

Blockchain Technology: A Smart and Efficient Way for Securing IoT Communication

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Abstract—Blockchain is the trending topic now-a-days due to its decentralized and security feature. Internet usage on the other hand is increasing rapidly along with the increase in threats and attacks. The Internet of Things, or IoT, is the arrangement of billions of physical devices around the world that are connected to the internet for the purpose of collecting and sharing data, worldwide. IoT appliances and devices are the boom in the technology but the biggest concern in IoT devices is its security. A lot of attacks are discussed on IoT. Existing technologies are not enough to secure the IoT devices completely. BIoT or Blockchain IoT is the mechanism of using security feature of Blockchain in IoT to make it more secure and vulnerable to communication attacks. In this paper we have discussed the basics of Blockchain, IoT and How various work have been varied out on BIoT

Keywords—Blockchain, BIoT, Bitcoin, Ethereum, IoT, MQTT, Smart Contract, Solidity.

I. INTRODUCTION

Blockchain is a distributed ledger that contains data in an interconnected form of chains that are secured. Or one can easily understand it as a database that stores some kind of information in the interconnected blocks. Whenever any new data arrives then it is to be inserted into a new block. Once the block is ready with data it is to be inserted and interconnected with the previous existing blocks in that Blockchain in chronological order, by the help of hash techniques. The following figure shows the network of Blockchain.

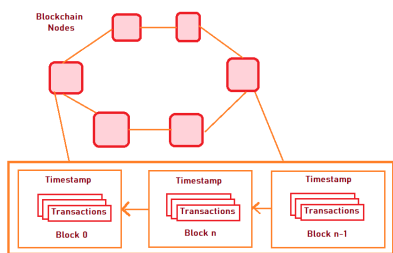


Fig. 1. Architecture of Blockchain.

In Blockchain we can store different types of information or data that may be inter-related or totally different from each other. It is the emerging technique with wide variety of applications. Blockchain is gaining popularity because of its decentralized and secure nature. It uses Hashing technique to store hash of previous data is stored and a secure chain is formed that's hard to manipulate. People are investing in Bitcoins and accepting the concept of Blockchain.

Bitcoin, the term was first suggested by Satoshi Nakamoto as "Bitcoin: A peer-to-peer electronic cash system". [3] Bitcoin and Blockchain are two different things as Bitcoin uses the concept of Blockchain. Another term that is equally important is Ethereum Blockchain. Following Figure 2 shows the architecture of Ethereum.

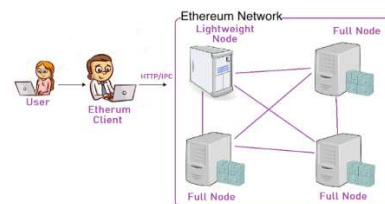


Fig. 2 Architecture of Ethereum

Ethereum was created by a crypto currency researcher and programmer named Vitalik Buterin [5]. Ethereum is a Blockchain-based, decentralized platform used for its own crypto currency, "ETHER". It helps in building Smart Contracts and Distributed Applications so that they can run without any downtime, fraud, and interference from any third party.

All Mining in Bitcoin is usually done for solving computations. Users willingly participate in the competition to update the Block in Blockchain. Users get query to solve and if his/her system is faster than others then he/she wins and adds the block in the Blockchain successfully. The EVM is Ethereum virtual machine is a software platform that allows execution of code for each and every smart contract. To maintain the consensus in Blockchain every Ethereum code is executed on the EVM.

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IoT is the emerging trend in today’s internet dependent world. Internet-Of-Things (IoT) is a loosely coupled system of multiple homogeneous and heterogeneous devices having sensing, processing, and network capabilities power.[7] IoT has wide variety applications in areas such as smart cities, connected vehicles, healthcare, smart agriculture, smart grid, smart retail, technology enhancement etc. Figure 3 shows few applications of Blockchain for IoT.

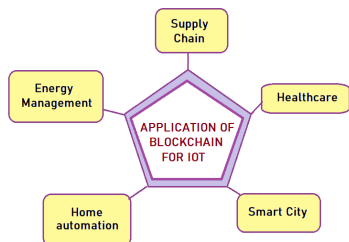


Fig. 3 Applications of Blockchain for IoT.

But along with its advantages it has some severe issues of privacy and security in IoT. As Blockchain is a distributed and secure yet powerful mechanism for providing security and privacy we can use both of them together. With the help of Blockchain we can decentralize the IoT networks and by eliminating single points of failure we can make connected devices more secure and less vulnerable to malware and other attacks. BIoT is the Blockchain IoT that is more secured than simple IoT and a lot of work has been done on this topic. The figure 4 shows the attacks on IoT.

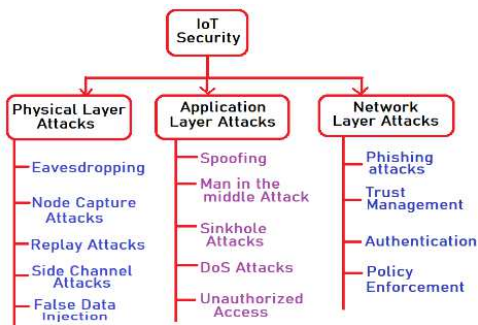


Fig. 4 Various issues related to security in IoT

Some real world examples of BIoT are as follows:

1. Smart Homes

BIoT has enabled security system of smart homes that can be handled from the smartphones remotely. No doubt IoT devices are smart enough to reduce the work manually but they lacks in security and privacy. With help of Blockchain the communicated data is protected against various types of attacks. An Australian telecommunication & media company named Telstra that is famous for home solutions also uses BIoT to make their smart devices secure and privacy protected. They store the information such as biometrics, voice recognition and facial recognition on Blockchain.

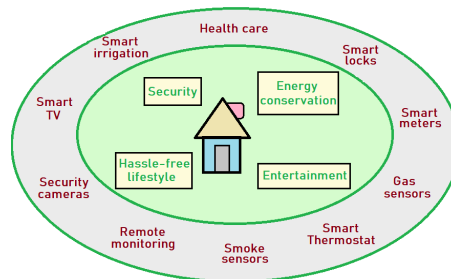


Fig. 5 Smart Homes using BIoT.

2. Smart Automobile

IoT-enabled sensors are used in automobiles to make them smart and fully automated. All the devices are connected through decentralized network. Benefit of connecting them in decentralized network enables many users to exchange sensitive information effortlessly and rapidly. The BIoT can be used as automated fuel payment, autonomous cars, smart parking & automated traffic control.



Fig. 6 Smart parking in Automotive Industry using BIoT.

3. Supply Chain and Logistics

The vast network of logistics and supply chain contains some stakeholders i.e. dealers, clients and providers of raw material. Involvement of many stakeholders makes system more prone to attacks and insecure. Tracking the shipment, reliable payment and other imp features can be securely carried out with the help of BIoT. All sensitive data is stored in Blockchain and all connected, verified and valid stakeholders are listed in smart contracts and only they can access that information. A renowned distributor and producer of food products which uses BIoT to improve its accountability and transparency by creating a protected, irreversible and observable ledger manageable and accessible by verified participants i.e stakeholders is Golden State Foods.

4. Budget Distribution

Sharing of Economy or distribution of budget with the help of BIoT has become a very popular and secure idea. It decentralizes the whole system to earn revenue by sharing all the sensitive information among users without any third party to rely on. “Stock.it” is using BIoT for objects/devices.

5. Pharmacy Industry

The pharmaceutical sector that develops, manufacture and distributes the drugs or medicines is also an important application of BIoT. By the help of BIoT we can track the drug’s complete journey in any very easy and efficient way. “Mediledger”- a BIoT designed transparent and visible offering simplified payment process, controlling user access etc.

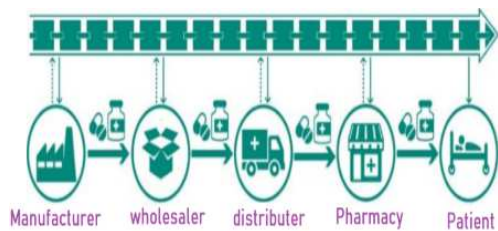
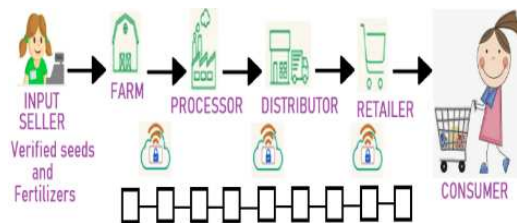


Fig. 7 Pharmacy companies using BIoT.

6. Agriculture Industry

One of the major problem faced by the world today is of rapid growing population which in turn makes us concern about growing more food for them. BIoT helps the farmer to select the crops based on humidity, temperature, soil moisture, light etc. Also the BIoT can be used in Food supply chain to know the food’s source and check whether eatables are safe to eat or not. The phases are as follows:

- Data is sensed by IoT sensor or farmer manually stores
- Dissemination of harvests to food processing companies.
- Processed food to be supplied to the retailers.
- Customers can back-track supply chain.



Data stored in this network is shared and secured
Fig. 8 Agricultural Industry using BIoT.

II. LITERATURE REVIEW

BIoT is a revolution in the latest technology in terms of security and privacy in smart devices. Various works have been done on BIoT. Mohanta B. in 2020 [6], secured the IoT devices with Blockchain and Ethereum. For unique identification 160 bit hash value is used that is generated by ECDSA algorithm. For message communication MQTT, XMPP, etc protocols are used but they are not so secured so the author has used Blockchain in which there is no need for key distribution. For individuals or groups, all data access strategies, interval and circumstances are written in smart contract. The smart contract offers the right to ownership of

IoT devices that supports updating, adding, or decision-making procedure strongly.

Yakut S. et. al[7] proposed a method in which they have used raspberry pi along with solidity language to create smart contract. They have used hyper ledger fabric platform for connecting organization in Blockchain. As a future work, they will work on verification and authorization security tools with lightweight cryptographic methods.

Fakhri D. et al. [2] in their paper they showed how the data is secured in IoT smart devices by experimenting on smart refrigerator first without using Blockchain and then with using Blockchain. They have used MQTT broker protocol in without Blockchain for transmitting data from smart refrigerator to smart television. The same communication data is secured replacing the protocol with Ethereum. EVM used is Go Ethereum with Golang programming language. Framework for smart contract is truffle with solidity programming language.

BIoT is also used in exchanging information or data in a secured manner. Hien Thi Thu Truong et. al [9] proposed a Sash framework in which they coupled IoT platforms with Blockchain. BIoT is also used in E-voting system. Garg k. [13] in her paper compared the various techniques used during E-Voting system and how that techniques contribute towards more secure, privacy and decentralized voting system.

Urien P. [10] introduced a Blockchain Transaction Protocol for Restraint Nodes-the BIoT paradigm, whose foremost concern is to attach a sensor data in Blockchain connections.

Jinha S. et. al.[12] proposed a system to verify and detect data on the IoT Blockchain like transaction generation intermission, Generation rate of Blockchains and the indicators of IoT data. They also implemented visualization tool for monitoring the Blockchain robustness and IoT data in a reliable interpretation via visualization of real-time Blockchain updated events, Blockchain network measurements, and finally the IoT sensing data stored on Blockchain as a new and updated transaction. The Blockchain anomaly detection can be detected by inspecting if the Blockchain works under normal conditions or not and to identify malevolent node that execute some malicious behavior, for that they used Blockchain anomaly detection for that they used some threshold or SVM. The conception tools are executed on HTML5-enabled Web browsers for transferability.

Shin S. et. al. [11] CyExec (Cyber Security Exercise System), containing a virtual environment using Virtual Box and Docker, is a low-rate and flexible cyber security exercise system, proposed by the authors. The high rate of Cyber Range scheme and lack of personnel to preserve and cope up the exercise environment are the reason human resource

development is not progressing. CyExec is, supposing the overview of higher education institutions and small and medium-sized enterprises, is the exercise system to acquire the elementary methods of cyber-attack and resistance.

The following table shows the summary of some researches and surveys done on BIoT on various application whose main aim was to provide security and privacy to the data communicated between smart devices and users.

Table 1. Details of work done on BIoT in past some years

AUTHOR NAME	PARAMETER	CONTRIBUTIONS
B. K. Mohanta et. al. [6]	For Securing IoT communication. Parameters taken Security, Privacy.	First they created smart home environment based on IoT technology. They used 1. Raspberry Pi device to gather data from sensors devices. 2. Ethereum platform connected to Blockchain. 3. Decauth authentication technique to authenticate intermediate devices. 4. Solidity platform for writing smart contract in Ethereum network.
S. Yakut et. al.[7]	For security and privacy purposes.	Authors performed applicability of various Blockchain framework with Hyper ledger on IoT device. For that they used Raspberry Pi 3B with 16 GB SD card. Hyper ledger Composer and Hyper ledger Fabric are tested on Raspberry
D. Fakhri et. al. [2]	For securing data transfer in IoT devices.	Author showed the difference between with and without using Blockchain. The data communication between smart refrigerator & smart TV with MQTT protocol and then they have compared it with technology using Blockchain, Ethereum, ECDSA encryption algorithm.
S. Shin et. al. [11]	IoT security exercise content.	They proposed CyExec for security which is low cost and flexible consisting of a virtual environment using Virtual Box and Docker.
J. Song et. al. [12]	Anomaly detection	They suggest a process for sensing differences that may follow in an IoT Blockchain platform. They too proposed a conception device for monitoring healthiness of Blockchain by analyse & visualize log data.
K. Garg et. al. [13]	Anonymity and security	They compared the various algorithms and already done work on E-Voting system.
K.M. Giannoutakis et. al. [14]	Security	The paper projected a distributed method for supportive IoT security in smart homes through Blockchain technology.

III. CONCLUSION

Clearly it’s seen and observed that we are using BIoT in various applications and in coming years it will be scaled more in other application areas also. IoT is an emerging technique but in it security and privacy is not maintained. Blockchain is also a current emerging technique that is famous for its secure and decentralized nature. Together Blockchain IoT (BIoT) is used to make smart appliance more secure and private. In this paper we have reviewed the existing work and techniques in contribution to making IoT more secure in various applications like agriculture, automobile and healthcare etc.

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