Quest as a particular concrete object we are able to build on Saker and Firth's theorisation of MVR as changing the phenomenological experience of VR – as something characterised by a coextensive relation with space (2020). Attending to the Quest's materiality (and recognising this as distinct from existing forms of VR), we demonstrate, is useful in developing political economic critique of Oculus products, particularly key (yet missing from existing analyses) in light of Facebook's ownership of Oculus (and recent integration of Oculus' development into Facebook Reality Labs). Much like other forms of mobile media (see, e.g. Frith and Wilken, 2019; Wilken 2015), the technics of mobile sense-making are not neutral but bound up with political economic questions of power; technics are the means to some social or economic end. The work of Wilken (2015: 53) is particularly instructive in highlighting the necessity of coupling analyses of mobile media's technological affordances and dimensions with political economic analysis – particularly as they pertain to data and the capitalization thereof. As we show, the concretisation of the Quest and MVR not only serves profit motives relating to things like user experience or reducing overall cost for users (and achieving further market penetration) – but rather that the Quest's use as a concrete object is generative of various kinds of profitable network effects commensurate with Facebook's platform economic business model. Specifically, we refer to the use of data generated by Quest users as feeding into future AR product design and into Facebook's ad network and targeted advertising, as specified in Facebook's October 2020 amendment to the Oculus EULA. In sum, drawing from Simondon, questions of Oculus MVR's political economy (particularly concerning data) become clear once we consider its concretisation with an eye to the wider ensemble of Facebook.

Concretisation and technology

Simondon's thought largely spans two main texts – *Individuation in the Light of the Notions of Form and Information* (2020, *ILFI* hereafter) and *On the Mode of Existence of Technical Objects* (2017, *METO* hereafter), both of which were presented for his doctorate, defended in France in 1958. Across these projects Simondon maintains a common interest in characterising systems – whether physical, vital, technical or psycho-social – in terms of ontogenesis, that is, of becoming or individuation; in so doing, contesting 'metaphysical theories [that] assume a priori the existence of fully-constituted individuals' (Mills, 2015: 62). *ILFI*, Simondon's main thesis, expansively deals with the individuation of social and biological individuals, such as psychic and collective individuals. It is here that he develops the concept of the transindividual – a category which 'attempts to account for the systematic unity' (Simondon, 2020: 9) of different kinds of individuation. For example, the mind – the psychic individual – is not originary but constructed in a collective sense, through relations (social, symbolic, technical) 'exterior to the individual' (Combes, 2013: 26).

These ideas form the basis for much of Simondon's thought on technology in *METO*, his complementary doctoral thesis. It is here that Simondon's ambition is to reconcile the 'false' (2017: 16) opposition between technics and culture. He states that there are two 'contradictory attitudes' (2017: 17) that prevail in thinking about technology in relation to culture. First, the tendency to crudely understand technology in terms of its actualisation or utility, devoid of signification and bracketed off from the social (2017: 17). Second, as 'fetishized' (as Heaney, 2019, puts it) – a tendency to fear or exalt the technical object for its capacity to bear upon human life (2017: 17). Simondon's wager is that to properly understand the role of technology in society, we need to walk the line between these two poles of technological and social determinism. It is as such that to think technics is to think in terms of the transindividual (see Simondon, 2017: 247–261), to think of technics as 'mediators between man and nature' (Simondon, 2017: 16).

The method posed by Simondon to focus attention onto technics emerges in his philosophy of 'mechanology' – a positivist leaning object analysis, bridging the fields of philosophy and engineering. Simondon offers the concept of technicity as a way of thinking about how technical objects exist in the world (Mackenzie, 2002), squarely focused on the lives *of* technologies, so to speak, as entities within human societies. For Simondon, to think of the role of technics in society, we must first explore the network of more-than-human relations that form between and around technics and humans.[1] While this analysis may seem distinct from his focus on the individuation of organic beings, many of the themes of process and relationality we see in *ILFI* have a direct bearing on his ideas in *METO*. There is, however, some terminological difference in how Simondon speaks of technics. Distinct from the relational process of psychic or social individuation, technical objects, or 'individuals' (e.g. engines or transistors or tractors or hydroelectric dams, to give a few of Simondon's own examples), undergo a (similar) process of 'individualization'.

Key to our analysis is a specific process Simondon calls concretisation, a term he proposes in *METO* to think about the interdependency of an object's technical componentry as they pertain to overall functioning. Concretisation denotes the evolution from what Simondon calls an 'abstract' state – that is, a state of organisation where elements have singular functions and operate in a chain-like fashion – towards a more synergetic integration and inner-convergence, one where elements become 'pluri-functional' (that is, taking on several roles at the same time). The point is to conceive the genesis of technical objects as emerging from the interior of the technical object itself as 'successive designers and manufacturers integrate previously separate or abstracted systems… into more concrete arrangements' (Ash, 2017: 30).[2] To help clarify this somewhat abstruse terminology, we provide some examples from Simondon's work, and from more recent digital media studies that adopt Simondon's thought.

Early in *METO* Simondon illustrates concretisation through the example of the shift from water-cooling to air-cooling systems in combustion engines. Water-cooled engines, he writes, are abstract because they feature a separate system attached to the main engine (e.g. featuring a pump and circulatory system to keep the engine from overheating). The air-cooled engine, on the other hand, is concrete because the cooling mechanism is built *into* the engine. The air-cooled engine – which in Simondon's example involves adding fins to the cylinder – is conceived as more concrete because the engine's functioning is no longer provided by a separate, closed water-cooling system, one which requires its own conditions for operation separate to that of the engine. The air-cooled engine operates as part of the normal operation of the engine as a single technical system. Additionally, a further degree of concretization can be noted in that the same fins that are used for air-cooling also provide structural integrity to the cylinder head. We therefore witness in this progression a move from an arrangement of (abstract) structures to a single concrete system which supports multiple functions.

A more up to date illustration of concretisation comes from Bernhard Rieder's mechanology of software in *Engines of Order* (2020). As Rieder notes, the way Simondon conceptualises the movement from an abstract to concrete state in pre-digital technics is complicated through software and the practice of programming. Rieder characterises, for instance, 'a program that relies on pre-existing modules or libraries as an example for an abstract technical object' (2020: 71). He elaborates that 'since the compiler' – that is, the software that translates computer code into different programming languages to create a program – 'builds the actual technical object and reproduction comes down to mere copying, a more abstract or modular 'construction will be much faster and cheaper to create than a more concrete, optimized, and integrated object'' (2020:71). Thus, in the context of software development, an abstract object is not necessarily 'less' optimised than a concrete one – and is something that is actually more adaptable and widely used. This is not to say that Simondon's categorisations of abstract and concrete no longer hold water today; rather it is to say that new technologies complicate and create further permutations of abstractness-concreteness.

To reiterate: Simondon's goal is by no means to push an anti-correlationist view of humans and technics, as is the fashion of recent new materialisms or object-oriented ontologies. His attention to the elements comprising the object and the agency of matter must be understood within the context of a broader motivation to theorize the technical as imbricated within the social or cultural. It is through mechanology – through a 'phenomenology of the technical object' (Simondon, 2017: 250) – that we are equipped with a systematic and rigorous method to show just how life is materially subtended. Yet despite the normative force to 'put culture and technicity on equal footing' (Rieder, 2020: 64) there is one major limitation worth addressing, pertaining to Simondon's treatment of the social: the absence of any explicit social or political critique (see Bardin, 2015).

The problem, as diagnosed by writers like Daniela Voss, is that Simondon 'shows no ambition to criticise the social relations of domination, in stark contrast to the Marxist intelligentsia around him' (2019: 282). Simondon's engagement with political economic theory – particularly Marx and the idea of alienation with respect to automated factory work – is a good example. As Voss summarises it, for Marx alienation describes how 'the worker is not simply subject to the machine but to the technologically embodied rationality of the productive process itself, i.e. the logic of capital' (2019: 294). While Simondon does not outright deny the role that socioeconomic factors play in technological development (2017: 254), or the wide-ranging contexts into which technology enters, he argues – on a vulgarised account of Marx – that those socioeconomic factors are understood in overly deterministic terms. Instead, Simondon re-defines alienation, taking it to describe a (supposedly more profound) psycho-physiological loss of a capacity for technological intellection by way of minimizing the agency of the human operator in technologically mediated practices (see Simondon, 2017: 25–29).[3]

Simondon's wager is obviously problematic and limited in this sense in its potential to deal with political struggles surrounding technology (such as those concerning labour), as we must always speak of technology Janus-faced, to both the social and the material. Decades of research in fields like Science and Technology Studies (e.g. Winner, 1978; Pinch and Bijker, 1984), and a recent resurgence of interest in questions around the 'social' dimensions of technology like data and algorithms (see, e.g. D'Ignazio and Klein, 2020; Eubanks, 2018) – particularly as they pertain to equity, power and fairness – would suggest that it is exigent to understand concretisation as a social, political and economic phenomenon, underlain by certain ideologies and interests.

Despite limitations in leveraging his philosophy for social critique, Simondon offers a fruitful framework, through his 'normative pedagogy of technical culture' (Bardin, 2015: 228), for those advancing technopolitical critique today.[4] For Simondon, to be alienated is to be deprived of the capacity to participate in technical development or transformation due to an ignorance of the relationship between 'man' and 'object'. Indeed, for Simondon and us today, this is particularly urgent, in light of the status of technology as one of the 'activities and processes that are called human' (Bardin, 2015: 231). While not drawing on a Simondonian framework, there are clear resonances between Simondon's normative mechanology and recent attempts to understand the relationship between technical objects and the social, in efforts rooted in social justice to address the harms of technology through 'unlocking' its 'black box' (see, e.g. Crawford and Paglen, 2019). It is in such a tradition (drawing from Simondon's ideas) that we situate our response to Oculus' MVR.

In the following section, we cast Oculus' MVR in terms of concretisation as a theoretical and conceptual move to understand how the Quest's sensing capacities are centrally reliant upon a high degree of synergism and plurifunctionality, in contrast to more abstract, functional chains in previous forms of VR (focusing on the popular Oculus Rift CV1). Beyond its explanatory power, we believe that the material orientation Simondon provides has critical scope – providing the means to articulate how the Quest as MVR is not simply a benign 'experience generator' but a sophisticated arrangement of sensing – and data intensive – technics. We go on to show – through reference to Facebook's public facing materials and legal documentation – that this concretisation of MVR is not *just* to achieve a more mobile, coextensive relation to space (cf. Saker and Frith, 2020). We argue that concretisation through more mobile, data intensive VR fits within the corporate aims of Facebook – particularly their data and surveillance centred business models.

Mobile VR and concretisation

Innovations in contemporary VR sensors have progressed through various stages. Up until recently, Oculus' VR has been reliant upon external optical sensors. We see this in previous iterations of Oculus hardware (such as the Oculus Rift CV1, the first commercial version of the Rift, on market from 2016–2019) – which tracked the movement of the user in space using fixed-in-place 'Constellation' sensors. Constellation is the Rift's rotational and positional tracking system, used to track the position of the users' head and hands (specifically, the controllers). The Constellation's optical sensors (which are in fact cameras located within the Rift's 2 external sensor devices, see UploadVR, 2017) are used to track light emitted from LEDs on the controllers and head mounted display (HMD).

For the Rift to 'make sense' of movement and space, frames captured by the sensor are sent to the user's PC over USB cable. The PC then processes each frame, identifying the position of each infrared LED and thus the relative position of each object. Each frame is subjected to processing so that the infrared signals are clearly highlighted. External components, such as a light filter are also used in order to ensure that excess light does not inhibit retrieval of the X, Y and Z coordinates of the LEDs on the headset and controllers. The Rift, in Simondon's language, might be described as more 'abstract' – less multifunctional, a system comprised of a number of different self-sufficient things. The fact that the Rift's functioning is reliant upon a range of different components with singular functions means that any interruption to any of these components' functioning severely effects the overall functioning of the Rift (e.g. if a sensor is blocked or knocked over).

MVR technologies such as the Oculus Quest have instead developed to be more concrete. The concretisation of the Quest can be understood in terms of developments in the hardware and software layers comprising its navigational 'stack'. At the basic (yet fundamental) level of hardware, the concretisation of the Quest is in large part reliant upon a mix of advanced computing power (particularly, as emphasised in Facebook's technical documentation [Hesch et al., 2019) the device's processor). Much like Simondon's mid-century examples, the Quest relies upon concretised thermal management – with thermal management noted as a significant design consideration in a blog post summary of designing the Quest's navigation stack (see Hesch et al., 2019). Indeed, as Mark Zuckerberg has noted elsewhere (The Information, 2021) it is CPU cooling that is one current technological barrier to Oculus adding more advanced sensing capabilities to the Quest (such as eye and facial expression tracking).

Heat evacuation is as necessary for modern-day computing as it is for mid-century technics (like the aforementioned combustion engine) – excess heat for both engines and computers resulting in diminished performance, and potentially the complete breakdown of the object altogether. As Oculus have noted, the Quest is reliant on an overclocked Qualcomm Snapdragon 835 processor – meaning that the CPU runs at speeds higher than those certified by Qualcomm (allowing it to process data from multiple different sensors, to make sense of surroundings, to track and follow the controllers and so on). Doing so, however, means that the CPU requires higher voltage, and therefore generates more heat, and for this reason Oculus have implemented a 'robust cooling system' (Pruett, 2019: n.p.). Specifically, as revealed in Twitter user Goroman's disassembly of the Quest 2 (Goroman, 2020), the device is cooled through an electrically powered fan and the arrangement of the chipset such that it facilitates passive airflow and heat dissipation – both of which sustaining the requisite overclock speed, voltage and temperature. While aspects of this cooling system are concrete – such as the passive cooling system, which at once directs air and provides structural integrity for the front of the headset, the reliance on a fan makes it more abstract than the previous Oculus Go. This said, despite the Go being 'more concrete' in this sense, it is limited in its capacity to render high fidelity graphics, or to sense bodily movements with a high degree of accuracy (due to only having a single passive cooling system, which is insufficient in cooling higher power CPUs). It contrasts further to the highly abstract Rift – which relied on passive cooling in the headset itself, but with the further need to properly cool the PC, doing the bulk of computational processing. To recapitulate Rieder's (2020) claim, digital technics are not necessarily 'less' optimised by being more abstract/less concrete; here, something that enables greater degrees of mobility.

The Quest's move from an abstract functional chain of external sensors to an integrated, concrete system is also centrally reliant upon the componentry directly involved in sensing movements of the body and movements of the device through space. The Quest's 'Insight' navigation stack is an assemblage of sensing components (cf. Mackenzie and Munster, 2019; McCosker and Wilken, 2020: 55–70). Insight operates mainly through a form of visual-inertial Simultaneous Localization and Mapping (SLAM). Put simply, SLAM is a computational method of constructing a digital map of the environment the device is located within (see Kanderske and Thielmann, 2019). SLAM enables the device to know where it is, relative to where it was (important in VR as to properly calibrate motion). The SLAM system – as Facebook put it in their technical documentation – is reliant upon data captured by the now pluri-functional camera.[5] As Facebook note in their documentation of Insight, the camera fulfils two main roles in the Insight stack:

1. 'Image data from cameras in the headset helps generate a 3D map of the room, pinpointing landmarks like the corners of furniture or the patterns on your floor. These landmarks are observed repeatedly, which enables Insight to compensate for drift (a common challenge with IMUs, where even tiny measurement discrepancies build up over time, resulting in inaccurate location tracking).
2. Infrared LEDs in the controllers are detected by the headset cameras, letting the system bound the controller position' (Hesch et al., 2019: n.p.)

As the documentation notes elsewhere,

> 'As you move, Oculus Insight detects pixels in images with high contrast, such as the corners of a window. These high-contrast image regions are tracked and associated over time, from image to image. Given a long enough baseline of observations, Oculus Insight is able to triangulate the 3D position of each point in your surroundings. This forms the basis of the system's 3D environment map.' (Hesch et al., 2019: n.p.).

The optical sensors in an Oculus Quest do not just observe the room that the user is in, but they provide precise, accurate and efficient positional tracking. This enables VR experiences, as movements of the head and hand, to be quickly translated into changes in perspective and the movements of the virtual avatar.

Further to the camera's role in navigation, a further degree of concretization can be noted in the camera's plurifunctional role in augmented reality applications. The Quest's camera is used in the 'Passthrough' system, where the user's view will shift from that of the software to a stereoscopic, black and white view of the space around the user should the user breach the bounds of the demarcated space (e.g. so they do not collide with objects). Outside of this, users can manually activate the Passthrough system to view their surroundings, and recent promotional material by Facebook focuses on the ability to move seamlessly between these spaces (Oculus, 2020a). Facebook have begun to promote Passthrough enabled AR applications. One recent example is Oculus' Infinite Office – allowing users to manipulate a virtual keyboard and desktop, while still able to see a greyscale image of the setting in which the user is working. Further, Facebook will reportedly offer a Passthrough developer API in 2021 (Heaney, 2020), enabling third party development of virtual objects to be superimposed over the environment. In this sense, Passthrough is framed as a stopgap for future AR ambitions, and a means for further AR software development. In short, the plurifunctionality of the camera enables new kinds of 'coextensive' user relationships with space, or, more precisely, new relations between users, space *and Facebook.*

The Oculus (and Facebook) ensemble

Facebook's efforts in the development of a more concrete form of VR are clearly motivated by economic interests. A singular, synergistic Quest console not reliant on a powerful PC means that it is cheaper for consumers and is sufficiently mobile to be adopted by a wider range of users in more diverse contexts beyond the home. Saker and Frith's (2020) study of MVR – which gets at the increased mobility afforded by the Quest – would suggest that this profit motive is fulfilled by creating more engaging phenomenological experiences – a point consistent with claims made by Facebook's software engineers, in describing the Insight SLAM system as a way to achieve tracking with 'submillimeter level precision' (Hesch et al., 2019: np) and to avoid undesirable experiences of lag or jitter. Further to this, the kind of 'coextensive' experience of space (as Saker and Frith, 2020 theorise it) – afforded through features like Passthrough – are framed by Facebook as generating positive user experiences, specifically, through creating AR experience with feelings of 'haptic trust' (Chaurasia et al., 2020) due to the perception of image depth enabled through the Quest's stereoscopic camera lens.

While the creation of habitual and perceptual modes of attention is certainly a question pertinent to that of MVR's political economy, we focus on the Quest as it pertains to political economic questions of data capture and expropriation, particularly as they may come to operate in service of Facebook's motives of power and profit – through the use of data to further empower Facebook's highly profitable advertising arm or future product development (such as future AR products). To think of the Quest's concretisation in terms of the wider Facebook network, we find some resource in another Simondonian concept – the ensemble. For Simondon, ensembles denote networks or systems (of varying scales) of concrete objects – networks which give rise to new individuals and elements (2017: 69). Further, it is at the level of the ensemble that we see 'liaison between the technical and the economic domains' (2017: 76). An example could include an industrial factory or laboratory (Simondon, 2017: 71–81) – arrangements of technical individuals in certain ways for certain purposes, such as enhancing production capacity. As Simondon notes, the role of human oversight in the arrangement of an ensemble is important as to prevent discrepancies between different objects. In this way, within the ensemble objects tend to exchange information yet remain functionally separate; the ensemble 'avoid [ing] internal concretization of technical objects it contains and uses only the results of their concretization' (Simondon, 2017: 66). As recent Simondonian analyses of networked digital technics show, the idea of the ensemble could apply to things like digital platforms (see Hui, 2016: 70; Rieder, 2020: 72). Hui, for instance, writes of the 'technical system' comprised of different 'digital objects' – in which data is transmitted between different parts to support the system's overall functioning – a point that chimes with how platform scholars studying Facebook would describe the interconnectedness of Facebook's software ecosystem (see, e.g. Nieborg and Helmond, 2018; Helmond et al., 2019) – a point we have made elsewhere about Oculus (see Egliston and Carter, 2020).

As much scholarship to date has highlighted (see, e.g. Srinivasan, 2018 for a comprehensive overview), Facebook is principally an advertising company – deriving the majority of its revenue from its ad network, powered by the company's glut of 'first party' data (that is, data generated from user interactions with Facebook's software). The company's advertising arm has a history of being strengthened by the early, and strategic adoption and integration of new technological formats (such as the mobile phone, see Goggin, 2014). Mobile media provided additional data points for the company to connect Facebook users with advertisements through its ad service. Notable, as Wilken (2014) writes, was the data point of location – allowing Facebook to further triangulate its ad network's targeting. Facebook's ambition with VR is remarkably similar. Oculus' EULA, ever since the company's acquisition by Facebook, has included boilerplate text informing users that data (in a broad, unspecified sense) will be used to 'market to you'. Notably, a 2020 update to the company's privacy policy (and 'Supplemental Oculus data policy') provides a greater degree of specificity over just what kinds of data will be collected. Relevant to our discussion of the device's sensing capacities:

> "We collect information about your environment, physical movements, and dimensions when you use an XR device. For example, when you set up the Oculus Guardian System to alert you when you approach a boundary, we receive information about the play area that you have defined..."

Further to the potential use of spatial data for advertising, like many other platforms (see Srnicek, 2017), Oculus seeks to turn interactions that takes place on its platform into economic value through feeding data back into the design of its future products (Oculus, 2020a, 2020b).[6] As their EULA reads, data will be used to 'develop the XR ecosystem' (Oculus, 2020b). While the company does not specify how this may be the case, it is worth noting that within Facebook Reality Labs there are a number of active AI and machine vision projects and applications which could theoretically benefit from the data yielded through VR headsets. Elsewhere, as internal Facebook memos suggest, leaked in the 2021 Facebook Files, this ecosystem is one from which Facebook expects to derive unparalleled 'ARPU' (average revenue per user) (see Rodriguez, 2021). Taken together, through the concretisation of the Quest, space and movement are not only inscribed in the generation of the Quest's 3D map – but in Facebook's data centres and ad networks, a means to further advance the company's surveillance capitalist (Zuboff, 2019) ambitions into the home.

The normative pedagogy of mechanology is, as we have demonstrated thus far, both intellectually but also critically valuable. Mechanological understandings could well provide the means for further productive explorations of technocultural and technopolitical alternatives to Facebook's data extraction centred MVR future. One such area that would benefit from a mechanology of MVR is the law. Legal and regulatory mechanisms responding to VR/MVR are yet to sufficiently address data extraction and the role of Oculus within the wider Facebook ensemble.[7] As Heller (2021) suggests, regulatory initiatives have been limited due to a fundamental failure to grasp contemporary VR and XR as *technology*, often conflating them with gaming technologies (and thus understanding VR/XR in terms of its *use* rather than its *technicity*). Operating under this auspice, Oculus is given a perfect alibi for entering into homes and lives without a second thought, and for evading more stringent oversight. Simondon himself does not discuss the importance of technology policy and regulation, yet as others have noted, policy could take the role of what Simondon calls 'social filter' (see, e.g. Voss, 2019; Feenberg, 2017) – in essence, the way that technologies are always subject to social or cultural forces. Policy in this sense can create unfavourable milieus for technology such that they are 'met with strong rejection' (Voss, 2019).

Beyond the policy space, grassroots efforts to disentangle the Quest from the Facebook ensemble (due to concerns of surveillance and privacy) have shown some promise of the value of a technopolitical project that takes seriously MVR's technicity. Following the release of the Quest (and more recently, with the Quest 2), Mozilla's Robert Long posted on Twitter his offer of a $5000 reward for the first person to successfully 'jailbreak' the Quest as to circumvent software restrictions imposed by Facebook (specifically, the requirement of a Facebook login) (see Long, 2020). While a jailbreak has not, at time of writing, been made publicly available, individuals such as Reddit user Tiger-Hobbes (Tiger-Hobbes, 2020) have engineered workarounds to the Quest's mandatory Facebook login. This method involves using a technical glitch to do with an older version of the Oculus mobile app (the mobile application used in the initial setup of the Quest). The software version, while since patched by Oculus, can be accessed via filehosting repositories like Apkmirror (for Android devices) and run on an Oculus Quest following a factory reset. The end result is that the Quest is 'tricked' into thinking that the user has input all requisite login information (i.e. their Facebook login). From this perspective we see a promising consideration of technicity as a means through which technopolitical and technocultural alternatives may emerge.

We believe that the core tenets of Simondon's philosophy of technology – a focus on process and material specificity – provides not only the explanatory power to take VR for what it really is (another form of sophisticated digital sensor we are bringing into our lives) but a normative and prescriptive framework that invites questions of agency and critique. Rather than subscribing to the kind of infelicitous romantic humanism of philosophers like Heidegger (1977), who would see the technical as encroaching on the sanctity of human life (as *gestell*), resistance and refusal, and an effort to create the conditions for new subjectivities or worlds that we would like to emerge (those that go beyond extraction) lie in questions of technologies' materiality and relation to both human and more-than-human things.

Conclusion

Drawing from the thought of Simondon on technical objects, we have argued that recent developments in MVR, with attention to the Oculus Quest, represent a shift in the technicity of VR. Specifically, the Quest (and Quest 2) represents a shift from an abstract functional chain of interdependent sensing technics (as with the Rift) to a tightly integrated system – particularly through the concretization of software and hardware in the Quest's navigational stack. Consistent with existing analysis (Saker and Frith, 2020), this affords mobility and is generative of new phenomenological experiences of spatiality. Building on this, we argue that the concretization of VR through MVR and the Quest represent a means to generate profitable network effects commensurate with Facebook's surveillance and data centered business model. As we show, through reference to Facebook Reality Labs' recent technical and legal documentation, data generated through the Quest's concrete design feed into Facebook's future AR product design, and into their ad network and targeted advertising algorithms. In short, VR – particularly as Facebook and Oculus have become more tightly interwoven over the last several years, Oculus a more central part of the Facebook 'ensemble' – shows the potential for Facebook to further intensify its extractive and accumulative tendencies. Through the framework of concretization – and specifying MVR's apparatuses of sensemaking – we introduce new questions that 'critical VR' (Carter and Egliston, 2021) scholars would do well to ask about the role of VR within the business models and political economies of big tech companies investing in the VR space (see Egliston and Carter, 2020), and what big tech stands to gain through this intervention.

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Notes

1. Technicity (broadly, and the more specific range of ideas ventured in *METO*) that have been taken up recently in fields like philosophy of technology (Hui, 2016; Stiegler, 1998), human geography (e.g., Ash, 2017; Dekeyser, 2018; Kitchin and Dodge, 2011) and media studies (e.g., Mackenzie, 2002; Mills, 2015; Rieder, 2020), generally to explore the agency of technological matter, a category of being that is distinct from (but related to) human life.
2. In his analysis of concretisation, Simondon limits this process of concretisation to a consideration of how the object's componentry interfaces together as to maintain that object's functioning (although elsewhere he identifies some special cases where external environments, such as geographical phenomena, which are taken into the perpetuated inception of that object. See Simondon, 2017: 53).
3. A full consideration of Simondon's engagement with Marx is beyond the scope of this article. Readers might see also Muriel Combes' (2013) consideration of Simondon's reduction of Marx to economism.
4. See also, the philosopher Bernard Stiegler's remark that 'there is no Simondonian politics, while the question of individuation' (and by extension, individualisation) 'is entirely political' (Stiegler 1998; cited in Bardin, 2015: 217).
5. This builds upon Facebook's previous use of SLAM in mobile devices for AR, using the smartphone camera and an inertial measurement unit to track the phone's position and allow it to interface with content anchored to objects in the real world.
6. A move that has historically been more typical of companies like Google and Amazon with their smart speaker hardware (with Oculus Facebook's first major foray into hardware production).
7. Market-focused initiatives, such as an antitrust case initiated in October 2020 by Germany's national competition regulator (see Robertson, 2020) have focused on the monopolising benefits of requiring a Facebook login, and the legal basis of this coupling – rather than what this may mean for how data gets fed into the Facebook ensemble. Further, while data-governance laws – such as the GDPR and the CCPA – apply to Oculus' data processing, these measures are hamstrung by being framed around improving mechanisms for consent for surveillance, rather than imposing harder-line limits on data capture (see Viljoen, 2020) – especially pertinent given that these devices are embedded into home life. Beyond Facebook's own use of this data, as we have argued elsewhere through a case study of VR edutech companies (Carter and Egliston, 2021), increasingly being rolled out in workplaces using Oculus hardware, third party uses of VR data have the potential to materialise forms of social inequality.

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