ADI Journal on Recent Innovation (AJRI)
Vol. 5 No. 1 September 2023

p-ISSN : 2685-9106
e-ISSN : 2686-0384

Secure and Transparent Elections: Exploring Decentralized Electronic Voting on P2P Blockchain

Mochamad Heru Riza Chakim[1], Aliyah[2], M. Adhit Dwi Yuda[3], Rifqi Fahrudin[4], Dwi Apriliasari[5]
University of Raharja, Cikokol, Tangerang, Indonesia[1, 3, 5]
Cendekia Abditama University, Klp. Dua, Kabupaten Tangerang, Indonesia[2]
Catur Insan Cendekia University, Cirebon, West Java , Indonesia[4]

e-mail: heru.riza@raharja.info[1], aliyah@uca.ac.id [2], adhit@raharja.info[3], rifqi.fahrudin@cic.ac.id[4], dwi.apriliasari@raharja.info[5]

Author Notification
20 May 2023
Final Revised
26 June 2023
Published
08 August 2023

To cite this document:
Riza Chakim, M. H., aliyah, Yuda, M. A. D., Fahrudin, R., & Apriliasari, D. (2023). Secure and Transparent Elections: Exploring Decentralized Electronic Voting on P2P Blockchain. ADI Journal on Recent Innovation, 5(1Sp), 54–67.
DOI: https://doi.org/10.34306/ajri.v5i1Sp.959

Abstract

Voting is one of the methods used by humans to determine decisions in a case. Along with the development of technology, conventional voting also follows the transformation in the adaptation of the current digital era. There is an electronic version of this voting which is often called e-voting (electronic voting). Of course, the application of technology in voting will raise public opinion about concerns about maintaining network privacy and security in e-voting. Of course, security problems can be overcome with technology that is currently being utilized optimally in various fields of life, namely blockchain technology. In enhancing e-voting security, blockchain will be used in P2P networks. The application of the blockchain system in e-voting will produce a safe e-voting system so that it can reduce the percentage of forgery of votes in the e-voting system. Implementing a blockchain-based e-voting system will involve 3 elements, namely cryptography, software engineering theory, and voting theory. In realizing blockchain-based e-voting, several stages are needed. (1) vote counterfeiting is avoided by adjusting the voting recording model based on ledger technology, (2) in terms of authentication, this technology is equipped with elliptic curve cryptography (ECC) based user model design, (3) providing a model designed for voters to change their vote before the specified time limit. The integration of these three designs is an important requirement in the e-voting process, proving and verifying a blockchain-based e-voting system in a P2P network that has been designed on linux.

Keywords: Blockchain, E-Voting, Security

1. Introduction

Indonesia is a just, democratic and prosperous country [1], where the application of democracy and the voting system are determined as a method of solving a problem fairly [2]. Voting is usually used in debates, election campaigns and discussions. Voting itself is a procedure or method that focuses on the preferences of each individual [3], group or meeting [4]. Voting is used within the scope of groups or organizations such as companies, voluntary associations, school spheres, and residences in [5] where voters are usually given the freedom to choose the candidate they like, with the privacy of voters being maintained from others [6]. In Indonesia, general elections are held based on the principles (direct, general, free, confidential, honest and fair) or abbreviated as LUBER JURDIL as stipulated in Law no. 7 of 2017 [7].

Currently, conventional general elections have many shortcomings, ranging from frequent errors and even manipulation of incoming vote data [8] [9] and even in holding conventional elections it can be said that they have not attracted the attention of the public, especially the millennial generation, in giving their right to vote, this is This can be seen from the increasing apathy (indifference) of the younger generation by not giving their right to vote in recent years [10]. With the problems previously described, there is a need for transformation in the electoral system. So it is necessary to make adjustments to the voting system so that it can keep up with current technological developments [11]. Technological developments are increasingly rapidly, with this rapid development there must be maximum utilization in aspects of life to facilitate and create community welfare [12]. Electronic voting or (e-voting) is the proposed solution, which from the abbreviation of the name already looks very familiar, e-voting is online voting or technology-based voting [13] which will involve technological advantages starting from the voting process to counting. votes cast by the voting office [14]. The application of e-voting can attract the attention of certain groups, namely the younger generation compared to traditional voting [15], because its use is easier. The use of technology makes elections look bigger and the application of e-voting will also provide benefits for the state budget costs incurred for each general election activity. E-voting offers cost savings in terms of labor, as well as the provision of facilities (places) [16]. Through e-voting, voters can submit their choices to election authorities from any location and offer a high level of security that cannot be denied by anyone with authenticated encryption on the implementation of the e-voting system [17].

1.1 Background

Voting is a very important thing in a country that adheres to a democratic ideology to determine the fate of a country or organization [18]. However, voting that has existed until now is still done manually where in this all-manual implementation there are still many visible frauds, ranging from coercing voters' voting rights by giving the lure of a reward and there are even prospective spouses who manipulate results of the vote by replacing the ballot box in the polling place with his own. Seeing the important role of voting for the future of the country because of the election of a leader who will govern a country for 5 years, it is necessary to develop a voting system that can provide security for voters to choose the desired candidate so that later the decision of the country's leader is the pure vote of society without the interference of parties who are not concerned. And it is hoped that there will be a voting system that can attract voters (the public) to participate and advance the state in the form of giving their voting rights, especially the younger generation seen in recent years give apathy towards voting in Indonesia. With e-voting following current technological developments, it is necessary to stipulate a number of important principles that adapt the conventional general election system, where e-voting or (electronic voting) needs to have the characteristics of accurate calculations.real-time, availability of high security for voter data, data accuracy [14]. Electronic general elections (E-voting) will provide many advantages by providing several advantages compared to conventional elections, including being able to save time and energy, high efficiency and flexibility [4]. Of course, the submission of e-voting will lead to pro and con opinions from the public regarding concerns about the level of privacy security offered by e-voting in utilizing technology [13]. Voting procedures by e-voting will be used in technological devices such as mobile devices, computers with the help of the internet, which are the areas of research on signature algorithms, cryptography and encryption [6] [17] [19]. Additionally, it is important to explore the potential challenges and limitations of implementing blockchain technology in the

voting system, such as scalability, transparency, and the need for a robust consensus mechanism. However, maintaining one of the important elements in voting namely anonymity is not adequately handled by data encryption [20]. Of course, this statement is a public question about how to design a practical and safe e-voting system [21] for the information or privacy of each voter in voting. Therefore, in answering people's concerns in this study we present a system that utilizes blockchain in the development e-voting system to increase voter security and anonymity. Where Blockchain is a record of direct peer-to-peer transactions that are connected in a decentralized manner where each data will be secured cryptographically [22]. In recent decades, blockchain technology has received a lot of attention from data management, technology security, and scientific research [23]. Whereas in blockchain e-voting will be equipped with signature algorithms, data encryption, and cryptography as elements that can strengthen data security in the system from hackers as well as providing a sense of security and trust for the public that technology can facilitate human activities.

1.2 Framework Study

Here, we present a strategy for implementing blockchain in e-voting systems to enhance voter privacy security. Blockchain itself is a technology discovered by Nakamoto in 2008, where the blockchain is based on distributed ledger technology that functions as a public transaction ledger for the bitcoin cryptocurrency. In the blockchain system, there will be synchronization with the validation carried out by the community on the system from replica ledgers created by several nodes in the blockchain system [24] [25]. Every data that is input into the blockchain technology system will be encrypted using secure hash algorithm 256 (SHA-256) at regular intervals to form a chain or block and then sent to all networks that are connected peer-to-peer [26]. Blockchain implementation in the e-voting system in research will go through several stages:

1. Avoiding voting fraud, a synchronous system will be designed with a distributed ledger that can be used to track data that has occurred. This data is important so that it can be updated in real-time thereby reducing reconciliation activities [27].
2. The authentication function will be designed based on elliptic curve cryptography (ECC) in the credential model.
3. There will be a voting function for voters to change their choice before the specified time limit.

The blockchain-based e-voting system will be designed on the Linux platform,Where on this platform can be used to prove or verify the system scheme to be run [28]. This blockchain-based e-voting system involves 3 important things, namely software engineering theory, voting theory, and cryptography. Through the implementation of these 3 important points, we propose the design of a blockchain-based e-voting scheme that also complies with the principles of conventional voting procedures. By implementing blockchain in the e-voting system, it can reduce voting fraud by blocking vote fraud which often occurs in conventional general elections and ensuring increased voter safety in voting.

E-voting decentralization will be presented in 4 sessions:

1. Section 2, introduction to the structure of the blockchain-based e-voting system design.
2. A detailed description of the blockchain-based e-voting scheme is in section 3.
3. Presentation of the blockchain e-voting scheme for further evaluation of its shortcomings will be explained in section 4.
4. Part 5 or the completion stage, will present a ready-made blockchain e-voting system design summary.

2. Literature review

In research on decentralized electronic voting based on blockchain P2P, 12 literature reviews related to blockchain will be discussed starting from the application of blockchain in education, social and other fields. There are 7 literature reviews discussing the application of blockchain in the world of education, starting from the use of learning methods to certification. 2 literature reviews on industrial applications, 1 reviewReferences the application of blockchain

p-ISSN : 2685-9106
e-ISSN : 2686-0384

technology which has contributed to the pandemic situation, and there are 2 literature reviews that will discuss the security offered by blockchain technology [29].

Research on blockchain certificates in the world of education, to be precise [30], blockchain implementation is used to increase data security and minimize manipulation. certificate by providing a unique numbering for all teacher certificates (Lecturers). The implementation of another blockchain theme that raises the topic of blockchain in verifying the authenticity of written data to reduce the recognition of data that is not their right has been successfully carried out. Data security in the world of education that utilizes blockchain technology is currently being carried out very intensively so that other research has been successfully carried out and discusses the security of data provided by the blockchain system, where data stored on the blockchain will be encrypted with a different unique code. thus making it difficult for people who do not have access to modify data.

The application of Blockchain in learning methods has also been successfully carried out by research and presented in the form of papers by several authors. One of the applications of blockchain in learning methods to be precise [22] which focuses on the characteristics of the blockchain, namely distributed, where in this study the blockchain succeeded in presenting a structureLTAI belonging to Raharja University students to be precise at the Alphabet Startup incubator is getting neater. Other research discusses the role of blockchain technology in providing innovative gamification learning techniques at Raharja University. Universities that provide engineeringFun Learning for students to be more active in learning. Blockchain is also used in the evaluation of learning in the world of education, namely exams that students will pass, which discusses the use of blockchain technology that supports social distancing where students don't need to come to campus to take exams, they only need the internet to access exams in real time. time.

In the world of education, Blockchain can also be applied in making applications that provide a sense of security for students and student guardians to store personal data that utilizes technological developments.

In addition to the application of blockchain in the world of education, this research raises several other review literature whose applications are outside the scope of education. Blockchain research is used in improving transaction security which explains 5 principles, namely database distribution, transparency, 2 peer-to-peer transmission, records that are difficult to change, and Blockchain computing logic in providing a sense of security for users in making transactions In other studies discussed the implementation of Blockchain for developed, just and prosperous countries for their people, which in this paper explains that the use of blockchain can reduce the problem of corruption that is often carried out by state officials.

The blockchain literature review then discusses the application of blockchain in the industrial world. discusses the use of blockchain in security enhancements that can reduce industry expenses and simplify production. In 2020 blockchain research that can provide an advantage for the industry in selecting new employees is the application of blockchain technology in checking the authenticity of this research diploma certificate.

Furthermore, Blockchain can be applied to solve the pandemic problem that is currently hitting several countries in the world where blockchain can be used to track the supply of relief goods to the public with its transparency characteristics.

From the 12 literature reviews described above, it is clear that blockchain is focused on the world of education in order to produce quality young people. As well as the use of blockchain in this literature review, all of them focus on the security advantages offered, because in this literature review there are many discussions in the field of education, therefore the researcher chooses to conduct research that will take advantage of the security advantages of blockchain in electronic voting systems that will enter into social scope in its application.

3. Research Purpose

Of course, in conducting research, it is necessary to have goals to be achieved so that the research becomes more focused, here are the research objectives regarding blockchain-based decentralized electronic voting on P2P networks:

p-ISSN : 2685-9106
e-ISSN : 2686-0384

1. To take advantage of blockchain technology beyond the scope of education, the use of blockchain technology in e-voting will have a big impact on many people (Social).
2. The use of blockchain can bring innovation, where voters do not need to be in a direct location to cast their right to vote, with this advantage voters who are traveling abroad can still vote via smartphone.
3. This e-voting application aims to attract the attention of the younger generation to use their voice and not become apathetic citizens.
4. Makee-voting blockchain as a solution to overcome the problem of conventional voting (Manual).

4. Method

Deep blockchain application cryptocurrency is an interesting topic for implementing blockchain systems in various fields ranging from education, social, economics, industry, and offices. The blockchain system uses a distributed ledger where the system is continuous,form new blocks that contain new data in the system so that later new blocks can be assembled into one unit that stores the hash value of the previous block and that has been made by several previous nodes in the system [45], of course adding new blocks to the system requires approval or verification the existing community in the network (Figure 1). The process is quite complicated to ensure that the trusted security of implementing the blockchain system in the bitcoin cryptocurrency is the forerunner of blockchain exploitation in the need for increased security in the design of e-voting systems, which is currently a popular topic of public concern. Here are some improvements in terms of voting security compared to conventional voting:

1. Design a voting model that avoids vote falsification by implementing a blockchain system based on distributed ledger technology.
2. Provision of authentication features equipped with a credential model based on ECC.
3. The advantage of the voice changer feature is the opportunity to change the voter's vote submitted before the specified time limit by withdrawing the vote.

The designed scheme will be presented in Figure 1. along with the elements in the blockchain e-voting scheme design.

Figure 1. Schematic design of a blockchain-based e-voting system

1. Voter list data will be added and stored in one block on the blockchain system.
2. Voters have advantages over the blockchain e-voting system, namely the option to withdraw votes before the specified time.
3. All votes entered into the e-voting system will be stored at the polling office. The polling office has the right to process vote verification as well as inquire about the public key held by the voter.
4. Public Key, is an element that handles the security of the selector's public key with encryption.
5. Every vote entered and managed at TPS will be entered into a database voting so that the number of voters can be seen in the statistical database.

p-ISSN : 2685-9106
e-ISSN : 2686-0384

4. Blockchain-Based E-VOTING STRUCTURE

The votes received will be included in the block by going through the verification steps carried out by miners to get a hash to maintain the security of the votes stored in the block.

4.1 Understanding Blockchain in Blockchain-Based E-voting Systems

In the blockchain-based e-voting design there is a block chain, where in this block all data has been submitted and arranged based on distributed data (Figure 2).

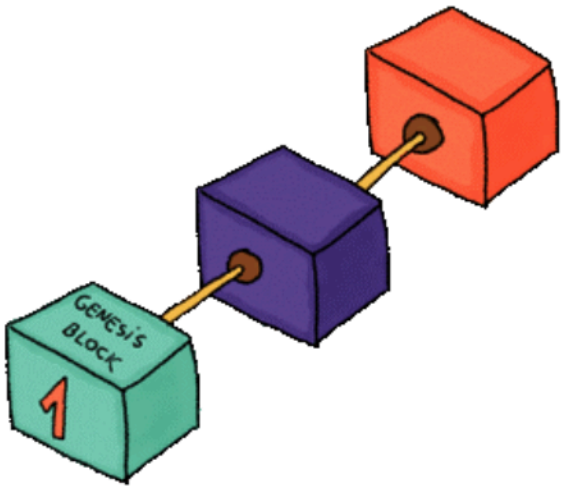

Figure 2. Illustration of the arrangement of voter data storage blocks

The elements stored on this block include (Picture 3):

1. Signature
2. Timestamp
3. Selector Voter ID

Each block will have a high level of security with it has different, where this hash will go through several processes starting from completion problem mathematics by paraminer that need to be validated by other member nodes. When a hash is found, a new block will be formed and form a chain between the previous block and the new block. This fairly complicated process will maintain the security of the data stored in this block and will be difficult to deceive because the data will be mutually encrypted. The block will store several elements, namely:

1. Voter ID, where in e-voting they play a role in voting for the pair of candidates they choose.
2. Of course in general elections there seems to be. The incoming ballot invoice is the voter's choice for the candidate partner who is of interest.
3. In electronic voting to verify the authenticity of the stored votes, it requires the voter's signature to sign the hash of the votes so that later the votes will be stored safely without any leakage of votes. This signature will assess the authenticity of the data received.
4. The blocks stored in the blockchain-based e-voting system have a time record, namely the block creation time in UNIX time format which is the number of seconds that have passed since 00:00:00 Thursday, January 1, 2021.
5. Each block will have a unique hash, where with this hash, the blockchain e-voting system will find it difficult to modify the data it stores. This hash system implements the SHA-256 algorithm used in bitcoin.

p-ISSN : 2685-9106
e-ISSN : 2686-0384

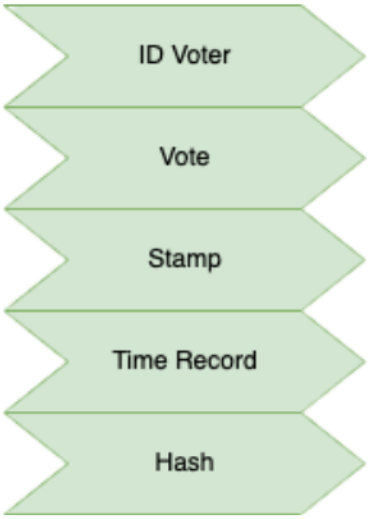

Figure 3. Elements on the block

4.2 Implementation of ECC on User Credentials

In the features offered by the e-voting system, namely authentication, there will be a model design that applies ECC to user credentials. Here are the steps for implementing ECC.

1. The results of each voter's vote will be stored securely and will only be known to him with the security of using the voter's signature to verify his vote.
2. To authenticate the voting results, each voter will be directed to use a private *key* to mark blocks with hash and signature of each individual using the ECDSA signature.

The signature inputting process is described in Figure 4. There are 7 elements in the signature inputting process in the system. e-voting namely:

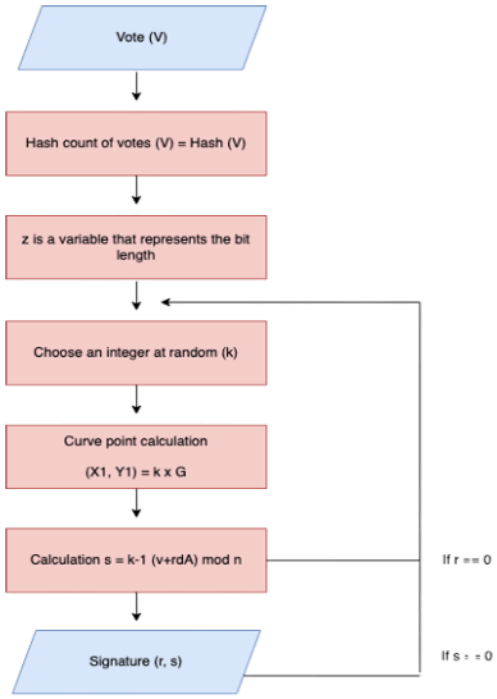

Figure 4. Signature print

p-ISSN : 2685-9106
e-ISSN : 2686-0384

1. Vote count = Number of Hash votes
2. Z to represent the bit length (Ln) of the left side sound. (Ln)
3. Selection of random numbers (k) starting from [1, n - 1].
4. Calculation (X1, Y1) = k (random number) x G
5. Calculate r = x1 mod n. If r == 0, process returns to (3).
6. Calculate s = k-1 (v + rdA) mod n. If s == 0, return to (3).
7. Voting signature in symbols (r, s).

An explanation of the variables involved in the hash block signing process.

n: As an integer
G: The point of the basic elliptic curve
O: As a marker of the element ID selector or identity of the selector n As an integer in the formula nx G = O. Ln, where Ln is the bit length indicator (n)
In calculating the length of the bit (n) will be given an illustration of nx G = o. Ln, where G = denotes the base of the elliptical curve.

In using the blockchain system in the e-voting system, of course there are familiar terms that need to be known, namely the elements public *is* and private *key*. The two keys on the blockchain will be used by voters to generate block hashes and keep their privacy safe. Where in this blockchain-based e-voting scheme,*private key* denoted as dA with integer units. While the public key is a curve point which is denoted by QA = dA × G, (x) as a multiplication sign for the points of the ellipse image.

4.3 Calculating Block Hashes With Sha-256 Conditions

Improving the blockchain from a blockchain-based e-voting system, a unit is needed between the old block that has been created and the new block, for this it is necessary to have hashes that can integrate. old block with new block is required by calculation based on SHA-256. The hash value calculation will be explained in Figure 5 in detail.

1. Notifications are represented in a variable (m) by applying a binary expression
2. M = pad (m) drawn for length (m) 64 bits with binary expressions and pad (m) for order 1000….000
3. Next, m will be truncated into smaller numbers with 512-bit binary chunks, expressed as M (1), M (2), M (3), and so on ... ... M (n)
4. 64 constants are used, each denoted by W0, W1, ..., W63
5. Eight work variables labeled a = 0x6a09e667, b = 0xbb67ae85, c = 0x3c6ef372, D = 0xa54ff53a, e = 0x510e527f, f = 0x9b05688c, g = 0x1f83d9ab, and h = 0x5be0cd19 used as the initial hash value.
6. Compute the 64-cycle cryptographic iterative computation for the first chunk.
7. The result of the last iterative computation is the hash.

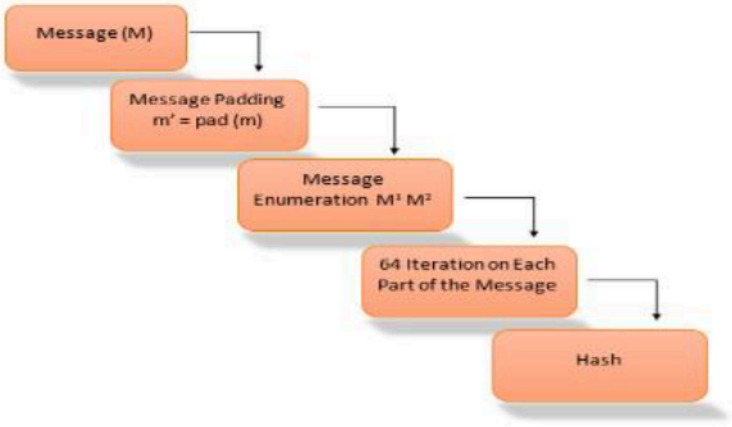

Figure 5. Hash creation process

4.4 Formation of New Voting Block and Miner Hash Block

Voters who have successfully submitted to the e-voting system will then be stored in that block. The creation of this block will use the same Pow algorithm and application as SHA-256 to be able to decode a unique code to integrate new blocks with old blocks in P2P networks. Votes that have been verified are authentic, and want to be included in a new block, a miner's role is needed to generate a hash through the information obtained from voting, when a miner finds a suitable hash, the next step is to inform participants in the P2P network. When a new block is successfully created and it turns out that the timestamp on the block is the same, the block with the highest signature value will be selected.

4.5 Security considerations

Security issues are of course highly considered in implementing this blockchain-based e-voting scheme. In the election protocol, public privacy data must be maintained so that it does not leak and prevent unwanted bad things from happening. In a blockchain e-voting system, this will prevent that from happening, with blockchain implementation it will be difficult for hackers to enter the network and manipulate data. The level of security provided by blockchain technology is very high, as evidenced by the copying of data that enters the system to all participants in the system.

With the distribution system in the blockchain technology system, it will prevent hackers from entering the system, whereby when hackers force entry into the system, they are required to change the entire content of blocks in the blockchain chain. For example, when a hacker wants to falsify data in block number 7, he must also replace the previous block, and of course this will not be easy because there is a hash code that belongs to each block which is very difficult to crack. If the hacker succeeds in changing block number 7, the system will verify that the block after number 7 is valid because it detects an irregularity in the data entered. From the user side of the blockchain system, they will not be affected by hacker activity, they will keep original data records without any fake data being made by hackers, and the system will continuously create new blocks in the blockchain. chain. With the security that blockchain provides to users, a blockchain-based e-voting scheme will provide a sense of security for the public to vote and eliminate concerns in terms of negativity regarding the use of technology.

5. Result

From the results of data analysis, voting in Indonesia still has injustice that is felt by the community. Judging from the chaos that occurred after the announcement of the results of the leadership voting. The injustice felt by the community was triggered by bribes from candidates, justification for roads in an area in exchange for choosing a candidate, to the issue of ballot box manipulation in several areas where all the votes were filled for fraudulent candidates.

The e-voting system can certainly be a solution to the problem of vote falsification that is experienced during general elections. The blockchain-based e-voting system makes it easier for voters to vote (efficient), very easy to use (practical), reduces the state budget spent on conventional election security, and maintains the security of voter privacy because of its nature (anonymous). The blockchain design scheme has been designed on the Linux platform with the Ubuntu system with source code using the Python programming language. In improving the security of election votes, votes that have been stored in the system will be stored in blocks contained in the blockchain system. Where in this block will store 5 important elements to prevent fraud loopholes.

1. The hash that belongs to the previously created block.
2. A timestamp is found on every block that has been successfully formed.
3. Votes cast by voters.
4. Voter's signature, to verify the authenticity of the vote.
5. Voter ID.

The design of the e-voting system model above will describe the implementation of blockchain in the system below:

p-ISSN : 2685-9106
e-ISSN : 2686-0384

1. By implementing blockchain in the e-voting system, voting willin decentralization, public, and distributed, and voters' votes are recorded on the device so that the goal is achieved to minimize fraud, namely vote falsification.
2. Audit and verification using e-voting technology can minimize state budget spending.
3. Minimize vote rigging, by implementing a peer-to-peer network in timestamps and validating votes with the consensus of members in the network.
4. With a blockchain voting scheme, it will increase security in fraud loopholes.

The use of technology in the development of electronic voting will result in a high difference in terms of security compared to conventional voting. The following differences will be explained in detail.

1. The nature of blockchain-based e-voting promotes anonymity, where user privacy (identity or personal data) will be stored securely in the system because voters need an ID to vote.
2. Increase security in terms of vote falsification, votes will be difficult to change after being stored in a block because the e-voting model is synchronized with the distributed ledger.
3. Vote refusal is difficult due to the design of the ECC-based user credential model for authentication.
4. Voters are given a second chance to change their previous voting rights with new choices as they wish, provided that they do not exceed the time limit for inputting all voter data.

A. Voting Blockchain-Based E-Voting Workflow

1. Dead will provide an identity ID to distinguish voters from each other, and also voters get their credentials from the polling office.
2. Since the e-voting system implements the blockchain system, voters need to have an important element in the blockchain, ie private *key* and public *key*.
3. The private key will be kept by one voter without anyone knowing and the public key will be handed over to the polling office which has the right to access the public key in the process. general elections.
4. Miners will be randomly assigned to find a unique code for the creation of a new data block.
5. Once a miner finds a unique code, a block is generated. The schematic is illustrated in (Figure 6).

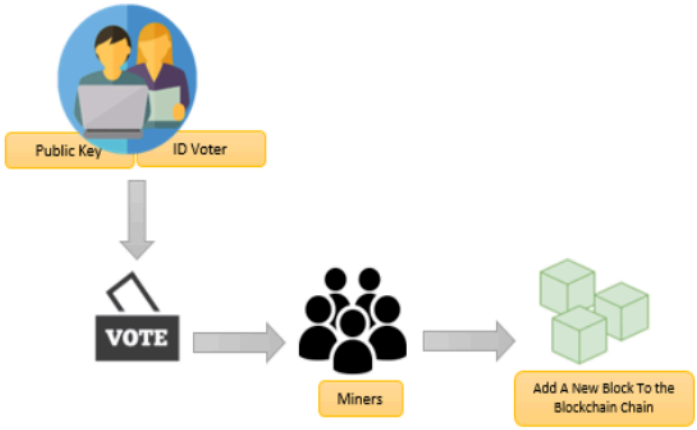

Figure 6. The flow or process of blockchain-based e-voting

p-ISSN : 2685-9106
e-ISSN : 2686-0384

B. Voting

Voting is depicted in Figure 7. and is illustrated as follows:

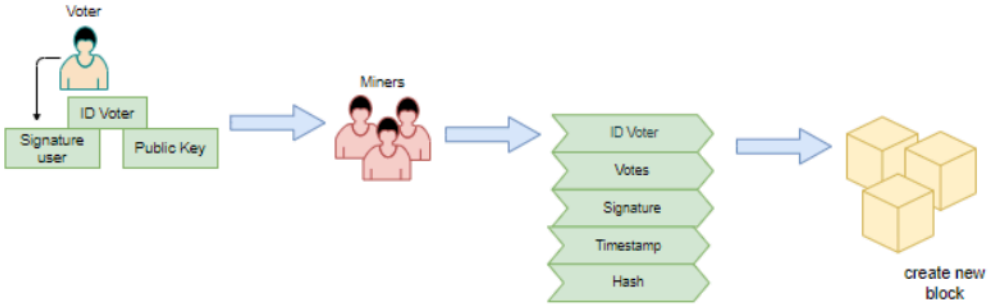

Figure 7. Voting Process

1. The voter hash is obtained from H = Hash (voter ID + Vote + timestamp in the block).
2. The voter's private key will be used to create a signature (S).
3. Miners have the right to access Vote, S, timestamp, public key, ID selector in creating a new block that is integrated with the previous block.
4. In obtaining block hashes, miners use SHA-256 with the calculation H = Hash (ID + Timestamp + voting)
5. *Public key* which is granted access to miners will be used in the voter signature verification process to get Hash (H)
6. After getting H, the miner will compare one H with another H contained in the block, if both are the same then S is received and successfully verified.
7. Miners will create a new block that is integrated with the previous block with the help of voting and hash information that the previous block has.

The application of blockchain technology in the e-voting system is equipped with 8 benefits, namely:

1. **Anonymity,** namely the application of the principle of election to the principle of secrecy. Where the characteristics of this anonymity make the voter's choice known only to himself.
2. **Transparency**, with blockchain technology, of course, this feature is already familiar because blockchain is famous for the transparency of all activities that occur in the system. The application of the characteristics of transparency in e-voting provides justice and increases honesty because the data stored in the system will be open to the public.
3. **His validity**, the application of blockchain technology will make it difficult for people who do not have access to enter the system and damage the data. Due to Chara's tourism feasibility, it only provides an opportunity to vote for voters who already have access to the system.
4. **Verifiability** This fourth characteristic is a characteristic that is used to verify the procedures performed by the system.
5. **Dependability**, the fifth feature is proof of e-voting security, there is no need to doubt it, because in a blockchain-based e-voting system, voters (voters) cannot be replaced by other people, multiply votes, or delete voter choices.
6. **Audit Capability,**When a counting error occurs, the system must be able to provide features that can assist the vote counting petition.

7. **Political Side,**e-voting can reduce fraud that is often committed by a candidate by replacing the ballot with his choice at the TPS. By minimizing this fraud, leaders will emerge that are wanted by the community.
8. **Economic Influence,**politics can no longer influence voters from the lower class to give their right to vote to several candidates by coercion in the form of money given before the election .

With the presence of blockchain-based electronic voting, it can achieve the goal of reducing vote falsification which often occurs in conventional voting. By achieving this goal, it can present leaders who are in accordance with the people's choices without coercion from various parties and can present a just, prosperous and prosperous atmosphere for the people of Indonesia with leaders who can build a better country.

6. Conclusion

The idea of adopting a digital voting system to make the voting process cheaper, faster and easier, is one that is attractive in modern society [18]. Electronic voting will provide many advantages and efficiencies compared to conventional general elections, in terms of vote counting time. Conventional vote counting will be counted one by one, making counting quite time consuming. The existence of electronic voting will simplify vote counting and minimize the use of time in calculating vote results.

A digital voting scheme that utilizes blockchain technology can be the best solution for overcoming election problems that often occur, e-voting design schemes also meet important requirements in conventional elections. Through blockchain-based e-voting, all incoming data will be cryptographically linked between the old block and the new block. The application of blockchain to electronic voting systems will provide 3 security improvements, namely:

1. Easy to detect, all data that enters the system will be easily detected by the process making it difficult to manipulate.
2. Difficult to falsify as all selection processes are tracked from start to finish, it will be difficult to manipulate and all data will be distributed to every node in the network.
3. Decentralized, the blockchain e-voting system is not centralized on one party, because all nodes in the system will keep a copy of the voting data [69].

These three security improvements prove that the e-voting scheme prioritizes voter privacy security by providing difficulties in modifying data for parties who wish to commit fraud because the data stored in the block will be integrated with the previous block so that this integration will result. in invalid data if any. who want to modify one of the blocks assembled into one unit [70]. Of course, no matter how sophisticated the technology is, there are still drawbacks, where the implementation of blockchain in the e-voting system has attacks that make the data in the e-voting system threatened. The attack that the blockchain-based e-voting system must watch out for is the quantum computer attack.

References

[1] U. Rahardja, Q. Aini, F. Budiarty, M. Yusup, and A. Alwiyah, “Socio-economic impact of Blockchain utilization on Digital certificates,” Trans Aptitude. Manag., flight. 5, no. 2, pp. 106–111, 2021.
[2] R. Surbakti, D. Supriyanto, and H. Asy'ari,Maintain the integrity of the voting and counting of votes. Partnership for Governance Reform, 2011.
[3] S. J. Brams and P. C. Fishburn, “Voting procedures,” Handb. Soc. choice Welf., vol. 1, p. 173–236, 2002.
[4] J.-L. Zhang, J.-Z. Zhang, and S.-C. Xie, “A choreographed distributed electronic voting scheme,” Int. J. Theor. Phys., flight. 57, no. 9, pp. 2676–2686, 2018.
[5] T. Rogers, D. P. Green, J. Ternovski, and C. F. Young, “Social pressure and voting: a field experiment conducted in a high-salience election,” Elect. Stud., vol. 46, p. 87–100, 2017.

p-ISSN : 2685-9106
e-ISSN : 2686-0384

[6] E. Ahene, C. Jin, and F. Li, “Certificateless deniably authenticated encryption and its application to e-voting system,” Telecommun. Syst., flight. 70, no. 3, pp. 417–434, 2019.
[7] J. H. Wijaya, A. Zulfikar, and I. A. Permatasari, "Implementation of the E-Voting System to Improve the Quality of Democracy in Indonesia,"J. Government. And Wise., flight. 1, no. 1, pp. 51–59, 2019.
[8] O. Daramola and D. Thebus, “Architecture-Centric Evaluation of Blockchain-Based Smart Contract E-Voting for National Elections,” in Informatics, 2020, vol. 7, no. 2, p. 16.
[9] Q. Aini, B. S. Riza, N. P. L. Santoso, A. Faturahman, and U. Rahardja, “Digitalization of Smart Student Assessment Quality in Era 4.0,” Int. J., flight. 9, no. 1.2, 2020.
[10] F. S. Hardwick, A. Gioulis, R. N. Akram, and K. Markantonakis, “E-voting with blockchain: An e-voting protocol with decentralisation and voter privacy,” in 2018 IEEE International Conference on Internet of Things (iThings) and IEEE Green Computing and Communications (GreenCom) and IEEE Cyber, Physical and Social Computing (CPSCom) and IEEE Smart Data (SmartData), 2018, pp. 1561–1567.
[11] M. Yusup, Q. Aini, and K. D. Pertiwi, "Audio Visual Media Using Videoscribe as Presentation of Learning Information in Operating System Classes,"Technomedia J., flight. 1, no. 1, pp. 126–138, 2016.
[12] U. Rahardja, Q. Aini, and M. B. Thalia, "Implementation of Yii-Based Online Payment Confirmation Menu in Universities,"Creat. Inf. Technol. J., flight. 4, no. 3, pp. 174–185, 2018.
[13] E. Priyono and F. N. Dihan, "E-Voting: The Urgency of Transparency and Accountability," inNational Seminar on Informatics (SEMNASIF), 2015, vol. 1, no. 5.
[14] N. M. Shakiba, M.-A. Doostari, and M. Mohammadpourfard, “ESIV: an end-to-end secure internet voting system,” Electron. Commer. Res., flight. 17, no. 3, pp. 463–494, 2017.
[15] D. A. Gritzalis, “Principles and requirements for a secure e-voting system,” Comput. Secur., flight. 21, no. 6, pp. 539–556, 2002.
[16] N. Kshetri and J. Voas, “Blockchain-enabled e-voting,”IEEE Softw., flight. 35, no. 4, pp. 95–99, 2018.
[17] G. Madhavan, C. Phelps, and R. Rappuoli, “Compare voting systems to improve them,” Nat. News, flight. 541, no. 7636, p. 151, 2017.
[18] R. Hanifatunnisa and B. Rahardjo, “Blockchain based e-voting recording system design,” in 2017 11th International Conference on Telecommunication Systems Services and Applications (TSSA), 2017, pp. 1–6.
[19] S. Polyakovskiy, R. Berghammer, and F. Neumann, “Solving hard control problems in voting systems via integer programming,” Eur. J. Opera. Res., flight. 250, no. 1, pp. 204–213, 2016.
[20] A. Kiayias, T. Zacharias, and B. Zhang, “An efficient e2e verifiable e-voting system without setup assumptions,” IEEE Secur. Priv., flight. 15, no. 3, pp. 14–23, 2017.
[21] Q. Liu and H. Zhang, “Weighted voting system with unreliable links,” IEEE Trans. Reliab., flight. 66, no. 2, pp. 339–350, 2017.
[22] U. Rahardja, E. P. Harahap, and D. D. Christianto, "EFFECT OF BLOCKCHAIN TECHNOLOGY ON THE LEVEL OF AUTHENTICITY OF DIPLOMAS,"Technomedia J., flight. 4, no. 2, pp. 211–222, 2020.
[23] U. Rahardja, T. Nurhaeni, A. Khoirunisa, and R. D. I’zzaty, “LTAI TECHNOLOGY-BASED BLOCKCHAIN TO IMPROVE ALEXA RANK,” inSENSITIf: National Seminar on Information Systems and Information Technology, 2019, pp. 373–380.
[24] B. Lee and J.-H. Lee, “Blockchain-based secure firmware update for embedded devices in an Internet of Things environment,” J. Supercomput., flight. 73, no. 3, pp. 1152–1167, 2017.

p-ISSN : 2685-9106
e-ISSN : 2686-0384

[25] M. Liet al., “Crowdbc: A blockchain-based decentralized framework for crowdsourcing,” IEEE Trans. Parallel Distrib. Syst., flight. 30, no. 6, pp. 1251–1266, 2018.
[26] H. Willysandro P, "Design of an Electronic Voting Information System for Blockchain-Based General Elections." Multimedia Nusantara University, 2020.
[27] U. Rahardja, Q. Aini, M. Yusup, and A. Edliyanti, "Application of Blockchain Technology as a Security Media for E-Commerce Transaction Processes,"CESS (Journal Comput. Eng. Syst. Sci., flight. 5, no. 1, pp. 28–32.
[28] R. Yanget al., “Public and private blockchain in construction business process and information integration,” By car. Construction, vol. 118, p. 103276, 2020.
[29] U. Raharja, N. Lutfiani, I. Handayani, and F. M. Suryaman, "Student Learning Motivation for the iLearning+ Online Learning Method in Higher Education,"SISFOTENIKA, flight. 9, no. 2, pp. 192–202, 2019.
[30] F. Agustin, Q. Aini, A. Khoirunisa, and E. A. Nabila, “Utilization of Blockchain Technology for Management E-Certificate Open Journal System,” Trans Aptitude. Manag., flight. 4, no. 2, pp. 133–138, 2020.