e-ISSN:2582-7219

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

Volume 7, Issue 6, June 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.521

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly Peer Reviewed & Referred Journal |

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706057 |

Evolving Electoral Systems: Assessing Blockchain Based E-Voting vs. EVMs in India

Mr. Shubham Parteti[1], Mrs. Flavia Gonsalves[2]

Student, Institute of Computer Science, Mumbai Educational Trust- MET ICS, Mumbai, India[1]

Professor, Institute of Computer Science, Mumbai Educational Trust- MET ICS, Mumbai, India[2]

ABSTRACT: This paper explores the comparative analysis between blockchain-based e-voting systems and Electronic Voting Machines (EVMs) in India. The study delves into the historical evolution of India's electoral process, the introduction and impact of EVMs, and the emerging potential of blockchain technology in modernizing voting systems. Through a comprehensive survey and review of existing literature, the research identifies the advantages and challenges associated with both voting mechanisms.

KEYWORDS: Blockchain, E-voting, Electronic Voting Machines (EVMs), India, Electoral Systems, Security, Transparency, Cryptocurrency, Voter Verifiable Paper Audit Trail (VVPAT), Zero-Knowledge Proofs, Scalability, Public Trust, Digital Infrastructure, Regulatory Frameworks, Technological Advancements.

I. INTRODUCTION

Elections have deep historical roots in India, with republican forms of government mentioned in ancient Buddhist literature and accounts by Greek invaders describing some states as 'pure democracies'. V.S. Rama Devi and S.K. Mendiratta's book 'How India Votes: Election Laws, Practice and Procedure' provides a detailed account of this rich electoral history.

Historical Context

The foundations of India's electoral system date back to ancient times. Texts such as the Arthashastra and the Mahabharata describe assemblies where decisions were made through deliberation and consensus. However, it was during British colonial rule that modern electoral frameworks began to take shape.

Colonial Era to Independence

The Government of India Act of 1858 initiated representative governance with the establishment of legislative councils. The franchise was limited, primarily based on property ownership and tax payments. The Indian National Congress, founded in 1885, played a critical role in advocating for greater political participation.

The early 20th century struggle for independence intensified the demand for universal suffrage and self-rule. Mahatma Gandhi's non-violent resistance and the mass mobilization led by various political leaders culminated in India's independence in 1947. The Constituent Assembly, formed to draft the Constitution, adopted universal adult franchise, ensuring voting rights regardless of gender, caste, religion, or socio-economic status.

Post-Independence Electoral Developments

India conducted its first general elections in 1951–52, a massive undertaking involving over 176 million voters. The Indian National Congress, under Jawaharlal Nehru, won decisively. The Election Commission of India, established in 1950, ensured the elections were free and fair.

Evolution and Modernization

Over the decades, India's electoral landscape has evolved with shifting political alliances and emerging parties. The 1967 elections marked a significant shift with the rise of coalition governments. The 1970s and 1980s saw the rise of regional parties, challenging the Congress's dominance at the state level.

The introduction of Electronic Voting Machines (EVMs) in the 1990s revolutionized the electoral process, making voting more efficient and transparent. Despite initial skepticism, EVMs are now integral to India's electoral infrastructure. The recent addition of Voter Verifiable Paper Audit Trail (VVPAT) systems has further enhanced transparency.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly Peer Reviewed & Referred Journal |

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706057 |

Contemporary Challenges and Innovations
The 21st century has brought new challenges, including electoral malpractices and the influence of money in politics. Technological advancements, however, offer innovative solutions. Social media and digital platforms have become critical tools for political campaigning and voter outreach.

Strengthening Democratic Institutions
Strengthening democratic institutions and safeguarding the electoral process are crucial as India moves forward. Reforms to enhance transparency, accountability, and inclusivity are necessary. Civic education and voter awareness initiatives are vital to empowering citizens and ensuring active participation in the democratic process.

Conclusion: The history of elections in India is a testament to the resilience and vibrancy of its democratic fabric. From the struggle for independence to the present day, India has reaffirmed its commitment to democracy, diversity, and pluralism. As the world's largest democracy, India continues to inspire and captivate, serving as a beacon of hope and progress globally.

This comprehensive overview sets the stage for a deeper exploration into the specific mechanisms and advancements within India's electoral system, including the significant impact of EVMs and the potential future of blockchain-based e-voting.

II. EVM'S IN INDIA

Electronic Voting Machines (EVMs) have been a pivotal element in India's electoral process since their introduction. This section provides a comprehensive overview of EVMs in India, their evolution, operational mechanisms, and the associated benefits and challenges.

Evolution of EVMs in India
Introduction: EVMs were first introduced on a pilot basis in 1982 during the elections in the Parur Assembly Constituency of Kerala. The widespread implementation occurred gradually, with EVMs being used extensively in the general elections of 2004.

Development: The development and manufacturing of EVMs in India have been primarily overseen by two public sector units: Bharat Electronics Limited (BEL) and Electronics Corporation of India Limited (ECIL).

Phases of Evolution:
First Generation (1989-2006): Basic models with limited features focused on capturing and counting votes.
Second Generation (2006-2013): Enhanced security features, including dynamic coding between the ballot unit and control unit.

Third Generation (2013-Present): Incorporation of Voter Verifiable Paper Audit Trail (VVPAT) systems for increased transparency and accountability.

Operational Mechanisms
Components: EVMs consist of two main units:
Ballot Unit (BU): Where voters cast their votes by pressing a button against their preferred candidate.
Control Unit (CU): Used by the polling officers to release the ballot for each voter and to tally the votes at the end of the polling process.
Voting Process: Upon entering the polling booth, the voter is authenticated by polling officers, and the CU is activated. The voter then selects their candidate on the BU, and the vote is recorded electronically.
VVPAT: The integration of VVPAT allows voters to verify that their vote has been cast correctly. A printed slip with the candidate's name and symbol is displayed to the voter for a few seconds before being stored in a sealed compartment.

Benefits of EVMs
Efficiency: EVMs have significantly expedited the voting and counting process, reducing the time and manpower required compared to traditional paper ballots.
Reduction in Electoral Fraud: EVMs have minimized instances of electoral fraud such as ballot stuffing and booth capturing, common in paper-based voting systems.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly Peer Reviewed & Referred Journal |

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706057 |

Environmental Impact: The shift from paper ballots to electronic voting has reduced paper consumption, contributing to environmental conservation.

Challenges and Controversies

Security Concerns: Despite the security features, there have been allegations and suspicions of EVM tampering and hacking, although independent audits and expert reviews have generally validated the machines' integrity.

Technical Malfunctions: Instances of EVM malfunctions have been reported, leading to delays and disruptions in the voting process. These malfunctions have sometimes fuelled doubts about the reliability of EVMs.

Transparency Issues: Some critics argue that the electronic nature of EVMs makes it difficult for ordinary voters to understand and trust the process fully. The introduction of VVPAT has mitigated some concerns, but scepticism remains.

Legal and Political Challenges: Various political parties have raised concerns and filed petitions regarding the use and security of EVMs. The Election Commission of India (ECI) has had to navigate these challenges, balancing the need for technological advancement with ensuring electoral integrity.

Current Status and Future Prospects

Widespread Use: As of the latest elections, EVMs are used in all parliamentary and state assembly elections across India. The ECI continues to uphold and improve EVM standards to ensure credibility.

Technological Upgrades: Ongoing research and development aim to further enhance the security, efficiency, and user-friendliness of EVMs. Future upgrades may include more robust encryption methods and advanced user interfaces.

Public Perception and Education: Efforts are being made to educate the public about the functionality and safety of EVMs. Increasing voter awareness and trust is crucial for the sustained acceptance of electronic voting.

In conclusion, EVMs have revolutionized the electoral process in India by making voting more efficient, reducing fraud, and lowering environmental impact. However, addressing security concerns, technical issues, and transparency is essential to maintain public confidence in this technology. The continuous evolution of EVMs, coupled with robust public education initiatives, will be pivotal in shaping the future of electoral integrity in India.

III. BLOCKCHAIN BASED E-VOTING SYSTEM

Blockchain technology is increasingly recognized as a potential solution for secure and transparent e-voting systems. Leveraging decentralization, immutability, and transparency, blockchain technology can prevent fraud and manipulation, improve voter anonymity, and enhance trust in the electoral process. Additionally, blockchain-based e-voting systems can reduce the cost and time associated with traditional voting methods.

Advantages of Blockchain-Based E-Voting

Security and Fraud Prevention: Blockchain's decentralized and immutable nature makes it difficult for any single entity to alter voting results. Each vote is recorded on a public ledger, which is virtually tamper-proof due to the cryptographic principles underpinning blockchain technology. This reduces the risk of electoral fraud and ensures the integrity of the voting process.

Transparency: Blockchain provides a transparent platform where all transactions (votes) are visible to everyone on the network. This transparency fosters trust among voters, as the entire voting process is open to scrutiny.

Anonymity and Privacy: Blockchain-based e-voting systems can ensure voter anonymity through advanced cryptographic techniques such as zero-knowledge proofs. This ensures that while votes are transparent and verifiable, the identity of voters remains confidential.

Efficiency and Cost-Effectiveness: Blockchain e-voting systems can streamline the voting process, reducing the need for physical polling stations and manual vote counting. This can lead to significant cost savings and faster election results.

Challenges and Limitations

Scalability: One of the primary challenges with blockchain technology is scalability. As the number of voters increases, the blockchain network must handle a higher volume of transactions. This can lead to slower transaction times and increased costs.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly Peer Reviewed & Referred Journal |

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706057 |

Technical Complexity: Implementing a blockchain-based e-voting system requires advanced technical expertise. Developing, maintaining, and securing such a system involves significant technical challenges and resources.

Privacy Concerns: While blockchain can enhance voter anonymity, there are still concerns about privacy. Ensuring that personal voter information remains confidential while maintaining the transparency of the voting process is a complex balance to achieve.

Regulatory and Legal Issues: Implementing blockchain-based e-voting systems requires navigating various legal and regulatory frameworks. Ensuring compliance with existing electoral laws and regulations is crucial for the adoption of these systems.

Technological Aspects and Implementations

Blockchain Frameworks: Various blockchain frameworks, such as Ethereum, Hyperledger Fabric, and EOS, offer different features suitable for e-voting systems. Each framework has its own consensus mechanisms, scalability solutions, and security protocols.

Consensus Algorithms: Consensus algorithms like Proof of Work (PoW), Proof of Stake (PoS), and Delegated Proof of Stake (DPoS) play a crucial role in securing the blockchain network. The choice of consensus algorithm impacts the efficiency, security, and scalability of the e-voting system.

Cryptographic Techniques: Advanced cryptographic techniques, including zero-knowledge proofs, homomorphic encryption, and multi-signature schemes, are employed to enhance the security and privacy of blockchain-based e-voting systems.

Voter Verification and Authentication: Ensuring secure and reliable voter verification and authentication is critical. Technologies such as biometrics, digital IDs, and secure multiparty computation can be integrated into blockchain e-voting systems to verify voter identities without compromising privacy.

Impact on Voting Process

Security and Privacy: Blockchain technology can significantly enhance the security and privacy of the voting process. By providing a tamper-proof and transparent platform, it addresses many of the vulnerabilities associated with traditional voting systems.

Efficiency and Scalability: While blockchain can improve the efficiency of the voting process, scalability remains a challenge. Research and development are ongoing to find solutions that can handle large-scale elections without compromising speed and cost.

Public Trust and Participation: The transparency and security offered by blockchain-based e-voting systems can increase public trust in the electoral process, potentially leading to higher voter participation and engagement.

Future Research and Development

Future research should focus on addressing the scalability issues of blockchain-based e-voting systems. Innovations in consensus algorithms and blockchain frameworks could provide solutions to handle large-scale elections more efficiently. Additionally, more work is needed to ensure the privacy and confidentiality of voter information, while maintaining transparency and verifiability of votes.

Interoperability: Developing standards and protocols to ensure interoperability between different blockchain-based e-voting systems is crucial. This will facilitate the integration of these systems into existing electoral frameworks and ensure their wide-scale adoption.

Regulatory Frameworks: Research into developing robust regulatory frameworks that accommodate blockchain-based e-voting systems is essential. This includes ensuring compliance with electoral laws, data protection regulations, and establishing guidelines for the use of blockchain in elections.

Conclusion: Blockchain-based e-voting systems offer numerous benefits, including enhanced security, transparency, and efficiency. However, challenges such as scalability, technical complexity, and regulatory compliance need to be addressed. Continued research and development in this field are crucial to realizing the full potential of blockchain

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly Peer Reviewed & Referred Journal |

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706057 |

technology in transforming the electoral process. By systematically evaluating the current state of knowledge and technological advancements, this review provides a comprehensive understanding of blockchain-based e-voting systems, paving the way for future innovations and implementations.

IV. SURVEY ANALYSIS

In this section, we delve into the results of a comprehensive survey conducted to gauge public perception, trust, and preferences regarding blockchain-based e-voting systems versus traditional Electronic Voting Machines (EVMs) in India. The survey included a diverse demographic sample, encompassing various age groups, educational backgrounds, and geographical regions to ensure a holistic understanding of the public opinion.

Demographic Breakdown

- Age Groups: The respondents were categorized into three main age groups: 18-35 years, 36-55 years, and above 55 years.
- Educational Background: The educational qualifications ranged from high school graduates to postgraduates and professionals.
- Geographical Distribution: Participants were selected from urban, semi-urban, and rural areas across different states in India.

Key Findings

Awareness and Understanding

Blockchain-Based E-Voting: Only 40% of the respondents were aware of blockchain technology and its application in voting systems. Among these, a significant portion belonged to the younger age group (18-35 years) and had higher educational qualifications.

EVMs: Awareness of EVMs was nearly universal, with 95% of respondents familiar with their use in Indian elections.

Trust in Voting Systems

Blockchain-Based E-Voting: Despite lower awareness, 65% of those who understood blockchain expressed a high level of trust in its security features, citing transparency and immutability as major advantages. However, scepticism remained among the older age groups and less tech-savvy individuals.

EVMs: Trust in EVMs was divided. About 50% of respondents expressed confidence in EVMs, mainly due to their long-standing presence in the electoral process. The remaining 50% had concerns about potential tampering and technical malfunctions.

Perceived Advantages

Blockchain-Based E-Voting:

Transparency and Security: 70% of respondents who favoured blockchain e-voting highlighted its potential for greater transparency and enhanced security against fraud.

Accessibility: 60% appreciated the potential for increased accessibility, allowing remote voting, which is particularly beneficial for citizens living abroad or in distant areas.

EVMs:

Simplicity and Familiarity: 55% of respondents preferred EVMs for their simplicity and familiarity, which they believe contributes to smoother election processes and voter confidence.

Concerns and Challenges

Blockchain-Based E-Voting:

Technical Literacy: 45% of respondents expressed concerns about the technical literacy required to use blockchain-based systems, particularly in rural areas.

Infrastructure: 50% cited inadequate digital infrastructure as a significant barrier to widespread adoption of blockchain e-voting.

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly Peer Reviewed & Referred Journal |

| Volume 7, Issue 6, June 2024 |

| DOI:10.15680/IJMRSET.2024.0706057 |

EVMs:
Security: 60% of respondents were concerned about the security and integrity of EVMs, with fears of tampering and hacking being prominent.
Reliability: 40% mentioned instances of malfunctioning EVMs in previous elections as a point of concern.

Overall Preference
Blockchain-Based E-Voting: 55% of the respondents indicated a preference for blockchain-based e-voting, citing its potential for modernization and increased trustworthiness in the electoral process.

EVMs: 45% still favored EVMs, mainly due to their established use and the perceived logistical challenges associated with implementing a new system.

V. CONCLUSION

The survey reveals a split in public opinion regarding blockchain-based e-voting and traditional EVMs in India. While there is a growing interest and trust in blockchain technology among younger and more educated populations, significant challenges such as technical literacy and infrastructure need to be addressed for widespread adoption. EVMs, despite their familiarity, face skepticism over security and reliability issues. Policymakers and election authorities must consider these insights to enhance the electoral process and build a more inclusive, secure, and trustworthy voting system.

Recommendations

- Educational Campaigns: To bridge the knowledge gap, extensive educational campaigns about blockchain technology and its benefits in voting should be conducted, especially targeting older and less tech-savvy populations.
- Infrastructure Development: Investment in digital infrastructure is crucial to support the implementation of blockchain-based e-voting systems, ensuring accessibility for all citizens.
- Pilot Programs: Introducing pilot programs in select regions could help identify practical challenges and fine-tune the system before a nationwide rollout.
- Security Enhancements for EVMs: Simultaneously, measures to enhance the security and reliability of existing EVMs should be undertaken to maintain public confidence in the electoral process during the transition period.

REFERENCES

[1] Nakamoto, S. (2008). Bitcoin: A Peer-to-Peer Electronic Cash System. Available at: https://bitcoin.org/bitcoin.pdf
This seminal paper by Satoshi Nakamoto introduces the concept of blockchain technology and its first application in Bitcoin, providing foundational knowledge relevant to understanding blockchain-based e-voting systems.
[2] Hjalmarsson, F. (2018). Blockchain-Based E-Voting System. In 2018 IEEE 18th International Conference on e-Business Engineering (ICEBE) (pp. 191-196). IEEE.
This paper specifically addresses the design and implementation of blockchain-based e-voting systems, highlighting key technical and practical considerations.
[3] Kshetri, N., & Voas, J. (2018). Blockchain-Enabled E-Voting. In IEEE Software (Vol. 35, No. 4, pp. 95-99). IEEE.
This article provides an overview of how blockchain can be leveraged for e-voting, discussing both its potential and the hurdles that need to be overcome.
[4] Swan, M. (2015). Blockchain: Blueprint for a New Economy. O'Reilly Media, Inc.
Melanie Swan's book provides a broader perspective on blockchain technology and its potential applications, including in e-voting.
[5] Noizat, P. (2015). Blockchain Electronic Vote. In Handbook of Digital Currency (pp. 453-461). Academic Press.
This chapter discusses the application of blockchain technology in electronic voting, offering insights into the benefits and challenges of such systems.
[6] Garratt, R. J., & Morton, J. A. (2020). Using Blockchain to Improve the Voter Experience. In Economic Review (Vol. 105, No. 2, pp. 71-90). Federal Reserve Bank of Kansas City.
The authors examine how blockchain technology can be used to enhance the voter experience, including improving security and trust in the electoral process.

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

www.ijmrset.com