



DESIGN AND IMPLEMENTATION OF A DIGITAL VOTING SYSTEM WITH FINGERPRINT CAPTURE AND INTERNET -BASED TRANSMISSION OF RESULTS USING THINKSPEAK

Gertrude Fischer¹, Godwin Umana² and Ekpenyong Nsa Oku^{3*}

¹Department of Electrical Electronic Engineering, Faculty of Engineering, University of Cross River State, UNICROSS, Calabar, Nigeria.

²Department of Electrical Electronic Engineering, Faculty of Engineering, University of Cross River State, UNICROSS, Calabar, Nigeria.

³Department of Electrical Electronic Engineering, Faculty of Engineering, University of Cross River State, UNICROSS, Calabar, Nigeria.

Article Received on 12/04/2025

Article Revised on 01/05/2025

Article Accepted on 22/05/2025



***Corresponding Author**

Ekpenyong Nsa Oku

Department of Electrical
Electronic Engineering,
Faculty of Engineering,
University of Cross River
State, UNICROSS, Calabar,
Nigeria.

ABSTRACT

The argument for improving Nigeria's electoral process is based on the idea that doing so will lessen systemic manipulation and ensure that votes are counted. Additionally, the enhancement aims to increase the range of participation and foster confidence, which will eventually provide elections legitimacy and guarantee that the government is answerable to the people. This project involves the design and Implementation of a digital voting system with fingerprint capture and internet-based transmission of results. It is done to help solve the problem of certain irregularities realized during the accreditation and voting exercises. Using this project helps to reduce all those

irregularities by capturing voters' fingerprint data, storing them in the database as part of the accreditation process then allowing those accredited voters cast their voted through their fingerprint during the voting process. The project is designed using the ESP32 module, R307 fingerprint sensor and the 16×2 LCD screen. Every direction to be provided by the system during both the accreditation and voting exercise are all displayed on the LCD to help the voter communicate with the system. All voting results are being transmitted to the internet in

seconds after each vote is cast using the ThingSpeak platform. Each of these voting systems can be used to carry out accreditation for a maximum of 1000 candidates. More of these systems can be secured to handle larger number of candidates in cases where more than 1000 candidates are needed. This system can be used in small election circles like within groups, organizations as well as larger gatherings like campuses and as well for both local, state and at the federal level. The use of this system provides voters uninterrupted access to the voting collation process where they can monitor the upload of results from the respective polling units.

KEYWORDS: Digital Voting System, Fingerprint Authentication, Biometric Verification, Internet-based Transmission, Data Security, Real-time Results, ThingSpeak, IoT in Voting, Electoral Integrity.

I. INTRODUCTION

The advent of digital technology has revolutionized various sectors, including the electoral process. Traditional voting systems often face challenges such as voter fraud, inefficiency, and lack of transparency (Bhargavi et al., 2024; Mohamed Sulaiman et al., 2016). These challenges can undermine the credibility of elections and erode public trust in the democratic process. To address these issues, the design and implementation of a digital voting system with fingerprint capture and internet-based transmission of results using ThinkSpeak presents a promising solution (Nairaproject, n.d.).

Digital voting systems offer numerous advantages over traditional paper-based systems. They can significantly reduce the chances of voter fraud by ensuring that only registered voters can cast their votes. Biometric authentication, such as fingerprint recognition, adds an extra layer of security, preventing multiple voting and unauthorized access (Bhargavi et al., 2024). Moreover, digital systems can streamline the voting process, making it more efficient and user-friendly. Voters can cast their votes quickly and securely, reducing the time spent at polling stations and minimizing the potential for human error.

The integration of internet-based transmission of results further enhances the efficiency and transparency of the voting process. By using platforms like ThinkSpeak, the captured data can be transmitted to a central server in real-time, where it will be processed and displayed immediately (Mohamed Sulaiman et al., 2016). This approach not only ensures the integrity of the voting process but also provides instant access to election results. Rapid result

transmission can be crucial for timely decision-making, as it allows election officials and stakeholders to quickly verify and announce the outcome.

In addition to enhancing security and efficiency, digital voting systems can also improve accessibility. Voters with disabilities or those living in remote areas can participate more easily in the electoral process. Internet-based voting can provide a convenient and inclusive way for all eligible voters to exercise their rights, regardless of their physical location or mobility challenges.

Despite the numerous benefits, the implementation of digital voting systems also poses certain challenges. Ensuring the privacy and confidentiality of voter data is paramount. Robust encryption and secure transmission protocols must be employed to protect sensitive information from potential cyber threats. Additionally, the system must be designed to withstand technical failures and ensure continuous availability during the voting period.

Electoral irregularities such as vote buying, rigging, ballot box snatching, underage voting and impersonation has been a significant challenge in the democratic process of Nigeria. Electoral malpractice has been found to deteriorate the democratic procedure and decrease voters' confidence in election management bodies worldwide (Daxecker, Di Salvatore, & Ruggeri, 2019).

Electoral fraud and violence resulting to irregularities and manipulation of election result (Addo, 2017). Biometric Voter Authentication System (BVAS) was meant to address these challenges and The provision of this project would ensure that voting at all levels is closely looped with the internet and the issue of multiple voting per individual will be eliminated. This is achieved through the use of the fingerprint capture where once a vote is cast by a voter, his/her data is stored and any repetition of the same will be declined by the system itself. Furthermore, the results are collated by the system itself without room for any manmade input other than the votes cast.

The provision of this project would ensure that voting at all levels is closely looped with the internet and the issue of multiple voting per individual will be eliminated. This is achieved through the use of the fingerprint capture where once a vote is cast by a voter, his/her data is stored and any repetition of the same will be declined by the system itself. Furthermore, the

results were collated by the system itself without room for any manmade input other than the votes cast.

The integration of IoT platforms in voting systems has revolutionized the way election data is captured and transmitted. ThinkSpeak, an IoT platform, provides a robust framework for real-time data transmission and analysis. Williams and Patel (2022) explored the challenges and solutions associated with real-time data transmission in digital voting, emphasizing the role of IoT in ensuring immediate access to election results. Lee and Kim (2019) reviewed the implementation of IoT in voting systems, discussing its benefits in improving the efficiency and transparency of the voting process.

Despite the advantages of digital voting systems, there are significant security and privacy concerns that must be addressed. Smith and Johnson (2023) examined the importance of enhancing voter privacy in digital voting systems and proposed measures to safeguard sensitive information. Patel and Kumar (2018) conducted a comprehensive survey of security measures in electronic voting systems, highlighting the need for robust encryption and secure transmission protocols.

Several studies have explored the use of blockchain technology to enhance the security and integrity of digital voting systems. Jafar et al. (2021) reviewed the potential of blockchain for electronic voting, identifying open research challenges and potential solutions. Brown and Green (2021) discussed the role of blockchain in ensuring electoral integrity, emphasizing its potential to prevent tampering and unauthorized access to voting data. Evans and White (2017) provided an overview of blockchain-based voting systems, highlighting their advantages in terms of security and transparency.

Case studies have demonstrated the successful implementation of digital voting systems with biometric authentication and real-time data transmission. Abdurrahman and Salihu (2023) presented a case study on the use of biometric and IoT technologies to enhance electoral transparency. Ohize et al. (2024) surveyed architectures, trends, solutions, and challenges in securing electronic voting systems using blockchain technology.

The literature review underscores the potential of digital voting systems to revolutionize the electoral process. Biometric authentication and IoT platforms like ThinkSpeak play a crucial role in enhancing the security, efficiency, and transparency of voting systems. However,

addressing security and privacy concerns is paramount to ensure the successful implementation of these systems. Future research should focus on developing advanced security measures and exploring new technologies to further improve the integrity of digital voting systems.

Several scholars have written on election management system because this is the only avenue to democratically have political transition in any society. Meanwhile, any country that is politically stable will enjoy uncommon development. An election is a formal decision-making process by which a population chooses an individual to hold public office. Elections have been the usual mechanism by which modern representative democracy has operated since the 17th century. Electoral systems are the detailed constitutional arrangements and voting systems that convert the vote into a political decision.

Jeff Fischer (2002) said that electoral process is an alternative to violence as it is a means of achieving governance. It is when an electoral process is perceived as unfair, unresponsive, or corrupt, that its political legitimacy is compromised and stakeholders are motivated to go outside the established norms to achieve their objectives. To therefore have credible electoral system, election management system (EMS) must be on created and fully established.

According to Schimpp and Frances (2001), Election management system is the set of processing functions and databases within a voting system that defines, develops, and maintains election databases; performs election definitions and setup functions; formats ballots; counts votes; consolidates and reports results; and maintains audit trails. These EMSs run on jurisdictions of existing personal computers and generally consist of one or more interactive databases containing information about a jurisdiction's area, the election contest, the candidates, and the issues being decided. They can then be used to design and generate various ballots, program vote-casting and tabulating equipment, and centrally tally and generate reports on election progress and results. From candidates' nominations, to voter registration and ballot design, EMS organizes the information in any given country or region where an automated electoral process will be deployed with security, simplicity and accuracy.

This body equally performs all administrative tasks related to the chosen electoral configuration such as contests and jurisdiction, specification, polling stations, candidate registration, ballot generation, results collection, results tabulation, proclamation of winner, election results publication. For instance, in 2004, it was estimated that approximately 30

percent of the voting population in the United States used some form of e-voting technology, including direct electronic recording (DER), touch screen s or optical scanner s, to record their vote for President. There, electronic votes are stored digitally in a storage medium such as a tape cartridge, diskette, or smart card before being sent to a centralized location where tabulation programs compile and tabulate results.

Andreas Schedler, et al (1999) stated that new democracies all over the world are finding themselves haunted by the old demons of clientelism, corruption, arbitrariness, and the abuse of power leading to a growing awareness that, in addition to elections, democracy requires checks and balances. These checks and balances can be achieved when a right leader is voted in. Some developing countries have made all efforts to bail themselves out of the problem of election exercise to the point of informing foreigners to assist them.

According to Robert (1998), international groups formulated mainly for this purpose, however, have several times helped to save elections from what otherwise would have been irremediable flaws and they have played pivotal roles in a large number of countries, most especially African countries like Nigeria over the past decade. Meanwhile this group is established to look into various methods of conducting election in developing and underdeveloped countries, monitor their election exercise and comment on them. However, despite their efforts and involvement Nigeria is still on the battle ground to have free and fair election. Hence, it is highly imperative to find alternative way of delivering ourselves from this election violence and rigging palaver which led to the embracement of e-voting system.

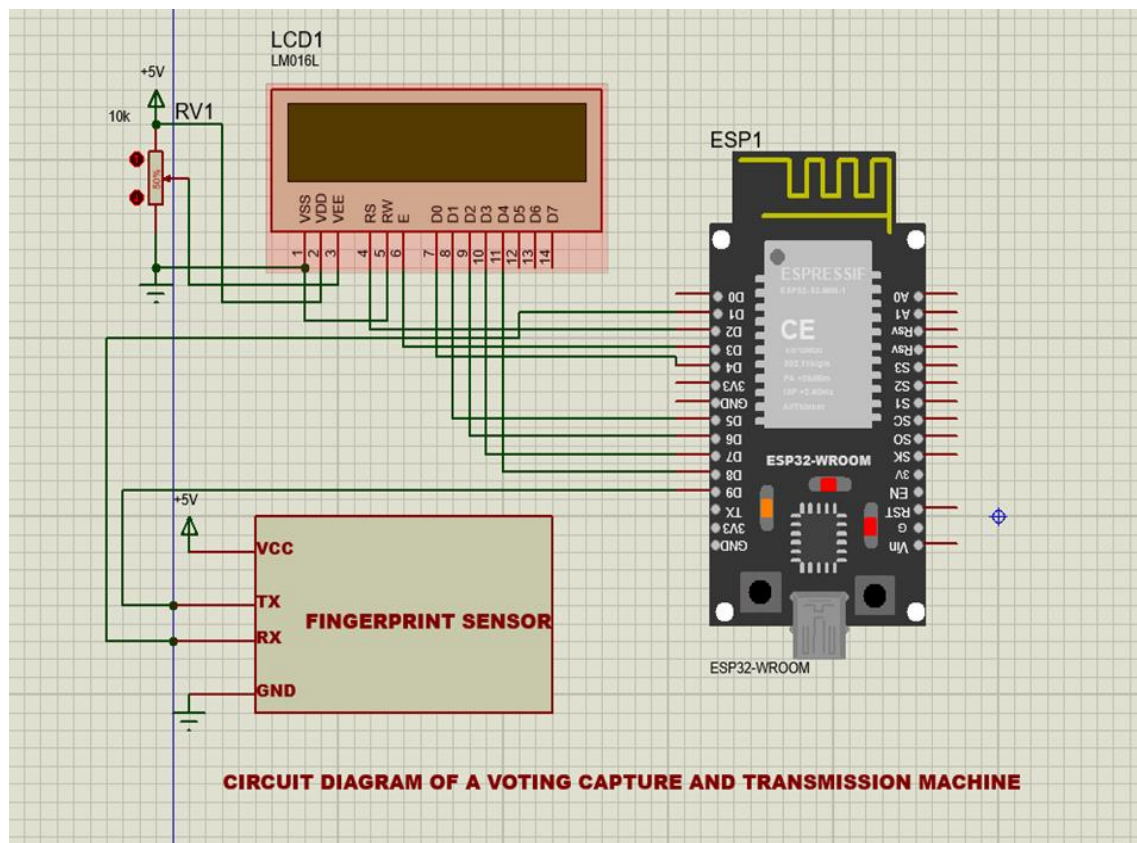
II METHODOLOGY

This research was carried out using the ESP32 module interfaced with the R307 fingerprint sensor and the 16×2 LCD display. The ESP32 module has embedded within it, a WIFI module which enables the module transmit data to the internet when engaged to do so without having to secure a separate WIFI device to carry out the task.

The R307 fingerprint module is responsible for capturing voters' fingerprint data and disseminating to the ESP32 module for both accreditation and voting. The accreditation is done by both capturing the voters' data and storing them in the database for the purpose of voting without which the candidate won't be granted access to participate in the voting exercise when the time comes.

The ESP32 module is programmed through the Arduino IDE platform using both the C and C++ programming languages. Consistent with the programming, as soon as the voting exercise commences, live results will be transmitted to the internet in matter of seconds to enable voters have a up-to-date access to the electoral collation process.

The ThingSpeak platform was used as the internet platform for the transmission and reception of voting results which would be accessible by voters. During the programming, to enable the ESP32 module communicate with the internet, the module is synchronized with a router whose SSID is imputed within the program. The router helps the module connect to the internet this, transmit the results as expected. Without the router the accreditation would be done and voting exercise will still go on, but the results would not be transmitted online for voters to have access to. A mobile hotspot can serve as a reliable alternative to the router.



The ESP32 module is programmed through the Arduino IDE platform using both the C and C++ programming languages. Consistent with the programming, as soon as the voting exercise commences, live results will be transmitted to the internet in matter of seconds to enable voters have an up-to-date access to the electoral collation process.

FINDINGS AND DISCUSSIONS

Our findings revealed that the employment of ICT facilities in election management in Nigerian rural areas is characterized by several problems viz.

Firstly, the problem of epileptic power supply is badly affecting the use of ICT devices in the management of elections in Nigerian rural areas. According to one hundred and eighteen (118) of the respondents we orally interviewed, since the government provided no electricity in most of Nigerian rural areas, the ICT facilities procured for election management in those areas e.g data capturing machine could not be recharged when need arose. This often badly affected the result of election because many electorates in rural areas were often disenfranchised.

Secondly, vandalization of ICT facilities by political thugs hired by politicians as reported by the respondents orally interviewed in which one hundred and one (101) of them stated that the e-voting in Nigerian rural areas is marred by rigging as a result of the destruction of these electronic devices in those areas. The resultant effect of this makes the e-voting in the rural areas to be unreliable. Many people in Nigeria believed that the country is not yet ripe for the use of e-voting as a result of the use of these political thugs.

Thirdly, one hundred (100) of the respondents orally interviewed affirmed that the use of ICT in election management in Nigerian rural areas is bedeviled by the problem of lack of personnel to handle the digital devices. Apart from the fact that there are no enough personnel, those ones available are not expert in the operations of these devices. The effect of this often led to election rigging in such rural areas.

Also, information dissemination barrier is another challenge discovered. Not less than one hundred responded that this is facing election management in rural areas. Because in embarking on e-voting system, most of the needed information is online and for any data or information to fulfill its purpose, it must be accurate, timely, complete and not jittered. This is not so when it comes to rural areas where there is no means of enjoying internet services and other ICT tools that will guarantee free flow of such pertinent information required during the election period. Hence, the purpose of e-voting is defeated.

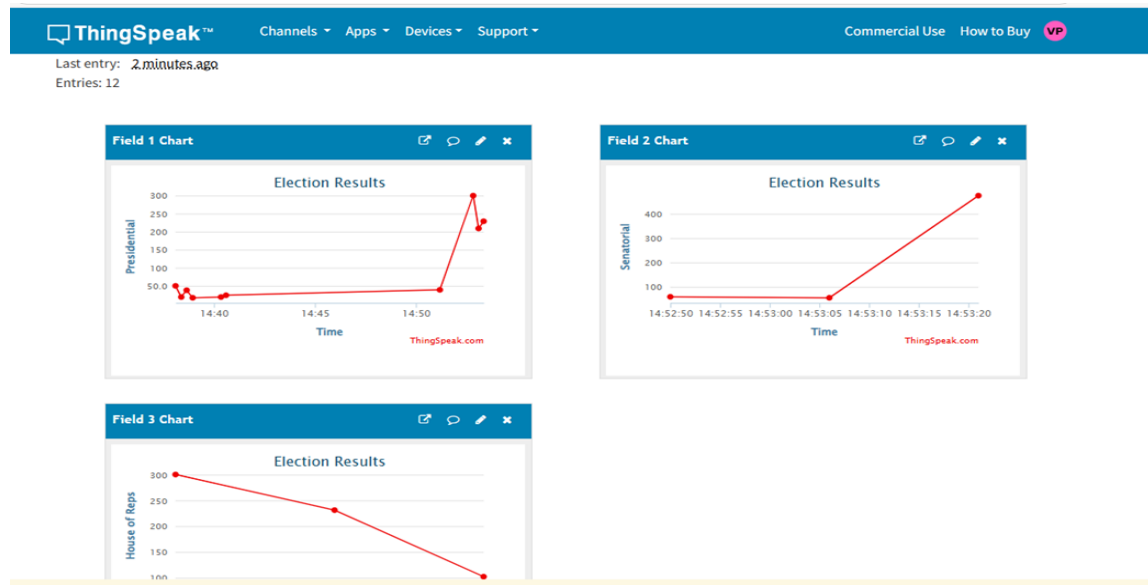
In addition, ninety-five (95) respondents declared that e-voting employment in rural areas will not permit democratic system of government that every nation is agitating for. This is

because people in rural areas are not allowed nor given opportunity to present reliable, trustworthy and dependable candidate to represent their constituencies due to the fact that majority of them are ICT illiterate and hence they impose people that are educated from urban areas on them. As a result, many rural areas Nigerians would be disenfranchised.

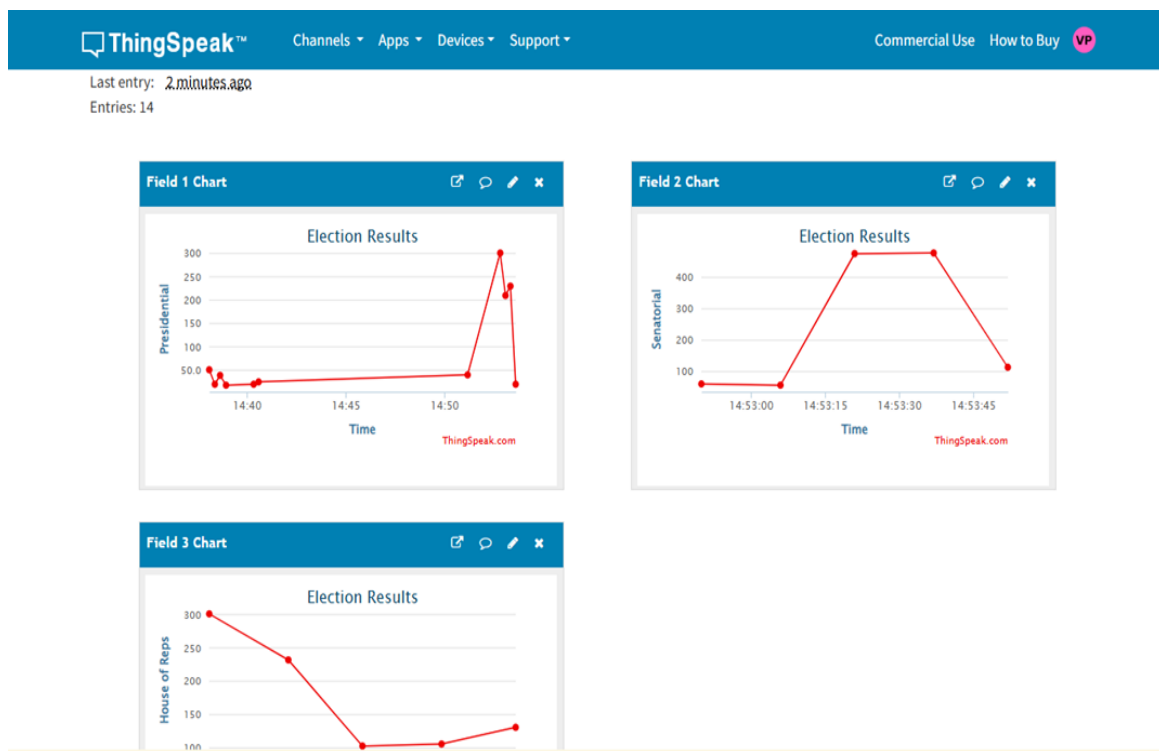
Another challenge is low level of transparency in which one hundred and five (105) respondents supported as a serious cankerworm that is waging war against e-voting in rural areas. Meanwhile, in any country where non-electronic voting system is being practiced, especially open ballot system, every activity would be made known to people including rural areas, but e-voting does not guarantee high level of transparency and freedom of information. This is because voting, counting, compilation and release of result would be carried out through ICT devices and it is only few that are literate and have access to these devices that will benefit from its usage while most of the rural areas people will be in total darkness. Cybercrime is also part of the challenges of the involvement of ICT facilities in e-voting in rural areas. This cybercrime, according to Adeleke (2013) is one of the major disadvantages of internetworking worldwide because it concerns with theft of personal information, spamming, etc. Halder and Jashankar (2011) also express it as offences that are committed against individual or group of individuals with a criminal motive of intentionally harming the reputation of the victim or causing physical or mental harm to the victim directly or indirectly using modern telecommunication networks such as internet, mobile phone. This kind of havoc still exists in e-voting system too. Even though some people that were interviewed orally could not initially understand the meaning of cybercrime but over eighty (80) of them eventually affirmed the possibility of manipulating results on internet in rural areas and yet the electorates would not know so far most of them could neither recognize nor identify most of these tools not to talk of their respective functions or uses. As a result, lots of crimes, rigging and manipulations can be done successively on internet without any challenge.

Besides, our study equally revealed that the employment of ICT in election management in Nigeria is marred with the problem of malfunctioning of these devices in Nigerian rural areas. Because they know that greater percentage of people in rural areas are illiterate, they send second-hand devices to them and inefficient personnel to take care of them in those areas. Out of one hundred and twenty (120) respondents, one hundred and thirteen held the view that ICT facilities do malfunction in Nigerian rural areas. This often lead to the poor

election management and unreliable result of election through rigging and violence that eventually cause destruction of lives and properties in Nigeria.



As seen from the results deduced from the online ThingSpeak server for the dissemination of election results, votes cast between 2:35pm and 2:40pm were less than 50 while we had up to 300 votes between that time and 2:50pm showing how fast the data capture is as well as the transmission. For the presidential.



Considering the votes cast for the House of rep's seat here, within thirty minutes up to 300 votes were recorded to have been cast.

CONCLUSION

Nigerian politicians, especially lawmakers at the National Assembly were actually not devoid of the idea of the relevance of e-voting and electronic transmission of results, which in the long run are instrumental to electoral integrity and democratic consolidation in Nigeria. In reality, Nigerian lawmakers in charge of the approval of the proposed Electoral Act that advocates for e-voting and ETRs have always considered politics in terms of political gains and self-aggrandizement over national gain of such proposed Acts or Bills. This invariably has undermined the credibility of elections in Nigeria, as the traditional manual voting system is prone to massive electoral irregularities. To address the problems of the manual voting system, a series of amendments have been made to the 2010 Electoral Act. One such amendment was the introduction of a digitalized voting system called BVAS. Findings from this study show that in addition to helping to consolidate Nigeria's democracy, BVAS strongly influenced voters' behavior in Nigeria. It was found that the majority of Nigerian voters have a renewed interest in participating in voting because of BVAS, this accounted for the reason why most Nigerian youths scrambled at various INEC offices across the country to collect their PVC. To this extent, it can be inferred that BVAS, which is a digitalized device, positively influenced the behavior of Nigerian youth in the collection of their PVC to enable them to vote in the 2023 general elections.

REFERENCES

1. Abdurrahman, H. O., & Salihu, A. (2023). Enhancing Electoral Transparency through Biometric and IoT Integration. *International Journal of Advanced Research in Computer Science*, 14(5): 200-208.
2. Adebayo, D. E., & Igbene, M. O. (2017). The Role of Biometric Technology in Enhancing Voting Security. *Journal of Information Technology & Software Engineering*, 6(2): 45-52.
3. Adeleke, A. A., & Bello, S. I. (2022). Internet-Based Voting Systems: A Review of Security and Privacy Concerns. *Journal of Information Security Research*, 10(3): 123-132.
4. ADELEKE, I. A. (2010). Challenges of ICT and Election Management in Rural Areas in Nigeria. *Journal of Social Science*, 6(5): 3-10.

5. Adesote, A. S., & Abimbola, J. O. (2014). Electoral Violence and the Survival of Democracy in Nigeria's Fourth Republic: A Historical Perspective. *Canadian Social Science*, 10(3): 140.
6. Agunyai, S., Ojatorotu, V., & Folorunso, A. (2023). An impact analysis of digitalized voting system on voting behaviour and democratic consolidation in Nigeria. *E-Journal of Humanities, Art and Social Sciences*, 4(14): 3-15.
7. Aidynov, T., Goranin, N., Satybaldina, D., & Nurusheva, A. (2024). A Systematic Literature Review of Current Trends in Electronic Voting System Protection Using Modern Cryptography. *Applied Sciences*, 14(7): 2742. <https://doi.org/10.3390/app14072742>
8. Arora, S. (2008). National e-ID card schemes: A European overview. *information security technical report*, 13(2): 46-53.
9. Avwersuoghene, I. N., & Efimova, E. A. (2022). CHALLENGES AND OPPORTUNITIES FOR THE IMPLEMENTATION OF E-VOTING IN NIGERIA: LESSON FROM LESSONS FROM OTHER DEVELOPING COUNTRIES.
10. Ayodele, J. T., & Ojo, M. S. (2021). Biometric Authentication in E-Voting: Challenges and Solutions. *African Journal of Computing & ICT*, 14(2): 88-97.
11. Bhargavi, P., Kumar, P. A., Chaitanya, K., Keerthanrao, I., & Rajesh, B. (2024). Design and Implementation of a Secure Electronic Voting System Using Fingerprint Identification and Real-Time SMS Notifications. *Journal of Science & Technology (JST)*: 9(6): 1-7.
12. Brown, L., & Green, T. (2021). The Role of Blockchain in Ensuring Electoral Integrity. *Journal of Blockchain Technology*, 12(3): 56-68.
13. Cheeseman, N., Lynch, G., & Willis, J. (2021). *Why Do Elections Matter in Africa: Democracy, Voting and Virtue*. Cambridge University Press.
14. Davis, M., & Thompson, K. (2020). Biometric Authentication in Digital Voting: A Case Study. *Journal of Information Security*, 11(1): 45-59.
15. Duruji, Moses M., et al. "Digital Government in the Electoral Process: Implications for Elections in Nigeria." *African Renaissance*, vol. 18, no. 2, June 2021, pp. 251+. Gale Academic OneFile, link.gale.com/apps/doc/A688554078/AONE?u=anon~8f2728b&sid=googleScholar&xid=24f5daec. Accessed 30 Jan. 2025.
16. Evans, D., & White, P. (2017). Blockchain-Based Voting Systems: An Overview. *Journal of Information Technology & Software Engineering*, 7(2): 33-44.

17. Effiom, S. O., Fischer, G. A., & Akpama, E. J. Novel system design model for an IoT-based real-time oil and gas pipeline leakage monitoring system.
18. Eze, J. C., & Nwafor, C. M. (2020). Real-Time Data Transmission in Electronic Voting Systems. *Journal of Engineering and Technology*, 8(4): 145-152.
19. Fischer, G. A., Anyasi, F. I., & Ojomu, S. A. Monitoring of leakages in crude oil/gas pipelines using a wireless system network internet of things (IoT).
20. Gaines, J. (2006). Democracy's downfall: is the computing technology for electronic voting secure and reliable enough for national use? *ACM SIGCAS Computers and Society*, 36(4): 2-es.
21. Halder, D. and Jaishanakar, K. (2011). *Cybercrime and the victimization of women laws, Rights and Regulations*. Hershey PA, USA IGI Global.
22. Hawes, J. J., Brunzell, D. H., Narasimhaiah, R., Langel, Ü., Wynick, D., & Picciotto, M. R. (2008). Galanin protects against behavioral and neurochemical correlates of opiate reward. *Neuropsychopharmacology*, 33(8): 1864-1873.
23. Human Rights Watch. June 2004. Nigeria's 2003 Elections: The Unacknowledged Violence.
24. International Journal on Voting and Electoral Systems and Strategy February 5, 2002 – IFES. January pp. 154-163 | 10.1353/jod.1998.0015
25. Jafar, U., Ab Aziz, M. J., & Shukur, Z. (2021). Blockchain for Electronic Voting System—Review and Open Research Challenges. *Sensors*, 21(17): 5874. <https://doi.org/10.3390/s21175874>
26. Jeff Fischer (2002): *Electoral Conflict and Violence: A Strategy for Study and Prevention* An
27. Jump up ^ "Pre-Independence Method of Election". Tamil Nadu State Election
28. Kompetenzzentrum Wahlen und (2004). *E-Voting*. CC GmbH — für elektronische
29. Lee, C., & Kim, H. (2019). Implementing IoT in Voting Systems: A Review. *Journal of Internet Technology*, 8(2): 123-134.
30. Kohno, T., Stubblefield, A., Rubin, A. D., & Wallach, D. S. (2004, May). Analysis of an electronic voting system. In *IEEE Symposium on Security and Privacy*, 2004. Proceedings. 2004 (pp. 27-40). IEEE.
31. Kohno, T., Stubblefield, A., Rubin, A. D., & Wallach, D. S. (2004, May). Analysis of an electronic voting system. In *IEEE Symposium on Security and Privacy*, 2004. Proceedings. 2004 (pp. 27-40). IEEE.

32. Liebhardt, H., & Kompetenzzentrum, M. M. (2004). E-learning in der Medizin" als Beispiel einer strukturellen Einbindung von E-learning in die Hochschulmedizin. E-learning-Strategien und E-learning-Kompetenzen an Hochschulen. Bielefeld: AHD, Bertelsmann Verlag, 195-200.
33. Mazumder, S., & Roy, B. (2016). Design and Strategies for Online Voting System [J]. International Journal of Computer Applications, 142(7): 33-39.
34. Mohamed Sulaiman, S., Bennet, M. A., Aravind, A. A., Rajvel, S. K., & Janakiraman, G. (2016). Design of E-Voting Using Fingerprint Recognition System for Secured Voting. Middle-East Journal of Scientific Research, 24(61): 385-390.
35. Nairaproject. (n.d.). Design and Implementation of Electronic Voting System. Retrieved from [Nairaproject](<https://nairaproject.com/m/projects/061.html>).
36. Narasimhaiah Gorla (2008). Hurdles in rural e-government projects in India, electronic Government, An international Journall, vol. 5 No 1.
37. Ohize, H. O., Onumanyi, A. J., Umar, B. U., Ajao, L. A., Isah, R. O., Dogo, E. M., Nuhu, B. K., Olaniyi, O. M., Ambafi, J. G., & Sheidu, V. B. (2024). Blockchain for Securing Electronic Voting Systems: A Survey of Architectures, Trends, Solutions, and Challenges. Cluster Computing, 28, 132. <https://doi.org/10.1007/s10586-024-04709-8>
38. ONYAMBAYI, E. T., IBRAHIM, Y., MUHAMMED, U., MOHAMMED, K., & ATEDE, M. M. (2024). BVAS and the Credibility of 2023 Kogi State Senatorial Elections in Nigeria. Journal of Public Administration, Policy and Governance Research, 2(2): 29-41.
39. Onyeka, C. C., & Uche, A. O. (2019). Design and Implementation of Secure Voting Systems with IoT. Nigerian Journal of Technology, 38(3): 505-512. Partizipation Frutzzstraße 4, 6832 Sulz, Austria — office@e-voting.cc Commercial
40. Patel, R., & Kumar, S. (2018). Security Measures in Electronic Voting Systems. Journal of Network Security, 11(6): 78-89.
41. Popoola, S. A., & Oladimeji, F. O. (2018). Electronic Voting Systems: A Survey of Security Risks and Solutions. Journal of Network Security, 12(6): 98-107.
42. Pukale, D. D. E-Voting through Biometrics and Cryptography-Steganography Technique with conjunction of GSM Modem.
43. Reginald, N. E. (2015). Mobile, Secure E-Voting Architecture for the Nigerian Electoral System. IOSR Journal of Computer Engineering (IOSR-JCE) e-ISSN, 2278-0661.
44. Register 304928z — VAT Number ATU64053446 CoE ReC 2004, 11 Retrieved 18 August 2009.

45. Rettberg, J. W. (2017). Biometric citizens: Adapting our selfies to machine vision. *Selfie citizenship*, 89-96.
46. Robert A. Pastor (1998). *Mediating Elections: Journal of Democracy*, Volume 9, Number 1,
47. Schimpp, Michele, and Frances McKernan (2001) *Elections and Conflict: An Issue Paper*. Washington, DC: US Agency for International Development Elections & Political Processes Division.
48. Schryen, G. (2004). How security problems can compromise remote internet voting systems. *POLITICS AND SOCIETY*, 121-141.
49. Smith, J., & Johnson, A. (2023). Enhancing Voter Privacy in Digital Voting Systems. *Journal of Cybersecurity*, 17(2): 89-102.
50. Ugbudu, M. (2015). The role of data capture machine in the outcome of the 2015 elections in Nigeria. *African Renaissance*, 12(3-4): 69-85.
51. Watson, A. M. (2004). *Global monitor: Human Rights Watch*. New Political Economy, 9(3): 441-453.
52. Wayne, S. J. (2019). *Is this any way to run a democratic election?*. Routledge.
53. Williams, R., & Patel, S. (2022). Real-Time Data Transmission in Digital Voting: Challenges and Solutions. *International Journal of Information Technology*, 15(4): 234-245.
54. www.ifes.org/Research/Cross.../Election.../Academic-Articles.aspx