Impact of Blockchain in the Voting System

Anamika Kannoly, Samiksha Arun, Ganesan Subramanian, S.K.Pandey, M.Arumugaselvi

Abstract: Voting is important for any democratic country. It can be considered as one of the major factors that make a government for the people and by the people. The most common methods of voting that currently exist are ballot-based voting, purely electronic methods, and Electronic Voting Machines, among others. Over the years, it has been a challenge to build a secure E-voting program that provides the privacy of current voting systems while offering a means of accountability and versatility. Using blockchain technology and cryptography we can make the process of elections as open and cost-effective as possible. In this review paper we discuss a new, blockchain-based electronic voting system that addresses some of the limitations in existing systems and evaluates some of the popular systems designed to create a blockchain-based e-voting system.

Keywords: Blockchain, decentralized, electronic voting, organization, transparent, voter.

I. INTRODUCTION

Blockchain technology is a distributed ledger technology that underlies cryptocurrencies like bitcoin and provides a way to record and transfer data [1].Voting is a very important part of democracy because it provides people a chance to voice their opinion. Blockchain voting has already been used for the higher cognitive process in smaller organizations, including political parties and firms. Some people say that blockchain could help voters interact more deeply and make higher complex processes more understandable. Nowadays, besides the financial sector from which the blockchain concept has aroused, substantial efforts made by many organizations are being witnessed, distinct political sectors are using blockchain technology to develop various innovative ways for completing its corresponding processes. One such prominent process of where blockchain is getting used within the political sector is in its legal system.

A few countries in the world have utilized blockchain to enhance their voting systems and a decentralized peer to peer network with the help of a public ledger. Sierra Leone, a country in West Africa became the first country within the world to use blockchain Technology to verify the count of votes in an election in March 2018 [3]. Citizens cast their vote with pen and paper, the ballots were then collected by the workers of Agora, an organization that played a serious role within the organization of the entire voting system and entered it into the system manually. The blockchain that ran through the entire voting process was private and not public which implies that only authorized personnel could make entries, also running on fewer centralized servers. Sierra Leone's government contains a reputation of corruption and there's often lots of violence surrounding the elections. Voting with the assistance of blockchain, helped ensure an orderly result because the public had access to the read-only blockchain, cryptographically verifying that the results of the voting weren't tampered with.

The inability to vary or delete information from blocks present within the blockchain system makes it the best technology for voting systems.

The technology of blockchain is supported by a distributed network that consists of many interconnected nodes. There's no single authority that controls the network.

The acceptance of a transaction depends on the choice of most of the nodes within the blockchain.

Each of those nodes has their copy of the distributed ledger (information) that contains the total history of all the previous and present transactions that the network has processed. In traditional elections, we tend to typically have a central authority that records, counts and checks all of the votes and with blockchain the strategy becomes localized. So, everyone can add a duplicate of the total voting record on their own devices. the info is encrypted to guard the identity of individual voters. Illegitimate votes cannot be added and also the account cannot be changed because everyone holds a duplicate and may if all the votes suit the principles and are counted properly.

II. CHALLENGES IN CURRENT VOTING SYSTEM

In a democratic system, every vote count. But many citizens don't go to cast their votes on the Election day.

They may be traveling or feel that the voting center is too far. Some might not go because they would feel that their vote does not count due to the unfair election results.

Even the citizens who got to vote have to wait for a long time in queues to cast their respective votes.

In the current voting system, voting is generally done either by ticking against your preferred candidate (paper ballot system) or by electronic voting machines.

The paper ballot system has been used for decades by most countries in the world for voting purposes.

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117

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Voters get to mark their vote on paper and the vote is then placed in the ballot box. At the end of the elections, the votes are counted manually, and the results are declared indicating who won the elections.

Replacement of this traditional system is necessary to limit the voting frauds and to make voting as well as the counting process more transparent. Further a system is required that makes voting convenient for the voters and that minimizes the cost of conducting elections as the amount of money that goes into the organizing the elections is huge.

So, there are a lot of disadvantages in this system, to counter this digital voting systems have been employed but remote electronic voting requires strict and precise security measures. Moreover, there is a risk of hacking activities by hackers who could directly harm the servers. A hacker can infect specific machines with malware that can alter the votes or even access the back end to move around and negate the votes as they wish. Traditional voting systems have been no strangers to the problem of booth capturing where supporters of a party or candidate gain physical control of a polling booth and cast false votes by threatening everyone or by preventing genuine voters from reaching the booth on time and the problem of rigging where malpractices are indulged by a party or a candidates to increase the number of votes. It includes recording multiple votes by the same person and bribing or coercing the polling officers to favor a particular candidate.

For as long as two decades, EVM's have been utilized for election purposes in India. Altering of electronic voting machines is by all accounts a more concerning issue than booth capturing. These machines are vulnerable to both hardware and software attacks which can change the results of the election and violate the ballot secrecy. The BEL and ECIL (EVMs manufacturers) have shared the top secret EVM software program to copy it onto the microcontrollers used in EVMs with two foreign companies, Microchip(USA) and Renesas (Japan) [9].This strategy could likewise be utilized by the Indian producers. Other than this when they handover the microcontroller chip, the code is incoherent by the Indian EVM producers. With such existing confirmations both software and hardware of EVM's are not secure and safe.

Lack of physical security is another challenge with respect to EVM's in India as any insider can manipulate hardware to steal the votes. In remote areas especially hilly areas, sometimes election officials are required to carry all the necessary equipment including the EVM machine and paperwork with them across tough terrain and sometimes face obstacles in doing so.

Table-I : Comparison between Current Voting system and Blockchain based Voting System

SL.NO	Features	Blockchain based	Current voting system
1.	Verification	Machine and votes cannot be altered	Machine and vote can be tampered.
2.	Update	People can change votes	Not permitted
3.	Authentication	Users are identified with unique ID	Not permitted
4.	Ease of Accessibility	One can cast their votes from anywhere. Not necessary to be physically present at voting area.	Presence at the voting area is mandatory.
5.	Calculation of Result	Less time taken	More time taken
6.	Live Update	Possible	Not Possible
7.	Type of Technology Used	Smart Contract	Logical Contract
8.	Cost	One time set up cost	Cost varies depending on several factor.

III. PROPOSED BLOCKCHAIN SOLUTION AND ITS ADVANTAGES

The proposed voting system to replace the existing voting system is blockchain-based voting techniques. Blockchain voting is an efficient tool for fair elections. In this blockchain-based voting method the first and foremost step is to verify the identity of the voter. It is very important to ensure that someone's identity cannot be faked here because in this type of voting system every vote is counted and is equally important [2]. To keep a check on this the voters need to download the remote voting booth on their mobile, laptop or any other smart device.
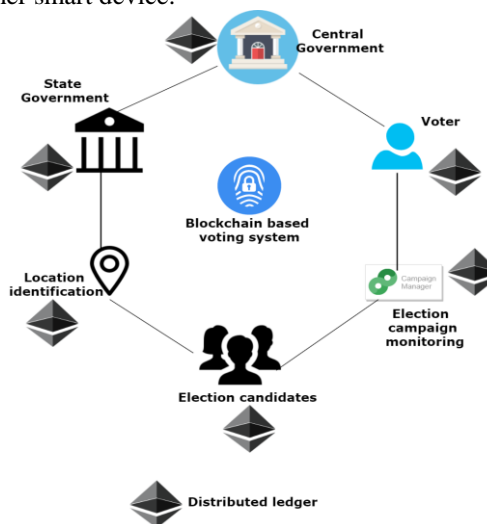
Fig.1.Parties involved in blockchain based voting system

After that, they must provide information about their identity which is checked by the organization conducting such elections. The organization must refer to the registered voter's database to check that the individual registered in its database and is qualified to vote. Then all the details of the voter will be updated to the voter blockchain. After verification of their identity, a smart contract will be executed which will issue a ballot that permits them to vote and submit it to the ballot box. In a blockchain-based voting system, when a voter votes, the polling stations consult the voter blockchain to ensure the voter has not already used up the vote. If the user's vote is legitimate, the polling station will approve their vote and if the vote is found to be invalid, the polling station will reject their vote. Thus, this solves the issue of casting many votes by a single person. After voting, the vote is considered as a transaction and after encryption, it is stored in the blockchain. And once the vote is cast, they also give the voters the ability to change their votes any number of times until the deadline. This is how blockchain helps to create more secure, transparent and cost- effective votes. The voters will be able to verify that their votes were casted and counted via blockchain. Even in the ballot box, the voter can audit every ballot and check that the election results are correct while maintaining the privacy of other voters. This takes days in the current scenario for the results of the election to come out. In addition to this, the announced election results are vulnerable to human error, but the election results can be announced with blockchain directly after the voting is over without any chance of errors.

Blockchain technology provides the voter with the required flexibility to log in and vote from any part of the world. This world encourages more and more people to vote and become part of a democratic society where every person's opinion matters. A person requires only a phone and an active internet connection. The valuable votes won't get wasted, by this system. The major benefits which the proposed blockchain voting systems can provide are:

• Blockchain provides a safe and fair upgraded system.

• Transparency allows different sources to track, count and compare the votes.

• Anonymous transactions of blockchain maintain voter's privacy and ensures that a user does not vote multiple times.

• Data is stored in networks on various computers, as the system is distributed. Issues of data loss can be avoided in this manner.
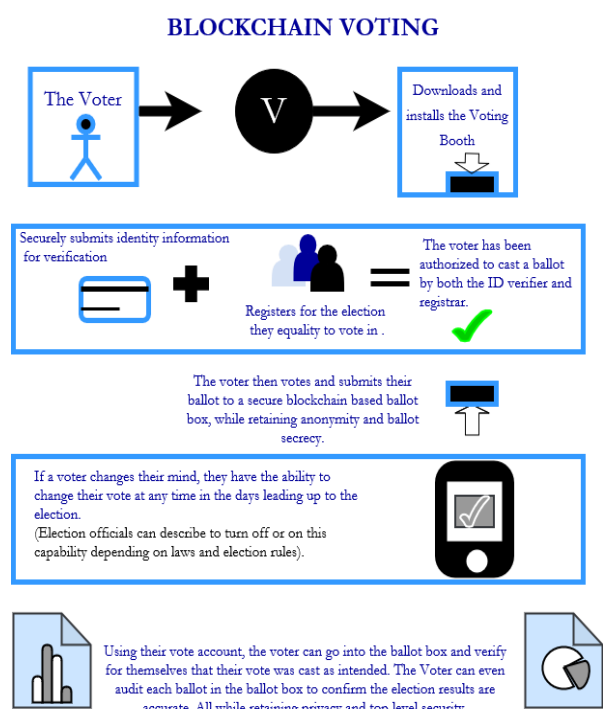

Fig.2. Steps invloved in blockchain voting

IV. BLOCKCHAIN AS A SERVICE FOR E-VOTING

The main components that take part in the blockchain e-voting system are: -

1) Voter: The voter will have a crucial part in the system. He/she will register themselves onto the blockchain system by providing their credentials. For example - voting confirmation number, address, contact number, etc.

2) Election Administrator: Checks and manages all data entered by the user are correct or not and produces private and public keys for the voters.

3) Election Process: In this process, the voters select and vote for their preferred candidate of choice [2].

Working of the service: -

At the time of registration, the service will use a unique voting confirmation number provided by the voter. This unique voting confirmation number will be used to create a unique public and private key for every voter. After taking all the necessary information from the voter, the system will check whether or not the voter is eligible for voting and then accepts the voter's registration.

Private key and Public key: -

During the election process, the private and the public key is required for login purposes and casting a vote for the preferred candidate. It serves as the login id and password during the voting process. It is also used for data encryption and decryption. These two keys are in the form of hash values, therefore making it unreadable for the user.

After the registration process is completed, these keys are sent to the registered email id or mobile number provided by the voter.

After the successful authentication and producing the private and public key, the voter will login to the system using these keys. On entering into the system, the voter will have to choose and give their vote to the preferred candidate. This will be done through a user-friendly interface. After the voter casts their vote, the system will generate an input that contains the unique voter identification number, which was provided by the user initially, followed by the name of the vote with the hash value of the previous vote. This way each input as well as the encrypted output will be unique.

On the cast of each vote, the block header will record the encrypted information. This vote will then be then converted into a block which will be added to the blockchain system and is broadcasted to every system in the network. In this way, all voters will follow the same process and every block is added to the system where the hash value of each block will be calculated.

Every block present in the blockchain system will contain the data, hash of the block and the hash value of the previous block. After a block is created, and depending on the candidate selected, the information is recorded in the corresponding block of the blockchain.

Each block will be linked to the previously cast vote as well. As blockchain is a decentralized system, the votes will not be tampered with and hackers cannot hack easily into the blockchain system to manipulate the votes. After the whole election process is over, the votes are calculated, and results are announced.

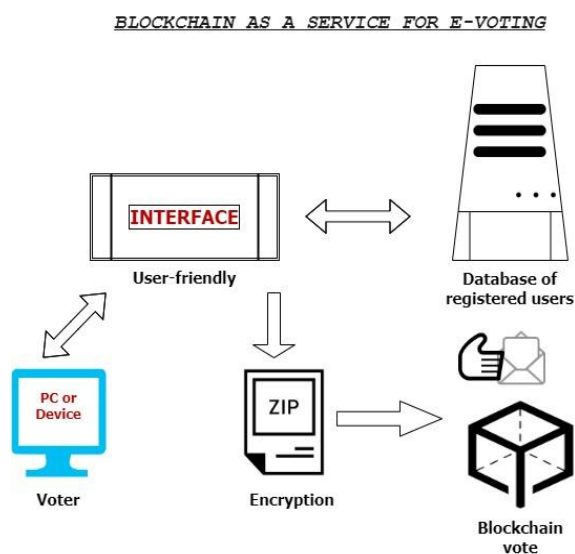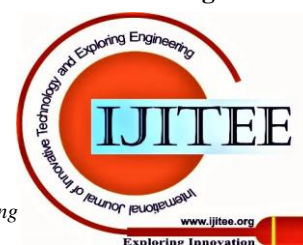**Fig. 3. Blockchain as a service for e-voting**

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119

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V. CASE STUDY

Part-I

The World's First Blockchain- Powered Elections were Conducted in Sierra Leone

The world's first blockchain-powered presidential election was held in Sierra Leone on March 7th, 2018 which was recognized as a global milestone. Sierra Leone is a country in the south-west coast of Africa [3]. After serving two five-year terms as the president of Sierra Leone, Ernest Bai Koroma left his office. The voters had to choose their next president from a group of 16 candidates which included the ruling party's Samura Kamara, the longtime foreign minister and Julius Maada Bio, former military head of state who represented the main opposition party. Using a permissioned blockchain, the votes were manually recorded by Agora, a Swiss foundation that offered digital voting solutions. The idea behind this was similar to blockchain technology that helps us ensure transparency with blockchain transactions using public ledgers. Agora was used to records each vote on blockchain and it also ensured transparency with votes cast in the district by storing it in an immutable ledger thereby offering instant access to the elections result. Thus, blockchain entries can be seen by all but can only be checked by approved individuals. The goal of this initiative is to minimize the cost of voting by cutting down on paper ballots and eliminating corruption in the voting process. When the results of the elections were declared by Sierra Leone's election commission (NEC), the data suggests a run-off between Bio and Kamara is likely. Both the candidates failed to secure the required 55% votes. Considering the country's recent major disasters, Sierra Leone's next president will have to face the difficult tasks of rebuilding the country. It was a major loss for Sierra Leone one of the poorest countries of the world when an Ebola outbreak occurred which led to the death of nearly 4,000 and GDP losses estimated at $1.4billion in 2014. Recently, the capital was also affected by floods and mudslides which have claimed more than 1,000 lives. Many elections around the world have experienced a lack of transparency, but particularly in some African countries where large parts of the electorate are often accused of incumbent parties or ethnic loyalties having been responsible for manipulating the results in favor of one candidate or another. Even though there has been only little evidence of manipulation, these suspicions still remain. To regain trust, transparent voting systems were required.
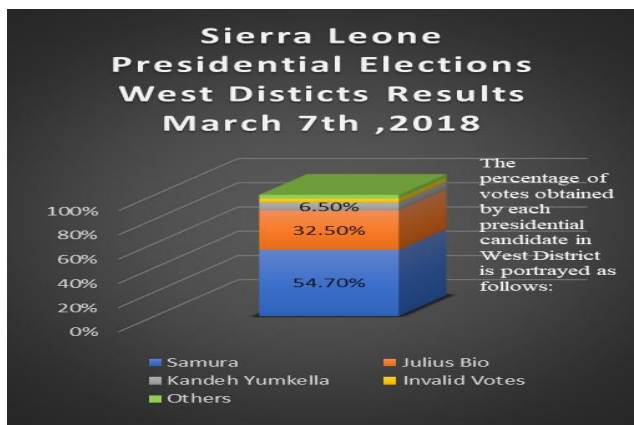

Fig. 4. Statistics of blockchain based elections conducted in Sierra Leone[11]

Fig.3. shows the count of votes received by each candidate only in the West District and it only features the statistics of those candidates who have received more than 2% of the total votes.In Agora 's count, Kamara won the western district elections by 54.7 per cent, short of the 55 per cent constitutionally required votes to win a national election.

Leonardo Gammar, CEO of Agora thinks that if they could do it in Sierra Leone, they could implement it in other parts of the world too. Poor network connectivity, low literacy levels and frequent electoral violence are some of the developmental challenges faced by Sierra Leone that makes it difficult to achieve electoral transparency.

The big picture for Agora is to use biometric data and customized cryptographic keys to implement solutions to automate the entire voting process with people voting electronically and the votes in turn verified by blockchain. Gammar hopes that Agora will be able to replicate its work on a larger scale in other African elections but admits that doing so would require a clear understanding of the various challenges faced by other countries.

Part-II

Zug, a City in Switzerland Conducted its First Test of a Local Blockchain Voting System

Zug, a city in Switzerland conducted its first voting pilot for its resident's identities and polling system. The system was operated on blockchain technology. This pilot e-voting system based on blockchain took place between June 25 and July 1, 2018. The city authorities issue digital ID's on November 15, 2017 [5]. A digital trial was conducted and tested before the actual polling according to local government authorities. Zug is no stranger to the world of blockchain in crypto technology. The city is already home to what is known globally as "Crypto Valley" as it has many crypto startups. It was developed to make the city more familiar with blockchain technology.

The voting took place with the help of Zug's electronic ID system. Luxoft Holding Inc, a global IT service provider helped create the first blockchain e-voting system. They built the authorized blockchain based on the Hyperledger Fabric including the network as well as the applications and algorithms. This was then integrated with Zug's digital Id registration app based on Ethereum which was authorized by uPort to allow the voters to cast their respective votes.

The votes were placed with this Ethereum based mobile app that allowed the voters to give their feedback if they believed that digital identity should be used to pay parking fees and to borrow books from the library. They were also asked to give their feedback on the inclusion of fireworks at the Annual Lakeside Festival. Among the 220 residents with digital IDs, 72 casted their votes through the blockchain system and 95 gave their feedback through an online survey.

The process was completed without the involvement of a single server and the results have shown that majority of voters found the system easy and convenient. The voters acknowledged the voting solution provided by Luxoft, from verification to the use of private keys.

However, some of the voters felt that not much had been done regarding the awareness which led to the inactive participation at the time of voting. Despite the high level of approval for e-voting using blockchain by the residents, however, some of them were doubtful regarding its security. The result of this polling was non-binding and not of much importance as the polling was only a test run according to authorities. However, the city is trying to determine if blockchain technology can be used on a wider scale.

VI. ADVANTAGES AND DISADVANTAGES OF BLOCKCHAIN BASED VOTING SYSTEMS

Elections around the world today face challenges such as crime, corruption, long waiting queues, transparency, affordability, and privacy [7].Blockchain networks offer new data storage techniques for securing trust and transparency. Now in this section, we look into some of the pros and cons of using blockchain technology.

Advantages

• Blockchain is immutable, decentralized blockchain networks have secure data storage, as any modifications to the data stored will be visible to all network users.

• Blockchain systems are a secure way to store election data as it is easy to detect any interference with the system's results such as manipulation of voting records.

• Blockchain can provide a safer mode of voting system, for instance in some countries like Nigeria and Kenya where election-related violence and murders occur it would not only provide ease and security but also the safety of voting from one's own home.

In general, the electronic voting system can provide solutions to most of the problems faced by today's elections like providing equal access to all people, long waiting queues, distance to polling locations or the expense for reaching there. If voting from phones were possible, it would be faster and more convenient for people to cast their votes, regardless of where they work or stay.

Disadvantages

Just like every technology has its own limitations, blockchain also has drawbacks in elections the same way. We will look into some of the drawbacks of blockchain technology.

• Even though blockchain is a secure technology, sources show there is a chance of a 51% attack which is one of the weaknesses of blockchain technology. People with more computing knowledge can interfere with the blockchain network and can manipulate or make fake blocks. It is possible that the attackers could be hackers, user groups or even the Election Commission.

• Another challenge faced by this type of technology is that it requires the creation of a safe computational resource that can process the votes of more than 75 million of voters.

• The expense of such a computational resource will also be more which is a drawback of blockchain technology.

• When using a blockchain system to store data, the system must ensure that the data is reviewed by the public and that the system is decentralized. If the system is not decentralized, but only controlled by one person or corporation, changes may be made to the data and if there is no public access to the data, those changes could not be detected.

• Validation of data is very important in this kind of voting system. Even if data can be stored efficiently and safely in a blockchain, a block-chain based voting system always needs to ensure that the records are accurate There is a possibility of inserting inaccurate data into a blockchain especially about events outside electronic medium, like voting. In situations where people can vote from their phones, precautionary actions must be taken to protect it and prevent hackers from manipulating them. Many cybersecurity experts claim that any form of online voting would pose new threats and security issues and hence it is difficult to secure connected devices. Blockchain voting helps improve the process of electronic voting by protecting against fraud, hacking, and several other malpractices. There has been, however, many situations where blockchain voting systems still contain security vulnerabilities in some way.

VII. CONCLUSION

The idea of integrating e-voting systems to make the voting process cost-efficient, faster and simpler in modern society is challenging. The existing voting system has many drawbacks. In this review paper, an e-voting system based on blockchain technology has been discussed. We also looked into the various features of blockchain and how it can provide a new opportunity to resolve the major drawbacks of the current electronic voting systems which also ensures the integrity, security and transparency of elections. In conclusion, we must require an efficient system like blockchain which can act as a comprehensive solution that satisfies all the requirements

REFERENCES

1. Mrs. Harsha V. Patil, Mrs. Kanchan G. Rathi, Mrs. Malati V.Tribhuwan(2018). A Study on Decentralized E-Voting System Using Blockchain Technology, November 2018, IJERT,pp. 1-4.
2. Dipali Pawar , Pooja Sarode , Shilpa Santpure , Poonam Thore, Prof. Pravin Nimbalkar(2019). Secure Voting System using Blockchain, November 2019, IJERT.
3. Yomi Kazeem(2018). The world's first blockchain-powered elections have just happened in Sierra Leone, March 2018, Quartz.
4. John Biggs(2018). Sierra Leone just ran the first blockchain based election, March 2018.
5. Jimmy Aki(2018). Switzerland's "Crypto Valley" Successfully Completes Blockchain Voting Trial, July 2018.
6. SriRaksha S Arun, Shibani, Spoorthi S, Vaishnovi R Kamath, Dr. C Vidya Raj(2019). Blockchain Enabled E-Voting System, April 2019, IJARCCE, pp. 1-4.
7. Signe Agerskov(2019).Pros and Cons in Blockchain-based Voting Systems, November 2019.
8. Friðrik Þ. Hjálmarsson, Gunnlaugur K. Hreiðarsson, Mohammad Hamdaqa, Gísli Hjálmtýsson(2018). Blockchain-Based E- Voting System, July 2018,IEEE 11th International Conference on Cloud Computing (CLOUD), pp.1-3.
9. Dr. Khomdon Singh Lisam(2012). How Can Electronic Voting Machines (EVM) Be Manipulated?, March 2012.
10. Vishwa Bhaskar Rao and Mohit Giri Goswami(2017). E- Voting: An analysis of Security Issues in EVM, Research Trend.
11. Michael del Castillo(2018). First Results of Sierra Leone's Blockchain Vote Are In, March 2018, coindesk.

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121

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