AN IMPROVED E-VOTING SYSTEM USING BLOCKCHAIN TECHNOLOGY

Joel Ifeoluwa Ademola[1], Abiodun Muyideen Mustapha[*2], Temitope Elizabeth Abioye[3]

[1, 2] Department of Computing, Anchor University, Lagos State, Nigeria.

[3] Department of Computer Science and Information Technology, Bells University of Technology, Ota, Ogun State, Nigeria.

[1] joel.ademola@student.aul.edu.ng , [2*]amustapha@aul.edu.ng ,
[3]teogunbiyi@bellsuniversity.edu.ng

[*]*Corresponding author*

ABSTRACT

The rapid growth of technology has led to significant advancements in the voting process. However, the existing voting systems face various security and privacy challenges, including a lack of transparency, centralized control, tampering, fraud, inefficiency, and limited accessibility for disabled voters. In response to these limitations, this paper proposes a comprehensive solution that leverages public blockchain technology to revolutionize the voting process. The system uses a decentralized architecture on a public blockchain network to ensure transparency, immutability, and security in the voting process. All network nodes have access to and can verify the integrity of votes, reducing tampering and fraud risks. The system includes a user-friendly web-based application for secure voting and compatibility across devices. The implementation uses smart contracts that enforce voting rules and ensure cast votes' integrity, eliminating the need for a central authority and enhancing security. This research project introduces a real-time result viewing system for stakeholders, enhancing transparency and monitoring the voting process. Utilizing a decentralized blockchain network and smart contracts, the solution ensures cast vote integrity, security, transparency, and accessibility for all voters. The implementation showcases the feasibility and benefits of decentralized voting systems. The outcomes of this research demonstrate enhanced transparency, integrity, and accessibility in the voting process, paving the way for more secure and inclusive elections in the future.

Keywords: Voting Systems, Blockchain, Security, Trust, Immutability, Smart Contract

INTRODUCTION

Electoral voting serves as a profound expression of citizens' rights in any given nation, embodying the triumph of democracy (Chipato, 2021). It is of paramount importance that the electoral process upholds the tenets of democracy by being fair, independent, and transparent, thereby allowing every individual to voice their opinions without fear (Nweke & Etido-Inyang, 2020). The return of Nigeria to democratic governance in 1999 after years of military rule marked the continued use of paper-based voting systems (Keping, 2018). Various jurisdictions, such as those in the UK's 2014 general election and the US's 2014 presidential election, have proposed transitioning to digital voting systems from their traditional paper counterparts. While cryptographic techniques have been employed to enhance the security and convenience of e-voting systems, they are not without drawbacks (Al-Zoubi et al., 2022). There's a potential for vote data manipulation in centralized systems, especially if administrators exploit their authority. Furthermore, their use has been limited to small populations due to the inherent risk of a single point of failure (James & Garnett, 2020).

Recent advancements, particularly in the realm of blockchain technology, present promising solutions. Blockchain has been lauded for its potential to bolster the security, traceability, transparency, and trust of shared corporate data (Berdik et al., 2021). A blockchain comprises a series of blocks, each with a cryptographic hash of the preceding block, a timestamp, and transaction data, making it virtually impervious to tampering and alteration (Choi et al., 2020). To ensure optimal data security, we propose using blockchain technology. Its decentralized nature allows for data replication on a peer-to-peer network and shares this data with all nodes within the blockchain network.

In the modern world, democratic nations grapple with a plethora of issues that impede progress. These issues range from various illicit activities and human rights infringements to flaws in the electoral system that hinder citizen participation (Norris, 2015; Zhou et al., 2021). To address these challenges, extensive research has been conducted. There are various issues that hinder citizen participation in elections, ranging from infringements on rights to flaws in the electoral system. To tackle these challenges, there has been a lot of research conducted to use computing technology to improve the electoral process. However, upon analyzing these systems, it becomes evident that there are significant risks involved in transitioning to them leverage computing technology for electoral enhancement (Khan et al., 2020). However, analysing such systems reveals significant risks in transitioning to an electronic voting system due to software anomalies, insider threats, network susceptibilities, and audit complications. The indelible nature of the blockchain, when employed as a bulletin board, guarantees the legitimacy and authenticity of the voting outcomes (Wu et al., 2022).

E-voting systems powered by blockchain technology, despite their myriad benefits, encounter significant challenges such as Election Integrity, which is a common concern with electronic voting (Khan et al., 2020). There is widespread consensus that proof of work demands substantial computational resources and time; scalability and performance are also challenged as the e-voting system necessitates numerous network nodes and experiences rapid growth when network size, throughput, and latency parameters are considered.

This research proposes to leverage the public blockchain and proof of stake consensus procedure, which effectively addresses these limitations. The method is built upon the latest iteration of the ethereum blockchain, along with its advanced features. The proposed method can be used in large-scale e-voting systems to guard against manipulation and fraud, uphold election integrity, and enhance security, performance, and scalability. By enabling remote vote casting, the system provides the convenience of voting from home. With real-time vote counting, it offers the potential to eliminate invalid votes and reduce election-related violence.

RELATED WORKS

Alvi et al., (2022) presented a blockchain-based decentralized method that would use smart contracts to guarantee the security of the digital voting system. The three external entities in the author's proposed architectural mechanism are the Election Commission, which is in charge of and oversees the entire election, Voters, who are the citizens who will cast their votes, and the Crypto Server, which encrypts the vote before it is stored in the blockchain to prevent unauthorized access. The author claims that this system's limitations include the lack of an OTP

(One Time Password) option during the registration process and the fact that after the election, the encrypted vote data saved on the blockchain is no longer useful.

Indapwar, (2020) presented a blockchain-based digital voting system and defined blockchain as a distributed, digital, consensus-based safe data storage system. In their article, they discuss how to use blockchain to build a trustworthy and secure online voting system. The review's main objective is to assess the current state of blockchain-based voting research and any related potential roadblocks in order to predict future developments. For blockchain systems to be developed, symmetrical and asymmetric cryptography must be improved. The system's weakness is that because it relies on a centralized database and might be attacked or damaged, data could be lost. A paper on a suggested voting system employing blockchain technology to increase voting process security and transparency was presented by Navamani et al., (2022). Smart contracts are the foundation of the planned Digi Vote system, which leverages digital identities to verify voters. Blockchain technology may be advantageous for electronic voting systems since it can offer a transparent and secure voting environment. E-voting systems can benefit from using blockchain technology because of its decentralized nature and capacity to offer an immutable record of transactions. Voter verification using smart contracts and digital identities could increase voting process security and transparency. The limitation of the proposed system is that there is no voter authentication because of the lack of public API for voter ID.

Alam et al., (2020) presented a method that would use blockchain technology to address issues with traditional voting systems in African countries. The paper's ability to provide a thorough analysis of the various applications of blockchain technology in the electoral process, including voter registration, vote counting, and results administration, is one of its strongest points. The report also examines the potential advantages of using blockchain technology, including enhanced security and openness as well as faster and more accurate vote counting. This system's weakness relates to socioeconomic issues like vote buying, which are challenging to resolve.

Khan et al., (2020) suggested using blockchain technology to do away with the issues with traditional elections. With blockchain technology and a widely accessible voting system that ensures the security of voter identity, data transfer, and verification, this thesis seeks to develop a decentralized electronic voting technique as opposed to a centralized one. The suggested solution incorporates technologies such as ganache, truffle framework, Hardhat, and MetaMask. This system's drawbacks include the fact that the casting vote is visible during the voting process and that voters' anonymity is not guaranteed. The following criteria are satisfied by the voting system that Ben Ayed, (2017) presented using a blockchain: authentication, anonymity, accuracy, and verifiability. With the use of a Social Security number that is generated locally by local authorities, the voter(s) log in to the voting application. Despite the fact that this system employs blockchain technology, there are numerous third parties involved, which allows for system manipulation and vote-rigging by hackers.

Shuaibu et al., (2017) developed an electronic voting system for Nigeria that represented the electoral processes using the Unified Modelling Language (UML). It allows voters to cast ballots using mobile devices and offers a number of registration processes. Using the Unified Modelling Language (UML) makes it easier to intuitively represent transactional, real-time, and fault-tolerant systems. The ICTs handle the vote collation by saving the vote data on an unsecure external storage device, which increases the risk of data loss.

A suggested electronic voting system by Mursi et al., (2016) uses cryptographic methods to increase the security and audibility of the voting process. One of the paper's main strengths is the description of a complete and well-structured strategy for using cryptographic methods to protect e-voting systems. The proposed method for securing the confidentiality, precision, and integrity of the voting process uses public key cryptography, homomorphic encryption, and zero-knowledge proofs. Although these factors may be essential for the successful adoption of electronic voting systems, the paper's limitations prevent it from providing any information about the practical implementation of the suggested scheme, including information about its viability in real-world scenarios and its usability and user experience.

For a state in Nigeria, Abdulhamid et al., (2013) presented a web-based real-time E-voting system. There were various modules in the system. Numerous tools, including PHP, MySQL, Java Query, CSS, and HTML, are used by the author. The devices' ability to improve voting efficiency and accuracy while also raising voter turnout is one advantage. E-voting technologies can help make voting simpler for those in rural areas or with disabilities. Additionally, the technologies can transmit results in real-time, enabling quick and accurate vote counting. The drawback is that installing and maintaining e-voting systems can be expensive. Another obstacle to the adoption of e-voting systems may be a lack of technical expertise and infrastructure. The assessment's weakness is that it is an outdated review, released in 2013, and the field of e-voting technology has advanced significantly since then.

A framework for electronic voting put up by (Olaniyi et al., 2011)asks for a multilingual mobile e-voting system centered on Nigeria's three main ethnic groups, the Yoruba, Igbo, and Hausa. To enable voters to cast ballots using their mobile devices from any place, the framework specifies a sequence of steps that must be taken before, during, and after an election. the process of entering the votes into a database or other repository to be counted. The system's disadvantage is that a central database and server are still needed, making it susceptible to nefarious hacker assaults as well as alterations and manipulations by a third party. Also, it continues to lack trust and integrity. Hence the requirement for an upgraded blockchain-based mobile e-voting architecture.

Looking at all the blockchain technology proposed for e-voting, there were still susceptibility to nefarious hacker assaults as well as alterations and manipulations by a third party. This makes the voting process lack transparency and integrity. The method proposed in this work is built upon the latest iteration of the ethereum blockchain, along with its advanced features. The proposed method can be used in large-scale e-voting systems to guard against manipulation and fraud, uphold election integrity, and enhance security, performance, and scalability.

METHODOLOGY

This section described the design method and the architectural design of the proposed system.

The Design Methodology

The method for the e-voting system using blockchain technology used process and build design and it involved four phases. They were: the registration phase, voting setup phase, voting phase and the result phase. The research work flow is depicted in Figure 1 while the detailed of each phase were presented in this subsection.

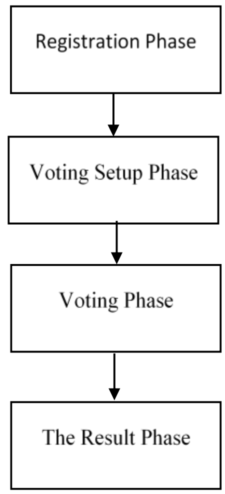

Figure 1. Research Process Flow

Registration Phase

The voter registration module is a critical component of any digital voting system, and it would be an important part of the methodology for developing the system. The phase is divided into two parts – voters and candidates' registrations.

Voter Registration

Due to its reliance on decentralized technologies like blockchain and decentralized identity management, Web 3.0 signup and registration procedures differ from those of regular online services. The process of signing up and signing in in a Web 3.0 environment is described in general here. The flowchart showing the process is shown in Figure 2.

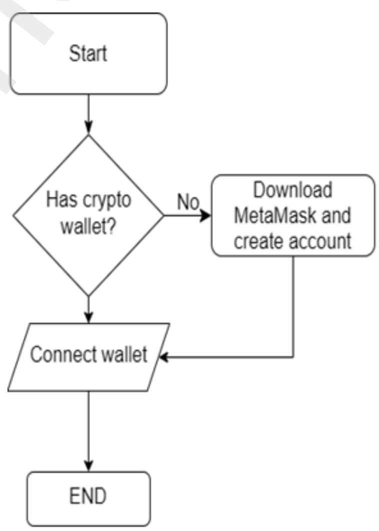

Figure 2: Voters Registration Flowchart

i. Decentralized Identity (DID): Users of Web 3.0 have a decentralized identity or a distinct identification that serves as the user's representation on the decentralized network. This identification often comes from a public-private key pair, where the private key is used to authenticate users and sign transactions while the public key serves as the user's DID.
ii. Wallets and Key Management: Users require a wallet to safely handle their private keys. Wallets can be mobile apps or web extensions. Private key generation and storage, transaction signing, and communication with decentralized apps (dApps) are all handled by wallets.
iii. Sign Up: A username, password, or email address is often not required when a user registers for a Web 3.0 application. As an alternative, they link their wallet to the dApp, which then links their DID to the program. A display name or avatar could be requested by the dApp, although these details are often optional and can be saved on decentralized storage systems like IPFS.
iv. Sign in: The user must link their wallet to the app to sign into a Web 3.0 application. The wallet is then asked by the dApp to sign a message or a transaction as identification for the user. The user's private key is used by the wallet to sign the message, and the user's public key (DID) is used by the dApp to verify the signature. The user is given access to the program if the signature is legitimate.
v. Authentication and Authorization: After the user logs in, the dApp may authenticate and approve operations inside the application using the user's DID.

Algorithm 1: Voters Registration

Input: voter's bio-date
Output: voting ID
Steps:
1: start
2: create a *new* voting *object with a unique ID.*
3: set the voter *object*'s *properties, such as the voter*'s *name, email, and password.*
4: save the voter *object to the blockchain.*
5: return the voter *object*'s *ID.*
6: stop

Candidate Registration: candidate registration takes another turn in the sense that instead of the candidate registering, the registration will be done by the electoral commission (EC), the electoral commission, or admin we register all the political parties involved in the election since the candidate is just a representative of the party.

Voting Setup Phase

The election created by the electoral commission would organize an election on the blockchain network, utilizing smart contracts to describe the election's rules and regulations, such as the parties, and voting duration. This is described in Figures 3.

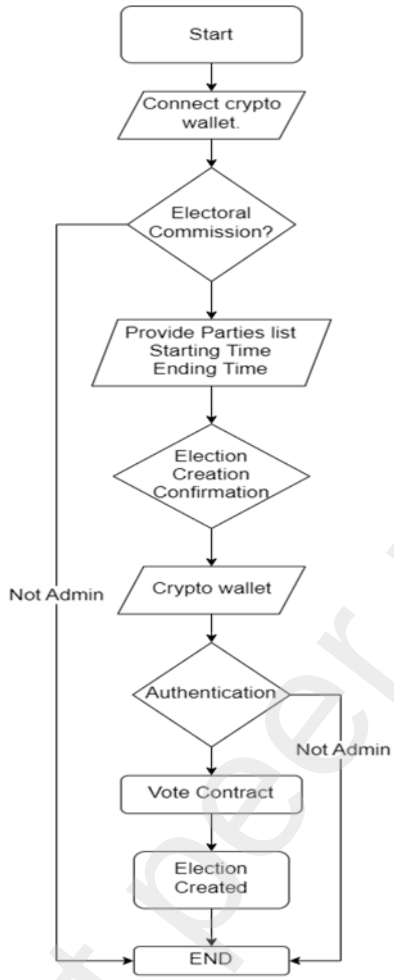

Figure 3: Election Creation Process Flowchart

Algorithm 2: Vote Creation

Input: vote property
Output: vote ID
Steps
1: start
2: create a *new* vote *object with a unique ID.*
3: set the vote *object*'s *properties, such as the vote title, description, and options*.
4: save the vote *object to the blockchain.*
5: return the vote *object*'s *ID.*
6: stop

Election Activation

The election activation will be done by the smart contract since it has been passed to the smart contract to handle during election creation.

Algorithm 3: Vote Activation

Input: voter's ID
Output: activation code
Steps
1: start
2: for int i = 1 to all voters
3: check *if* the voter is registered *and* has *not* yet voted.
3: *If* it's true,
4: generate a *unique* activation *code and* send it to the voter's public *key*.
5: end if
6: *Save* the activation *code* to the blockchain.
7: *Return* the activation *code*.
8: end for
9: stop

Voting Phase

The voter contract oversees the voting process after the election has been activated by the electoral commission. The voters must complete the authentication process before they can vote, voters must first sign into their wallets using the private key. In this project, the wallet receives the credentials and compares them to other values on the blockchain. If both values are discovered to be equivalent, the voter is eligible to vote. The voter contract also helps check if the voter had participated in the voting before granting access to vote. Then the voter can then select his/her choice after which there will be a confirmation form to confirm the voter's choice before being stored in the blockchain. Figure 4 presents a flow of processes involved in the voting phase.

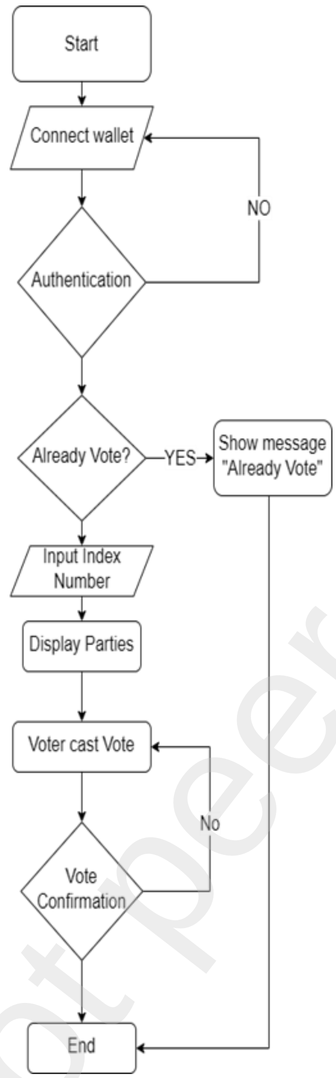

Figure 4: Voting Process Flowchart

Algorithm 4: Vote Authentication

Input: activation code
Output: voting status
Steps
1: start
2: for i = 1 to n of all voters
3: check *if the* activation code is valid *and* has *not* expired.
4: if true, go to 5
5. cast vote
6: else, go to 7
7: mark *the* voter *as* having voted *and add the* vote *to a new* block.
8: add *the* block *to the* blockchain.
9: end if
10: return *a* success message.

11: end for
12: stop

Result Phase

The result is programmed to work real-time. On the results page, users will have to input the index number of the vote they are willing to check. This guarantees that the results are available, transparent, and verifiable by all nodes in the network, providing a level of trust in the electoral process.

Algorithm 5: Vote Counting and Result Publishing

1. Retrieve all blocks *from the* blockchain.
2. Count the number of votes for each block *for each* option.
3. Save *the* vote counts *to the* blockchain.
4. Return *the* vote counts.
5. Retrieve *the* vote counts *from the* blockchain.
6. Calculate *the* percentage *of* votes *for each* option.
7. Display *the* results *to the* user.

The Architectural Design of the Proposed System

The architecture of the proposed system shown in Figure 5 gives a clear picture of how it works The use of blockchain technology is introduced into an e-voting system. There are also some external entities that interact with. They are stated as follows:

1. Electoral Commission (Admin): The Electoral Commission (EC) oversees the election's lifetime. With this position, only the creator of the vote is enrolled in this role. In addition to creating the election, configuring ballots, registering voters, and deciding the election's lifespan, the election commission also decides the election type (Hjálmarsson and Hreiðarsson). After the election is finished, the EC announces the results and keeps track of the whole voting process.
2. Voters: All eligible voters who cast ballots in the election are represented in this module. Voters oversee casting their ballots and making sure that their votes are accurately recorded. Voter participation is crucial for guaranteeing the legitimacy of the election because it gives citizens a way to express their preferences and hold their elected officials accountable (Kshetri and Voas 2018).
3. Smart Contract: Smart contracts are used to automate the voting process and ensure the integrity of the voting process. They are stored and replicated on the blockchain and can be programmed to automatically trigger when certain conditions are met.
4. Blockchain: The blockchain is responsible for maintaining and
5. managing the network, which is used to record and store all the data related to the voting process securely and transparently.
6. Sharding: Sharding improves the scalability, security, transparency, and cost-effectiveness of the proposed system, by dividing the blockchain into smaller parts, called shards. making it a more dependable and effective digital voting solution.

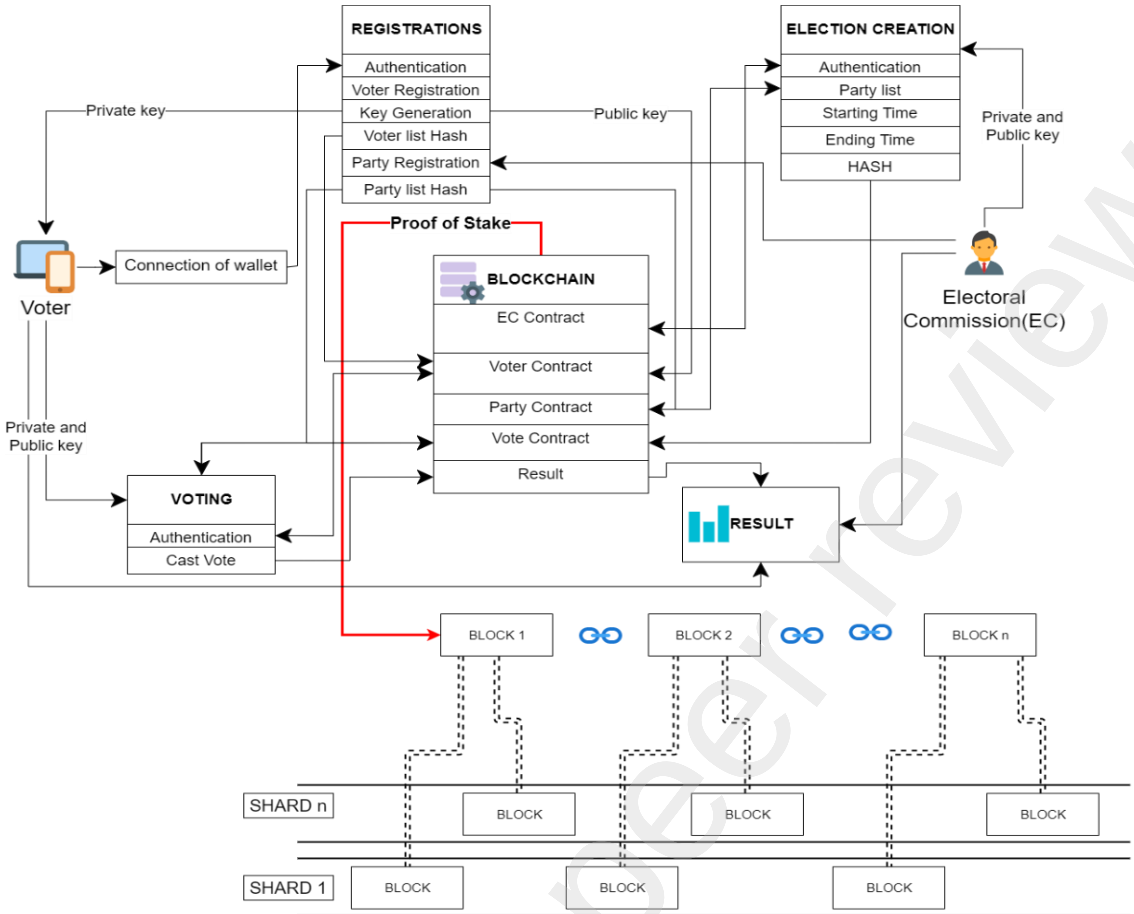

Figure 5: Blockchain-based Digital Voting using smart contracts and Sharding

IMPLEMENTATION

The designed and developed digital voting system for voting was implemented using Web 3 and JavaScript react library for the front end and with blockchain, and Smart Contract for the backend portion of the work. The implemented voting system is to assist the government, companies, or individuals in any voting activities.

The system was built using Ethereum, Smart Contract, Solidity, Next JS, Web 3, and Hardhat. The system's front end was built with a JavaScript react framework library, Next JS. The front end makes use of Web 3 to interact with the smart contract which is the backend of the system for Ethereum written with solidity. Hardhat is a development environment for Ethereum software. It consists of different components for editing, compiling, debugging, and deploying your smart contracts and dApps, all of which work together to create a complete development environment.

Landing Page

The landing page is the first page that the user sees first after visiting the URL. It explains more about the voting app, shows the user functionality of the app, and creates an opportunity for the user to ask questions. Figure 6 depicts a screenshot of the landing page of the E-voting system.

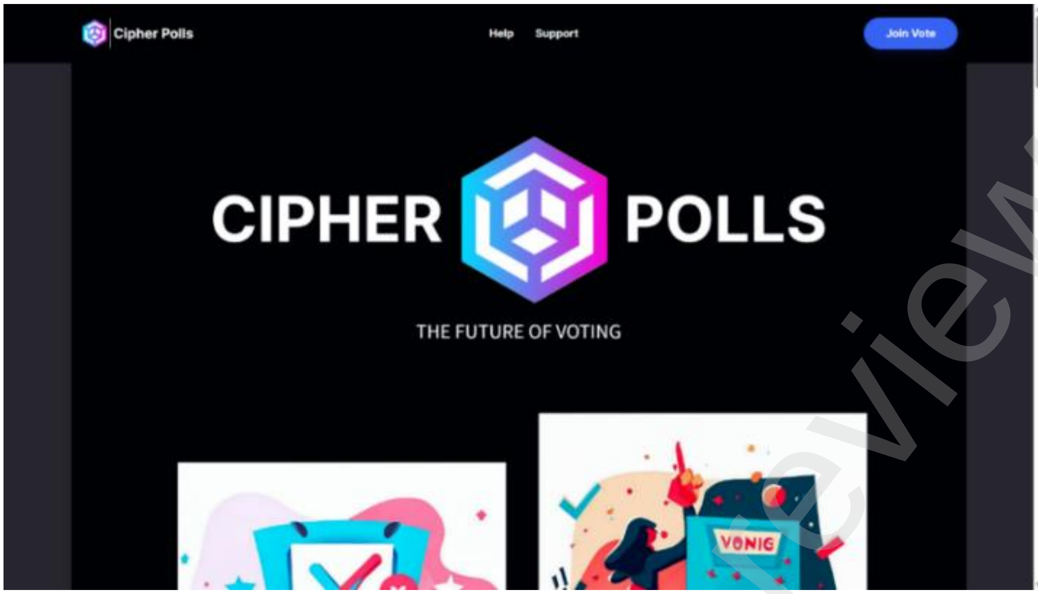

Figure 6: Landing Page

User Dashboard

Figure 7 shows the dashboard from where the user can see a different vote that has been created and can also choose what operation to perform with the application after clicking the Join Vote on the landing page.

User Prompt

Figure 8 shows how the application prompts the user to connect the wallet before performing any operation on the application.

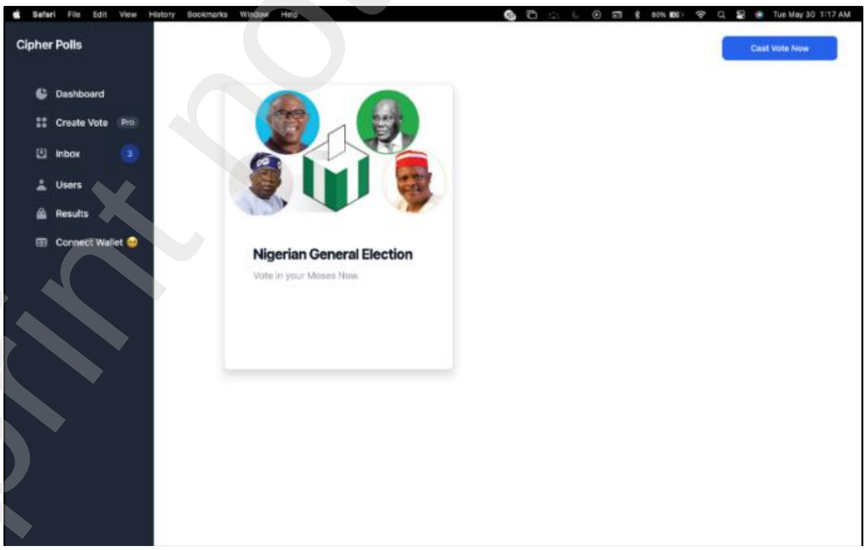

Figure 7: User Dashboard

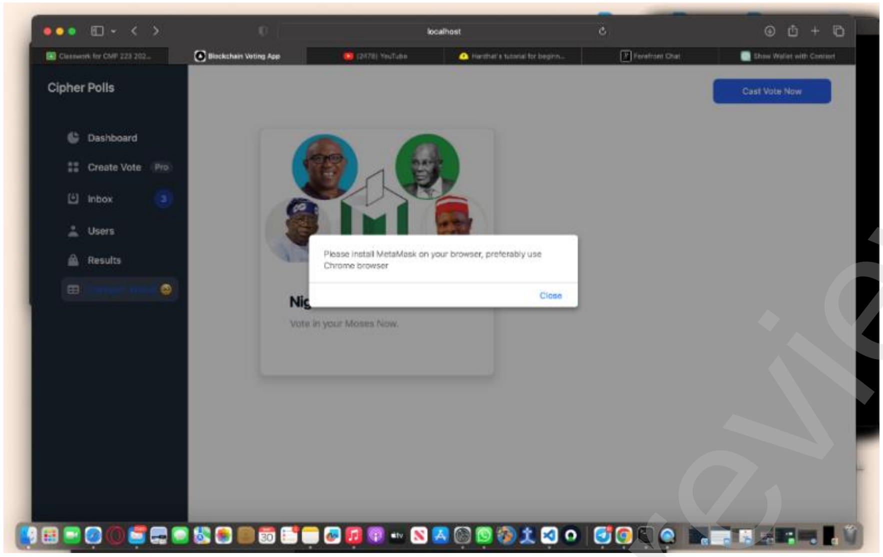

Figure 8: User Prompt

Vote Creation Page

Figure 9 shows a page on which the admin can create a vote by putting the required options.

Vote Casting Page

Figure 10 shows how the user is going to cast a vote by inputting the required options.

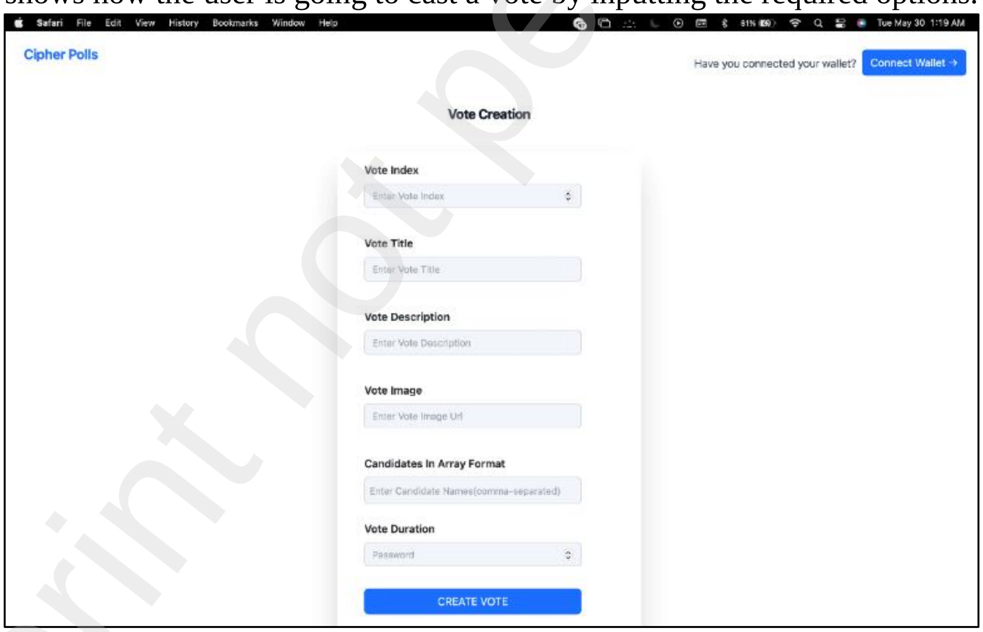

Figure 9: Vote Creation Page

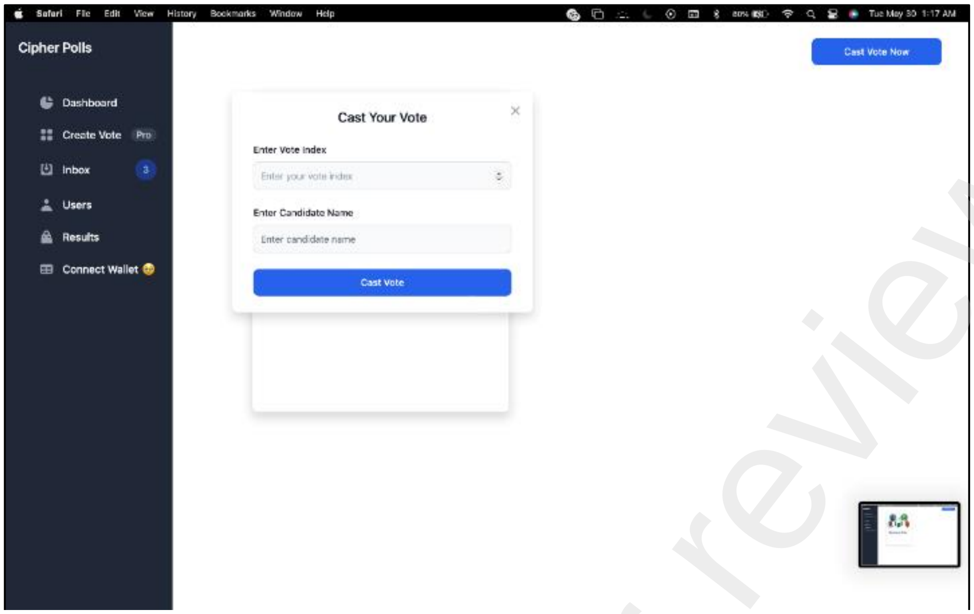

Figure 10: Vote Casting Page

Result Page
Figure 11 shows the tallied result of the election after the user has input the voting index of the result to check.

Figure 11: Result Page

Validation

The study investigates participant acceptability of a blockchain-based voting system by measuring perceived usefulness (PU) and perceived ease of use (PEOU) using the Technology Acceptance Model (TAM). TAM incorporates important concepts like PU and PEOU to help explain user acceptability. It offers perceptions of the variables affecting people's choices to embrace new technologies. The validation checked for what ways the blockchain-based voting system improves voting process accuracy and dependability in the eyes of users, how the behavioral intentions of users are influenced by certain elements to embrace and utilize the proposed system in the next elections, and the opinions and experiences of users about the practicality and efficacy of the adopted blockchain-based voting system. The study utilized a used a questionnaire approach to gather responses from a diverse sample of participants. The questionnaire consisted of structured and open-ended questions, capturing demographic information, familiarity with blockchain technology, perceived usefulness, perceived ease of use, behavioral intention to use, actual system use, factors influencing future use, and user feedback.

To guarantee representation across age groups, genders, and educational levels, participants were recruited through a variety of sources. An online survey platform made it easier to collect results quickly and effectively. While open-ended questions allowed participants to offer more thorough input, structured questions used Likert scales to evaluate user opinions. The emphasis on anonymity and secrecy throughout data collection assured participants that their answers would only be utilized for the study. The user-friendly design of the questionnaire ensures that participants will have a seamless and enjoyable experience. The collected information offers a thorough grasp of users' viewpoints about the blockchain-based voting system, enabling a detailed examination of the advantages, difficulties, and potential areas for development. Figure 12 shows the awareness of respondents about blockchain-based voting system.

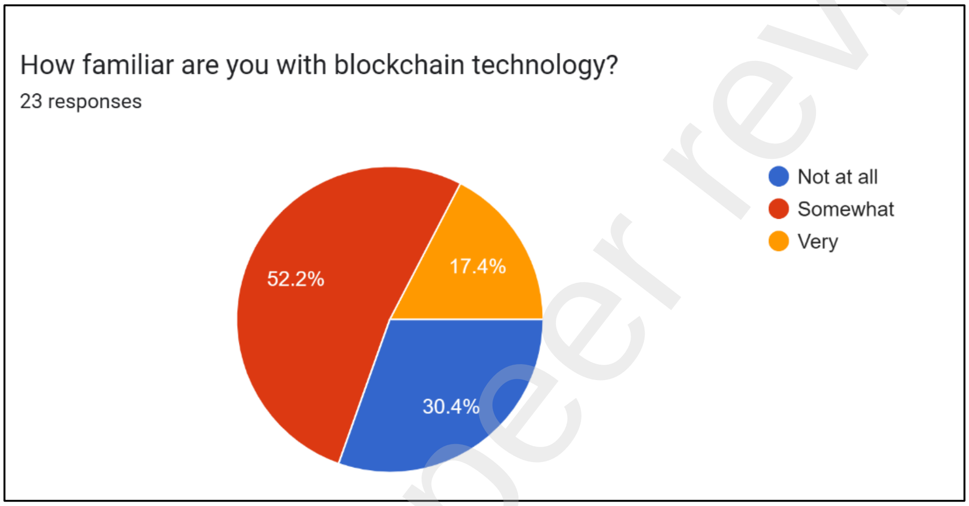

Figure 12: Respondents level of awareness about the system.

Perceived Usefulness (PU)

Perceived usefulness responses indicate a generally positive attitude. A sizable portion agree or strongly agree that the method improves voting accuracy, upholds the integrity of the electoral process, and boosts outcomes dependability. These positive opinions highlight the potential benefits that people may get from implementing blockchain technology for voting. Table 1 shows the statistics of participants' response to the PU questions.

Table 1: Participants responses to the perceived usefulness of the proposed system.

Question	**Response Summary**
Using the system would enable me to vote more accurately	Strongly agree (8), Agree (8), Neutral (7)
The blockchain technology enhances the integrity of the election process	Strongly agree (6), Agree (10), Neutral (6), Disagree (1)
I believe that using this system would increase the reliability of election results.	Strongly agree (8), Agree (10), Neutral (5)

The blockchain-based voting system is a valuable improvement over traditional voting methods.	Strongly agree (7), Agree (10), Neutral (6)
The use of blockchain in voting contributes to a more transparent election process.	Strongly agree (6), Agree (12), Neutral (5)

Perceived Ease of Use (PEOU)

Although most people think using the system is simple and uncomplicated, a sizeable percentage have mixed feelings. Responses differ on how easy it is to use the system and how clear the user interface is. This variety shows that even if a lot of people think the system is user-friendly, there could be space for improvement in a few areas of the user experience. Table 2 shows the summary responses to the PEOU.

Table 2: Participants responses to the PEOU of the proposed system.

Question	**Response Summary**
Interacting with the blockchain-based voting system is easy for me.	Strongly agree (5), Agree (8), Neutral (10)
Learning to use the system is straightforward.	Strongly agree (3), Agree (11), Neutral (8), Disagree (1)
The user interface of the blockchain-based voting system is clear and intuitive.	Strongly agree (2), Agree (11), Neutral (8), Disagree (2)
I find the overall interaction with the system easy and uncomplicated.	Strongly agree (3), Agree (8), Neutral (10), Disagree (1), Strongly disagree (1)
Using the blockchain-based voting system requires little effort on my part.	Strongly agree (3), Agree (11), Neutral (9)

Behavioral Intention to Use (BIU)

Most participants indicate that they would strongly like to employ the blockchain-based voting system in the next elections and that they prefer it to conventional techniques. Positive signs of user acceptance include the readiness to put in time and effort and the propensity to refer others to the system. Table 3 shows the summary responses to the BIU.

Table 3: Participants responses to the BIU of the proposed system.

Question	**Response Summary**
I intend to use the blockchain-based voting system in future elections.	Strongly agree (6), Agree (8), Neutral (9)
If given the opportunity, I would prefer to vote using the blockchain-based system.	Strongly agree (2), Agree (12), Neutral (9)

I am willing to invest time and effort to participate in the blockchain-based voting process.	Strongly agree (3), Agree (10), Neutral (8), Disagree (2)
Using the blockchain-based system is something I see myself doing in the upcoming elections.	Strongly agree (1), Agree (13), Neutral (6), Disagree (3)
I plan to recommend the blockchain-based voting system to others.	Strongly agree (2), Agree (10), Neutral (11)

Actual System Use (ASU)

A portion of participants has previously accessed the system and has provided feedback on their satisfaction levels. Different people use it more or less regularly; some use it more frequently than others. The spectrum of user experiences, from excellent to mediocre, suggests a varied but largely positive opinion. Table 4 shows the summary responses to the ASU.

Table 3: Participants responses to the ASU of the proposed system.

Used the System	Overall Experience	Frequency of Use
No (19), Yes (4)	Satisfactory (12), Very good (4), Excellent (2), Fair (4)	Occasionally (6), Frequently (7), Rarely (8), Always (2)

The three main factors determining future usage are accessibility, security, and transparency. The necessity of a safe and transparent voting procedure is emphasized by the respondents, but issues with accessibility for all voters and the requirement for further blockchain education remain. The validation of the blockchain-based voting mechanism offers insightful information on user opinions and experiences. A possible adoption of blockchain technology in the voting area is indicated by the good reception of perceived utility and behavioral desire to utilize it. Although the technology appears promising, user feedback emphasizes how critical it is to resolve security issues, maintain openness, and enhance usability. The system has to be continuously improved, as evidenced by the inconsistent experiences with its real use. These findings must be taken into account going ahead when creating and implementing blockchain-based voting systems. Expanding user acceptability may be achieved by emphasizing the improvement of security protocols, clear information dissemination, and user interfaces. This study lays the groundwork for additional study and development by highlighting the significance of user-centric design and ongoing improvement to match user requirements and expectations with blockchain-based voting systems.

CONCLUSION AND RECOMMENDATION

After a thorough examination and research into both manual and electronic voting processes, it was discovered that manual voting and some digital voting method causes numerous problems and inconsistencies, which in turn leads to serious manipulations and rigging of the process, resulting in conflicts and disagreement among the people. That is why we advocated for the use of an electronic voting method with blockchain, which is more secure than manual and ordinary digital voting, to prevent future disagreements among citizens. International evidence shows that electronic voting with blockchain systems can ensure a legitimate and reliable election, with results produced in real time and no risk of election results being tampered with. As a result, this work has served as a springboard for proposing an electronic voting system that will propel our democracy forward. Generally, the goal of this study is to improve the efficiency of the voting process as well as the image of the Independent National Electoral Commission (INEC). Finally, this study has examined, created, and executed how an electronic voting system with blockchain will help in governance, organization, and even beyond.

To avoid unneeded breakdowns, the software for this system must be carefully developed. The users, both admins and voters, must be adequately trained. Also, the law should be changed to provide for proper public enlightenment at least two years before the elections, so that people are aware of and prepared for the process. Following an extensive study that revealed the problems with manual and ordinary digital voting, we are confident that the problems identified via this research can be overcome if electronic voting with blockchain is implemented.

In conclusion, this proposed voting system has the potential to create a significant impact on the electoral process and various stakeholders involved such as; enhanced security, increased transparency, real-time results, improved efficiency, accessibility and inclusion, improved image of the electoral commission, and potential for innovation etc. The voting system demonstrates the potential of using blockchain technology to improve the voting process by making it more secure, transparent, and accessible. The use of a decentralized blockchain network and smart contracts helps ensure the integrity of votes cast and results tallied. The e-voting application also aims to provide a convenient way for voters to cast their votes. This system is recommended for governance, companies, and individuals in any voting activities. Adoption of this designed system in voting sectors will allow electoral bodies to provide effective service provision. As a means of improving the system's performance, we would like to suggest that more research be conducted in this area.

REFERENCES

Abdulhamid, S. M., Adebayo, O. S., Ugiomoh, D. O., & AbdulMalik, M. D. (2013). The Design and Development of Real-Time E-Voting System in Nigeria with Emphasis on Security and Result Veracity. *International Journal of Computer Network and Information Security*. https://doi.org/10.5815/ijcnis.2013.05.02

Al-Zoubi, A., Aldmour, M., & Aldmour, R. (2022). Preserving Transparency and Integrity of Elections Utilising Blockchain Technology. *Journal of Telecommunications and the Digital Economy*. https://doi.org/10.18080/jtde.v10n4.626

Alam, M., Yusuf, M. O., & Sani, N. A. (2020). Blockchain technology for electoral process in Africa: a short review. *International Journal of Information Technology (Singapore)*. https://doi.org/10.1007/s41870-020-00440-w

Alvi, S. T., Uddin, M. N., Islam, L., & Ahamed, S. (2022). DVTChain: A blockchain-based decentralized mechanism to ensure the security of digital voting system voting system. *Journal of King Saud University - Computer and Information Sciences*. https://doi.org/10.1016/j.jksuci.2022.06.014

Ben Ayed, A. (2017). A Conceptual Secure Blockchain Based Electronic Voting System. *International Journal of Network Security & Its Applications*. https://doi.org/10.5121/ijnsa.2017.9301

Berdik, D., Otoum, S., Schmidt, N., Porter, D., & Jararweh, Y. (2021). A Survey on Blockchain for Information Systems Management and Security. *Information Processing and Management*. https://doi.org/10.1016/j.ipm.2020.102397

Chipato, F. (2021). Performative citizenship and the politics of scale: Local, national and global citizenships in Zimbabwe. *Political Geography*. https://doi.org/10.1016/j.polgeo.2021.102472

Choi, M. K., Yeun, C. Y., & Seong, P. H. (2020). A Novel Monitoring System for the Data Integrity of Reactor Protection System Using Blockchain Technology. *IEEE Access*. https://doi.org/10.1109/ACCESS.2020.3005134

Indapwar, A. (2020). E-Voting system using Blockchain technology. *International Journal of Advanced Trends in Computer Science and Engineering*. https://doi.org/10.30534/ijatcse/2020/45932020

James, T. S., & Garnett, H. A. (2020). Introduction: the case for inclusive voting practices. *Policy Studies*. https://doi.org/10.1080/01442872.2019.1694657

Keping, Y. (2018). Governance and Good Governance: A New Framework for Political Analysis. *Fudan Journal of the Humanities and Social Sciences*. https://doi.org/10.1007/s40647-017-0197-4

Khan, K. M., Arshad, J., & Khan, M. M. (2020). Investigating performance constraints for blockchain based secure e-voting system. *Future Generation Computer Systems*. https://doi.org/10.1016/j.future.2019.11.005

Khan, S., Arshad, A., Mushtaq, G., Khalique, A., & Husein, T. (2020). Implementation of Decentralized Blockchain E-voting. *EAI Endorsed Transactions on Smart Cities*. https://doi.org/10.4108/eai.13-7-2018.164859

Mursi, M. F. M., Assassa, G. M. R., Abdelhafez, A. A., & Abosamra, K. M. (2016). A Secure and Auditable Cryptographic-Based e-Voting Scheme. *Proceedings - 2015 2nd International Conference on Mathematics and Computers in Sciences and in Industry, MCSI 2015*. https://doi.org/10.1109/MCSI.2015.16

Norris, P. (2015). Why elections fail. In *Why Elections Fail*. https://doi.org/10.1017/CBO9781107280908

Nweke, K., & Etido-Inyang, E. (2020). National Elections and Political Apathy: A Comparative Study of Voter Turnout in the 2019 General Elections of Nigeria and South Africa. *Advances in Social Sciences Research Journal*. https://doi.org/10.14738/assrj.512.8003

Olaniyi, O. M., Adewumi D O, & Bashorun, O. E. A. (2011). Framework for Multilingual Mobile E-Voting Service Infrastructure for Democratic Governance. *Africa Journal of Computing & ICT*.

Shuaibu, A., Mohammed, A., & Ume, A. (2017). A Framework for the Adoption of Electronic Voting System in Nigeria. *International Journal of Advanced Research in Computer Science and Software Engineering*. https://doi.org/10.23956/ijarcsse/v7i3/01310

T M, N., Sondhi, T. S., & Ghildiyal, S. (2022). DigiVoter: Blockchain Secured Digital Voting

Platform with Aadhaar ID Verification. *ECS Transactions*. https://doi.org/10.1149/10701.7427ecst

Wu, L., Lu, W., Zhao, R., Xu, J., Li, X., & Xue, F. (2022). Using Blockchain to Improve Information Sharing Accuracy in the Onsite Assembly of Modular Construction. *Journal of Management in Engineering*. https://doi.org/10.1061/(asce)me.1943-5479.0001029

Zhou, Z., Serafino, M., Cohan, L., Caldarelli, G., & Makse, H. A. (2021). Why polls fail to predict elections. *Journal of Big Data*. https://doi.org/10.1186/s40537-021-00525-8