Pegem Journal of Education and Instruction, Vol. 13, No. 4 , 2023 (pp. 729-736)

RESEARCH ARTICLE **WWW.PEGEGOG.NET**

ON THE USE OF BLOCK CHAIN TO ENABLE A HIGHLY SCALABLE INTERNET OF THINGS DATA MARKET PLACE

M.Swathi[1], Ms. K.Hema gayatri[2], Ms. K.Vyshnavi[3], Ms.Tanmayai[4]

[1] Assistant Professor, Department of Information Technology, Sridevi Women's Engineering College, Hyderabad

anr304@gmail.com

[2, 3, 4] Department of Information Technology, Sridevi Women's Engineering College, Hyderabad

ABSTRACT

Data, as the world puts it, is the new oil. Massive deployments of IOT equipment have resulted in an unprecedented deluge of data. Additionally, many services are becoming "smarter" via the integration of artificial intelligence (AI) and machine learning (ML) technologies. But data is still in silos throughout different organizations, which limits how much value it can be extracted. Data owners may now monetise their data via the emergence of digital markets. Privacy, security, and issues with unjust payment settlement are some of the problems that prevent such platforms from being widely used. Furthermore, big international firms control the cutting-edge platforms, so there is no transparency between sellers and buyers about listing information, payment details, data finding, or storage. New decentralized digital data marketplace platform for Internet of Things data suggested in this study. In order to host IOT data reliably and fault tolerantly, the platform utilizes a decentralized data streaming network. Fair trade, privacy-preserving data storage and transmission, and trust metric computation for network participants are all provided by the platform. The suggested platform's viability is investigated by creating an open-source library on a real-time Google cloud platform. The library is constructed using Hyper ledger Fabric and has a data network layer that is based on VerneMQ. We analyze the findings for performance, overheads, and scalability after testing the library.

INTRODUCTION

Businesses that have spent a lot of money on IOT infrastructure over the last few decades are showing interest in the new Sensing-as-a-Service market, which is expanding at a fast pace. They have come to the realization that the data produced by their isolated system may be turned into a valuable commodity. The availability of AI-based solutions has increased the monetary worth of data used to train new machine learning models. Big amounts of IOT data are often needed by federated ML models.

How to cite this article: M.Swathi1, Ms. K.Hema gayatri2, Ms. K.Vyshnavi3, Ms.Tanmayai4. ON THE USE OF BLOCK CHAIN TO ENABLE A HIGHLY SCALABLE INTERNET OF THINGS DATA MARKET PLACE .Pegem Journal of Education and Instruction, Vol. 13, No. 4, 2023, 729-736

Source of support: Nil **Conflicts of Interest:** None.

DOI: 10.48047/pegegog.13.04.80

Received: 12.10.2023

Accepted: 22.11.2023 **Published:** 24.12.2023

Some businesses, however, are prepared to pay for trustworthy data streams from diverse areas such as weather, population density, soil type, etc., but are hesitant to spend in establishing IOT infrastructure. They make money by purchasing data from companies that have these sensors set up. In such cases, a platform that facilitates the easy acquisition and sale of data is essential. Uncertainties about trust, the cross-domain trading capability, fair transactions, and security continue to make widespread acceptance of this notion difficult. Businesses and vendors seeking to trade data as a commodity are seeking confirmation of the legitimacy of IOT devices. For IOT data trading to become a reality, we need to overcome obstacles such as siloed identification verticals, unauthorized harmful entities masquerading as data providers, centralized platform control, and concerns about fair payment settlement. Independent IoT business initiatives may sell and acquire data reliably and trustworthily with uncontested

recompense to all parties involved in this paradigm, which is built on the notion of data sovereignty. We contend that a platform that eliminates the middleman, the central storage operator, is necessary for this endeavor. Removing centralized control from trustworthy third parties (TTP) is essential for achieving openness, accountability, and fairness in areas such as fair listing and seller discovery, identity validation, and payment settlement. Thus, the suggested online market employs the block chain platform, a decentralized trusted third party, to enable the equitable listing of data streams, the authentication of identities, and the settling of payments using smart contracts. In order to meet legal obligations, data modification or deletion must be feasible, as stated in GDPR Articles 16 and 17 (Right to Rectification and deletion). The integrity and trustworthiness of data should not be jeopardized by storing it on an immutable storage like blockchain, which does not permit data modifications. As a result, the proposed architecture does not use blockchain to store any personally identifiable information. In addition, storing large amounts of data via blockchain is not a practical solution. To ensure data distribution is always available, even in the face of failure, the suggested architecture makes use of a decentralized data storage layer that is replicated across all nodes involved. Each entity has its own unique Decentralized Identifier (DID) [10] to authenticate on the platform, and the authentication of actors is carried out via the Self-Sovereign Identity (SSI) concept. Numerous industries, including banking, healthcare, energy, and the automobile sector, among others, have used blockchain-based solutions in recent years. There have been major advancements in the proposed platform's trust and fairness assurances, even though entrepreneurs have suggested data sharing marketplaces [6]. By 2030, the value of the Internet of Things data marketplace is projected to reach 3.6 trillion USD [6]. Healthcare, smart cities, enhanced transportation infrastructure, smart-grids, power, research, and other related businesses will all benefit from the elimination of data exchange friction and the promotion of interoperability.

LITERATURE REVIEW

Nowadays, digital markets include a wide variety of commodities, e-books, music, pictures, and videos, among other physical and intangible things. Consumers benefit from the convenience and low prices offered by these online markets, which are known as E-Commerce [20]. Software as a service (SaaS) and infrastructure as a service (IaaS) trade ecosystems have been promoted by these platforms [3]. Unfortunately, sellers have very little say over the details of the license agreement on most of these digital platforms due to the opaque nature of the listings and prices. In addition, there is a centralized authority that controls and owns these platforms, and it has a disproportionate amount of say in the decisions made [19]. A rising segment of the global digital economy is based on peer-to-peer (P2P) data sharing networks [8]. Services, information trading, and peer-to-peer financing are now all part of this value exchange model. Regulatory hurdles and the difficulty of establishing a marketplace on these networks make them less than ideal. Although BitTorrent and similar platforms scale effectively, it is not possible to construct a marketplace on them since they do not have the necessary qualities, such as confidence assurances, fairness, and payment settlements among network members. Distributed and Decentralized Storage: Unlike centralized cloud servers controlled by a single entity, distributed storage solutions use a peer-to-peer network that hosts and shares data in a robust and fault-tolerant way. The benefits of distributed storage, including as fault tolerance, collusion resistance, and attack resistance, have attracted interest from both academic institutions and businesses. IPFS and similar decentralized storage systems have sparked initiatives like Filecoin and OrbitDB. IPFS is a storage system that can be addressed by content, which helps to avoid duplication and ensures that material is always available. Integrating storage platforms like IPFS with regulatory technologies like blockchain can facilitate the development of comprehensive solutions such as Storj [31], Filecoin [17], and Sia [30]. These systems do provide a way for participants to be incentivized, but they don't contain the essential features of a digital marketplace, such as assurances of fairness, trust, and economic logic. Dispersed Internet of Things Marketplaces: One company owns the cloud infrastructure that powers the most cutting-edge markets today [13]. Data sharing marketplaces have been conceptualized in an effort to capitalize on the growing body of literature on decentralized markets [24], [18], and [26]. But the ecosystem of markets for IoT data is still in its early stages of development. Xu et al. [36] investigate a potential use of blockchain marketplaces in the energy and smart grid industries. The authors lay forth a blueprint for an ideal energy market business model that follows the guidelines laid out by the European Union's Smart Grid Architecture Model (SGAM). A concrete architectural design with an incentive system and security elements is, however, absent from their work. In their proposal, Missier et al. [22] lay out a decentralized system that would allow users to trade Internet of Things (IoT) data in the form of a "cube" via trustworthy edge gateways. They determine if it's feasible by calculating the price of a "cube" settlement. The system's scalability and trust metric, however, are not easy to determine. A decentralized registry for exchanging Internet of Things (IoT) data for smart cities is presented by Ramchandaran et. al. [27] using a basic smart contract implementation. Nevertheless, crucial aspects of a data marketplace such as trust, privacy, and payment schemes are mostly disregarded in their work. In their proposal for off-grid networking, Niavis et al. [23] suggest a distributed file system and blockchain network as a decentralized data sharing architecture. Many aspects, such as identity management and private data sharing, are considered in their study. However, aspects like payment settlement, trust among trading organizations, and fairness have not been investigated. We try to build a decentralized system for exchanging IoT data that is fair, transparent, dependable, and trust-less by drawing inspiration and knowledge from the shortcomings of the works that have been addressed.

SYSTEM DESIGN:

EXISTING SYSTEM

• A decentralized system for the exchange of Internet of Things (IoT) data called a "cube" between consumers and producers, facilitated by trustworthy edge gateways, is proposed by Messier et al. [22]. They determine if it's feasible by calculating the price of a "cube" settlement. The system's scalability and trust metric, however, are not easy to determine. A decentralized registry for exchanging Internet of Things (IoT) data for smart cities is presented by Ramchandaran et. al. [27] using a basic smart contract implementation. Nevertheless, crucial aspects of a data marketplace such as trust, privacy, and payment schemes are mostly disregarded in their work. In their proposal for off-grid networking, Niavis et al. [23] suggest a distributed file system and blockchain network as a decentralized data sharing architecture. Many aspects, such as identity management and private data sharing, are considered in their study. However, aspects like payment settlement, trust among trading organizations, and fairness have not been investigated. We try to build a decentralized system for exchanging

IoT data that is fair, transparent, dependable, and trust-less by drawing inspiration and knowledge from the shortcomings of the works that have been addressed.

DISADVANTAGES

- There is no Self-Sovereign Identity the (SSI) framework system which is not in an existing system.
- There is no technique called Trusted Exchange between the datasets.

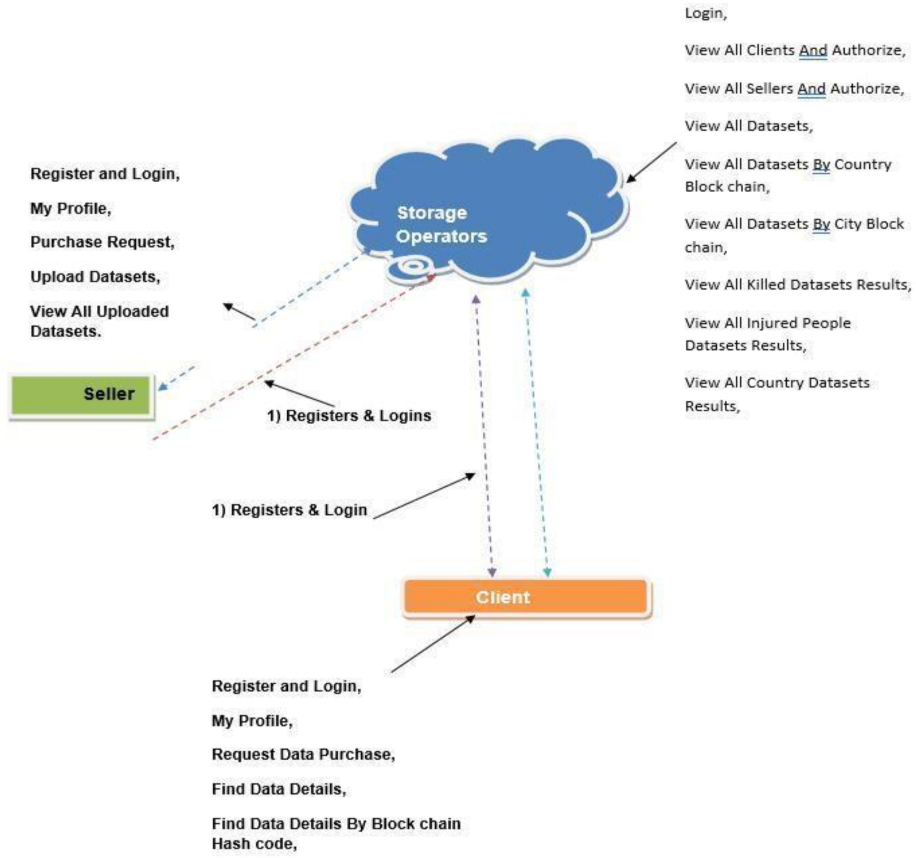
PROPOSED SYSTEM

An innovative combination of blockchain, DID, peer-to-peer data stream storage, and end-to-end encryption allows us to propose a new proof-of-concept decentralized solution to the Internet of Things (IoT) data marketplace. This solution would support actor verification, trust metric calculation, and a secure and transparent transactional model for paying the sellers. The proposed model ensures that (i) all parties involved will be fairly compensated, (ii) content will be listed impartially using the calculated trust metric, (iii) data streams hosted and delivered by peers will be secure, and (iv) data will be delivered reliably even if storage network peers are faulty. Hyperledger Fabric is used for the blockchain layer and distributed apps (DApps) while VerneMQ is used for the decentralized real-time stream data storage layer in our proof-of-concept implementation [4]. The system's performance is studied and discussed in the paper, showing that it scales effectively with reasonable overheads.

ADVANTAGES

Client Trust and Reputation Management: The framework relies on identity verification to help clients establish and maintain their trust. The proposed job requires the vendor to undergo an identity verification process. The option for DID verification is available to clients. Because certain vendors may choose to work with certified customers exclusively, a client's data stream options will expand if it decides to go through the verification process. Both sellers and buyers may profit from this, as sellers can charge higher prices for verified data while purchasers can enjoy discounts and download authorization for crucial data.
As will be discussed later on in this work, the marketplace keeps track of a TRUST SCORE (TS) statistic for each network actor. Credibility and reputation are the two main sources from which TS is generated. The computation of trust scores does not involve any central authority.
Data Security: Our process involves encrypting seller data before sending it to a storage operator. Only clients who pay in advance have access to the decryption keys. Internet of Things (IoT) data is encrypted in our architecture from end to end. Encryption using TLS and SSL is applied to all connections.

ARCHITECTURE



MODULES

SELLER

This section deals with the data provider uploading encrypted data to a server in the cloud. Before storing the data file on the server, the data owner encrypts it for security reasons. It is possible for the data owner to do the following actions on the encrypted data file: Login and Registration, My Profile, Request for Purchase, Dataset Upload, and Dataset View.

STORAGE OPERATORS

The Data Owners rely on the storage operator to oversee the provision of data storage services. Before storing their data files on the server, data owners encrypt them so that data consumers may access and use them. Data consumers access the shared data files by downloading encrypted data files from the server, which are subsequently decrypted by the server. When a person seeks permission to view a file and then does processes like Sign in, Peruse All Customers and Grant Permission, Peruse All Vendors And Grant Permission, Explore Every Database, Check out the results for all datasets by country and block chain, all datasets by city and block chain, all datasets by injured people and killed people, and all datasets by country.

CLIENT

The data file in this module can only be accessed with the secret key. Filtering the file according to a user-specified keyword is possible. You may do things like register and log in, see your profile, request data purchase, find data details, and find data details by block chain hash code. The data that fits a certain term will be indexed in the cloud server and then sent to you.

CONCLUSIONS

Since sophisticated AI algorithms rely on large amounts of data to make educated conclusions, our study tackles the problem of decentralized, real-time trading of IoT data, which is becoming a reality in the near future. The proposed system ensures availability, privacy of data from peers hosting content, fault tolerance, and fairness to all participants despite the presence of maliciousness by utilizing innovative combinations of blockchain, peer-to-peer storage, and decentralized applications. It does this without relying on a central facilitator. The difficulties encountered during the design process of such a system could serve as the basis for further investigation in this area. The first obstacle is still coming up with fair payment methods for both sides. Crypto currencies, local tokens, or other payment mechanisms may be agreed upon by the parties. Crypto-tokens may also be used as a way to reward users that are quick to use the site. One of the next tasks is to design a payment layer that can be used over this kind of system architecture. Restricting the long-term external sharing of platform IOT data is still another obstacle. This may be accomplished by using game theory techniques to create more effective pricing models and data sharing agreements. Although we have only presented a rudimentary incentive mechanism in this study, we hope to see more strong and theoretically proven techniques for discouraging unjust transactions in future research. Some of the difficulties with the suggested structure lie in these areas, which also provide great potential for development.

REFERENCES

[1] K. R. A˜ zyilmaz, M. DoA¨ an, and A. Yurdakul. "IDMoB: IoT Data Marketplace on Blockchain". In: 2018 Crypto Valley Conference on Blockchain Technology (CVCBT).

[2] S. Bajoudah, C. Dong, and P. Missier. "Toward a Decentralized, Trust-Less Marketplace for Brokered IoT Data Trading Using Blockchain". In: 2019 IEEE International Conference on Blockchain (Blockchain).

[3] P. Banerjee, R. Friedrich, C. Bash, P. Goldsack, B. Huberman, J. Manley, C. Patel, P. Ranganathan, and A. Veitch. "Everything as a Service: Powering the New Information Economy". In: Computer 44.3 (2011).

[4] M. Bender, E. Kirdan, M.O. Pahl, and G. Carle. "Open- Source MQTT Evaluation". In: 2021 IEEE 18th Annual Consumer Communications Networking Conference (CCNC).

[5] J. Benet. "IPFS - Content Addressed, Versioned, P2P File System". In: CoRR abs/1407.3561 (2014). URL: http://arxiv.org/abs/1407.3561.

[6] A. Broring, S. Schmid, C. Schindhelm, A. Khelil, S. Kabisch, D. Kramer, D. Le Phuoc, J. Mitic, D. Anicic, and E. Teniente. "Enabling IoT Ecosystems through Platform Interoperability". In: IEEE Software 34.1 (2017), pp. 54–61.

[7] B. Cohen. Incentives Build Robustness in BitTorrent. 2003.

[8] M. Cohen and A. Sundararajan. "Self-Regulation and Innovation in the Peer-to-Peer Sharing Economy". In:

[9] Decentralized Finance (DeFi). https://ethereum.org/en/ defi/. [Online: Accessed 11-Feb-2021].

[10] Decentralized Identifiers. [Online]: https://www.w3.org/ TR/did-core/. [Accessed: 15-Feb-2021].