The Application of Blockchain and Cryptocurrency in Meta-universe and NFT

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Abstract. Contemporarily, the metaverse seamlessly merges the physical and digital worlds, enabling avatars to engage in a wide range of activities like trading, social networking, entertainment, and production. The Non-Fungible Token (NFT) market has surged in recent years. Nowadays, NFT's use is restricted to digital fantasy gaming, collectibles, and art, however, because of its unique features, protocols, and platforms, it might be applied to real-world problems. Blockchain and cryptocurrency technology is a core pillar technology for both the metaverse and NFT. Blockchain technology has many real-world applications. For example, ModelChain can apply blockchain technology to machine learning to solve the privacy-preserving healthcare predictive modeling task. In addition, the trading behavior of the trading subject of B2B and B2C electronic trading platform based on blockchain will be completely proven and unrepudiated. This study will give an in-depth look at the application of blockchain and cryptocurrency to the metaverse and NFTS, and highlight some key initiatives to demonstrate the use of blockchain in NFT applications and services. The limits of blockchain and cryptocurrency technologies will also be covered in the article. These results will inspire additional studies on NFT and Metaverse adoption in various contexts as well as shed light on the connection between blockchain, meta-universe and NFT.

Keywords: Blockchain; Non-Fungible Tokens; Metaverse; Digital economy.

1. Introduction

A trust-free electronic payment system based on cryptographic proof was proposed by Satoshi Nakamoto in 2008, enabling any two interested parties to conduct business directly with one another [1]. An electronic currency was described in the study as a series of digital signatures. A hash of the previous transaction and the public key of the incoming owner are digitally signed and added to the end of the coin as the currency is transferred from one owner to the next. Since then, the blockchain industry has grown rapidly. A non-fungible token (NFT), which was created only for digital use, amounted to $69 million when it was sold on March 11, 2021. Anyone with Internet connection may view or purchase this piece of artwork created by Beeple. In fact, the technology that powers Bitcoin was the first to provide a secure decentralized infrastructure for digitally mapping non-fungible assets, even though the concept of NFTs was conceptualized long before blockchain technology [2]. Along with the NFT by Beeple, other notable NFT transactions include the sale of the price of the first tweet ever ($2.9 million), the price at which the meme animation Nyan Cat was auctioned off 0.6 million, and the amount at which the band Kings of Leon sold the rights to use their music in NFTs ($2 million) [3]. NFTs are unquestionably a current phenomenon that has given rise to incredibly creative ideas. The next stage of technical development is the metaverse, which expands the range of services beyond conventional systems with internet connectivity and has the power to take digital usage to astounding new heights. The trend towards increasing efficiency in the business world is the digitization of services. the earth, space, power, buildings, medical supplies, and many other things can be found inside the metaverse [4]. As the metaverse data storage is completely decentralized, everyone owns it, everyone manages it, and everyone will work together to ensure its continued existence as the metaverse builds upon it, everything is secure here.

The number of studies and surveys on the metaverse has grown over the past few years and is publicly available. Among the other pillars, blockchain has been identified as one of the technology enablers. Data sharing, data interoperability, and data storage are the three key uses for blockchain technology [4]. A more thorough analysis of blockchain was omitted due to the large scope. While

its potential application for connecting virtual reality objects is specified, it is also discussed how significant a role blockchain played in the creation of the metaverse. In this study, however, falls short of describing those specific facts in depth. A survey was provided on the idea of utilizing blockchain and AI to expand the metaverse [5].

In addition, colored Coins could be seen as the precursor of NFTs built on top of the Bitcoin network. The fungibility of bitcoins notwithstanding, it is still feasible to label them to make them stand out from the rest. Cryp-toPunks, the first Ethereum-based NFT, was created by Larva Labs in 2017. It has 10,000 distinct, randomly generated characters that resemble humans. The Ethereum smart contract would maintain the legal ownership of each character, and owners may exchange them. CryptoKitties was inspired by the CryptoPunks project. Inventor of blockchain games and NFTs Cryp-toKitties, which debuted in late 2017, attracts NFTs. Users of the virtual CryptoKitties game, a blockchain-based game, acquire and trade characters with distinctive traits that resemble cats. The ERC-721 token, which was produced via an Ethereum smart contract, became the first widely acknowledged standard token for NFTs on the Ethereum blockchain thanks to the creation of this game. [6].

The primary objective of blockchain technology, which is quickly becoming essential, is to secure the digital content that each user of the metaverse owns. Blockchain is used by the metaverse eco-system to account for its transactions and content, protecting users' reputation, privacy, and integrity. Furthermore, despite the fact that NFT technologies are still in their infancy, they have the potential to have a significant impact on both the opportunities for future economic growth as well as the current decentralized markets.

The contributions are provided as follows. Firstly, a brief overview of connections between blockchain, meta-universe is presented, and NFT [6]. Secondly, this study discusses application of blockchain for meta-universe and Blockchain is being used in some intriguing metaverse projects like De-centraland, Sandbox, Axie Infinity, and Illuvium. The discussion of the most recent NFT solutions' design models follows. To be specific, the fundamental technical elements are listed that go into making NFTs. Finally, this research highlights several unresolved issues in meta-universe and NFT ecologies NFT systems utilizing blockchain still encounter inescapable problems includes issues with data accessibility and privacy.

2. Connection between Blockchain, Metaverse & NFT

When it comes to the metaverse, our imaginations might wander to a variety of fascinating experiences or entertaining games. only in an alternate universe where the ecosystem is inevitable constitutes the scenario that is most like our own. In addition, the digital assets, such as non-homogenized tokens based on ERC-721 or ERC-1155 and homogenized tokens based on ERC-20, are the core services provided by the blockchain [6]. Every aspect of the Metaverse adheres to the idea of decentralization, which requires the support of the decentralization technology to ensure the safety and functionality of the Metaverse. Blockchain technology is the most prevalent form of decentralized technology used in the Metaverse, along with distributed computing, storage, and other technologies [7]. The reason is that it can maintain the health of the metaverse's economy, blockchain technology is essential to its survival. Blockchain also provides essential technical support for the metaverse. For example, Providing Data Security and Privacy, Making Data Interoperability Possible, Smart contract deployment and the most important support is NFT.

Indivision and uniqueness are the most crucial characteristics of NFT, making them appropriate for identity representation, like with assets that are singular, undivided, and open to trade and transfer. The ownership certificates for these virtual assets are referred to as NFTs in the metaverse. Blockchain-based NFTs make it easier for enthusiasts to manage NFTs completely, transfer ownership of their NFTs to a buyer, and produce NFTs on the blockchain using the common token format. Another type of token that includes the traits of both fungible and non-fungible tokens are semi fungible tokens. Semi-fungible tokens can be used in more than one class or at the same time,

but they cannot be used in other classes or at other times. Because a charter ticket may be traded for another charter ticket but not for a first-class ticket, an aircraft ticket can be viewed as a semi-fungible token. Blockchain-based games primarily use the idea of semi-fungible tokens, which also lowers NFT overhead [6].

3. Applications of Blockchain in Meta-universe

The amount of research on this subject is still quite limited because Metaverse has only recently attracted attention [8]. The majority of current works concentrate on resource distribution for the metaverse. The use of blockchain to facilitate Metaverse interactions, such as the trading of digital assets and the sale of services, is still in its infancy. Furthermore, the scalability problem with blockchain is not addressed. Blockchain could wind up becoming the bottleneck in future Metaverse apps that include millions or perhaps billions of users if this problem persists.

As a result, the idea of MetaChain, a cutting-edge blockchain-based framework, was put forth. a state-of-the-art blockchain-based architecture that can properly manage resources depending on application needs and expedite numerous interactions between the Metaverse Service Provider (MSP) and the Metaverse's users, and urge MUs to add resources to the blockchain and Metaverse applications will benefit both the Metaverse Users (MUs) and the Metaverse Service Provider (MSP). Without the aid of a trustworthy third party, various interactions between the MSP and the MUs can be enabled and automated [9]. MetaChain specifically makes use of smart contract mechanisms. The number and size of the shards should be chosen based on the demands of the Metaverse applications, enabling variable resource allocation for the MSP. This will increase the blockchain's scalability. Furthermore, using Stackelberg game theory, an incentive mechanism for Metaverse applications was designed because they frequently call for large computational resources. By using MU resources, this technique enables the MSP to handle blockchain processes and Metaverse apps.

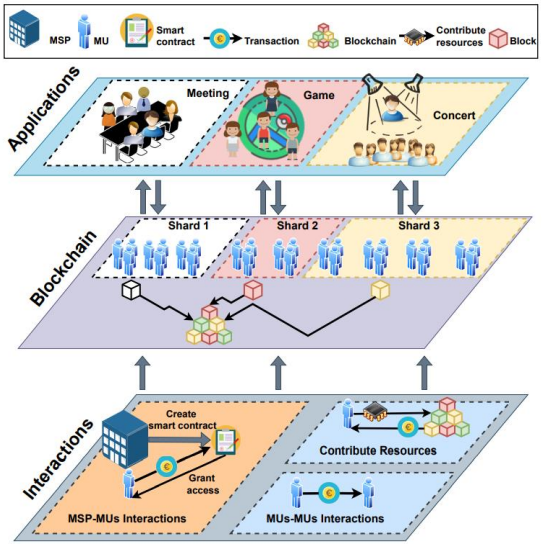

Fig. 1 A representation of the suggested system

A general overview of MetaChain is shown in Fig. 1 [9]. The MSP is referred to in the framework as a service provider that offers its products and services to the MUs, including virtual reality games, conferences, and concerts. Each MU has a system account and any related items, coins, or tokens. By paying the MSP, MUs can access the service and send digital assets to other MUs. Additionally, MUs can reward themselves by adding computational power to the blockchain. The MSP-managed blockchain acts to control all communications between the MUs as well as the MSP and the MUs. These exchanges are captured in blockchain as transactions, along with the assets of the MUs.

3.1 MUs-to-MUs Interactions

The asset transfers made by the MUs can be tracked using the blockchain as an immutable database. Furthermore, the framework permits inter-MU transactions without the requirement of a reliable third party. Digital assets can be easily transferred and exchanged between MUs via the blockchain. For instance, just like in real-world situations, a MU can sell a virtual concert ticket to another MU if they can't attend. The suggested framework can facilitate such exchanges through blockchain or smart contract transactions in a safe and open manner.

3.2 Blockchain Shadings

Millions of MUs are expected to use Metaverse applications, which is very difficult for traditional PoW blockchain networks (e.g., Facebook and Twitter) and many other social networks. It is advised to use the shading mechanism as a result [10]. The blockchain network is split up into smaller sub-networks using the shading process. Every sub-network creates blocks that are added to the chain using a different consensus process. In a network with several shards as opposed to a network without shards, blocks can be generated much more quickly. More shards can be built as the application's demand increases to give MUs a high Quality-of-Service.

Furthermore, Metaverse applications frequently exhibit high computational resource requirements, such as the need to build virtual worlds. Despite the fact that user device capabilities are rapidly developing, this problem can still be avoided to some extent. There are still some applications, like gaming, where the MUs require a unified setting in order to interact. With the help of the Metaverse applications, MUs will be able to offer their computational resources in exchange for virtual currency, it is suggested that a framework be built using blockchain shards. With the help of this tactic, by utilizing the MUs' resources, the MSP can expand the network by enlisting additional MUs. The MSP can individually specify a payment rate for each share based on demand for that particular shard. For instance, the pay-per-share protocol [11] enables MUs to receive network tokens in exchange for their resource contributions to the shards.

In conclusion, to enable smart and reliable interactions between the MSP and the MUs, MetaChain makes use of the benefits of blockchain and shading technology. Additionally, a new shading strategy is suggested that can both boost MetaChain performance and make use of Metaverse application resources from MUs. the behavior of the MUs using Stackelberg game theory analysis has been examed, and one has created an economic model that aids the MSP in distributing resources among the MUs in a way that is in line with the requirements of the Metaverse applications.

4. Applications of Blockchain in NFT

NFT implementation was pioneered by the Ethereum blockchain. Previous scholars have used Stackelberg game theory analysis to analyze the behavior of the Mus. In order to support the requirements of the Metaverse applications, an economic model that aids the MSP in dividing up resources among the MUs has been created. the NFTs standards that have been implemented on the aforementioned blockchains in this section are shown.

The first NFT standard created in Ethereum, ERC-721, is a free and open-source standard. ERC-721 does not support fungible tokens as smart contracts have the ability to combine tokens with the same configuration but different attributes. In addition, Enjin created ERC-1155, a new standard that supports non-fungible, and semi-fungible tokens and has more functionality than ERC-721. The open-source blockchain platform EOSIO was introduced in 2018 and makes the claim that it will reduce transaction fees and boost transaction throughput. When compared to Ethereum, EOSIO's wallet creation algorithm and transaction handling process are different.

A brand-new, high-performance public blockchain called Algorand was introduced in 2019. Scalability is offered while security and decentralization are upheld. Users only need to complete one transaction in the Algorand blockchain to create NFTs or FTs, and they can do so without writing smart contracts. Another open-source, decentralized blockchain is Tezos. The idea of meta-consensus

is supported by Tezos. To overcome the scalability constraint of the Ethereum blockchain, Dapper Labs created Flow. Games and digital collectibles are the focus of the quick and decentralized blockchain called Flow. A comparison of the described standards is given in Ref. [6]. Table. 1 compares the support for fungible, non-fungible, batch, operator, and fractionalized non-fungible tokens (NFTs), where an NFT can be divided into various tokens and each exchange is dependent on the other.

Table 1. Comparing NFT standard

NFT Standard	Support NFTs	Support Batch Transferring	Support Operator	Fractionalized NFTs
ERC-721	Yes	No	Yes	No
ERC-1155	Yes	Yes	Yes	No
dGoods	Yes	Yes	No	No
Algorand	Yes	Yes	Yes	Yes
Tezos	Yes	Yes	Yes	Yes
Flow	Yes	Yes	Yes	No

4.1 NFT Framework

As illustrated in Fig. 2, this section suggests a structure for the presentation of NFT-based patents. The five main layers of the suggested framework are Storage Layer, Authentication, Verification, Blockchain, and Application Layer.

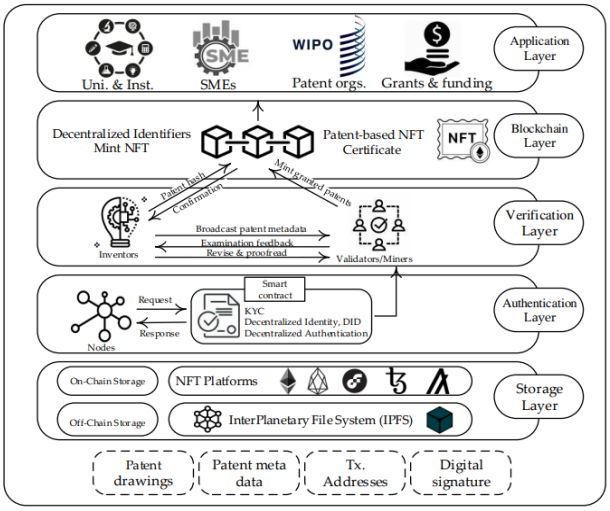

Fig. 2 Proposed Architecture for NFT Presentation

4.2 NFT's Opportunities

The gaming sector is one where NFT has a lot of potential. Decentraland, SandBox, AXIE, Illuvium (depicted in Fig. 3) and other cryptogames are already available [4]. An intriguing aspect of these games is the "breeding" mechanism. Users might choose to devote much time to caring for pets and producing new progeny. They might also decide to buy the rare or limited edition virtual items and then resell them for a premium price. Older, essentially dormant projects can now successfully compete in the market thanks to the success of newer NFT projects. Additionally, older projects influence newer projects. These results suggest that the market is expanding swiftly despite its relative youth.

Fig. 3 Decentraland, Sandbox, Axie Infinity, and Illuvium

5. Limitations & Outlooks

It has been suggested through the previous review that blockchain is a key technology for NFT and the metaverse. the metaverse is still in its infancy, despite the technologies' potential to create a scalable, reliable, and effective metaverse. Thus, this section discusses the challenges, limitations and future outlooks.

Even though blockchain technology has made significant advancements [5], fusing blockchain with the metaverse still presents difficulties and unresolved problems. The high transaction volumes in the metaverse are incompatible with the current NFT platforms used in the real world. On blockchains, special cryptographic tokens called NFTs are employed. NFTs digitalize physical objects like artworks and real estate by giving them non-reproducible features. The NFT platforms available today, however, are still in their infancy. The service levels of NFT platforms must be increased to accommodate the high-volume requirements of forthcoming metaverse applications. The blockchain-powered application model used in real-world applications cannot be directly imported into the metaverse. These days, infamous worries about the metaverse have been raised by the widespread speculation surrounding hundreds of cryptocurrencies and the initial coin offering (ICO) frauds. Furthermore, the current blockchain-powered application models cannot deliver the high throughput and low latency performance needed for metaverse. For the numerous applications utilized in the future metaverse, a high-performance and secure blockchain-powered application model is therefore required. For the metaverse, new blockchain infrastructure and consensus methods are needed. Due to the limitations of current consensus mechanisms, which include numerous security issues and extensive hash computing.

In the metaverse, where there is a risk of privacy violation, identity theft, and other forms of fraud, the most pressing issue is how to ensure users' security and privacy. From the perspectives of users, developers, and metaverse companies alike, this issue is crucial.

For NFT, there is a field where NFTs may be advantageous [12]. Since NFT-based tickets are unique and uncommon, once they have been purchased, the owner cannot resell the ticket. For the benefit of all parties, including the customer and the event organizer, a transparent ticket exchange platform is provided, through the blockchain-based smart contract. Without the need of intermediaries, customers can rapidly and securely buy and sell cryptocurrency tickets from the smart contract.

Blockchain offers the perfect decentralized setting for the online virtual world. Participants have access to a variety of fascinating use cases in these blockchain-powered alternate realities, including playing games, showcasing their own artwork, and exchanging assets and virtual properties (such as artwork, land par-cells, names, video clips, and wearables). Users can make money using the virtual economy as well. To obtain the bond, they can rent out the structures (such as offices) or raise and trade rare animals for rewards. In reality, all of the aforementioned applications are included in the metaverse ecosystem.

6. Conclusion

In summary, this paper has analyzed the essential roles of blockchain technologies in the ever-expanding metaverse and NFT market. At the beginning, the development of the metaverse and the formation of NFT are discussed. Then, this paper clarifies the internal connection between blockchain metauniverse and NFT, and respectively clarifies the application of blockchain in metauniverse and NFT. Finally, this paper also analyzes the current limitations and future development prospects of

this technology. Collaboration between academia and business is necessary for further metaverse exploitation and interdisciplinary research in order to work toward an open, just, and rational metaverse of the future.

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