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A Review on Application of Blockchain in Stock Exchange

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ABSTRACT: Blockchain has many use cases in sectors like finance and cyber security. In blockchain, a ledger is used to store all the events occurring during transaction. Although its popularity is because of Bitcoin, we can use it in trading events performed by stock markets. In this paper, we present a simple review on the application aspect of blockchain in stock exchange. Current stock exchange centers have many issues like managing pre-trade and post trade events, centralized ledger, double spending,complete reliance on broker for stock trading. It is vital for these major issues to be solved for flawless online trading of stocks. Blockchain has the potential to solve all these major challenges and improving the existing stock market processes.Types of blockchain to be used also varies between different use cases and needs. A detailed study of all the types and different platforms available for building a network is mentioned in this paper. A detailed study of hyperledger fabric with a review of an application of blockchain in securities exchange is done in this paper. Further we have reviewed the blockchain implementations of a few major stock exchanges. Finally we conclude with, what the future implications blockchain might have on the global scenario of online stock exchanges.

KEYWORDS: Stock Exchange, Online Trading, Blockchain, Hyperledger

I. INTRODUCTION

With the fourth industrial revolution, we are now more connected to the world than ever before. The Internet has boosted connectivity among the people. Stock exchanges are one of the major revolutionary financial opportunities that have recently created additional ways to earn money. Online trading has changed the making of business decisions for many entrepreneurs. But today's stock exchange centres are impoverished. They only work on working days for office timing of 9:00 am to 5:00 pm. These create a barrier for trading shares between two companies of different country. So the future of stock exchanges lies very heavily on communication between a stockholder and right now the internet is the best mean for communication. Also, an internet-based trading environment is more secure, fast and steady. Moreover, the web-based trading system offers more connectivity, 24 by 7 access and instant trading of bonds. For example, Nepal stock exchange is still following a very traditional method for stock exchange and is showing unsatisfactory results. It takes more than 24 hours for a complete transaction of a stock [1]. This is inefficient and involves a high risk of failure for stock trading.

Recently Bitcoin has been a big boom in the financial sector. Everybody has heard about Bitcoin but very few people know the technology behind it. It's the blockchain technology that has created Bitcoin. The blockchain is a relatively new technology although it has been presented by Satoshi Nakamoto in Bitcoin [2]. Blockchains are of different types and depending on the type of case we use blockchain technology. Blockchain has features like high security, low risk, faster implementation and scalability which makes it such a strong technology. Its can revolutionaries many businesses and change the course of doing business. Some industries in which blockchain can improve the process are banking, chain supply, a stock market and cybersecurity. There are various blockchain platforms for building our own network. These are public, private and Consortium Blockchains. Most commonly used public blockchain protocols are based on Proof of Work (PoW) consensus algorithms. These are open source and are not permissions so anyone can access them. No permission is needed for participation. Consortium blockchains conduct operations as the leadership of a group. These types of blockchain don’t allow any person with access to the internet in the participation of process for verifying transactions. Private blockchain has editing permissions kept in centralized to one organization. Anyways read permissions may be public or may have varying degrees of restriction [3].

Hyperledger fabric is a consortium blockchain and provides the channel. A channel can be stated as a private medium of communication between many network numbers, used for conducting a confidential and private transaction. Members of organizations, shared ledger, anchor peers per member, the ordering service node and chain code application all define a channel [4].

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The rest of this paper is organized as follows. Section II introduces the current system of the securities exchange. Section III is a literature review of eight technical papers. All key points mentioned in the paper is summarized and presented in the form of a review. Section IV discusses the future scope of stock exchange with regards to new emerging technologies like blockchain. Finally, we conclude out our paper in section V.

II. CURRENT STOCK EXCHANGE SYSTEM

The current system has many tasks involving pre-trade, post-trade, transferring ownership of stock, etc[5]. The traditional system of stock exchange faces many issues. The major problem with the current stock exchange system is that it has a centralized ledger which stores all digital asset at a central location. A centralized database is more expensive to handle.

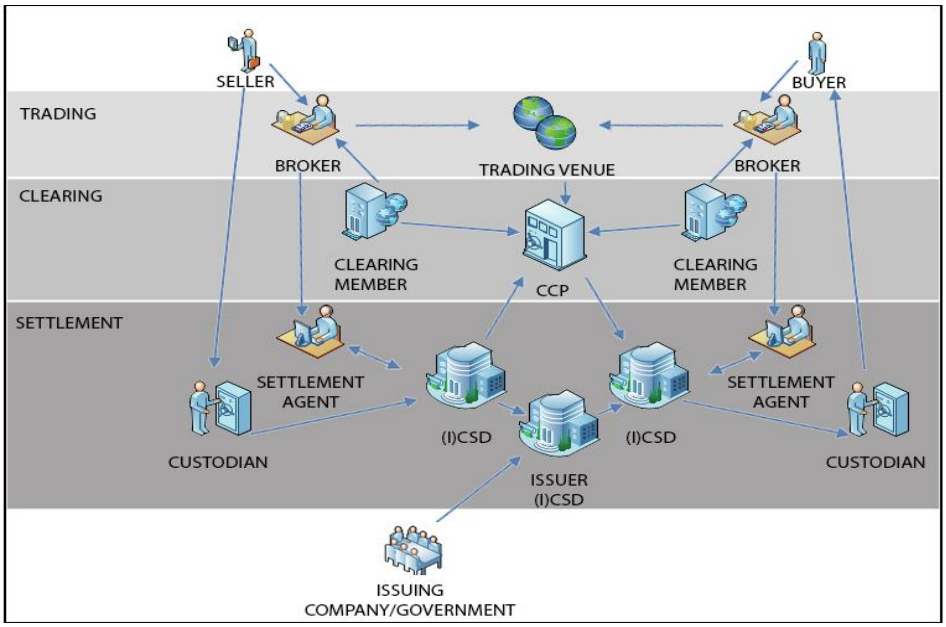

Fig. 1. Post trading process [6]

Also, the current stock exchange system requires lots of intermediaries to invest in the stock which leads to participants having to spend lots of money in the stock investment process. Traditional system lack of transparency where one participant is unable to view the decision of other participant results in information asymmetry. One Of the major disadvantages a stock market participant has to go through is that a complex process of validating ownership of the trade, leads to 2-3 days to complete the entire transaction[7]. When the same digital currency is spent more than once it is called double-spending. Now this a flaw that is unique to the transaction of stock because digital information is something that can be reproduced rather easily.

III.LITERATURE REVIEW

In this paper[8]the authors have explored an internet-based approach to stock trading. Web-based exchanging is leading stock exchanges on the web by means of a few sites. Over the years the rising organizations have a concise history of progress all because of the web. The online exchange procedures of fund comprehensive of purchasing and offering of securities, stocks, and different ventures, these all go under web-based exchanging. The real situation of all the business patterns have differentiated their business into an online exchange of their products and ventures and truly it greatly affects their offer of business.

In this paper [1] the author describes a system model of the online trading system for Nepal Stock Exchange.The NSE, with its current implementation, is found to be inefficient. Even after the introduction of ATS and the Central Depository System, the time required for the trading process to complete is significant. Thus for providing a solution to these problems the authors have proposed a new model of online trading after studying the existing IT solutions in similar fields. Thus a relative investigation of the Trading System of the SAARC nations demonstrates that the

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settlement cycle of NSE is the longest of the other stock trades. This usefulness destroys the issue of security, lack and reserves deficiency amid settlement of the exchange.

In this paper [9] an overview of blockchain as a developing innovation has been examined. It is basically a decentralized ledger or data structure. It can be referred to as blocks in a chain where the corresponding blocks link with blocks, prior to them. We can compare blockchain with an example of a book where the entry in each page refers to blockchain transaction. It is easy to detect whether a page has tampered or not. It is easy for the miners to find the tampered block just by knowing the signature in a Public Blockchain. The historical backdrop of the blockchain can be appeared by thinking about the case of one of its partners. They have discussed the Bitcoin blockchain. Satoshi Nakamoto developed Bitcoin and from that point forward, it is the most prominent and utilized cryptocurrency. He built up the idea of Bitcoin as money, as flexible and reliable. Be that as it may, it had a couple of peculiarities. It has been utilized generally by Multinational organizations like IBM, Amazon and so forth and will be utilized further in the coming years. They have outlined the working of Bitcoin exchanges fundamentally with the end goal to clarify the working of blockchain component. Bitcoin utilizes a type of evidence under cryptography natives instead of completely trusting on the outsider. The exchanges must be endorsed and validated with the end goal to be reflected in an open record. Initially, the validator must realize that the sender has the privilege to spend it. In blockchain, the exchanges are requested in the type of squares in a direct chain, which is connected to one another. Each square contains the hash value of another connected square in a chain. This paper could infer that there are various chances of research around there and there is a critical need to investigate and look for advancement just by limiting the defects and by upgrading its effectiveness.

This paper[10] describes the blockchain technology in detail by considering the example of Bitcoin. The blockchain is a transaction database which contains information about transactions ever executed in the past. If the majority of the nodes agree in favor of the transaction, then it is approved and a new block gets added to the existing chain. Each blocks are linked to each other and refers to the previous block in the chain. They are identified by a hash which is generated using a secure hash algorithm, cryptographic hash algorithm on the header of the block. It looks into the details of the Bitcoin network and explains the various components in it. Bitcoin is computerized cash distributed as open-source programming in 2009. It is decentralized digital money delivered by all the partaking hubs in the framework at a characterized rate. The chain of Bitcoins made over the period and connected to one another called blockchain. It very well may be utilized to look through any past exchange occurred over the system between Bitcoin addresses. At the point when another square of exchanges is made, it gets added to the blockchain. The various advantages of blockchain in terms of security, cost, efficiency, etc. have been examined. The gadget cost is diminishing and processing power is expanding each day consequently Blockchain presents a huge probability in the Internet of Things (IoT) and giving security. Blockchain can offer a trust less framework having a peer-to-peer informing conventions and anchored appropriated information sharing

In this paper [11] author discussed how the cryptocurrencies gained popularity with Bitcoin. Blockchain provided unique features like transactional privacy, system transparency, immutability of data, security with cryptography, etc. These features paved the way for Blockchain in advancing many technologies like voting systems, IoT applications, supply chain management, banking, health care, insurance, etc. Blockchain development was boosted with the increasing demand of the technological update. In this paper,the authors discussed three different blockchain platforms that can be used for financial transactions. Ethereum is a project which is used to build the technology on which all transaction-based concepts can be built. It provides a system to end-developer for building software on formerly unexplored computer models in the mainstream. The key goal of this project is to facilitate transactions between individuals who would have no means to trust one another Hyperledger project was started in December 2015 under Linux foundation for open source blockchain development with an aim to improve the performance and reliability of these systems. There are 5 types of the Hyperledger frameworks under the Hyperledger project for the blockchain development.Distributed ledger platform, Corda, is for recording and processing financial agreements. It is specialized for use with regulated financial institutions. It is inspired by blockchain systems, but without the design choices that make traditional blockchains inappropriate for many financial scenarios.

In this paper [12] the authors propose a various approach to deciding whether an existing system requires the addition of blockchain technology. If the addition of blockchain technology is demanded then how would existing system gain benefits? This paper also concentrates on deciding which part of an existing system are to be substituted by decentralized applications(dapps) that is blockchain technology. Authors state various difficulties like finding out which attributes of blockchains are important for a given use case and to decide which elements of architecture should employ blockchain technologies and how current approaches only give a glimpse of blockchain technology in use case.

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Habitually we pick from only three types of blockchain obliged for a given use case but in addition to this, Wuest and Gervais add the fourth variant and distinguish between public and private permissioned blockchains. This option is based on the question of whether public provability is required, argue that blockchain technology has many configurations and variants. The paper outlines an idea to derive a hybrid architectural draft by identifying participants, their trust relations and interactions. This is especially relevant when applications are not built or rewritten from the ground up based on blockchain technology but rather are extended with blockchain aspects for certain subsystems. The paper is structured as follows: Section 2 explains the author's approach and its four steps in detail. In section 3 authors conclude the paper and summarize their findings. Our ongoing research is outlined in section 4 as well as an outlook on the author's future work regarding architectural patterns and design patterns for code contracts is mentioned.

In this Paper [13]the author discussed security in Hyperledger. Since blockchain has a concept of the shared ledger to every node it is very difficult to store the private data on blockchain since it can be view by anyone who is the participant of node this will limit the use of blockchain in any sector. If everyone sees the same ledger how can we have private data that can be seen by only some participants in the blockchain and others not.a common solution in many system that store the hash value of private data in the blockchain while keeping the actual data with participant who own that data but this solution is not enough if the smart contract depends on the private data. So author suggested a solution to use a secure Multiparty Computation(MPC) protocols. In the private data is stored on separate peer where semantically meaningful entities have data on the ledger By using secure-MPC protocol allows us to use blockchain as identity management and communication.

	Public No centralised management	Consortium Multiple Organisations	Private Single Organisation
Participants	Permissionless • Anonymous • Could be malicious	Permissioned • Identified • Trusted	Permissioned – Identified – Trusted
Consensus Mechanisms	Proof of Work, Proof of Stake, etc.. • Large energy consumption • No finality • 51% attack	Voting or multi-party consensus algorithm • Lighter • Faster • Low energy consumption • Enable finality	Voting or multi-party consensus algorithm • Lighter • Faster • Low energy consumption • Enable finality
Transaction Approval Freq.	Long Bitcoin: 10 min or more	Short 100x msec	Short 100x msec
USP	Disruptive Disruptive in the sense of disintermediation. No middle men needed. Unclear what the business models will be	Cost Cutting Can radically reduce transactions costs. Similar to SAP in the 1990s. Extreme cost cutting opportunities. Less data redundancy, higher transactions times, more transparency	Cost Cutting Can radically reduce transactions costs. Similar to SAP in the 1990s. Extreme cost cutting opportunities. Less data redundancy, higher transactions times, more transparency

Fig 2. Comparison of types of blockchain[16]

In this paper [14]the author investigates how blockchain can be used to secure stock exchange transactions, with an especial focus to the legal aspects as well as techniques of such applications. Blockchain technology is increasingly

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being researched as well as applied in many other domains including the Financial Technology (Fin-Tech), Regulatory Technology(Reg-Tech) and Legal Technology(legal tech) for escalated security and privacy for sensitive data while safeguarding the anonymity of the users. To facilitate transacting – which includes both entering into contracts and transferring ownership of securities and cash – stock exchanges have been highly dependent on their infrastructure can blockchain technology add value in transaction settlement?. The answer to this question needs to examine the capabilities of blockchain in theoretical and practical aspect. Because stock exchange orders and ownership-related private data are transmitted electronically, and ownership is also evidenced electronically security of this data is a major concern. The level of transparency less as in public blockchain. Blocks being added with hashing techniques as well as a time-stamp. Since blockchain has capabilities to reduce post-trade process it is very easy to adopt by participant and regulators.rather than following trend author suggested that investigate how much it is feasible to introduce blockchain in securities exchange.

IV. FUTURE STOCK EXCHANGES

Blockchain is a promising technology offering lots of benefits when used correctly [12]. With its features such as transparency and immutability it has the ability to transform many industries including stock exchange. Stock exchanges across the globe are on the verge of a reform, since recent advancements in blockchain technology offer to solve most, if not all, the problems faced by current methods. Considering

the current research, blockchain serves to be the best choice for maintaining the transparency while improving the security of transactions in stock exchanges.

According to literature surveyed, a hybrid approach of blockchain can be quite suitable for an application such as stock exchange [14]. The papers that we have reviewed suggest the use of Hyperledger Fabric as the blockchain framework for the use-cases that require security and privacy while also being easily audit-able. Fabric being a hybrid blockchain has several advantages over other types of blockchain architectures.

Although saying is easier than doing. Implementing a live stock exchange with real time transactions occurring round the clock requires effort from public as well as private organizations and also the government. The risk factor involved while implementing a live stock exchange on blockchain is high, due to the huge volume of transactions performed everyday. It requires high degree of collaboration between a number of parties involved in the stock exchange. Initial monetary investment is also high. Above all the issues, there is the issue of trust among the parties involved in implementing a decentralized stock exchange. This can be solved using Hyperledger Fabric while it also addresses other minor issues.There have been quite a few large scale implementations of stock exchange over blockchain [15].Some of the notable examples are London Stock Exchange(LSE), Australian Stock Exchange(ASX), NASDAQ, and Hong-Kong Stock Exchange. These government establishments along with some private organizations such as IBM are implementing BC systems for their respective exchanges. These are the pioneers in applying blockchain to stock trading and once they manage to implement it successfully, others will follow. It is just a matter of time now, before we see a global adoption of BC in this field..

V. CONCLUSION

In this review, we have concluded that blockchain will be the future of online stock exchanges. The major stock exchanges in the world have already started experimenting with their own large scale implementation. Within next 2 to 5 years it is expected that the LSE and other exchanges will complete their implementation of the decentralized exchange platform. There are several security and legal issues regarding blockchain based financial systems which create a huge hindrance to smaller stock exchanges. Once successfully implemented by the fore-runners, it could get adopted by majority of systems in the world, which will bring about a complete decentralization of stock exchange. More involvement from academia and open-source contribution would follow. This would bring about a new era in securities trading whereby the traders would be able to seamlessly trade without worrying about the flaws that are present in the current systems.

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