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BLOCKCHAIN ROLE IN THE HEALTHCARE SECTOR

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ABSTRACT

Since blockchain was introduced through Bitcoin, exploration has been ongoing to extend its operations tonon-financial use cases. Healthcare is one assiduity in which blockchain is anticipated to have significant impacts. Research in this area is fairly new but growing fleetly; so, health informatics experimenters and interpreters are always floundering to keep pace with exploration progress in this area. This paper reports on a methodical review of the ongoing exploration in the operation of blockchain technology in healthcare. The exploration methodology is grounded on the Preferred Reporting particulars for Methodical Reviews and Meta- Analysis (PRISMA) guidelines and a methodical mapping study process, in which a well- designed hunt protocol is used to search four scientific databases, to identify, prize and dissect all applicable publications. The review further highlights the state- of- the- art in the development of blockchain operations for healthcare, their limitations and the areas for unborn exploration. To this end, thus, there's still the need for further exploration to more understand, characterize and estimate the mileage of blockchain in healthcare.

Keywords: blockchain, healthcare, Bitcoin.

1.INTRODUCTION:

Blockchain gained fashion ability as a distributed tally technology following the Bitcoin white paper published in October, 2008(1). As the underpinning technology for Bitcoin, the main mileage of blockchain is that it makes possible the exchange of electronic coins among actors in a distributed network without the need for a centralized, trusted third party. Deals involving the exchange of electronic currencies between persons or companies have traditionally reckoned on a trusted third party(TTP), similar as a bank, as a middleman. The reliance on a TTP isn't desirable for a number of reasons. A trusted third party may malfunction, fail or be compromised virulently to render the fiscal system unapproachable or insecure; therefore, a TTP undermines a system potentially as a single point of failure. A TTP also charges sale freights and adds some sale detainments. The provocation behind Bitcoins is, thus, to overcome these limitations associated with the reliance on TTP in electronic deals. A time after the publication of the notorious white paper on Bitcoin, the Bitcoin cryptocurrency was enforced, with the law released as open-source, which made it possible for others to modify the law and ameliorate on it to produce different generations of blockchain- grounded technologies.

The first executions of blockchain- grounded cryptocurrencies, similar as the Bitcoin, constitute the first generation of blockchain technology, which is also appertained to as blockchain1.0(2). Other blockchain technologies include Monero(3), gusto(4) and Litecoin(5), to name a many. The alternate generation of blockchain technology(blockchain2.0) is associated with the preface of smart parcels and smart contracts (2). The smart parcels are those digital parcels or means whose power can be controlled by a blockchain- grounded platform, while the smart contracts are the software programs that render the rules of how the smart parcels are controlled and managed. exemplifications of blockchain2.0 cryptocurrencies include Ethereum (6), Ethereum Classic (7), NEO (8) and QTUM (9). structure on the below, the third generation of blockchain technology(blockchain3.0) is now concerned with thenon-financial operations of blockchain (2). To this end, sweats have been made to acclimatize the technology to other operation areas, outside finance, so that other diligence and use cases can profit from the intriguing features of blockchain.

Accordingly, blockchain is now considered as a general-purposetechnology (10,11) that has set up operations in different diligence and use cases, similar as identity operation, disagreement resolution, contract operation, force chain operation, insurance and healthcare, to name a many (10,12). With the growing seductiveness for blockchain and its relinquishment in different associations and diligence, healthcare has come to represent a significant area where a number of use cases have been linked for the operation of blockchain. still, blockchain being a fairly new technology and with a lot of hype in the press as well as in slate publications in the form of opinion pieces, narrative, blog posts, interviews,etc., there's a lot of inaccurate information, enterprises and misgivings about the implicit mileage of blockchain in the healthcare assiduity. Members of the exploration community and interpreters would want to understand the specific areas of operation or use cases of blockchain in the healthcare assiduity; and of these linked use cases, what blockchain- grounded healthcare operations have been developed? What are the challenges and limitations of the blockchain- grounded healthcare operations, how are these challenges presently being addressed and what are the areas for enhancement?

This paper reports on the methodical review that's conducted to address the below questions. While there live some intriguing reviews in the literature that are related to this content (13 – 17), ours is different in terms of the methodology and the objects. In the review conducted by Angraaletal. (13), they identify some exemplifications of the operation of blockchain technology in healthcare. These include the Guardtime, an establishment which operates a blockchain- grounded healthcare platform for the confirmation of cases' individualities for the citizens of Estonia; and the MedRec design, which was created to grease the operation of warrants, authorization and data sharing between healthcare realities. also, Engelhardt (14) outlines a collection of 'noteworthy' exemplifications of blockchain technology companies in the healthcare sector.

These companies are grouped under different healthcare use cases, videlicet; tradition medicine fraud discovery, case- centered medical records and the dental assiduity. This review is inversely analogous to the one conducted by Mettler (15) where he reports some exemplifications of blockchain- grounded operations and companies in the areas of public health operation, medical exploration and medicine counterfeiting in the pharmaceutical assiduity. On their part, Ku etal. (16) publishes the crucial benefits of blockchain when compared to traditional databases for healthcare operations.

2.METHODOLOGY:

In conducting and reporting this review, we espoused the guidelines for methodical literature review (18) and the process for methodical mapping study (19), as well as the guidelines described in the PRISMA statement (20). As explained in (19), the thing of a methodical mapping study is to get an overview of the exploration area, and to round this by probing the state of substantiation in specific motifs. In this case, the results of the mapping study would help us to identify and collude the blockchain use cases in healthcare, and to understand the extent to which blockchain- grounded operations have been developed in relation to the linked use cases. They would also help us to identify areas of possible exploration gaps. The methodical review would again enable us to probe the current trends in terms of the specialized approaches, methodologies and generalities employed in developing blockchain-grounded healthcare operations. In what follows, we go through the methodical mapping process as shown in Figure 3.

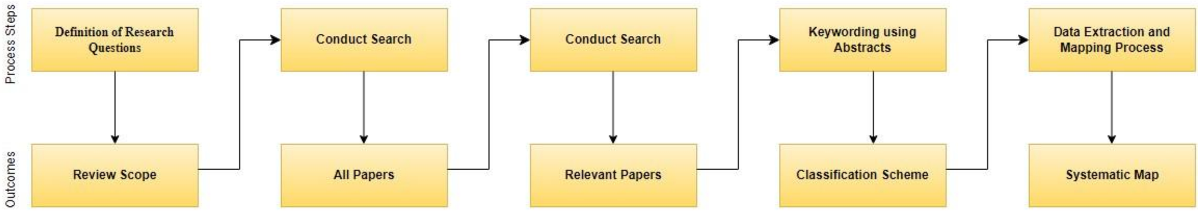

Figure 1. The systematic mapping process steps.

2.1. Description Of Exploration Questions:

As the first process step in the methodical mapping study, we defined the following four exploration questions in line with our ideal which is to unravel the state- of- the- art in exploration on the operation of blockchain technology in healthcare.

2.1.1. Use Cases of Blockchain in Healthcare?

The primary question in this exploration is to understand the different areas of healthcare that blockchain has been shown to find operation. By reviewing the applicable papers from scientific databases, we're be suitable to identify what healthcare problems that blockchain can break, and by so doing, insulate those problems which are more answered using other ways. Given the delirium in the media in which a lot of problems are supposed soluble by blockchain, a chart of problem disciplines in healthcare in which blockchains are applicable will help experimenters and interpreters to concentrate their interest on those promising areas of blockchain operation in the assiduity.

2.1.2. Of The Linked Use Cases, What Blockchain- Grounded Operations Have Been Developed?

Numerous areas of operation of blockchain have been proposed in scientific literature. still, not all of these proffers have been restated into working prototypes. It's thus important to understand the extent of real- world executions of blockchain- grounded healthcare operations in relation to the linked use cases. This will help to punctuate areas where there are exploration gaps and the need to shift exploration focus to these areas.

2.1.3. What Are the Challenges andLimitationsof The Blockchain-Grounded Operations?

This question seeks to understand the challenges facing the executions of blockchain-grounded healthcare operations. Grounded on the prototype operations that have been developed,

2.1.4. How Are These Challenges and Limitations presently Being Addressed?

This exploration question seeks to understand the approaches taken to develop blockchain-grounded healthcare operations with a view to guiding unborn systems, so that there will be no need to resuscitate the bus. Since the first blockchain perpetration inBitcoin cryptocurrency, several variations and advancements have been made to the technology to make it adaptable tonon-financial use cases.

2.1.5 Open Research Issues and the Areas for Future Research?

This exploration question looks at the current trends in terms of the specialized approaches and methodologies that are employed in developing blockchain- grounded operations for healthcare. The last question addresses the issues for unborn exploration. relating exploration gaps and the challenges in the field will help experimenters to streamline their unborn exploration to concentrate on addressing these exploration gaps and challenges. Keywording on the Base of the Abstract This process step was intended to collude the applicable exploration papers in the literature into orders.

3. OVERVIEW OF BLOCKCHAIN:

The detailed specialized underpinnings of the blockchain technology are outside the compass of this paper. still, for the purpose of our discussion going forward, it's important to exfoliate light on some blockchain generalities, features and languages that will foster the understanding of how blockchain is applied to break healthcare problems. maybe, the most egregious and outstanding benefit of blockchain is the fact that it removes the need for a centralized trusted third party in distributed operations. By making it possible for two or more parties to carry out deals in a distributed terrain without a centralized authority, blockchain overcomes the problem of single point of failure which a central authority would else introduce. It also improves sale speed, by removing the detention introduced by the central authority, and at the same time, it makes deals cheaper since the sale freights charged by the central authority is removed. In place of a central authority, blockchain uses an agreement medium to attune disagreement between bumps in a distributed operation. In Figure 1a, there are multiple checks but all the records are held in one central place, in this case, the Regional Health Information Organization (RHIO). In substance, the RHIO maintains the state of the tally. When there's a disagreement between two bumps about the “truestate” of the tally, the RHIO is consulted as the final arbitrator to determine the “truestate” of the tally. On the negative, in Figure 1b, there is only one tally, but all the bumps have a dupe of the tally and some position of access to its contents. To maintain the integrity of the tally, the bumps must have a means to agree on the “truestate” of the tally, in the absence of a central authority. When the bumps agree on a particular “truestate” of the tally, it's appertained to as agreement. The different ways in which agreement is achieved in blockchain will be explained in the remaining part of this Section.

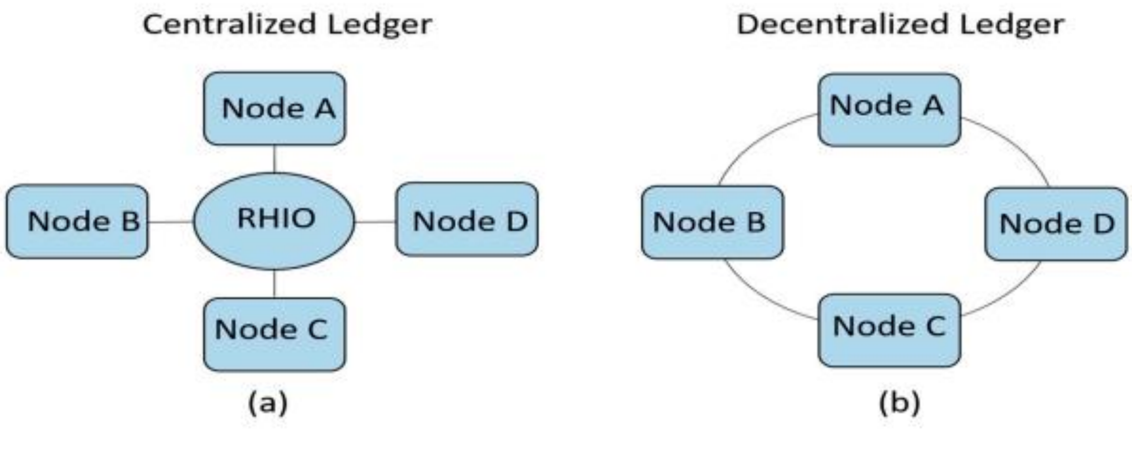

Figure 2. Centralized. Decentralized System. In(a), there are multiple checks but all records are held in RHIO, whereas in(b), there's only one tally but every knot has some position of access to that tally. The decentralized armature removes the need for trusted third party, makes deals briskly, and removes the sale freights charged by the trusted third party (RHIO).

In addition, the invariability property of blockchain which makes it insolvable to alter or modify any record that has been added to the blockchain aligns veritably well with the conditions for storing healthcare records it is veritably important to ensure the integrity and validity of cases' health records. What's further, the use of cryptographic algorithms to cipher the data stored on the blockchain ensures that only the druggies who have licit warrants to pierce the data can decipher them, thereby perfecting the data security and sequestration. likewise, since the individualities of the cases in a blockchain are pseudonymized through the use of cryptographic keys, the health data of cases may be participated among healthcare stakeholders without revealing the individualities of the cases. Blockchain also supports smart contracts (2) that can be used to program the rules that allow the cases to be in control of how their health records are participated or used. This is particularly applicable to the European General Data Protection Regulation (GDPR) which prohibits the processing of sensitive particular data of cases unless unequivocal concurrence is given, or specific conditions are met (26). thus, blockchain can grease the development of a GPDR- biddable EMR operation system, by garbling in the smart contract a set of rules that ensure that cases' sensitive data cannot be participated or used without applicable authorizations. The implicit benefits of blockchain to healthcare operations are added up in Table 1.

Decentralization	The veritably nature of healthcare, in which there are distributed stakeholders, requires a decentralized operation system. Blockchain can come that decentralized health data operation backbone from where all the stakeholders can have controlled access to the same health records.
Advanced data security and sequestration	The invariability property of blockchain greatly improves the security of the health data stored on it, since the data, formerly saved to the blockchain cannot be corrupted, altered or recaptured. All the health data on blockchain are translated, time- stamped and added in a chronological order. also, health data are saved on blockchain using cryptographic keys which help to cover the identity or the sequestration of the cases.
Health data power	Cases need to enjoy their data and be in control of how their data is used. Cases need the assurance that their health data aren't misused by other stakeholders and should have a means to descry when similar abuse occurs. Blockchain helps to meet these conditions through strong cryptographic protocols and well- defined smart contracts.
Vacuity/ robustness	Since the records on blockchain are replicated in multiple bumps, the vacuity of the health data stored on blockchain is guaranteed as the system is robust and flexible against data losses, data corruption and some security attacks on data vacuity.
translucency and trust	Blockchain, through its open and transparent nature, creates an atmosphere of trust around distributed healthcare operations. This facilitates the acceptance of similar operations by the healthcare stakeholders.
Data verifiability	Indeed, without penetrating the plaintext of the records stored on blockchain, the integrity and validity of those records can be vindicated. This point is veritably useful in areas of healthcare where verification of records is a demand, similar as pharmaceutical force chain operation and insurance claim processing.

Table 1. Benefits of blockchain to healthcare operations.

4. CONCLUSION:

Blockchain technology has evolved from the time it was introduced to the world through Bitcoin into a general- purpose technology with use cases in numerous diligences including healthcare. To understand the state- of- the- art of the operation of blockchain technology in healthcare, we conducted a methodical review in which we created the chart of all applicable exploration using the methodical mapping study process (19). Specifically, the objects of the study were to identify the blockchain technology use cases in healthcare, the illustration operations that have been developed for these use cases, the challenges and limitations of the blockchain- grounded healthcare operations, the current approaches employed in developing these operations and areas for unborn exploration. Our hunt and paper selection protocol produced 65 papers which we anatomized to address the exploration questions. Our study shows that blockchain has numerous healthcare use cases including the operation of electronic medical records, medicines and pharmaceutical force chain operation, biomedical exploration and education, remote case monitoring, health data analytics, among others. A number of blockchain- grounded healthcare operations have been developed as prototypes grounded on arising blockchain paradigms, similar as smart contracts, permissioned blockchain, off- chain store house, etc. still, further exploration still needs to be conducted to more understand, characterize and estimate the mileage of blockchain technology in healthcare. farther exploration is also demanded to condense ongoing sweats to address the challenges of scalability, quiescence, interoperability, security and sequestration in relation to the use of blockchain technology in healthcare.

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