Decentralising Virtual Reality

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Abstract. Socialising in virtual reality environments is becoming increasingly popular. Research outlines the possibility of using the blockchain technology in order to create a peer-to-peer network for the virtual reality environment. By doing so, this paper considers the possibilities of decentralising the virtual reality space which was previously accessed through centralised platforms. There is a growing support for the claim that participation between peers is higher on a decentralised virtual reality platform compared to participation on a centralised platform. This study draws on ethnographic research of a digital community formed around a decentralised virtual reality platform and observes their group activities and engagements. The paper finds that individuals tend to show a high activity when it comes to co-designing virtual worlds and puts forward three concepts to discuss positive and negative angles of the decentralised virtual reality, i.e. co-creation of the content, visuals and governance. This implication is supported by an observation that users of the decentralised virtual reality platform co-build virtual ecosystems without a centralised authority.

Keywords: Virtual reality, collaboration, decentralisation, blockchain, Ethereum network

Decentralizacija navidezne resničnosti

Prispevek predstavi možnost uporabe tehnologij veriženja podatkovnih blokov v kombinaciji z vzpostavitvijo decentralizirane platforme za dostop do navidezne resničnosti. Z etnografsko študijo se je preučilo frekventnost participacije ter vzpostavitev omrežij, ko vodijo v potrditev ter realizacijo kolektivno izbranih skupnostnih vsebin. Prispevek tako potrdi predpostavko, da decentraliziranost navidezno resničnostnih okolij spodbuja k so-oblikovanju novih, od spodaj navzgor vzpostavljenih ekosistemov.

1 INTRODUCTION

From the Stephenson's fictional Metaverse and Cline's Oasis to Altspace and Second Life's spinoff Sansar, these collective virtually shared spaces create different realities by offering individuals to collectively experience and share immersive virtual environments. The simultaneous telepresence, a sensation of being immersed in a mediated environment and not where the physical body is located is becoming a popular way to experience the alternative reality [1, 2]. The virtual reality as an interactive computer-generated experience therefore does not only open the possibilities to share and co-experience immersive environments, but also dematerialises consumption and decreases the complexities of learning new skills [3]. Altogether, it changes the way we interact with each other.

Markets today offer a handful of centralised social virtual reality environments such as Facebook Spaces, AltSpaceVR, and the aforementioned Sansar. These privately owned and managed platforms have a centralised system that narrates how individuals should interact when immersed into a selected reality. Their participation in co-building immersive worlds and co-designing their content are thus limited. Because of the rising demand, several emerging social virtual reality platforms are seen experimenting with decentralised ownership and democratising the content creation.

New technologies such as the blockchain enable the development of decentralised ecosystems that are not controlled by a central authority and where individuals are offered a sandbox for escapism in an unregulated virtual reality. Decentraland (DCL), a newly emerged decentralised virtual reality platform and a social space powered by the Ethereum blockchain is studied in order to set a new perspective on the possibilities brought by decentralisation. This interdisciplinary research thus focuses on the DCL community activities and processes on the blockchain that are being carried out in order to construct a fragmented alternative reality to be owned by its users.

1.1 Methodological framework

For the purpose of this research paper, we have deployed a qualitative method of the online ethnography in order to understand the development of virtual communities which form a DCL project and a collaborative interaction between its peers. The research has been divided into three phases, starting with an initial exploration and data

collection, continuing with a data comparison and finishing with collected a data analysis.

The initial exploration of the subject was performed during a period of a three-month participant observation between December 2017 and February 2018, while the data were collected between March and April 2018. The final descriptive analysis was carried out in May 2018. The online ethnography was selected on the ground belief that digital communities co-create a shared culture enabling them to co-build virtual ecosystems.

Participating as passive observers on the main community communication platform RocketChat, we found highly engaged community members discussing building processes and plans for the DCL development. The number of participants was steadily rising, starting from 7620 in December 2017 and more than doubling to 16585 by April 2018. All participants were members of one group entitled "#general", where general discussions about randomized topics were taking place. The discussions were running in the form of posted treads. There were 357 posts on an average daily basis. The participants were also members of other groups evolving around the DLC community districts where more focus-orientated debates were taking place, allowing us to follow direct proposals and discussions. The least but not the last, we have also taken part in more closed and selective chat group such as "#district_leadership" with a total of 77 members, ranging from the DLC community district leaders to the DLC founders. Observing this group has allowed us to gain an insight in both the content development process and dealing with technical challenges that we will describe in the next chapter.

In using this medium, we aim at a deeper immersion into the community, encircling the inner social processes which can be considered as causes for the development of various collaborative activities between other members of the DCL community. Communication between the participating members has been transcribed and analysed. The method of the online ethnography has been selected due to the novelty of the researched field and nonexistence of related publications that would explore the future of decentralisation, development of the virtual reality platforms without central authority and impact on its users.

The main motivation behind the research is to observe sequences of activities and engagements of the DCL community members. We have studied how these individuals group together in order to developed community districts that will represent different areas within the DCL metaverse. The districts are being co-developed by active members of the DCL community who not only co-construct visual and content aspects of selected areas, but also take steps in order to propose the governance framework. Although the DCL community chat system is publicly open and DCL operates on a public and globally accessible blockchain, ethics have been considered while carrying out the research. The risk of influencing the observed community channels has been minimised by not exposing the research role to community, but only to one of the community managers. Steps such as participating in chat discussions or deliberately influencing decisions have been avoided. In order to respect a user privacy – although DCL remains in the public domain, and, individuals are using their nicknames to hide their identities – this paper is not using any names or indications which would otherwise expose peers to a potential manipulation, interception, or republication of their activities.

First, we will discuss technical challenges related to the virtual reality, namely the problems around immersiveness that would impair perspectives of social VR and the needed interaction between peers. Afterwards, DCL will be explored from the perspective of functionality on the blockchain and the use of the ERC-20 and ERC-721 crypto tokens that enable users to do transparent market transactions and manipulate with the DCL content. Secondly, we will explore different aspects of co-engineering the virtual reality space with decentralised districts and observe how individuals engage in interactions with other community members in order to generate a content. One of the more proactive user-led DCL areas, the Aetheria District, has been selected as a focus point based on the measurement of the frequency of interactivity amongst peers in order to build-up a use case.

2 IMMERSIVE VIRTUAL REALITY REALISM

The peripersonal space can be seen as the first margin between the surface of our body and the external world and needs to be contextualised and understood as an interpersonal space, which is influenced by the emotional characteristics of stimuli [4]. The level of the visual stimuli experienced is the core of visual realism which induces the participant presence in immersive virtual environments. This presence allows individuals to identify with their virtual bodies and perceive the virtual environment with a subjective sense of being in the place as a parallel reality [5].

In the context of the virtual reality, immersion stands for the extent to which high fidelity physical inputs such as sound waves and light patterns are provided to various sensory modalities such as vision, touch and audition in order to generate illusion of the reality in each. This immersion is therefore not only one-dimensional, but can be divided into a tactical, strategic, narrative, spatial, psychological and sensory immersion [6]. The first obstruction that DCL and similar social VR applications will need to overcome is the sensory immersion. However, there is a number of technical limitations which obstruct individuals from perceiving and interacting with virtual worlds, and performing spontaneous or coordinated activities with others to

consider. There are two requirements to meet – the available system in the form of a virtual reality headset needs to be able to isolate the human perception from influences of the real world and stimulate the human perception in order to achieve both the audio-visual and psychological illusion of a non-existing environment that can be perceived as real [7].

Modern HMDs (head mounted displays) can broadly be categorised as tethered, mobile and standalone. While mobile devices such as Samsung Gear VR or Google Daydream are commonly used in a combination with smartphones, their processing power is limited and results in both visual limitations and non-accurate position tracking. The standalone headsets such as Oculus GO for example are also limited in this way in the context of an insufficient processing power. While the standalone headsets and mobile devices mainly use the 3DOF motion tracking, the tethered devices such as Oculus Rift and HTC Vive allow users to take the advantage of the 6DOF motion tracking and experience translation along the x, y, z axes and rotation about them. This enables individuals not only a complete freedom of movement, but also of a virtual environment perception that they are engaging with.

As insufficiently immersive environments may not engage the user nor offer a fully realistic social experience, completely replicated and digitalized environments would need a technological solution for improvement. This improvement would offer benefits in addition to freedom of movement, including the possibilities of conformance of human vision, physical interaction with a haptic feedback and 3d audio that would replicate natural positioning of sounds relative to people and objects [8]. Achieving an immersive reality will be dependent on the technological progress. As the social VR environments such as DCL will simulate real-world events and societal interactions with other peers and AI-powered boots, achieving an immersive reality will be dependent on the technological progress.

3 DECENTRALAND – A TECHNOLOGICAL DYSTOPIA

DCL represents a traversable digitalised world powered by the Ethereum blockchain. As the blockchain is a peer-to-peer network that represents a virtual foundation for a range of interactions, it has a potential in coordinating the human activity on a mass scale. Furthermore, it can be understood as a system enabling the user-centric paradigm of transparency, equity and decentralisation [9].

Ethereum represents an open software platform based on a distributed public blockchain which enables building and deployment of decentralised applications. A computer code that can facilitate the content, various shares, money and property is delivered in the form of smart contracts which become a self-operating software

on the Ethereum blockchain. Because of this, the blockchain is virtually unalterable, making it difficult to manipulate to facilitate fraud, interference and censorship. This allows developers to design, create, and deploy decentralised applications that are not controlled by any internal entity having the wherewithal to make changes to the data [10]. By using the Ethereum blockchain, DCL allows users to co-create, design, and monetise or source an open content within its immersed three-dimensional virtual world. As such, the DCL protocol is comprised of three layers – the Consensus layer that allows tracking the plot ownership and content, the Land content layer that contains a content description through a hash of the file content, and finally, the real-time layer that enables individual users to connect and interact with each other [11].

As the platform has been decentralised through a crowd sale of its own native currency, DCL allows its users to have full control on co-designing and co-building a visual content on virtual plots, of which they have gained ownership. The DCL ERC-20 crypto currency, known as MANA, is not limited only to an external purchase of virtual plots of land but can also be exchanged for various goods and services within the virtual reality space. This allows DCL the development of a platform economy wherein users can create records of ownerships through the public Ethereum blockchain [12]. The native token therefore allows the implementation of a process where individuals can impose a claim over parcels within a DCL metaverse. This can be done with the purchase of non-fungible (NFT) ERC-721 tokens called LAND that represent each parcel in the DCL virtual world with x and y coordinates. In contrast with the standard fungible tokens, the non-fungible tokens such as LAND are cryptographically unique and their rareness may result in a high value depending on the amount of the visual traffic it experiences due to its location in the DCL metaverse. They can also be altered and thus visualised, have specific attributes and interactions may be performed in them. This makes the LAND tokens fit in multi-user DCL metaverses as they can be altered according to the user preferences and traded by changing the digitally recorded ownership. LAND token signatures in the form of the x and y coordinates are linked with the individual's crypto wallet address in order to keep track of the ownership, but also to hide individual's identity.

Transferring the ownership of the LAND tokens to individuals has taken the control of the DCL metaverse from its creators and made the DCL future infrastructure and governance completely decentralised. This has been achieved through periods, starting with the so-called Stone Age where the DCL world has been created, and Bronze Age, where the newly modelled 3d world has been divided into parcels. Transitioning to the Iron Age, the process of installing economy driven co-creation of

the DCL content and implementing a scripting system for the peer-to-peer communication was started. A full-fledge metaverse with the customizable laws of physics and other assets that will allow users the complete freedom will be named the Silicon Age [13].

Figure 1: DCL hexagon grids during the Terraform event

The Terraform event took place in December 2017 when DCL auctioned a public land containing ten square meter plots for interested individuals. In order to participate, individuals needed to possess both Ether, a native cryptocurrency token of the Ethereum blockchain, and MANA. The LAND tokens represented as virtual reality parcels were sold to the highest bidders. The Terraform event saw the overall generation of 70,399 parcels of the land with 161,000,000 of MANA spent on them [14]. Figure 1 shows hexagonal tiling as plots of land generated in an identical size. The unstacked parcels were transitioned to the DCL land market that also opened the possibility to transfer already bought land, give it a data stamp and open a trade between users [15]. Backed by a smart contract, the DCL marketplace secures a transparent exchange of resources. This opens the possibility for users to co-engineer the DCL metaverse by grouping activities under various community districts, co-build both visual and content aspects and propose a governance mechanism that will ensure equal decision-making processes.

4 CO-ENGINEERING THE VIRTUAL REALITY SPACE WITH DECENTRALISED DISTRICTS

When observing the DCL development process, it is important to note that its digitalised world can be considered "curated" to some extent. The Genesis City with Genesis Plaza as the first entry point for new users is located in the very middle of the DCL metaverse and creates a centre-of-gravity effect. The central positioning of the city core that has been proposed by the DCL

creators does not impact only the general layout of the map, but it also directly affects the in-world economy. Although the auctioned virtual land proves to be more expensive near the centre point, the implemented road system spreads the value around the map instead of only concentrating it in the very middle [15]. Nevertheless, parcels near the 0.0 coordinates are expected to have more traffic and are thus valued much higher than the average LAND price. However, while some plots of land can be seen as positioned privately and planned to be individually constructed, other parcels are grouped into community districts and are forming subnetworks. These districts can generally be seen as areas of virtual plots of LAND that have built up the intention for shared pursuits by building unique digital ecosystems.

Districts are constructed upon a shared framework that is built on front-end libraries and smart contracts that allow the creation and operation of communal marketplaces. These districts are interconnected with virtual roads that allow users to discover the content hosted on different parcels and can be thus seen as a spatial browsing tool. By joining community districts, the users are involved in the process of increasing computing powers and are therefore able to co-develop their lands. Each district may release their own resource tokens in the form of NFTs. Depending on each district and its core purpose, they can be used for the entry admission, voting process, trading resource or certificate issuing.

There are twelve proposed districts that are currently in a sandbox and are being co-engineered by the DCL subnetworks: Aetheria, Arena, Conference Center, Design Quarter, Dragon City, Festival Land, Museum, The Movement, University, Vegas City and The Seven7 VR (formerly referred to as The Redlight District). These community districts are a direct result of collaborative actions between individuals who form subnetworks based on the same or similar interests. Aetheria, the largest and most active DCL district is for example planned as a large cyberpunk-agglomeration where individuals will be able to experience diverse contents and will resemble a virtual world similar to the fictionalized the Cline Oasis.

LAND owners within the Aetheria district are encouraged to build a utopian content and express their ideas through cyberpunk ethos as a culture of technological embodiment. As cyberpunks represent a subculture populated by individuals who contemplate their ideas within the wireframe of scientific achievements and advanced technologies, members of this DCL subnetwork tend to combine the entertainment industry with profit and non-for-profit operations by dividing themselves into different classes according to their interests [16].

In contrast to the Aetheria district, the DCL Arena district is based on a real-life community in North London, U.K.. Resembling the ideals of creating a

parallel world similar to the Doppel proposed by MacManus where a seamless jump between the physical and virtual worlds is possible, the district of Arena envisions an interactive simulated environment that will allow individuals to participate simultaneously in activities resembling to a real life such as visiting performances by artists, concerts by musicians or socialising in a virtual coffee shop [17]. On the other hand, the Festival Land district focuses solely on building an interactive virtual land for hosting multimedia festivals. Similar to Arena, the Conference Centre district strives towards proposing a real-world resembling an open area that would invite individuals to socialise over meaningful discussions in a form of scheduled talks, virtual conferences and similar services.

The Design Quarter Districts form a subnetwork of stakeholders that have interest in transitioning special disciplines such as architecture and engineering from a physical to a virtual world. The Dragon City districts group together the DCL subnetwork of individuals who are interested in combining the China culture with the Western modernisation. The Museum District tends to allocate virtual museums and galleries, while the DCL subnetwork behind the Movement district proposes an area for grassroot innovation and borderless collaboration. The University district proposes creation of a functional educational establishment in DCL and the Vegas City district accommodates LAND owners who are building an emulation of the Vegas strip, alongside with virtual casinos and performance halls. Finally, the Seven7 VR district stakeholders envision recreation of real-world red-light districts and provide an adult-themed content. While these community districts have already taken the first steps to generate the content material, we need to note that there are various other grass-root and unstructured districts that are simultaneously forming up according to the neighbouring LAND owners. These individuals tend to form weak bonds via using the DCL community chats and form partnerships that result in a manifestation of the same interests.

4.1 Visual and content aspects

There are two main layers of creating a content on LAND, individually and in the premise of a selected subnetwork that groups individual stakeholders within one of the community districts. As Figure 2 suggests, there is a content development process that may – at least in some cases – point toward a circular model. When a group of individuals purchases bordering parcels and share a common interest, this can be recognized as a district starting point [18]. Planning a district may start with a strategic development that is proposed by proactive peers within a DCL subnetwork.

As decentralisation loses the central authority, a democratic governance model needs to be installed in order to prevent a conflict of interests and moderate the

process of development according to mutually agreed restrictions. A governance body is commonly designed based on a mutual agreement between stakeholders who can vote, propose and track decisions that affect their plots of land and future presence in a selected community district.
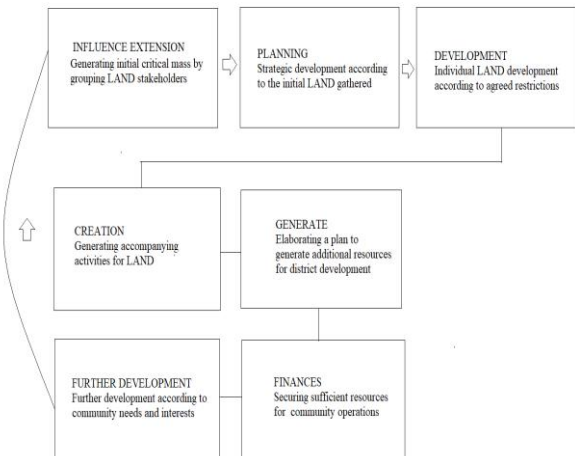

Figure 2: DCL district content development

When a mutual agreement is achieved, the development process can transition into the creation phase, where accompanying activities for land are being created. This would generally lead to generating the content by altering an individual LAND and modelling its visual appearance in the DCL metaverse. However, it is commonly projected amongst users of different DCL subnetworks that securing sufficient resources for community operations is existential. Not only by contributing or generating financial resources from external sources, but mainly by creating an in-market economy that will also enable it to serve as a support mechanism of a district existence. Based on the success factor, this could be measured by internal activities, frequency of visits or stability of in-market economy. A further district development will be possible in several ways. Firstly, the district could potentially rearrange its subdistricts according to subnetworks needs and interests or pivot to all-in-all pivot to other directions. Secondly, a district with a high activity and engagement rates could expand its sphere of interest and possibly merge with other districts. This assumption is based on a similar organisational structure or several districts where the leadership team is made up by the same individuals. Lastly, the DCL district could also witness a negative trend of a complete disintegration and repeat the whole process proposed in Figure 2.

As it goes from the technical perspective, stakeholders can either outsource services or individually craft the content by altering their LAND. This can be done by using a 3d rendering engine such as WebGL in combination with 3d content libraries such as Google

Poly Library, SketchFab or Autodesk 3d Models Gallery, to name a few examples, and the JavaScript library such as A-Frame with extended subsets like A-Minus that makes it possible for DCL apps to recognize the Ethereum blockchain and grant account permissions. Collaborative editing cannot be done simultaneously, but merely by passing the code between individuals and uploading separately. As stakeholders hold the ownership over the DCL parcels on an individual basis, a strong factor of trust needs to be present within a subnetwork in order to enable collaboration. This is achievable by proactive users who overtake the symbolical role of district leaders. Their main objective is not only to steer the process of the content development as seen in Figure 2, but mainly to nourish the ties and relationships between stakeholders.

A steady and ongoing presence by community leaders on chat channels such as the observed RocketChat is thus essential. In the opposite case, the district development process is stalled. Individualism with non-coordinated actions may cause a complete disintegration of district proposals and separated subnetworks. Externally, this can be therefore recognised as a failed attempt of a collective action caused by the non-existence of a central authority who would be able to take an action [19]. However, we have observed that a decentralized governance system may prevent a possible disintegration and be perceived as a core for a collective process of crafting the district content.

4.2 Governance aspects

As the DCL virtual reality space will be launched, preconstructed districts are set to be governed by whatever the governance mechanism the founders will decide to use. The projected levels of governance could thus vary from deployment of the so-called Lex Cryptographia or a set of rules administrated through a self-executing smart contract and autonomous organisations to lawless landscapes [20]. We can anticipate that the vast virtual reality space of DCL will not appear ungovernable but will be composed with customary laws that commonly arise in computer-mediated cyber communities [21].

Community leaders need to be proposed and approved by the majority of the selected subnetworks. As the governance wireframes are non-existent at this point, pools are conducted by using the freely available online tools such as Google Forms and the provision of the cryptographic signature by each voting contributor that is verified via Etherscan. Newly selected leaderships propose the so-called Districts Startup Plans that are publicly available and contain a description of how a selected district will be governed, outline a plan for a minimum viable product and present their vision for a continuous development. The proposed plans are accepted only if two thirds of the LAND owners that are

positioned within the parameter of the selected district vote in favour. As constructing the governance for a decentralised platform on the blockchain can be highly controversial and complex, the majority of the DCL peers as well as the DCL founders are in favour of integrating external resources.

The DCL community and its subparts that are co-constructing proposals for different districts are in favour of integrating the principles of the Aragon Network (AN), a platform for managing effective decentralized organisations, which aims to disintermediate the creation and maintenance of organisational structures by using the blockchain technology. This is done by providing the tools and an individual user interface to manage an entity whose governance and bylaws are managed by smart contracts via the Ethereum blockchain. Similarly to the DCL token MANA, AN also operates with its own native cryptocurrency, the ANT token. Aragon provides users a complex set of tools including courts with a randomised judge selection and public voting system that acts as a digital jurisdiction over a selected area. In this matter, Aragon can be understood as a decentralised application (dApp) that lets individuals manage organizational foundations on the Ethereum blockchain.

By running DCL and its districts through the Aragon governance system, each district would have its own set of rules for every parcel included within the district and would be able to adapt its collectively-tailored voting. As already outlined, this can be achieved by tailoring NFTs by every district and distributing them amongst the LAND stakeholders. These tokens are not meant only for ensuring a democratic process of voting and creating national pools, but also to establish other transparent mechanisms, such as an arbitration system for solving conflicts within the border limits of each district.

Individuals who have the tendency to control their LAND within the district and others mainly seeking a return of investment clashed in December 2017. In May 2018, a community-driven governance body that would use smart contracts was proposed in order to apply democratic and transparent mechanisms. These mechanisms would be built upon establishment of a Decentralised Autonomous Organisation (DAO) with memberships and voting shares based on the contributed LAND counts. The voting shares will be represented by the Aetheria tokens. In order to pass the proposal, at least 50% of tokens will need to be contributed by token holders. Apart from dealing with democratic voting processes, DAO will be authorised to manage other affairs such as land allocation and its use. Smart contracts could also be used as a prediction model of actions done by the leadership team. This would ensure a further transparency.

Other districts have proposed similar governance bodies where the NFT membership tokens would represent the core component of the voting mechanism.

In order to follow transparency, a communication- and governance-related content, such as election notifications, will be provided in undisclosed chat channels. Research has shown that individuals tend to be in favour of a transparent governance based on equality and democratic mechanism.

5 CONCLUSIONS

This is for the first time that a qualitative method of the online ethnography is used to explore a decentralised virtual reality platform. The themes of the increased social interactivity and collective action recurred throughout the dataset. There are several possible explanations for this result.

First, as opposed to the virtual reality platforms with a centralised authority, decentralised platforms such as the observed DCL are based on a collaborative interaction between its peers. The activity, contribution and self-realisation of these individuals are the measuring factors of building the progress. As the LAND tokens and, subsequently, the virtual parcels are owned by stakeholders, moderation of the DCL users is needed to form strong subnetworks and secure co-creation and co-engineering of a decentralised metaverse. Moreover, founders of a decentralised platform do not have the mechanisms – apart from proposing and utilizing the core framework – to terminate the ownership nor alter the owned plots of the virtual land. For example, if the majority of the selected community districts decides to pivot their purpose, the governing body would need to accept their request. This makes the decentralised virtual reality platforms unregulated and individual stakeholders hold the majority of the power to narrate their future development.

Secondly, the social interactivity is higher because of the perceived self-control. It is suggested that the perceived interactivity in digital environments positively correlates with the perceived control over the used platform as well as with the perceived responsiveness and personalisation of the platform [22]. This means that the higher the level of personalisation and perceived responsiveness, the higher the level of the expected interactivity. Individuals tend not only to interact with other peers but are interacting with their surroundings. From this perspective, this interactivity can also be understood as a self-expression [23]. Stakeholders and LAND owners tend to propose diverse contents and are faced with very little limitations when it comes to expressing their interests. They can propose a new governing body, new set of rules and change the in-market economy as they have the access to all the information. This may however reduce the stability of a decentralised metaverse or part of it and cause unpredictability when it comes to development planning.

The least but not the last, as the decentralised virtual reality platforms need to be built on the blockchain network, a high level of anonymity would be in place. Therefore, the centralised platforms such as AltSpace VR or Sansar can, for example, enforce a strict set of rules limiting the interactivity to previously regulated limits, whereas decentralised platforms such as DCL do not have similar restrictions. Moreover, decentralised platforms are not dependant on the real-world economy and profitability of the entity that controls the centralised platform. DCL is in contracts positioned on the blockchain and owned by stakeholders possessing its NFTs. This may be seen as positive from the perspective of independency and prospectiveness but perceived negative from the perspective of effectiveness and security. A lost cryptographic log-on may mean a loss of a user account and its possession over resources, while a lost or forgotten password on the centralised platform can be recovered.

This research has opened many questions needed to be further investigated. Though the increased social interactivity is common for the decentralised virtual reality ecosystems such as DCL, the topic needs to be further researched. More precise understanding of the relationship between the virtual reality as a tool for constructing an unregulated alternative reality and the blockchain as a decentralised network will need to be provided in the time ahead. We are thus obliged to identify limitations and propose further research.

6 LIMITATIONS AND FURTHER RESEARCH

The ethnographic research has proven to be an effective method to secure the descriptive data. The community chat stream and proposed actions by both the district leaders and DCL team of founders have provided us with a constructive image on the projected development of the observed decentralised virtual reality platform. However, this data must be carefully interpreted as they are a novelty of the field. The decentralised platforms such as DCL emerged only in 2017 and are being collaboratively constructed through a technically complex and socially challenging process. From this perspective, the paper provides a helpful insight in decentralisation of the virtual reality and its future challenges.

However, generalisability of these results is subject to certain limitations. For instance, while a qualitative research provides descriptive data and a valuable insight into further exploration of decentralisation and virtual reality, it does not measure their impact on individuals and their well-being or personal development for instance. The relationship development that is a direct result of the interactivity would need to be measured using detailed questionnaires and analysed by different approaches.

Technical aspects are also changing and developing fast as the involved individuals are constantly seeking for both improvement of platforms and personal gain. A complex tokenisation of services and ecosystems may

change the way people engage themselves in group interactions such as co-creating the content. Following the above, the further research should be towards using multiple ways of data collecting over a longer period of time.

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