

Online E Voting System by Using Block Chain Technology

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Abstract— One of the essential features of a democratic system is voting. There are many flaws in online voting systems such as security, tampering, and transparency issues despite most companies and organizations embracing online services and platforms today. Some of these flaws may jeopardize the voter trust factor.

The creation of a secure, open, and reliable website for voting is the main objective of this study titled "Online E-Voting System Using Blockchain Technology. Each individual's vote is stored as an encrypted information block that cannot be deleted or changed because it uses the form of a blockchain. The proposed online voting system checks each voter's credentials before casting their vote to guarantee both anonymity and avoid duplication of votes.

The suggested online voting system will help keep voters' anonymity while using a robust blockchain system to guarantee election integrity. Because of the encoding mechanism, dishonest voters and hackers will be unable to interfere with the voting data. In addition, the voting system proposed will have a transparent vote-counting procedure that will result in quick results.

The proposed e-voting system will be suitable for conducting college and university elections, organizational and government elections due to its simplicity and reliability. Using a blockchain system increases voter confidence while reducing the possibility of fraudulent acts. This will provide a reliable digital voting system for future elections.

Keywords: Blockchain Technology, Secure Voting, Voter Authentication, Cryptography, Decentralization, Transparency, Election Security, Digital Voting and Smart Contracts

I. INTRODUCTION

A. The Demand for a Safe Voting Method

In a democratic society, the right to vote is a fundamental right. It enables citizens to select their preferred leader and voice their concerns openly and fairly. Paper ballots or traditional electronic voting machines are used in most elections.

Despite their prevalence, these techniques have various drawbacks, such as votes being tampered with, slow counting processes, human faults, lack of transparency, and high expenditures. When it comes to something as serious as choosing the nation's leader, the flaws in the current voting system undoubtedly erode the confidence of the electorate.

B. Contribution of Blockchain Technology

An alternative strategy for conducting transparent and secure online voting is blockchain technology. Information is saved

in connected blocks on a blockchain, a decentralized digital ledger. Once information is stored on the blockchain, it is close to impossible to edit or delete it without the permission of the entire network.

This feature makes it extremely hard to tamper with the system, therefore blockchain technology provides a high level of security. With its aid, every cast vote on an online voting system will be stored securely as a block, making it inaccessible to hackers and other unauthorized persons.

C. Why it's important to vote securely online

Modern individuals are increasingly turning to the Internet and e-services, and voting is no exception. The introduction of a safe online voting system allows voters to cast their ballots from any location without having to go to polling stations. This method benefits students, employees, the elderly, handicapped individuals, and residents of remote areas since it is more accessible. In addition, a safe online voting system allows for faster vote counting and provides election results in a timely and transparent manner while also maintaining voter anonymity..

D. Issues with Standard Voting Systems

Traditional voting techniques have a few limitations, necessitating the transition to a blockchain-based system. Paper voting involves a time-consuming and labor-intensive procedure that requires a large number of workers. Traditional electronic methods, on the other hand, are vulnerable to central database manipulation, cyber attacks, and single-point failure. Additionally, there is the danger of vote duplication, unauthorized access, and slower vote counting procedures. The requirement for a safer and more transparent voting process becomes apparent when considering these limitations..

E. How the Voting Process Can Be Improved by Blockchain

Blockchain technology can help overcome many of the current voting system's shortcomings by providing a decentralized platform. Being based on decentralization, it is safe and secure. Votes registered on the blockchain are encrypted and saved as blocks, making them impossible to tamper with or delete. Using encryption, each voter is provided with the opportunity to vote only once, while maintaining his/her anonymity. By implementing such a system, the voting process becomes more reliable and transparent since all the data is stored securely and is

available for independent verification without disclosing the details of individual voters' ballots.

F. The Planned Electronic Voting System Online

This project aims at developing an "Online E-Voting System Using Blockchain Technology," which allows persons to vote conveniently, safely, and reliably. The process of registering and logging in as a voter, voter authentication procedures, voting itself, storing the cast votes on the blockchain and tallying them are the key aspects of the developed system. Being based on the blockchain, the proposed solution ensures the reliability of voting data, prevents fraud, and maintains privacy. It should contribute to the improvement of election results by providing accurate vote counting and timely disclosure of results.

G. Expected Results and Objectives

Designing a blockchain-based online voting system intended to increase the transparency of the voting process, ensure the security of the voters' data, and, ultimately, improve the quality of elections is the primary objective of this project. Enhancing the trust of the electorate in voting systems is the central idea of this project, but it is equally crucial to ensure that election fraud, duplicate voting, vote tallying, and overall transparency are improved in line with modern standards. This online voting system can become a convenient and dependable solution that can be integrated into different organizations to conduct the voting process among their employees, students, or electorate in general

II. Issues with Traditional Electronic and Online Voting Systems The main issues with traditional voting systems and the need for a blockchain-based solution are as follows:

A. Voting fraud

One of the most serious challenges associated with traditional voting systems is the likelihood of election fraud, which can impede the fair outcome of an election.

B. Transparency Deficit

The inability to ensure total transparency of the voting process is another major concern, as neither voters nor election commissioners can be certain that their votes have been counted accurately.

C. Threats to Safety

Traditional voting systems face multiple threats to safety and security, including phishing, hacking, and denial-of-service attacks,

D. False or duplicate voting

It is impossible to deny the likelihood of the occurrence of false or duplicate voting in conventional systems due to the absence of a robust user identification mechanism.

E. Security Concerns

Each voter's data and voting history must be kept secure and private; nevertheless, the design flaws of traditional systems can compromise the safety of the information and expose it to external threats.

F. Single Failing Point

If the central server, which stores all voters' requests and information, fails, the entire voting process will be interrupted..

G. Slow Counting of Votes

In the case of major elections, where millions of people exercise their right to vote, the manual counting of votes can be tedious and time-consuming, ultimately resulting in voter dissatisfaction.

H. Costly Elections

Hiring election commissioners, securing the voting stations, and maintaining the voting machines are just some of the expenses attributed to conventional elections, making them a relatively costly affair.

I. Accessibility Issues

Voters who lack access to polling stations are unable to exercise their right to vote; thus, there is a need for a more accessible system that takes into account persons with restricted mobility, the elderly, and individuals living in rural areas.

J. Lack of Faith

Due to the inability to audit and check the accuracy of their ballots, voters are unable to obtain complete confidence in the current voting system.

II. RELATED WORK

In recent years, there has been an increasing amount of research on "online voting systems"

as the demand for reliable and transparent elections grows

The databases that such systems use are highly vulnerable to hacking, data manipulation, and unauthorized access attempts. Various researchers have been working on methods for developing voting systems that are safe, transparent, and nearly impossible to tamper with in order to find a solution to this issue. With the help of Blockchain technology, it becomes nearly impossible to change or delete any information that has already been stored on it, ensuring the reliability of election results

A. Blockchain in Voting Systems Online

Blockchain-based voting systems have been suggested by various researchers in order to improve the security of elections and ensure their transparency. Transactions in the form of votes are stored in Blockchains as unique codes that cannot be deleted or altered

According to researchers, the use of Blockchain technology has been demonstrated to increase election integrity, prevent voter fraud, and boost overall confidence in the voting process. Besides that, a number of studies have suggested the application of smart contracts in Blockchain-based voting systems. Smart contracts allow for the automatic calculation of election results, storage of votes, and identity verification without the involvement of any other party. As a result, voting becomes faster and more efficient.

B. Secure Authentication of Voters

A voting system should have certain features in order to ensure the security of elections. First of all, only eligible voters should be able to cast their votes with the help of a voting system that has been developed. In order to achieve this goal, various researchers suggest applying different authentication methods, such as One-Time-Password, biometric, Aadhaar, and digital authentication, in order to ensure the confidentiality and integrity of the voting process. These methods suggested by the researchers allow for preventing voter impersonation and ensuring that each voter casts their vote only once. Election security and integrity are further improved by combining these methods with Blockchain technology.

C. Smart Contracts for the Management of Elections

Smart contracts play a critical role in e-voting systems that are based on Blockchain technology. Various aspects of the

election process, including voter registration, vote counting, validation of votes, and storage of election data, can be automated with the help of smart contracts.

According to researchers, smart contracts allow for ensuring that all terms established by the election authority are followed and reducing the overall amount of election-related paperwork and human intervention in the election process. Election integrity is further increased due to the automatic execution of smart contracts, which ensures that the election process adheres to the regulation requirements.

D. Blockchain Voting: Privacy and Safety

The secrecy of the ballot with the required level of transparency is one of the main challenges while voting online. Researchers make use of cryptographic primitives (encryption, digital signatures, and hash functions) to develop voting protocols that satisfy the desired level of data confidentiality.

Using Blockchain, election officials can ensure that the voter's data is not compromised while maintaining transparency by making the data publicly available. Additionally, Blockchain's decentralized nature helps in protecting the voting system against attacks and failures.

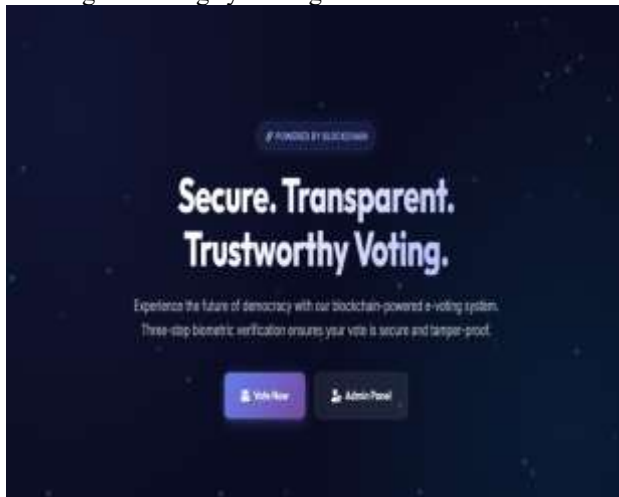


Fig 1: Admin Panel

E. Problems and Prospective Solutions

Despite many advantages conferred by implementing Blockchain technology in election systems, several challenges hinder its development and adoption. Among the challenges affecting Blockchain elections, high costs, scalability issues, slow transaction times, and the need to ensure accurate voter authentication are of great concern. Moreover, the public's perception of Blockchain-based voting systems needs to be studied.

Researchers should devote more effort to analyzing ways of improving Blockchain networks' performance, optimizing smart contract processes, enhancing authentication protocols, and developing intuitive yet safe voting applications.

III. PROPOSED METHODOLOGY

A safe, open-source, and reliable voting platform is what the proposed "Online E-Voting System Using Blockchain Technology" is all about. The system ensures voters cast their ballots confidently as the system's encryption mechanism protects the data. The proposed solution checks the credibility of each voter's input and guarantees that only a voters cast their ballots. Here is a list of the proposed methodology:

A. Registration to vote

The first step in the voting process is to register as a voter. In this case, voters must submit their personal information such as the name, voter ID, email, or any other relevant information needed for the registration to vote. Once the information has been validated, the voter is offered a login session where the user enters the generated login credentials to gain access to the voting system.

B. Secure Authentication and Login

The next procedure involves authentication and login, which requires the user to enter their login credentials. To enhance the security of the voting process and prevent vote tampering, secure authentication mechanisms such as OTP and fingerprint scan could be used to authenticate the voters and allow them to cast their ballots. This step also prevents the duplication of votes because the authentication makes sure that only one vote is allowed for each voter.

C. Casting votes

At this stage, authenticated voters cast their ballots by choosing their preferred candidate from the list of registered voters. When the voter clicks on a candidate's name, the system generates a ballot where the user can submit their votes. This ballot cannot be changed or canceled after casting the votes.



Fig 2: Voters Directory

D. Keeping track of votes on the blockchain

Votes are recorded on a blockchain network as encrypted transactions. Each transaction is encrypted using a hashing algorithm to generate a unique hash value that links one block to the previous block. The blockchain voting system has robust security features that make it safe and reliable in capturing votes.

E. Verification of Votes

The verification process ensures that the votes captured on the blockchain network are legitimate. The blockchain network checks the validity of the transaction and, by extension, the vote. As a result, the verified votes are safe on the blockchain network as they cannot be deleted or altered.

IV. EXPERIMENTAL SETUP

The design of the experiment describes the process of developing, testing, and evaluating the "Online E-Voting System Using Blockchain Technology." To accomplish this objective, the voting application was designed and tested using a wide range of software systems and technologies. The software used in the development process is described below

A. Environment for Development

The proposed application was designed using blockchain software and modern web technologies. The front end offers a

user-friendly interface for the registration, login, and voting processes. The back end, on the other hand, is responsible for managing voter data, authentication, blockchain data, and election results.

Software Requirements:

- * Operating system: Linux or Windows 10/11
- * Programming language: JavaScript and Python
- * HTML, CSS, and JavaScript for the front-end
- * Flask (Python) or Node.js for the back end
- * Database: MySQL / MongoDB
- * Ethereum and Ganache are the blockchain platforms.
- * Solidarity as a Smart Contract Language
- * Visual Studio Code is a tool for development.
- * Opera: Microsoft Edge or Google Chrome

Equipment Requirements

The following configuration of a typical personal computer was used to test the system:

- * Processor: at least an Intel Core i5
- * 8 GB or more of RAM
- * Storage: SSDs larger than 256 GB
- * A connection to the Internet is required to use the voting application.

B. Test Methodology

Several testers were registered as voters and requested to vote. All the registered voters voted for their preferred candidate after logging in with their credentials. Every voter's cast vote was validated before being stored in the block and added to the blockchain. After all voters had voted, the system automatically tallied all the votes to determine election results. A few tests were conducted to ensure: Only valid voters could access the application Each voter submitted their vote once and only once All cast votes were protected and accessible on the blockchain. The voting process was not altered after submission The election results were accurate

C. Evaluation of Performance

The following parameters were used to evaluate the performance of the proposed online e-voting system: Security: This is achieved by preventing vote tampering and ensuring votes are not removed from the blockchain

Transparency: This involves making all the votes in the blockchain available to every legitimate voter while protecting the privacy of the voters' personal information

Accuracy: There should be no room for human error during the counting process of all valid votes.

Privacy: Ensuring that a voter's personal information such as the location of the voter remains confidential throughout the voting process.

Efficiency: Achieved when votes are recorded and tallied electronically and instantly

Reliability: The system should be reliable and efficient, even when processing hundreds of votes simultaneously

associated with challenges in terms of ensuring the absence of voter fraud, ballot coercion, and overall integrity of the election process. Overall, these vulnerabilities make the process of holding elections challenging and undermine the trust of voters in the system. Thus, it is essential to design a secure online voting system that will ensure the reliability of the voting process.

The proposed Online E-Voting System using Blockchain Technology is intended to resolve the issues associated with traditional voting systems, as it offers a reliable framework that empowers election officials and ensures the integrity of the voting process. The e-voting system uses blockchain technology that allows for the safe storage of votes and prevents data from being tampered with. In addition, the developed system would address the issues of voter fraud and duplicate voting by ensuring the identity of the voter before casting a ballot. Overall, the proposed solution would prevent fraud and provide a safe, convenient, and transparent environment for voting.

The primary goal of the Online E-Voting System using Blockchain Technology is to make the voting process faster and cheaper while also minimizing the efforts of voters. Implementing the blockchain technology allows reducing the risks of interference in the election process due to the absence of a central server. Using decentralized data storage minimizes the risks of hacking and tampering with election data, thus providing a reliable and safe environment for voting. The proposed solution ultimately aims to provide opportunities for conducting digital elections that are convenient, transparent, and safe.

B. Planned Operation

The system under consideration is characterized by a relatively simple interface and allows the users to perform numerous operations conveniently and quickly. The online e-voting system consists of three primary components, namely the blockchain network, voters, and admin panel. In terms of the system's operation, adding the voters to the database, managing candidates, scheduling elections, and tallying votes are the primary responsibilities of the admin. The voter is required to register to the system, choose a preferred candidate, and cast a ballot. The system allows voters to securely log in and choose one of the available candidates. Next, the system stores the voter's choice in the blockchain network as an encrypted transaction and ensures the integrity of the election data.

V. SYSTEM ANALYSIS AND DESIGN

A. Analyses of Systems

The objective of the systems analysis phase is to determine the limitations of the current voting systems and propose a more reliable and safe voting system. Paper-based and conventional electronic voting systems have a number of disadvantages, ranging from votes tampering to counting errors. Additionally, conventional voting systems are

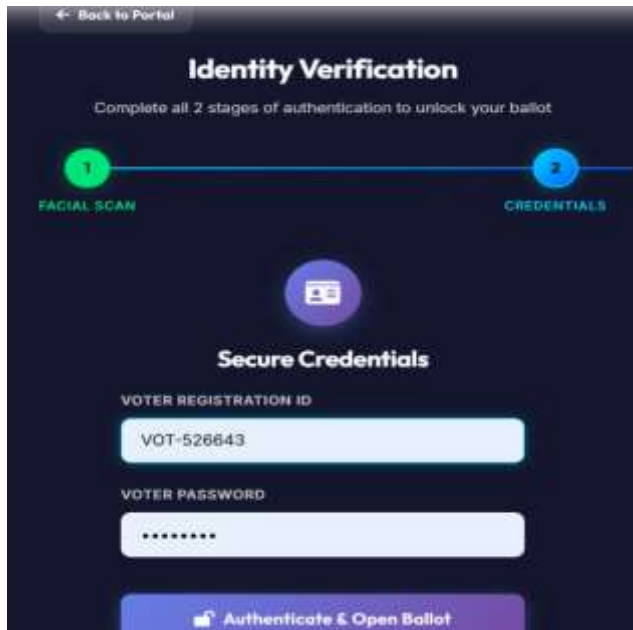


Fig 3:Secure Credentials

First, the voter needs to be registered in the system in order to gain access to the e-voting system. The registration process includes the provision of the personal data of the prospective voter and the verification of the information provided. When registering, the voter needs to provide a user name, a strong password, and personal information for verification. After completing the registration and reviewing the personal information provided, the admin can approve the registration of the voter. After that, the voter may securely log in to the system by entering the provided user name and password. After logging in, the voters are redirected to the dashboard where they can see the list of the candidates. After choosing the preferred candidate and casting a ballot, the vote of the voter is encrypted and stored in the blockchain network. The voting system relies on the blockchain technology that allows ensuring the accuracy of election results and preventing tampering with the votes casted.

The safety and integrity of the votes is ensured by the utilization of the blockchain technology, which allows recording the votes as encrypted transactions. First, the blockchain network provides the encryption of the data stored, which in turn ensures the security of the election data. Second, the proposed voting system relies on decentralized storage of data, which minimizes the risks of hacking or tampering with election results. The use of the blockchain technology ultimately contributes to the reliability of the voting process and its transparency. Specifically, the transactions in the voting blockchain network cannot be altered due to utilization of the complex mathematical algorithms. At the same time, the decentralization of the system eliminates the possibility of fraud by ensuring that there is no one specific server where the votes can be altered. The proposed system allows for tallying votes by automatically reviewing the data stored in the blockchain network. It should be noted that the automatic counting of votes ultimately reduces the time spent on processing the ballots.

The results of the election are viewable at the dashboard of the admin panel. At the same time, the transparency of the voting process can be achieved by reviewing the blockchain transactions that are utilized for storing the votes casted. At the same time, the privacy of the

voters is protected due to the fact that the personal information is stored separately from the votes. The proposed system is designed to be reliable and convenient, with a minimized likelihood for fraudulent activity. The online voting system would ensure transparency and prevent voter fraud, thus being a safer alternative to the traditional voting systems. In addition, the system would prevent duplicate voting and protect the identity of the voters. Ultimately, the development of the voting system would reduce the expenses and efforts associated with the conduct of elections. These features and benefits make the proposed Online E-Voting System using Blockchain Technology convenient and beneficial for businesses, governments, colleges, and universities in terms of conducting reliable elections.

VI HIGH-LEVEL DESIGN



Fig 4: Vote sealed cryptographically

A. Architecture of the System

The “Online E-Voting System Using Blockchain Technology” that is proposed provides an efficient, transparent, and reliable framework for conducting online elections. The system comprises several modules that are interconnected and perform different tasks to ensure that the voting process is secure from fraud and tampering. The proposed solution differs from the traditional online voting system because it stores votes on a blockchain database rather than a centralized database. This feature makes it possible to ensure the integrity of the votes casted, prevents forgery, and enhances security. Voter registration, voter authentication, candidate management, voting, storage of votes on a blockchain, vote verification, automatic vote counting, result generation, and performance evaluation are the main modules of the proposed system.

1. Registration of Voters

Voter registration is the first step in the voting process. Every eligible voter is required to provide certain personal information such as name, voter ID, email address, mobile number, and password before they can cast their votes. Before approval, the provided information is cross-verified by the election administrator to ensure that only eligible and genuine voters are allowed to participate in the election process. Upon successful registration, the voter is issued an authentication key that enables them to log in to the online voting system. It is through proper registration that the system can prevent unauthorized access and hacking.

2. Authentication of Voters

A voter can access the online voting system through the voter authentication module using the registered username and password. The system can use OTP, biometric, or digital identification authentication to confirm the legitimacy of the voter. This module also prevents double voting by checking whether the voter has already casted their vote. It is through this module that a voter can only cast their vote once and not multiple times.

3. Management of Candidates

The candidate management module allows the election administrator to add, update, or delete information about the candidates. Prior to the election, the administrator adds the details of the candidates such as their names and symbols to the system. The details of the candidates are made available to voters during the election and appropriately stored in the system. This module also prevents unauthorized modification of the candidate's information. It ensures that the information about the candidates is authentic and available for voters' reference

4. Casting votes

After the voter has been authenticated, the system presents the list of candidates. The voter then selects their preferred candidate after reviewing the details of all the candidates. The selection is then submitted to the system as the vote. The voter can be prompted to confirm the selection to avoid accidental voting. Once the vote has been casted, it cannot be changed or retracted. This is to prevent voters from changing their votes after casting them, thus, ensuring the integrity of the voting process.

5. Vote storage on the blockchain

Vote storage on the blockchain is the most important component of the proposed system. It makes it possible to store the votes securely and prevent tampering. Votes are stored in the blockchain network after they have been encrypted using cryptographic algorithms. Each vote is stored as a digital transaction that is encrypted and added to the blockchain as a block. This block contains the voting details, timestamp, encrypted vote, and hash of the previous block.

This process makes it possible to secure the vote by linking each block to the previous one using cryptography. It also prevents votes from being altered since any changes to a block would be detected when the hash value does not match.

6. Vote Verification

The authenticity of the vote is verified by the blockchain network before it is stored on the blockchain. The verification process checks the legitimacy of the voter, whether the voter has already voted, and the validity of the submitted transaction. The vote is then added to the blockchain ledger if it passes the verification process. The votes that do not pass the verification test are rejected. This feature enhances the credibility of the voting process by preventing forgeries and ensuring that only valid votes are

stored in the blockchain

7. Automatic Vote Counting

The automatic vote-counting feature is undoubtedly the most efficient aspect of the proposed system. The system automatically counts all the votes that have been stored on the blockchain at the end of the voting period. The manual counting of votes is not necessary since all the valid votes are already stored on the blockchain. In addition to saving time, this feature also prevents counting errors from occurring. Moreover, the accuracy and efficiency of the voting process are improved by this feature.

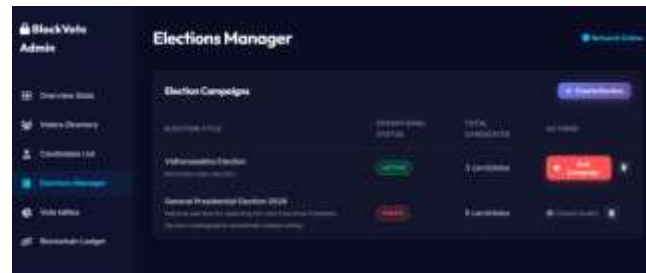


Fig 5:Elections Manager

8. Getting the Job Done

The result generation feature enables the system to generate election results after votes have been counted. The election results are available in a secure dashboard where the administrator can view the total number of votes received by each candidate. The result generation is transparent since the results are based on the votes stored on the blockchain, which can be independently audited if necessary. Although the individual votes are secure and anonymous, information about the total number of votes is made public. This feature also enhances the credibility of the election process by ensuring the integrity of the votes stored on the blockchain

9. Evaluation of Performance

The performance of the proposed online voting system is evaluated based on security, transparency, accuracy, reliability, execution time, and scalability. Various tests such as security, accuracy, and reliability tests can be used to measure the performance of the proposed system. For example, a security test can be conducted to ensure that the votes stored on the blockchain cannot be altered. On the other hand, an accuracy test can be performed to ensure that all valid votes are counted without any omissions or repetitions. At the same time, transparency is achieved when all the votes are traceable and auditable while maintaining voter anonymity. Reliability is ensured when the system works smoothly even when multiple voters are using it simultaneously. The execution time of the system can also be evaluated to ensure that the voting process is efficient in terms of time. Overall, these performance tests demonstrate that the proposed system using blockchain technology is capable of enhancing the efficiency and reliability of the online voting process.

VII. CONCLUSION

An effective, transparent and secure way of conducting digital elections is suggested in the "Online EVoting System Using Blockchain Technology." Vote tampering, double voting, slow counting of votes, and the lack of transparency are some of the challenges facing conventional voting systems that can be resolved by implementing the "blockchain technology" to store voters'

data securely and prevent it from being tampered with. The proposed solution aims to ensure that eligible voters cast their ballots online after successfully registering, verifying their credentials, casting their ballots securely and receiving the results electronically. The voting process will be transparent and verifiable to prevent vote duplication and ensure that voters' information remains confidential since it will be stored in an encrypted format using the blockchain technology. Election malpractices will be prevented, and at the same time, the results will be trusted and unquestionable. Another benefit of the proposed solution is that it will expedite the vote-counting process and publication of results since it will be automated, thus removing the need for manual counting of ballots and minimizing the chances of errors occurring in the process. In addition, the system will be protected from possible cyber-attacks due to the nature of the blockchain technology.

The proposed voting system can be enhanced by incorporating features such as "biometric authentication," "facial recognition," "mobile voting apps," and "cloud-based blockchain services" among others. The proposed solution can be adapted to government, corporate, university, and organizational elections. Overall, the project is an excellent way of improving the voting process by demonstrating how the "blockchain technology" can be integrated into a system that offers a convenient, efficient, transparent, and secure way of conducting elections while enhancing trust in the voting systems and protecting voters' data.

REFERENCES

- 1]. Nakamoto (2008): The Beginning of Blockchain: This paper introduced Bitcoin and the concept of blockchain technology. It explained how a decentralized digital ledger can securely record transactions without requiring a central authority, forming the foundation for blockchain-based applications such as online voting.
- 2]. Wood (2014): Smart Contracts with Ethereum: This paper introduced the Ethereum blockchain platform and smart contracts. It explained how programmable contracts can automatically execute predefined rules, making blockchain suitable for secure online voting systems.
- 3]. Swan (2015): Blockchain Beyond Cryptocurrency: This book explained how blockchain technology can be applied in different fields such as healthcare, finance, education, and electronic voting. It highlighted the benefits of transparency, decentralization, and security.
- 4]. Christidis and Devetsikiotis (2016): Blockchain Applications: This research discussed how blockchain technology and smart contracts can improve the security, transparency, and reliability of various applications, including online voting systems.
- 5]. Crosby et al. (2016): Blockchain Technology Beyond Bitcoin: This paper explained the architecture, working principles, and advantages of blockchain technology. It described how blockchain prevents data tampering and ensures secure record management.
- 6]. Hao, Ryan, and Zieliński (2010): Secure Electronic Voting: This study proposed a secure electronic voting protocol that protects voter privacy while ensuring vote integrity and election fairness.
- 7]. Kiayias and Panagiotakos (2015): Blockchain Security: This paper discussed the security aspects of blockchain technology and explained how decentralized systems protect against cyberattacks and unauthorized modifications.
- 8]. Xu, Weber, and Staples (2019): Blockchain System Architecture: This research presented different blockchain architectures and explained how blockchain applications can be developed for secure digital services, including online voting.
- 9]. National Institute of Standards and Technology (NIST) (2018):Blockchain Technology Overview: This report provided a detailed overview of blockchain technology, including its architecture, security features, cryptographic mechanisms, and practical applications.
- 10]. Dorri, Kanhere, and Jurdak (2020): Blockchain Security in Digital Systems: This paper explained how blockchain improves data security, privacy, and trust in distributed applications. It also discussed the challenges and future directions of blockchain technology.