

Financial and Non-Financial Applications of Blockchain



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Abstract- There are hundreds of technologies today. Companies and brands continuously try to create and bring something innovative in the market to attract consumers to them in order to get a rise in market share. In the world where people have started getting used to hundreds of technologies, if asked about those which have affected them the most in last ten to twelve years, no one will miss mentioning blockchain. Blockchain has gained very much popularity after the introduction of bitcoin and ethereum in its environment. Blockchain mainly has two types of functionalities. One that involves transactions and the other which talks about contracts. This work highlights some of the very much talked about applications of this technology in the real world. The work also considers various factors and methods by which this technology can be introduced to the audience by suggesting ways in which blockchain can be introduced in the lives. Discussion on how this technology can affect human lives in the future is also an important part of this paper. Because blockchain has huge number of applications that the paper has tried to inculcate, it can be a technology of future which many scientists and industrialists have already started to believe. That is why this work finds a unique and all in one collection of applications and possibilities of Blockchain.

Keywords- blockchain; bitcoin; smart contract; cryptocurrency; ethereum; ether; ledger

I. INTRODUCTION

Blockchain, known as one of those technologies that have adversely transformed the computer world in the past few years by finding its application in a variety of domains. It gained its popularity among the geeks when bitcoin got introduced as cryptocurrency. Since then, many different advancements in this fast growing, flourishing and hot domain of computer science have taken place. Some highlighting features which have contributed to the popularity of blockchain include Immutability, Irreversibility, Decentralized, No third party fees, Digital currency, etc. Before diving into the applications, few frequently used terms in blockchain world have been highlighted in the table that follows.

Table I. Frequent Terms

Term	Description
Ledger	A record of all the transactions that take place between two different systems or nodes. Some like to call it decentralized bookkeeping.
Blockchain	Decentralized, distributed and generally public digital ledger that records transactions which can't be altered retroactively.
Bitcoin	Virtual currency or cryptocurrency that was created in 2009. It uses peer to peer technology.
Mining	It is process of adding transaction records to public ledger of past transactions.
Consensus	A fault tolerant mechanism used to reach an agreement on single data value or state by distributed network of systems.
Hash	Hash function that is used to check the safety and integrity of a transaction that is requested over a network of distributed and decentralized nodes.
Smart Contract	It is a contract that executes itself when the buyer and seller reach an agreement. It is directly written as lines of code. The code and the agreements are contained in a distributed and decentralized blockchain network.

II. WORKING OF BLOCKCHAIN

In A systematic literature review of blockchain-based applications, applications of blockchain have been very well classified and the work has been praised by many. The classification comes out to be very comprehensive and palatable, even for people who don't connect with the technology at some required level. [1] It is important to actually know how blockchain really functions for everything that follows to actually strike the brain.

There are five basic requirements of a blockchain network to function how it does. [2] They include-

1. Distributed Database

Each node in the network has access to one common database that contains information about all the transactions that happen across the network. It can be used for verification and validation purposes by the network. Any change that takes place in the directory should reflect everywhere else.

Revised Manuscript Received on April 30, 2020.

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2. Peer to Peer Transmission

All types of exchanges take place directly without involving any third party or common channel for the communication.

3. Transparency with Pseudonymity

Every transaction with its associated value is visible to the nodes which are part of the network. Exchange occurs between blockchain addresses.

4. Irreversibility of Records

After a transaction has happened and is carried out successfully, its entry is made in the database. These records cannot be altered because they are connected to every other node in the network. Hence, any change will affect every other node (hence the 'chain').

5. Computational Logic

Setting up of algorithmic rules and regulations in blockchain functionality is very much necessary for it to function according to user based needs. Computational logics are important to be built in for Smart Contracts.

With so many facilities that blockchain has brought with it, it also brings some concerns. Many different networking models have been adopted in order to have a limit on the data that is to be shared. These networking models are namely-Public blockchains, private blockchains, consortium blockchains and hybrid blockchains. It is hard to actually model public blockchains. Private blockchains on the other hand have many drawbacks including the implementation cost. This is the reason why most of the projects use to beneficial sides of consortium blockchain and hybrid blockchain. [3] Despite of so many difficulties, let us see how this technology has found its place in various domains on which human life depends.

III. APPLICATIONS OF BLOCKCHAIN

Blockchain has found its place and role in many places which include but not restricted to supply chain management, business, healthcare, banking, IoT, privacy, tourism and travel, education and research. With the introduction of bitcoin, there is no doubt that rapid growth in cryptocurrency-related technology was observed but, blockchain fused its capabilities in the contract world too. With the development of Smart Contracts (SCs), the creation of a self-executing code on reaching a specified set of conditions in a private and secure environment has been made possible. Though the idea of SCs is old, one of the first person to mention about it includes N. Szabo in his work. [4]

A. Blockchain in Healthcare

The blockchain has capability to transform healthcare in many ways through its data architectural design which extends its applications far beyond bitcoin. It can be used in healthcare in order to have a better command over business processes, gaining more profit or providing relief from the increased profit amount to the needy, enhance compliance, enable better use of healthcare-related data, etc. There are certain aspects in management of healthcare which can cause inefficiencies in the workforce which is responsible for carrying out the management task. Some mundane day to day activities that include degree verification, credentialing, etc. can be very much contributing to the lack of interest in managing the processes and thus can cause risk to patient life in the hospital boundaries to some extent. It can be time

consuming and of done incorrectly, can directly result in increased costs. Through use of blockchain medical credentialing can become easier as the verification process will be done using the decentralized database by matching the entries with the one present at the source. [5]

For complying with the Health Insurance Portability and Accountability Act of 1996, blockchain requires to have robust security and privacy mechanisms for high-level authentication. It has been observed that there have been many different causes to propose blockchain based decentralized distribution of systems for healthcare. It included causes such as data security, data privacy, data integrity, authentication, interoperability, etc. [6]

Blockchain has yet another application in healthcare that is in medical imaging. It is known that imaging needs lots of storage requirement and high performance computing. Blockchain might prove to be handy in storage of these images as it is decentralized. Also, the access can be shared among the doctors who are responsible, pharmacist and even patients. Within healthcare, blockchain can also be used to track medical devices. [7]

Through its decentralized nature, blockchain can also boost research in radiology. One of the main problems that the radiology department faces is the sharing of patient data and create large imaging databases. Due to development in AI and radionics, this problem has been gaining lots of attention as interpreted from many published articles and papers. Blockchain can help in achieving targets to finally conquer the goal in this field. It can use Public-Key Infrastructure and provide a secure identification method for accessing the image dataset and use it for designing various ground-breaking techniques. [8]

For providing decentralized process of machine learning, a system has been proposed. BinDaaS, which focuses on enabling deep learning as a service just like many other services which are provided over networked nodes. It integrates and makes blockchain work alongside deep learning and hence combining two of the most powerful technologies in computer history. Blockchain enables the storage of EHR securely while deep learning is used on these EHR datasets to predict future diseases based on current indicators and features of patient. [9]

B. Blockchain in Agriculture

Those days are gone when people used to consume goods that were produced in their locality and proximity. The concept of globalization has totally changed the way in which people utilize resources that are not only generated locally but also those from far away destinations. Not just globalization, agricultural practices have also been affected by the technological advancements in human life. Basic example can be of introduction of machinery in the fields, which have significantly increased the productivity in the last few decades. It's true that the cost incurred by the utilization of these machineries have also increased but those costs directly contribute to overall economic development of the society at smaller scale and nation at a larger scale. [10] With incredible amount of imports and exports that happen around the world, agricultural products comprise of major ratio of all.

This is the area in which blockchain can help significantly by easy management of food supply chains. Today, these supply chains have become so much complex that in some scenarios and duration of the year when the demand and supply is high, mistakes are almost inevitable. Involvement of more and more suppliers who are backed up by numerous stakeholders, make this whole process even more complex.

Existing agricultural process involves Seed Company, Farmer, Grain Elevator, Grain Processor, Distributor and finally Retailer. This means, there is immense possibility for the crop to get contaminated at any stage that is involved. In order to overcome the issue, it is necessary to have a tracing mechanism. Some authors have proposed ethereum blockchain and smart contracts based tracking and traceability across the supply chain and the idea has been implemented at smaller scale. [11] It has proven to be very useful in this scenario.

C. Blockchain in Banking

Blockchain is future of banking. It is said to have many promising prospects in the banking field. Blockchain can easily help banking industry to clear pending payments and to secure credit card information. Major banking corporations namely JP Morgan, UBS, Goldman Sachs, American Express, etc. have already established blockchain laboratories and are continuously working to integrate this new FinTech in their systems. Many other industry leaders in banking have joined hands to form a consortium blockchain network which can be shared. [12] Blockchain can be used to achieve asset digitization and point to point value and funds transferring. All this will be possible at reduced costs and hence increased profits. [13]

In another review, it has been said that blockchain is hot topic of discussion at present due to its possibility of affecting large number of technologies which are capable of decentralizing there day to day centralized work. Hence, enabling them to work from different places around the globe and giving them more portability. Thus in this manner, FinTech sector is highly susceptible to the various benefits that blockchain has for it. [14]

A recent development in this motivated sector of applications of blockchain is MudraChain. It is, in simple language, a framework for automated cheque clearance. The developers realised the burden that financial institutions have in the world where, millions of transactions occur at hourly basis. An upgrade in the Cheque Truncation System (CTS) was felt to be introduced. Many limitations including illegal duplication, invisible ink usage, amount on the cheque, etc. are faced by the institution. MudraChain can be used as the blockchain technology for proper validation and verification of cheque before actually confirming the transaction. [15]

D. Blockchain in Education

Any educational system in the world cannot be perfect. There are always some chances and possibilities of improvement that can make the system better. Blockchain finds its place in educational application also. Nowadays there can be found many institutions and universities which have implemented blockchain in their system. [16] Most of those universities use it for degree management. It can help in reducing degree fraud very significantly.

Blockchain technology can also be used to construct a transcript of the student who might have some performance

record in past and have achieved rewards in the form of grades. If talked about Smart Contracts, it reduces frauds in many ways and hence its functionalities can also be used in educational system in order to improve fairness in evaluation as compared to the traditional methods. [17]

For the higher educational purposes, current model is becoming very much difficult to handle as colleges and universities receive huge number of applications every year. That is why; profile evaluation in that case becomes very difficult for the admission office of the school of that department. [18] Thus blockchain here will help the system to become decentralized and make it easier for the evaluators of the team to work in efficient manner and provide with opportunities to the candidates who deserve the chance of becoming better in whatever field they wish to.

E. Blockchain in Tourism and Travel

With the globalization, people began to understand different cultures around the globe. To experience those cultures, people began to travel to places where those specific practices are conducted. Those destinations can be domestic or international. Due to increased number of travels and commute, the numbers of transactions taking place in a time interval have also significantly shown an upper bulge graphically. Now, management of flight or train network in this huge and complex scenario has automatically become cumbersome. Blockchain again, may find a role by decentralising the traditional system with direct effect on tourism. This will cost the companies a lot lesser and hence can result in lowered rates of flights and trains. [19]

Another application can include the booking and enquiry system. With booking system, smart contracts can come into play in order to verify details of travellers with the national identity produced by them. This will automatically reduce fraud rates that are faced by passport officials every year. This can be done by partially giving access of common database to the travel booking websites and registered brokers. [20]

F. Blockchain in Smart Cities

Several nations aim to go smart in the coming few years by implementing automation of many days to day tasks which are tough for humans to do. These tasks can demand for the precious time which can be diverted to something better and more important.

For instance, blockchain can be used to mark down residential addresses, to register car number plates, to track and maintain waste deposition, etc. [21] This will not only educated citizens about technology but also provide them with better lifestyle in the developing nations.

Blockchain has often been termed as 'the trust machine', which means that it takes care of trust issues among individuals. Implementing blockchain at various levels in the life of citizens of the nation will disseminate trust on the population whole. Trust is what plays a role when the business involves the transactions going through a third party agent. Welcoming blockchain in the business of citizens of a city will not require the presence of an external party which will make transactions trust-free and hence, secure. [22]

G. Blockchain in IoT and Cloud Computing

The Internet is everywhere. These days, it has been extended to things such as TV,

Refrigerator, Watches, Farming Equipment, etc. It has been predicted to have approximately 18 billion devices by 2022 to be part of this massive web called, Internet of Things. IoT has been influencing markets and businesses in a very striking manner.

It is time to move from centralized control where owners and machines are part of the same trust network. It is time to move towards a decentralized control network where owners may or may not be under the tree of the same control or trust network of machines or devices they need to access. [23]

If blockchain and IoT are integrated, users will be benefitted by the combined power of both the technologies. It will help to enhance communication between network elements by making it more secure, support of peer-to-peer architecture, database redundancy, privacy in exchange of data, the addition of new devices in the network automatically, etc. [24]

On the other hand, it is known that efficient task scheduling and security are two of the most important characteristics that make any cloud platform trustworthy.

With the innovations in high performance computing, scheduling tasks have become comparatively easier. With the help of Particle Swarm Optimization and Fruit Fly Optimization techniques, scheduling is being taken care of. [25]

For security on the other hand, blockchain has many things to offer for cloud computation and storage. It promises to ensure data integrity and security by decentralising the data. It can provide a tamperproof environment for the data as it will be hosting an image of the data and not the original data most of the times. ProvChain is one such proposed architecture that collects and verifies the data transactions to merge cloud storage and blockchain technologies. [26]

IV. RESULT AND DISCUSSION

In the content presented so far in this paper, it has been made very clear that even if blockchain is new to computer science field, it has managed to find and set its foot in many computer aided industrial applications. Blockchain was first known to be useful for only currency exchange and something to invest into for future returns.

But today, it has found non-financial applications such as that of securing transactions with the help of smart contracts. When combined with decentralized web and mobile applications which use data and servers remotely, blockchain can also achieve decentralization and hence increasing the security even more.

At the end, it is important to note that blockchain is the technology that is growing really fast and can be combined with other existing technologies to achieve security and distribution or decentralization.

V. CONCLUSION

Though blockchain is a technology worth bringing to the lives of humans, it still presents some challenges. One such challenge is of having enough financial backup to pay for the implementation and then maintenance in the future. Other is the level of feasibility and to have a well-structured plan of the establishment.

Even then, continuous efforts are being made by major technological leaders in the world to bring this great invention

in the human and the computer world with a highly enthusiastic research and development team. The only challenge after blockchain is introduced in life remains is the challenge of acceptance by the users for a better future in the world where fraud and con rates are increasing day by day.

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