Journal of the Nigerian Association of Mathematical Physics
Volume 55 **(February *2020 Issue*), pp157 –162**

NIGERIA ELECTORAL SYSTEM AND THE ELECTRONIC VOTING OPTION

A. Abuh[1a], O. Adejoh[1b] and P. E. Orukpe[2a]

[1a, 1b]Department of Electrical/Electronic Engineering, Federal Polytechnic Idah, Kogi State, Nigeria.
[2a]Department of Electrical/Electronic Engineering, University of Benin, Edo State, Nigeria.

Abstract

The Nigerian democracy is characterized by immense experimentations. The experimentations have marred the process of producing democratically elected governments due to the trial and error approaches adopted by the authorities saddled with the responsibility of a credible process. The electoral process in Nigeria had been completely manual until the 2015 general elections when electronic accreditations were introduced to help reduced electoral malpractices. The voting system which is the heart of democracy is still manually conducted, and this action exposes the entire process to serious electoral manipulations and frauds, such as stuffing of ballot boxes, destruction of electoral materials, falsification of elections results etc. In order to reduce the electoral frauds to a bearable minimum, an alternative method of voting is necessary. In this paper, the current electoral process was reviewed and a robust framework for electronic voting (e- voting) is presented as an alternative to the manual voting. It will help to produce free, fair and credible elections in Nigeria. This framework is capable of handling electronic voter registration, verification, collation of vote cast, counting, display of votes received by political parties and printing of results at the polling units. However, transmission of results from polling units to a central server is not part of this design due to the level of development of telecommunication services in Nigeria.

***Keywords*:** Credible process, Democratic system, Elections, Electronic Voter register, Electronic voting machines

1.0 Introduction

Elections are the highest level of democracy where citizens have the opportunities to choose their leaders or representatives. The credibility of the elections and the electoral processes are fundamental to the integrity of democracy. The process must be robust, transparent and credible for voters and candidates to accept results of elections [1]. The Nigerian democracy is still on trial. This is because it has been characterized by serious experimentations, especially in the electoral process which is the bedrock of any democracy. Elections in Nigeria have been characterized by massive frauds, which include: vote buying, vote rigging and in some cases assassinations and intimidations of political opponents [2], [3].

The Nigerian democracy aims at ensuring political stability and enhancing fundamental human rights. Elections in Nigeria should have been the driving influence to achieving a stable democracy, but because of the massive election rigging, trust and confidence in the process no longer exist. The quest to win by all means is a major threat to the democratic system in Nigeria. This has claimed lives of the electorates, electoral officials and candidates. Hoodlums who want to control the government have used dubious and dangerous means to acquire power, and as a result, credible Nigerians have been discouraged from participating in the political space [4], [5].

Election rigging has taken various dimensions in Nigeria. According to [6], [7], elections can be rigged by printing of voter card illegally, printing of fake result sheets, stuffing of ballot boxes, falsification of election results, under age voting, manipulation of voter register, deliberate refusal to supply election materials, change of electoral officials, harassment of participants and use of fake collation centers. These challenges have made it difficult for the current electoral process to produce leadership that is acceptable and accountable to the people. Hence, Nigerian politicians have made it loud and clear that an electoral reform is essential in order to build the confidence of the Nigerian people in elections and democratic process [8]. In this paper, a framework for an electronic voting system for Nigeria democratic system is presented. It takes into consideration the peculiarity of the Nigerian state and the challenges of the e-voting system.

1.1 Electronic Voting

Elections are the most important parts of a country's democratic system. The credibility of any democracy lies strongly in the credibility of the electoral process. The way and manner elections are conducted and the acceptability of the outcome by all participants determines the stability, credibility and sustainability of the democratic system [9].

The electronic voting is defined as a system where elections involve the use of electronic devices for the purpose of registration, casting and counting of votes, and the display of results [10]. Electronic voting may also refer to the use of technology in the voting process. The technologies include internet and digital broadcasting [11]. This system adds credibility to election results; builds trust and confidence in the electoral process and advances democracy. There are three types of e-voting namely polling station e-voting, kiosk e-voting and remote

Corresponding Author**:** Abuh A., Email: abdullahi.idah@gmail.com, Tel: +2348104591994 (PEO)

e-voting [12]. The e-voting has numerous advantages [13], [14]. Some of which are: voting is more convenient, voting is more cost effective, increased voters' turnout, eliminate rigging, encourages the handicapped to participate in voting, eliminates falsification of results and allows credible election. However, the e-voting is also faced with some challenges, which include internet or virus attack, voter's authentication issues and manipulations by hackers.

1.2 Electronic Voter Register in Nigeria

The Nigerian electoral system witnessed the introduction of Electronic Voter Register (EVR) in 2010 for the purpose of the 2011 general elections. The system was introduced to eliminate duplication of names and discrepancies in the electoral process. It was embedded into a notebook laptop with other components such as printer, camera, fingerprint scanner and card reader. A biometric data capturing machine was also introduced in the same year to help reduce fraud and cases of multiple registrations [15]. Though, in Nigeria presently, there is no legislation or legal framework in support of electronic voting. The effort of the Independent National Electoral Commission (INEC) in 2010 to introduce technology in the electoral system only stops at the accreditation of electorates. Both the electronic voter register and the card reader were not completely error free. Dubious politicians capitalized on the lapses to commit electoral malpractices. In [12], the authors presented a framework for e-voting in Nigeria using Unified Modeling Language (use case and activity diagram), which was not implemented. In this paper, we will design and implement an electronic system for e-voting in Nigeria that is user friendly and it is a standalone device to be placed on every polling station.

2.0 Methodology

In this paper**,** the development of an electronic voting framework using modern programming language, activity diagrams and flowcharts to illustrate the voting processes and the design and construction of a prototype electronic voting machine for the Nigerian electoral system will be carried out.

2.1 System Requirement

A voting system irrespective of the method (i.e. manual, electronic or internet) must meet certain standard requirements, which include: flexibility, convenience, accuracy, uniqueness, integrity, authentication, verifiability and transparency [16]. The developed framework presented in this paper captures the following processes involved in electronic voting system: registration of voters, verification and authentication of voters, casting of ballot, collation and counting of votes and presentation of election results.

2.2 System Operation

This section explains the operation of each process of the electronic voting system as stated in section 2.1, using system algorithm, activity diagram and flowcharts.

2.2.1 Registration of voters

The registration process includes the use of scanner, keypad, camera, computer system and printer. This process is done offline. It includes:

1. Prospective voter presents himself/herself.
2. The face is captured.
3. The fingerprint is captured.
4. Other necessary information requested from him/her.
5. Information is stored.
6. A voter card is then printed for the prospective voter.

The activities stated above are illustrated with the activity diagram of Figure 1.

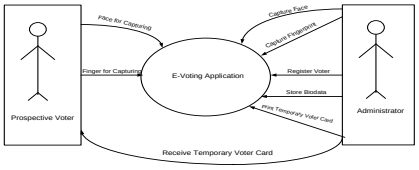

Figure 1: Activity diagram of the registration process

At the end of the registration exercise at all polling units, the bio-data stored on all the machines used for the registration process are transferred to the central machines for further check. The check is to eliminate multiple registrations, under age voter, and then produce permanent voter cards for the voters. The flowchart presented in Figure 2 shows the sequence of operation at the final registration stage.

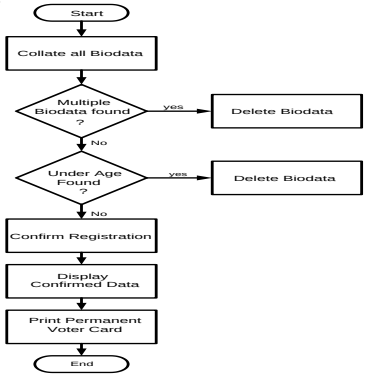

Figure 2: Flowchart showing the final registration stage.

2.2.2 Voting Process

This section presents the activities that take place on the Election Day. The first activity is the verification of the voter card. This is done with the aid of a card reader. This activity restricts the use of only recognized voter card issued by the electoral body (in this case, the INEC) on the Election Day. If verification is successful, the fingerprint of the voter is authenticated to avoid impersonation. After successful verification and authentication, the voter is allowed to cast a vote for his/her preferred candidate. Where either verification or authentication fails, the voter is denied opportunity to cast a vote. In an event where a voter intends to cast more than one ballot, an alerting message pops up on the LCD displaying "ALREADY VOTED". It is accompanied by an audio alarm. This condition will remain until the reset button is activated.

At the end of the voting exercise, the electronic voting machine automatically collates the vote cast, displays the number of accredited voters and the number of votes received by each political party on the Liquid Crystal Display (LCD). Figure 3 is the flowchart diagram that shows the activities on the Election Day.

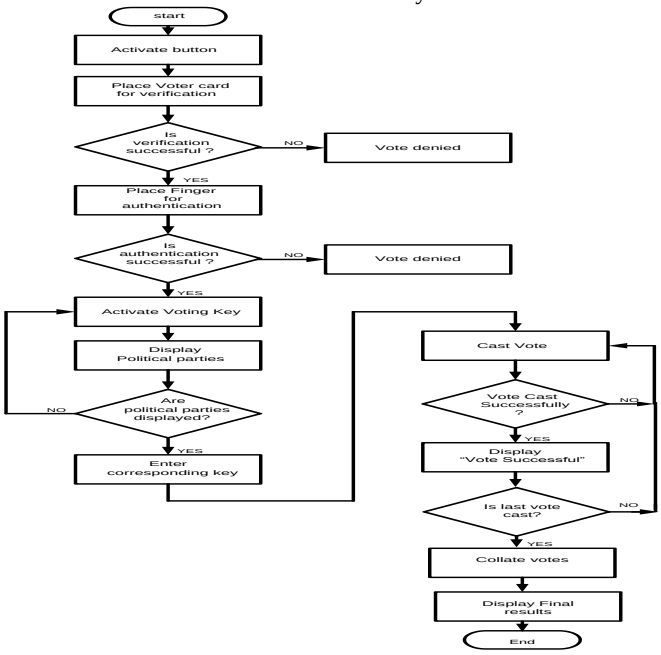

Figure 3: Flowchart illustrating the voting process

2.3 System Design Analysis

This section presents the design of the various units of the electronic voting machine.

2.3.1 Building Blocks

The electronic voting machine presented in this work is made up of the building blocks shown in Figure 4.

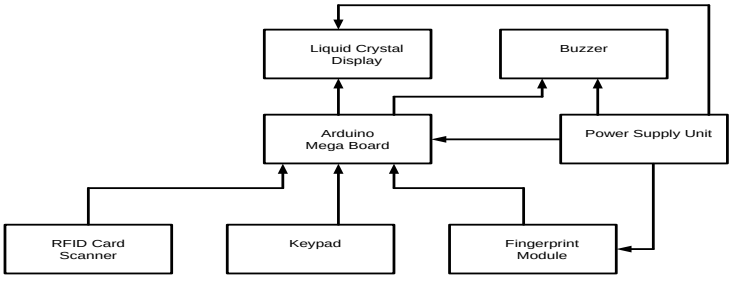

Figure 4: Block diagram of the e-voting machine.

2.3.2 The Power Supply Unit

This unit provides the DC voltage needed for the operation of the system. It comprises of a 220V/12V step down transformer, a bridge rectifier, a filter capacitor and a +5V voltage regulator. The regulated power is enough to drive the microcontroller and other units of the design [17].

A 220V/12V, 500mA transformer was used. The output of the transformer was rectified using a bridge rectifier. For full wave rectifier design, the maximum voltage (Vmax) is given by:

$$Vmax = \sqrt{2} \times Vrms \quad (1)$$

$$\therefore Vmax = \sqrt{2} \times 12 = 16.97V$$

The DC output voltage (Vdc) is given as:

$$Vdc = 0.636Vmax \quad (2)$$

Hence, $Vdc = 0.636 \times 16.97 = 10\ 79V$.

The Peak Inverse Voltage (PIV) for rectifying diode must be greater than Vmax and the forward current must be greater than the load current [18]. Hence we choose Irms of 500mA. Therefore, IN4001 silicon diode with PIV of 50V and forward current of 1A was chosen (i.e. D1- D4 = IN4001).

The capacitance of the filter capacitor used was obtained from the relation:

$$Vr = \frac{Irms}{2fC} \quad (3)$$

where Vr = ripple voltage, f = input frequency (50Hz) and C = capacitance of the capacitor. But

$$Vr = Ripple\ factor \times Vmax \quad (4)$$

Assuming a ripple factor of 14%, then

$$Vr = 0.14 \times 16.97 = 2.38V$$

$$\therefore C = \frac{Irms}{2Vrf} \quad (5)$$

$$= 500 \times \frac{10^{-3}}{2 \times 2.38 \times 50} = 2.1 \times 10^{-3}\ F = 2100\mu F.$$

The nearest standard working capacitor of 2200μF, 25V was chosen. The 5V regulator used is a fixed voltage regulator from the family of the 78XX series. Figure 5 shows the circuit diagram of the power supply unit.

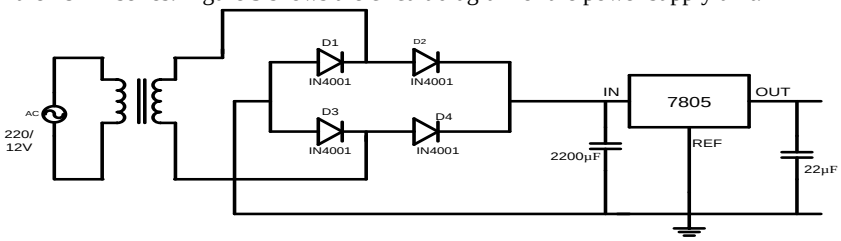

Figure 5: The power supply unit

2.3.3 The RFID Scanner

The RC522 proximity card reader was used in this design. It reads the information on the RFID card (i.e. voter card) and sends data to the microcontroller for verification of card in order to ascertain that the card belongs to the electoral body. It is a low cost, small sized and low voltage device that uses an advanced modulation and demodulation concept in the 13.56MHz, which makes it to be completely integrated with all kinds of positive contactless communication methods and protocols [19].

2.3.4 The Fingerprint Biometric Scanner

The Adafruit optical fingerprint sensor was used in the work for capturing the fingerprints of the prospective voter. The captured fingerprints are stored in the database for authentication. The Adafruit has amongst its characteristics, fingerprint image time of less than one second, false acceptance rate of less than 0.001% and false rejection rate of less than 1%.

2.3.5 The Arduino

The Arduino mega board was used in this design. It is an open-source electronics prototyping platform based on flexible, easy- to- use hardware and software. It consists of an Integrated Development Environment (IDE) and core libraries (www.adafruit.com).

2.3.6 Liquid Crystal Display (LCD)

The LM016L liquid crystal display was used in this design to display the voting processes that will guide the voter. It is a 16×2 character display device with gray as its display colour. The LCD operates with +5V single power supply and has a display area of 61W $\times$ 15.8H mm. It has an input controller, LSI HD44780 with character size of $2.96W \times 4.86H\ mm$, operating temperature of 0 - 40^0C and storage temperature of -20 to 60^0C [20].

2.3.7 The Oscillator

In this work, a 16MHz crystal oscillator served as the clock input to the microcontroller. Hence, the execution cycle for each instruction is determined by [21]:

$$Fc = \frac{clock\ \ input}{4} \quad (6)$$

$$Fc = \frac{16MHz}{4} = 4MHz.$$

Therefore, the time taken to execute a single instruction is determined by:

$$Fc = \frac{1}{T} \quad (7)$$

$$\therefore T = \frac{1}{Fc} = \frac{1}{4MHz} = 0.25\mu secs.$$

3.0 Programming/Simulation

The programming language used in the operation of the microcontroller is the C language. The developed program controls each stage of the election process. The designed circuit was then simulated with Proteus 8. A sample of the developed program is shown in Figure 6. Figure 7 shows the designed circuit diagram.

Figure 6: Sample of the developed program

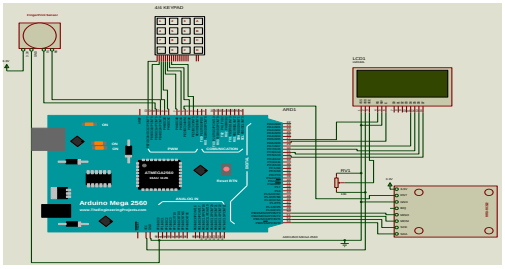

Figure 7: Circuit diagram of the e-voting machine

3.1 Test and Evaluation

The constructed work of the electronic voting machine was tested to ascertain its operations. After engaging the activation button, the voter was requested to place his/her voter card on the scanner as shown in Figure 8. If verification is successful, the voter is requested to place his/her finger on the fingerprint scanner for authentication as shown in Figure 9. The voter is then allowed to cast a vote after successful verification and authentication. At the end of the voting exercise, result sheets are printed out showing the number of registered voters, the number of accredited voter and the number of votes received by each political party. A sample is shown in Figure 10.

Figure 8: Verification

Figure 9: Authentication

Figure 10: Sample of result sheet

From the demonstrations shown in Figures 8-10, the major challenges such as ballot box stuffing, manipulation of election results, over voting and multiple voting in the current voting system are completely eliminated. This will in turn add credibility to the electoral process.

4.0 Discussion

In this paper, we have presented an overview of the electoral system in Nigeria and the challenges affecting its credibility. Some of the challenges include: ballot box stuffing, over voting, multiple voting, falsification of election result, destruction of ballot papers and ballot boxes, etc. This work has provided an electronic voting system as an alternative to the existing manual process.

The electronic voting machine presented in this paper handles verification, authentication, voting, collation, display of election result and printing of result sheet. The result sheet is customized to contain information about the polling unit, and provisions are made on it for the signatures of the presiding officer, party agents and security personnel. The machine is designed to operate for a minimum of eight hours if the battery is fully charged.

5.0 Conclusion and Recommendation

This paper presents an electronic voting system that could help solve the challenges faced by the existing voting system in Nigeria. An electronic voting machine with features capable of solving most of the challenges faced by the manual voting system has been designed, constructed and its operation demonstrated.

From the demonstration, the electronic voting machine shows a great deal of improvement in the voting process as most of the challenges confronting the existing manual voting are taken care of. However, it is worthy of note that the design does not include transmission of results from the polling unit to a central server. This is because of the unavailability of the Global System for Mobile communication (GSM) network all over Nigeria that could aid transmission of data, and the risk of hacking of the server by dubious politicians.

It is however recommended that necessary amendment be made in the electoral act to allow the use of electronic voting machine. The implementation of this machine in the electoral process of Nigeria will go a long way in reducing the fraudulent acts perpetrated in the electoral process, eliminate completely the numerous post election cases at the tribunal and increase the credibility of the entire electoral process.

References

[1] Aishetu S., Abubakar M. and Arthur U. (2017) "A framework for the adoption of electronic voting system in Nigeria". International Journal of Advanced Research in Computer Science and Software Engineering, 7(5), pp 258-268.

[2] Idike A. N. (2014) "Democracy and the electoral process in Nigeria: problems and prospects of the e-voting option". Asian Journal of Humanities and Social Sciences, 2(2), pp.133-141.

[3] Uganden I. A. (2010) "Political accountability in Nigerian governance: implications for long-term development". Journal of Social Science and Public Policy, Vol. 2, pp. 86-95.

[4] Nwokeke P. O. and Jayum, A. J (2011) "The Electoral process and democratic consolidation in Nigeria". Journal of Politics and Law, 4(2), pp. 128-138.
[5] Iyayi F. (2005) "Elections and Electoral practices in Nigeria: dynamics and implications". The Constitution Journal of Constitutional Development, 5(2), pp. 1-10.
[6] Aina A. D. (2006) "Party competition and the sanctity of Electoral politics in Nigeria: Unresolved issues revisited". pp. 54.
[7] Adekanye J. B. (1990) "Elections in Nigeria: problems, strategies and options". Nigerian Journal of Electoral and Polytical Behaviour, 1(1), pp. 2.
[8] Iwu M. M. (2008) "Electronic voting and the future of the electoral system in Nigeria". The Nigerian Electoral Journal, 2(1), pp. 1-29.
[9] Masuka N. (1994) "Transferring election management". South Africa Journal of Independent Electoral Commission, 7(8), pp. 23-30.
[10] Adeleke A. R., Kayode A. S., Rasheed J. G. and Idowu O. D. (2013) "Modelling and evaluation of e-voting system for a sustainable credible election". International Journal of Applied Information systems, 5(3), pp. 8-14.
[11] Musial-Karg M. (2014) "The use of e-voting as a new tool of e-participation in democratic procedures". Poznan, PP 4' 14, pp. 99-105.
[12] Shuaibu A., Mohammed A. and 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, 7(3), pp. 258-268.
[13] Bellis M. (2000) "The history of electronic voting machines and related voting technology". Retrieved from http:/www./votingmachines.procon.org./view.timeline.php?timeline. Accessed 11th December, 2019.
[14] Svensson J. and Leenes R. (2003) "E-voting in Europe divergent democratic practice". Information Policy, 8(1), pp. 3-15.
[15] Aranuwa F. O. and Oriola O. (2012) "Improved electoral fraud prevention mechanism for efficient and credible elections in Nigeria". African Journal of Computing and ICT, 5(6), pp. 70-77.
[16] Eva W. (2001) "Voting system requirements". The Bell, 1(7), pp. 1-13.
[17] Adewale A. A., Abdulkareem A., Agbetunji A. F. and Dike I (2013) "Design and development of a microcontroller-based wireless security access system". International Journal of Computer Science Engineering, 2(5), pp. 237-246.
[18] Abuh A. and Orukpe P. E. (2016) "Development of an integrated campus security alerting system. Nigerian Journal of Technology, 35(4), pp. 895-903.
[19] Mazidi M. A., Mazidi J. G. and Mckinlay R. D. (2006) "The 8051 microcontroller and embedded systems: using Assembly and C". 2nd Edition, Pearson/Prentice Hall, pp. 23-25.
[20] Vishay Inter- Technology, INC (2016). 16 × 2 character LCD (LCD-016 Data sheet). https://www.Vishay.com/docs/ 37297/ 37297. PDF. Accessed 12/3/2017.
[21] Abuh A., Chiemeke S. C. and Orukpe P. E. (2017) "Enhancing campus security system via access control". Journal of the Nigerian Association of Mathematical Physics, Vol. 43, pp. 447-454.