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Analysis of the Implementation of Blockchain and Cryptocurrency in Meta-universe

Shengchen Yu[1,a,*]

[1]*Department of Computer Science, Curtin University (Curtin Singapore), Singapore*
a. shengchen.yu@student.curtin.edu.au
**corresponding author*

Abstract: The Metaverse was imagined in science fiction as a collective virtual shared space, which is appearing in reality due to technologies including the blockchain and cryptocurrencies. This study aims to discuss these technologies as the foundation of the decentralized ownership, Deed's transactions, and governance in the virtual environment. Thus, by defining the place and significance of blockchain in terms of transparency and security, and discussing the possibilities that NFTs and cryptocurrencies open for digital assets and virtual economy in the context of the Metaverse, this work establishes the formative effect of these innovations. According to the analysis, blockchain offers the fundamental elements for safe asset handling and decentralized decision-making, NFTs represent fresh prospects for digital possession, and cryptocurrencies enable efficient economic transactions. Future developments in blockchain technology as well as the clarification of the legal environment will support the Metaverse even in areas where scalability is currently an issue or when getting the necessary licenses for its use is difficult. This study brings to light the fundamentals of blockchain, cryptocurrencies and NFTs in the context of determining the future of virtual economies and the digital world, and understanding their positive or negative effects on societies and economy.

Keywords: Metaverse, blockchain, cryptocurrencies, NFTs, decentralization.

1. Introduction

The metaverse was first introduced by Neal Stephenson in the science fiction novel Snow Crash in 1992 the metaverse is further defined as an entire reality created inside a virtual environment, virtually modeled in three dimensions where characters- avatars interact. However, in the past, the metaverse was confined only as a part of fiction, but with the development in the IT field, it is gradually becoming a part of reality, and thus has become an emerging field of interest in various research areas and sectors. In general terms, the metaverse is a virtual world that has been built by human beings using a digital system and that can be mapped from or is an extension of the real world and can in turn interact with the real world. It is a digital living space with a new social system in it [1]. Several stages can be identified regarding the development of the metaverse. The analogs of the virtual world are similar to games of the early 2000s such as 'Second Life' and 'World of Warcraft' which previewed the digital life of social interactions and generated content. This is especially the case with World of Warcraft because, being an open-world game, it provides the user with a superior Human-Machine Interface [2]. With the development of technology and the application of VR and AR the

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concept of metaverse has gotten more real. Current hardware like the Oculus Rift has made it possible for users to delve into virtual reality experiences that are as real as life, making the interaction beyond just gaming and social networks.

Recently, the metaverse has begun to grow, which can be testified by the change of name from Facebook to Meta, marking the company's intent to build the meta future around virtual space [3]. In the present-day context, the metaverse landscape is no longer limited to providing FUN and social venues but instead becomes part of major segments of the industries including education, health and commerce. It is an integration of both the online and offline worlds where people can perform actions including virtual conferences, online purchases and even buying properties online. The Metaverse is currently in its infancy, however, it has a great prospect as the new sphere of digital economy. Given technology–5G, blockchain, artificial intelligence, the metaverse is set to become an even more connected and real and virtual environment.

Blockchain and other cryptocurrencies as well as NFTs (non-fungible tokens) all in all form a part of these new age technologies that have revolutionized the world in the digital platform. Blockchain, a decentralized and distributed ledger technology that setup basis for Bitcoin by opening in 2009. Some of its main characteristics – openness, protected and unchangeability – record transactions into code that cannot be rewritten, deleted or changed, each transaction is an individual object [4]. Leading to the development of other programs apart from the digital currencies like smart contracts and the decentralized applications (DApps). While starting from bitcoin up to the latter such as Ethereum, they have introduced a shift in the financial architecture around the possible forms of transacting and exchanging value. These Digital currencies have become an essential economic infrastructure in the metaverse for the conduct of virtual assets trading, DeFi, and virtual markets. Whereas Bitcoin stands as the most famous application of blockchain, the possibilities of using blockchain go way beyond money and cryptocurrencies [5]. On the other hand, NFTs give a parasitic approach of ownership in the digital world. Every NFT is a token that refers to an individual virtual item – purchase, sale, or exchange of which in the metaverse can be an artwork, virtual house, etc. These tokens are used to generate and develop avatars and objects within the metaverse; They can all help to enhance the level of participation in the virtual space and expand the decentralized economy. It is for this reason that findings indicate that pricing of BTC and ETH can influence the NFT market hence establishing a strong positive relationship between cryptocurrencies and NFTs [6]. A combination of blockchain, cryptocurrencies and NFTs are at the technological base of a new digital economy in the Metaverse, and therefore carry almost limitless possibilities for development.

The potential driving force for this research comes from the relatively short but profound impact of the Metaverse and its strongly connected relation with Blockchain, Cryptocurrency, and NFTs in constructing its virtual environment. This is important in order to understand the relationships and interactions between these technologies and the functions of the Metaverse's virtual economies as the field develops. Such a paper's purpose is to discuss their use in the Metaverse and analyze their effectiveness in shifting ownership and decentralization into the digital realm. The further sections will provide a brief overview of blockchain technology, discuss relations and connection between the Metaverse, blockchain, and cryptocurrency, overview main use cases, and evaluate challenges and further possibilities of the Metaverse and connected technologies based on the blockchain.

2. Basic Descriptions of Blockchain Techniques

Blockchain is distributed ledger technology utilized for an assortment of applications and it includes the progression of contracts and exchanges between different systems where each exchange is non-reversible and secure. It works through a number of blocks – each of them containing a list of transactions that are interrelated and protected using cryptographic means. Other characteristics of blockchain represent the decentralized nature of the systems, which means that no central authority

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can control the network and the consensus mechanism, that may be the proof of work (PoW) or the proof of stake (PoS) for validating transactions. Blockchains are designed to be tamper-proof or in other words, they are non-erasable or once written, they cannot be rewritten [7]. Cryptocurrencies are probably the most famous use case of the blockchains and if talking about cryptocurrencies, one cannot but mention Bitcoin. Apart from digital currencies, there has emerged the smart contracts which can be defined as automated contracts within the blockchain technology, with clauses within a program code. These smart contracts create trustless and self-executable transactional relationships between multiple parties, and are utilized caly on the decentralized finance (DeFi) platforms.

In the Metaverse, the blockchain forms the basis for a decentralized environment among players that does not require the intervention of a third-party. It enables buying and selling of property like virtual space, game items and assets, NFTs among others empowering the holders with authority over the digital property. Moreover, the blockchain makes it possible to use secure and transparent voting opportunities in the decentralized self-governing organizations (DAOs) in the governance of virtual communities and platforms. In other words, DAO can be defined as an entity or structure with no specific human identity whose purpose is just to act in accordance with certain rules or rules acquired through a decentralized consensus [8]. Besides, the concept of blockchain is decentralized and it aligns well with the vision of the Metaverse, which is an open-society where people can communicate, engage in trade and work collaboratively with little or no control from a central authority. The integration of blockchain with Metaverse further improves the prospects of Metaverse by offering a reliable, secure and open system, which creates an environment for decentralized, microeconomic and self-growing Metaverse economy and digital environment based on interoperability.

3. Connections Between the Metaverse, Blockchain, and Cryptocurrencies

When it comes to the Metaverse, blockchain and cryptocurrencies are intertwined, with the help of which a decentralized virtual space can be created that fits into people's lives. Blockchain is the underlying technology for the decentralization of the Metaverse offering the user sovereignty over virtual identity and property without the help of the central authority, while Metaverse concentrates on the creation of digital property and smart contracts [9]. This decentralized nature is consistent with NFTs (non-fungible tokens), which are critical to defining ownership of an object in Metaverse. Based on blockchain, NFTs are a special form of digital asset like virtual land, art, in-game items, and so on, which can help users authenticate their property rights and trade the asset on cross-platform securely. Cryptocurrencies are also the main means of trade in the Metaverse economy, enabling the purchasing of virtual goods, virtual property, investments in virtual funds, and P2P transactions with no middlemen involved. Cryptocurrencies such as bitcoin and Ethereum are built in decentralized platforms guaranteeing safety and functionality for the users without compromising their decision on the money. Besides, things like smart contracts in Ethereum create contracts in Budapest automatically and facilitate the voluntary transfer of value any time certain conditions are met.

It also fosters the setup of the virtual economy for using the Metaverse by establishing the ownership and transfer of digital assets more securely, providing the cryptocurrencies for realizing liquidity, and making cross-border transactions to be conducted without the banking system. Almost all applications of blockchains based in the metaverse are tied to some form of asset [10]. For instance, in the Decentraland and The Sandbox platforms, users can purchase the virtual land using the token native to the respective platform. These assets are in the form of tokens and can be built, leased, or sold more efficiently with the aid of blockchain technology in a way that is easy to prove. Besides, technological breakthroughs in blockchain technology increase user engagement in decision-making processes in decentralized governance via Decentralized Autonomous Organizations (DAO), where users can vote on key issues including platform features, regulations, and policies. Thanks to the Blockchain, these governance processes occur transparently and safely and the subjects of virtual

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environments can contribute to their governance. Given the fact that metaverse, blockchain, and cryptocurrency are intertwined this closeness is crucial to support decentralization, conduct transactions in a virtual economy, and allow users to govern the development of their virtual world. A summary of the techniques are listed in Fig. 1 [11].

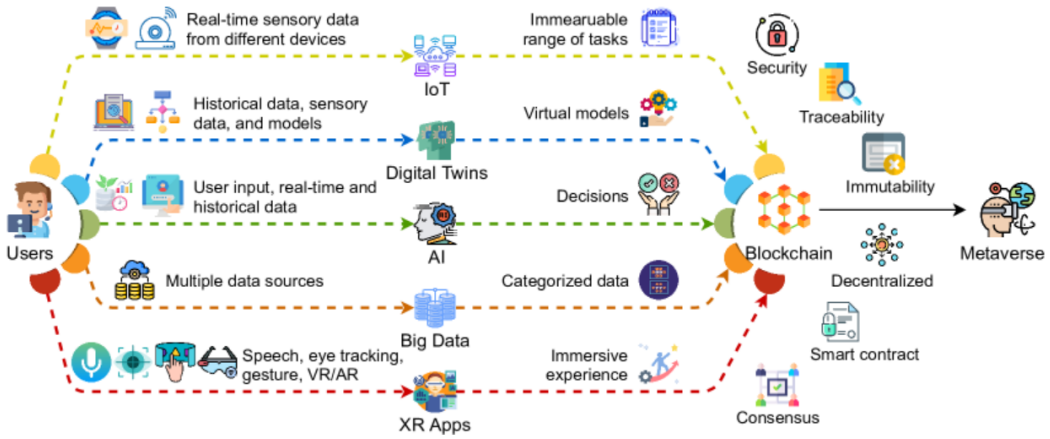

Figure 1: Blockchain for key enabling technologies of the metaverse [11].

4. Applications

Possibly, the most discussed use cases of blockchain in the metaverse include the virtual real estate. With development of the technology, they slowly start wondering if one can do the same with technology and transfer the ownership of the real estate faster, with less procedures, more safely, and less money [12]. Decentralized pieces of lands like Decentraland and The Sandbox allows that lets its users to buy plots of land, develop it and sell it, all of which is underpinned by the blockchain technology. These plots are in form of NFTs which offers a proof of ownership and can be fully traded directly on decentralized markets. Similar to the physical real world, virtual land is found to have value dependent on its location, possibility of development, and the market need in the particular platform. These assets are protected by a blockchain ownership system so that each and every one of the transactions that are made is beyond reproach.

The concept behind trading virtual land through NFTs remains almost as simple as how deeds work in the real world. Since NFTs are not similar to other types of cryptocurrencies, the benefit of getting engaged in NFTs is that they are distinct from the different NFTs [13]. By staking real estate in the form of an NFT, users make it possible for them to retain individual ownership over the property and be able to sell, lease or develop the virtual property when required. These properties can be converted into virtual shops, places of entertainment and even educational trips and thus give birth to a live electronic commerce. It is for this reason that virtual land has experienced an increase in value on the highly active Metaverse space due to the scarcity of prime spaces and often, one-of-a-kind opportunities for developments. Another area that can be associated with NFTs in the Metaverse is digital assets, which includes virtual assets such as avatars' apparels, accessories or items in the game. They can be owned, exchanged and personalized which means that they create a market of virtual objects which work in the same way as physical objects. For instance, players can buy and sell NFTs that are used to represent one-of-a-kind items in games like Axie Infinity or on places like Cryptovoxels. Through the application of the blockchain technology, these assets are rare, unique and truly belong to the user. One of the advantages of this approach of digital commerce is that creators and developers can directly generate revenue from sales of exclusive NFTs to consumer. When each

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is entered to a blockchain, the clients are assured that their acquisitions are safe and that they indeed possess them. This virtual property model has created new possibilities of income sources for artists, designers and developers since they can now sell their works in the virtual markets directly without the intervention of the middlemen.

There are two major use cases of blockchain and cryptocurrencies in metaverse. i.e., a shift to decentralized finance (DeFi) and virtual economies. However, in TradFi, such external constraints as regulation and an already set up infrastructure may slow down the rate of innovation, while DeFi takes place in a highly unregulated environment, with much less barriers to entry and a more freedom to innovate and offer new technologies or products [14]. In these ecosystems, users can directly interact with financial services in the virtual reality such as lending and collateralization, which is based on the blockchain and smart contracts. For instance, customers can buy platform-specific tokens such SNT for Decentraland's token or ENCH for The Sandbox token which is a native token in those worlds. Such tokens can be utilized to buy land, products, and services or locked in to earn a particular number of tokens. One of the most essential features of DeFi is that it does not require the involvement of centralized banking or middlemen and enables the users conduct financial operations in a completely decentralized and virtual environment. This gives the users the ability and chance to gain actual worth for the activities they are likely to undertake in the Metaverse; say renting virtual space or working in the Metaverse and being possibly paid in crypto. Therefore, while the virtual economy is already on the ascent, it has the capability to become as complex as the traditional economy if not than that.

Blockchain technology is also being utilized for coordinating the virtual meetings, conferences and social engagements in simulated environments. Events like concerts, art exhibitions and conferences are frequent on the platforms like Decentral and The Sandbox, where avatars can be used to 'attend' the event. This makes it possible for event tickets to be generated with blockchain applications where such tickets can be bought, sold or even traded in the market. This makes it that tickets are limited and use is owned by the users hence very few problems like those of fake tickets. It represents new forms of artistic encounter, of artists, performers, and organizers of events with an international audience in authentic, virtual space. For instance, musical performances generate thousands of viewers, performers perform in meta-universe that fans can buy unique NFTs merchandise. This model does not only benefit performers as another stream of revenue but makes the overall user experience better as those may own digital tokens associated with an event.

5. Limitations and Prospects

However, as insightful as the concept of blockchain and Cryptocurrency in the Metaverse is several barriers need to be addressed for these innovative technologies to harness their full potential. For limitations, first of all, there is a problem related to scalability, meaning that the application of this approach will be difficult in large corporations. That is why, for example, despite the increasing number of transactions in the Metaverse, the Ethereum platform has a problem with throughput. Uses are frozen due to slow transaction speed, and high fees represented by gas fees among other features. While other solutions such as layer-two scaling and the transition from PoW to PoS are being worked on, none of them have provided a comprehensive solution to the scalability issue. These among others are another major drawback including the unclear legal framework concerning cryptocurrencies, NFTs, and virtual assets. Even in the present, governments are still working on the systems as to how such digital assets will be governed. Such lack of clarity puts pressure on the development of virtual economies in the Metaverse for both the business side of things and the users themselves. While laws governing taxation and ownership of assets are particularly ambiguous and open-ended, especially in virtual worlds to which traditional legal frameworks do not map directly are the laws protecting intellectual property rights. Another major problem that is commonly discussed is the issue of

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interoperability. NFTs and most other blockchain-based assets, for that matter, are still largely restricted to their respective platforms today. The Metaverse strives to design a single integrated virtual universe in which avatars can freely transport digital resources. Nonetheless, poor general standards and non-uniformity across blockchains reduce the exchange of assets between different platforms, thus the mobility of the user experience.

In the future, these limitations can be solved by science and technology intervention which seems to be safe and sure. Some of the existing issues, for instance, the limited transactions per second or the constrained asset exchange that hinders the cross-chain interaction, can be solved by advancements of layer-two solutions and the implementation of other related protocols. They will be useful in the enhancement of virtual economies to increase efficiency and also expand the market to include other potential users. As for the government's active involvement in the regulation of the digital assets market, a number of them are currently trying to establish more transparent guidelines for the operation of the instruments. International cooperation may lead to a standardization of such rules and lead to more business and user involvement in the Metaverse. In the future, legal certainty will enhance the legitimacy and gradually create confidence in virtual assets and transactions within the digital economies. In addition, more development efforts are being made towards sustainability, especially with the integration of the PoS consensus mechanisms that are way more advantageous in terms of energy consumption than PoW. These sustainable measures will seek to align blockchain technology to environmental best practices with a view of overcoming probably the biggest challenge Ethereum has faced; sustainability.

All in all, there are certain limitations when it comes to using Blockchain, Cryptocurrency, and NFTs in the Metaverse but the future looks promising. Innovations in technology, changes in regulations, and the development of sustainability will define the levels of a highly integrated and efficient digital environment in the future steadily. Thus, further advances in these fields will open new opportunities for the formation of the virtual economy, control, and user experience in the Metaverse.

6. Conclusion

Blockchain and cryptocurrency have emerged as critical pillars for the construction of the Metaverse since these underpinned the architecture for decentralized ownership and digital commerce in the virtual world. Thus, this paper has provided an analysis of how blockchain guarantees safety, openness, and uncompromised decentralization in the digital environment and how NFTs offer the opportunity to own true digital assets and create one's digital persona. Cryptocurrencies on the other hand, seamlessly serve as the main conduit that allows Virtual economic transactions within Metaverse. These technologies work in harmony to bring a decentralized and highly scalable user-generated virtual world in the making that is revolutionizing the concepts of owning, governing, and buying in the virtual environment.

The work also establishes that blockchain holds a secure structure for the distribution and evolution of digitized properties and virtual goods like virtual estates and in-game valuables. NFTs have provided new ways through which users can have, sell, and even make profits out of assets in the digital world, that is the digital economy. Cryptocurrencies themselves serve as the currency within the Metaverse facilitate the transactions and further develop new staking models and methods of economic cooperation, such as DeFi and P2P. The application of all these technologies equates to the Spiritual Economy, wherein users' properties are independent / self-governed, and thus, economic activities can be performed without intermediaries. Moreover, venturing into the future, the Metaverse seems to be rather promising given that the advancements in blockchain scalability as well as the emerging regulations will address the current obstacles. The optimization of transaction speed and lowering the fees through the implementation of layer-two solutions and cross-chain solutions

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will make the Metaverse a more friendly and effective environment. Besides, the emergence of better legal definitions and legislation related to digital assets will help to reduce the risks and increase legitimacy attracting more people and companies to use them. It is for this reason that as blockchain advances towards being a greener technology the environmental impacts linked with cryptocurrencies and NFTs are set to reduce in the future an environment that will boast increased environmental standards for digital infrastructure. From the perspective of research implications, the present work advances the existing knowledge of the role that blockchain, cryptocurrency, and especially, NFTs play in reshaping virtual economies and digital environments. Analyzing their application in the context of the Metaverse, this paper contributes to the understanding of how these technologies intersect the environment, which can be classified as decentralized, transparent, and secure in terms of digital interactions. The identified conclusions also have applications beyond the virtual worlds but extend to other domains including finance, real estate, entertainment, and others, where decentralized systems are gradually embraced. This research also shows that digital asset ownership and blockchain technology can significantly propel the development of the digital economy through the Metaverse and other growth possibilities for users, businesses, and content originators.

All in all, the use of the blockchain, cryptocurrency, and NFTs as the Metaverse core indicates the global transition to a decentralized user-powered economy. These technologies form the basis for newer forms of ownership and control, and business models in virtual environments, which are emerging for virtual worlds and will emerge in the future. Adding to that, the use of blockchain and cryptocurrency will continue to become even more intertwined as the Metaverse becomes larger and more intricate. In this regard, this study speaks to the need for these technologies in the construction of the online and social environments ahead.

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