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Review Article

Economic Growth and Development of the Country through E-Voting, Free and Fair Elections
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ABSTRACT
Elections are an important means to elect the democratic governments for a specific period to rule the country and work for the growth and development of the people. Voting, in this regard, is used as a tool in this democratic process. The traditional voting systems witnessed low turnout of masses, result delays, rigging and formation of handicap governments, litigation, protests and several other problems including high cost of this futile exercise. In this scenario, e-Voting (Electronic Voting) seems the ultimate solution to pull the county out of jeopardy and helps in the creation of popular governments duly elected by the majority votes of the masses. This study is an attempt to develop a solution model for all such countries, including Pakistan, where Elections are of paramount importance, but the outcomes of elections are compromised thereby resulting in weak democratic system which remains vulnerable and lacks popular support of masses in general.

KEYWORDS
Democracy, Elections, e-Voting, Bitcoin, Blockchain Technology.

1 | INTRODUCTION

Voting is indeed a cornerstone of democratic societies, enabling citizens to exercise their right to choose their representatives and influence government decisions. However, traditional voting systems often encounter several challenges, like low turn-out rates resulting in low voter participation in the democratic process which can undermine the legitimacy of elected governments. In such societies, voting can be inconvenient for many citizens, particularly those with disabilities, those living in remote areas, or those with demanding schedules. Delayed Results is another issue when counting votes manually can be time-consuming, leading to delays in announcing results (Zhao & Chan, 2015). Traditional voting methods can be susceptible to fraud and manipulation, leading to questions about the integrity of the results and are labeled as 'Rigged Elections'. High Costs in conducting elections involving costs for polling stations, staff, security, and materials is another issue in traditional voting systems. Similarly, all these challenges often lead to disputes in election results, leading to protests, litigation, and sometimes the formation of weak governments (Wu, 2017).

1.1 | Problem Statement

The traditional voting takes place in assigned polling stations which restrict the voters with place and time

constraints to cast their votes, whereas the e-voting system offers online voting, which is beyond the time and place restrictions. In e-voting, people can cast their votes by using their own online gadgets at their homes, offices, or from anywhere in the World. e-voting has a leading-edge over traditional voting in terms of voters' convenience, low cost, high transparency, robust results, and overall satisfaction of the masses. However, e-Voting faces certain challenges like electronic fraud, stealing of identity, threats to voters, or vote purchase. This study is an endeavor to identify the issues of e-voting system and provide a solution model for safe and secure e-voting.

2 | LITERATURE REVIEW

2.1 | What is E-Voting

E-Voting, or electronic voting, refers to the use of electronic systems and technology to cast and count votes in an election. It encompasses a variety of methods and systems, like 'Direct Recording Electronic Voting Machines' which allow voters to cast their votes directly on an electronic device, typically through a touch screen, buttons, or similar interfaces. Votes are recorded and stored in the machine's memory. Similarly, 'Open Scan Voting Systems', where voters mark their choices on a paper ballot, which is then scanned and counted by an electronic device. This system allows for a physical paper trail that can be audited. 'Internet Voting', which is a modern concept of e-voting, where voters cast their votes remotely using an internet-connected device, such as a computer or smartphone. This method can facilitate voting for people who are unable to physically visit polling stations. 'Kiosk Voting' is another method of e-voting which is like DRE systems, kiosk voting involves casting votes on electronic devices located at designated polling stations (Spycher et al., 2011; Zhao & Chan, 2015).

2.2 | Origin and Evolution of E-voting

The origin of e-voting can be traced back to the late 20th century, with the development of electronic systems to facilitate the voting process. Here is a brief overview of the origin and key milestones in the evolution of e-voting:
a. Early Electronic Voting Systems (1960s-1980s): The concept of electronic voting emerged in the 1960s, with early experiments using punch cards and electromechanical devices. In the 1970s and 1980s, some countries began adopting rudimentary electronic voting machines for use in elections. These machines typically recorded votes electronically but did not have advanced features like internet connectivity or touch screens. b. Advancements in the 1990s: The 1990s saw significant advancements in electronic voting technology. Direct Recording Electronic (DRE) voting machines were developed, allowing voters to cast their votes directly on electronic devices. Optical scan systems, which scanned and counted paper ballots electronically, also gained popularity during this period. c. Internet Voting (1990s-2000s): The late 1990s and early 2000s witnessed the emergence of internet voting as a potential solution to increase voter participation and accessibility. Countries like Estonia, Switzerland, and the United States began experimenting with internet voting systems for certain elections, such as overseas or absentee voting. d. Widespread Adoption (2000s-Present): The widespread adoption of electronic voting (e-voting) systems, beginning in the 2000s and continuing into the present, represents a significant evolution in the administration of elections. During this era countries like Brazil and India pioneered the use of e-voting on a large scale. Brazil conducted its first nationwide electronic election in 2000, while India followed with its first large-scale use of Electronic Voting Machines (EVMs) in the 2004 general elections. Similarly, the Help America Vote Act (HAVA) of 2002 spurred the adoption of electronic voting machines across many states, aiming to modernize the voting process and address issues from the 2000 presidential election. Countries like Estonia, Switzerland, and the United States began experimenting with internet voting systems for certain elections, such as overseas or absentee voting. DRE machines, optical scan systems, and internet voting platforms continued to evolve, incorporating enhanced security features, accessibility options, and auditability.

Today, e-voting continues to evolve with advancements in technology, such as blockchain-based voting systems that offer enhanced security and transparency. Countries and organizations are exploring innovative solutions to address the challenges associated with e-voting while leveraging its potential to improve the democratic process. Overall, the origin and evolution of e-voting reflect a trajectory of technological innovation, regulatory adaptation, and ongoing efforts to balance the benefits and challenges of electronic voting in democratic elections (Takabatake et al., 2016; Jason and Yuichi, 2017).

2.3 | Importance of E-voting

E-voting can play a crucial role in modernizing elections, addressing longstanding challenges, and strengthening democratic systems by making the voting process more accessible, secure, efficient, and transparent. The importance of e-voting lies in its potential to address several key challenges and enhance the democratic process. e-voting is considered significant due to a) Increased Accessibility and Convenience- e-voting can make it easier for people to vote, particularly those who face physical, geographical, or time constraints. This includes people with disabilities, the elderly, those living in remote areas and citizens abroad. Internet voting allows people to vote from anywhere, increasing voter participation; b) Faster Results- Electronic voting systems can significantly reduce the time required to tally votes and announce results. This speed can help in reducing tensions and uncertainties that often accompany prolonged vote counting periods; c) Improved Accuracy- Properly designed electronic systems can minimize human errors in vote counting and ballot handling. This can lead to more accurate election results and increase the integrity of the electoral process; d) Cost Efficiency- Over time, e-voting can reduce the costs associated with printing, distributing and storing paper ballots. It can also lower the administrative burden of managing large-scale elections; e) Enhanced Security- With appropriate safeguards, e-voting systems can enhance the security of the voting process. Features like encryption, secure access controls and audit trails can help prevent tampering, fraud and other security breaches; f) Reduction of Fraud and Malpractice- Electronic systems can incorporate measures to verify voter identities and ensure that each vote is counted accurately. This can help reduce instances of voter impersonation, ballot stuffing and other forms of electoral fraud; g) Environmental Benefits- e-voting can reduce the need for paper ballots and other physical materials, contributing to environmental conservation by lowering the demand for paper and reducing waste; h) Increased Voter Turnout- By making the voting process more convenient and accessible, e-voting has the potential to increase voter turnout. Higher participation rates can lead to more representative and legitimate election outcomes; i) Transparency and Auditability- Advanced e-voting systems can provide detailed audit trails and transparency in the voting process. This allows for thorough post-election audits and increases public trust in the electoral process; and j) Adaptability- e-voting systems can be quickly updated and adapted to accommodate changes in electoral laws, voting methods, and voter preferences. This flexibility can enhance the responsiveness and relevance of the electoral process (Czepluch et al., 2015; Zhao and Chan, 2015; Takabatake et al., 2016).

2.4 | Issues and Challenges of E-voting

While e-voting offers numerous advantages, it also comes with several significant issues and challenges that need to be addressed for its successful implementation. Some of the key issues of e-voting include a. Security Concerns: One of the most critical issues is the security of electronic voting systems. These systems are vulnerable to hacking, tampering, and other cyber threats. Ensuring the integrity and confidentiality of votes in an e-voting environment requires robust cyber security measures, encryption protocols, and continuous monitoring. b. Trust and Transparency: Building trust in e-voting systems is essential for their acceptance and legitimacy. Transparency in how votes are cast, recorded, and counted is crucial. Voters, candidates, and stakeholders must have confidence that the system is fair, accurate and free from manipulation. c. Accessibility and Digital Divide: While e-voting can enhance accessibility for many voters, it can also exacerbate the digital divide. Not all citizens have equal access to technology, internet connectivity, or the necessary skills to use electronic voting systems. Ensuring equitable access and providing alternative voting options for those unable to use e-voting systems is essential. d. Technical Challenges: Electronic voting systems are complex and require reliable hardware, software, and network infrastructure. Technical issues such as system failures, software glitches and compatibility problems can disrupt the voting process and undermine trust in the system. e. Privacy and Data Protection: Protecting voter privacy and ensuring the confidentiality of voting data are paramount. Unauthorized access to voter information or the exposure of sensitive data can lead to privacy breaches and undermine the credibility of e-voting systems. f. Auditability and Verification: Verifiability and auditability are crucial for ensuring the accuracy and legitimacy of election results. e-voting systems must allow for independent audits, recounts and verification mechanisms to detect and correct any discrepancies or irregularities. g. Legal and Regulatory Framework: Developing comprehensive legal and regulatory frameworks for e-voting is essential. This includes addressing issues such as voter authentication, data protection, dispute resolution mechanisms and standards for electronic voting systems. Clear guidelines and oversight mechanisms are necessary to ensure compliance and accountability. h. Resistance to Change: Introducing e-voting may face resistance from various stakeholders, including political parties, election officials and the public. Addressing concerns about the reliability, security and fairness of e-voting systems is crucial for gaining acceptance and support. i. Cost and Resource Allocation: Implementing and maintaining e-voting systems can be costly,

requiring investments in technology, training, security measures and infrastructure. Allocating sufficient resources and budgetary support is essential for the successful adoption of e-voting. j. Ethical and Social Implications: e-voting raises ethical considerations regarding transparency, accountability, voter coercion and the potential for disenfranchisement. Addressing these ethical concerns and engaging in public dialogue and consultation are vital aspects of e-voting implementation. Addressing these issues requires a multidisciplinary approach involving technology experts, election officials, policymakers, civil society organizations and the public. Collaboration, transparency, continuous evaluation and adaptation are key to overcoming challenges and realizing the potential benefits of e-voting in democratic processes (Juels et al., 2010; Spycher et al., 2011).

2.5 | Blockchain Technology: A Solution to E-voting Fraud

Blockchain is one of the safest and secure mechanisms to conduct fair, transparent and temper resistant elections in the modern democratic processes. This system of voting has gained the attention of most of the countries where elections results obtained from traditional voting were always disputable. This technology works on a series of steps involving: The first and foremost step is the validation and confirmation of voter's identity who is going to exercise his democratic right of vote cast. To do so, the voter must download and install the remote voting booth on his smart device, laptop or the desktop computer. After that, he/she is required to submit his/her personal information to the election authorities, which is securely added to the voter's blockchain. The election authorities compare the submitted information with the database of registered voters and determine the eligibility of the applicant to cast the vote. After confirmation of the identity of the applicant voter, a smart contract will be executed, and a ballot paper is issued to the voter to mark his/her choice (of contestant) on the ballot paper and submit it to the ballot box without possibility to cast multiple votes by a single voter (Luo, 2015). Each time when a new voter signs in to cast the vote, the blockchain-based voting system confirms the identity of the voter with its existing database, maintained by election authorities, to ensure that the voter is not repeating the vote and is declared a fresh voter. After confirmation of a fresh voter's identity, the digital polling station accepts his/her vote. Similarly, if a voter's vote request is invalid, his/her vote is declined by the e-Polling station. In this way, use of multiple votes by a single voter can be avoided quite easily. In blockchain voting system, each vote is an Electronic Transaction between a Voter and the Election Authorities. Similarly, this transaction cannot be modified, once the vote is cast. The voter is also given an option to print the receipt of his/her vote cast, as a proof. Using blockchain, each voter can also confirm that his vote has been counted and can audit each ballot in the ballot box and confirm it with the election results while retaining the privacy of other voters (Jason and Yuichi, 2017).

3 | RESEARCH METHODS

Articles from well reputed databases such as Scopus, Web of Sciences, EBSCO were downloaded and used in the manuscript. Moreover, well reputed journals which published relevant papers, theses, case studies were also used for review.

4 | DISCUSSION

In traditional manual voting, several days are spent to declare the election results, which are prone to human error and/or intentional tempering. In this regard, clear deviations of Form-45 and Form-47 results are reported by the political parties and public/social media, in the February 2024 General Elections of Islamic Republic of Pakistan. However, using blockchain technology, the error-free and timely results can be declared immediately after the election is over. Similarly, Blockchain technology provides ease and convenience to the voter to vote from anywhere without any trouble. In this connection, he/she just needs a smart phone or laptop/desktop with internet connectivity. Thus, it will result in increased participation of voters in the democratic process and ultimately leads to the formation of strong democratic governments with clear cut mandate of the masses (Takabatake et al., 2016).

The success of e-voting greats depends on the issues to be addressed. For example, e-voting systems are vulnerable to various cyber threats, including hacking, malware attacks, and tampering with electronic records. Ensuring the security and integrity of the voting process is critical to prevent unauthorized access, manipulation of votes, and potential fraud (Zhao & Chan, 2015). Similarly, maintaining transparency in e-voting processes is essential for building trust among voters and stakeholders. It's important to have mechanisms in place for independent auditing, verifiability of results, and ensuring that votes are accurately recorded and counted. Since, e-voting can improve

accessibility for certain groups, such as people with disabilities or those living in remote areas, however, it can also create barriers for individuals who are not familiar with technology or lack access to reliable internet connections. Ensuring equitable access to e-voting platforms is crucial for promoting inclusivity in the electoral process. e-voting systems must adhere to strict data protection regulations to prevent unauthorized disclosure of personal information and ensure that votes remain anonymous (Takabatake et al., 2016).

Similarly, implementing and maintaining e-voting systems require robust technical infrastructure, including secure networks, reliable hardware, and up-to-date software. Technical issues such as system failures, software glitches, and compatibility issues can disrupt the voting process and undermine trust in the system. Public trust in e-voting systems is essential for their acceptance and legitimacy. Addressing concerns about the reliability, security, and fairness of e-voting platforms is crucial for building confidence among voters and ensuring that election outcomes are perceived as credible. Developing comprehensive legal and regulatory frameworks for e-voting is essential to address issues such as voter authentication, data protection, dispute resolution mechanisms, and standards for electronic voting systems. Clear guidelines and oversight mechanisms are necessary to ensure compliance and accountability (Juels et al., 2010). Introducing e-voting may face resistance from various stakeholders, including political parties, election officials, and the public. Addressing concerns and engaging in public education and awareness campaigns are important for gaining acceptance and support for e-voting initiatives. Addressing these issues requires a collaborative effort involving government agencies, election authorities, technology experts, civil society organizations, and the public. By addressing security vulnerabilities, ensuring transparency and inclusivity, and building trust in e-voting systems, it's possible to mitigate many of the challenges associated with electronic voting and realize its potential benefits in enhancing the democratic process (Jason & Yuichi, 2017).

5 | CONCLUSION

The success of e-voting can be measured in several ways, including its impact on voter participation, efficiency in election administration, security and integrity of the voting process, and public trust in electoral outcomes. The acceptance of e-voting varies depending on factors such as cultural attitudes, technological readiness, regulatory frameworks, public trust, and previous experiences with electronic voting systems. In this regard, public trust in the security, reliability, and integrity of e-voting systems plays a crucial role in their acceptance. Transparency in how e-voting systems work, robust cyber security measures, and verifiable audit trails can enhance acceptance of e-voting. Transparent e-voting processes, including verifiable vote counting, independent audits, and public scrutiny of election results, contribute to accountability and trust in the electoral system. Providing transparent mechanisms for verifying and validating election outcomes is key to gaining acceptance. e-voting can improve accessibility for voters with disabilities, those living in remote areas, and citizens residing abroad. Informing the public about the benefits, risks, and safeguards of e-voting is essential for building acceptance. Public education campaigns, demonstrations of e-voting systems, and engagement with stakeholders can address misconceptions and increase awareness. Similarly, clear and comprehensive legal and regulatory frameworks for e-voting inspire confidence and acceptance. Regulations addressing data protection, voter privacy, security standards, dispute resolution mechanisms, and electoral transparency are crucial for acceptance. Last but not the least, conducting pilot projects and demonstrations of e-voting systems can showcase their functionality, security features, and user-friendliness, leading to increased acceptance among voters, election officials, and policymakers.

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