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A Review of Block chain in the Metaverse

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Abstract
The metaverse has emerged as the new standard for social networks and three-dimensional (3D) virtual worlds when Facebook formally rebranded itself as Metaverse in October 2021. The metaverse uses a variety of relevant technologies to provide consumers with tailored, 3D immersive experiences.In the metaverse, consumers' digital content and data security is a natural concern despite its widespread attention and advantages. Because of its unique characteristics of decentralization, immutability, and transparency, blockchain is a possible answer in this area. We hope to offer a comprehensive overview of blockchain's metaverse applications so that readers can gain a deeper understanding of the technology's place in the metaverse. the metaverse's technical difficulties and thereafter emphasize how blockchain might be useful.We also look at how blockchain affects important metaverse enablers like digital twins, big data, artificial intelligence, multi-sensory and immersive apps, and the Internet of Things. Also, we offer some significant initiatives to highlight how blockchain is used in metaverse services and applications. Finally, we outline some encouraging avenues for future research and development that will advance the usage of blockchain in the metaverse.

Keywords: *- Blockchain, metaverse, privacy, Vertical Applications*

I. INTRODUCTION

The metaverse is the next phase of digital evolution that can revolutionize the digital adoption to a staggering level and extends the domain of services beyond the standard systems with online access. Digitization of services has become the trend for improving the efficiency in the fields of businessentertainment, education, or any other system that can be integrated with online access over the past few decades. These services and systems were improved to its maximum potential with the capabilities provided with digital systems and online storage/ processing facilities at remote data centres and cloud platforms. With the efficiency, performance, and quality of the service access reaching to its highest potential, the perspective has been shifted towards the consumer experience. Thus, the demand for improved service experience with more interactive capability is ever increasing and service providers are keen on elevating their existing standards to the next level. In fact, consumers are demanding haptic and immersive capabilities with their digital interfacing, where such traits are only possible with the emerging technologies of Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), and Extended Reality (XR) [1].

The metaverse is the solution that Amalga mate all these pertinent technologies in the global context. This concept creates a simulated digitized environment that can be endured as an immersive virtual world for its prosumers. Users can interact with this virtual eco system through their digital avatars in compliance to the duality principle [2]. Concretely, the avatars are the virtual embodiments of the users, and has the same legal authority in the metaverse as one's legal rights in the real world; this makes the avatar warranted for any transactions made within the virtual domain and restricts from repudiating any committed action. The access can be gained by any person having a VR/ AR enabled immersive device, such as a headset or a glass under the minimal capability [3]. On the contrary, full-body haptic bodysuits such as Teslasuit or Holosuit carries the potential to embrace the immersiveDespite the metaverse being developed and intended to expand the scope of capabilities in social media, its potential for other industrial, commercial, societal, educational, medical, military, and governmental sectors are immense. Lack of immersive experience is a well-known drawback with the online remote access and control systems. Specially in the instances of controlling Supervisory Control and Data Acquisition (SCADA) or Programmable Logic Controller (PLC) based remote automation systems [4], fitting on apparels, perception in commercial real-estate or architecture, understanding Three-Dimensional (3D) visualization in medical/ engineering/ or architectural education, remote controlling of unmanned aerial/ naval/ or ground vessels, experiencing digital entertainment beyond the 2 dimensions are areas that required more innovation. Though AR and VR technologies offered standalone solutions for these areas, an all-in-one platform

or an environment was lacking to combine these tools. experience to its peak with the capability to track the motions, extract haptic feedback along with transcended biometrics.

Blockchain for IoT in the Metaverse

1) Introduction: The metaverse platform gathers data from a variety of Internet of Things (IoT) devices to ensure that it runs efficiently in several applications of the metaverse such as medicine, education, and smart cities [3]. The IoT devices will connect the metaverse through the use of a diverse range of hardware, controllers, and physical items. Connecting to the metaverse and navigating both physically and virtually is made possible by IoT devices equipped with specialized sensors. The capacity of IoT devices to perform operations in the metaverse will be critical to the user's ability to operate in the met averse [6].

2) Challenges related to IoT in the Metaverse: There will be a huge number of connected IoT sensors in the metaverse. With so many connected devices, IoT storage and security are undoubtedly a concern. It is incredibly difficult to analyse IoT data that is unstructured and real-time [4]. The quality of data can be judged by the amount, precision, and speed of data [5]. In addition, the metaverse data must be error-free for analysis. The use of a centralized strategy is not advantageous when it comes to storing data across virtual worlds. If even a single piece of data has been tampered with, it will harm the entire set of results produced by the IoT devices. The cross-platform capabilities of IoT devices are critical for sharing data between virtual worlds [6]. IoT data must be tracked for safety and regulatory compliance reasons.

3) How blockchain can help: Blockchain enables the IoT devices in the metaverse to communicate data through crosschain networks, which in turn produce tamper-resistant records of shared transactions in virtual worlds as depicted . As a result of blockchain technology, applications and users will be able to share and access IoT data without the need for centralized management or control. To eliminate conflicts and increase confidence among the metaverse users, each transaction is recorded and authenticated. In the metaverse, IoT-enabled blockchain enables the storage of data in realtime. All stakeholders can rely on the data and take action promptly and efficiently because of immutable blockchain transactions [8]. Blockchain technology allows stakeholders to keep track of their IoT data records in shared blockchain ledgers this will help resolve issues in the metaverse.

4) Summary: Blockchain will enable IoT devices to share and store real data securely over multiple virtual worlds. Blockchain technologies require a significant amount of processing power to keep them running. Blockchains are vulnerable if a small group of miner's controls most of the network's total mining hash rate. It is not possible to verify IoT data that is not public due to a lack of governance before it is published on the blockchain in the metaverse. Smart contracts in the metaverse that are executed on a distributed transaction ledger may violate the laws. It is difficult to trace down all IoT transactions involving unlawful services in the metaverse because of the anonymity provided by blockchain technology. While the blockchain's automatic function offers numerous advantages, pinpointing which parties are responsible for specific behaviours remains a difficult challenge [9]. The blockchain should be regularized to carry out the expansion of the metaverse.

II. CONCLUSION AND RESEARCH DIRECTIONS

The paper has comprehensively investigated and analysed the roles and impacts of blockchain for the foundation and development of applications and services in the metaverse. The fundamental concepts of blockchain and the metaverse were sketched at the beginning of this work, along with the role of blockchain regarding the foundation and development of the metaverse. Later in this work, several prominent technical aspects and use cases of blockchain in the metaverse were investigated exhaustively besides the insightful challenge analysis and applicability discussion given. Finally, some technical improvements of blockchain were provisioned for the metaverse, which in turn enhances the performance and practicality of potential applications and services in the virtual world. Besides making the conclusion, we sketch out some future research directions as below. Relying on the systematic investigation of blockchain for the metaverse in both the technical and use case perspectives, blockchain had showed a great potential to revolutionize the immersive experience with various applications and services built in the virtual world. Many technical and applicable aspects of all current blockchain versions have been attracting much more research activities, including consensus algorithms, network management, and blockchain interoperability.

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