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A Block Chain and IoT Based Hybrid Students Record System for E-Governance

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Authors' contributions:

This work was carried out in collaboration among all authors. Author RDB contributed the block diagram, activity diagram and the related contents of the student record systems in the manuscript. Author SJ included the applications and challenges of Bloackchain IoT and the related work (literature survey) and author RM managed the content of the introduction part, Blockchain and IoT details to the manuscript. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

Aims: This paper addresses a system for the students' record management by the educational institutions using the IoT and Block chain technologies.
Motive for this Research: The growth of the contemporary technologies around the world has made almost all the chores easier and faster. Yet, the government and private organizations are struggling to identify the appropriate candidates for the required positions and to verify their credentials during the recruitment process. The recruiting companies are facing the issue of deceitful activities during the certification and other credential verifications. Moreover, the data are available only in the universities and the verification processes are very often manually completed and they are time demanding. Thus maintaining data integrity and security becomes the major concern for the organizations, which have widely suggested considering AI technology applications in the educational institutions which are ubiquitous nowadays, especially with the current rapid change in the technology landscape. In higher education institutions as a modernization process

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they have started using the IoT devices for recording the students' status and performing many activities automatically. The Block chain technology is used for secured peer to peer networks for the private data maintenance. Since it is demanding good Internet infrastructure and the transactions are computationally expensive, there are some hesitations in adapting Block chain technology for the regular activities by the organizations. Despite the security features of the Block chain, there are very few systems and proposals available using IoT and Block chain due to the technical complications while merging these technologies.

Study Design: We have highlighted the various concepts of these two technologies, their applications, advantages, challenges, etc.

Place and Duration of Study: Department of Information Technology, University of Technology and Applied Sciences – Salalah, Oman, from Dec 2019 to February 2021.

Results: A system architecture is proposed and it explains and shows how the Block chain security is being imposed on the IoT based applications especially for the student data management system. The activity diagram of the proposed system helps and assists in understanding the flow of the correspondences among the organizations and the candidates (students) and the way the information is maintained.

Conclusion: The proposed system architecture This system is secure, fast and it can be used by the government and the private institutions not only for the students' record management and verification, but for many other different purposes within the scope of data management systems.

Keywords: Block chain; iot, students records; decentralized cloud storage; students management system; public key; genesis block.

1. INTRODUCTION

The contemporary computing technologies are tuning the world to inevitably adapt to the smart changes, especially in the aspects of better security and easy accessibility. Nowadays the technical terms are being known or used by common men through the broadly available gadgets and knowledge about them. The recent terms uttered by many of the researchers, investors, stock marketers, bankers and customers are the Block chain and the related technologies. Block chain is the distributed ledger technology with the crypto currency concept. Initially it was considered to be appropriate only for monitorial transactions but the application is being brought to other applications like medical records, personal details, voting systems and to maintain a huge amount of information records.

One of the equally valued technologies which has already reached the general usage of the people is the Internet of Things (IoT), which is the idea of connecting the user appliances with the help of IoT devices like sensors, Radio Frequency Identification (RFID), smart cameras etc., through the Internet for automated applications. Most of the countries have started stepping towards smart applications in many fields including smart home, health care, smart agriculture, smart traffic control, smart city, Industrial IoT and many more. Few applications really are in need of increased security provisions for some valid reasons. IoT is a technology which provides more automation but lesser security. So, it would be suitable if any of the additional security mechanisms are merged with IoT.

It is been well understood that almost all of the growing computing technologies are somehow related and interlinked to each other in the way they are used or developed and can easily be merged. For instance, IoT deals with data of huge amount which can be stored in the Cloud and processed to produce valid information using Data Analytics. Similarly, the machine learning is a descendant of Artificial Intelligence. Whenever there is an emergence of technology which may directly impact the common life of people will be considered more for its benefits to the society. In that context, the Block chain technology's security features have been considered for IoT's enhancement by many of the researchers. The distributed nature and cryptographic hash functions (Secure Hashing Algorithms - SHA 256) of the Block chain technology are the highly denoted features of security provision which could improve the IoT data security during storage and transmission.

This paper has highlighted some of the key points related to the IoT and Block chain technologies and proposed an architecture for student record management system using both

the Block chain and IoT technologies which would provide a better secure platform for many applications in the near future.

2. IOT AND BLOCK CHAIN

In this section some of the key features of IoT, Block chain, benefits and issues in combining both the IoT and Block chain technologies for different applications were included.

2.1 Internet of Things (IOT)

IoT is one of the emerging platforms where the things communicate with each other without or less human intervention. It makes the things (embedded, non-phone devices) [1] to be smart with the presence of Internet and mainly makes use of sensors, actuators, Wireless Sensor Networks (WSN), smart cameras, RFID readers and tags. The state-of-the-art technology has introduced a credit card sized on-board device Raspberry Pi, which is highly recommended for IoT projects. The following Fig. 1 of IoT architecture is self-explanatory.

Updating with modernity is inevitable which is expected to include speedy actions with more intelligence, improved safety and security, energy efficiency, low cost, less man power, anytime anywhere availability, interoperability, long life, scalability, high throughput and easy accessibility. IoT plays imperative roles in enhancing the smartness of the world in an intelligent manner. There was a debatable issue whether all the small devices could be connected to the IoT. This induced the Internet Engineering Task Force (IETF) to introduce the new concept IEEE 802.15.4 6LoWPAN which is a combination of the IPv6 and Low power Wireless Personal Area Network for the smallest devices with limited specifications. With IPv6 addresses (128-bit address, hence 2^128 addresses), it is possible to address massive number of large and small devices. IoT devices are producing enormous amount of data which are being processed and validated with the customized data processing units and the IoT cloud storages are being used for storing the processed information. Though the IoT has already got a complete structure and used for diverse applications worldwide, the security issues are still persisting and many researches are going on to resolve them.

2.2 Block Chain

Block chain is a Distributed Ledger Technology (DLT) with Peer-to-Peer topology, initially meant for secure transactions, that allows the data to be stored and shared in a distributed manner in numerous servers worldwide. The need of centralized data server is eliminated. The Block chain technology comprises special software to be used by the computers involved in the chain of blocks (chunk of transactional data) for maintaining the ledger. The security is enriched with the cryptographic hash algorithms (SHA 256, 512) and the transactional data are immutable with the hash code being saved in the next blocks as well. Breaking the chain and letting the data out is not an easy task like breaking a single password in the centralized network. The following Fig. 2 depicts the Block chain structure.

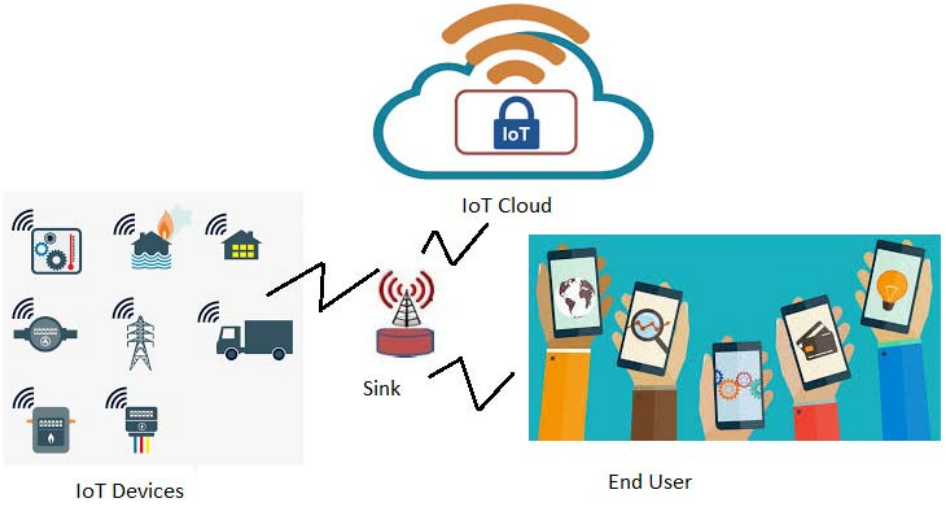

Fig. 1. IoT architecture

Fig. 2. Block chain structure

There are three basic categories of Block chain which include Public (Eg., Bitcoin, Ethereum), Private (Eg., Hyperledger Fabric, R3 Corda) and Hybrid [2]. The public Block chain is known as 'permission less' as it allows anyone to participate in the chain. It is been used by different countries those who do cryptocurrency transactions and it involves miners. The miners are basically programmers who are creating and maintaining the blocks in the distributed network of Block chain. They are using their high configuration computers as nodes, download the customized Block chain software, solve the complex cryptographic problem to obtain the hash code, join the chain, communicate to all the nodes of the chain regarding transactions, maintain the ledger and validate or invalidate the transactions for which they are paid accordingly.

The private Block chain, known as 'permissioned' needs prior approval for the people who wants to join the chain; the permission is given by the central authority. It is meant for an institution, banking sector, organization or group of similar organizations, do not need worldwide miners, the employees or participants can work as miners and validate the transactions. Generally, these kinds of private Block chains are used for securely maintaining the valuable information including employee details, tangible and intangible assets details. The private Block chains are highly preferred by the organizations as they involve more security as well as less computing power and smaller ledger.

Block chain forking is also an important part of it which is a temporary or permanent divergence happens during the split of Block chain. The forking may be caused by any changes in the consensus algorithm or the software. There are three types of fork, soft, hard and temporary (accidental). Soft fork provides backward compatibility when the protocol is altered (i.e) the newly created Block chain is considered to be valid by the older version of the Block chain software. Hard fork is not backward compatible. The temporary fork occurs when two miners accidentally mine a new block at the same time [3].

The following Fig. 3 [4] shows the evolutions of the Block chain from it is invented. The evolution enables the usage of the technology in many different fields and along with the other technologies.

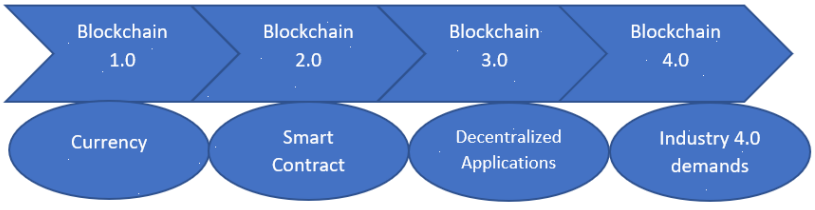

Fig. 3. Block chain versions

2.3 Characteristics of Block Chain and Iot

2.3.1 Economy

The inclusion of Block chain in IoT makes the system to be more economical. (A. [5]) IoT possesses centralized architecture with high end servers, processors and customized protocols which acquire the overhead cost and maintenance cost to be more. Since the Block chain is distributed in nature, the architecture cost is considerably low which in turn benefits the IoT.

2.3.2 Transaction speed

Block chain has the capability of easy access of the blocks in a secured, reliable way, which can enable the automated exchange of data. IoT data access is speeded up with the Block chain since the third-party acceleration for the transactions is eliminated.

2.3.3 Decentralization

IoT is a centralized technology that has its own drawbacks of overall cost, maintenance and single point of failure. But the inclusion of Block chain in IoT makes it a decentralized system where the failures and errors in the transactions are not propagated. The given Fig. 4 depicts the centralized and distributed network skeletons.

Generally, the centralized and decentralized systems depend on the control, single point of control or multiple [6]. But the distributed systems deal with the location variation, where parts of the system are located in different physical locations.

2.3.4 Identity and access management

Identity and access management of Block chain improves the IoT security. IoT devices are commonly using private Block chains to store [7] cryptographic hashes of IoT devices state and configuration. This permanent record is used to validate the authenticity of the devices. Thus the Block chain can provide defense against IP address forgery attacks and IP spoofing attacks as well as protects from fake signatures.

2.3.5 Resilient and reliable transaction

IoT devices in Block chain store distributed ledger copies on their memories that accumulate all transactions. Since each device holds the ledger, the sharing of information adds additional processing, storage and power consumption to achieve better resiliency among the devices. Block chain blocks are immutable; when included in IoT devices, they improve the traceability and accountability of the sensor devices and assure the proper message delivery.

2.3.6 Security

The Block chain is a distributed ledger in which each block is finger printed and time stamped to maintain its uniqueness. If one block content is changed, the finger print is changed and the block is no longer considered as the same block and each block stores the hash of the previous block as well. It also ensures the security among the blocks by avoiding a changed block to be part of the chain [8].

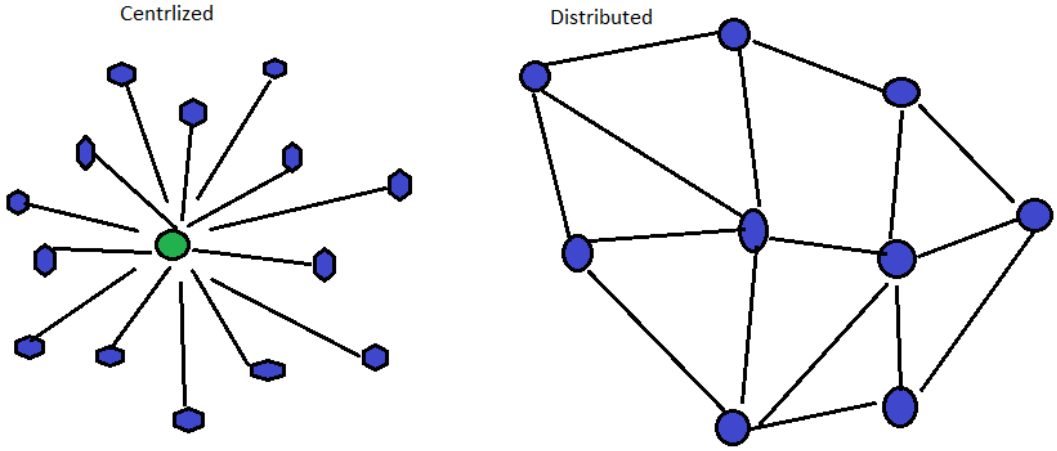

Fig. 4. Centralized and distributed networks

2.4 Comparison of Block Chain and Iot

IoT and Block chain technologies can surely be merged to promote their advantages in various applications still both the technologies have some differences. IoT is a centralized technology whereas the Block chain is decentralized and distributed [9,10]. Resources are constrained in IoT devices but resource consumption is more in Block chain. Latency time is low in IoT but it is more in Block chain mining due to the distributed ledgers. IoT deals with large number of devices but the Block chain scalability is not appreciated. IoT consumes limited bandwidth and resources as it contains the smaller devices, but Block chain consumes more bandwidth due to its design and ledger. The major dissimilarity which is highly spoken is the security that is less in IoT technology and more with Block chains [11].

2.5 Applications of Block Chain in Iot

Though uniquely IoT has many applications, including Block chain technology is enhancing the power of IoT. Block chain IoT is applicable for Government, Banks, smart monitoring, health care, commercial applications, agriculture and communication systems. Here some of the applications of Block chain IoT are highlighted.

2.5.1 Health care

The patient care and emergency support are enhancing with IoT which can be secured with Block chain. The medical records can be consolidated with Block chain and saved securely in a way that cannot be tampered. Only the authorized people can view the details for any history clarification, correct billing and medical claims from the corresponding insurance companies and proper medication [12]. This enhances the IoT to be super smart in its performance.

2.5.2 Supply chain

The prevalent application in industry development of Block chain IoT is supply chain management and fleet monitoring. In supply chain management, all the transactions are made transparent and traceable with the help of Block chain. It is common that the industries keep ledgers for their reference and records only, the outlets will not be monitored once they are delivered. But it is beneficial to keep track of the supply chain until the product is reaching the end consumer to ensure the quality of the product.

For instance, the Block chain IoT can be used to track the complete cycle of a final product like potato, where it is cultivated, which variety of potato it is, which chips producing company purchases it, in which part of the country it is sold and the feedback of the consumers, the process has been shown in the above Fig. 5. This kind of information is not only useful for the consumers to consume healthy and quality products; it is helpful for the manufacturers to improve the product in their own competitive way.

2.5.3 Energy distribution

Electricity is one of the inevitable parts of our lives. Nowadays the generation of electricity is not limited to the Government or private companies; even the home generated electricity is also growing with the Solar power systems. So, the utilization has to be streamlined with the consumers and producers. This can be done with the Block chain IoT by maintaining a distributed ledger of the producer consumer details and making it transparent for the users. Energy Distribution is not only for household and industry purposes, also for the automobiles in the near future.

Fig. 5. Supply chain management with iot block chain

2.5.4Smart Homes and smart parking solutions

IoT devices are the major parts of securing homes and making them smart. The insecure nature of few IoT devices and centralized features are overcome with the Block chain inclusion and security is highly enhanced. A company named NetObjex [13] has proposed a smart parking solution for automated payment with crypto wallets and for finding the empty parking slots and the ways in a highly crowded region with the application of Block chain IoT.

2.5.5 Financial transactions

The world is moving towards cashless, online transactions which are in need of higher end authenticity and authorization. Where the technology grows, the loopholes will also grow in parallel. The online transactions are well and good to avoid taking cash in hand and delivering to the receiver but the cybercrimes are also growing to threaten the growth of the technology. The Block chain IoT provides a better security and reduces the fear of online threats towards the financial transactions.

2.6 Challenges of Block Chain Iot

Though the convergence of the two massive technologies has a lot of applications for the society, in reality, it has some challenges too. In this section, we discuss some of them. The noticeable challenges are scalability, energy consumption, processing time and storage.

2.6.1 Scalability

The network is becoming bigger in size and wider around the world, thus the transactions are also increasing. This is normal for an IoT, but when combining with Block chain, the limited bandwidth in the usage of cloud computing and processing of data in real time makes it cumbersome. The amount charged for the cloud services including data storage, transaction fee is also increasing as the network grows. This in turn affects the growth of Block chain as it is in need of large storage and resources. Few companies are trying to overcome this defect by applying mini- Block chains, tree-chains and side – chains [14]. Mini Block chains are to reduce the scalability issues of Block chains which do not include high bandwidth occupying historic blocks.

2.6.2 Energy consumption

In the context of Bitcoin mining where the transaction records are added to the public ledger of the past transactions, the Block chain is always having high energy consumption. Generally, the IoT is with the devices which consume lesser energy and battery powered. Due to the processing of more records, the energy is more consumed by the Block chain, which does not match with IoT. With the help of mini Block chains, the energy consumption can also be reduced considerably.

2.6.3 Processing time

Since the Block chain is more secured through cryptography, encryption and hashing process, the processing time is becoming more. But in case of IoT, it needs and holds lesser processing time small devices and time constrained applications. This difference in process time is a major flaw of the convergence.

2.6.4 Storage

Block chain distributed technology doesn't use a central server to store the transaction details. It is having distributed ledgers, that each device involved has its own copy of the ledger, consequently, when the ledger size grows gradually, the storage needed by the ledger copies is also growing. This growth of storage is also in par with the number of devices and transactions among them. Storage not only increases the cost of using it, also is not coping up with minimal storage devices of IoT [15].

Some of other legal issues may arise due to the crypto security and non-central control of the authorization servers, as the IoT do not maintain such distributed security. Care must be taken to merge these two technologies to be pertinent for the real time applications.

3. RELATED WORK

The investigators around the world have already initiated the merger of the two distinct technologies for different applications. Many of the researchers have proposed their customized schemes to improve security of IoT with Block chain technology. In this section some of such proposals and research works have highlighted.

The researchers Ali, Salil and Raja [16,17] have considered the "Proof of Work" less Block chain IoT architecture for smart home application, in

which they have mentioned that it is applicable for other similar platforms too. The architecture has got three tiers including smart home, overlay network and cloud storage. Smart home has got the IoT devices installed at home, home's miner, local Block chain and local storage. The overlay network is a peer-to-peer network which may include high end resources. The nodes in the overlay network are considered to be in dynamic clusters to reduce energy consumption overhead. The cluster heads maintain the public keys of the transaction requests and transaction details. Cloud storage enables any third party (Internet Service Provider) to access the user data through accessing specific blocks for additional processing and services. The researchers have included the methods of accessing, monitoring and storing the data in a secured manner with the customized Block chain technology adoption. Additionally, they have included that to what extend the Denial-of-Service attack, modification attack, dropping attack and mining attack can be overcome or reduced using the proposed architecture. The proposed work is giving a motivation to adapt to the Block chain technology to secure the IoT for the indoor applications.

An extended survey has been attempted by a group of researchers [18] on Block chain based IoT Use cases. They included smart industry, smart health, smart city and smart home with the analysis of functional and non-functional requirements. In case of industrial applications, the food safety and drug safety have been high pointed. The functional requirements include totality, traceability and transparency and the non-functional requirements involve performance, flexibility, scalability, privacy and security for providing better end product or service through the merger of Block chain and IoT technologies. The smart health with Block chain IoT may be provided by maintaining secure electronic medical records (Health Information Exchanges – HIE) of the patients which can enable easier and faster data sharing, claim management and quick services. The smart city use-cases are real-time data-centered with applications like transportation, utility services and citizen engagement. The use-case encompasses the location-based tracking, real-time decision making and interoperability to be the functional requirements and privacy preservation, securing the infrastructure and ensuring trust among people to be the non-functional requirements. The smart home use-case commonly deals with smart appliances, well being and convenience of using the smart devices. The characteristics of the use-case highlighted by the researchers are unified control, intelligence, heterogeneity and threat protection. The functional requirements include context awareness, real-time monitoring and responsiveness whereas the non-functional requirements contain interoperability, flexibility, safety and security. The survey has included some of the well known IoT supported Block chain platforms like Waltonchain, OriginTrail, Slock.it, Moeco, IOTA, IBM Watson and NetObjex Platform. The architecture, types of nodes, Consensus and reward of each platform and other relevant details have been discussed along with applicable use-cases. This survey paper has given a clear idea about the two different technologies and their combined use-cases, their features, pros and cons for the beginners to proceed with their implementations.

Another set of technological contributors [19] have come up with the credibility verification method for IoT entities using Block chain technology. IoT credibility verification is nothing but the confirmation whether the data comes and goes to the right device and no data is hacked in between and the devices are performing correctly. The asymmetric encryption-based security is difficult and expensive to implement with IoT devices. But it can be achieved with Block chain provided the Proof of Work (PoW), scalability and network traffic are handled carefully. The researchers have proposed a credibility verification framework and a corresponding data model for IoT devices based on Block chain and the performance of the proposed work is experimentally analyzed. The usual single Block chain is replaced with multiple Block chain networks (Block chain structure – BCS) with Managing Servers (MS) which communicate with IoT devices. MSs are responsible for generating public key for the devices, providing private key, storing the information in the local or cloud storage and managing the lower level MSs as well. The verification includes three aspects – recording the addition or removal of IoT entities, credibility verification process of the accessing entity and credibility verification of data. The efficiency of the verification process has been analyzed intensively in terms of response time and storage space which has proved that the proposed framework yields better results compared to the full Block chain method. The researchers concluded that though there are some drawbacks and it is complex to scale for larger

IoT network, it is not impossible to enhance IoT security with customized Block chain technology.

4. IOT AND BLOCK CHAIN BASED STUDENTS RECORD MAINTENANCE SYSTEM ARCHITECTURE

The proposed system has two levels of architectures. The first level architecture covers the higher education institute which has IoT devices for recording and monitoring the students' information in the students' record maintenance system. This architecture can be taken as a Smart campus architecture. The details of the students could be stored in a local memory server. This local server maintains a separate database for the complete details of the students. The consolidated details or the current status of the student with few key particulars like study status, grades etc., would be stored in a block structure by having the birth id (Public Key, PK – Unique personal address) as a key [17,20]. The birth id is given by the Government when the hospital registers the birth of a child. When the child goes for a primary education the initial block (generally called as Genesis block) would be created in the Government Educational Directorate Office (GEDO) of that region. The institute where the kid joins for the primary education would request the Government agency (GEDO) to verify and allow to create the next block with the current educational institutions students' details using the PK. The IoT based internal server updates the students' details regularly. The block created after the approval of the Government office would be updated periodically (yearly during schools and every semester during college education). The educational directorate (GEDO) is responsible for the administration of the Block chain agreement and to sort out the unverified exchanges. The verification is not done through public network instead it is taken care by the Government office. The detailed database maintained by the institute should be online always. The institute when they give admission for a student would create a block for a student from the already existing chain of blocks in the Government office. The structure of the block will be as given below in Fig. 6.

The second level of Block chain architecture is the one which connects all the institutes of a region to GEDO and the Connections among the GEDO.

When a student moves from one institute to another institute a new block would be created from the previous block of that person (student using PK) which is verified by the Government office. When a student moves from one region to another region, the verification authority will also change from the educational directorate of the old region to the new region and the blocks will be stored in the cloud storage of the new office. The block diagram of this architecture is given in Fig. 7.

The institute in which the student wants to continue the studies, may check the credentials and validate his/her previous studies by making a request to the educational directorate of the Government to join the Block chain network using the PK. Once the Government directorate allows the new institute to join the Block chain network of them, the directorate verifies the certificates submitted by the student to the new university with the records in their database and validates the credentials and sends their approval.

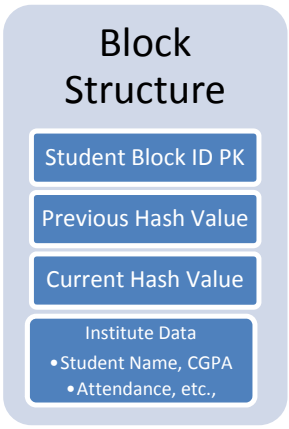

Fig. 6. Block structure

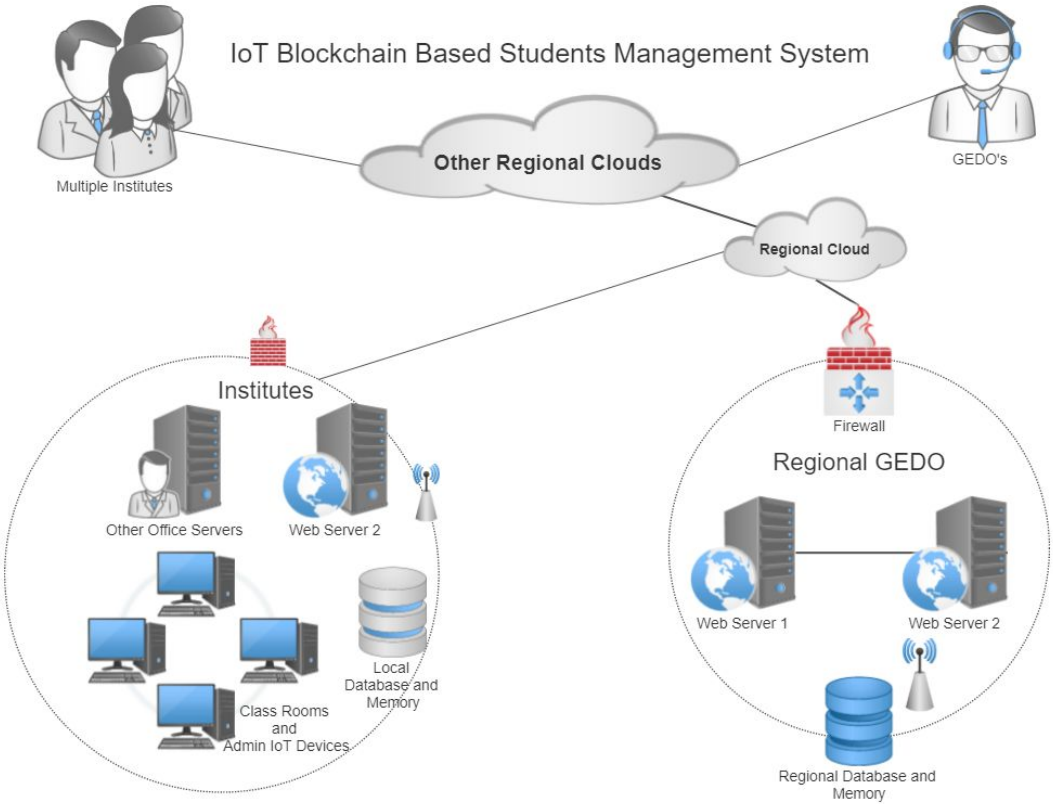

Fig. 7. Block diagram of IoT & block chain based students management system

The new institute creates a block for the student (s) in the Block chain of the Government and starts storing the students' details available in their institute. Initially it would be like the course details in which the students have joined with the joining date. This new institute also updates the students' details periodically depending on the nature of the study.

Here each institute in different regions of the country have its local Block chain memory to store the details of the students like attendance, exam marks etc., which are collected by the IoT devices available in the institute. The local network is needed to be online always and be connected to the Block chain network of the Government. Each region of the Government Educational Directorate Office (GEDO) is also connected to other region GEDOs and uses the cloud memory to store the general block details.

The proposed infrastructure helps any institute which is willing to check the credentials of the student who wishes to join. The institutes can be within the same country or anywhere in the world. They have to initially request the GEDO for validating the credentials by joining their network. The GEDO would allow the new institute to join their Block chain network if the institute is within the same region. If not, the GEDO would send the complete details to the GEDO of the region where the new institute is situated. The GEDO which has got the Blocks of the students would allow the new institute to join their Block chain network and also check the credentials which are submitted by the student to the new institute.

The below given activity diagram explains the stages from the data collection till the certificate validation done by the new institute when a student goes for the further education.

The details would be stored in blocks. Each institute has their own block for each student. The student block would always have a link with the block maintained by the previous institution. The block creation and verification process in Institute and the GEDO is explained in the activity diagram in Fig. 8.

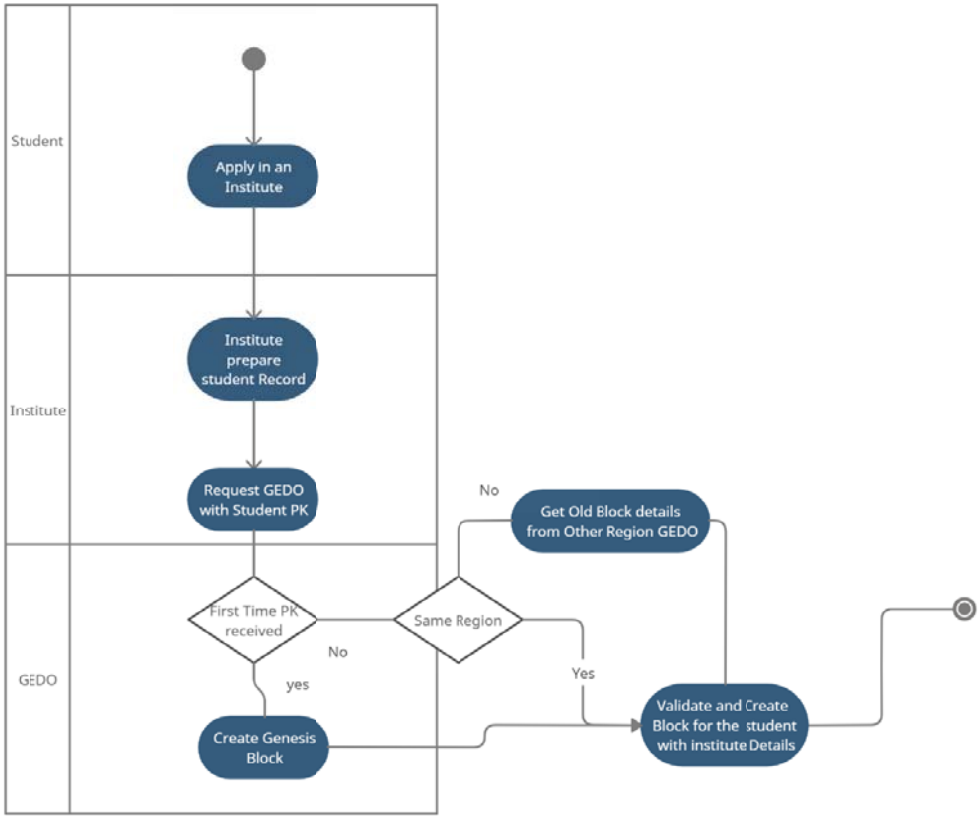

Fig. 8. Activity diagram explain the whole block creation and verification process

The same infrastructure can be used by the companies to verify the certificates submitted by the candidates who wish to join that company using the PK which is specified by the student in his/her job application or the PK specified in the academic certificates. They can request the GEDO of the region from which the student completed his/her last study to verify the certificate. The GEDO can just confirm the credentials validity without allowing the company to join their Block chain network.

5. DISCUSSION

The public keys and the private keys are playing inevitable roles in Block chain applications which are commonly known to be Rivest Shamir and Adleman (RSA) algorithm. The algorithm is more secured with the two keys and becomes the basis for the cryptographic security of the Block chain. The Secure Hashing Algorithm (SHA 256 or 512) is used for producing the hash codes which are unique for each block and are of same length despite the input size. Hash value is one another security enhancing feature of the Block chain which is the interest of the researchers in improving the IoT applications.

The proposed system may replace GEDO with the countries' embassies in case the student applies for the higher education in other countries. The system architecture can be used by the ministry of Manpower to help the companies to verify the certificates and credentials of the short listed job applicants. The Fig. 8 is suitable for few similar applications like manpower system, healthcare, elections, asset management etc, where the institute to be replaces with the corresponding organizations. In this case, the first condition to be removed in the activity diagram to check whether the PK is submitted for the first time in the GEDO.

The proposed system has two architectures which are IoT dominated Institute infrastructure and Private Block chain based network among Institutes and the GEDOs. The Block chain network that is proposed in this paper is private

which has its own advantages in merging with the IoT applications. The IoT dominated infrastructure also uses blocks to store the students' information and the database to store the complete information of the students collected by the IoT devices. The data which are collected by the system will be more accurate and the data availability will be 24x7. As discussed earlier, the technical glitches may occur when the IoT based system links with the basic backbone Block chain network which connects the institute with the GEDOs. Nevertheless, the proposed system is having a few disadvantages, the system can be adapted for everlasting security and integrity of the data.

6. CONCLUSION

The ever-growing innovations and technological up gradations are mainly focusing on improving the quality of life and satisfying the requirements of people in different forms including availability, accessibility, security and many more. Though the researchers concentrate on all the above mentioned provisions, the security is always a threat in almost all real time applications. Availing the secured communication, transaction and storage are becoming a nightmare due to different types of physical attacks and cyber-attacks. Yet, the recent Block chain technology enhances the security of the transactions in an acceptable and irreversible way besides its practical complications. When the Block chain is merged with the established and well known IoT technology, the usability of the benefits with enhanced security can surely be achieved. In that way this paper has brought a new conceptual way of storing and accessing the student data using IoT and Block chain. The proposed architecture can be used for other similar valuable data storage and maintenance so that the malfunctions on information and further fraudulent activities can be avoided.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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