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LEVERAGING TECHNOLOGY FOR TRANSPARENT AND ACCESSIBLE ELECTIONS

Abstract

Given the widespread mistrust surrounding traditional voting systems, ensuring democratic voting in any country has become increasingly critical. Citizens have witnessed their fundamental rights being compromised, and existing digital voting systems have faced challenges due to their lack of transparency. The opacity of most voting systems poses a significant obstacle to building voter confidence in governments. The inherent vulnerability of traditional and current digital voting systems has contributed to their failure, allowing for potential exploitation.

The primary objective is to address the shortcomings of both traditional and digital voting systems, which often result in mishaps or injustices during the voting process. Blockchain technology presents a promising solution for conducting fair elections and reducing instances of injustice. However, physical voting systems also exhibit numerous flaws, while digital voting systems are not yet sufficiently refined for widespread implementation. This underscores the urgent need for a solution to safeguard the democratic rights of citizens.

This article proposes a platform based on modern blockchain technology that prioritizes maximum transparency and reliability to foster trust between voters and election authorities.

The proposed platform offers a framework for conducting digital voting activities without the need for physical polling stations.

Keywords: Blockchain Technology, E-voting, Ballot Paper, Transparency

***Introduction*:**

In the ever-evolving realm of democracy, the convergence of technology and elections emerges as a beacon of hope, fostering transparency, inclusivity, and integrity within the electoral sphere. Across the globe, societies grapple with the urgent need to ensure equitable representation and unrestricted access to voting. Leveraging technological progress emerges as a pivotal strategy to confront longstanding hurdles and inaugurate a new epoch of democratic engagement.

From electronic voting machines to blockchain-enabled platforms, a vast array of digital tools holds immense potential to revolutionize election procedures, oversight, and citizen participation. Through innovative endeavours, governments and electoral bodies can pave the way for electoral systems that are more transparent, secure, and accessible, ultimately reinforcing the bedrock of democracy.

This article delves into the multifaceted realm of utilizing technology to promote transparent and accessible elections. It explores how digital solutions profoundly influence electoral integrity, voter engagement, and the core tenets of democratic governance. By examining essential strategies, hurdles, and exemplary practices, we unveil how technology acts as a catalyst in advancing the democratic ideals of fairness, inclusivity, and accountability in contemporary society.

***Past scenario relating to election process*?**

The "Ballot Paper Election Process" represents the conventional methodology employed in electoral proceedings, utilizing paper-based ballots. Here's a concise breakdown of each stage:

1. Voter Authentication: At designated polling stations, individuals provide identification documents, such as ID cards or voter registration cards, to confirm their eligibility. Upon verification, they receive a paper ballot.

2. Voting Enclosure: Voters proceed to secluded voting booths to make their selections on the paper ballot, ensuring the confidentiality and autonomy of their choices, free from external influence or coercion.

3. Paper Ballot: Featuring candidate names or available options, the paper ballot serves as the medium for recording voter preferences. Voters mark their selections using prescribed methods such as box ticking or circle filling.

4. Ballot Concealment: After marking their choices, voters fold the paper ballot to protect the privacy of their selections, preventing unauthorized access.

5. Ballot Receptacle: Folded ballots are then placed into secure ballot boxes, designed to safely accumulate and preserve them until the tallying phase, ensuring the integrity of the electoral process.

6. Tallying Facility: Following the conclusion of voting, ballot boxes are gathered and transported to dedicated tallying stations or central facilities. Here, election officials meticulously unlock the boxes and unload the paper ballots in preparation for counting.

7. Manual Tabulation: Election officials systematically scrutinize each paper ballot to determine the votes cast for each candidate or option. This meticulous process involves tallying the marks or indicators made by voters on the ballots to accurately record their selections.

8. Result Declaration: Upon completion of the manual counting process, election authorities compile the results and publicly announce the election outcome. These results are disseminated to the public and relevant authorities to affirm the integrity and validity of the electoral process.

***What is E-voting pertaining to global trends*?**

E-voting systems are increasingly being viewed as viable substitutes for traditional paper-based voting methods, presenting numerous advantages that stand to enhance the electoral process significantly.

Furthermore, e-voting systems hold promise in improving accessibility for individuals with disabilities. By integrating features such as audio ballots, these systems enable visually impaired voters to independently listen to ballot options and make selections. Additionally,

customizable interfaces can cater to the specific requirements of voters with mobility impairments or other disabilities, ensuring their participation in the electoral process with dignity and ease.

Despite these advantages, it is imperative to address potential challenges surrounding the security and reliability of e-voting systems. Robust cybersecurity measures must be enacted to safeguard against hacking or manipulation of electronic voting systems, thereby ensuring the integrity and trustworthiness of election results. Additionally, comprehensive testing and validation procedures are essential to verify the accuracy and dependability of e-voting systems before widespread implementation.

To date, Estonia remains the only country in the world in which any citizen can cast a remote electronic vote during elections to their national parliament (the Riigikogu), to local government councils, or to the parliament of the European Union. The Baltic state, which became an online voting pioneer in 2005, is now a standard reference for the use of Internet voting technology, and their citizens are increasingly taking advantage of it. During the 2019 Riigikogu elections, for example, 247,232 voters cast an online ballot. That same year, 47% of the valid votes cast during the elections to the European parliament were cast by online voters. France started piloting the use of online voting for voters abroad in 2003, offering this possibility to all citizens living abroad for the first time during the 2012 parliamentary elections. Shortly after becoming a possibility, online voting became the first choice by more than half of voters living abroad. In other countries, such as Armenia, this possibility is further reserved to diplomatic and military staff posted abroad.[1]

What is Electronic voting machine in context of Indian elections?

India, renowned as the world's largest democracy, is known for its ability to manage cultural, regional, economic, and social disparities. In 2004, it adopted Electronic Voting Machines (EVMs) for parliamentary elections, facilitating the participation of 380 million voters across more than a million devices. Developed by two government-owned defence equipment manufacturing units, Bharat Electronics Limited (BEL) and Electronics Corporation of India

[1] Pérez, A.R. (2021) *Which countries use online voting?*, *Medium*. Available at: https://medium.com/edge-elections/which-countries-use-online-voting-3f7300ce2f0 (Accessed: 30 April 2024).

Limited (ECIL), these identical systems adhere to the specifications set by the Election Commission of India. Each system comprises two devices powered by 6V batteries.[2]

In August 1980, Electronics Corporation of India Ltd (ECIL) introduced a prototype voting machine to political parties. In 1982, the Election Commission of India (ECI) decided to pilot the machine in 50 out of 84 polling stations in the Parur constituency during the Assembly elections in Kerala. Despite lacking central government sanction, the ECI invoked its constitutional powers under Article 324 to proceed. Following the election results announced on May 20, 1982, wherein Sivan Pillai (CPI) secured victory over Ambat Chacko Jose (Cong) by 123 votes, with 19,182 votes cast via the voting machines out of Pillai's total of 30,450. Jose contested the outcome in trial court, which affirmed the validity of machine voting and upheld the election result. Jose then appealed to the Supreme Court, where a Bench comprising Justices Murtaza Fazal Ali, Appajee Varadarajan, and Ranganath Misra presided over the case.[3]

Key issues surrounding the use of EVMs include security and integrity concerns, with studies revealing vulnerabilities that could enable vote tampering despite claims of tamper-proofing. Additionally, transparency and verifiability are questioned, particularly regarding the effectiveness of the VVPAT system in providing a reliable paper trail for auditing electronic results. Usability and accessibility are also significant factors influenced by EVM design, ballot layout, and voter education.[4]

***What is blockchain technology*?**

Blockchain technology has emerged as a disruptive force in reshaping the electoral landscape. Its decentralized and distributed ledger system is at the forefront of providing

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[2] UMMAL SARIBA BEGUM T, A.K.D. (2012) *Electronic voting machine — A review | IEEE conference publication | IEEE Xplore*, *researchgate.net*. Available at: https://ieeexplore.ieee.org/document/6208285 (Accessed: 30 April 2024).

[3] Karpuram, A.S. (2024) *When Supreme Court junked the election Commission's first EVM experiment in Kerala*, *The Indian Express*. Available at: https://indianexpress.com/article/explained/explained-law/a-long-way-from-1984-when-sc-junked-ecis-first-evm-experiment-9292936/ (Accessed: 30 April 2024).

[4] J. Alex Halderman, H.K.P. (2010) *Security problems in India's electronic voting system*, *Electrical Engineering and Computer Science*. Available at: https://eecs.engin.umich.edu/event/security-problems-in-indias-electronic-voting-system/ (Accessed: 30 April 2024).

unprecedented levels of transparency, security, and efficiency throughout various aspects of the electoral process.

At its core, blockchain meticulously records every transaction or vote on a public ledger, thereby ensuring transparency by granting accessibility to all stakeholders. This transparent nature enables voters, election officials, and other interested parties to scrutinize the entire process, fostering trust and confidence in the electoral system.

Furthermore, the security of blockchain is underpinned by robust cryptographic algorithms, which serve to safeguard the integrity of the process. These algorithms make it virtually impossible for unauthorized alterations to occur without consensus from the network participants. As a result, the blockchain ensures that the sanctity of each vote is preserved, mitigating the risk of fraud or tampering.

Operating within a peer-to-peer network framework, blockchain eliminates the need for centralized oversight, which is a significant departure from traditional electoral systems. This decentralized approach greatly reduces the vulnerability to manipulation or interference by any single entity. Instead, control and validation of transactions are distributed across multiple nodes within the network, enhancing the system's resilience and reliability.

Moreover, each vote or transaction leaves behind a traceable imprint on the blockchain, providing an immutable and verifiable audit trail. This traceability not only enhances accountability but also serves as a deterrent against malfeasance, as any attempt to tamper with the records would be immediately detected.

"*Advantages of Blockchain in Electoral Processes*"

Utilizing blockchain technology in electoral processes can significantly alleviate the challenges associated with traditional polling stations, such as resource allocation, staffing, and security vulnerabilities. Conducting digital elections through blockchain not only results in cost savings but also mitigates the risk of voting inequity. By leveraging modern technologies like blockchain, the voting system can achieve enhanced transparency, reliability, and transaction traceability.

In contrast to conventional digital voting systems that rely on centralized databases and vulnerable voting machines, blockchain offers a decentralized solution. This distributed

ledger system ensures data integrity and resilience against tampering, as each transaction is continuously verified across the network. Unlike a centralized system susceptible to single points of failure, a blockchain network remains unaffected by individual attacks, maintaining uninterrupted service provision through its peer-to-peer architecture.

The security and trust levels provided by blockchain surpass those of previous technologies, reducing the need for extensive staffing, security personnel, and physical polling stations. Instead, resources can be allocated to support blockchain miners, further enhancing the efficiency and robustness of the voting process.

Tamper-Proof System: Utilizing blockchain ensures the integrity of electoral rolls, preventing unauthorized intervention. Blockchain-powered voting devices, replacing Electronic Voting Machines (EVMs), authenticate voters via biometric data, generating unique hash keys for secure voting access.

While blockchain technology offers several potential benefits for election systems, it also presents some limitations and challenges:

Blockchain's transparency and immutability pose privacy concerns for voters, potentially compromising the secrecy of the ballot by allowing individual votes to be traced. Despite its security features, blockchain remains vulnerable to cyberattacks, enabling malicious actors to manipulate election results or disrupt the voting process. Implementing blockchain-based voting systems requires significant technical expertise and resources to develop secure, user-friendly interfaces, ensure network integrity, and navigate legal and regulatory challenges. However, introducing blockchain-based voting may exacerbate existing digital accessibility gaps, leading to unequal representation. Moreover, integrating blockchain into election systems faces legal and regulatory hurdles, including compliance with election laws, privacy regulations, and certification requirements, potentially necessitating legislative changes and government cooperation. Additionally, blockchain-based voting platforms are susceptible to software bugs, vulnerabilities, and glitches, posing integrity and trust challenges. The absence of universal standards further complicates implementation, with varying consensus mechanisms, cryptographic algorithms, and governance models hindering interoperability and stakeholder consensus. In conclusion, while blockchain offers potential benefits for election systems, its practical deployment necessitates careful consideration and

collaboration among technologists, policymakers, election officials, and stakeholders to address these challenges responsibly.

***Blockchain's Role in Electoral Transparency*?**

Blockchain's potential to enhance electoral transparency is pivotal, particularly in democracies like the US and India, where election trust issues persist. By leveraging decentralized platforms for polling, counting, and result announcements, we can address these concerns and fortify the electoral process.

Blockchain technology guarantees secure and tamper-proof voting records, safeguarding the confidentiality and integrity of votes using cryptographic algorithms. It also enables transparent and auditable record-keeping. Incorporating blockchain into voting systems provides advantages such as end-to-end verifiability, transparency, and security measures, promising to modernize the voting process and instil confidence in democratic systems. Although scalability and public opinion present challenges, practical implementations and case studies underscore blockchain's potential to enhance the security, traceability, and reliability of electronic voting systems. [5]

West Virginia became the first U.S. state to allow internet voting by blockchain in primary elections. While the voter participation through this platform was estimated to be small, the intention of the administrators was to test the technology in a pilot project with no immediate plans to implement it at a larger scale. Utilizing open-source blockchain voting platforms can enhance the efficiency of elections. These platforms lack proprietary components, enabling citizens and organizations to scrutinize the application's functionality and enhance its security collaboratively. An open-source approach is crucial for ensuring the integrity of elections. Numerous startups, including Democracy Earth Foundation, Follow My Vote, democracyos.org, VoteWatcher, Milvum, and VotoSocial, have emerged in recent years, focusing on developing open-source online voting applications aligned with the principles of open data. Pete Martin, CEO of Votem and a supporter of online voting, suggests that within two years, significant elections in the U.S. could be conducted using blockchain technology.

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[5] essentials, election (2023) *The role of blockchain in electronic voting: Enhancing security, traceability, and trustworthiness*, *ElectionBuddy*. Available at: https://electionbuddy.com/blog/2023/07/10/the-role-of-blockchain-in-electronic-voting-enhancing-security-traceability-and-trustworthiness/ (Accessed: 30 April 2024).

As governmental practices evolve, so too will the methods of electing officials, and blockchain could be integral to this evolution.[6]

Conclusion

In conclusion, the adoption of blockchain technology in electoral processes holds promise for enhancing transparency, security, and trustworthiness. By leveraging decentralized platforms, blockchain ensures secure and tamper-proof voting records while enabling transparent and auditable record-keeping. Despite facing challenges such as scalability and public opinion, practical implementations underscore blockchain's potential to modernize the voting process and instil confidence in democratic systems. Furthermore, open-source blockchain voting platforms offer opportunities for collaborative scrutiny and improvement, contributing to the integrity of elections. As governmental practices evolve, blockchain could play an integral role in shaping the future of electoral systems, potentially revolutionizing the way officials are elected and votes are cast and counted.

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[6] Mayer, W.G. *et al.* (2022) *How blockchain could improve election transparency*, *Brookings*. Available at: https://www.brookings.edu/articles/how-blockchain-could-improve-election-transparency/ (Accessed: 30 April 2024).

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