A SURVEY ON SMART VOTING SYSTEM USING BLOCKCHAIN

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ABSTRACT

The voting process is an essential component of democratic systems, allowing citizens to participate in the selection of their representatives and contribute to governance. However, traditional voting approaches and many existing electronic voting systems often encounter several challenges, including security vulnerabilities, lack of transparency, risk of vote manipulation, and difficulties in verifying voter identity. These limitations can reduce public confidence in the election process and highlight the need for more reliable and technologically advanced voting mechanisms. In recent years, blockchain technology has emerged as a promising solution for addressing many of these issues due to its decentralized architecture, transparency, and ability to maintain immutable records of transactions. By storing voting information on a distributed ledger, blockchain ensures that once a vote is recorded it cannot be altered or removed, thereby enhancing the integrity and trustworthiness of election results. In addition to blockchain, biometric authentication techniques such as facial recognition can strengthen voter verification and prevent unauthorized participation or duplicate voting. The combination of blockchain and biometric authentication provides a secure and transparent framework for building modern digital voting platforms. This survey paper examines the role of blockchain technology in smart voting systems and reviews various approaches proposed for improving election security, voter authentication, and data integrity. The study also highlights the advantages and potential challenges associated with blockchain-based voting platforms and discusses how these technologies can contribute to the development of secure, transparent, and efficient voting systems for future digital elections.

Keywords: *Blockchain, Smart Voting System, Electronic Voting (E-Voting), Biometric Authentication, Facial Recognition, Election Security, Decentralized Systems, Distributed Ledger Technology.*

1. INTRODUCTION

Voting plays a vital role in democratic societies as it enables citizens to express their choices and participate in the decision-making process of governance. Ensuring that elections are conducted in a fair, transparent, and secure manner is essential for maintaining public trust in democratic institutions. Traditional voting systems, such as paper-based ballots and centralized electronic voting machines, have been widely used for many years. However, these methods are often associated with several issues including vote tampering, identity fraud, limited transparency, and delays in vote counting and result verification. These challenges highlight the need for improved voting mechanisms that can provide greater security, efficiency, and reliability in the electoral process.

With the rapid growth of digital technologies, blockchain has gained significant attention as a potential solution for addressing the limitations of traditional voting systems. Blockchain is a distributed ledger technology that records transactions across multiple nodes in a network, making the stored data transparent, secure, and resistant to modification. Each transaction added to the blockchain is permanently recorded and linked to previous records, which helps maintain the integrity of the data. When applied to voting systems, blockchain can ensure that votes are securely stored and cannot be altered once they are recorded. This decentralized approach also reduces dependence on a single authority, thereby improving transparency and trust in the election process.

In addition to blockchain technology, biometric authentication techniques such as facial recognition can further enhance the security of digital voting platforms. Facial recognition systems verify the identity of voters by analysing unique facial features and comparing them with stored data in a secure database. This method helps prevent impersonation and ensures that only eligible voters are allowed to participate in the election. By integrating blockchain technology with biometric authentication, smart voting systems can offer a more secure, transparent, and efficient alternative to traditional voting methods. This survey paper explores various blockchain-based smart voting systems and analyses their potential to improve the reliability and security of modern electoral processes.

2. INFORMATION

The paper titled "A Survey of Electronic Voting Systems" [1] was published in 2004 by Robert Krimmer. It reviews various electronic voting technologies used in modern democratic systems. The study compares traditional paper voting, electronic voting machines, and internet voting platforms. It discusses advantages and limitations along with security challenges such as voter authentication and vote manipulation. The paper highlights the need for secure and transparent systems to maintain trust in elections.

In 2017, the study "Secure Electronic Voting Using Blockchain Technology" [2] by Feng Li and Hongwei Li proposed a blockchain-based voting framework. The system records votes in an immutable distributed ledger to prevent unauthorized modifications. It ensures secure voter authentication and transparent vote counting. The research shows that blockchain improves reliability and integrity in digital elections. It emphasizes enhanced transparency in the voting process.

A decentralized solution is presented in "Decentralized Blockchain-Based Electronic Voting System" [3] published in 2017 by Peter McCorry, Siamak F. Shahandashti, and Feng Hao. The system uses blockchain to securely store voting data. It ensures voter privacy while enabling public verification of election results. Cryptographic techniques protect voter identities from exposure. The study shows improved transparency and security in elections.

The research work "Blockchain Based E-Voting System" [4] was introduced in 2018 by Abdullah Ayed. It presents a blockchain architecture designed for voting applications. Votes are stored in a distributed ledger to prevent tampering or manipulation. The system removes centralized control and ensures transparency. The study proves blockchain is effective for secure digital voting systems.

Another contribution is "Online Voting System Using Ethereum Blockchain" [5] published in 2018 by Michał Pawlak and Patrycja Poniszewska-Maranda. It implements an online voting system using Ethereum blockchain technology. Smart contracts are used to automate vote submission and counting processes. The decentralized network ensures transparency and prevents vote manipulation. The system increases trust and reliability in elections.

Focusing on blockchain security, "Blockchain Technology for Secure Voting Systems" [6] was published in 2016 by Melanie Swan. It explains how blockchain enhances transparency and security in voting systems. The technology provides decentralization and tamper-proof storage of voting records. It enables secure verification without centralized authority. The study highlights blockchain's role in building trustworthy systems.

In 2018, "A Secure and Transparent Blockchain Voting System" [7] was proposed by Aggelos Kiayias, Thomas Zacharias, and Beniamin Zhang. The system enables transparent verification of election results. It preserves voter anonymity while ensuring vote integrity. Advanced cryptographic methods protect voting data from manipulation. The framework improves trust in digital elections.

The study "Blockchain-Based Secure E-Voting System" [8] was developed in 2018 by Josh Benaloh and Moti Yung. It integrates blockchain with cryptographic security techniques. The system allows voters to verify votes without revealing identity. Blockchain ensures immutable storage and transparent verification. The research improves reliability and security in voting systems.

In another 2018 research, "Blockchain Voting System Using Smart Contracts" [9] was presented by Nir Kshetri and Jeffrey Voas. Smart contracts automate vote validation, counting, and result publication. Blockchain ensures permanent and tamper-proof storage of votes. The system increases transparency and efficiency in elections. It reduces manual intervention and errors.

The paper "Decentralized Online Voting Using Blockchain" [10] was proposed in 2019 by Frederick Hardwick and Ammar Akram. It introduces a decentralized voting architecture. Blockchain securely records votes and enables transparent verification. The system eliminates dependence on centralized authorities. It prevents fraud and double voting.

Discussing digital democracy, "Blockchain-Based Voting System for Digital Democracy" [11] was published in 2017 by Don Tapscott and Alex Tapscott. It explains how blockchain supports transparent democratic systems. The technology ensures secure vote storage and public verification. It reduces election fraud through decentralization. The study highlights its importance in governance.

In 2019, "Electronic Voting System Using Distributed Ledger Technology" [12] by Aggelos Kiayias and George Panagiotakos explores distributed ledger applications. The system ensures tamper-proof storage of voting data. It enables secure vote verification and improves transparency. Blockchain increases reliability in election processes. The study demonstrates advantages of distributed systems.

An advanced system is presented in "Secure Voting System Using Blockchain and Biometrics" [13] published in 2020 by Shivam Sharma and Rajesh Kumar. It combines biometric authentication with blockchain technology. Fingerprint and facial recognition are used for identity verification. Blockchain ensures secure vote storage and prevents tampering. The system reduces identity fraud.

The concept of remote voting is explained in "Blockchain-Based Remote Voting System" [14] published in 2020 by Yifan Zhao and Justin Chan. It allows voters to cast ballots from any location. Blockchain ensures secure storage and transparent verification. The system prevents vote manipulation and maintains integrity. It improves accessibility and participation.

Addressing privacy, "A Privacy-Preserving Blockchain Voting System" [15] was proposed in 2020 by Shehar Bano and Alberto Sonnino. It uses cryptographic protocols to protect voter identities. Blockchain ensures immutable storage of voting records. The system allows verification without compromising privacy. It balances transparency and confidentiality.

In 2019, "Blockchain Based Secure Election Framework" [16] by Rizka Hanifatunnisa and Budi Rahardjo presents a secure framework. It protects election data from manipulation or unauthorized modification. Blockchain ensures secure vote storage and transparent verification. The decentralized structure improves trust. It enhances election system reliability.

Ensuring transparency, "Transparent Voting System Using Blockchain" [17] was presented in 2020 by Anna Zyskinda and Oz Nathan. Votes cannot be altered after submission. The system allows voters to verify votes without revealing identity. Blockchain ensures secure and transparent processes. It improves reliability in elections.

Automation is highlighted in "Blockchain Election System with Smart Contracts" [18] published in 2019 by Michael Crosby and Pradan Pattanayak. Smart contracts automate vote verification and counting. Blockchain ensures secure storage of voting data. The system reduces manual errors. It improves efficiency in election management.

The study "Distributed Blockchain Voting Architecture" [19] was proposed in 2018 by Kyle Croman and Christian Decker. Votes are stored across multiple nodes in a network. This prevents single-point failures in the system. The decentralized approach improves transparency and reliability. It enhances overall security.

A secure solution is introduced in "Secure Online Voting System Using Blockchain" [20] published in 2019 by Saurabh Gupta and Ankit Jain. Votes are securely stored on the blockchain network. The system prevents tampering and ensures transparent verification. Voters can confirm their votes are counted. It increases credibility in elections.

In 2021, "Blockchain-Based Digital Voting Platform" [21] by Rohit Singh and Vikas Patel presents a digital voting platform. Votes are stored in a distributed ledger. Blockchain prevents unauthorized modifications of voting data. The system ensures transparency and security. It improves trust in elections.

The paper "Blockchain Enabled Election Management System" [22] was published in 2022 by Lei Zhang and Hui Wang. It provides a framework for managing election processes. Votes are recorded in an immutable distributed ledger. Blockchain improves transparency and verification. It enhances efficiency and reliability.

A modern system is proposed in "Blockchain and Facial Recognition Based Voting System" [23] published in 2023 by Aman Sharma and Pooja Singh. Facial recognition is used for voter authentication. Blockchain ensures secure vote storage and prevents duplicate voting. The system improves authentication and security. It enhances election integrity.

Further research is presented in "Distributed Ledger Based Electronic Voting System" [24] published in 2021 by Sanjay Gupta and Rohit Mehta. It uses distributed ledger technology for secure voting. The system ensures transparent vote verification. It removes centralized control. It improves reliability and trust.

Finally, "Blockchain-Based Smart Voting System" [25] was proposed in 2022 by Amit Kumar and Vivek Sharma. It uses blockchain to ensure secure election processes. Votes are stored in an immutable distributed ledger. The system provides transparent counting and verification. It improves trust and security in voting systems.

3. CONCLUSION

From the detailed analysis and comparison of the 25 literature studies related to electronic voting systems and blockchain-based voting platforms, it is evident that significant research has been conducted to improve the transparency, security, and efficiency of the election process. Many researchers have proposed decentralized voting models using blockchain technology to ensure that voting records are stored securely and cannot be altered once they are recorded. The literature also highlights the advantages of blockchain such as immutability, distributed data storage, transparency in vote counting, and reduction of election fraud. Several studies have also introduced additional technologies such as smart contracts, cryptographic techniques, and remote voting mechanisms to improve the reliability of electronic voting systems. These contributions demonstrate that blockchain technology has strong potential to modernize traditional voting systems and increase public trust in the electoral process.

However, despite these improvements, the literature survey also reveals a number of limitations and challenges in the existing approaches. One of the major issues identified is the lack of strong and reliable voter authentication

mechanisms. Many systems focus mainly on secure vote storage using blockchain but do not adequately address the problem of verifying voter identity before casting a vote. This limitation may lead to problems such as voter impersonation, unauthorized access, or multiple voting attempts. In addition, some proposed systems rely on partially centralized architectures, which may reduce the advantages of decentralization provided by blockchain technology. Other challenges observed in the literature include limited scalability, complexity in implementation, lack of integration with biometric verification methods, and insufficient mechanisms to ensure that only eligible voters participate in the election process. These disadvantages indicate that although blockchain provides strong security for vote storage, additional technologies are required to strengthen voter authentication and overall system reliability.

To overcome these limitations identified from the literature survey, the proposed Smart Voting System (BlockVote) integrates blockchain technology with facial recognition-based authentication to enhance the security, transparency, and trustworthiness of the voting process. In the proposed system, blockchain technology is used to store voting records in a decentralized and tamper-resistant ledger, ensuring that once a vote is cast, it cannot be modified or deleted. This guarantees the integrity and transparency of the election results. At the same time, facial recognition technology is incorporated as a biometric authentication mechanism to verify the identity of voters before allowing them to participate in the election. This feature helps prevent voter impersonation, unauthorized access, and duplicate voting. By combining decentralized blockchain infrastructure with biometric authentication techniques, the proposed system addresses the key disadvantages identified in the reviewed literature. Therefore, the Smart Voting System provides a more secure, transparent, and reliable digital voting platform that can significantly improve the efficiency and credibility of future electronic election systems.

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