

Social games and Blockchain: exploring the Metaverse of Decentraland

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Abstract—Online Social Networks gained a crucial role in people’s everyday life, acting as the medium through which people can interact with each other. The introduction of blockchain technology prompted a new generation of social media based on the concept of Non-Fungible Token (NFT) and other Web3 technologies, giving birth to the Metaverse. Decentraland is one such platform, where users can explore a 3D virtual world and communicate with each other. The main feature of Decentraland is that the virtual world is divided into parcels, implemented through NFTs, that can be traded among users and where owners can create buildings or mini-games for other users to play with. In this work, we explore the virtual world of Decentraland by presenting the main details of the virtual world and by focusing on the economic impact of NFT trading on the description of the parcels. In detail, the parcel’s description can be used to advertise the proximity of the parcel to infrastructures or special projects to attract potential buyers. This paper’s findings show the impact and the magnitude of this phenomenon, highlighting entire quarters that adopt this technique throughout the map by overriding the playful aspect of the platform.

Index Terms—Virtual Worlds, Metaverse, Blockchain, Non-Fungible Token, Web3

I. INTRODUCTION

Online Social Networks (OSNs) are web services that play a crucial role in terms of how people can socialise and interact with each other. Thanks to their virtual nature, they are able to shatter the physical barrier among people, leading to their adoption on a worldwide scale. Current popular OSNs are implemented on a centralised architecture, which was identified as a possible source of problems, including scalability, dependence on a provider, privacy [1], and poor value redistribution [2], [3]. Thanks to their massive widespread, these problems prompted researchers and developers to find innovative solutions, in particular by exploiting decentralised architectures. Fuelled by the revelations of the Cambridge Analytica scandal [4], many Decentralised Online Social Networks (DOSNs) implemented on peer to peer architectures have been proposed [5], [6]. However, it is only thanks to the blockchain technology that OSN platforms experienced a true revolution, in particular with the introduction of rewarding systems and creating socioeconomic digital environments, giving birth to the so-called Blockchain Online Social Medias (BOSMs) [7].

The economic systems built upon the blockchain technology rapidly evolved, and while in the beginning, they included single fungible tokens, such as the case of Bitcoin, they are now much more complex. For instance, the Ethereum blockchain also includes standards for fungible tokens (ERC-20), non-fungible tokens (ERC-721), and semi fungible tokens (ERC-1155). Non-Fungible Tokens (NFTs) in particular gained massive momentum in many blockchain-based applications, including BOSMs, thanks to their ability to represent the digital ownership of a unique (digital or physical) asset, such as a piece of art, a collectable item, or an estate. The introduction of NFTs boosted the development of BOSMs, which started harnessing the full potential of blockchain to offer more complex services. One such way is to create the so-called Metaverse: a virtual space where users can socialise, interact, play video games of all sorts, with an economic layer supported by the blockchain and Web3 technologies.

Decentraland¹ is one such example of a Metaverse where the gaming and the social facets are extremely intertwined. The platform runs on top of a Peer-to-Peer (P2P) network that manages content distribution, and leverages the Ethereum blockchain to implement a set of NFTs that represent the objects in the game. The main feature of Decentraland is that the virtual space is divided into parcels that are represented by NFTs and users can buy and sell these NFTs to acquire the property of the respective parcel. Owning a parcel grants the right to build whatever the owner wants, including interactive objects or mini-games. All users can traverse the virtual three-dimensional world with their avatar, see and interact with the things built by the other users. Decentraland is a mix of concepts and it can be described as a Social virtual world. Indeed, it is a game that includes a social media experience where people can interact with each other in the virtual world. The goal of Decentraland is to create an open-source system for users to have social interactions and build whatever they want within the decentralised virtual space.

In this paper, we explore Decentraland, focusing in particular on the parcels that constitute the virtual world of the social game. The scarcity of the commodity creates an interesting market, where users can acquire multiple parcels

¹<https://decentraland.org/>

and then try to find a buyer that is willing to pay more for the same parcel. Not all parcels are available on the market: some of them are reserved for roads, while others are dedicated to large projects, such as public squares or Chinese culture districts. The presence of these special parcels affects the market, and make other parcels in close proximity much more desirable. By studying each parcel's description through multiple analysis techniques, we show the magnitude and impact of this phenomenon.

The rest of the paper is structured as follows. In Section 2, we review the relevant literature and other similar projects. In Section 3, we describe the main features of Decentraland, while in Section 4 we present a study concerning the land parcels of the virtual world. Section 5 concludes the paper, pointing to possible future works.

II. STATE OF THE ART

With the term Social Media, we refer to several different platforms. Following the classification introduced in [8], there are six different types of social media: Collaborative projects, blogs and microblogs, content communities, social networking sites, virtual game worlds, and virtual communities. The Metaverse can be identified as a combination of at least two of these categories: Social networking sites and the virtual game world. Today, the goal is to create interoperable, secure, fast, and decentralised metaverses. As concerns decentralisation, the blockchain is today the most suitable technology, because it allows, for example, to keep on a decentralised register the information concerning the virtual world, such as the properties of the avatar and other digital assets (clothes, real estate, etc.).

Blockchain technology has been employed in several ways in Blockchain-based Video Games (BVGs) [9]. The most primitive form of BVG is perhaps represented by betting systems, such as Satoshi Dice², TT Guess³, and Find Six Dice⁴, which usually consist of correctly guessing the outcome of a random process. With the evolution of blockchain technology, also BVGs progressively changed. One of the most successful examples of BVG is represented by Splinterlands⁵, which is a collectable cards game, with the additional benefit that players can trade their cards, and are awarded cryptocurrency for each of their wins. The game is implemented on top of the Steem blockchain [3], where each action performed by its users, such as the games, is stored in the form of a JSON string in the blockchain's transactions.

With the advent of smart contracts and Non-Fungible Tokens (NFTs), BVGs have evolved further to provide even more functionalities and a more transparent behaviour towards their users. The most important BVG that exploits these two functionalities is CryptoKitties⁶ where users can collect, trade, and breed virtual cats. CryptoKitties is implemented through a

digital asset, in the form of NFT, where each cat corresponds to a unique token, and a smart contract that orchestrates the breeding of the cats and the auctions needed to trade them. A step further is represented by BVGs like Bombcrypto⁷, a video game similar to Bomberman, where users can collect unique heroes, and use them within the actual game. Also in this case heroes are implemented as NFTs, and can be traded alongside many other collectable decorative items.

Thanks to the introduction of Web3, BVGs are changing towards more social environments, with a decentralisation of the power and control, and the application of more immersive technologies. BVGs in this direction are trying to build the so-called Metaverse. Important approaches in this direction include AlienWorlds⁸, Sandbox, Enjin, Bloktopia, Star Atlas, and Decentraland.

III. THE VIRTUAL WORLD OF DECENTRALAND

Decentraland is the first Web3 virtual world where users can create and monetise their content and applications. In particular, they can buy, build, and sell digital estate, artworks, or NFTs. The platform is community-owned and built on the Ethereum blockchain. Thanks to its decentralised implementation, it is possible to play the game even without an actual account, because all the information are managed through a decentralised network and therefore available to anyone on the Internet. However, to have access to all the functionalities of Decentraland, it is mandatory to create an account, and link a valid Ethereum digital wallet. Two different tokens are used in Decentraland. These are:

- **LAND.** A non-fungible token (NFT) is used to define the ownership of land parcels representing digital real estate.
- **MANA.** An ERC-20 token that can be used to buy virtual goods and services in Decentraland.

A. The architecture

Decentraland has many layered components built using Ethereum smart contracts. Its infrastructure is Peer-to-Peer (P2P), and the Decentraland protocol refers to three layers (Figure 1):

- **Consensus layer:** it maintains a ledger that tracks the ownership of land parcels;
- **Land content layer:** Download assets using a decentralised distribution system. For each parcel that needs to be rendered, a reference to a file with the description of the parcel's content is retrieved from the smart contract. The current solution uses BitTorrent and Kademlia DHT networks by storing a magnet link for each parcel.
- **Real-time layer:** Enable users' world viewers to connect to each other.

Land content is referenced through a hash of the file's content which can be downloaded from BitTorrent or IPFS. The downloaded file contains a description of all the elements

²<https://satoshidice.com/>

³<https://ttguess-b5023.web.app/>

⁴<https://www.findsixdice.com/>

⁵<https://splinterlands.com/>

⁶<https://www.cryptokitties.co/>

⁷<https://bombcrypto.io/>

⁸<https://alienworlds.io/>

⁹Whitepaper: <https://decentraland.org/whitepaper.pdf>

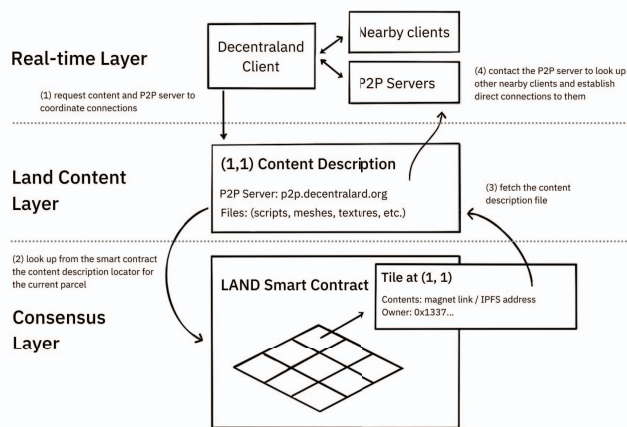


Fig. 1. Decentraland Architecture⁹

needed to render the scene. It also contains the URL of a rendezvous server to coordinate connections between P2P users that are exploring the tile simultaneously. The decentralised distribution system allows Decentraland to work without the need for any centralised server infrastructure. This allows the world to exist as long as it has users distributing content, shifting the cost of running the system to the same actors that benefit from it. This decentralisation degree grants the system a strong resistance to censorship. In the future, the infrastructure cost can be covered by the use of protocols like Filecoin. Finally, P2P connections are needed to provide social interactions between users. To coordinate the bootstrap of P2P connections, landowners will have to provide rendezvous servers or understand that users will not be able to see each other in their parcel.

B. The virtual space

The virtual space in Decentraland is called *LAND*, and it is finite, reversible by players, and three dimensional. LAND is implemented as a collection of NFTs maintained in an Ethereum smart contract. The virtual space is divided into smaller fragments, called *parcels*, that are squares of side 16 meters, uniquely identified by a set of Cartesian coordinates. Each parcel is an NFT and it is identified by its location/coordinates on the virtual world. It also contains information about its owner. Each parcel can be owned by a single user and can be purchased using *MANA*, which is the Decentraland's ERC-20 cryptocurrency token. Aside from coordinates and owner, a parcel also contains a content description file or parcel manifest that describes and encodes the content of the parcel. The owner can customise the owned parcels, creating digital static art, 3D scenes, or even applications and mini-games. A single user can group sets of pairwise adjacent parcels, forming a so-called *Estate*. Owners of parcels can organise themselves into communities and put together some parcels to create a so-called *District*. By organising parcels into Districts, the community can create shared spaces with common interests and uses, like thematic

quarters of an imaginary city. The districts mechanic is the main mechanism that includes a strong multiplayer aspect in the management of parcels. The content of each parcel that makes up the Decentraland virtual world is stored and distributed via a decentralised network, Bittorrent [10] or IPFS [11], by a set of approved nodes, as explained above. Due to its cost, the Ethereum blockchain is used only to record parcel ownership and MANA transactions.

Finally, each parcel varies in colour when inspected by the official map scanner¹⁰ (see Figure 2). The light grey lines, for instance, are roads and cannot be bought. Similarly, the green areas are plazas owned by the Decentraland community, whereas the light blue coloured parcels are available for sale through the official Marketplace. The deep grey parcels are owned by people for their own business. The parcels in Savoy Blue represent the ones dedicated to particular projects. Figure 2 shows the 8 largest project districts with the respective names. Among these project districts we find:

- **Aetherian Project** (8,008 parcels): a cyberpunk futuristic city;
- **Vegas City** (6,776 parcels): a gambling district;
- **Dragon city** (6,485 parcels): a Chinese city with mixed ancient and modern architecture;
- **Fashion Street** (2,098 parcels): a fashion district;
- **District X** (2,001 parcels): a red light district;
- **University** (1,550 parcels): the Decentraland university;
- **Altix** (1,197 parcels): a Chinese culture district, formerly known as Dragon Kingdom, not related to Dragon City;
- **Conference centre** (799 parcels): a place to host large virtual meetings.

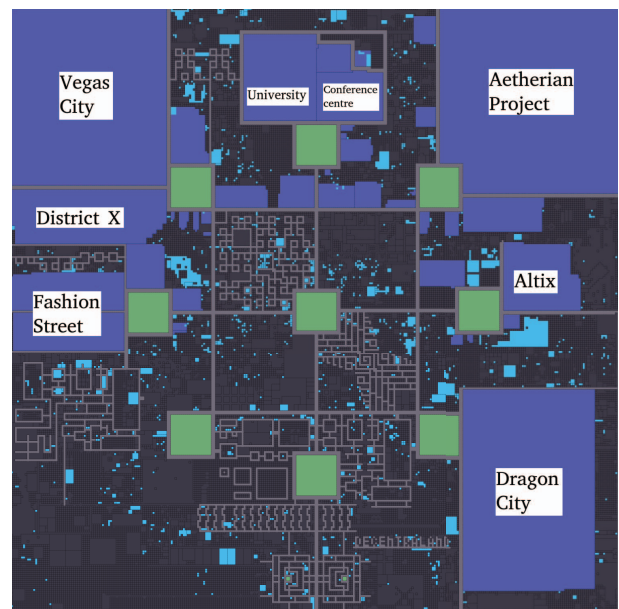


Fig. 2. Map of Decentraland

¹⁰<https://github.com/decentraland/atlas-server>

¹⁰<https://nftplazas.com/decentraland-districts>

C. The Decentraland DAO

The Decentraland decision process is decentralised as well, and it is managed by a Decentralised Autonomous Organisation (DAO). The Decentraland DAO owns the most important smart contracts and assets that make up Decentraland, such as the LAND Contract, the Estates Contract, Wearables, Content Servers, and the Marketplace. Holders of MANA and LAND tokens have access to the DAO and have voting rights in the proposals. Through votes in the DAO, the community can make changes to most of the aspects concerning how Decentraland works. Each user participating in the DAO has an associated *Voting Power* (VP) that is computed according to the following rules:

- Each MANA token held, grants 1 VP;
- Each LAND token held, grants 2000 VP;
- Each estate held grants 2000 VP for each parcel in that estate.

Each time a user casts a vote, the vote is weighted by the VP of the user when the proposal was initially launched to prevent users from exploiting their capital to influence the whole application. The VP associated with each asset is determined to give more voting power to the real contributors and the ones with the greater personal stake, i.e. the owners of the parcels of the virtual space. Decentraland's DAO also owns a fund of MANA, which is used to help sponsor community grants and to help grow the Decentraland platform according to the decisions and directions voted on by the community.

D. The smart contracts

Decentraland uses multiple smart contracts to manage its aspects:

- **The MANA contract:** MANA is the fungible resource of Decentraland, and is implemented as an ERC-20 token on the Ethereum blockchain. It is mainly used to buy parcels, but can also be used as currency for goods and services on Decentraland.
- **The LAND contract:** This contract manages the NFTs that represent the parcels of the virtual space. The DAO is the owner of this contract, meaning that any changes or modifications to that contract must be carried out through the DAO.
- **Catalyst nodes:** The list of Catalyst nodes that serve content and establish the P2P connections needed to keep Decentraland's virtual world running is also owned and controlled by the DAO.
- **Marketplace contracts:** The Decentraland Marketplace dApp makes use of several smart contracts to manage the process of selling and bidding on LAND, Estates, and other NFTs.
- **Grants:** The vesting contracts used to make recurring payments as part of the DAO's grant framework.
- **Other contracts:** other features managed by the respective contract are: estates, names, banned names, wearables, and points of interest.

Parcel type distribution

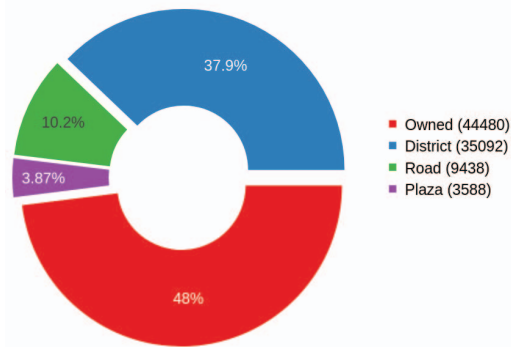


Fig. 3. Distribution of the parcel types.

All contracts, but the MANA contract, are owned by the Decentraland's DAO, meaning that the source code of these smart contracts can be modified, according to the regulations of the DAO, and involve a successful vote on a proposal. On the other hand, the MANA contract, being an ERC-20 token, operates according to the standard, and the contract that created it self-destructed after its creation so that no one can modify its functioning.

IV. ANALYSING THE VIRTUAL WORLD

In this Section, we analyse the virtual world of Decentraland, focusing in particular on the parcels to gain important knowledge concerning the usage of the virtual space. More in detail, we study the type and *name* field of each parcel with the ultimate goal of studying how much these fields impact the NFT market. The parcel names, that are used to provide a very concise description of the contents of each parcel, are studied by the means of the graph and textual analyses. The state of the parcels was obtained as of the 5th of February 2022 through atlas¹¹, the official map API.

In total, there are four different types of parcels in Decentraland:

- **Owned:** single parcels owned by users;
- **District:** a set of parcels grouped together used for special projects;
- **Road:** special parcels that cannot be owned by anyone. Buses periodically pass by roads to transport users around the virtual world;
- **Plaza:** act as main squares of the virtual world and serve as public meeting points. Like Roads, these parcels are not meant to be owned by anyone.

In Figure 3 we show the number of parcels per parcel type. The Figure shows that only 15% of the parcels cannot be owned because they serve as Roads and Plazas. In particular, the amount of Roads is higher because they need to stretch all the virtual world. Among the remaining parcels, we observe that districts are quite common, highlighting the importance of the feature.

¹¹<https://github.com/decentraland/atlas-server>

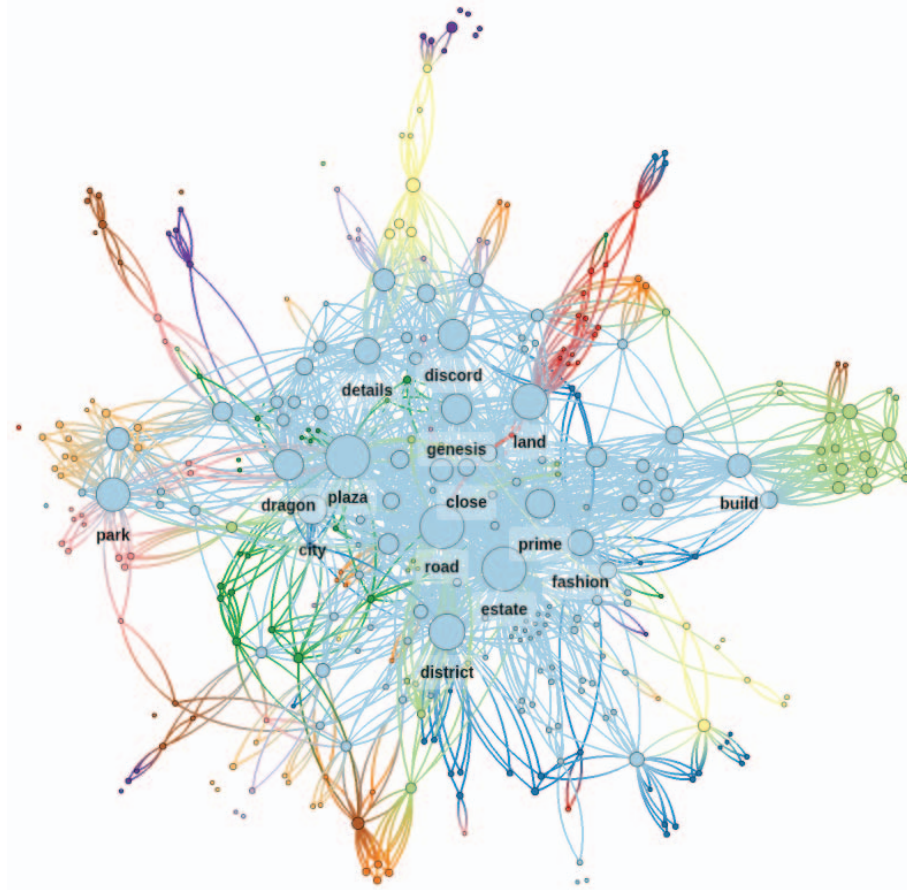


Fig. 4. Co-occurrence graph of the terms in parcel names.

To have a better understanding of the parcels as NFT and how the economy can affect the game, we decided to analyse the *name* tag that can be assigned to a parcel by its owner. The tag can be used for multiple purposes, such as a very short description of the content of a parcel, or as a label. In this way, we are able to evaluate the presence of specific words which can be used to improve the value of a parcel, as in a real estate market. Figure 4 shows the co-occurrence graph of the terms appearing in the parcel names.

In this graph, the nodes represent the terms, while the edges represent the fact that the two terms appear in the same name. The size of each node is weighted by its degree in the graph, while the colours reflect the structure of the graph. The Figure shows that the majority of the largest nodes all belong to the light blue component, highlighting its importance on the whole system. Among the key nodes of the graph, it is possible to identify some that contain keywords, such as *plaza*, *district*, *estate*, *road*, and *land*, which are important keywords in Decentraland. Another important word used in the game's jargon is *genesis*, which identifies the area around the centre of the map with coordinates (0,0). Other relevant words include *close*, mainly used to communicate that a parcel is close to a road or a plaza, and *discord*, which refers to the popular



Fig. 5. Wordcloud of the most recurring terms in parcel names.

Voice over IP application, that is used in these parcels that are on sale to communicate a way to contact the owner. One last important term is *dragon*, which refers to Dragon City a project created by Metaverse Labs¹², in which they created an imaginary Chinese city with mixed ancient and modern architecture.

¹²<https://metaverselabs.com/>

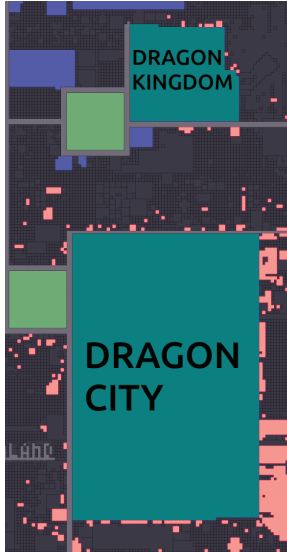


Fig. 6. LAND parcels that mention the Dragon City or the Dragon Kingdom (now Altix).

To get a more detailed vision of the most recurring terms in the parcel names, we show in Figure 5 a word cloud, where the 100 most common terms are represented, and their size is guided by the number of occurrences. Some of the known terms are also visible in this Figure, including *roads*, *dragon*, *city*, *genesis*, *plaza*, *estate*, and *district*, to name a few. Other important terms related to official projects appear, such as *aetherian*, *project*, *university*, *battleground*, *fashion*. We also detect more terms related to sale offers, such as *discord*, *next*, *location*, *front*, *rare*, *close*, and *marketplace*. The Figure also shows some words related to activities that can be done in the virtual world, such as *museum*, *gallery*, *exhibit*, *sciart*, and *nft*.

To capture the magnitude of the phenomenon connected to parcel trading, we further inspected the name provided by each parcel. Since the coordinates are not as expressive, often the parcel owners put a description of the parcel location in the parcel name intending to make it more desirable in the parcel market. Just like in the estate market, where houses close to services (e.g. mass transit) and landmarks (e.g. monuments, squares, parks) are more attractive in the market, parcels close to roads and other famous districts tend to have a higher value and can be traded more easily. To visualise this phenomenon, we analyse the parcel description to collect all the parcels belonging to the Dragon City and Dragon Kingdom (two very important project districts, in teal). The nearby parcels that mention them are highlighted in salmon in Figure 6. It is very interesting to see that multiple parcels and districts all around Dragon city mention it to hint to potential buyers the strategic location of the parcel. A similar effect can be observed for plazas (green) and the parcels that mention plazas (salmon) shown in Figure 7, although in this case the effect is much more distributed because there are 9 different plazas

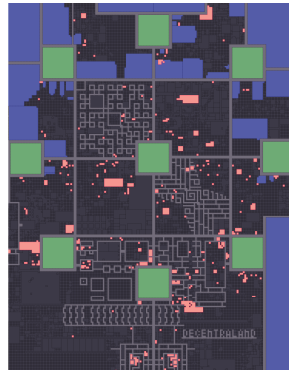


Fig. 7. LAND parcels that mention plazas.

in Decentraland.

V. CONCLUSIONS AND FUTURE WORKS

In this paper, we explored the Metaverse built by Decentraland, a social decentralised video game where numerous features are implemented as NFTs. The main feature of the game is that users can own pieces of the virtual world, and create their buildings or minigames. In this paper, we showed how the economic side affects the main goal of the virtual world. Some parcels are reserved for roads, plazas or large projects, such as the Dragon City, encouraging some users to sell their parcels, mentioning their closeness to some of these features. The paper shows the impact of this phenomenon by taking into account the parcel *name* field, which contains a small description of the parcels. Our analysis uncovers the magnitude of this phenomenon, detecting entire quarters on sale mentioning their closeness to these important projects. As future works, we plan to perform more detailed analyses concerning the bidding process that enables the parcels trade, and to study patterns to uncover possible scams around these NFTs.

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