A Review of Blockchain Technology:

For Modern Industry and Society

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APPROVAL

This Thesis titled **"A Review of Blockchain Technology: For Modern Industry and Society",** submitted by **"Bishwajit Saha"**, ID No: **215-25-051** to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of M.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on **21-09-2022**.

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I, hereby declare that, this project has been done by me under the supervision of **Ms. Nazmun Nessa Moon, Associate Professor, Department of CSE,** Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

Nowadays blockchain is the most innovative and groundbreaking technology in tech era. Information is store in a chain of blocks in blockchain and this storage is decentralized with distributed network. This paper aim is to a review of how blockchain work in intelligent manner for modern industry and society. Blockchain is a decentralized transaction and data management technology industrialized first for Bitcoin cryptocurrency. The attention in Blockchain technology has been growing since the idea was invented in 2008. This review objective is to understand the current research topics, challenges and future directions regarding Blockchain technology from the technical perspective.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Nowadays blockchain is regarded as a game changer with other development technologies such as artificial intelligence, autonomous vehicles, cloud computing. Many experts believe that the blockchain revolution has the potential to disrupt many sectors of commerce and our society as a whole. The private and government sectors have high expectations of blockchain technologies. These technologies deliver the foundation of peer-to-peer mechanism for digital information and transaction without the intermediaries. Blockchain has the ability to change many commercial fundamental and expend the control of authority [1]. Blockchain technology has fueled the crypto-currency Bitcoin. This is a decentralized framework for transactions, where all transactions are documented in a public ledger, which everyone can observe. Providing unrecognizability, safety, confidentiality and transparency to all its customers is what Blockchain is all about [2].

1.2 Motivation

During the last decade, the focus on Blockchain technology has been dramatically increased since 2013. The increase in articles went from 2 in 2013 to 41 in 2015 [2]. Also improve more Blockchain-based applications over and above Bitcoin and other crypto-currency schemes. Bitcoin system is currently oriented research; but research also shows that Blockchain technology can be applied to other alternatives such as smart healthcare system, smart energy distribution system and financial system.

1.3 Rational of the study

In this paper has generally examined the significance of blockchain in industry and society. How it has adequate potential to restructure the commercial organization. Using blockchain diminishes risks, costs, the likelihood of cyber-attacks in organizations, and the ability to

accurately audit organizations. Also merely deliberated the usage of blockchain in commercial application is very anticipated and appropriate, because of its features. This sustainability in the industry can be achieved thanks to the presence of secure blockchain. This technology has the potential to provide a variety of benefits to both the existing industrial system and society. Blockchain can raise the swiftness and competence of operation, enhance the operation period and networks record, minimize commercial fees and increase the prospective opportunities for access to the financial market. Today, we still do not have comprehensive regulations for cryptocurrencies and Bitcoin.

1.4 Research Questions

- ❖ Why we would embrace the blockchain for the future?
- ❖ What will be the effects in our society and industry to implementation of blockchain?
- ❖ What are the current applications developed with and for blockchain?
- ❖ What are the future research directions?

1.5 Expected Output

This review provides a technical insight into blockchain technology. It examines various categories of delivery approaches. It deals with elements of blockchain technology and delivers illustrations and instances to the extent possible. It addresses, on a high level, certain consensus patterns used in blockchain networks. It also delivers an overview of how blockchain technological shifts are affecting industry and society. It provides details on how blockchain technology overloaded beyond demonstrable deals to include attested application methods known as smart contracts. It also draws on some of the frontiers and falsehoods around technology. Lastly, this paper outlines certain aspects that institutions should consider when considering blockchain technology.

1.6 Report Layout

Chapter 01: consist introduction of thesis work, motivation of this review, rational of the study, research queries and predictable output.

Chapter 02: will be briefly talked about background of blockchain, related works is includes few work of researchers, research summary, scope of the difficult and challenges.

Chapter 03: is research methodology and here describes of research subject, data collection procedure, statistical analysis and implementation requirements.

Chapter 04: is experimental results and discussion and this chapter contain experimental results, descriptive analysis and summery of this chapter.

Chapter 05: contain summary of the study, conclusions, recommendations and implication for advance study.

BACKGROUND

2.1 Introduction

A blockchain is a chain of blocks which can be used to collection and share data in a distributed, transparent and damage-resisting mode. Every block contains data and is connected to the remaining blocks by pointers. These connections provide veracity and resistance against tampering in the blockchain. The link to the free end is created that stretches the blockchain through a block or unit when a new record is added to the blockchain. Figure 2.1 presented the basic blockchain-based architecture.
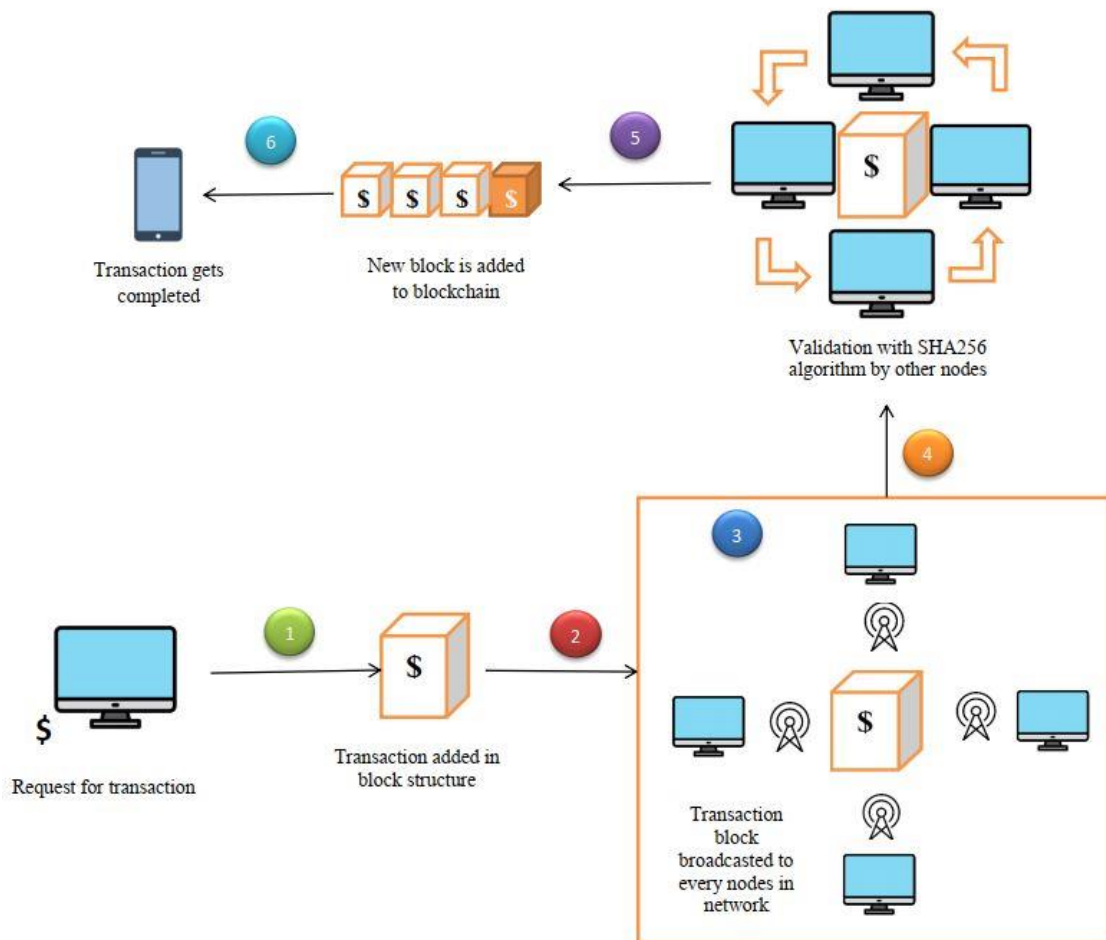
Figure 2.1: The basic blockchain-based architecture

Since more data is added to the blockchain, it becomes longer and the string increases in size. It shatters cryptographic links that disrupt the entire blockchain, whether any of the blocks are changed in the string. In addition, it allows the user to authenticate the integrity of the information in storage [3]. Blockchain technology provides resources for harmless and protected transactions without the need to trust a third party. That blockchain concept is known as "trustlessness" while every contributor to a transaction can have confidence in the correctness and truthfulness of the document; trust between the parties is not an obligation [4].

Blockchain is a peer-delivered ledger technology that was primarily used in the commercial sector. The blockchain is a chronological record of communications confirming the truthfulness of the info included, may be used for capturing and recording both requests and their communicative responses. Blockchain 2.0 brings the idea of smart contracts, it is no longer restricted to cross-currency transactions, and more detailed instructions will be built into the block chain. The smart contract does not require a joint trust, because it is not simply well-defined by the code, but performed by the code. Moreover, it is entirely automatic and cannot be interfered with [5].

Store the information of transactions which is similar to a public ledger in a sequence of blocks in the blockchain. Those blocks are linked together with a reference hash that belongs to the preceding block known as the parent block. The genesis block is the introductory block and it haven't parent block. A header and a body hold in a block [6]. The block header contains metadata such as block version, parent block hash, Merkle tree root hash, timestamp, nBits, and nonce as shown in Table 2.1 and Figure 2.2.

Table 2.1: Block header attributes.

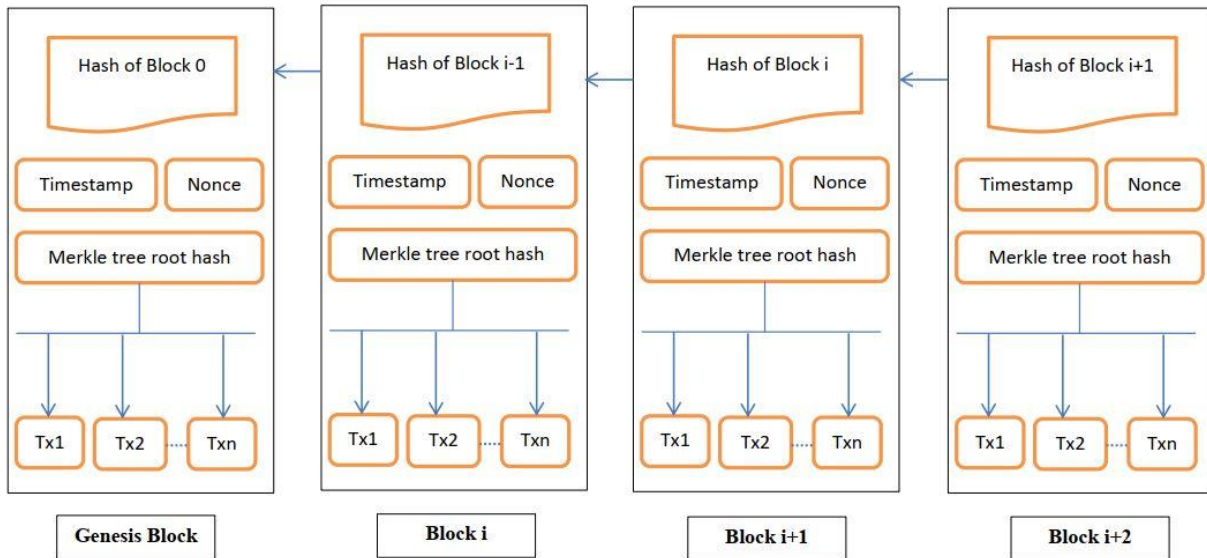| Header Attributes	Definition
Block Version	Set of block validation rules
Previous Block Hash	Points to the previous block
Merkle tree root	Hash value of all the transactions
Timestamps	Seconds
nBits	Compact format
Nonce	A 4-byte field

Figure 2.2: Block structure

Permissioned and permission-less are the types of blockchain technology. Public blockchain is permission-less and publicly accessible for users. Users can download the blockchain code into their personal systems or modify it and implement as their requirements [7]. Also it is easily accessible and open to read and write to all users on the network. These public blockchain is using complex protocols for security and consensus mechanisms. Public blockchains are hugely accepted for their immense decentralization and openness. A transaction on public blockchain need to approved 10 minutes or more depends on the number of users in the network and the mathematical complexity of using for consensus algorithms.

2.2 Related Works

Tomaso et al. [1] provides elementary ideas about Blockchain and presents our perspective on the contests, future opportunities and likely impact of the Blockchain and ledger tools distributed across industry and society. Of course describes the root of blockchain technology and Bitcoin crypto-currency to contemporary applications. Moreover, they discussed future implementation of Blockchain in our society with the flaws and hazards.

Dylan et al. [8], their main determination is the easy way to understand blockchain technology. Also described how this technology are temper evident and resistant with distributed ledgers and absent of an intermediary. In a community all of users can shared the ledger and record transactions also transparent. No transaction is possible to alter after issuing in a blockchain network. A sophisticate paper of blockchain technology is derived by them.

Umesh et al. [3] describes as the technologies are boosting in last few decades and dramatically raise the applications in many sector from farming to energy grids and healthcare to trade. But, all of the applications are still in a concern of the security and privacy. Blockchain technology will be the right solutions regarding the concerns as writers suggest. A systematic review with blockchain-based solutions is presented in this paper. They also explored the current up-to-date explanations in the blockchain technology to the uses.

Ahmed et al. [9] said that most of crypto-currencies fundamental is blockchain technology. Digital signatures with the information are stored in blocks which are formed in a chain and it all in decentralized with distributed network. Few features of blockchain are transparency, decentralization and safer-tamper-proof transactions. Alongside crypto-currency blockchain is now implemented in social services, healthcare facilities and voting etc. They also present the taxonomy and architecture of blockchain and deliberate few challenges such as power consumption.

2.3 Research Summary

Blockchain, only authorized users could do transaction and read or validate the entries [10]. In this review paper understand the clear picture of blockchain and find out the effecting sector where it can be utilize for better future. The feature of blockchain make it more robust to implementation in secrecy applications where minimize the contemporary threats. Additionally, the blockchain technology deals with the safe and secured storage which is the useful to the industry as well as society. The raise of users trust in the blockchain is the key point to implementation in various sector in our society will be justify.

2.4 Scope of the Problem

Blockchain technology is a quite new technology in the field of tech era. Not frequently used in practical manner but few of crypto-currency are fueled by this technology. Most of papers are theoretical proposal not in current operation in the applications.

2.5 Challenges

My aim is to this review paper to understand the contemporary research in where should we implementing this technology with a great change manner. At the beginning of work I have collected 47 papers from publications as a source. But most of papers are regarding crypto-currency or Bitcoin system. Few of papers are well describes of the future opportunity to blockchain technology for the modern industry and society.

CHAPTER 3

REASEARCH METHODOLOGY

3.1 Introduction

The research methodology for this review paper is systematic mapping study. Primarily the aim of a systematic mapping study is to deliver an overview of a research area, research evidence and count the amount of evidence. The main reason to choose the systematic mapping process is explore the current studies on blockchain technology. The outcome would help us to identify research areas related to blockchain technology. The process for the systematic mapping study is presented in Fig 3.1.
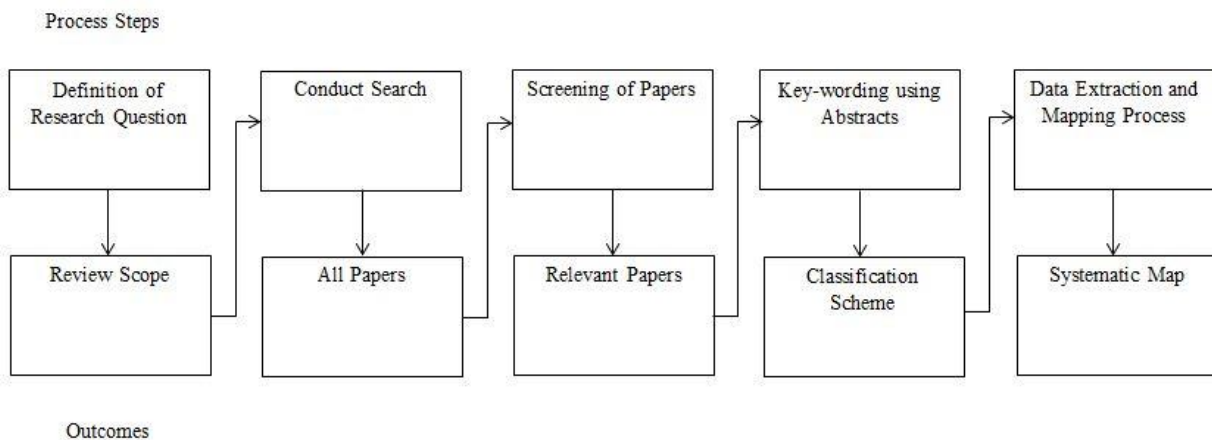
Process Steps

Definition of Research Question	Conduct Search	Screening of Papers	Key-wording using Abstracts	Data Extraction and Mapping Process
Review Scope	All Papers	Relevant Papers	Classification Scheme	Systematic Map

Outcomes

Figure 3.1: The Systematic mapping process

3.2 Research Subject and Instrumentation

Research subject and instrumentation of this paper are below:
- A basic understand of blockchain technology.
- A clear picture of future implementations in our industry and society.
- An ultimate image of benefits from this technology to our life.
- Lastly, the challenges in industry and society to the execution of this technology.

3.3 Data Collection Procedure

Definition of the research questions is the first stage of the systematic mapping process. Therefore, here defined the research questions bellow:

❖ **Why we would embrace the blockchain for the future?**

Distributed ledger technology (DLT) and tamper-resistant transactions are a few of characterized of blockchain technology. This element gives security, privacy and trust to industry and society by implementing blockchain in applications.

❖ **What will be the effects in our society and industry to implementation of blockchain?**

The main concern of this paper is why and how we would to implementing blockchain in applications which will change our society as well as industries.

❖ **What are the current applications developed with and for blockchain?**

Bitcoin is the most know for blockchain but we can develop with and for blockchain to other domains in our industry. Firstly, find out the current developed applications which are implemented blockchain and the opportunities to future directions.

❖ **What are the future research directions?**

What issues require to be solved and where the research on blockchain should be directed are the future research directions of blockchain technology.

Not all papers are directly connected with research questions but they required to be evaluated for their significance. Screening of the papers is the next phase of the procedure. In the screening phase title of the papers are observed firstly then find out the research questions in description. On the other hand, in some cases hard to determine the importance of papers ground of the title.

Few papers need a full concentration for find out the significance of relevancy to research questions.

3.4 Statistical Analysis

The search and selection process is presented in Fig 3.2. Initially 47 papers collected from research database and most of papers are regarding Bitcoin. Selection by title is the next process of selection then duplication removal. Finally abstract and full paper reading are the chose for final primary papers to review.
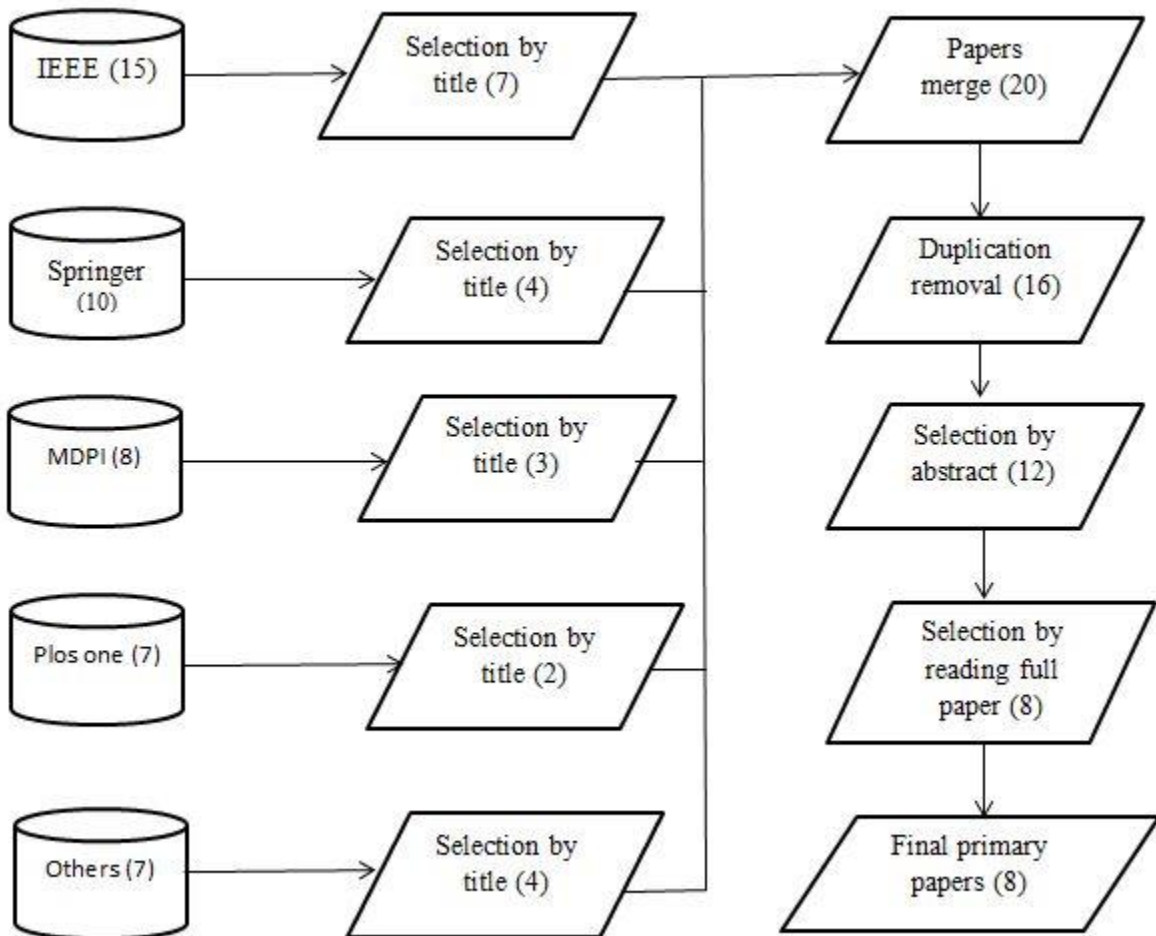

Figure 3.2: Search and selection process of the papers

Fig 3.3 shows the publication year distribution of the selected papers for review. I tried to select papers from recent years; 4 papers (50%) in 2019. Fig 3.4 shows the publisher or source where I get the papers to selected; 3 papers (38%) from IEEE and rest of from Springer, MDPI, Plos one, NIST and Kings College London.
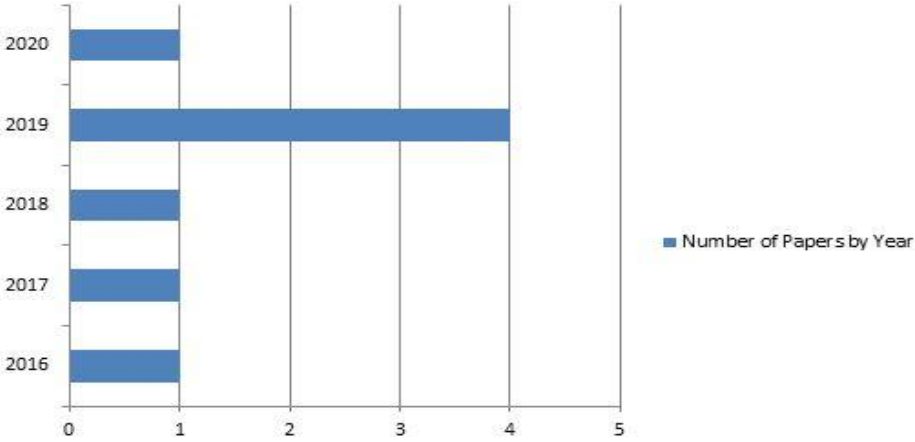

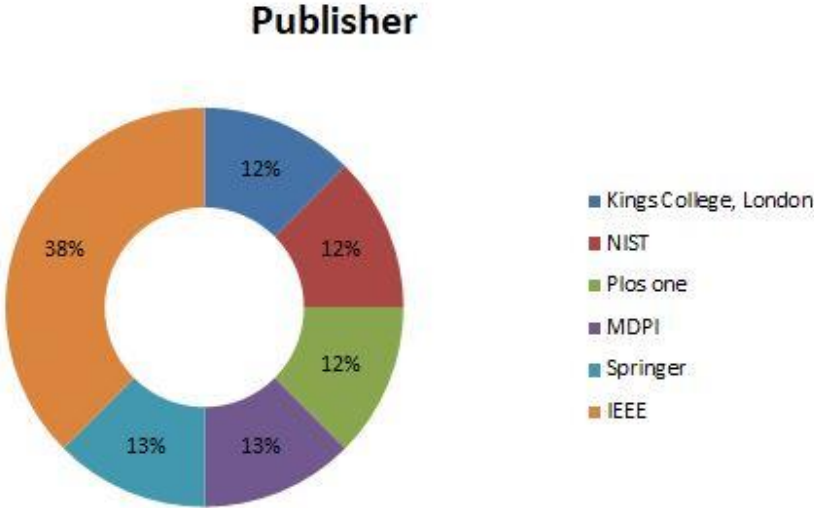Figure 3.3: Publication year and number of papers

Figure 3.4: Source of the papers

In this part discussion will be reflect of existing few paper of blockchain that what kind of methodologies they applied and how they are collected the information for their research. Few of blockchain papers are distinguish by the research methodology and key features with table 3.1 below:

Table 3.1: Summary of the reviewed papers in blockchain

Papers	Research methodology	Key features
Tomaso et al.	Conceptual	Theoretical proposal
Jesse et al.	Conceptual	Literature review based analyses
Umesh et al.	Conceptual	Literature review based analyses
Xudong et al.	Empirical	Computational analyses
Dylan et al.	Conceptual	Theoretical proposal
Ahmed et al.	Empirical	Computational analyses
Rathore et al.	Empirical	Computational data empirical analyses
Pronaya et al.	Empirical	Computational analyses

CHAPTER 4

EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Introduction

Many blockchain systems are developed to focus the service deliveries to the society and industry. Blockchain technology and IoT together game changer to the modern industry. Collecting real time data and preserved for usability, the ultimate pleasure of user's satisfaction are the main target to implementation of blockchain in our society [11].

4.2 Experimental Results

The detailed taxonomy of blockchain deployment in real-time applications such as healthcare, smart city, energy, supply-chain & logistics, manufacturing, agriculture, business, digital content distribution, IoT, and tourism & hospitality is shown in Figure 4.1.
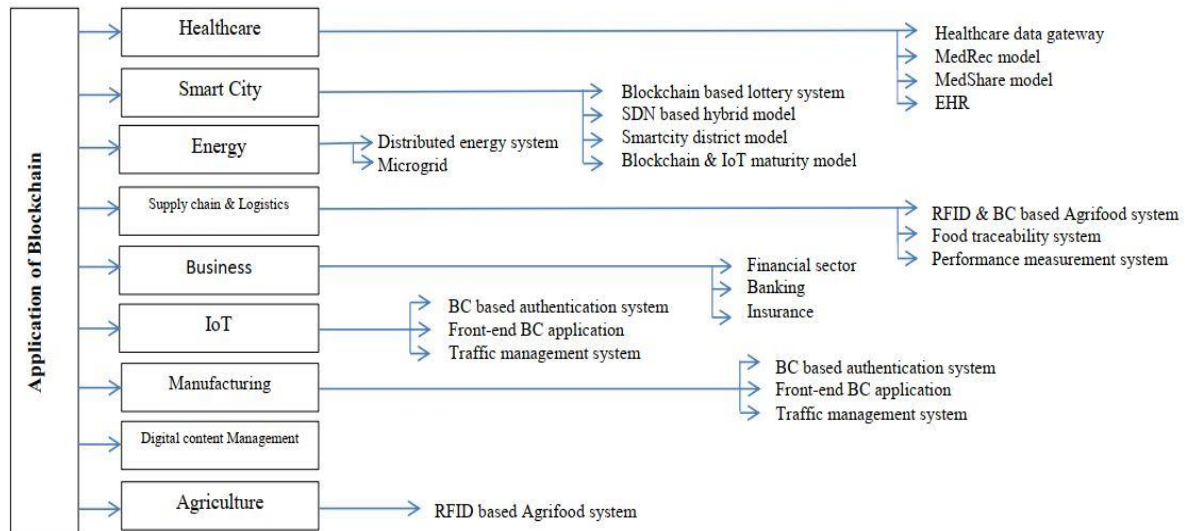

Figure 4.1: Taxonomy of Blockchain for industry

4.3 Descriptive Analysis

Many people are believed that blockchain is bitcoin; instead, bitcoin is the most successful applications of blockchain technology [12]. Bitcoin is digital crypto-currency and build with an open and public blockchain network. Several applications are developed with blockchain technology. However, many experts wants to implemented this technology in different domains, such as supply chain management, voting , law enforcement agency and many more. At the moment blockchain is in the early stage. Figure 4.2 represents few application domains of blockchain.

Figure 4.2: Application domains of Blockchain technology

Deployment in Healthcare

Many healthcare solutions implement the blockchain for their managing client's data, to support the patients, medicine tracking and the data shared securely by both stakeholders and many more. Several blockchain systems updated the healthcare system for the better facilities to the patients. Figure 4.3: represents a blockchain and IoT together fueled the healthcare with well-organized and proper data management.
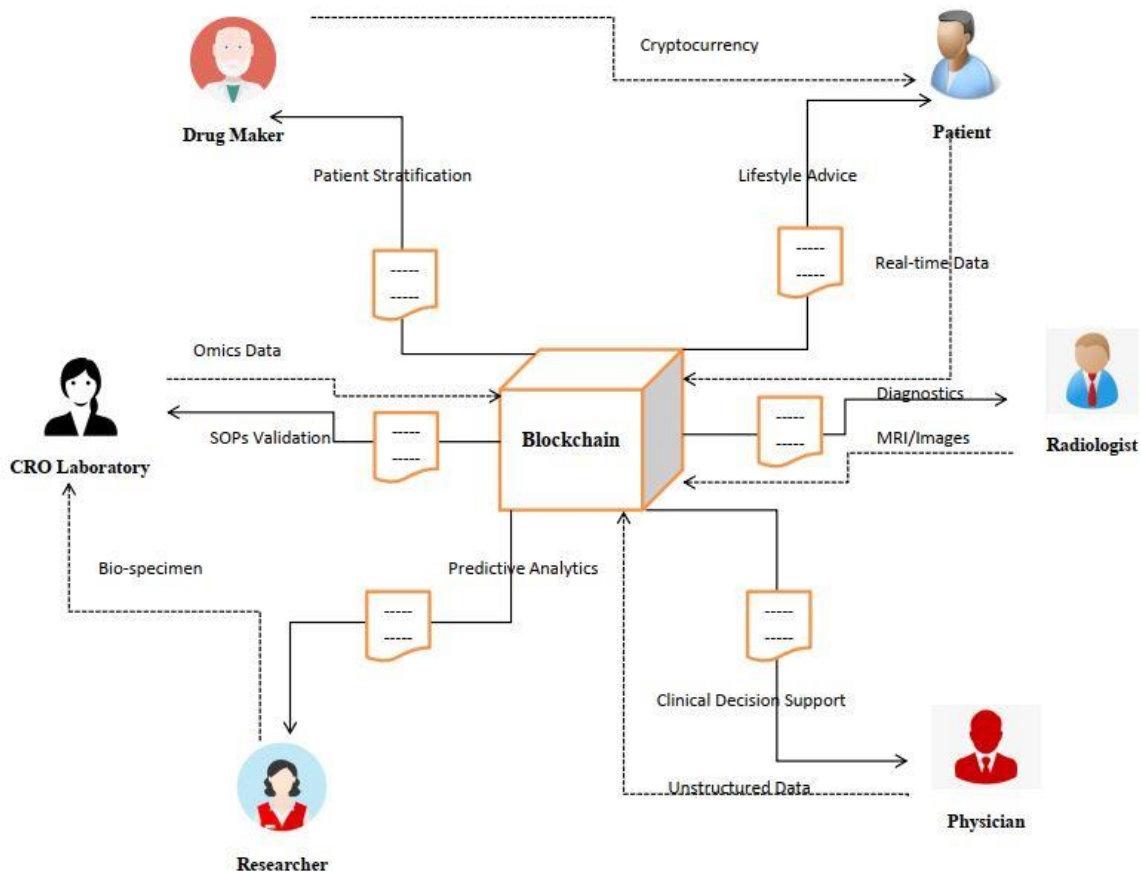

Figure 4.3: Blockchain as platform for healthcare

Bhattacharya et al. propose a system called BinDaaS (Blockchain-Based Deep Learning as-a-Service). Blockchain and deep-learning methods are implemented in this system for distributed EHR records in stakeholders. At the beginning of operation an authentication and signature

assigned built on lattices cryptography. Deep Learning as-a-Service (DaaS) is set for EHR for forecast the diseases based on recent concern and the past history of the patient. The obtained results are associated with few factors such as timing, correctness and costing [13].

Deployment in Energy

Mohamed et al. suggest a smart grids called DeepCoin which is based on deep learning and blockchain technology. Used two preparations for this DeepCoin framework one of blockchain-based and other is deep learning-based. Part of blockchain consists of five phases such as setup, agreement, generating a block, consensus-making and view-change. Byzantine fault tolerance algorithm is applied for reliable peer-to-peer energy system. Avoiding the possible threats the proposed system are consist short signatures and hash functions in generating blocks. IDS (intrusion detection system) are based on deep learning which is identifying network attacks by neural networks [14]. Fig 4.4 shows the blockchain-based smart grids.
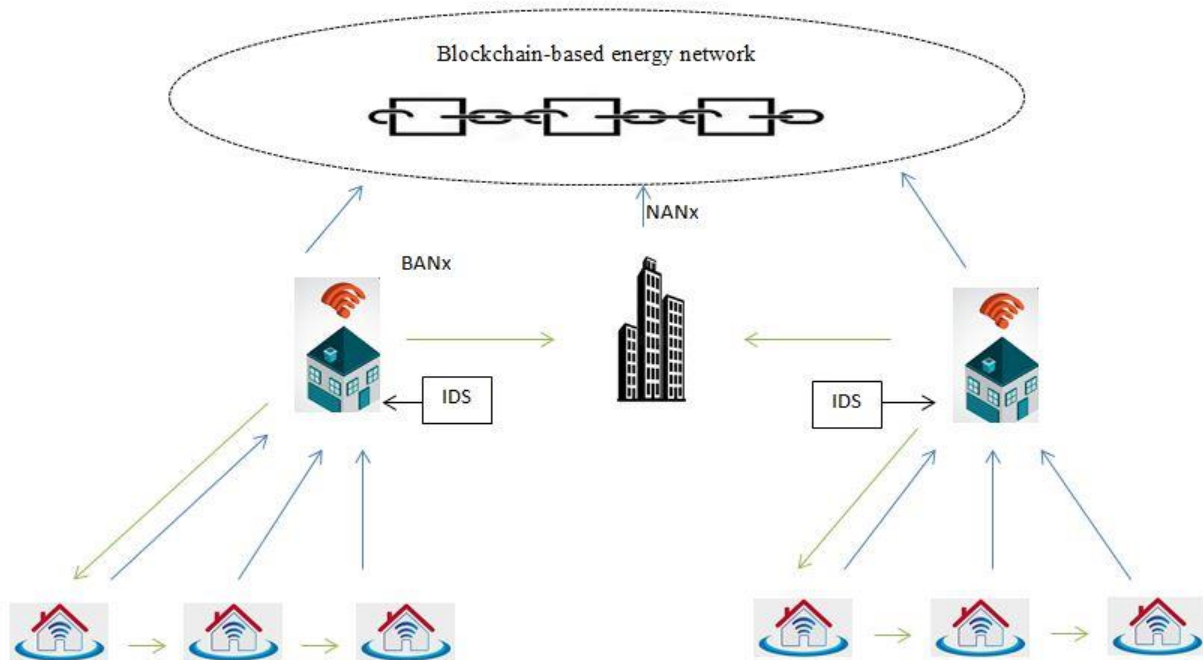

Figure 4.4: Blockchain for smart-grids

Deployment in Finance

Bitcoin is a digital crypto-currency which is the most secured and distributed oriented. Blockchain technology is the fundamental of this idea and this transactions are decentralized. All users maintain a distributed ledger with authenticating a new transaction. An authentic user have the right to change the distributed ledger after an effective transaction. Hash functions are utilize for blockchain, data integrity, privacy in all transactions [3].

4.4 Summary

Security and ability will be the key points for the future of the blockchain technology. Shared ledger, consensus, provenance, immutability, and smart contract are the few components of blockchain which are helping to attain the aim of this technology.

CHAPTER 5

SUMMARY, CONCLUSION, RECOMMENDATION AND IMPLICATION FOR FUTURE RESEARCH

5.1 Summary of the Study

Blockchain helps guarantee the security and privacy of sensitive information. Blockchain used for being an unchallengeable record in the network along with facilitates security. Ensures security to sharing and exchanging information among users. Also blockchain have the detection ability to abnormal performance and threats. As a distributed ledger assistances immutable computing settings. Smart 5G environment will be require secure and decentralized resource which is possible by blockchain technology.

5.2 Conclusions

In this paper, I deliver understandings to the audience the significance of the blockchain for the industry and society. This review is allocated into four parts. The first part deliberates the introduction of the blockchains. The second part defines the basic contextual of the blockchain technology, including the scope of the problem and challenges. The third part emphasizes on the research methodology are implemented in reviewing papers. Lastly, to establish the appropriateness of the blockchain technology for smart applications and shows case studies on three application areas: healthcare, energy and finance.

5.3 Recommendations

In the automobile industry, "Vehicular Edge Computing" is a developing domain. On the other hand, vehicles share the personal data in the compromised with the central service provider. Decentralized point to point transaction system is built by blockchain which is secured.

5.4 Implication for Further Study

We are living in a cutting-edge technology period were changes are frequent. This changes also affected to our society and industries. Blockchain technologies have the ability to mitigate the present issues in society.

- Is a peer-to-peer disintermediated marketplace more trustworthy than exist one?
- Would operators and consumers be more or less protected in such a market?
- Would a peer-to-peer market be more or less steady during periods of strain?
- How many collective irrational phenomenons such as sentiment/confidence swings will affect the capability of these markets to operate?
- How can we manage and control these systems to avoid abuses and defend users?

These are all queries that need further understanding and study.

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Appendices:

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A review of Block chain technology (4)

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