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Evaluating the Effectiveness of Electronic Voting Systems in Nigeria: Challenges and Opportunities

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Abstract

In many countries, Electronic voting systems have gained significant recognition as a potential solution to enhance electoral processes' transparency, efficiency, and credibility. Elections in Nigeria have been fraught with anomalies even before the advent of the fourth republic, the 2023 general elections inclusive. This paper aims to assess the effectiveness of electronic voting systems in Nigeria by examining the challenges and opportunities associated with their implementation. Methodologically, the explanatory research design was adopted whereby a comprehensive analysis of existing literature and case studies was carried out. This study beamed light on the key issues faced in adopting electronic voting systems in Nigeria and explores their potential benefits. The findings of this research contribute to the current discourse on electoral reforms and provide insights for policymakers, electoral commissions, and stakeholders to make informed decisions regarding the future of electronic voting systems in Nigeria.

Keywords: Electronic voting, Elections, Electoral processes, Voting, Transparency

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Introduction

The conduct of free, fair, and transparent elections characterizes the entrenchment of Democracy in a polity. Electoral processes in Nigeria have often been marred with discord and dissents even before the advent of the fourth republic; this has been a major concern as it has kept the Nigerian nation in a state of turmoil and uncertainty as resources are wasted, and lives are sometimes lost in rancours that are aftermaths of elections. It has also contributed to the low level of development as time is expended in resolving election petitions rather than concentrating on

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good governance. Furthermore, a significant concern arises when the will of the electorate fails to be accurately reflected in the outcomes of the elections. A history of electoral challenges includes voter intimidation, ballot stuffing, and delays in result transmission, amongst many others (Durotoye, 2016). These issues have raised concerns about the integrity and fairness of the electoral process. In this context, electronic voting systems offer the potential to address these challenges and usher in a new era of transparent and efficient elections.

The voting system that was in place after Nigeria gained independence was manual, which made it vulnerable to manipulation by emerging politicians (Taye & Adedeji, 2022). Ikelebe (2013) opined that the inadequate voting system or electoral process often leads to post-election crises and an influx of litigations in election tribunals. In recent years, there has been considerable scholarly discussion surrounding the adoption of electronic voting systems as a potential means to enhance the effectiveness and credibility of electoral procedures on a global scale. In 2015, the Independent National Electoral Commission (INEC) introduced the Card reader and the Permanent Voter's Card (PVC) as mechanisms aimed at ensuring the integrity of the electoral process. However, despite these initiatives, a number of challenges and obstacles emerged that hindered their successful implementation. Since 2011, the Independent National Electoral Commission (INEC) has been gradually integrating information technology into the electoral process in Nigeria. This has involved the implementation of various technological tools such as the Electronic Voters Register (EVR), Automatic Fingerprint Identification System (AFIS), and Smart Card Reader (SCR).

The passage of the electoral bill into law in 2022 strengthened INEC's legal status and provided the commission with the authority to utilize electronic voting (BVAS) in conducting elections throughout Nigeria (Ogieva & Ajisebiyawo, 2023). The most recent 2023 general elections were heralded with a clamour for electronic voting, yet the elections came and were not without the usual anomalies, which have culminated in the ongoing litigations contesting the outcome of the election despite the massive funds expended towards the process and the introduction of the new technology (Nwabuoku, Esavwede, & Mrabure, 2023) hence the need first to identify and analyze Nigeria's challenges in adopting electronic voting systems. Understanding these

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challenges is crucial for devising appropriate strategies to mitigate them effectively. Second, this study explores the opportunities and benefits of electronic voting systems to the Nigerian electoral landscape.

Evolution of Voting System in Nigeria

Nigeria's democracy is fashioned to a large extent after the United States. As with the United States, voting systems have undergone significant changes throughout history. Initially, voting was conducted publicly and orally during the Pre-colonial period but transitioned to printed ballots as population growth and suffrage expansion made voice voting impractical. However, even with printed ballots, the process remained public, with political parties using ballots of different sizes and colors to represent their candidates. Towards the late 19th century, the introduction of the secret ballot, also known as the "Australian" ballot, became common practice (Herrnson, Niemi, Hanmer, Bederson, Conrad, & Traugott, 2009). This government-printed ballot allowed voters to mark their choices and deposit them into designated boxes privately. However, the implementation of paper ballots, including secret ones, brought challenges such as bribery, fraud, stolen ballot boxes, and counting irregularities. In some instances, the vote totals did not align with the number of votes cast. Alongside voting system evolution, the study of electoral systems encompasses various factors, including the electoral formula, ballot structure, the size of the polling district, and administrative aspects of elections. These aspects, such as polling unit distribution, candidate nomination, and voter registration, play a crucial role in the effectiveness of any chosen electoral system. Furthermore, the voting system's design influences related areas of electoral laws, such as local government boundary drawing, ballot paper design, and the vote-counting process, highlighting the interconnectedness of electoral processes.

The voting or electoral systems translate the votes cast in a general election into seats won by parties and candidates. Very critical to this is the electoral formula utilized, whether a plurality/majority, proportional, mixed or other system is used, and what mathematical formula is used to calculate the seat allocation (Abubakar, Abdulsalam & Kolawole,2021).The Independent National Electoral Commission (INEC) in Nigeria has been actively involved in studies and campaigns on e-voting since 2004. However, progress in this area was hindered by

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restrictions in the electoral law. Nevertheless, technological advancements have been gradually incorporated into various election processes. Starting from 2003, the Optical Mark Recognition (OMR) system was utilized to create an electronic register of voters, and the Automated Fingerprints Identification System (AFIS) was implemented to eliminate double registrations.

Until the 2015 elections, Nigeria employed three different voting methods; the Open Ballot System (OBS), the Modified Open Ballot System (MOBS), and the Re-modified Open-secret Ballot System (REMOBS) (Esan & Ayeni, 2017). The Open Ballot System (OBS), also known as Option A4, involved voters openly indicating their candidate of choice through queuing or other visible means. Unlike a secret ballot, OBS ensured voters' choices were publicly known. This method aimed to minimize election rigging and fraudulent practices. OBS was successfully utilized in the 1979, 1983, and June 12, 1993 elections, which are considered some of the fairest and freest in Nigeria's history (Esan & Ayeni, 2017). The Modified Open Ballot System (MOBS) was a variation of the open ballot system. While the open ballot system openly exposed each voter's choice at the polling booth, MOBS allowed voters to make their choices secretly while still maintaining an open process. This method was adopted for the 1999, 2003, and 2007 general elections.

Furthermore, the Re-modified Open-secret Ballot System (REMOBS) represented an advanced form of MOBS. It involved openly accrediting voters and providing them with ballot papers, after which they would proceed to a private area to cast their votes. Accreditation of voters occurred simultaneously across the country, followed by immediate voting. Only accredited individuals were permitted to vote, and once the counting process began, no additional individuals were allowed to join the queue. The total number of votes cast should not exceed the number of people in the queue. Voters were encouraged to remain and ensure the legitimacy of their votes. REMOBS was adopted for Nigeria's 2011 and 2015 general elections (Esan & Ayeni, 2017).

In 2006, Direct Data Capture Machines (DDCM) were used for voter registration, followed by an enhanced DDCM system in 2010 to prepare for the 2011 elections. Biometric accreditation of voters was introduced before the 2015 elections, and the Smart Card Readers (SCR) were

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deployed to authenticate votes (Abubakar, Abdulsalami& Kolawole, 2021)). Additionally, a Polling Unit results viewing portal was experimented with during a bye-election in Nassarawa state and in the off-cycle governorship elections of Edo and Ondo states and subsequent bye-elections. In late June 2021, INEC recommenced the Continuous Voter Registration exercise, which had been suspended since mid-2018. An online pre-registration portal was launched, allowing prospective voters to provide their Bio-data in advance of a later biometric data capture process. The portal also enables registered voters to upload images, re-validate their information, confirm their polling unit details, or request a replacement for defaced or damaged Permanent Voter Cards (PVCs). With these technological advancements in voter registration and accreditation, the implementation of e-voting or an electronic balloting solution emerges as the next area for potential enhancement of Nigeria's electoral process (ECES, 2018).

In 2021, the Independent National Electoral Commission (INEC) initiated the experimentation of two technological innovations, namely the Bimodal Voter Accreditation System (BVAS) and the INEC Election Result Viewing Portal (IReV). These innovations have been recognized for their potential to enhance transparency in election results and foster public trust in electoral outcomes (Itodo, 2022). The BVAS was first tested during the Isoko South constituency one bye-election in Delta State and subsequently deployed and successfully utilized in the local government election in Kaduna State. The BVAS was then employedin a statewide election for the first time in November 2021 in Anambra State (Ogieva & Ajisebiyawo, 2023).

Electronic Voting Systems

An electoral system, also known as a voting system, encompasses a collection of principles and regulations that dictate the procedures for conducting elections and referendums and determining the outcomes of these processes. It serves as a framework that governs the fundamental aspects of the electoral process, ensuring fairness, transparency, and democratic representation (Mukade et al., 2023).

Qadah and Taha define the term electronic voting as the “use of computers or computerized equipment to cast votes in an election”. They consistently highlight the core objectives of e-voting, which revolve around enhancing participation, reducing election costs, and improving the

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accuracy of results. (Qadah & Taha, 2007). Electronic voting systems, also known as e-voting systems, refer to the use of digital technology to facilitate the casting, recording, and counting of votes in an election (IDEA, 2011). These systems aim to replace or supplement traditional paper-based voting methods with electronic processes. There are various types of electronic voting systems as follows:

Direct-Recording Electronic (DRE) Systems: DRE systems are characterized by touch-screen interfaces or electronic keypads that allow voters to make their selections directly on the machine. Votes are stored electronically and can be tallied automatically. The first DRE voting took place in 2004 USA presidential elections (Ahmad et al, 2021)

Optical Scan Systems: Optical scan systems involve the use of paper ballots that are marked by voters and then scanned by specialized devices. The scanned data is electronically processed and tallied. Optical scan voting systems are widely recognized for their enhanced safety measures, primarily due to their inherent ability to generate a voter-verifiable paper trail. This crucial feature empowers auditors and recount officials to conduct accurate and transparent hand-counted procedures, as the paper trail directly reflects the voters' input (Antonyan et al, 2021)

Remote or Internet Voting Systems: Remote voting refers to the electronic voting process enabling individuals to vote remotely. This method encompasses various electronic mediums, including the Internet and mobile phones. Specifically, Internet voting, often referred to as i-voting, falls under the category of remote electronic voting and involves casting votes through online platforms such as websites or voting applets. This approach offers the advantage of rapid and accurate vote counting while allowing individuals to vote outside of traditional polling unit and operating hours. Additionally, remote e-voting facilitates voting from abroad, irrespective of the availability of diplomatic and consular missions or the reliability of postal services (Okediran et al, 2011).

Hybrid voting Systems: Hybrid voting is an electoral method that integrates both in-person and electronic voting, providing a comprehensive approach to conducting significant elections. This voting system presents a reliable and secure means of facilitating crucial electoral processes while ensuring that individuals are not impeded from exercising their right to engage in decision-making. It accommodates participants who may face challenges related to geographical distance

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from voting locations or limited familiarity with digital technology, thus promoting inclusivity and accessibility in the electoral system (Electionbuddy,2023).

Theoretical Framework

In the explanation of E-voting, the Innovation Diffusion Theory, introduced in 1962 and further refined by Rogers in 1995, aims to understand the spread of innovative ideas and technologies within a social system. This theory takes a unique perspective on change, viewing it as an evolution or "reinvention" of products and behaviors to suit the needs of individuals and groups better rather than focusing on persuading individuals to change (Roger, 1995). In this framework, the primary focus is on the innovations themselves undergoing transformation rather than people changing. Diffusion, as described by Rogers in 2003, refers to the process through which innovations are communicated over time among members of a social system. Wani and Ali (2015) define diffusion as the spread of technology across a population of organizations. The concept of diffusion of innovations often involves the dissemination of ideas from one society to another or from one focus or institution within a society to other parts of that society (Roger, 1995).

Innovation Diffusion Theory can be divided into four key elements, starting with the concept of innovations. Innovations are perceived as new by individuals or other units of adoption and encompass new products and services and existing ones that present novel uses to users (Wani & Ali, 2015). Applied to technology in elections, this framework suggests that stakeholders' willingness to adopt and embrace technological solutions depends on their perception of the benefits and compatibility of the innovation with existing electoral practices. Factors such as ease of understanding, compatibility with democratic principles, and observing successful implementations in other contexts can influence the diffusion and acceptance of technology in electoral processes. By incorporating these insights into the design and implementation of technology solutions, policymakers and election authorities can promote successful integration that aligns with user needs and preferences.

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Methodology

This study thoroughly investigated the capabilities of the e-voting systems and scrutinized a number of case studies. These case studies were critically analyzed, focusing on election processes, irregularities, the implementation of electronic systems, and the subsequent outcomes.

Major Capabilities of the E-Voting Systems

Understanding the capabilities of e-voting systems is essential to comprehend their potential impact. This section presents a comprehensive but not exhaustive list of end-user functionalities these systems offer voters and election officials (IDEA, 2011).

- Electronic Voter Lists and Authentication: Electronic voter lists can cover individual polling units or the entire country. These lists facilitate the authentication of eligible voters and record their participation.
- Poll Worker Interfaces: Poll workers can access specialized functionalities, such as resetting the vote count at the start and closing polling units. Additional features include result printing and transmission.
- Voting Interfaces: E-voting systems employ various interfaces for casting votes, including touch screens, optical mark recognition (OMR) ballot papers with scanners, touch-sensitive tablets, push buttons, web pages, and dedicated client software for internet voting.
- Special Interfaces for Handicapped Voters: Handicapped-accessible interfaces accommodate individuals with disabilities, such as Braille or audio input devices for the blind, improved physical access for voters with disabilities, and simplified interfaces for illiterate voters.
- Result Output Interfaces: Voting machines utilize printers or digital displays to present the recorded results once voting concludes.
- Printed results serve as physical evidence, distributed to stakeholders present at polling units, and made available for public display.

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- Voter-Verifiable Receipts: Some systems provide printers to generate voter-verifiable receipts for each vote, ensuring transparency and enabling individual verification (Voter-Verified Audit Paper Trail, VVPAT).
- Result Transmission System: Many voting machines transmit results to central counting systems through communication channels like the Internet, telephone, mobile phones, or satellite connections.
- In the absence of communication links, physical transportation of results is possible using electronic storage media, such as memory cards.
- Result Tabulation Systems: Result processing centers house tabulation systems that automatically compile electronic results from polling units, aggregating them for various competitions and districts.
- Result Publication Systems: Preliminary and final election results can be published through various mediums, including websites, CDs, geographic visualization systems, and granular reporting down to individual polling units.
- Confirmation Code Systems: Certain e-voting solutions incorporate control codes that allow voters to verify their cast votes individually.

By encompassing these features and functionalities, e-voting systems aim to enhance the efficiency, transparency, and accessibility of electoral processes (IDEA, 2011).

Electronic Voting: The Benefits and Challenges

Having evaluated the intricate features of e-voting, it is pertinent that we explore the benefits and challenges inherent. Electronic voting systems offer numerous benefits that enhance the electoral process. Firstly, they improve efficiency by expediting voting, reducing queues, and wait times at polling stations. The automation of vote counting accelerates result tabulation and minimizes human errors. Secondly, electronic voting systems enhance accuracy by minimizing manual vote counting and data entry mistakes. They also incorporate built-in validation mechanisms to prevent over voting (Ahmad et al., 2021). Transparency is another advantage provided by some electronic voting systems. These systems allow voters to verify their selections before casting their votes, increasing transparency in the process. Additionally, digital audit trails enhance the

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traceability of votes, making the entire process more transparent and accountable (Ahmad et al., 2021).

The accessibility of electronic voting systems is a crucial aspect. They can be designed to accommodate voters with disabilities by offering features such as audio instructions, large fonts, or tactile interfaces. This ensures that all individuals have equal opportunities to participate in the voting process (Tas & Tanriover, 2020). They prevent fraud by reducing human intervention during polling, transmission, and result tabulation. Internet voting can lead to cost savings, as it eliminates shipment costs and delays associated with traditional postal voting. Moreover, it can minimize vote-selling and family voting by allowing multiple voting where only the last vote counts. Electronic voting systems also reduce spoilt ballot papers by warning voters about invalid votes (IDEA, 2011). Electronic voting systems bring with them a multitude of challenges and disadvantages that must be carefully considered. Foremost among these concerns are the security risks that these systems inherently possess. Cyber security threats such as hacking, tampering, and data breaches pose significant dangers, making it crucial to prioritize the safeguarding of vote integrity and confidentiality.

Technological dependencies present another obstacle to electronic voting systems. Their smooth operation relies heavily on a stable power supply, network connectivity, and reliable hardware and software. Without sufficient infrastructure, implementing these systems may be hindered, leading to reliability issues that compromise the voting process. However, one of the most formidable challenges facing electronic voting systems lies in building trust and acceptance among the public. Transparency, privacy, and the potential for manipulation are key concerns that can breed skepticism and resistance from stakeholders and the general public. The lack of transparency in the system, limited openness for non-experts, and the absence of widely agreed standards for e-voting systems contribute to this skepticism (Ahmad et al., 2021).

Moreover, there is a risk of violating the secrecy of the vote, especially in systems that combine voter authentication and vote casting. Insiders with privileged access to the system or external hackers may manipulate the results, raising questions about the credibility of the entire process. Fraud can also be perpetrated through large-scale manipulation by a small group of insiders,

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further eroding trust in the system. In addition to these challenges, the introduction of electronic voting systems may exacerbate existing social and technological disparities. Certain segments of the population may lack access to the necessary technology or digital literacy, widening the digital divide and disenfranchising specific communities (Abu-Shanab, 2010).

The adoption of electronic voting systems also incurs increased costs for purchasing and maintaining the necessary infrastructure. The requirements for power supply, communication technology, and environmental conditions such as temperature and humidity further add to the financial burden. Additionally, meeting the heightened security requirements to protect the voting system during and between elections, including transport, storage and maintenance, places additional strain on resources. Furthermore, the election administration may experience reduced control due to their dependence on vendors and specific technologies. This can lead to a loss of oversight and potential vulnerabilities in the system. Recount possibilities may be limited, undermining the ability to verify and rectify any discrepancies that arise (IDEA, 2011).

Global Trends and Experiences with Electronic Voting Systems

The implementation of electronic voting systems has been observed in different countries worldwide, leading to diverse experiences and outcomes. Notably, countries like Brazil, India and Estonia have emerged as notable pioneers in adopting electronic voting systems and have encountered varying levels of success. Examining their experiences offers valuable insights into the advantages, obstacles, and recommended approaches associated with the deployment of electronic voting systems.

The Brazil Experience

Electronic voting (e-voting) has gained significant traction in Brazil as a means to enhance the efficiency and transparency of the electoral process. Since its introduction in 1996, Brazil has successfully conducted several elections using electronic voting systems known as "urnas eletrônicas." Brazil holds the distinction of being the first country to conduct elections entirely through an electronic voting system, starting in 2000. Since then, Brazil has consistently maintained a leading role in advancing and adopting electronic voting technologies (Schneider, 2020).

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Additionally, the introduction of e-voting in Brazil has yielded positive outcomes, such as a significant reduction in instances of spoiled or invalid ballots, thereby enhancing the accuracy of election outcomes (Schneider, 2020).Despite initial skepticism and challenges related to accessibility and voter education, e-voting has gained widespread acceptance in Brazil, contributing to increased public confidence in the electoral process (Goldsmith & Ruthrauff, 2013).Adopting the Voter-Verifiable Paper Audit Trail (VVPAT) mechanism further enhances audit transparency and accountability (Risnato et al., 2020).However, to ensure the continued success of e-voting systems in Brazil's democratic landscape, ongoing research, and continuous improvement are vital. This includes addressing emerging security threats and strengthening the resilience of the e-voting infrastructure. By doing so, Brazil can maintain the efficiency, accuracy, and integrity of its electoral processes, bolstering public trust and upholding the democratic values that underpins its electoral system.

The India Experience

The switch from paper to electronic voting in India has had substantial political effects. Invalid voting was virtually eliminated, accompanied by an increase in the vote share for smaller political parties, often from outside the traditional party system. However, electronic voting machines (EVMs) had modest or null effects on voter error and turnout, and there is little evidence that they impacted fraud. Contrary to concerns about partisan bias, voting machines did not have a systematic effect on state incumbent party vote shares or the vote shares of specific national parties. These results, particularly the decline in invalid voting, echo the findings of the existing literature but reveal that the effect represents a redirection of protest votes rather than reduced unintentional errors (Desai & Lee, 2021). A significant portion of Indian voters dissatisfied with the political system expressed their discontent through different forms of protest voting. This included casting blank or spoiled ballots before 1998, voting for minor parties when electronic voting was introduced, and subsequently opting for the "None of the above" (NOTA) option after its introduction. The inclusion of the NOTA option in 2014 allowed voters to cast protest votes explicitly. This suggests that protest votes are fungible across different forms of protest and that voting technology can transform generalized anti-system sentiment into support for specific candidates, demonstrating the substantial and consequential effect voting technology

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can have on how anti-system sentiments are expressed within the electoral system (Desai & Lee, 2021).

Electronic voting (e-voting) in India has emerged as a significant technological advancement in the country's electoral system, aiming to streamline the voting process, enhance transparency, and ensure efficient vote counting. The Election Commission of India (ECI) has been at the forefront of promoting and implementing e-voting methods, primarily through the use of Electronic Voting Machines (EVMs). EVMs are standalone units enabling voters to cast their votes electronically by pressing buttons corresponding to their preferred candidates, and their reliability and security have been reaffirmed by studies conducted by the Indian Statistical Institute in 2010 and the Massachusetts Institute of Technology in 2017. The ECI has implemented various measures to maintain the integrity of the voting process, including tamper-proof seals, rigorous security protocols, and mock polls, despite occasional controversies and concerns. The successful implementation of EVMs in India has revolutionized the country's electoral system, leading to increased voter turnout, reduced electoral fraud, and improved representativeness, particularly for vulnerable sections of society. Furthermore, the introduction of the Voter Verified Paper Audit Trail (VVPAT) system in 2013 has enhanced transparency and added an additional layer of verifiability and assurance to the electoral process. India's experience with EVMs positions it as a pioneering "techno-democracy" and provides a model for other democracies seeking to leverage technology for efficient and accountable governance (Ravi, 2019).

The Estonia Experience

With a population of 1.3 million, Estonia is recognized as a competitive multi-party democracy that upholds high standards of political rights and civil liberties (Ehin et al., 2022). The country holds elections for its 101-member national parliament, Riigikogu, every four years and nationwide elections for local government councils, which have a four-year term. Since its accession to the European Union in 2004, Estonia has also conducted European Parliament elections every five years. The electoral system in Estonia follows an open-list proportional representation, where voters have the opportunity to vote for a candidate on a party list, and seats

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are allocated to parties in proportion to the share of the vote they receive. The voting age in Estonia is generally 18, except for local elections where 16- and 17-year-olds have been eligible to vote since 2017 (Estonian National Electoral Committee, n.d.).Voter registration in Estonia is compiled automatically based on the Population Register, requiring no action on the part of citizens (Ehin et al., 2022). For conventional paper voting, Election Day is typically held on a Sunday, and early voting is available during a designated week. To ensure inclusivity, voters with special needs can have the ballot box delivered to their homes or residence, providing them with the necessary accessibility (Estonian National Electoral Committee, n.d.). Furthermore, Estonian citizens residing permanently or temporarily abroad, which have numbered over 80,000 in recent elections, can vote at Estonian diplomatic representations or request a mail-in ballot (Ehin et al., 2022). Estonia has been at the forefront of implementing internet voting since 2005, offering an optional alternative to conventional paper voting for national, European, and local elections (Ehin et al., 2022). Referred to as i-voting, this system is available during a specified early voting period, usually from the tenth day until the fourth day before Election Day. It allows voters to cast their ballots from any internet-connected computer worldwide.

The process begins by downloading a voting application from the election web page and launching it on the voter's computer. Authentication is then carried out using either the Estonian ID-card or a mobile-ID, ensuring secure identification (Ehin et al., 2022). Voters can then access the list of candidates running in their district, make their selection, encrypt their choice, and confirm their vote with a digital signature. Remarkably, the entire i-voting process takes less than two minutes on average. Importantly, voters have the flexibility to change their electronic votes an unlimited number of times during the early voting period, with each new vote overriding the previous ones. However, if a voter chooses to cast their ballot at a polling station during the early voting period, their internet vote becomes invalid (Ehin et al., 2022). These provisions are in place to preserve the secrecy of voting, allowing voters who may have been coerced or intimidated to cast a new ballot and overwrite their previous vote (Estonian National Electoral Committee, n.d.). Previously, i-voters were unable to cast a ballot on Election Day as their names were removed from the relevant voter lists. However, starting from 2021, i-voters have the option to cast a paper ballot on Election Day, thereby invalidating their electronic vote (Ehin et

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al., 2022).Estonia's embrace of internet voting has been a subject of interest and study, demonstrating the country's commitment to leveraging technology for democratic participation and engagement. The adoption of i-voting has enhanced accessibility, efficiency, and convenience for Estonian voters, allowing them to exercise their democratic rights from anywhere in the world with internet access

Electronic voting in Estonia has gained widespread recognition as a pioneering example of utilizing technology in the electoral process. Since its introduction in 2005, Estonia's e-voting system has been lauded for its efficiency, security, and accessibility. The system allows eligible voters to cast their ballots remotely through an encrypted online platform, offering convenience and flexibility. Studies on Estonia's e-voting system have highlighted its success in attracting voter participation, particularly among younger and technologically adept demographics (Mozley, 2021). The security measures implemented in the system, such as digital signatures, end-to-end encryption, and decentralized data storage, have been lauded for safeguarding the integrity of the electoral process. While concerns about potential vulnerabilities and external interference have been raised, comprehensive audits and ongoing improvements in the e-voting infrastructure have contributed to maintaining public trust and confidence (Tamang, 2020). Estonia's experience with electronic voting serves as an instructive case study for other countries seeking to embrace technology-enabled solutions to enhance democratic processes. By leveraging advancements in information technology and employing robust security measures, Estonia has successfully established itself as a leading advocate for e-voting, demonstrating its potential to increase accessibility, efficiency, and public participation in elections (Mozley, 2021).

Challenges and Mitigations of E- Voting Systems in Nigeria

Beyond the general challenges associated with e-voting, as discussed earlier in this study, implementing electronic voting systems in Nigeria presents specific obstacles that must be addressed to ensure their effectiveness and successful adoption (Alausa & Akingbade, 2017). These challenges encompass various areas:

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a. Infrastructure Limitations: Nigeria's remote or underdeveloped regions face infrastructure limitations, such as unreliable power supply, inadequate internet connectivity, and limited access to technology (Bisong, 2019). These constraints can impede the deployment and functioning of electronic voting systems.

b. Cyber security Risks: Electronic voting systems are vulnerable to cyber security risks, including hacking, tampering, and unauthorized access (Alausa & Akingbade, 2017). Establishing robust cyber security measures is essential to safeguard the integrity and confidentiality of voting data, ensuring resilience against cyber threats.

c. Trust, Transparency, and Verifiability: Building public trust and confidence in electronic voting systems is paramount. Ensuring transparency in the system design, operation, and auditing and incorporating mechanisms for verifying the accuracy of votes is crucial to address concerns about potential manipulation and upholding trust in the electoral process

d. Voter Education and Acceptance: Sufficient voter education is necessary to familiarize the population with electronic voting systems and address potential resistance or skepticism (Omotayo & Adekunle, 2021). Many voters may be unfamiliar with the technology, raising concerns about usability, reliability, and privacy. Conducting extensive voter education campaigns can alleviate these challenges.

e. Legal and Regulatory Framework: Establishing a comprehensive legal and regulatory framework is vital for governing the implementation and use of electronic voting systems. This framework should address issues such as voter privacy, data protection, dispute resolution mechanisms, and the roles and responsibilities of stakeholders involved in the electoral process.

f. Cost and Financial Resources: Implementing electronic voting systems necessitates significant financial resources, including technology acquisition, infrastructure development, system maintenance, and election officials' training. Nigeria must allocate adequate funding and develop sustainable financing mechanisms to support the adoption and maintenance of electronic voting systems.

g. Political Will and Stakeholder Engagement: The successful implementation of electronic voting systems in Nigeria relies on the commitment and political will of relevant stakeholders, including government institutions, electoral commissions, political parties, civil society

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organizations, and the general public (Bisong, 2019). Engaging stakeholders in the decision-making process and addressing their concerns and expectations is crucial.

h. Continual System Evaluation and Improvement: Establish mechanisms for ongoing evaluation and improvement of electronic voting systems. Regular assessments, independent audits, and feedback mechanisms from stakeholders can help identify areas for enhancement and ensure that the systems evolve to address emerging challenges and incorporate technological advancements.

i. International Collaboration and Knowledge Sharing: Engage in international collaboration and knowledge sharing with countries that have successfully implemented electronic voting systems. Learn from their experiences, best practices, and lessons learned to adapt strategies to the Nigerian context.

j. Ethical Considerations: Implementing electronic voting systems necessitates addressing ethical considerations, such as protecting voter privacy, ensuring data security, and preventing potential manipulation or bias in the technology or its implementation

Overcoming these challenges requires a collaborative effort between government institutions, electoral commissions, technology experts, civil society organizations, and the public. Conducting pilot projects, engaging in stakeholder consultations, and learning from international best practices can help Nigeria address these challenges and unlock the potential benefits of electronic voting systems.

Conclusion

Nigeria stands on the precipice of an electoral evolution that can greatly empower its citizens and strengthen its democracy. The incorporation of technological solutions such as the Bimodal Voter Accreditation System (BVAS) and the INEC Election Result Viewing Portal (IReV) has undoubtedly marked an essential step towards more transparent and trusted elections in Nigeria. These advancements are commendable as they have begun to tackle longstanding issues in the country's electoral process, as outlined by Itodo (2022). Nonetheless, transitioning to electronic voting systems in Nigeria will not be without hurdles, as evidenced in the 2023 elections. However, the potential gains are substantial, as seen in the case studies reviewed. Notably, these systems have the capacity to significantly improve the accuracy and speed of vote tallying,

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increase transparency, provide easier access for voters, and potentially generate financial savings in the long run. Furthermore, the shift towards digitization is an essential component in fostering a democratic environment that is both inclusive and participatory. It is crucial to remember that implementing a novel system is not simply about importing technology. A blend of robust cyber security, a widespread voter education campaign, an engaged group of stakeholders, and a solid legal framework must back this technology. In navigating these challenges, Nigeria stands to not only enhance its electoral process but also uplift its democratic practices, creating a more robust, more empowered citizenry. Nigeria's journey toward an effective electronic voting system is a marathon, not a sprint.

Recommendations

Firstly, robust cyber security is of paramount importance. To protect against digital threats and secure the integrity of the voting process, Nigeria must leverage cutting-edge security measures and practices. Ensuring the system is impervious to cyber-attacks will foster trust and ensure that every vote is counted accurately. Secondly, a comprehensive voter education program is essential to implement electronic voting systems successfully. The public must understand how to use the system to cast their votes. Thirdly, maintaining an open dialogue with all stakeholders is critical. From policymakers and election officers to the public, all parties should have a voice in the process. Their input will be crucial in shaping the system to meet Nigeria's unique needs, ensuring a more widespread acceptance. Lastly, a solid legal and regulatory framework should be established to support the electronic voting system. Such a framework should clarify electronic voting rules and processes and provide clear remedies for potential disputes or problems. Moreover, learning from the experiences of other nations that have successfully implemented electronic voting systems could provide invaluable insights and best practices that could be adapted to Nigeria's context. This could save Nigeria valuable time and resources by helping to avoid potential pitfalls and to focus on proven strategies.

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