

IOT with Distributed Ledger Technology, A Review of Advantages and Challenges

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Abstract: *The way technology is evolving, in coming years the learning experience will be impacting in many ways. Internet of Things (IoT) is a new vision that continues to hold its ground for development of societies through the Information and Communication Technologies. IoT is an emerging topic and it is expected to grow rapidly. IoT works in a centralize model. Due to it's centralizing nature, it gets exposed to many problems like, security, privacy issues, operational cost, functional approach and scalability. To address this kind of challenges and keeping into account the IoT evolution of future, it is important to handle the information coming from the billions of sources. Blockchain an emerging key technology that has decentralization operational model is a better solution to this kind of issues. The technology is applied in many sectors were information and connectivity is the key. With the help of the blockchain the IoT data will be safely managed stored at various locations e.g. cloud. It will also eliminate the possibility of tampering or leaking the data. It's so robust and flexible that it will solve the scalability problem effectively. However current blockchain has several challenges with the IoT but that can be minimized or rectified in future. This paper will focus on the advantages of integrating blockchain with IoT and how it can benefit in higher education.*

Keywords: IOT, blockchain, security, distributed ledger, decentralization

I. INTRODUCTION

The Internet of Things (IoT) is a rapidly growing technology that connects the connection in the network to get benefit from it. It is a global network, which is growing day by day as the technology is advancing[2]. Nowadays every person, machine, devices, homes, schools, offices every thing which be connected to Internet are part of this global network. Due to IoT schools are converted into smart school, homes into smart homes, device to smart device and this is just the beginning of a new era. The figure represents the global network[7].



Figure 1: IoT Network

1.1 Markets Statistics

As per market research organizations and analysts the network is expecting billions of smart devices that will be leveraging any network. These IoT devices will interact with each other and transfer measure data to its peers. The connection is estimated to grow more than 20% annually. The growth will take the number of devices around 30-50 billions by 2022. If we consider the over all market it has the potential to grow more 1 trillion USD by 2022. If we consider the below figure we can estimate the way market growth for the connected IoT devices. But if we consider the contribution of the education sector then it is hard to predict as everything is in mode of transformation.

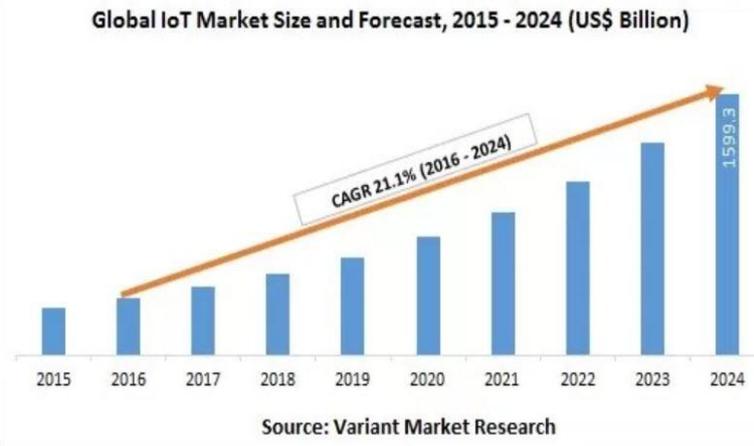


Figure 2: Global IoT Market Size and Forecast

1.2 Problems and Challenges

Every technology has its own limitations and opportunities but we will focus on the challenges in the education sector[9]. The way computer science and technologies are evolving such as Big Data, AWS, Cloud Computing and artificial intelligence, its very difficult to secure data from problems like, security, privacy issues, operational cost, functional approach and scalability.

II. BLOCKCHAIN

Blockchain technology is exceedingly popular nowadays. In 1991, with the intention to secure documents from being updated or tampering, this technique was described to timestamp digital documents. Initially the technique worked similar to a notary, which was further transformed and used for financial transactions, as digital currency[11].

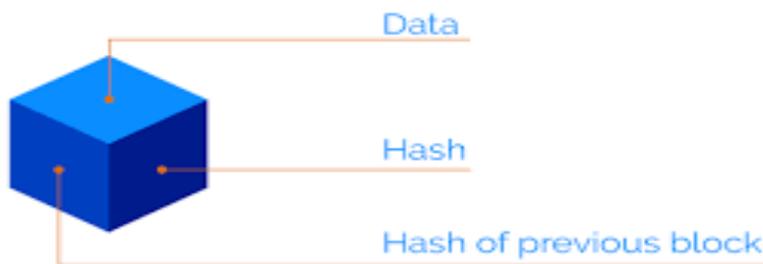


Figure 3: Information is hold by a block

2.1 Working Model

The distributed ledger, Blockchain has an appealing property that alteration of recorded data becomes very intricate. A blockchain can posses N number of blocks, each block restrain data. Cryptographic hash is calculated which includes current block data and the hash of the preceding block. A blockchain can hold any type of data depending upon the

application in which it is being worn. The hash of each block is always its unique distinctiveness or fingerprint. Being a distributed ledger, Blockchain can be viewed by all the nodes inside the network.

As blockchain is evolving at a rapid pace and it's just not the financial sector which is making most of it. In other areas like higher education or studies we need to see how IoT and blockchain integration goes hand in hand. This integration will provide into new ways of doing business.

2.2 Features of Blockchain

Blockchain is going to change many things. Need to see how industries adapt to this technology and make most of it. Blockchain comes with unique characteristics as listed below.

- Distributed Ledger
- Digital
- Real time update
- Chronological and time-stamped
- Cryptographically sealed
- Irreversible and auditable
- Fewer third parties

III. INTEGRATION: IOT AND BLOCKCHAIN

As IoT is transforming from the manual to digital at fast rate but there are challenges and issues which need to be addressed as billions of information is transferred around the globe. If we consider our education system the information is increasing day by day. Lot of online degrees and courses are available. Structured or unstructured learning materials need to be maintained and protected. Overall IoT era is going to shift drastically and we need cater to the challenges and seek for a proper solution.

Blockchain has come to the rescue IoT, although blockchain has its own challenges but we can adopt the best practices, which will serve our purpose. Following IoT challenges can be addressed or minimized by integrating blockchain in education.

3.1 Architectural Change

IoT is centralized in nature which the authorities who are managing the system has control over our devices and the data. They manipulate our personal data or information for their personal gains. Blockchain decentralization architecture solves this problem and address to the privacy concern monitored by the centralized design. That means if will be having controlled of our data and we will decided to whom it should be shared. See the pictorial representation of the centralized, decentralized and distributed networks in below figure.

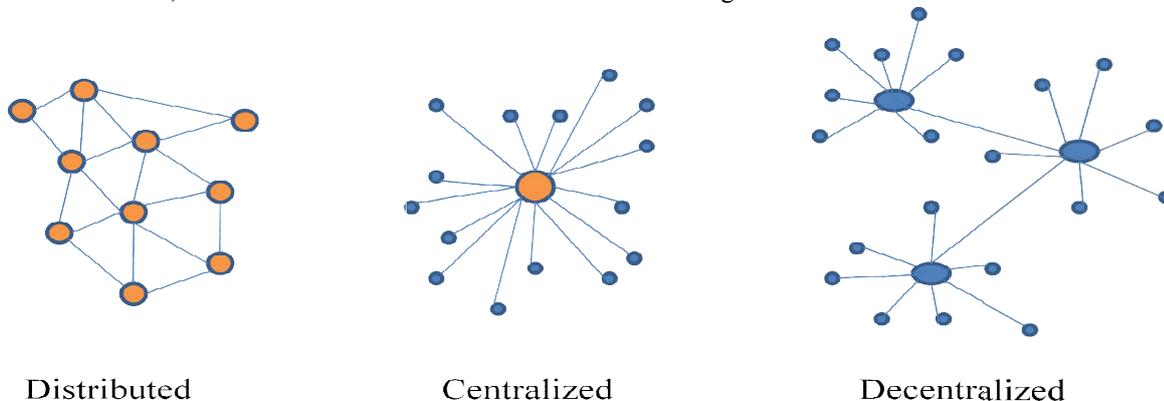


Figure 4: Types of distributed networks using blockchain

If we take an example in our education any research, academic data of institute, learning materials that are authentic and restricted can be prevented through blockchain and can be used for our own/organization benefits. The decentralized system will also improve the IoT bottlenecks the scalability.

3.2 Security and Privacy

One of the major challenges for IoT is the security and privacy. Millions of jobs are getting created in education sector, lots of training material is saved on the cloud, researches, personal data all this area require a reliable security mechanism. Education sector has possibility of getting attacked or harmed. So a collaborative mechanism needs to be placed by which we can bring the level of risk at minimal level.

Blockchain technology promises to minimize risk by allowing peer-to-peer consent this eliminates any centrally controlled authority to certify which leads to be a failure. Every user is accountable for its action in the network. In education system this can be implemented as group of organizations or institute or researchers need to provide their consensus what's going to be shared in network for future development and every person in the network will be accountable for its action. This will encourage and will develop a trust within the users to promote innovations and services.

3.3 Cloud Approach

In today's world most of things, which facilitates the real time access, are using cloud approach. This approach allows them to upload or download data irrespective of their location. Many organizations, universities are using their hybrid approach to deal with the IoT applications. As the tablet and mobile world is expanding everybody wants information on their fingertips. The info may be anything like learning material, audio or video clip, online tutorial, live seminar etc. The demand for the information is high as compare to the level access provided over the cloud. So this issue needs to be addressed to balance the in and outflow of the demand.

As blockchain is a decentralize network it stores the information across the nodes in the network, this can prove beneficial with the cloud approach. Every user or institute to have a control of the stored data can be securely achievable through blockchain. As this is little bit complex to understand how the operation of transferring the data will occur. But this approach will change the education sector in better way.

3.4 Mobile apps and Technologies

As mentioned above mobile apps and technologies developed around to felicitate the demands in the education section are growing. Lotsof Learning & Talent Management System LTMS are in market to provide with billions of information in whatever format. To access this information lot of mobile apps are developed so that it should be available to the end user or device.

Blockchain will serve this purpose by connecting the world across globe and making available information in the forms of live webinars, get student instructional info on demand. The mobile apps will mange to connect to the network and students can work on their assignments, research papers and can participates in any development across the globe if agreed. All this comes secure and reliable at any time.

IV. FUTURE WORK AND CONCLUSION

Every technology comes with benefits and challenges. This can be the case with IoT and blockchain, but most important part is how this disruptive concept will sustain and move forward. This has to be studied and implemented carefully by removing its challenges.

As new technologies are coming at a rapid pace and we need to take this opportunity of IoT and blockchain to a next level. Using this technology will lead individuals, universities and organization to build smarter working space around them. Keep updated with the development going on within the organization. Individuals and contribute with the teams for the research's. Smart learning center can be created, to provide students with the latest invention or development going around the network or globe.

Lot of work is carried out by most of the companies in this sector, which could be at implementation stage or in beta testing. Let see how world shapes specially the education sector, which has the capacity of building a smarter future.

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