

Review Paper on Smart Homes Using Blockchain Technology

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Abstract: The increasing trends of smart cities, smart home also have same demand for improving the basics of information technology infrastructure to ensure security, transparency and privacy of user data. Blockchain is a capable technology of addressing such demands. This paper provides an advancements of blockchain in smart home systems. We first discuss blockchain techniques as well as the prerequisites of a smart home to adapt blockchain technology. Then, we present and discuss the mostly used methods in the literature. We also present a case study to show how blockchain improves smart home transactions by eliminating the middle processes. This paper also gives information on the major challenges such as security and privacy, data analytics, data collection and sharing, and latency. Finally, the paper identifies mainly important areas for future research.

Keywords: Blockchain technology, Smart home, Adaptive requirements, P2P Data marketplace, Automation

1. INTRODUCTION

A smart home is an Internet of Things (IoT) integrated that provides complete information of home with its owner, etc. IoT is the platform of a smart home network which is used to interconnect heterogeneous smart devices such as smart phone, smart meter, smart devices, etc. Smart home system provides us soft independent living with security and privacy. Activity monitoring, device monitoring, health, cleanliness, etc all such activities belonging to smart home system. While maintaining smart home system some risks are also present such as malicious cyber attacks which affects on security and privacy of users. So, to avoid or minimize such attacks we require decentralized smart home application and it may be developed with the help of blockchain technology.

However, despite the increasing interest as well as demand in blockchain technology in the smart home domain, existing research is divided across various research areas. Hence, this work is conducted to fill the gap also give useful insights into blockchain technologies, methods, and their application in the area of smart homes.

2. Background of blockchain and smart home application framework

Blockchain:

Blockchain was invented by Satoshi Nakamoto in 2008. It is the platform of crypto currencies (e.g. Bitcoin) that provides a P2P transaction system to eliminate third-party as well as double spent problem. It is a decentralized data structure where every block of data is cryptographically connected with previous block's hash using SHA-256 (Secure Hash Algorithm). The fundamental structure of a block comprises of block number, previous block's hash, transaction data, nonce, and timestamp. The timestamp is a continuous variable and nonce is a random variable. The static (block) and dynamic (timestamp and nonce) data are continuously hashed by the validators or miners (computational nodes) to find a value that starts with a number of consecutive leading zeros. This process is widely known as cryptographic puzzle. The miner who finds the valid hash value first considers the winner who is given the permission to add the block in the blockchain. The methodology of certifying a block whether it is valid or not is called Proof-of-Work (PoW) consensus algorithm.

Smart home application framework:

Fig. 1 illustrates the blockchain architecture using IoT, internal mechanism, and workflow as well as IoT blockchain for smart home. The following steps describe the main functionalities.

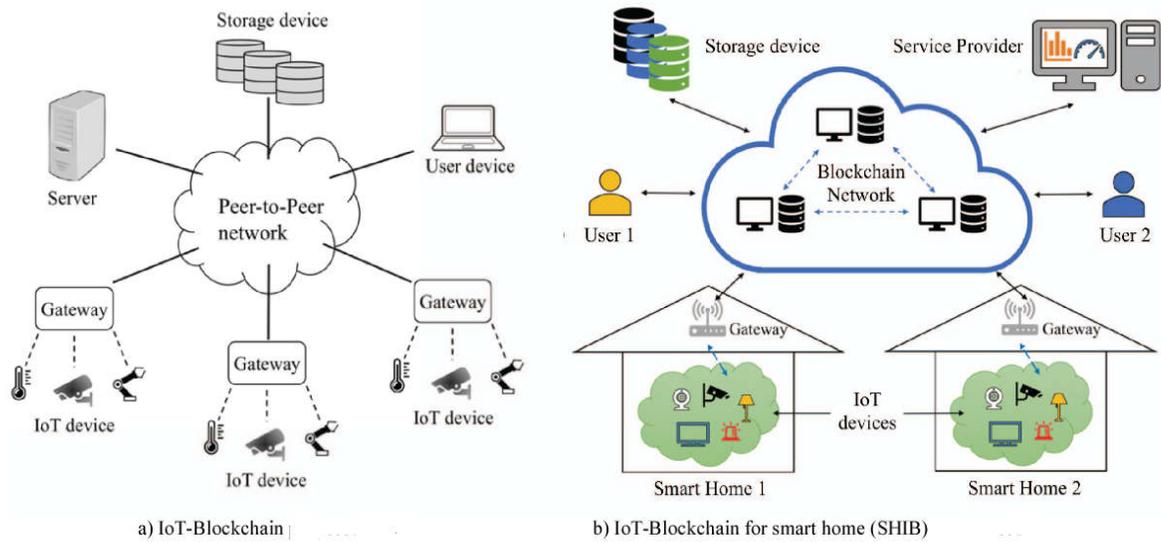


Fig 1: Data privacy in smart home

3. Operational Flow of the Smart Contract

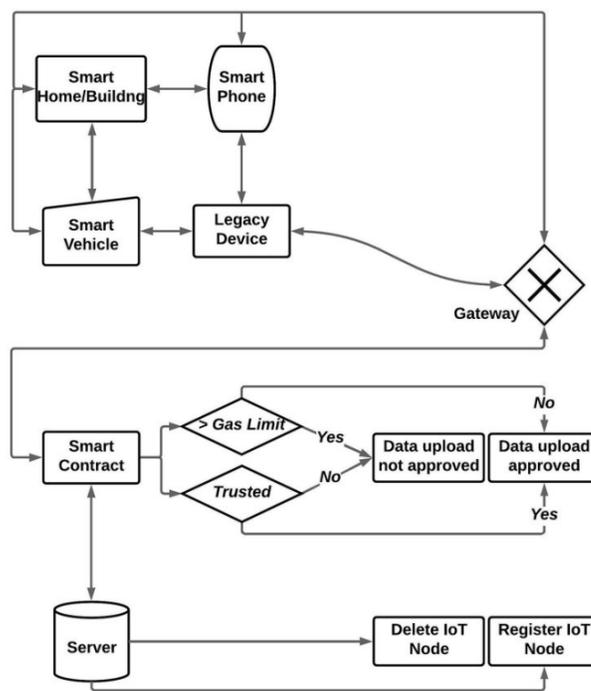


Fig 2: Flow diagram of blockchain for smart home using IoT

With the two types of nodes set up (server and IoT), the smart contract is deployed on the server node such that the contract will register the address of this node as the server for this IoT system. First, the smart contract has to be compiled before deployment. The flow of operation of the smart contract is as shown in Fig 2 above.

4. Conclusion

Blockchain has shown its enormous potential for transforming smart home applications with its key features including decentralization, security, immutability, and anonymity. In this paper, we started by describing the fundamental overview of the blockchain concept, mechanism, data structure, and mainstream popular open-source blockchain platforms. Then, we described requirements of smart home to adapt blockchain is analyzed with four implementation phases.

Specifically, we highlighted the potential of blockchain for creating a trustworthy smart home data marketplace by a large volume of data that generates from the smart home IoT ecosystem. Also, we discussed current research on smart home access management, which shows that the concern of security breach among smart home user hinders, yielding the benefit of customized access control. We found that few researchers focus on the large scale adoption of blockchain based homecare system. We determine that interoperability between homecare and third-party healthcare systems has enormous potential in the future because the scalability of autonomous blockchain is limited, and it remains an open challenge. Then, we outlined the challenges for creating an automated utility bill payment together with other smart city services. Furthermore, we analyze two case studies, firstly, local energy trading in a smart grid to aid P2P energy transaction, secondly, a Cyber-Trust blockchain system for collecting smart home forensic evidence during a malicious attack and sharing it with relevant agencies. Finally, the study discussed potential challenges and open research issues. In the future, we want to extend our research to develop a feasible prototype by implementing the blockchain platform for different smart home applications.

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