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Emergence of Blockchain Technologies in Digital Healthcare—*A Short Review*

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ABSTRACT

Blockchain Technology is a kind of encrypted record of data and it works on a distributed database which deals with the data regarding the transaction and contract. Blockchain lies on an independent record as a digital ledger and is considered as important which can be reachable in various platforms and is not confined in a particular place. Blockchain Technology or simply Blockchain is helpful in different financial activities and services. It is required in proper and healthy digital currency management i.e., bitcoin transactions. It is worthy to note that financial transaction becomes effective without the requirement of the third party and therefore it keeps the data encrypted. Additionally, here participants need not share any personal data and therefore all the data basically kept as encrypted. There are tremendous applications of Blockchain Technology in the recent past in different common and emerging areas. Among the emerging applications or sectors,the healthcare and medical sector is considered as one of the important and valuable industry sectors. This paper is conceptual and prepared with existing literature related to Blockchain Technology. Here basic aspects, viz. features, characteristics, and special basic applications of Blockchain Technology are described. However, the paper specially focused on Blockchain Technology applications in the healthcare and medical sector.

Keywords: Blockchain Technology, Blockchain, Financial Systems, Digital healthcare, Emerging Technologies, Business Informatics

Blockchain Technology offers different kinds of benefits and among these, important one is data breach, and it reduces data breach. Basically, Blockchain Technology supports multiple numbers of shared copies in the same database and therefore it offers a wage a data breach attack and more clearly simply the cyber-attack[1],[5]. Blockchain is now called as Blockchain Technology and is considered as a subfield of Information Technology with a great impact on the financial sector. Blockchain deals with various tangible and intangible assets and using this all the data can be tracked and recorded, additionally, all these can be done in a network and ledger. Blockchain is being considered as a tool, technique as well as procedure of healthy financial management and recently it is a field of study in many educational institutions in developed countries[3],[13]. The Blockchain is allowed to perform only to the authorized members to offer immediate, shared, and completely transparent information. Blockchain is most effective in different activities such as tracking orders, payments, accounts, and production. Using Blockchain Technology transactions the end users can see tracking and transaction details. Blockchain Technology is applicable in diverse areas such as business and commerce, education, health and clinical systems, government and management, entertainment and media, banking and trading, etc. and many other areas are increasing gradually. Blockchain Technology is supported with the fraud resistant system regarding revolutionizing the financial sector with more transparency and advancement. Blockchain Technology is coming with different advantages as mentioned in Fig. 1. It is more effective in traditional business processes and also growing in various sectors. It would be worthy to develop skilled manpower and for the same initiative is required in training, academic, and research programs in the areas of Blockchain Technologies[8],[24].

Fig. 1: Some of the Blockchain Technology applications at a glance

Objective of the Work

The current work entitled 'Emergence of Blockchain Technologies in Digital Healthcare—*A Short Review'* is conceptual and theoretical in nature. The core agenda of this paper is depicted as under:

1. To learn about the applications of Blockchain Technology focusing on foundations and historical background.

2. To learn about the features, as well as basic functions of Blockchain Technology briefly.

3. To dig out the emerging and basic applications of Blockchain Technology in the present scenario.

4. To know about the emerging applications of Blockchain Technology in allied technologies,especially in healthcare systems

5. To learn the main issues and challenges in Blockchain Technology applications in the healthcare and medical segment.

Methodology Adopted

This paper is theoretical in nature and basically prepares using various secondary sources, and primary sources. Secondary sources are accessed to learn about Blockchain Technology such as features, functions, etc. Various websites of different Blockchain Technology are studied to know about the current scenario of the field. In addition to these, Governmental policy work is also studied to reach the goal of the work as proposed.

Blockchain Technology: Fundamentals and Applications

Blockchain Technology *is a valuable technology rather simple* 'Blockchain' and it is not only a database but also a leader with a digital trust. In the year 1982 David Cham first coined as well as proposed 'blockchain' and later in the year 1992, Stuart Haber and W. Scott Stornetta mentioned details in their book and thereafter such ideas became established concept and practice of Blockchain[6],[7],[23]. Though, it is worthy to mention that the first implementation of the Blockchain Network was done by Satoshi Nakamoto after deploying the first digital currency, the Bitcoin. The tools, technologies, as well as the concept and protocols used in the Blockchain, are increasing day by day in the line of cryptocurrencies which is similar to the bitcoin. Blockchain is unable to change its transaction because it is immutable, and transactions are basically stored on the computer network. Here, cryptocurrency is being used in all three types of Blockchains—

- ❖ Public Blockchain,

- ❖ Private Blockchain, and

- ❖ Hybrid Blockchain.

Among the blockchains, *Public Blockchain* is featured with open nature, and here decentralized computer networks can be accessible to everyone with interest in transactions. Here one part of the system validates the transaction, receives rewards and here two models are being used Proof-of-work, Proof-of-stake. As far as a proposed example is concerned Bitcoin and Ethereum (ETH) considered as worthy and important. Blockchain Technology deals with following features—

- ❖ It integrates with High Security case to case basis,

- ❖ It supports and works an Open Environment,

- ❖ It deals Anonymous Nature,

- ❖ It is not so much regaled,

- ❖ It holds the uniqueness of Full Transparency,

- ❖ It deserves proper and Distributed, etc.

As far as *Private blockchains* are concerned it is restricted and not open, and having restrictions in the access. In private blockchains, permission is essential for the transaction in every step, and in this regard, the system administrator plays an important role[10],[12],[27]. Private blockchain is performed with the internal networking system and featured with the following—

- ❖ Full of privacy,

- ❖ High efficiency,

- ❖ Faster transaction,

- ❖ Better scalability,

- ❖ Faster and speediness.

Another blockchain is called Hybrid Blockchain and it is a merger of the public blockchain and private blockchain, and it is required in controlling and achieving higher goal. Additionally, it contains centralized and decentralized features. Hybrid Blockchains are not open, and here important features are integrity, transparency, and security. Here additionally, Maximum customization treated as main benefits of the Hybrid Blockchains. Here blockchain may be both public (keeping rest part as confidential) and private network[9],[25]. Blockchain Technology deals with impactful features and services like—

- ❖ Medical and health related data is effectively sharable using blockchain technology.

- ❖ The areas of NFT marketplaces possible using blockchain technology.

- ❖ Regarding Music royalties tracking and development.

- ❖ It is useful in Cross-border payments with Real-time IoT operating systems.

- ❖ Personal identity security development including Anti-money laundering tracking system.

- ❖ Regarding sophisticated Supply chain management and monitoring

- ❖ Regarding proper logistics and development monitoring

- ❖ In election and voting system and mechanism

- ❖ Regarding Advertising and Digital Marketing

- ❖ Regarding creation of the original content and information creation

- ❖ For the proper and sophisticated Cryptocurrency development and exchange

- ❖ In real estate processing platform and systems[18],[19].

Blockchain technology is useful in different areas viz. Financial Services, Education and Training, Healthcare, Government and Administration, Travel and Hospitality, Retail, etc. And in healthcare and

medical segment IT applications are emerging and increasing as depicted in Fig. 2. For the promotion of Digital Healthcare systems.
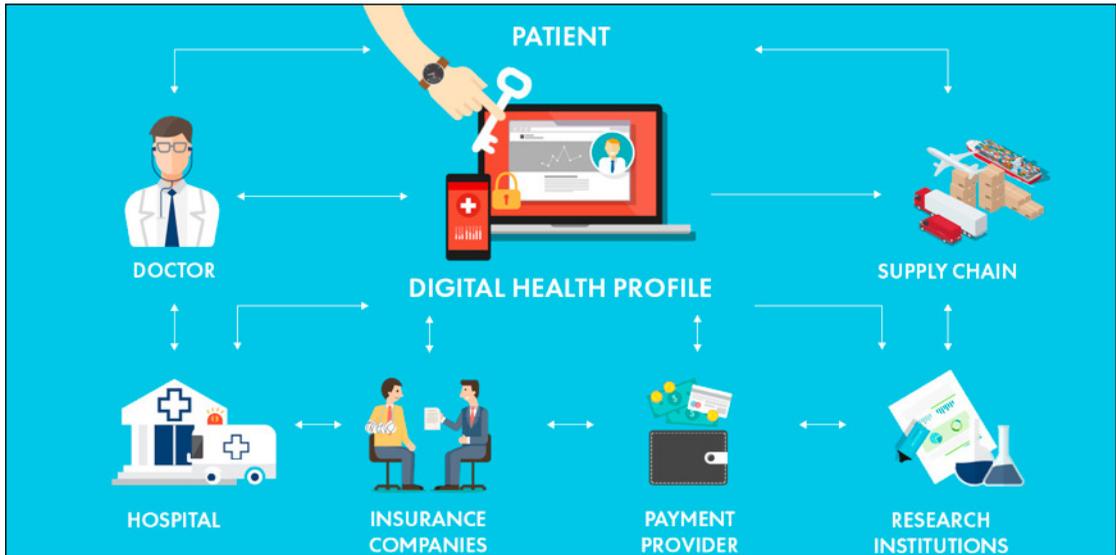

Fig. 2: Basic IT applications in Healthcare Sector

Blockchain Technology: Emergence and Significance in Healthcare Sector

Blockchain technology in the healthcare offers the variety of services and additional benefits. There are different problems of digital healthcare and that can be resolved with Blockchain technology. Among the potential solving issues important are care coordination, data security, as well as interoperability issues[15],[26]. Day by day medical and healthcare sector is growing and each day generating new data from different sources like medical records, test results of the diagnostic centre, finance and billing contents, healthcare monitoring from remote places, and so on. Blockchain technology is helpful in improving quality of data, protecting sensitive data from hackers, patient control, medical documentation, medical tourism management, and so on. There are several areas where Blockchain technology is effectively useful and among these important are *Electronic Health Records (EHRs)*. Interoperability, using blockchain nationwide interoperability of electronic health records becomes easy and possible. This ultimately helps to the patients' medical histories including current medications, furthermore prior imaging studies, etc. *Supply Chain Integrity* is another important feature of Blockchain in healthcare and medical systems. It is worthy to note that in every transaction of the medical systems this technology may be considered as fruitful and may results healthy drug manufacturers, wholesalers, pharmacists, and patients oriented services. Expert said that the secure drug supply can be considered as important. *Drug Development* is an important feature of Blockchain and can be treated as important in new drug development by making patient results more widely accessible. As far as *Smart Contracts* is concerned with the Blockchain advantages in medical domain and this can be used in creating rule-based protocols. Here patient with health insurance may be deemed as a prime example[4],[18]. There are different areas where Blockchain technology can be applicable and among these important are (as depicted in Fig. 3)—

Supply Chain Management and Transparency

In supply chain management and transparency systems Blockchain technology may be considered as important and useful. In the medical and healthcare systems supply chain management is important due to collection and distribution of different kinds of materials and systems uses in healthcare systems. Blockchain System can track the items from the root level even from the manufacturing stage. Day by day remote healthcare system is increasing and here this blockchain system can be useful in tracking healthcare systems. There are different kinds of supply chain systems and among these one of the important is MediLedger Systems. MediLedger comes with different advantages and similar features can be counted by any supply chain systems viz. Customer confidence, compliance, supply chain optimization, etc.[2],[11],[14]. Using blockchain customers can track different product details including manufacturers, shipping, compliances with medical device manufacturers. Proper and effective Blockchain technology is important in proper predict demand and optimize supply chain management systems.

In Patient-centric ICT enable health records

Healthcare Informatics is an important concern in digital healthcare system development and in this regard, various technologies are considered as valuable; and among these Blockchain technology considered as important and valuable. Healthcare systems in every country and region are struggling with intended or errors of omission in patient records[6],[16]. Medical records can be managed effectively like blockchain enabled EMRs.
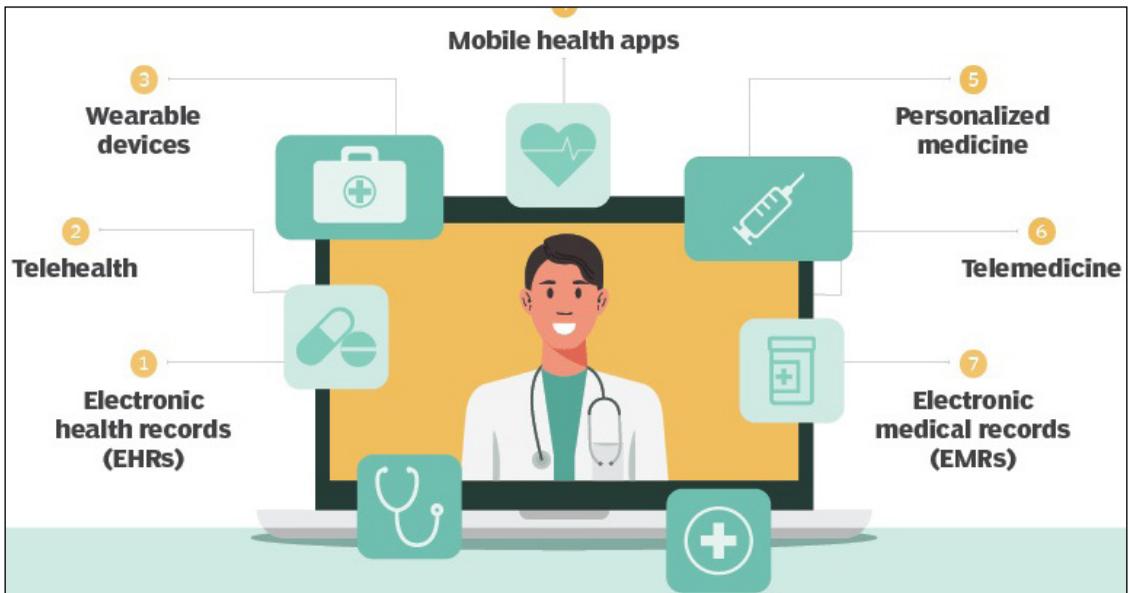

Fig. 3: Basic applications of Blockchain Technology in Healthcare Sector

Blockchain technology gives the opportunity in creating better experiences regarding patient medical records, creation of well managed healthcare systems. The transaction related data can be availed instantly using Blockchain[10],[17]. Medical insurance team can also get proper data and effective data with

the support of this technology. Patients can also choose to share their medical records (or part of their medical records) with researchers and set time limits on how long any third party can have access to their medical information. Medical insurers can receive immediate, validated confirmation of healthcare services directly from patients, without the time and cost of an intermediary. Apart from the developing blockchain-based medical records blockchain based system is required in developing a platform for the digital health solutions. Blockchain based system helps in virtual consultation service development including medical data exchange and digital health application development. Personalized medicine is an emerging system, and this is being supported by Blockchain systems[7],[19],[20]. As availability of quality data is an emerging issue therefore Blockchain technology is worthy and important.

In advancing smart contract regarding insurance and supply chain systems

There are number of companies increasing in smart contract regarding insurance of medical sector such as chronicled and curiosumand in this regard various players in healthcare sector plays an important role. In pharmaceutical companies, medical and instrument companies, etc. Blockchain is important and emerging. Blockchain technology is also able in tracking in medical professionals, and therefore it solves the issues in healthcare. In hiring process, transparency, emerging health care model delivery it is required.

Emphasis on Transactions

Blockchain technology is useful in developing healthy transaction systems in health and medical systems. Blockchain brings smart contracts and digital computer codes in the execution of the programs, functions or transactions[13],[21],[22].

CONCLUDING REMARKS WITH ISSUES AND FUTURE

Blockchain technology deals with several issues related to the technology, organization, and behavioral economics challenges. It also offers a reduction in complexity, helps in trustless collaboration, as well as immutable information. Healthcare Informatics is an evolving field and here government support is required to realize its full potential in health care. Regarding enhancing blockchain's future proper manpower development is also required. Blockchain technology is transforming the healthcare industry and that should be centralized, isolated, and small-scale systems. The quality of healthcare definitely increases using blockchain and it is further eliminates costly administrative inefficiencies. This brings a new paradigm with challenges minimization. Ultimately blockchain adoption in healthcare systems helps in proper developments in healthcare systems.

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