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BLOCKCHAIN IN SMART HEALTH : SYNERGY FOR NEXT GENERATION e-HEALTH SYSTEM

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***Abstract*— Blockchain technology expeditiously acquire traction in healthcare industry as one of the most stimulating technical evolution. Particularly blockchain technology presents various possibilities for healthcare industry such as lesser transaction costs, increase in regulatory reporting, expeditious healthdata management, data integrity and healthcare records generality. In the context of smart health blockchain may stipulate distinct benefits, especially from a context-aware perspective where efficient and personalized solutions may be provided to the citizen and the society in broad. This work presents how blockchain technology transmutes the healthcare system and how does blockchain works in healthcare industry. we will cover the future potential of this technology in the industry and consider current usage and also portrays some problems in healthcare industry and its solutions using blockchain technology.**

Keywords— **Blockchain, Healthcare, Smart health, Healthdata, Data integrity**

I. INTRODUCTION

Smart healthcare trends are largely driven by the need for better patient care,faster and gives better analysis and on demand access to medical data.The pace of innovation in digital healthcare began gaining strength with artificial intelligence(AI) and it is set to further accelerate as the industry turns to blockchain technology. Blockchains were originally developed to provide a practical solution to reaching to an agreement in an untrusted decentralised distributed environment through bitcoin[1]. More precisely, blockchains were introduced to solve the double spending problem (i.e. no one can spend the same bitcoin twice in his transactions [2]. Therefore from this blockchain creates a vast area to use its benefits in large financial industries like banking, insurance sector, investment services of course in healthcare service too.

Blockchain is a chain of blocks that can exchange information. This technique was originally described in 1991 by group of researchers. It is like digital time stamps that cannot be tampered like a notary. In 2009 Satoshi Nakamoto introduced Bitcoin as digital cryptocurrency. Blockchain is a distributed ledger, completely opens to anyone with smart contracts[3]. Once some data is recorded inside a blockchain it is very difficult to change it. Now let's know more about a block, a block consist of data, hash and hash of previous block. The first element in the block is data, data is the details of transactions or the records of patients, it is depends up on where the blockchain is used. For example in bitcoin block the data will be the sender details, the receiver details and the amount of bitcoin for the transaction. The second element in the block is hash, hash is the identifier of the block data which is a random value generated when each block is created and unique like finger print. The data change in the block will result the change of hash value, even a change in cases of the letters the whole hash value will change. The third element is the hash of previous block,this effectively creates the chain of block and makes the chain secure[4].

Lets take an example, there are three blocks connected together the third block has a hash of second block as previous hash the second block has a hash value of first block as previous hash then the first block has a special case, it will not be linked to any other block so its previous hash will be considered as 0000 and it is called genesis block[5]. Now if second block is tampered the its hash value will be changed which results the following block invalid. Using hashing is not enough to make a secure block so blockchain has something called proof-of-work(POW)[6],[7]. It is the mechanism that slows down the creation of blocks. In bitcoin there takes almost 10 minutes to create a new block. So if there any tampering of data then all the connected blocks hash and POW should be calculated. Hence gives the security with hash and POW. Another thing in blockchain is for security, it is being distributed. Instead of using a central entity to manage chain blockchain uses a P2P network that everyone allowed to join. when someone joins the network he can get all the copies of transactions. If any one creates the node then blockchain sends it to every one on the network and check whether the node is not tampered and creates a consensus. Another thing on the blockchain is smart contracts[8]. Smart contracts are small programs that can be programmed inside each blockchain.

Blockchain technology is being leveraged to transform the cooperative exchange of vital analysis and helpful aid of healthcare data [9][10], thereby enabling key stakeholders such as clinical researchers, doctors, pharmacists, and other healthcare providers to get assured, faster, simplified and

reliable access to electronic medical information. The technology records digital events during a approach that doesn't leave the info to be modified or recognized till it reaches the recipient[11]. That is why the foremost important advantage of block chain is the plan that knowledge is in theory secured and guarded from data breach threats. With widespread and rapidly increasing use, this technology is of explicit interest to monetary organizations.

Healthcare data[12] can be created, copied modified faster than ever before. If data is the fuel behind more efficient care, blockchain may be the vehicle to get us there. the healthcare system is losing $300 billion each year due to poor data integration[13][14]. Here blockchain offers healthcare a safe and secure system to share data more efficiently. An intricate system used to package data in a way that you can trust, it can only be modified by certain users. once data is created, its broadcast and verified on a peer to peer network and then a block of information is formed. only people with the correct key can access and change it. And every time the data is modified and added to the chain[14]. If someone tries to tamper with a transaction or block in the chain members with permission and validation tools work together to confirm or reject the new data. this process ensures the blockchain remains a safe, secure and trusted source. For healthcare the EHR data[15][16], blockchain can optimize real data through vast connectivity.

From this we can conclude that blockchain is the most secure method for health data storage. The rest of the paper is organized as follows. Related works are explained in section II. Healthcare management and blockchain are presented in section III. Trends challenges and open issue are explained in section IV. Concluding remarks are given in section IV.

II. RELATED WORKS

The emergence of 5th generation of wireless networks will help the blockchain to develop a faster and secure data management. As the customary speed of smart phones and tablets increased with the previous generation networks,5G promises reduced latency and higher capacity will enhance blockchain dominance. The new generation of faster-than-ever mobile (wireless) communications technology, 5G, is around the corner. With its unprecedented data transfer speed and strength, the technology is being seen as the holy grail of innovation, since it will help accommodate advances made in AI, machine learning, neural networks and blockchain across various verticals, including healthcare. As this new technology ecosystem come out, blockchain assures significant change in capturing and managing patient health records and claims data.

A promising approach has been considered to improve the quality of healthcare service , an online medical primary diagnosis system, which can provide convenient medical decision support through applying mobile communication and data analysis technology.an cost-effective and privacy-preserving online medical particular diagnosis framework (CINEMA). Within CINEMA framework, users can approach online health primary diagnosing service accurately without expose their medical data. Specifically, based on fast secure permutation and alikeness methods, the encrypted user's query is immediately operated at the service provider without decryption, and the diagnosis result can only be decrypted by the user, in the meantime, the diagnosis model in service provider can also be secured. Through extended analysis, we show that CINEMA can ensure that user's health information and healthcare service provider's diagnosis records must keep confidential, and has significantly decrease computation and communication overhead. In addition, performance evaluations via implementing CINEMA exhibit its effectiveness in terms of important atmosphere.

III. HEALTHCARE MANAGEMENT AND BLOCKCHAIN

Healthcare is a sector which is constantly trying to catch up with modern technologies and apply these technologies for further advancing the stipulated services to patients. In this regard, blockchains have already started being make use of several features, such as productive healthcare data management, interoperability or privacy. Additional synergies may also exist, particularly in the context of smart health. In essence, Smart health extends the models of each e- and m-health by providing context awareness of good environments to provide advanced healthcare services. The latter could improve the patient's quality of life, optimize resource allocation or perform costs reduction as services may adapt to their ever changing environment. While one could think about Smart Health as a bridge between healthcare and Smart Cities, the "smartness" of the environments and the context they disseminate may change the nature of the provided service.

In a conventional way the healthcare providers exchanged health data by the way that is the medical information is sent from one healthcare provider to another. then the providers request information from alternative suppliers. and then providers can view data inside another provider's record. Now, blockchain offers another way for providing a universal set of tools for cryptographic assurance and data integrity/standardised auditing where secure lifetime medical record-sharing across providers and even borders is enabled. Blockchain is one of the most trusted technologies related to data security today, but beyond the inherently sensitive nature of health information square measure the persistent challenges of ability, patient record-matching, and health information exchanges.

In conclusion the benefits of a blockchain based system for electronic health records are manifold: records are stored in a distributed way (they are public and easily verifiable across non-affiliated provider organizations), there is no centralized owner or hub for a hacker to corrupt or breach, data is updated and available constantly (as it is stored by millions of

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computers simultaneously), data from disparate sources is brought together in a single and unified data repository [43].

IV. TRENDS CHALLENGES AND OPEN ISSUES

Health professionals feel quite optimistic about fast blockchain implementation, with 37.9% predicting that it'll take solely 5 years to adopt it across medical organizations. For now, these organizations and professionals want samples of blockchain, and how it can be helpful in their field. Here, we are going to cowl samples of blockchain use with in the healthcare industry, describing existing problems with in the sector and considering potential solutions through the use of this technology. Blockchain in healthcare includes the following issues: Drug traceability, Data security in clinical trials and Patient Data Management.

One of the foremost serious issues in medical field is drug counterfeit. According to the Health Research Funding Organization (HRFO), approximately 10%-30% of drugs in developing countries are fake. US businesses lose up to $200 billion annually because of drug counterfeiting; but, the main reason is not in counterfeiting itself, but, rather, that these drugs gives completely different effects than their ancient healthcare counterparts. They may not help patients the least bit or may even be harmful and dangerous to a person's health. As all transactions in blockchain square measure times tamped and immutable, it is easy to detect fraudulent drug dealers. There are two blockchain types: private and public. Trustworthy healthcare blockchain distributors or producers have to register their products in the private system to ensure authenticity and the high quality of their medicines. Private blockchains are qualified by central entities, and the fact that a specific producer or distributor has access to the so called drug blockchain is proof of drug credibility. This is where blockchain transparency comes in useful. Once a drug is produced and relocate from the manufacturer to retailer, the operational data is registered on the blockchain. It makes it extremely easy to verify the whole path of the drug, and determine all chain links at whatever the instance.

Clinical trials are used to determine the effectiveness of particular medicines which cure specific diseases. These tests can either prove or disprove an offered hypothesis. During clinical trials, researchers acquire and attain a great deal of information concerning statistics, test results, quality reports, etc. Each ma of science is answerable for specific analysis, making it difficult to control everyone. Those information will then be simply changed or hidden so as to change the whole outcome of the research performed. Criminals are interested in recording the results that are beneficial for them, even if the data does not coincide with the reality. This technology permits users to prove the credibility of any document registered within the system. It furnish proof of existence by adding data within the style of the group action and collateral the health data by all system nodes. As mentioned above, blockchain records immutable data. This characteristic can leave the storage of results from clinical trials during a secure method , creating it not possible to change data. Two doctors from Cambridge University conducted a 2016 study to check however blockchain will give proof-of existence for clinical trials. They found that examination a novel data code, which is set by the system, with the original makes it attainable to verify whether or not the data of clinical trials has been changed, thanks to the inner SHA256 calculator that generates a novel hash whenever a modification is formed to the data.

Patient data privacy is strictly regulated by the Health Insurance Portability and Accountability Act (HIPAA), and requires PHI to be totally secure. There is, however, another drawback associated to PHI: typically, patients need to share their medical records with third parties (e.g. with pharmacies when they need to buy specific medicines). So, how can blockchain facilitate defend data whereas providing partial access at an equivalent time? The Blockchain creates a hash for every PHI block, together with a patient ID. Using an API, covered entities can receive the necessary information without revealing a patient's identity. In the same method, a patient can decide whom to provide with access and whether this access will be either full or partial. Furthermore, a patient can set specific third parties that would have to give their permission for sharing the PHI, if the patient is insecure in what he or she is doing.

V. CONCLUSION

Blockchain provides a tremendous potential of use in numerous industries, including healthcare. This technology has already become widespread within the monetary sector, but medical organizations still hesitate to implement it into their IT systems. This doesn't mean, however, that there are no healthcare companies currently using blockchain. Below, we be a brief list of startups that have created this technology the bottom of their operational structure.

Blockchain healthcare startups:

· Guardtime (a blockchain-based system for securing patient healthcare records);

· Gem Health (an initiative that promotes blockchain-based collaboration in healthcare);

· Cyph (a platform for building secure digital identities and making certain protected communication between healthcare providers);

· MedRec (a blockchain-based system for securing medical records management); and,

· Blockchain Health (a blockchain-based system for medical research management).

Blockchain is an impressive technology which will facilitate stop data breaches within the healthcare industry. It is a secure and reliable methodology of recording, storing, and sharing sensitive data. Caregivers will certainly benefit from implementing this technology, while remaining HIPAA compliant with this method of trustworthy digital protection.

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