VISVESVARAYA TECHNOLOGICAL UNIVERSITY,

BELAGAVI

A Seminar Report on

Blockchain-based Electronic Voting System for Modern Democracy

In partial fulfillment of requirements for the degree of

Bachelor of Engineering

In

Computer Science & Engineering

SUBMITTED BY:

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Under the Guidance of

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Shri Madhwa Vadiraja Institute of Technology & Management

Vishwothama Nagar, Bantakal-574 115 [2023-2024]

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CERTIFICATE

Certified that the Seminar on topic **Blockchain-based Electronic Voting System for Modern Democracy** has been successfully presented at **Shri Madhwa Vadiraja Institute of Technology** by **Sushanth Acharya,** bearing USN **4MW20CS097,** in partial fulfillment of the requirements for the *VIII Semester degree of* ***Bachelor of Engineering in Computer Science and Engineering*** *of Visvesvaraya Technological University, Belagavi* during academic year 2023-2024.

Ms. Soumya NH	**Dr. Sowmya J Bhat**	**Ms. Sahana**
Seminar Guide	**Head of Department (HOD)**	**Seminar Coordinator**

ACKNOWLEDGEMENT

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I perceive as this opportunity as a big milestone in my career development. I will strive to use gained skills and knowledge in the best possible way, and I will continue to work on their improvement, in order to attain desired career objectives.

SUSHANTH ACHARYA

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ABSTRACT

In the age of digital transformation, the landscape of democracy is evolving, and with it, the mechanisms through which citizens engage in the electoral process. Traditional paper-based voting systems have long been susceptible to inefficiencies, security breaches, and doubts regarding the integrity of election outcomes. In response to these challenges, the integration of blockchain technology into electronic voting systems has emerged as a promising solution, offering unprecedented levels of transparency, security, and accessibility. This abstract presents an innovative blockchain-based electronic voting system designed to revolutionize modern democracy.

The proposed system leverages the immutability and decentralized nature of blockchain to ensure the integrity and trustworthiness of the electoral process. Through the use of cryptographic techniques, each vote cast is securely recorded on the blockchain, providing a transparent and tamper-proof ledger of all transactions. This not only eliminates the risk of fraudulent activities such as double voting or tampering with ballots but also enables real-time verification of election results, fostering greater confidence among voters and stakeholders. Moreover, the decentralized nature of the blockchain ensures that no single entity can exert control over the voting process, thus safeguarding against central points of failure and mitigating the risk of external interference or manipulation.

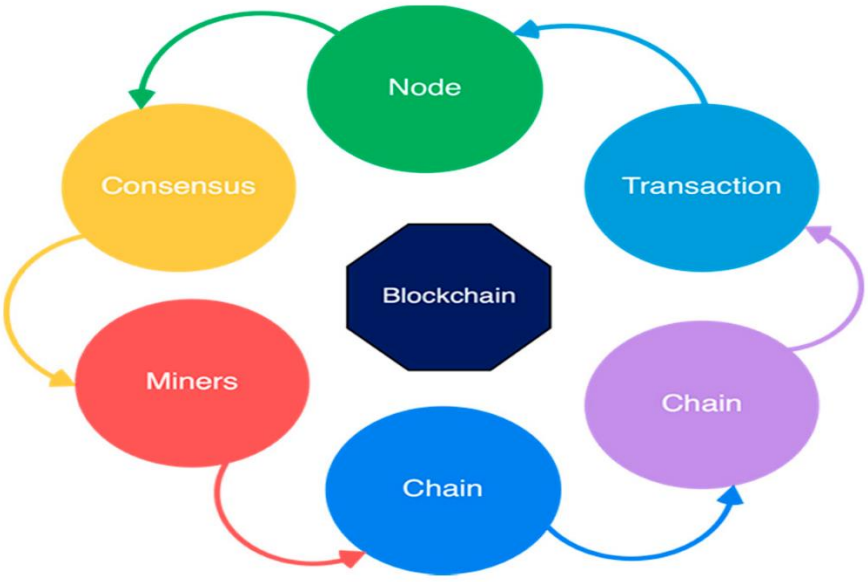
Furthermore, the adoption of a blockchain-based electronic voting system promotes inclusivity and accessibility, as it enables citizens to cast their votes conveniently from any location with an internet connection. By removing geographical barriers and offering alternative methods for participation, such as mobile voting applications, the system empowers marginalized communities and enhances voter turnout. Additionally, the transparency and auditability afforded by blockchain technology facilitate independent scrutiny and oversight, strengthening the democratic principles of accountability and fairness. Overall, the integration of blockchain into electronic voting systems represents a significant step towards realizing the full potential of modern democracy, fostering greater trust, participation, and legitimacy in electoral processes.

Chapter 1

1. INTRODUCTION

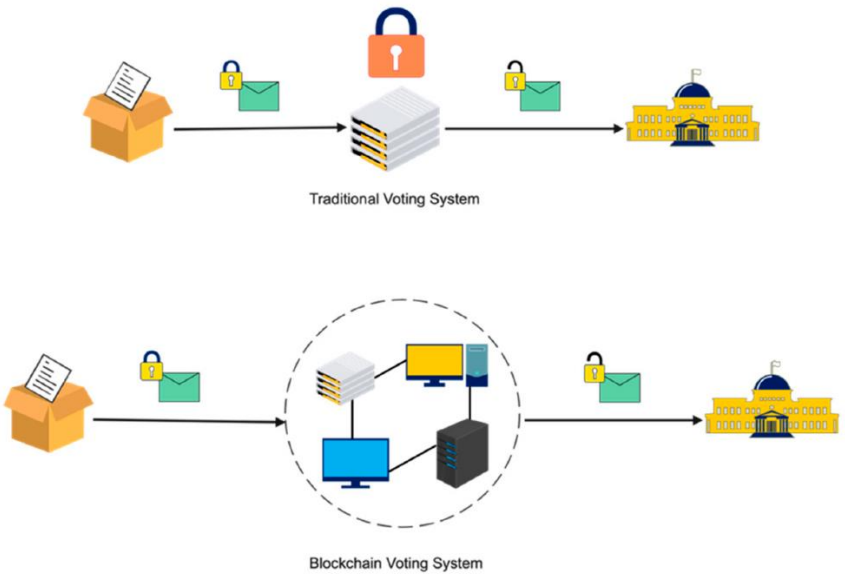
1.1 Background

In the digital age, traditional methods of voting are being reimagined to address longstanding challenges such as security vulnerabilities, inefficiencies, and accessibility barriers. As societies increasingly embrace technology, there's a growing demand for innovative solutions that can enhance the integrity and inclusivity of democratic processes. One such solution gaining traction is the implementation of blockchain technology in electronic voting systems. Blockchain, the decentralized and immutable ledger underlying cryptocurrencies like Bitcoin, offers a novel approach to address the shortcomings of traditional voting systems. By leveraging cryptographic principles and distributed consensus mechanisms, blockchain-based electronic voting systems aim to revolutionize the way elections are conducted, ensuring transparency, security, and accessibility like never before.



1.1.1 Blockchain Structure

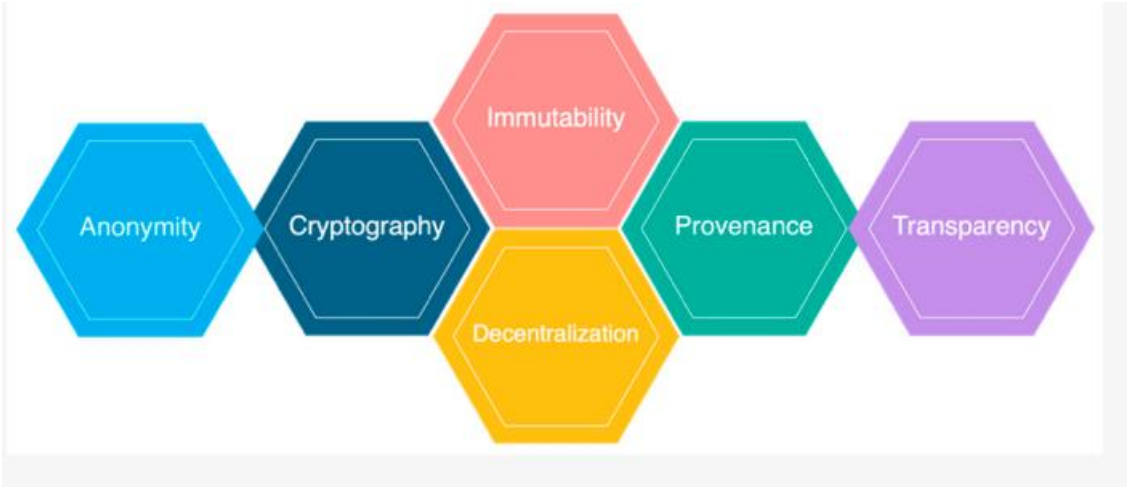
The integration of blockchain into electronic voting introduces a paradigm shift in the democratic landscape, promising to address fundamental concerns surrounding trust, verifiability, and participation. Unlike traditional paper-based ballots or electronic voting machines susceptible to tampering and manipulation, blockchain-based systems provide a transparent and tamper-resistant platform for recording and tallying votes. Each vote is cryptographically secured and recorded on a distributed ledger shared across a network of nodes, eliminating the risk of unauthorized alterations or fraudulent activities. Moreover, the decentralized nature of blockchain ensures that no single entity can control the voting process, thereby mitigating the influence of central authorities and safeguarding against external interference. This introduction sets the stage for exploring the transformative potential of blockchain-based electronic voting systems in modern democracies, offering a glimpse into how technology can reshape the foundation of electoral integrity and citizen engagement.



1.1.2 Comparison b/w traditional and blockchain voting system

1.2 Blockchain for Electronic Voting System

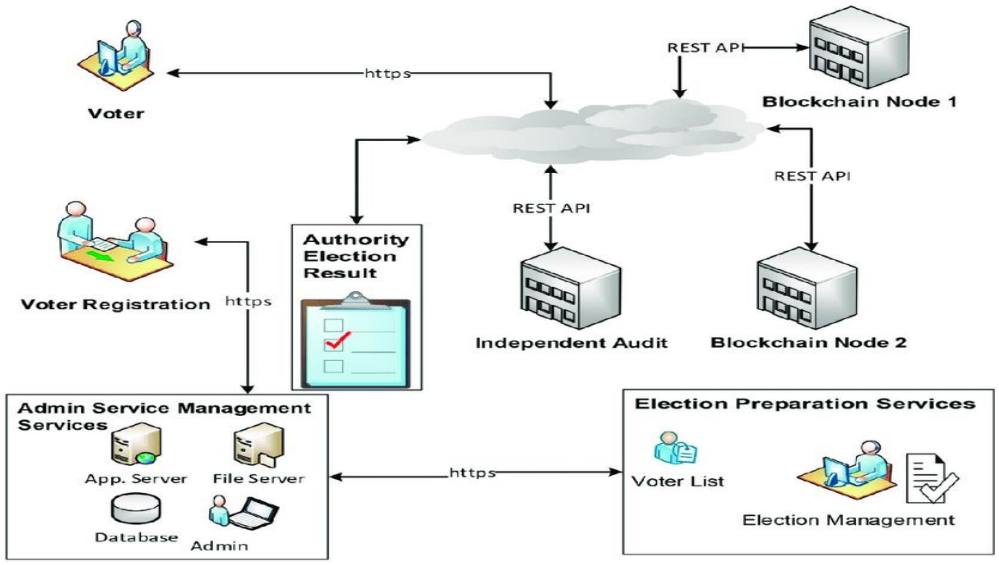
Blockchain technology presents a transformative solution for modernizing the electoral process in democratic societies through the development of electronic voting systems. By leveraging the decentralized and immutable nature of blockchain, these systems offer unparalleled security, transparency, and accessibility. Unlike traditional voting methods, where trust is placed in centralized authorities, blockchain-based electronic voting systems distribute trust across a network of nodes, making it extremely difficult for any single entity to manipulate or compromise the integrity of the voting process. Each vote cast is cryptographically secured and recorded on a tamper-proof ledger, ensuring that the results are transparent and verifiable by all stakeholders.



1.2.1 Characteristics of Blockchain Architecture

Furthermore, blockchain-based electronic voting systems address longstanding issues of inclusivity and accessibility in democratic elections. Through the use of digital platforms and mobile applications, voters can participate in the electoral process from anywhere in the world, removing barriers such as geographical constraints and mobility limitations. This fosters greater voter turnout and engagement, particularly among marginalized communities who may face challenges in accessing traditional polling stations. Additionally, the auditability and transparency inherent in blockchain technology enable independent verification of election results, enhancing confidence in the democratic process and strengthening democratic principles of accountability and legitimacy. As such, the integration of

blockchain into electronic voting systems represents a significant step forward in advancing modern democracy, paving the way for more secure, inclusive, and transparent elections.



1.2.2 Blockchain-voting-systems-architectural-overview

Chapter 2

2. LITERATURE SURVEY

1. **D. Weiss, J. Wolmer and A. Vatsa, "Blockchain-based Electronic Voting System for Modern Democracy: A Review," 2022:**

   This paper underscores the critical role of electoral integrity in bolstering public trust and accountability within democracies. By leveraging blockchain technology, electronic voting systems can ensure security, integrity, and trust, vital pillars of modern democracy. Blockchain principles such as universal ownership and immutable transaction records fortify e-voting systems, offering a cheaper, faster, and more transparent alternative. Smart Contracts eliminate intermediaries, providing digital proof of transactions and ensuring certification of votes.

2. **J. Wolmer, A. Vatsa and D. Weiss, "Retrieval of Data from the Database of a BCT–Voting System," 2022:**

   This paper introduces BCT-Voting, a secure and decentralized blockchain-based electronic voting system designed to enhance transparency and public trust in modern democracy. Deployed on the Ethereum framework, BCT-Voting incorporates five modules to manage the nomination process, voter identity, vote integrity, donation tracking, and final vote tallying. To address data retrieval challenges, the paper proposes Ethereum Query Language (EQL) for querying smart contract data, enabling efficient audits while safeguarding voter privacy.

3. **A. Mendon, B. Manoj Votavat and A. Lodh, "Blockchain based e-voting system," 2022.**

   This paper delves into the potential of Blockchain Technology as a solution to address the shortcomings of electoral systems worldwide, including in powerful democracies like India, the United States, and Japan. It explores the fundamental workings and characteristics of Blockchain from scratch, emphasizing its application in public voting systems.

4. **S. Prakash, V. Sahu and L. Kumar, "Blockchain Based E-Voting System," 2022:**

   This research presents the implementation of an e-voting system utilizing blockchain technology within a Django web application framework. Addressing the shortcomings of traditional paper-based voting systems, the study aims to provide a more reliable, secure, and modern approach to democratic processes. By leveraging blockchain's inherent security features, the proposed system offers a robust solution to digital voting security concerns, ensuring integrity and trust in electoral outcomes.

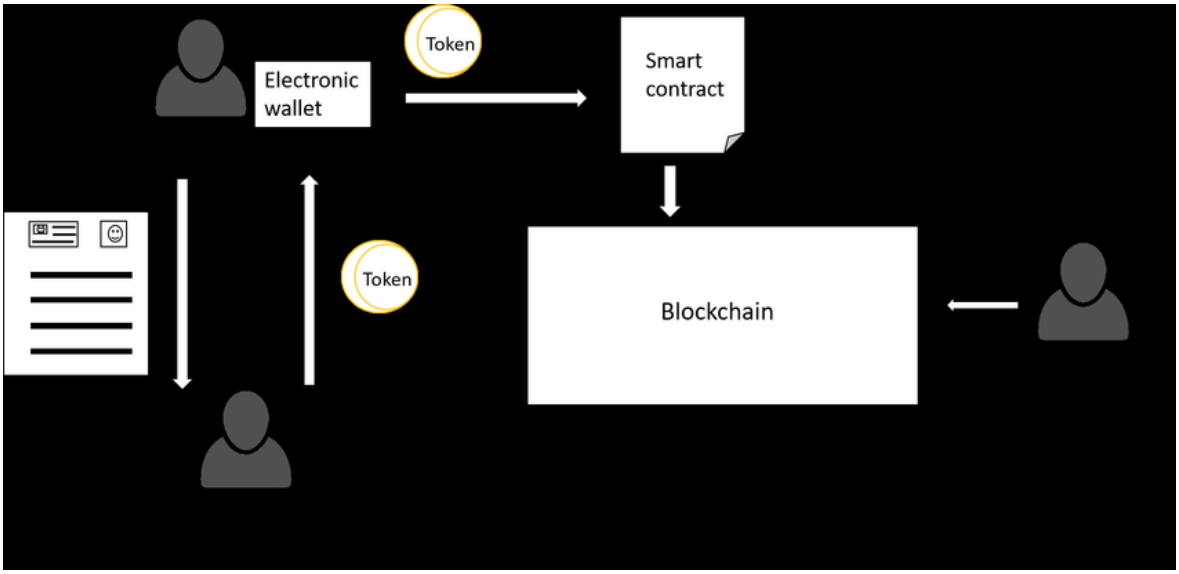
5. **V. Vijeya Kaveri, V. Meenakshi, A. S, A. P and K. B, "Blockchain based Reliable Electronic Voting Technology," 2022:**

   This research introduces a blockchain-based electronic voting system aimed at addressing the challenges of security and democratic responsibility in the digital age. By leveraging blockchain technology, the system offers decentralization, transparency, and the ability for voters to update their votes within specified timeframes, enhancing the integrity and verifiability of democratic processes.

Chapter 3

3. Blockchain-Based Voting System Implementation

Implementing a blockchain-based voting system involves several key steps to ensure its effectiveness, security, and usability.



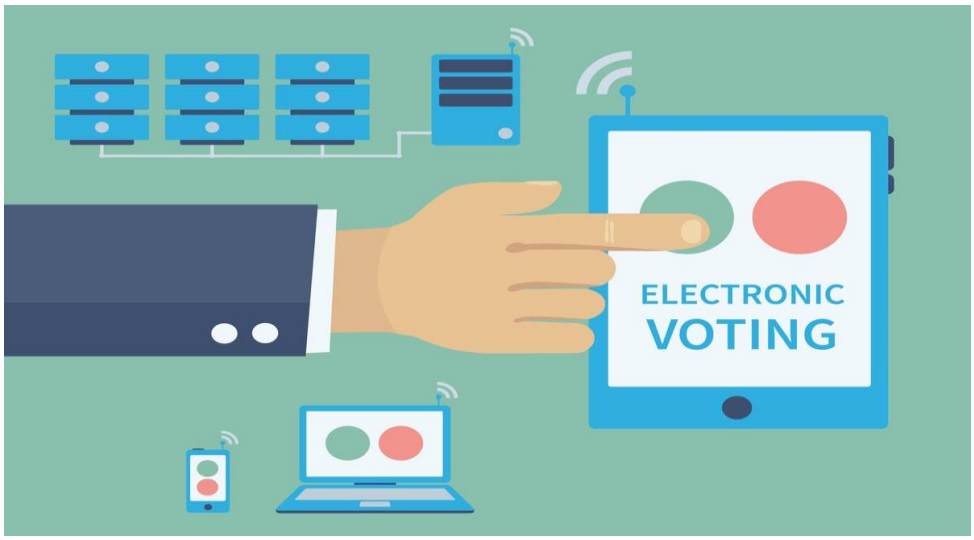
3.1 Blockchain Based Voting System

3.1 Steps in performing Blockchain-Based Voting System

1. **Requirements Analysis and Design**: Begin by defining the requirements of the voting system, considering factors such as the number of voters, voting methods (online, mobile, etc.), security measures, and regulatory compliance. Based on these requirements, design the architecture of the blockchain-based voting system, including the selection of appropriate blockchain platforms (e.g., Ethereum, Hyperledger), consensus mechanisms, smart contracts, and user interfaces.
2. **Development of Smart Contracts**: Smart contracts are self-executing contracts with the terms of the agreement directly written into code. Develop smart contracts to manage the voting process, including functionalities for voter registration, ballot creation, vote casting, and tallying. These

smart contracts should be programmed to ensure transparency, security, and fairness throughout the voting process, while also protecting voter privacy.

3. **Deployment of Blockchain Network**: Set up the blockchain network that will serve as the underlying infrastructure for the voting system. Depending on the requirements and preferences, choose between public, private, or consortium blockchains. Deploy the smart contracts onto the blockchain network and configure the necessary nodes to support the decentralized consensus mechanism.
4. **Voter Registration**: Implement a secure voter registration process to verify the identity of eligible voters and prevent fraudulent registrations. This may involve integrating identity verification mechanisms such as biometrics, digital signatures, or government-issued IDs. Ensure that voter registration data is encrypted and stored securely on the blockchain to protect voter privacy.
5. **Voting Process**: Develop user-friendly interfaces (e.g., web portals, mobile apps) to facilitate the voting process for voters. Enable voters to securely cast their votes using cryptographic keys and digital signatures. Implement mechanisms to prevent double voting and ensure that each voter can only cast one vote per election. All votes cast should be recorded as transactions on the blockchain in a transparent and immutable manner.



3.1.5 Electronic Voting

6. **Vote Tallying and Results Verification**: Once the voting period has ended, tally the votes recorded on the blockchain using the smart contracts. Verify the integrity of the voting results by allowing stakeholders, including voters and election observers, to audit the blockchain and independently verify the tally. Ensure that the voting results are transparent, verifiable, and tamper-proof, instilling confidence in the integrity of the electoral process.

7. **Post-Election Procedures and Audits**: Conduct post-election procedures, such as audits and recounts, to address any discrepancies or concerns raised during the voting process. Maintain an audit trail of all activities and transactions on the blockchain for accountability and transparency purposes. Continuously monitor the blockchain network for any suspicious activities or security breaches and take appropriate measures to address them.
8. **Regulatory Compliance and Legal Framework**: Ensure compliance with relevant regulations and legal requirements governing elections and data protection. Collaborate with election authorities, legal experts, and regulatory bodies to establish a legal framework for the blockchain-based voting system, addressing issues such as voter eligibility, data privacy, and dispute resolution.

3.1.8 Security requirements for electronic voting system

3.2 Advantages and Disadvantages of Blockchain-Based Voting System

3.2.1 ADVANTAGES

1. **Security:** Blockchain technology provides a high level of security through its decentralized and tamper-resistant nature. Each vote is cryptographically secured and recorded on a distributed ledger, making it extremely difficult for malicious actors to tamper with or manipulate the voting data.
2. **Transparency and Auditability:** The transparent and immutable nature of blockchain ensures that all transactions, including votes cast, are recorded and visible to all participants in the network. This transparency enhances trust and confidence in the integrity of the electoral process, as stakeholders can independently verify the authenticity of the voting data.
3. **Tamper-Proof:** Once recorded on the blockchain, voting data becomes immutable and resistant to alteration or tampering. This eliminates the risk of fraudulent activities such as double voting, ballot stuffing, or tampering with election results, thereby ensuring the accuracy and fairness of the voting process.
4. **Accessibility:** Blockchain-based voting systems can enhance accessibility by enabling voters to cast their votes remotely using digital platforms and mobile applications. This reduces barriers to participation, such as geographical constraints and mobility limitations, and encourages greater voter turnout, particularly among marginalized communities**.**
5. **Decentralization:** By distributing trust and control across a network of nodes, blockchain-based voting systems reduce reliance on centralized authorities and intermediaries. This mitigates the risk of single points of failure and enhances the resilience and robustness of the electoral process against external interference or manipulation.

3.2.2 DISADVANTAGES

1. **Technical Complexity:** Implementing a blockchain-based voting system requires expertise in blockchain technology, cryptography, and software development. Developing and deploying smart contracts, configuring blockchain networks, and ensuring interoperability with existing voting infrastructure can be technically challenging and resource-intensive.
2. **Scalability:** Blockchain technology currently faces scalability limitations, particularly in public blockchains like Ethereum, which may struggle to handle the large volume of transactions associated with nationwide elections. Scaling blockchain-based voting systems to accommodate millions of voters while maintaining performance and responsiveness remains a significant challenge.
3. **Privacy Concerns:** While blockchain ensures the security and integrity of voting data, it may also raise concerns about voter privacy. Although votes are recorded anonymously on the blockchain, the transparency of the ledger means that individual voting behaviour could potentially be traced back to specific voters, compromising their anonymity.
4. **Voter Education and Adoption:** Introducing blockchain-based voting systems requires educating voters about the technology and addressing concerns about its reliability and security. Ensuring widespread adoption and acceptance of the new voting system may require significant efforts in public awareness campaigns and voter education initiatives.
5. **Regulatory and Legal Challenges:** Blockchain-based voting systems may face regulatory hurdles and legal uncertainties, particularly regarding compliance with existing election laws and regulations. Establishing a legal framework that addresses issues such as voter eligibility, data privacy, dispute resolution, and auditability is essential for the successful adoption of blockchain-based voting systems.

CONCLUSION

In conclusion, the implementation of a blockchain-based electronic voting system holds tremendous promise for advancing the principles of modern democracy. By harnessing the capabilities of blockchain technology, such a system offers unparalleled levels of security, transparency, and accessibility in the electoral process. The immutability and decentralization inherent in blockchain ensure the integrity of each vote cast, safeguarding against tampering and manipulation while providing verifiable and auditable results in real-time. Moreover, by eliminating geographical barriers and offering alternative methods for participation, such as mobile voting applications, blockchain-based voting systems promote inclusivity and empower citizens to exercise their democratic rights more conveniently.

Furthermore, the adoption of blockchain technology in electronic voting systems enhances the overall trust and legitimacy of democratic processes. Through its transparent and tamper-proof ledger, blockchain in stills confidence among voters and stakeholders, reducing skepticism and doubts regarding the fairness and accuracy of election outcomes. Additionally, the decentralized nature of blockchain mitigates the risk of centralized control or external interference, ensuring that electoral processes remain resilient and resistant to manipulation. As we continue to navigate the complexities of modern governance, embracing blockchain-based electronic voting systems represents a crucial step towards fostering greater trust, participation, and accountability in democratic societies.

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