International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 11 | November - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

Survey on Decentralized Democracy: Blockchain Voting System

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ABSTRACT

Voting is a fundamental pillar of democracy, but traditional voting systems face numerous challenges, including concerns related to security, transparency, and accessibility. In recent years, blockchain technology has emerged as a promising solution to revolutionize the voting process. By leveraging the inherent characteristics of blockchain technology, a blockchain-based voting system can enhance the integrity and trustworthiness of the voting process. Blockchain-based voting systems offer several key features and benefits. One of the main advantages is the security and immutability of voter data, which makes it virtually impossible to tamper with or manipulate. Each vote is recorded as a transaction on the blockchain, creating a transparent and auditable ledger that can be accessed by all stakeholders. This eliminates the need for intermediaries such as government agencies or third-party voting providers, reducing the risk of interference and tampering. Another advantage of blockchain-based voting systems is increased accessibility. Remote and mobile voting can help improve voter turnout and participation, especially for individuals who may have difficulty accessing traditional polling stations. Moreover, blockchain technology can maintain the anonymity of voters while ensuring the verifiability of their choices, which guarantees the privacy of their decisions. Despite these benefits, challenges persist, including concerns about identity verification and cybersecurity. Addressing these issues is crucial for the widespread adoption of blockchain-based voting systems.

In conclusion, a blockchain-based voting system has the potential to transform the way elections are conducted by providing a secure, efficient, and transparent platform that empowers citizens and strengthens the democratic process. As the technology continues to evolve, it is essential to address its limitations while harnessing its advantages to build a more robust and inclusive electoral system.

Keywords: Blockchain, voting, election, decentralized, secure, transparency, immutability, privacy.

I. INTRODUCTION

Democratic voting is a crucial and serious event in any country. The most common way in which a country votes is through a paper-based system, but is it not time to bring voting into the 21st century of modern technology? Digital voting is the use of electronic devices, such as voting machines or an internet browser, to cast votes. These are sometimes referred to as e-voting when voting using a machine in a polling station and E-voting when using a web browser. The security of digital voting is always the biggest concern when considering implementing a digital

voting system. With such monumental decisions at stake, there can be no doubt about the system's ability to secure data and defend against potential attacks. One-way the security issues can be potentially solved is through the technology of blockchains. Blockchain technology originates from the underlying architectural design of the cryptocurrency Bitcoin. It is a form of distributed database where records take the form of transactions, a block is a collection of these transactions. With the use of blockchains, a secure and robust system for 3 digital voting's can be devised. This report outlines our idea of how blockchain technology could be used to implement a secure digital voting system.

II. LITERATURE SURVEY

Various proposals outline innovative approaches to electronic voting systems. These include blockchain-based systems on Ethereum for enhanced security, transparency, and privacy, as well as online voting platforms using cloud technology with advanced features for accuracy. Some proposals focus on decentralized electronic voting, employing blockchain and encryption for secure and transparent elections. Others highlight the challenges of developing secure and privacy-friendly systems and emphasize user-friendly, efficient, and debuggable solutions. The use of blockchain technology, smart contracts, and biometrics is prevalent, ensuring the integrity and transparency of the voting process. These proposals explore novel methods, such as cryptographic online voting, fingerprint-based systems, and decentralized e-voting portals. The goal is to overcome limitations, increase voter turnout, and provide secure, cost-efficient, and auditable election systems.

Vairam T, Sarathambekai S, and Balaji R proposed a paper "Blockchain-based voting system in local network". This paper presents a blockchain-based electronic voting system on Ethereum that enhances traditional voting. Built using Ganache, it ensures security, transparency, and voter privacy, while also enabling faster result announcements. Future improvements include UI enhancements and stronger authentication. [1]

Ramya Govindaraj, Kumaresan, P, K. Sree Harshitha proposed an "Online Voting System using Cloud. The Online Voting Platform provides advanced features like ticket creation, agenda highlights, vote counting, and classification, ensuring accurate voting and preventing invalid votes. It's user-friendly and straightforward for both directors and voters. [2]

Friðrik Þ. Hjálmarsson, Gunnlaugur K. Hreiðarsson, Mohammad Hamdaqa, and Gísli Hjálmtýsson proposed a system which is "Blockchain-Based E-Voting System. This paper introduces a blockchain-based electronic voting system using smart contracts for secure, cost-efficient elections while ensuring privacy. The system overcomes limitations and adoption barriers, ensuring election security, integrity, and transparency. However, larger countries require additional measures for increased transaction throughput. [3]

Ashish Singh and Kakali Chatterjee proposed a system "SecEVS: Secure Electronic Voting System Using Blockchain Technology" The electronic voting system uses blockchain technology to mitigate threats and attacks. It is a decentralized system with hashing and encryption for security. Only registered and eligible voters can vote. Once a vote is completed, a publicly verifiable block is created, and no modifications can be made. The system uses unique voter IDs for verification and ensures only one vote per user. [4]

Cosmas Krisna Adiputra, Rikard Hjort, and Hiroyuki Sato proposed a system "A Proposal of Blockchain-based Electronic Voting System" This paper proposes a blockchain-based voting system, describing its advantages and disadvantages. It provides a qualitative evaluation and analysis. While there's room for improvement, the system's novelty and the need for popularization make it a promising solution for future e-voting systems [5]

Rajesh M. Ghadi and Priyanka S. Shelar proposed an "Online Voting System" that offers advantages like cost reduction, faster results, accessibility, accuracy, and low error risk. However, developing secure and privacy-friendly systems remains challenging. Future development focuses on user-friendly, efficient, and debuggable systems that provide acceptable security and privacy. [6]

Albin Benny, Aparna Ashok Kumar, Abdul Basit, Betina Cherian, and Amol Kharat proposed a system "Blockchain-based E-voting System" This project introduces a blockchain-based electronic voting system using smart contracts for secure, cost-efficient elections while ensuring privacy. Blockchain technology overcomes limitations and adoption barriers, ensuring election security, integrity, and transparency. The Ethereum private blockchain can handle hundreds of transactions per second, easing the load. Transparency in the blockchain enables auditing and understanding of elections, making e-voting more open, transparent, and auditable. The blockchain is publicly verifiable and secure. [7]

Ms. Shubhangi D. Dhane and Prof. S. B. Rathod proposed a "Recent online voting systems: study & comparative analysis". Through the studied literature, it is found that cutting-edge technologies can make huge advancements in EVS and can provide adequate security, anonymity, and ease of use. Therefore, it is expected that the EVS can be modified which can facilitate the voters, thus providing a framework for fair elections. [8]

Emad Abu-Shanab, Michael Knight, and Heba Refai

proposed an “E-voting systems: a tool for democracy”. This system highlighted a language issue reducing the impact of two hypothesized predictors (PP & PS) and suggested further research and improvement of scale reliability. The study also highlighted the importance of building trust in e-voting system acceptance, highlighting the need for improved instrumentation and testing of new variables. [9]

Barot Kajal, Prof. Brijesh Vala, and Dr. Warish Patel proposed “A Review of online voting system security based on cryptography”. In this project Cryptographic online voting offers a safer and more efficient alternative to traditional voting systems, reducing costs and ensuring full privacy for voters. It uses a strong voting authentication mechanism, visual encryption, which encrypts information without mathematical calculations. This system allows people with internet connections to vote at home, providing reliable and intuitive voting indications. It also offers low costs and increased voting attendance, ensuring a secure and efficient online voting experience. [10]

Samarth Agarwal, Afreen Haider, Abhishek Jamwal, Param Dev, & Rajeevan Chandel proposed a “Biometric-based secured remote electronic voting system”. The paper presents a fingerprint-based voting system that overcomes existing issues in the voting system, ensuring a secure and efficient process for a developing nation's growth. It recommends national implementation for comprehensive e-voting system full-proofing. [11]

Voram Bhavan, Laxmi Koli, Lanka Rishi, and Marri Sankeerth Reddy proposed an “Online Voting System” This Online Voting System manages voter information, allows login and mock tests, and offers complete voting features. It tracks the vote count and candidate count for each party. Users log in using a unique email and password to vote. The system increases online voting proportions, reduces costs and time, and allows easy error correction. The project has been tested and achieved favorable results, with two-factor authentication being a potential feature. The app's performance is still being studied by users, indicating potential for future enhancements. [12]

Yang, Xuechao, Xun Yi, Surya Nepal, Andrei Kelarev, and Fengling Han proposed "A secure verifiable ranked choice online voting system based on homomorphic encryption." This paper proposes a secure voter-verifiable voting system that allows voters to assign arbitrary points to candidates. It uses the distributed ElGamal cryptosystem, which is encrypted before submission and remains encrypted at all times. The system's security and performance analysis confirm its feasibility for practical elections and show significant improvements over previous systems. [13]

Ms.V. Varalakshmi, S. Malarvizhi, A. Shamitha, S. Srimathi, and V. Vinisha proposed a “Blockvote: Aadhar Based Electronic Voting System Using Blockchain” This paper introduces a blockchain based electronic voting system that uses smart contracts for secure, cost-efficient elections, ensuring voter privacy. The system uses Ethereum private blockchain, allowing individual voters to vote in their preferred district, potentially increasing voter turnout. [14]

Bulut, Rumeysa, Alperen Kantarc, Safa Keskin, and Şerif Bahtiyar proposed a “Blockchain-Based Electronic Voting System for Elections in Turkey”. This paper proposes a blockchain-based evoting system for Turkey, offering a secure, fast, and trusted election system. The system is suitable for integration in other countries due to differing laws and election systems. Future work will focus on comparing the system's performance and security. [15]

Amit Kumar Tyagi, Terrance Frederick Fernandez, and Aswathy S U proposed a “Blockchain and Aadhaar-based Electronic Voting System” This project discusses the history of voting systems in India since 1950 and the implementation of Blockchain technology to incorporate distributed electronic voting systems. It proposes a modern, Blockchain-based system that enhances transparency and reduces costs. The work complies with the criteria of developing tamper-proof electronic voting systems and acknowledges the legal and technical drawbacks of using Blockchain as a Service. [16]

Killer, Christian, Bruno Rodrigues, Eder John Scheid, Muriel Franco, Moritz Eck, Nik Zaugg, Alex Scheitlin, and Burkhard Stiller proposed a system “Provotum: A Blockchain-based and Endto-end Verifiable Remote Electronic Voting System” In this project they used the Provotum is a cryptographic primitive-based system that combines mathematically proven cryptographic primitives with a practical approach. It uses a private permissioned BC as the Public Bulletin Board (PBB) in REV systems, ensuring vote encryption and proof generation on the voter's device, verifying cryptographic proofs on-chain by the ballot SC, and distributing trust among nodes. The Provotum REV system is the first in prototype operation, offering full auditability of the entire end-to-end voting process with pre-built Docker images. [17]

Mohamed Ibrahim, Kajan Ravindran, Hyon Lee, Omair Farooqui, Qusay H, and Mahmoud proposed “ElectionBlock: An Electronic Voting System using Blockchain and Fingerprint Authentication” In this project the ElectionBlock application is a centralized, permission-based blockchain voting system designed to improve large-scale elections by tackling voter fraud, providing transparency, and ensuring vote anonymity and security. The source code is publicly available for further development. [18]

Kriti Patidar and Dr. Swapnil Jain proposed a system "Decentralized e-voting portal using blockchain”.This paper introduces a blockchain-based e-voting system on

Ethereum, demonstrating its potential to overcome the limitations of centralized voting systems. It uses smart contracts and is tested on a virtual client, with future potential for large-scale elections. [19]

Awsan A. H. Othman, Emarn A. A. Muhammed, Haneen K. M. Mujahid, Hamzah A. A. Muhammed, Prof. Mogeeb A. A. Mosleh proposed a system "Online voting system based on IoT and Ethereum blockchain" This project paper proposes a decentralized electronic voting system using IoT and Ethereum blockchain technology for elections and referendums. The system ensures data protection and voting integrity, works on both governmental and private institutions, and reduces costs, time, and effort. It uses electoral card numbers, one-time password verification, one day password verification, and biometric verification. The system is designed for governmental elections and referendums but could be expanded with other verification tools. [20]

III. PROBLEM STATEMENT:

Traditional voting systems face significant challenges in ensuring the security, transparency, and accessibility of the electoral process. Issues such as voter fraud, data tampering, and the need for trust in central authorities can undermine the integrity of elections. To address these challenges, there is a critical need for the development of a blockchain-based voting system that can offer enhanced security, transparency, and accessibility while maintaining the privacy and anonymity of voters. This system should mitigate risks associated with traditional voting methods and establish a trustworthy, tamper-resistant, and efficient platform for conducting elections at various scales, from local to national, to strengthen the democratic process in the digital age.

IV. OBJECTIVE:

The objectives of a blockchain-based voting system, in simple terms, are:

Security: To make sure that votes are safe from tampering and fraud, ensuring the accuracy of election results.

Transparency: To allow everyone to see and verify the voting process, building trust in the fairness of elections.

Efficiency: To make voting faster and more accessible, reducing long lines and waiting times.

Accessibility: To enable more people to vote, including those who can't easily get to polling places.

Data Protection: To safeguard personal information and voting choices, maintaining privacy. Reliability: To create a system that's dependable and less prone to errors or disruptions.

Cost-Efficiency: To save time and resources compared to traditional voting methods. In essence, the aim is to make voting easier, safer, and more reliable for everyone involved.

V. PROPOSED SYSTEM:

The proposed system for a blockchain-based voting solution includes the following elements:

· **Blockchain Technology:** Implement a blockchain network, which serves as the underlying technology for the voting system. Utilize a permissioned or public blockchain depending on the specific requirements of the election.

· **Voter Registration:** Develop a secure voter registration process that verifies the identity of eligible voters and assigns them a unique digital identity on the blockchain.

· **Voting Interface:** Create a user-friendly, web-based or mobile application for voters to cast their votes securely. This interface should ensure the privacy and anonymity of voters.

· **Smart Contracts:** Implement smart contracts on the blockchain to automate the voting process, ensuring that votes are counted accurately and transparently.

· **Identity Verification:** Employ secure methods for verifying voter identities, such as facial recognition

· **Vote Storage:** Store votes as transactions on the blockchain, ensuring that they are immutable and transparent, but without revealing the voter's identity.

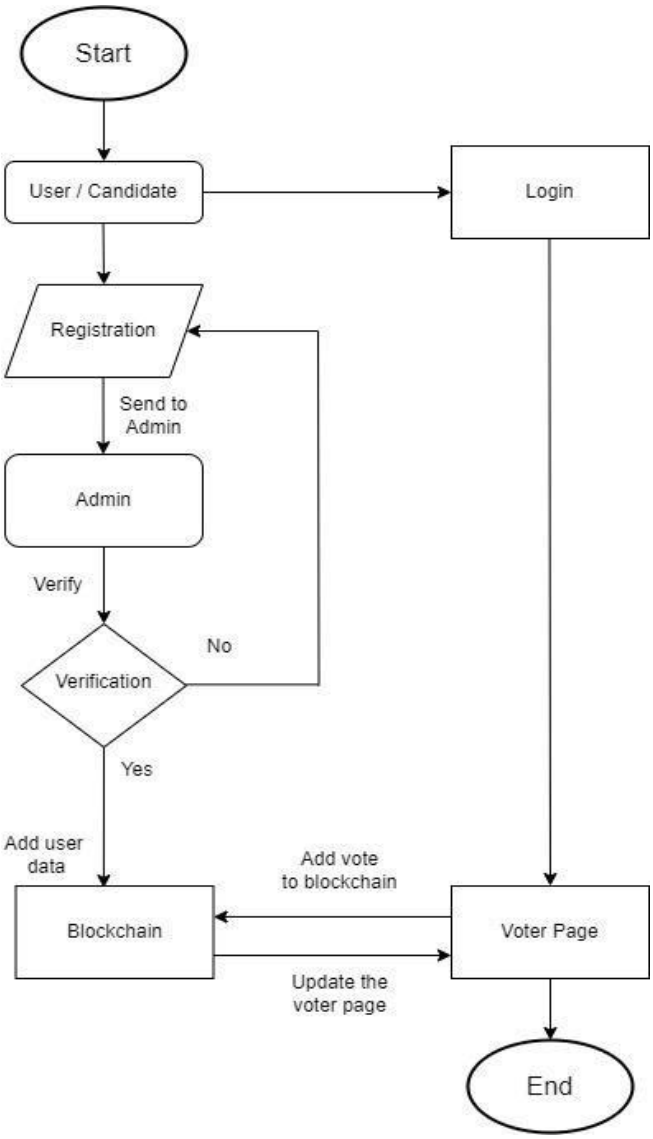
· **Security Measures:** Implement robust security measures to protect the voting system from hacking and fraudulent activities, including encryption, network security, and regular security audits.

· **Decentralization:** Distribute the blockchain nodes across multiple locations to enhance the system's resilience and eliminate single points of failure.

· **Verification and Transparency:** Enable voters to verify their votes on the blockchain, promoting transparency and trust in the election results.

· **Results Publication:** Develop a system to publish election results in real-time.

VI. SYSTEM ARCHITECTURE:



VII. HARDWARE/SOFTWARE SPECIFICATIONS:

Hardware Specifications: 1. Storage: SSD 2. Networking 3. Infrastructure: High-speed internet connections, routers, and switches are necessary for reliable data transmission.

Software Specifications: 1. Operating System: Windows, linux, Ubuntu Server for specific needs. 2. Programming Languages: HTML, CSS, JavaScript, react, solidity, and Python, Node.js and npm: Ensure you have Node.js and npm installed on your machine. Ganache: Ganache is a local blockchain for Ethereum development. Truffle: Truffle is a development environment for Ethereum. Install it globally using npm. 3. Blockchain platform: Choose a suitable blockchain platform (e.g., Ethereum, Hyperledger Fabric) for the voting system. 4. Database: PostgreSQL, MongoDB. 5. Backup and Recovery: Implement backup and recovery solutions to safeguard user data and content. 6. Version Control: Use version control systems like Git & Github for collaborative development and code management.

VIII. OUTCOMES:

Blockchain-based voting systems offer enhanced security, transparency, and reduced administrative overhead. By leveraging cryptographic techniques, these systems ensure that votes are secure and tamper-proof, reducing the risk of voter fraud and hacking. The immutability of the blockchain makes every vote a permanent and unalterable entry, eliminating the possibility of vote manipulation. The transparency of the public ledger provides a comprehensive and verifiable record of all votes, allowing citizens to scrutinize and verify the accuracy of the outcome.

Blockchain technology also brings tamper-resistance by distributing data across numerous nodes, ensuring unauthorized alterations to the voting data, and offering accessibility, making voting more inclusive for individuals with disabilities or those residing in remote areas. Digital voting systems built on blockchain technology offer real-time vote counting and reporting capabilities, contributing to a more efficient and transparent process. Advanced encryption and privacy features protect sensitive voter information, ensuring compliance with data privacy regulations, and making blockchain-based voting systems a secure and reliable option for elections.

IX. CONCLUSION AND FUTURE SCOPE:

The "Decentralized Democracy: Blockchain Voting System" presents a promising avenue for revolutionizing the way we conduct elections and make democratic decisions. This system leverages the transparency, security, and accessibility of blockchain technology to create a tamperproof and efficient voting process. By providing a secure and transparent environment for casting and counting votes, it addresses many of the challenges associated with traditional voting systems. Blockchain-based voting systems offer advantages such as security, transparency, reduced fraud, accessibility, and cost-efficiency. These systems have the potential to increase voter participation, enhance trust in the electoral process, and improve the inclusivity of elections by making it easier for remote or disabled voters to cast their ballots. However, the implementation of such systems comes with several challenges and limitations. These include technological barriers, regulatory compliance, identity verification, and accessibility concerns. Future work in this field must address these limitations to ensure the widespread adoption of decentralized democracy solutions.

FUTURE SCOPE:

1. Usability and Accessibility: Future work should focus on designing user-friendly interfaces that are accessible to all voters, including those with disabilities or limited technology access. Usability studies and accessibility testing can help improve the user experience.
2. Regulatory Frameworks: Collaborate with governments and regulatory authorities to establish clear legal frameworks for blockchain voting systems, ensuring that they comply with election regulations and data privacy laws.
3. Security Enhancement: Continuously improve security measures and conduct frequent security audits to mitigate potential vulnerabilities and cyber threats.
4. Pilot Programs: Conduct pilot programs and real-world testing of blockchain-based voting systems in smaller elections or within specific organizations to gain valuable insights and refine the technology.
5. Education and Awareness: Invest in public education and awareness campaigns to inform citizens about the benefits and proper use of blockchain voting systems.
6. International Adoption: Promote the international adoption of blockchain voting systems, particularly for expatriate voting, humanitarian purposes, and cross-border decision-making.
7.Decentralization Models: Explore various decentralization models (public, private, hybrid) and consensus mechanisms to determine the most suitable approach for different use cases.
8. Cross-Platform Compatibility: Develop solutions that can be accessed and used on various devices and platforms, including mobile phones and tablets.
9. Research and Development: Invest in research and development to discover innovative solutions, such as privacy-preserving cryptographic techniques, to address identity verification and privacy concerns.
10. Legal Protections: Advocate for legal protections for voters using blockchain-based systems, especially in cases where coercion or vote-buying may be a concern.
11. Global Collaboration: Encourage global collaboration to share knowledge and best practices in the implementation of blockchain voting systems, ensuring that lessons learned are shared and applied worldwide.

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