IOT conception based on blockchain technology: A review

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Abstract. Security and protection to internet of Things (IOT) stay a significant test, chiefly because of the large-scale and circulated nature of IOT organizations. Blockchain-based approaches give decentralized security and protection, yet they include huge energy consumption, delays, and computational overhead that isn't reasonable for most Resource-constrained IOT devices. The Internet of Things (IOT) alludes to the interconnection of savvy devices to gather information. Notwithstanding, an absence of characteristic safety efforts makes IOT defenseless against protection and security dangers. Blockchain abilities like immutability, transparency, auditability, data encryption and operational resilience can assist with addressing most structural inadequacies of IOT. This article presents a review on Blockchain and it's integrated with different applications and innovations particularly IOT. The goal of this paper is to analyze current research trends on the use of Blockchain related approaches and innovations in an IOT setting. This paper presents the accompanying curiosities, regarding related work: (I) it covers different application areas, coordinating the accessible writing as per this order and (ii)the conventions that utilized in IOT when incorporated with blockchain.

Keywords: Blockchain, IOT, Blockchain application, IOT Conception.

1 Introduction

The Internet of Things (IOT) can be defined as one of the lightweight organizations made up of sensor devices which may be connected to Internet and communicate remotely. A lightweight sensor IOT network is a system which oversees and totals data given by the sensor devices on focal hub which serves as focal executive. Devices of IOT have limited assets, such as a low registration power, limited battery capacity, and limited storage capacity, and have difficulty utilizing elite execution programming. Due to the fact that the high-performance security calculations can't be utilized with limited assets, security in light-weight organizations, like the IOT, is a problem. The Blockchain, which was built as a core Bitcoin innovation, offers very good security and is attracting much attention in areas which need high-speed security execution. The Blockchain's high security is considered as a proper approach for using it in frameworks with weak security, such as the IOT. This work aims to give a research pattern on IOT Blockchain, which aims to improve challenges that caused by the IOT features through utilizing Blockchains. The Blockchains ensures capabilities of robust security for trustworthy organization development by applying trustworthiness, anti-corruption, time-sensitive exchange tracking, and distributed capacity [1]. A review to apply Blockchains to the IOT has been suggested to compensate for the IOT organization's weaknesses. The most critical flaw which must be tackled is the security problem that arises from the low presentation of light-weight gadgets. It might address issues of incorporated design through using Blockchain's distributed features to IOT organizations, and it might resolve limited battery issues of current IOT gadgets, which need constant communication with focal hubs through eliminating focal hubs. As a result, several studies are being conducted in order to integrate Blockchain into IOT. Various researches are being performed for the purpose of developing light-weight Blockchain for the IOT and expand the scope of IOT framework utilization and enhance security.

2. Blockchain Applications

Blockchain technology has a wide range of uses beyond bitcoin and electronic money. Technology is influencing a wide range of areas, from contract enforcement to government efficiency, promoting justice

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and transparency while saving organizations money and time [2]. The following Figure (1) depicts the application in the Blockchain [3].
IOT, finance, social and public services, privacy and security, also reputation systems are the five essential areas for blockchain applications, as shown in the Figure below. The domains of application for such applications, as well as their related pros and cons, are summarized in the table (1) below.

The most essential applications that depend on blockchain technology is mentioned based on Table 1 below [7],[8]:

- Electronic medical records.
- Blockchain for the health care industry.
- Smart contact.
- Ethereum.
- Ledger.

What does "blockchain for the healthcare industry" entail? Patients presently are afraid to tell people about their treatment plans. In this circumstance, patients might use such technology to keep all information secret and secure from prying eyes. This Blockchain could be accessed via a mobile application or a web browser. On a blockchain, each user has two keys. There are two types of keys: private and public. A transaction might just be carried out by those who have access to it. Medical records include (e-medical records). All of this might be avoided if blockchain technology is used. When it comes to e-medical records, Blockchain must be able to manage a variety of frameworks for handling secrecy, authentication, and responsibility. It is most typically used when dealing with sensitive information. Blockchain will act as a decentralized application for online e-records. Also, all applications must be run in a centralized setting, and blockchain technology allows two parties to conduct a critical exchange-based transaction. Their true identity is unknown to the rest of the world. Bitcoin is also a digital currency which is created and kept in a digital format. It is a networked application. Its attempt to manage distributed transaction validation and monitoring through directly regulating the flow of digital money is one of its key weaknesses. It will keep track of all transactions. A smart contract is also referred to as a crypto contract due to the fact that Blockchain was intended primarily for exchanging digital currency. It is a computer program that controls the movement of digital currency directly. These contracts are stored using blockchain technology. A decentralized system is referred to as a smart contract. It was divided into two parts. It is not essential to pay a middleman. As a result, one can save both work and time. In smart contracts, a ledger is employed. Since a blockchain is a decentralized program, each member is assigned a distinctive identifier. A transaction is immediately entered in the ledger once it is done. Ethereum is a decentralized network built on the Blockchain. It is currently possible to create and deploy decentralized apps. Furthermore, Ethereum is a digital currency which functions in the same way as Bitcoin since it is a decentralized public blockchain network.

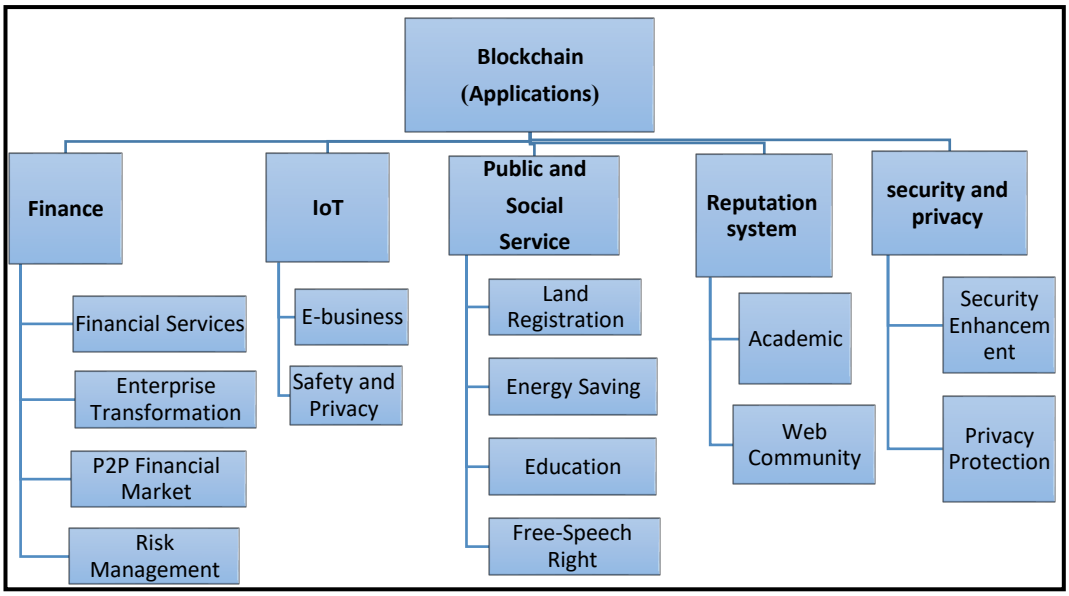

Figure1: blockchain application [4]

Table 1. blockchain application [5],[6],[3]

Name	Domain	Advantage	Disadvantage
Finance	The importance of blockchain technology like Bitcoin	Conventional commercial and banking services have suffered significant damage.	The financial industry can be transformed by Blockchain.
IOT	The most promising ICTs,	Consumers may access a number of significant IOT applications, including RFID-based logistics, smart grids, smart homes, and the maritime industry.	It is possible that it might require costly components and materials.
Public and Social Service	In social and public services, the term is commonly utilized.	Through patent administration, marriage registration, and income taxation procedures, it enhances knowledge, educational and social opportunities and sustains the zone's social cohesiveness and relevance. This method can help save a lot of paperwork.	Require various stretchers and types of Blockchain
Reputation System	The reputation of a person could be determined depending on previous interactions and transactions with the community.	It has the ability to tackle the problem of phony consumers and help to achieve.	There are a rising number of instances of forged personal reputation records, and such conditions are increasing at a quick rate.
Security and Privacy	Privacy protection and security enhancement	It is possible that this will help to improve the security of distributed networks. It can, for example, protect data from such privacy problems.	The increased risk of private data being exposed to malware, along with the fact that multiple mobile services and social network providers collect sensitive data, may have an effect on this type of data.

2.1 Challenge of Blockchain

Blockchain faces a host of obstacles and worries as a new technology, which may be grouped into different challenges depending on research and studies [4]. It is widely acknowledged as an outstanding technological achievement, and it has already piqued the interest of a number of major corporations. Throughout the last several years, the use of blockchain technology has skyrocketed in popularity [9]. The most well-known of such challenges is seen in the Figure or listed in Table 2 below.

Table 2. Challenges of Blockchain

Challenges name	Described
Internet of Things (IOT) [10]	For enabling a smart workforce, machine-to-machine and human-machine interactions are commonly utilized. Whereas evidence indicates that Blockchain and IOT technologies offer a number of significant benefits, they also have a number of substantial drawbacks. The need to handle privacy and security issues has resulted in such roadblocks. Legal issues, interoperability, access control, a lack of standards, developmental concerns, regulatory concerns, and increasing IOT economic concerns are just some of the issues that IOT and Blockchain technologies should address.
Healthcare system [2]	The method shows how Blockchain technology can be used in novel ways. Through publicizing customer choices and safeguarding patient privacy, using Blockchain for paying fees in Bitcoin helps all of the stakeholders, which include health-care, health authorities and hospitals. Information consumers were asked to fill out a form then submit it to the office of registration if they wanted to examine a patient's paper medical record. After approval, the consumer of the information will pay the cashier a copy charge and get a receipt bill. The data consumer then takes that receipt to the office of the registration in order to obtain a copy of the medical records of the patient. Medical data about a patient, on the other hand, could be reproduced or misplaced for some illegal purposes.
Spreading [11]	The typical transaction expanded considerably as more people became accustomed to it. It had a substantial influence on transaction processing speed because a more significant population means more computers are writing to and accessing the network, making the system more burdensome in general.
Attack [12]	Because the blockchain industry is unregulated by the government, it is a volatile environment suitable for market manipulation. There is often the risk of online wallets being hacked or being blacklisted by the government for engaging in illegal conduct.
Security [13]	A blockchain is a public ledger which anybody can see. It is required in various situations, yet when used in a delicate situation, it becomes a liability. Prior to blockchain technology being widely adopted, it still has a

	long way to go. The ledger has to be rebuilt such that only those who have permission to see it can access it.
Economic aspect [14]	Blockchain is frequently used in the value transfer process to reduce the costs related to third-party middlemen and intermediaries. Even though blockchain technology has numerous benefits, it is still in its early stages, making it challenging to integrate into current systems. Therefore, most governments and enterprises are unable to access it.

3. IOT Conception in Blockchain

It is critical to understand how IOT networks are employed in a variety of industrial, household, and military applications. Those IOT networks have a lot of actuators and sensors in common. Actuators and sensors are low-cost devices which might communicate without the need for human intervention [15]. Other network entities, along with such devices, connect the actuators and sensors to the backbone network architecture [16]. Switches, routers, cloud infrastructure, and aggregators are the components which control resource sharing and provisioning (including virtual servers and storage). Some of these needs are dynamic and verifiable device group membership, data integrity and authentication, resource-light operations, resilience against a single point of failure, and low latency communication [17]. Internet-connected objects can send data to private block-chain networks, which provide tamper-resistant shared transaction records. Without the requirement for centralized management and administration, Blockchain allows exchanging and accessing IOT data with business partners. To avoid disagreements and build trust amongst all of the network members with authority, each one of the transactions could be examined [18].

3.1 Benefits and application of IOT in blockchain

The next is a list of points that summarize the significance of the IOT in blockchain [1],[20]:

Get more flexibility depend on added security Build trust in the IOT data create new efficiencies.

Every one of the transactions is logged, kept in a data block, and added to an immutable, secure data chain which might just be added to and deleted from. With the use of Watson IOT® Platform, one might choose which data from IOT sensors and devices to analyze, manage, personalize, and share with permission with partners and clients, and Blockchain stream-lines operations and provides new business value across the eco-system [21]. The following Figure (2) depicts the domain of application: The following Figure (2) summarizes the most major Blockchain applications which enable the IOT:

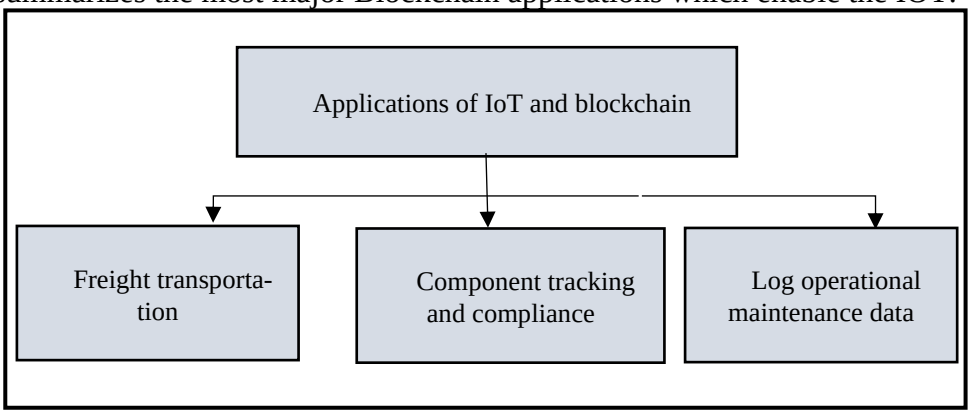

Figure2. Domain Applications of Blockchains and IOT [22].

Moving freight represents a challenging approach which involves a number of stakeholders, each with their own set of objectives location, temperatures, the status of shipping containers, and arrival times could all be tracked using IoT and blockchain as they are in transit. [23]. In addition, immutable transactions of the blockchains ensure that all parties could trust the information and that transactions are completed

quickly and efficiently. For both regulatory and safety compliance, the capability for tracking components going into an automobile, airplane, or other product is crucial by maintaining IoT data in shared blockchain ledgers, all stakeholders can trace the provenance of components throughout the product's life [23]. IOT devices keep track of the maintenance and safety of critical gear. The construction of a tamper-proof of operational data, as well as the associated maintenance of everything from engines to elevators, is made possible by Blockchain. After monitoring their work for preventative maintenance, third-party repair partners may utilize blockchains for tracking their work. Also, operating papers could be made available to government entities for ensuring compliance [3].

3.2 Protocols of Consensus on IOT

The processes that allow nodes in a blockchain network to agree on adding a new block to the chain are known as consensus procedures. Consensus is the method that permits a distributed blockchain network to function. The consensus method that a blockchain-based system utilizes determines how safe and dependable it is [24]. The most well-known consensus approach is proof of work, which is used by bitcoin. Recently, a number of consensus procedures have emerged. They are designed and manufactured to be employed in a wide range of scenarios [25]. In this section examine the merits and drawbacks of current consensus procedures. They could be implemented in a blockchain-based IOT network. Table 3 also compares the protocols mentioned in the previous study that have an impact on the IOT:

Table 3. Protocols That Have an Impact on The IOT [25],[26],[27].

Mode	Decentralization	Network access	Scalability	Latency	Computing	Network overhead	Storage overhead	IOT suitability
PoET	Moderate	Private	High	Low	Low	Low	High	High
PoS	High	Public	High	Moderate	Moderate	Low	High	Moderate
DPoS	Moderate	Public	High	Moderate	Moderate	Moderate	High	Moderate
PoI	High	Public	High	Moderate	Low	Low	High	Moderate
PBFT	Moderate	Private	Low	Low	Low	High	High	High
dPBFT	Moderate	Private	High	Moderate	Low	High	High	Moderate
Stella	High	Public	High	Moderate	Low	Moderate	High	Moderate
Ripple	High	Public	High	Moderate	Low	Moderate	High	Moderate
Tendermint	High	Public	High	Moderate	Low	Moderate	High	Moderate
Omni_ Ledger	High	Public	High	Moderate	Moderate	Low	Low	Moderate
Rapid_ Chain	High	Public	High	Moderate	Moderate	Low	Low	Moderate
Raft	Moderate	Public	High	Low	Low	Low	High	Moderate
Tangle	Moderate	Public	High	Low	Low	Low	Low	High

4. Discussion

In this paper, most of the applications that can be integrated with Blockchain are reviewed. In this part, these applications will be discussed as mentioned in Table (1) and it is clear that blockchain technology can be used with finance, IOT, public and social service, reputation system, and security. Each of which provides important characteristics that help improve the functioning of these applications but as it is Shown in Table 2, each of these applications suffers from many challenges. Since this work is a review the integration of the Blockchain with IOT in particular, so discuss the benefits and challenges of this integration, it provides many benefits as shown in Part 3.1 including: get more flexibility, dependent on additional security, building trust in IOT data, and creating new efficiencies. As for the challenges of integrating blockchain technology with IOT applications, it is the need to deal with privacy and security issues such as barriers, legal issues, interoperability, access control, lack of standards, development concerns, regulatory concerns, and increased economic concerns for the Internet of Things.

5. Conclusion

Two points were reviewed in this paper, the first of which is the applications that can be combined with Blockchain technology, as most studies link the Blockchain to digital currencies only, but this paper explains other applications, the most important of which are IOT applications because of their importance in the current technological revolution that aims to create smart homes and cities. This integration provides better performance for IOT applications as IOT is transformed from centralized in decision-making to decentralization and this eliminates the single point of failure for IOT applications. The second point is the most important protocols used in IOT applications when combined with Blockchain technology as shown in Table 3, each of which offers advantages that help in IOT work in terms of decentralization, network access, response time, computing, network and storage overhead, and the convenience of the Internet of Things.

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مفهوم IOT على أساس تقنية :blockchain مراجعة

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المستخلص

يظل أمان وحماية إنترنت الأشياء (IoT) بمثابة اختبار مهم، ويرجع ذلك أساسًا إلى النطاق الهائل والطبيعة المنتشرة لمنظمات .IoT توفر الأساليب القائمة على Blockchain أمانًا وحماية لا مركزية، ولكنها تتضمن طاقة هائلة، وتأخيرًا، وحسابًا تصاعديًا غير معقول بالنسبة لمعظم أجهزة IoT التي تتطلب أصـولًا. يشـير إنترنت الأشـياء (IoT) إلى الترابط بين الأجهزة الذكية لجمع المعلومات. على الرغم من ذلك، فإن غياب جهود السـلامة المميزة يجعل إنترنت الأشياء أعزل ضد مخاطر الحماية والأمن. يمكن أن تساعد قدرات Blockchain مثل الثبات والشفافية وقابلية التدقيق وتشفير البيانات والمرونة التشغيلية في معالجة معظم أوجه القصور الهيكلية في IoT. تقدم هذه المقالة مراجعة لـــ Blockchain وتكاملها مع التطبيقات والابتكارات المختلفة، وخاصة IoT.

الهدف من هذه الورقة هو كسـر أنماط البحث حول اسـتخدام المناهج والابتكارات ذات الصـلة بـــ Blockchain في إعداد IoT. تقدم هذه الورقة الشـرح الوافي فيما يتعلق بالعمل ذي الصـلة: (1) تغطي مجالات التطبيق المختلفة، وتنسـيق الكتابة التي يمكن الوصـول إليها وفقًا لهذا الطلب، و (2) الاتفاقيات المستخدمة في IOT عند دمجها مع blockchain.

الكلمات المفتاحية: Blockchain , انترنيت الأشياء , تطبيقات تقنية البلوك تشين ,مفهوم انترنت الأشياء

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