The Imperative of Electronic Voting System for Transparent and Credible Elections in Nigeria

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Abstract
This project focuses on the design and implementation of an automated voting system to address the challenges and limitations of the existing electoral system in Nigeria. The manual voting process is associated with several problems, including multiple registration, multiple voting, invalid voters' registers, ballot stuffing and snatching, electoral violence, inaccurate vote counting, poor organization, and logistical and administrative constraints. These challenges necessitate the adoption of an information and communication technology (ICT)-driven approach to improve electoral efficiency, transparency, accuracy, and credibility. The Structured Systems Analysis and Design Methodology (SSADM) was adopted for the development of the proposed system. Data were collected through observation, questionnaires, and oral interviews. The system was designed using electronic voter authentication, permanent voter card verification, fingerprint authentication concepts, electronic ballot casting, and secure transmission of votes to a central collation server through a public network. The system was implemented using PHP and MySQL to facilitate voter registration, authentication, candidate selection, vote casting, and automated result collation. Testing demonstrated that registered voters could log in, cast their votes, and transmit them electronically, while unregistered users were denied access and voters were prevented from voting more than once. The study concludes that an automated voting system has the potential to reduce electoral irregularities, minimize human errors, accelerate vote counting, and lower the cost of electoral administration. It is recommended that the Independent National Electoral Commission (INEC) strengthen its technological infrastructure, improve voter registration and authentication, and establish adequate security measures and legal frameworks to support the effective implementation of electronic voting in Nigeria.

1.0 Introduction

An automated voting system, also known as electronic voting (e-voting), involves the use of electronic technology to facilitate the casting and counting of votes. Depending on its implementation, it may use standalone electronic voting machines (EVMs), computers connected to the Internet, or online voting platforms. The technology includes punched-card systems, optical-scan voting systems, direct-recording electronic (DRE) machines, electronic ballot kiosks, and the transmission of votes through telephone networks, private computer networks, or the Internet. E-voting can accelerate vote counting, reduce the cost of manual counting, minimize human errors, and improve accessibility for voters with disabilities.

Electronic voting systems have been used since the 1960s, when punched-card technology was introduced. The United States adopted this method in several states during the 1964 presidential election. Subsequently, optical-scan systems were developed to allow computers to count

voters' marks on ballot papers. DRE machines, which record and count votes electronically, are widely used in countries such as Brazil and India. Internet voting has also been adopted for certain government elections, referendums, municipal elections, and party primaries in countries including Estonia, Switzerland, Canada, the United States, and France. Some systems combine electronic ballot marking with printed paper records to support verification and auditing. Despite these global developments, Nigeria still relies largely on manual voting procedures involving polling stations, ballot boxes, and paper ballot papers. Although electronic technology is used for activities such as voter registration and candidate authentication, the manual casting, reconciliation, and counting of votes remain time-consuming and may contribute to delays and electoral irregularities. Therefore, Nigeria needs to advance its electoral modernization efforts by adopting suitable electronic voting methods to improve the speed, efficiency, transparency, and credibility of elections.

As part of this modernization process, the Independent National Electoral Commission (INEC) also needed to identify and geographically locate approximately 120,000 polling locations across the country. The locations and their associated information were to be linked to the Electronic Voter Register (EVR). This would support better electoral planning, management, and coordination. Overall, adopting an effective automated voting system could help modernize Nigeria's electoral process and promote more efficient and reliable elections.

1.1 Motivation

This project arises from the need to address the challenges and limitations associated with the existing electoral system in Nigeria through the application of information and communication technology. Elections are essential to democratic governance, as they provide citizens with the opportunity to choose their leaders. However, **the continued reliance on manual voting** procedures, including paper ballot papers, ballot boxes, and manual vote counting, has contributed to delays in announcing election results, administrative difficulties, and concerns about the transparency, accuracy, and credibility of the electoral process. These challenges create the need for a more efficient, reliable, and technology-driven voting system.

Furthermore, this project is the persistent occurrence of electoral irregularities, such as multiple voting, ballot stuffing, ballot snatching, inaccurate vote counting, and other forms of electoral malpractice. Such practices can undermine public confidence in elections and weaken democratic institutions. An automated voting system can help address some of these problems by providing electronic voter authentication, controlled vote casting, and automated vote counting. By ensuring that only eligible registered voters can participate and preventing individuals from voting more than once, the system can improve the integrity of the electoral process. The successful adoption of electronic voting technologies in several countries demonstrates the potential of technology to improve electoral administration. While Nigeria has made progress in using electronic systems for voter registration and other electoral activities, the continued dependence on manual voting and counting highlights the need for further modernization. An automated voting system could reduce the time and human resources required to conduct elections, minimize counting errors, improve operational efficiency, and facilitate faster collation and announcement of results.

This project is also motivated by the need to strengthen electoral planning and management through effective information systems. Managing thousands of polling locations and maintaining accurate voter information require reliable technological support. Integrating electronic voting with appropriate voter registration and authentication mechanisms could enhance the coordination, monitoring, and management of electoral activities.

Therefore, this project seeks to design and implement an automated voting system that can improve the speed, accuracy, efficiency, and transparency of the electoral process in Nigeria. It is expected to provide a technological solution to some of the weaknesses of manual voting

while promoting greater public confidence in elections. Ultimately, the project is motivated by the desire to support credible elections, strengthen democratic governance, and contribute to the modernization of Nigeria's electoral system.

1.2 Contributions of the Paper

This study contributed to knowledge by the improvement and modernization of Nigeria's electoral system through the design and implementation of an automated voting system that addresses some of the limitations associated with the traditional manual voting process. Despite the adoption of information and communication technology in certain electoral activities, challenges such as electoral fraud, multiple voting, inaccurate vote counting, delays in result collation, administrative difficulties, and limited transparency continue to create concerns about the credibility of elections. The proposed system seeks to provide a technology-driven alternative that improves the efficiency, accuracy, and reliability of the voting process.

The first major contribution of this project is the development of an automated platform for voter authentication and vote casting. The system is designed to ensure that only registered and authorized voters can participate in an election. By incorporating voter login and authentication procedures, the system aims to restrict unauthorized access and reduce the possibility of multiple voting. This contribution is important because establishing the eligibility of voters and ensuring that each eligible voter votes only once are essential requirements for a credible electoral process.

Secondly, the project contributes to the automation of vote counting and result collation. In a manual voting system, counting and reconciling ballot papers require considerable time and human effort, and errors may occur during the process. The proposed system automatically records votes and facilitates their electronic collation, thereby reducing dependence on manual counting. This approach is expected to improve the speed of processing election results, minimize arithmetic and recording errors, and support the timely presentation of election outcomes. However, the reliability of the results will depend on proper system testing, security controls, and independent verification.

Thirdly, the project provides a structured electronic process for managing electoral information, including voter records, candidate details, and votes cast. Using appropriate database technology, the system can support the organized storage, retrieval, and processing of electoral data. This contribution can improve the consistency of information management and reduce some of the administrative difficulties associated with handling large volumes of paper-based records. It also provides a foundation for integrating additional electoral management functions in future system improvements.

Another contribution is the potential reduction of human intervention in critical stages of the voting process. By automating selected activities, the system can limit opportunities for certain forms of manipulation and reduce the workload of electoral personnel. Nevertheless, automation alone cannot eliminate electoral malpractice; appropriate access controls, secure data transmission, audit trails, backup mechanisms, and independent monitoring are necessary to protect the system against unauthorized access, data alteration, and other security threats.

Furthermore, this project contributes to the practical application of software engineering principles in solving a real-world electoral problem. Through the adoption of the Structured Systems Analysis and Design Methodology (SSADM), the project demonstrates a systematic approach to identifying system requirements, analyzing existing challenges, designing solutions, and implementing an information system. The use of technologies such as PHP and MySQL also demonstrate how web-based application development and database management can be applied to electoral administration.

Finally, the project provides a foundation for future research and development in electronic voting in Nigeria. Further improvements could include stronger biometric authentication, encrypted vote transmission, independent security audits, voter-verifiable paper records, accessibility features for persons with disabilities, and mechanisms for transparent result verification. These enhancements would be necessary before the system could be considered for deployment in high-stakes public elections.

2.0 Concept of Voting System

In general, voting system is a method through which people of a certain country elect their presidents, governments or other administrative or political officials. This method determines the conditions under which a candidate or a party can participate in the elections and the way votes are counted. (https://www.legit.ng/1161389-types-election-systems-nigeria-countries.html). Most countries, at a point started with ballot paper voting which is a type of voting used to cast vote in an election, and may be a piece of paper or a small ball used in secret voting. Due to some limitations associated with paper-based voting system, most countries have implemented automated voting which have eradicated the problems of
paper-based voting method (wikipedia) In a country's general election, the process of casting votes is one of the most important processes. It needs to be automated with a high level of security criteria such as integrity, confidentiality, availability, reliability and assurance (Neumann, 1993). In addition, it is a process that needs to be executed in the shortest possible time without compromising the integrity of the information. According to Carracedo (2002), in the last few years different governments have experimented with electronic voting and argued that further development is still required. He attributes this to basic factors such as, the technical difficulties to satisfy the security requirements in all the stages of the process as well as, the requirement to guarantee the right to vote for all the citizens. However, he said that the basic problem is the cultural change which implies that the society must trust the new system that not only requires skills to use the system, but the confidence on a technology that is not well-known, and that seems to be more vulnerable to external manipulation than paper voting.

Types of voting systems

i. Paper-based Voting Systems (PVS): record, count, andproduce a tabulation of the vote count from votes that are cast on paper cards or sheets. Some PVSS may allow voters to make selections by means of electronic input devices. Voter selections are, however, not independently recorded, stored or tabulated by such input devices.

ii. Direct-recording Electronic (DRE) voting systems: Record votes by means of a ballot display provided with mechanical or electronic optical components which could be activated by the voter. Such systems record voting data and ballot images in computer memory components. Also, data processing is achieved by the use of computer programs.

iii. Public network DRE voting systems (PNDRE): Make use of electronic ballots and transmit vote data from the polling stations to other locations over a public network. The votes may be transmitted as individual ballots as they are cast, or periodically as batches of ballots, or as one single batch, at the end of voting.

iv. Precinct count voting systems (PCVS): put the ballots in a tabular form at a particular place, say, a polling station. They provide mechanisms that store vote count electronically and transmit the results to a central location over public telecommunication network.

v. Central count voting systems (CCVS): Tabulate ballots from multiple precincts at a central location. Voted ballots are safely stored temporarily at the polling station. These ballots are then transported or transmitted to a central counting location. CCVSS may, in some cases, produce printed reports on the vote count.

The inconspicuousness of a voter's ballot must be preserved, in order to ensure that the voter is safe when voting against a candidate, and also to guarantee that voters have no evidence that proves which particular candidates received their votes. It is believed that the existence of such evidence could allow votes to be bought (Kohno et al., 2004). Secondly, the voting system must be tamper-proof in order to prevent a wide range of attacks, including ballot stuffing by voters and incorrect tallying by insiders (poll officials). Thirdly, it should be user-friendly. This means that it should be easily comprehensible and usable by the entire voting population.

2.1. Evolution of voting techniques

With the development of information technology, nations all over the world are replacing archaic punch cards and mechanical voting systems with electronic voting systems (e-voting) aimed at increasing voter participation and speeding up the release of election results (Kelly, 2003). Cranor (2011) gives an extensive list on references relating to electronic voting (including internet-based voting). Brazil and India are examples of countries that use e-voting for both general and state elections (Mira, 2004; Gadekar et al., 2011). Statistics show that the use of Electronic Voting Mechanisms (EVMS) - an e-voting system in India - has eliminated the occurrence of invalid votes during elections. Prior to their use, the number of invalid votes that were recorded in India was always more than the winning margin between the candidates. Aside from eliminating invalid votes, EVMs ensured that the total number of votes cast was tallied within two to three hours as against thirty to forty hours when the conventional means were used. In considering voting mechanisms, Kitcat (2004) examines the process of setting technical communication standards for e-voting. Awad and Ernst (2011) also analyze various attempts at e-voting and discuss their benefits and vulnerabilities.

St. Albans, UK, in May 2007, implemented a fully electronic election with no paper- based voting allowed. People were to use a number of channels to vote, the Internet, kiosks, Interactive Voice Recognition (IVR) via telephones or mobile phones, and also by post. Within six minutes, the system had counted all the ballots - recording the fastest ever vote count. Furthermore, no invalid vote was recorded, and all attempts to subvert the system by means of worms, viruses and Denial-of-Service proved futile (Kelly, 2003).

Newer and more improved trends in voting are showing that a greater number of developed nations are beginning to choose e-voting systems over manual voting systems due to their convenience and the ease which they offer voters and election officials (Gefen et al., 2005; Awad and Ernst, 2011). It is important to note that even though e-voting systems appear to be the best alternative to paper-based and other mechanical systems, they must be used with caution because experts believe that some of such systems could have challenges ranging from software engineering, auditing pitfalls, to insider threats, thereby undermining their integrity (Rubin, 2002; Lebre et al., 2004).

In his review on electronic voting security criteria, i.e., confidentiality, integrity, availability, reliability and assurance, Neumann (1993) concluded that a lot of such criteria are by nature very difficult to satisfy. Evers (2004) wrote on the US online voting system and the challenges it faces, Pescatore and Baum (2004) clearly pointed out critical security requirements for online voting and Evangelia et al. (2007) discuss e-voting privacy protection.

Despite all the success stories recorded on the use of electronic voting systems, it is believed that further studies must be carried out to improve upon them (Morse, 2002).

2.2. Electronic Voting System

It simply means the use of computer technology in undertaking such activities as Voter Registration Exercises, Voting and Vote Counting. Although the initial cost of developing electronic voting systems would be high, the long run effects would be that election costs would drastically reduce.

Electronic voting systems would make obsolete the need for ballot boxes and papers, because the system would simulate these. This would mean that printing costs would be reduced by a considerable amount. Computerizing the verification process by using the electronic voting systems would help to enforce relevant controls in order to verify whether or not a person has already cast a vote, leaving no need for indelible ink.
Electronic voting systems usually tally results as and when votes are cast. This also means that vote counting, which wastes time when done manually, would be eliminated. At the click of a button, results of an election would be known. In the
event of a run-off, there would be no need to print a different batch of ballot papers or purchase indelible ink. The computerized system would be reset to reflect the Candidates who would contest. A number of electronic voting systems have so far been developed (Joaquim, 2005; Eliasson et al., 2006; Sergei et al., 2011).

Types of Electronic Voting System

i. Paper-based electronic voting system: Sometimes called a document ballot voting system, paper-based voting systems originated as a system where votes are cast and counted by hand, using paper ballots. With the advent of electronic tabulation came systems where paper cards or sheets could be marked by hand, but counted electronically. These systems included punched card voting, mark sense and later digital pen voting systems.

ii. Direct-recording electronic (DRE) voting system: A direct-recording electronic (DRE) voting machine records votes by means of a ballot display provided with mechanical or electro-optical components that can be activated by the voter (typically buttons or a touchscreen); that processes data with computer software; and that records voting data and ballot images in memory components. After the election it produces a tabulation of the voting data stored in a removable memory component and as a printed copy. The system may also provide a means for transmitting individual ballots or vote totals to a central location for consolidating and reporting results from precincts at the central location.

iii. Public network DRE voting system: A public network DRE voting system is an election system that uses electronic ballots and transmits vote data from the polling place to another location over a public network. Vote data may be transmitted as individual ballots are cast, periodically as batches of ballots throughout the Election Day, or as one batch at the close of voting. This includes Internet voting as well as telephone voting. Public network DRE voting system can utilize either precinct count or central count method. The central count method tabulates ballots from multiple precincts at a central location. Internet voting can use remote locations (voting from any Internet capable computer) or can use traditional polling locations with voting booths consisting of Internet connected voting systems.

2.3. Electronic Voting Methods

i. Paper-based voting system: The Paper-based voting system is the classical voting process used in the past in many countries. Votes are registered on paper, punch-cards or mark-sense cards, and the results are generated on paper. It is also known as Manual Vote Collection (McGaley & Gibson, 2003). In some cases, the voter uses an electronic device to register the vote but the votes are not stored or saved in any kind of register or database (Tuesta, 2004). The different kinds of voting system in this category are Paper Ballot, Lever Voting Machines, Punched Card Voting, Mark-sense ballots and some other alternative processes such as vote by mail. A brief explanation of this voting system is given below.
The Paper Ballot system is the classical voting process, first introduced in Australia in 1858 Newkirk, (2004); (Jones, 2001), by the British Colony of South Australia as a way to introduce a secret vote while protecting voters from manipulation or intimidation. This way of voting was called the Australian Ballot and was adopted in Britain under the 1872 ballot act.

(Reynolds and Steenbergen, 2006). The paper ballot has been improved through the years and is still used today. Candidates' names are printed on paper ballots and the voters mark boxes next to the name of their candidate using a writing tool. The paper ballots are collected in ballot boxes and are counted manually by election officials (Fisher, 2001). This voting process has the problem that counting is laborious and subject to human error (IPI, 2001).

ii. Lever Voting Machines: It was first used in New York, United States, in 1892. They consist in rectangular array of levers that may be arranged with candidates from right-to-left and parties from top-to-bottom, or vice versa. Voters pull down the desired lever to make their choice; when the voter exits the private room, the levers return to their original positions and a connected wheel turns one-tenth of a full rotation to count the vote. At the end of the voting process the counters indicate the number of votes that were cast on each lever (Saltman, 1988). There is no paper ballot involved because the lever machines count the votes as they are cast, simply accumulating votes; therefore, there is no possibility to recount (Jones, 2001). The Internet Policy Institute (IPI) states in its Report of the National Workshop on Internet Voting (2001), that this voting method prevents voting for more than one candidate and that some versions produce an audit trail. It is still used in some counties of the United States but lever machines are no longer manufactured (IPI, 2001).

iii. Punched Card Voting was first used for voting purposes in 1964 in the United States. Even though punched cards were developed for data processing in the 1890's, only in the middle 1960s where they are used as a voting tool. This voting method is based on pre-scored cards, which require voters to record their vote by punching holes in the card in a specific location depending on their choice. The cards are counted at a central counting center using a punched card reader attached to a computer system (Jones, 2001). Some systems use hole punch type devices while others provide the voter with pins to punch out the holes. These methods of punching the cards have been subject to incomplete punches resulting in errors reading the cards (IPI, 2001). The system has the benefit that the punched cards can be manually recounted and audited (Fisher, 2001), as is the case for paper ballots. It implies an advantage over the lever voting machines, because the votes are stored for the first time, in a computer or memory storage.

iv. Mark-sense ballots are based on optical mark sensing technology first used in 1955 by the University of Iowa (United States) for educational tests. It consists in a physical paper ballot where the voter marks the selected choice by filling in an oval, a circle or a box with a writing tool. The ballots are read in a machine which uses light as a sensor. Ballots can be counted in a central-count setting with only one high speed counter serving an entire county or with mark-sense readers attached directly to each ballot box (Jones, 2001). The first generation of mark-sense readers allowed only a standardized ink or pencil lead and it was difficult to prevent voters from using their own pens or pencils, which invalidated the vote. Newer versions are based on scanners that can read marks made from almost anything. The problem is that if the ballot paper has a defect or a smudge darker than the paper it can be taken as a vote, which results in an over vote (Jones, 2001). An advantage of this kind of voting method is that it allows manual recounting of the votes, and the votes are stored in a computer memory as in the case of punched cards. The traditional poll site voting or paper-based voting has been enhanced with Alternative Processes or alternative ways to cast the votes (Michael Alvrez et al Dec. 13, 2012). The aim of these alternative voting processes is to increase the voting participation and give access to people with disabilities or those that are unable to attend the election in the polling places.One of the most used alternative processes is the Vote by Mail or Absentee Ballot. In this process the voter receives the ballot by mail before the election and has to return the completed ballot by mail. To be admitted to vote by mail the registered voter has to certify his impediment to getting to the polling place on the Election Day (IPI, 2001).

v. Direct Recording Electronic Voting System (DRE): The Direct Recording Electronic

(DRE) voting system is based on electronic machines that use microprocessor technology to record the vote electronically and process it by software. Therefore, it is the first voting method that uses computers at the front-end of the electoral process, such as a specialized voting machine or a voter-choice entry station in a voting booth, with touch screens, push buttons or a keyboard. The voting machines are connected to a stand-alone Personal Computer (PC) to store the votes in a digital format and to tally the votes electronically. It has the advantage that more than one voter can simultaneously record his or her vote with the entry device and all of the votes are summarized in a single computer (Saltman, 1988). In this voting system there is no need to have a paper ballot involved in the process: once the voter has entered and confirmed his or her vote it is stored in the computer memory and any recount or audit trail should be done electronically, unless a proof of the vote is printed, which the voter can place in a ballot. This alternative will be analyzed later in this study. The DRE was conceived originally with no printed proof of the vote. Direct Recording Electronic machines (DRE) were first introduced in the 1970s as a computerized version of the mechanical lever machine (Saltman, 1988), and are currently used in many countries.

DRE systems may be classified in two main groups depending on where the casting of the votes takes place. These groups are Electronic Ballot Voting and Electronic Kiosk Voting, which are explained below.

2.4. Electronic Ballot Voting

Electronic Ballot Voting refers to the casting of ballots at public sites. The entire process is controlled by election officials, from the authentication of the voter to the storage and transmission or physical movement of the summarized votes to the central centre. It involves ICT systems controlled by election officials. The voting choices are displayed on a computer screen or on a ballot posted on the machine; voters make their choice by touching the screen, using a keyboard or pushing a button (Theodosios 2018; Connolly, 2004). The votes are stored in databases to be tallied at the end of the voting period. These systems can be connected through virtual private networks (VPN) to the central processing center for tabulation of all the results; alternatively, they can be stored digitally at the place where the vote takes place and then sent to the central tabulation center via telephone lines or manually in removable data storage devices. (Saltman, 1988).

In the case of Electronic Kiosk Voting, the terminals are located inconvenient places like shopping centers, post offices, libraries, hospitals, embassies or schools. The whole voting platform remains under the control of supervisors, and the environment can be modified in order to monitor the terminals. Supervisors may include election officials, observers, volunteers and cameras, which address security and privacy to prevent coercion and guarantee the secrecy of the vote (IPI, 2001). The main characteristic of this kind of voting system is that results are not accumulated or counted at the polling place, like in Electronic Ballot Voting, but are instead sent via VPN to the central tabulation center. The votes can also be stored digitally on removable data storage devices to be physically transported to the central location where they are summarized.

2.5 Electronic Distance or Remote Voting System

The Electronic Distance or Remote Voting System is one step behind DRE voting in the sense that the votes are transmitted via the public internet using web servers. In this model the electronic registration, recording and counting of votes is done from different locations at private or public sites such as home, schools, office, libraries, post offices, malls or shopping centers. The results are not accumulated or counted in the polling places but at the tabulation center.

It is an ideal voting system because it allows users to use a more generic technology to cast their votes, such as interactive digital TV, telephone, Short Message Service (SMS) or the internet (Connolly, 2004).

The implementation of Remote Voting Systems was conceived in the United States to enable military personnel or US citizens outside the country to vote from embassies, hospitals, offices or home, given that people can virtually vote from anywhere at any time. The problems with this kind of voting system are the risks associated with the security and integrity of the data, which will be discussed later in this research.

According to Tuesta (2004), the remote voting or network voting system can be attended or unattended. These two different alternatives are briefly defined below

i. Attended Network Voting System

The voter has to move physically to a polling center to cast his or her vote. There, he or she will be authenticated by the administrator and assigned a computer or a terminal to register the vote using a keyboard, touch screen or push buttons. The voting place can be a polling place totally controlled by election officials or a public place, such as the kiosk voting method, also controlled by election officials, observers or cameras, but located in more convenient places such as libraries, shopping centres, post offices, etc. The data is transmitted to the central counting centre by internet or via a public network. (Tuesta, 2004).

ii. Unattended Network Voting System:

The voter is allowed to vote from virtually anywhere, using the internet as a platform to transmit the data.

It is a non-assisted voting system because the voter does not have to displace to a polling center and can use a more generic technology like interactive digital TV, telephone or internet, to cast the vote from any preferred place (Connolly, 2004). This type of voting system is also called Electronic Distance Voting (EDV) and has been used in many countries. Some of the modalities for EDV, as defined below, are Internet Voting, Short Message Service (SMS) Voting, Telephone Voting and Digital Television Voting.

iii. Internet Voting

Internet Voting refers to the use of the internet to register the vote, in any private place such as home, office, school, or any other place where the voter or a third party controls the voting client (IPI, 2003, cited by Connolly, 2004). This is an ideal form of voting which gives voters maximum flexibility for casting their vote. Internet voting has received intense scrutiny because of the risks associated with the security and integrity of the data transmitted versus the flexibility of voting. Internet Voting will be analysed later in this mini-dissertation.

iv. Short Message Service (SMS) Voting

Short Message Service (SMS) Voting is a method that has been used in some countries and allows the voter to register the vote by sending a short text message to the polling station. It is an application that reaches more voters due to the fact that more people have mobile phones than internet, so for governments it is also a way to overcome the digital divide. It allows greater parts of the population to vote without the fear of having to use a computer, which may be a factor for voters who have never used them before (Connolly, 2004).

v. Telephone Voting

Telephone Voting is not widely used; in spite of the advantages, it offers. It is used mostly for disabled people and consists of an interaction with the electronic voting system through a phone call. The voter calls a number and has to authenticate with a secret code to gain access to the

voting system. If he or she is a registered voter, he or she is given access to the system and follows the instructions to cast the vote. The first time this voting system was officially used was in the Liberal Party of the State of Novia Scotia in Canada, where about 7000 members participated in the election of party leaders by telephone (Slaton, 2000, cited by Connolly, 2004).

vi. Digital Television Voting

Digital Television Voting is also an electronic voting system, where the link consists of digital television, allowing users to interact with the system through their television sets. The data is transmitted using telephone technology. It has not been widely used in official elections, but has been employed for TV shows (Connolly, 2004).

2.6. The Techniques in Public Network Direct Recording Electronic Voting System.

The Public Network Direct Recording Electronic voting systems (PNDRE) makes use of electronic ballots and transmit vote data from the polling stations to other locations over a public network. The votes may be transmitted as individual ballots as they are cast, or periodically as batches of ballots, or as one single batch, at the end of voting.

It is an improvement transmitted electronically over a public network to a central server/collation Centre. The votes may be transmitted as individual ballots as they are cast, or periodically as batches of ballots, or as one single batch, at the end of voting. (Mercuri (2002)

The most important components of electronic voting are the electronic voting client or terminal (registers and captures votes (ballots) cast by voters), Electronic Voting Tallying Server (receives the ballots from the voting terminal, processes and collates the votes), and the Voter Information Database (contains the record of all registered voters). The simplest electronic voting design will be a Direct Recording Electronic (DRE) voting system that will embed all these components in a single unit machine. A more technologically advanced system will be the Public Network Direct Recording Electronic (PNDRE) voting system where the voting terminal and the tallying server sit at remote locations to each other. In this system, a medium of transmitting the ballots from the voting terminal to the tallying server becomes needful. The public network serves the purposes of transmitting the electronic ballots from the voting terminal to the server, normal client/server and also, server/server communications. Most of the current public network design implementations are a VSAT connection with Modem provided by an Internet Service Provider (ISP) except for non-supervised electronic voting where voters could cast their votes from any computer with internet connection. (Htet Ne Oo and Aye Moe Aung (2013) and Ofori-Dwumfuo)

2.7 Electronic Voting Machine

Electronic Voting Machine is a basic electronic machine that is used to store the votes in place of ballot papers and boxes which were used in traditional voting system. It is a simple device that is operated smoothly by the polling officers and the voters. It is a single machine with a secured network connection, and nobody can hamper with the programming and change the result. Keeping in mind the unpredictable power supply position in many areas in the country, the machines have been made to run on the simple batteries. EVM has only two main units: Control unit and Ballot unit. The main role of the Control Unit is to store all information and control the working of EVM. The solution which controls the operation of the control unit is written into a micro-chip in a manner which cannot be altered. Once it burns, cannot be read, replicate or modified. The EVM uses effective coding to increase security of data communication from ballot unit to control unit. The recent EVM have also implemented real time clock and date-time facility which authorize them to record the real time and date whenever a key is pushed. When the voting is over and the close button is pushed, the machine

does not receive any information or store any vote. With the pressing of TOTAL button, the control unit displays the total number of votes stored in the machine which can also be transmitted to a central location via a network; the stored votes can also be verified with the manual register of voters.

EVM display screen on control unit displays total number of votes recorded in at a polling station along with candidate-wise votes recorded in the machine when the RESULT' button is pushed by the counting officer in the presence of counting representative at the vote counting Centre. The control unit also exposes any physical damage made, if any, with the associating cable and communicates the same in the display unit. (Wikipedia).

As everybody watched the electoral situation occurred in Florida in 2000, people started wondering; Wouldn't all our problems be solved if they just used E- Voting? People all over the world soon started taking a hard look at their voting material and procedures, and trying to find out how to improve them. There are many strong reasons for moving towards Remote Internet Voting like voter convenience, increase voter confidence and voter turnout. However, there are many serious technical and social issues that make Remote Internet Voting infeasible in the visible future. Therefore, many technologists have suggested that public network direct recording electronic voting, where the voter can vote at the poll-site seems to be the best step forward as it meets all requirements including convenience without compromising with security aspect in electoral process.

The electronic voting machines are intended both to reduce errors and to speed up the counting process. Advantages of Electronic Voting Machine over the conventional ballot paper/ballot box system are:

It removes the possibility of invalid and uncertain votes which, in many cases, are the root causes of dispute and election appeal.

It makes the procedure of counting the votes much faster than the traditional system. It decreases to a great expanse of the quantity of paper used so saving a large number of trees making the process eco-friendly. It minimized the cost of printing almost to zero

2.8. The Application of Telecommunication Industry to E-Voting

The telecommunication industry in Nigeria with more than enough voice channel capacity, very robust internet broadband services and good internet gateway facility can be placed in the class of well-developed telecommunication industries of the world. The country also has a good mix of Global System for Mobile (GSM) communication networks, Code Division Multiple Access (CDMA) networks and Fixed Land Line networks.

According to Nigerian Communications Commission (2013), Nigeria at the moment has a total of four (4) active GSM service providers that include MTN Nigeria Communications, Globacom Limited, Airtel Nigeria and EMTS Limited (Etisalat).

These companies provide the country with telecommunication infrastructure for both voice and data services covering almost the entire landscape of the country.

Nigerian Communication Commission (2014) reports that at the end of December 2013, just about thirteen years after full liberalisation, Nigeria had over 127.6 million active lines with a tele-density of over 91.15 %; while the total number of Base Transceiver stations sites increased from 23,105 in December 2012 to 28,289 in December 2013, a sharp increase of 22.44%

2.9 Related Literature Review

2.9.1 International Status of Electronic Voting

Brazil: Brazil is the largest nation in South America and in Brazil currently all votes are registered by electronic voting machines. The Brazilian Supreme Election Court authorized the use of electronic voting method in the 1996 Brazilian metropolitan elections. In the year 2000,

the Brazilian government had transformed to fully electronic voting and established over 400,000 kiosk-style machines in elections that year. The voting machines feature an integrated screen and keyboard. To vote for a candidate, voters only need to press on the keyboard the number designated for a particular candidate. The candidate's picture then appears on the screen. Voters can confirm, reject, choose another candidate or start the selection process again. The Brazilian electronic voting technology is extraordinary in that the voting machine tallies the votes itself once voting finishes, producing the result both digital and printed details of the number of votes given to each candidate. 12,000 machines used to present a ballot paper that the voter could peruse and submit in a box for recount. These paper-trail machines were successfully used during the election. (free encyclopedia).

India: In India first election using electronic voting was held from April 20 to May10, 2004. The legal approval in the year 1989 to allow the use of Electronic Voting Machines, they have been used in many state level elections but were never used for an entire general election before this. Electronic Voting Machines were prepared by Electronics Corporation of India and Bharat Electronics. The Electronic Voting Machine has mainly two units, one for control by the polling officers and the other for the uses of voters to cast their vote. The ballot unit requires voters to press the button next to the candidate's name and symbol and the control unit registered the vote. A light next to the button glow and a short beep sound follows indicate the vote has been registered. The polling personal then take necessary step to enable the next voter to cast their vote. The Electronic Voting Machine comes in a reusable carry pack and can operate on a battery power source in remote areas. According to Election authorities, each EVM can record five votes' minute or nearly 3,000 votes in a polling day. (free encyclopedia)
Belgium: In Belgium Electronic voting was approved by law in 1994, and widelyused in the 1999 and 2000 general and municipal elections. In the general elections of May 18, 2003, 3.2 million Belgian citizens were able to vote electronically. Belgium's apply similar approach as Ireland's in that it does not modify the voting process, but rather replaces the ballot paper with a machine at the polling station and then uses an electronic counting system to tally the results. In 2003, an audit report released by the Federal Public Service of the Interior approved the systems after a simulation based on around 1 million votes. Some difficulties were recorded during the 2003 voting (May 18) in the Belgium elections where electronic polling booths were in use for the general elections, which renewed both federal assemblies of the country.
Delays occurred in voting operations in some localities causing some polling stations to have to remain open well after the official closure time of 3 p.m. Voters therefore had to wait for a long time to cast their vote in some areas. Most did wait, due to Belgium's compulsory voting system and fines for failing to do so, but it was reported that an estimated 10% of voters abstained from the ballot in certain areas (free encyclopedia)

Australia: In Australia EVM started in a close election in 1998. The AustralianCapital Territory (ACT) is one of eight states and territories in Australia. Members of the ACT parliamentary Assembly are elected using a corresponding presentation electoral system known as the Hare-Clark system. Hare-Clark is a variant of the single transfer vote system used in Ireland. Selector vote by success preferences for separate applicant. To be elected, an applicant needs to collect a quota of votes. Each voter has a single vote, which can be transferred from one candidate to another candidate on the basis to the preferences shown until all the vacancies are filled. In the ACT, the Hare-Clark system is used to elect 17 candidates from 3 multi-member electorates. The electorates of Brindabella and Ginninderra each select 5 candidates, and the electorate of Molonglo select 7 candidates. A close election in 1998 in the ACT found numerous problems in the state's hand-counting system, when two candidates

were separated by only three or four votes. After recounting, officials discovered that out of 80,000 ballots, they had made about 100 mistakes.
Ultimately, the ACT Electoral Commission adopted a new system known as eVACS or Electronic Voting and Counting System.
The system was created (by a company called Software Improvements) to run on Linux, which is a widely used, freely available open-source operating system. (Free encyclopedia)

Argentina: Argentina started an electronic voting system in the year 2003.
This system is basically based on the machines which are already used in country Brazil. The electronic voting machines (EVMs) parallel ATMs. At the time of voting each voters presents identity proof at the polling booth and the registrar enters the voter's identity number at a keyboard with a display. If it appears OK on the display, then the voters is authorized to vote and goes behind a place where the Electronic Voting Machine is located.
The screen of the Electronic Voting Machine shows the first office that the voter will vote for all the active parties that introduced candidates, each paired with a number. The voter chooses his or her preference by punching a key with the number of the selected party. The screen shows the name and photo of the selected candidate. To authenticate the selection, the voter punches a green key. If the voter wants to change the preference, he or she punches a red key. Once the preference has been made, the voter pushes a white key and then the green key to authenticate. The system also allows voters to cast "blank" votes, which in Argentina are counted in order to calculate the percentage of votes obtained by each party. After completing a vote for a particular office, another screen appears with the following office to choose and continues until the ballot is completed. At this point the Electronic Voting Machine disables, preventing a second vote. (Free encyclopedia)

United Kingdom: United Kingdom started EVM in May 2002, tested various technological improvements to voting or vote counting such as touch- screen voting machines while others tested techniques for voting remotely. Some jurisdictions allowed voters to cast their ballots using electronic methods such as interactive voice response (IVR) technology, PC-based systems and handheld mobile devices via short message service (SMS). Some of these jurisdictions allowed voters to cast ballots from PCs or kiosks in public places such as shopping centres. In the Electoral Commission's report to reviewing the e-voting trials it is found that the hardware and software performed successfully and without any significant problems. It also identified no evidence of fraud during the polls, although it did express concerns about potential security and privacy violations. (free encyclopedia)

Costa Rica: The EVM system was tried out in elections for mayors, district councillors, municipal district councils and aldermen on December 1, 2002. Electors who choose to vote electronically are given a blank receipt signed on the back by the members of the panel presiding over the polling station.
The electors' choice at each election is indicated on this receipt either by the electors themselves or with the aid of an assistant using a printer provided for that purpose. The chairperson of the Receiving Board activates the system so that each elector can vote. Electors are then presented with a monitor screen showing a ballot paper with the list of parties.
Electors vote for the number of the party of their choice, they are then shown the ballot paper for district councillors, and must follow the same procedure. When each elector has finished voting, he or she must take the receipt and fold it so that the signatures of the members of the panel are visible, then drop it into the relevant ballot box. Once the paper is in the box, the elector's ID card is returned and he/she must leave the polling station. (free encyclopedia)

Spain: Spain has experimented with various forms of electronic voting. In the March 14, 2004 general elections, numerous small-scale, non-legally binding electronic voting trials were successfully conducted. These included diverse technologies in addition to strictly Irish-style electronic voting systems such as Internet and SMS remote voting.
On November 16, 2003, three e-voting pilot tests were successfully conducted during the elections to the Parliament of Catalonia. This included remote voting via the Internet for eligible voters living abroad, and touch-screen voting coupled with an electronic counting system.

3.0. Materials and Method

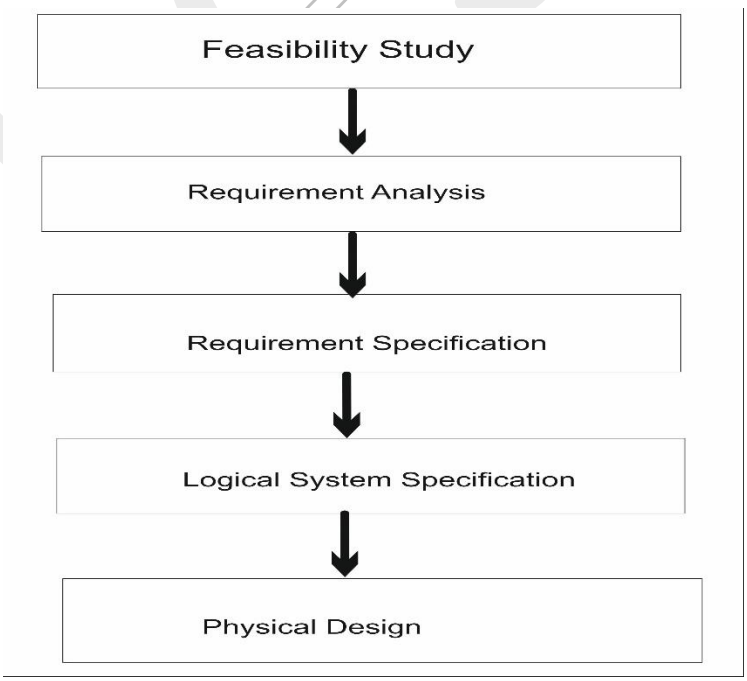
The method of data gathering for this study was through observation, questionnaire and oral interview. This was carried out by the researcher and Voters Registry department staff of Independent National Electoral Commission. Some live processes were also observed by the researcher on the field during elections with the aim to identify all the challenges and technologies used by INEC from inception to 2017. Respondents in the oral interview were randomly selected through random stratified sampling techniques and since the result is descriptive research the gathered information was studied and analysed.

3.1. Methodology

The methodology used was SSADM. The Structured Systems Analysis and Design Method (SSADM) is an approach to designing and analyzing information systems. This method uses logical data modeling, entity event modeling and data flow modeling in a 5-step process to determine how a system must be created or updated. It is a prescriptive methodology that combines many techniques and integrates them into a system development life cycle.
SSADM consists of three main components:

i. The default structure or framework of an SSADM project

The SSADM default structural model is based on a series of modules that begin with a feasibility study and end with the physical design. The modules are as shown in the figure below:



a. **Feasibility study**- here the scope of the proposed project is defined using some of the SSADM' core techniques to produce a high- level overview of processing data. Several options for taking the project forward to a full SSADM study are looked at and a single option is selected by balancing the benefits against cost. A decision to abandon the project might be taken if the project is found not to be feasible.

b. **Requirements analysis**- here a full analysis of requirements is done by modeling the current system with a view to drawing out existing problems and new requirements. Analyzing the current system helps us understand the functionality required of the new system, it increases users' confidence in the project developers ability to understand the requirements of the new system, it increases the chances of identifying a complete set of requirements, it provides an effective way for analyst to become familiar with the business area under investigation and the project scope and complexity can be deduced quite effectively from those of the current system. Through analyzing the current system, the analyst is able to come up with a comprehensive statement of user requirements which are examined and several options are developed for solving the business problem.

c. **Requirements specification**- this is where the user requirements are transformed and redefined into detailed and precise specification of what the system is required to do.

d. **Logical system specification**- here the development of the logical design is continued and the technical environment where the system will finally reside is chosen. Specification resulting from requirement specification provides us with enough information to propose alternative technical environments on which to implement our system design. The logical nature of the design means that it should reflect underlying business rules and activities rather than physical constraints.

Physical design- here the logical design is translated into the physical design based on the selected technical environment.
SSADM is a very structured method of creating information systems. It exercises control over every aspect of the creation process, well documented, thorough roadmap/guidelines i.e. it's hard to go off-track. A high-quality system is delivered at the end of the project and it suits hierarchical organizations like government bodies.

3.2. Investigation and analysis of the existing system

The recent election held in 2015 marked a new era in the deployment of sophisticated Information Communication technologies in the history of Nigeria elections in addition to existing technologies. Improved Automated Fingerprints Identification System (AFIS) was introduced to identify similar fingerprints on the register used for 2011 election.
A business rule technique was adopted and applied in addition to further clean the register of duplicated fingerprints. The business rule required that at least two fingers must be captured for a voter to be included in the register. For the first time, INEC adopted technology for accreditation of voters with the aid of INEC Voters Identification System (IVAS) popularly called the Smart Card Reader (SCR). Temporary Voters' Cards (TVCs) which were issued to voters for 2011 election were replaced with the Permanent Voter Cards (PVCs). The PVC replaced the Temporary Voter Card (TVC). According to INEC, quality, security; durability and cost effectiveness were underlying factors in the production of the Permanent Voter Cards by INEC. These cards have many components and specialized features (e.g. base substrate, security printing, personalization, lamination and chip embedding), and it was designed with an average life span of ten (10) years. With the SCRS, accreditation process was broken down

into three: Identification, Verification and Authentication. Identification physical comparison of the face of the card holder with the image displayed on the SCR when the PVC is read; Verification (that the card is original)- being able to read the information on the chip of the PVC presented;

Authentication-comparison of the fingerprint stored on the card with what was physically presented and scanned by the reader. Once PVC has been read and accredited by the SCR, the Voter Identification Number (VIN) is stored in the reader and it does not allow the accreditation of that VIN on that particular reader any longer.

After the accreditation, the voter takes the following steps:

Step 1: Join the queue with the intention of casting your vote

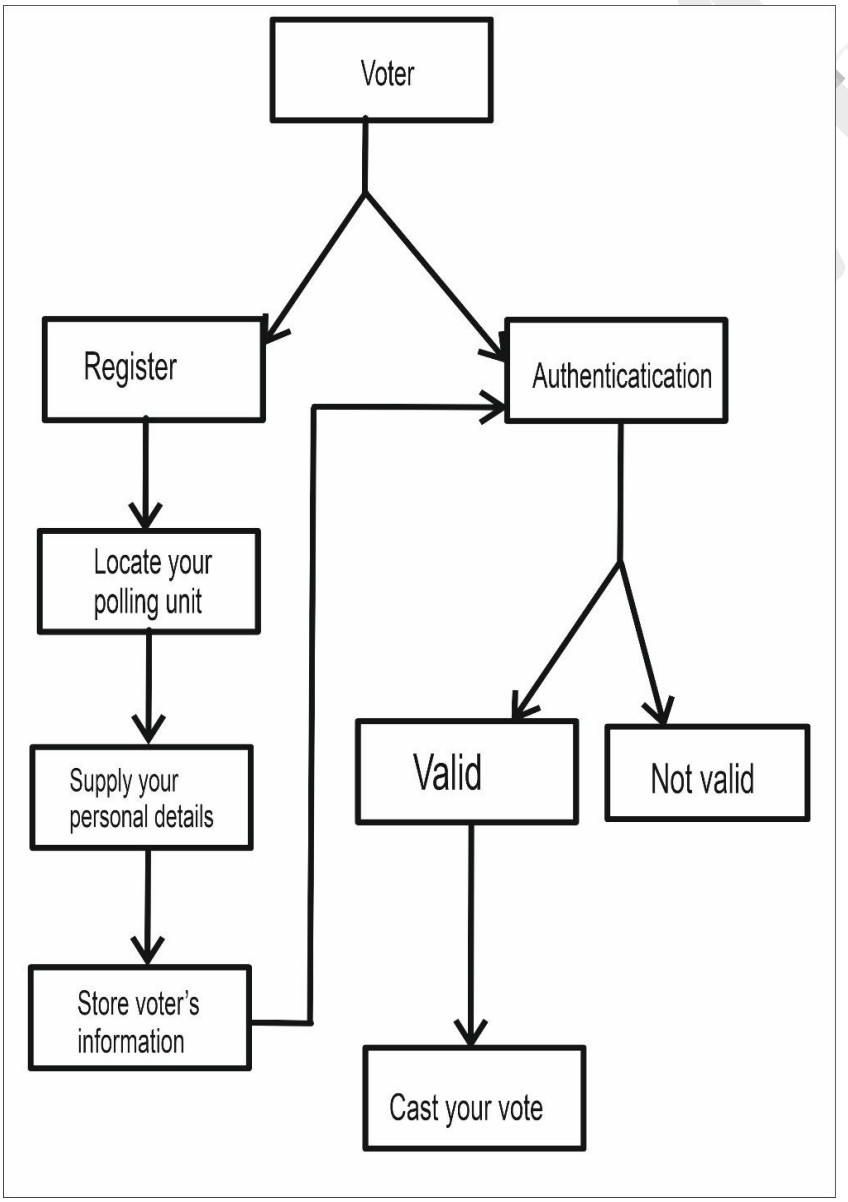
Step 2: When it gets to your turn, ensure your name is ticked in the voter register

Step 3: You would be given a ballot paper listing out the political parties

Step 4: Enter the booth and select your preferred candidate

Step 5: Place your ballot paper in the ballot box

Data Flow of the existing System



Strength of the Present System

- It is faster to create
- It is more accurate than previous manual method;
- Register can be updated on continual basis;
- Direct Data Capture Machines (DDCM) was introduced to eliminate double registration, double voting and other electoral malpractices.
- Business rule is applied in the machine in addition to further clean the register for duplicate fingerprint.

Weaknesses of the old System

The following are the weaknesses of the present system:

- No computer related application technology was used for voting
- Ballot papers used for voting were conveyed to collation centres manually after voting
- Sorting and counting of the ballot papers were done manually
- Ballot papers used were hijacked and manipulated because of the method of transmission

3.3 Analysis of the Proposed System

The Voters authenticating machine called Smart Card Reader (SCR) is the basis for determining who is eligible to vote and who is not on Election Day. The proposed system is designed to make use of some technologies of the existing system such as Optical Magnetic Recognition (OMR), INEC Voters Identification System (IVAS) popularly called the Smart Card Reader (SCR) to authenticate all prospective voters (also known as Prospective Registrants) who present themselves physically for registration at the Registration Centers. Automated Finger Prints Identification System (AFIS) will be used to clean the register of double registrations. The INEC Voters Identification System (IVAS) popularly called the Smart Card Reader (SCR) will be given to a voter who has been authenticated to vote electronically by inserting the permanent voter's card and thumbprint. The voter's card must be reprogrammed to include a chip where individual voter's information will be stored and read when the card is inserted. When the voter thumbprints and the information of the voter matched with the information recorded, the machine will allow the valid voter to continue to view ongoing elections, selects party choice and confirms vote, immediately the vote is transmitted via a public network to INEC collation office.

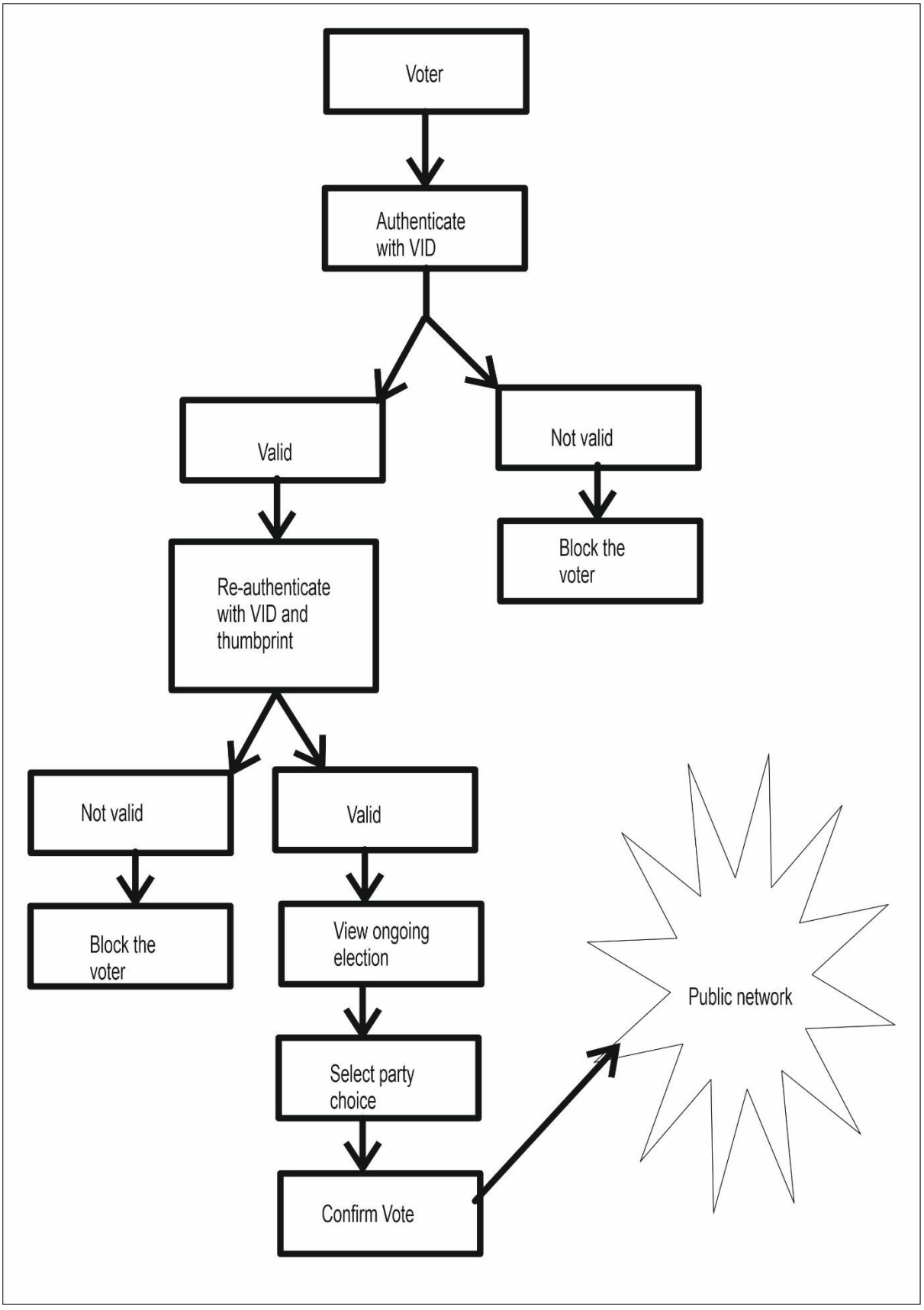
Very Small Aperture Terminal (V-SAT) will be installed in all the 774 INEC local government offices and state headquarter offices to enable the smooth transmission of election results from various local government areas

3.4 Objectives of the new Solution

Due to the limitations of the existing system such as voting, sorting, counting and collation of results which are still done manually. The proposed system will have the following objectives:

a) Authenticate the voter's ID and display valid or not valid
b) Re-authenticate the valid voter with thumbprint using the SCR
c) Disallow "Not Valid" to continue
d) Allow the valid voter to view all ongoing election
e) Allow the voter to select his/her party choice and confirm vote cast
f) Allow the vote cast to be transmitted via the installed public network

3.5. Decomposition and Cohesion of the high-level Model



3.6. Specification and Design

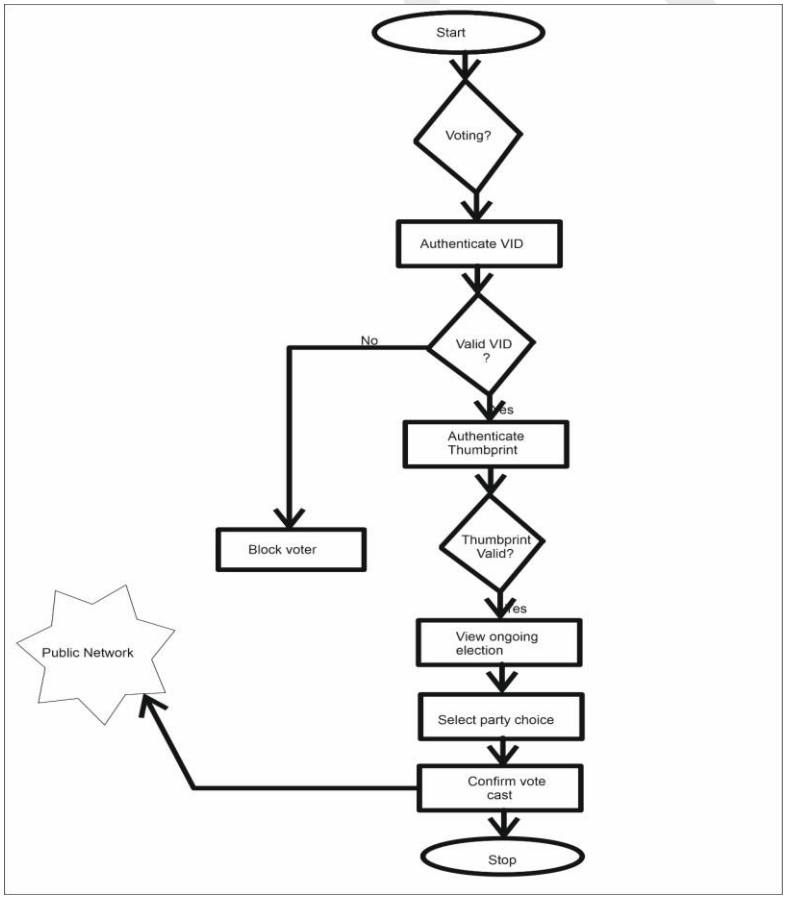
When any voter is authenticated with his/her voter's ID for voting process, the system verifies if the voter's ID is valid or invalid. If the voter's ID is valid then the voter will proceed to another step of re-authenticating with the ID by thumbprint.

If valid, the voter will be allowed to view ongoing elections and to select his/her party choice and confirm vote cast, otherwise, the voter will be blocked from continuing to vote.

Algorithm for the new System

STEP 1: Insert PVC into the Smart Card Reader (SCR)
STEP 2: The card reader reads the details of the PVC
STEP 3: The voter thumbprints on the card reader for authentication
STEP 4: The voter's thumbprint is matched with the details of the PVC which was read in STEP 2 above
STEP 5: If the thumbprint does not match, disallow the voter to participate: ELSE display ongoing elections for voter to choose election, such as {Presidential or Senatorial}
STEP 6: Voter selects election type to continue e.g. {Presidential or Senatorial}
STEP 7: The voter selects party of choice
STEP 8: The voter confirms choice of vote
STEP 9: Vote is transmitted to online server at the collation office via a secured wireless
10: Repeat STEP 6- STEP 9 above for all other ongoing election
STEP 11: Eject PVC to logout.

3.7. System Flowchart



3.8. Overview Description of the new System

The public network electronic voting is programmed to do the following:

a) Authenticate the voter's ID (VID) with The INEC Voters Identification System (IVAS) popularly called the Smart Card Reader (SCR)
b) Determine if the voter is qualified or valid to vote or not valid
c) Allow the valid voter to re-authenticate with thumbprint to verify if the displayed information matches with the one above
d) Block invalid voters to continue but allow re-authentication of VID
e) Allow the valid voter to view ongoing election and select the party choice
f) Allow the voter to confirm vote cast

This new system is designed to strengthen the parts of the existing system that are weak such as the method of casting vote (i.e. Ballot paper) and the transmission method which is physically conveying of votes to collation centre.

4.0. Results and Discussion

4.1 New System Requirements

The new system is designed to provide a single login interface which can provide as many activities as possible. The system is categorized into two sections: authentication and the voting section.The authentication section is where the registered voters are verified to know if the voter is valid or not valid to vote. The voting section is where the authenticated valid voter is allowed to view all ongoing elections, select his/her part choice and candidate and cast his/her vote.

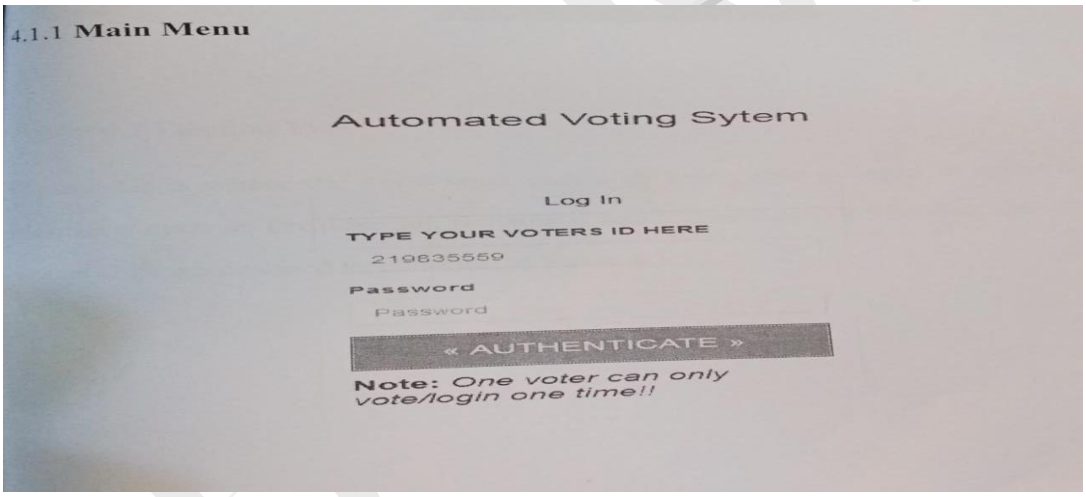
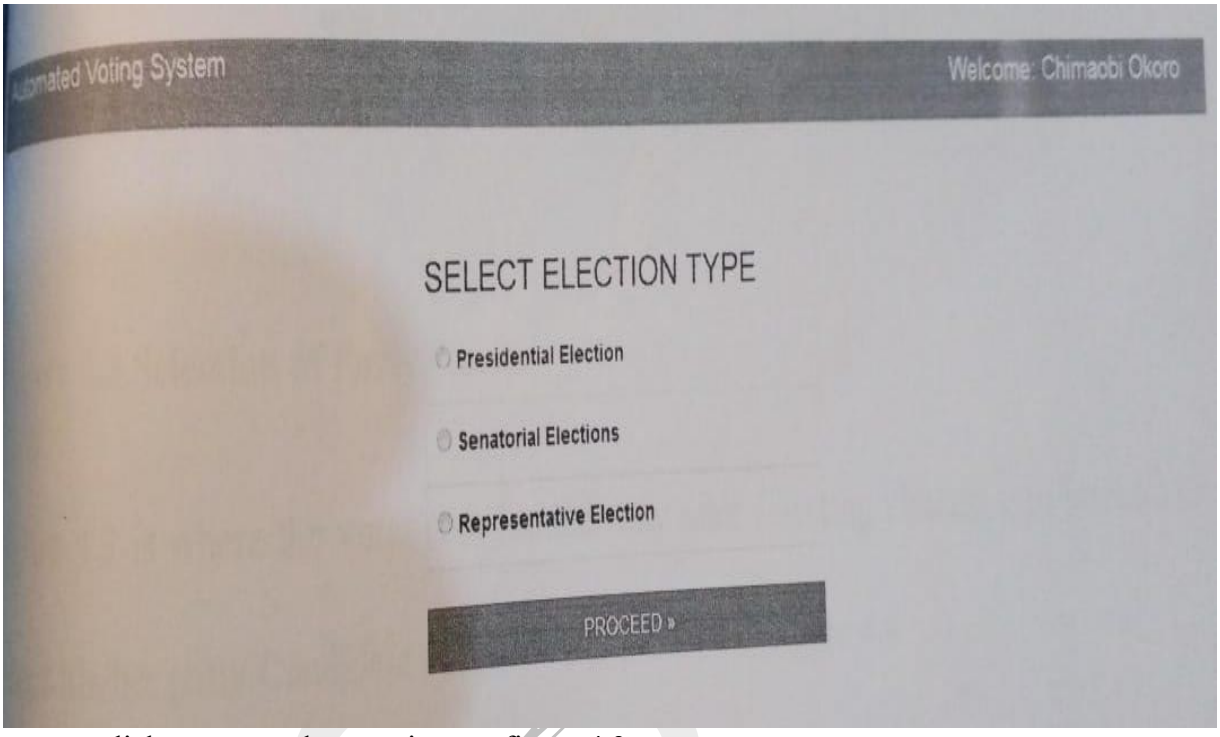


Figure 4.1 Voters Login/authentication page

The authentication page is where the voters enter their login details created during the time of voters' registration. If the login details are correct, the voter will be allowed to proceed to figure 4.2

Figure 4.2 Election Type

Figure 4.2 is where the valid voter sees after being able to login to select the ongoing elections such as Presidential, Senatorial and Representative Election. On selection, the



voter click on proceed to continue to figure 4.3

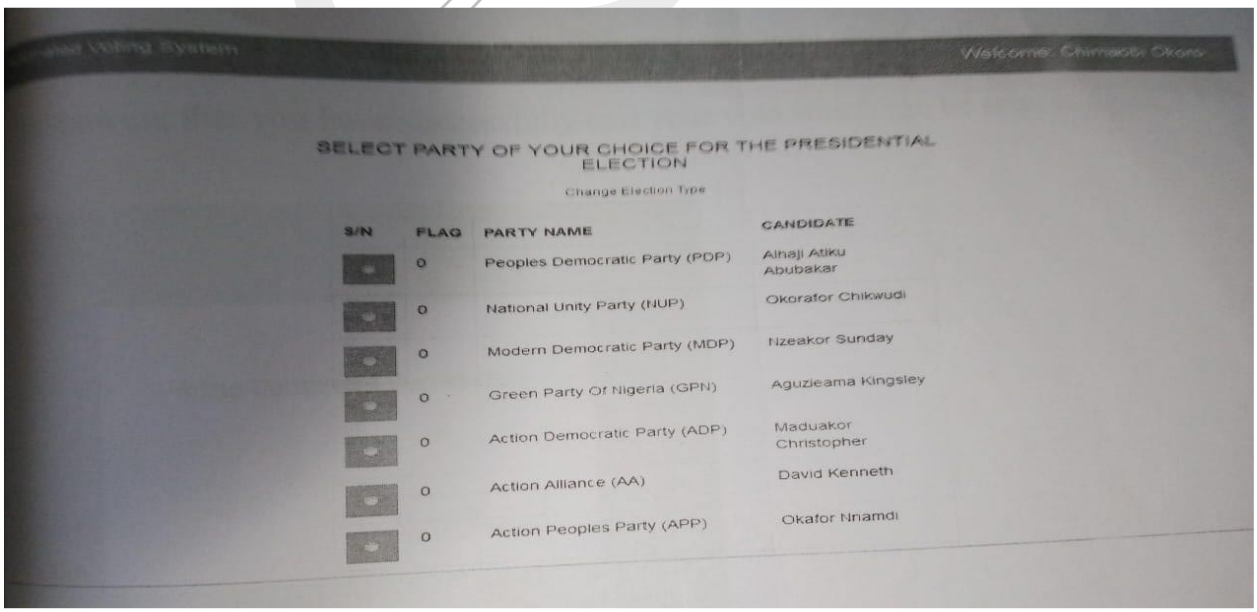
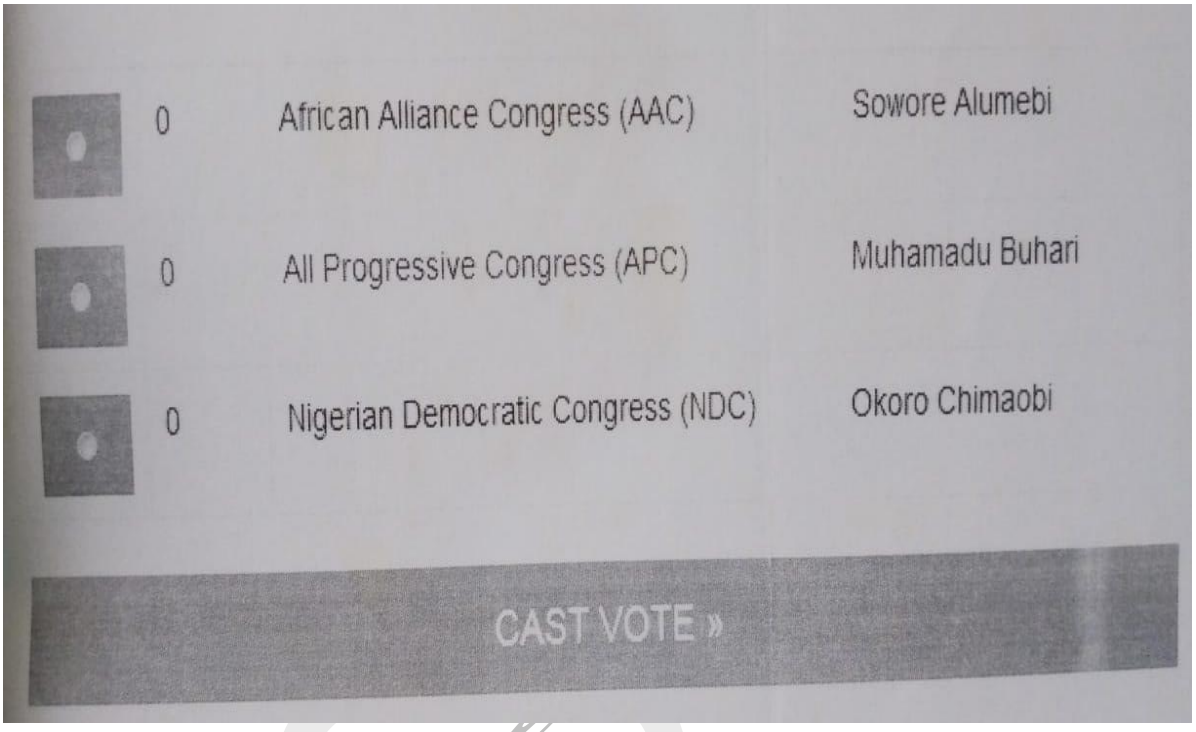


Figure 4.3 Selection of party choice

Figure 4.3 is where the voter sees immediately after selecting election type in order to select his/her party candidate of choice and proceed to figure 4.4

Figure 4.4 Cast vote

Figure 4.4 has party/candidate selection page and the button for casting vote after selecting the party/candidate of choice.



Immediately after party/candidate selection and cast vote, there will be a confirmation page showing that you have successfully cast your vote which can be seen in figure 4.5

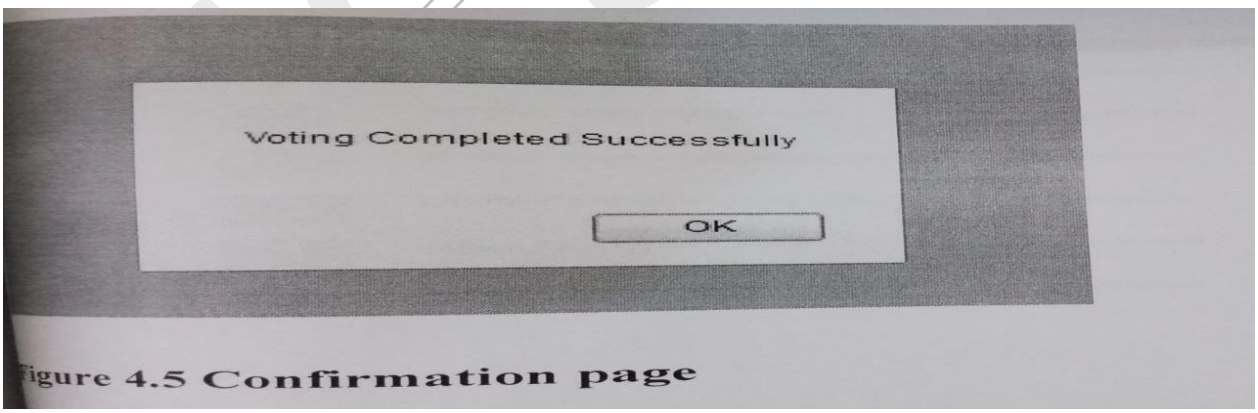
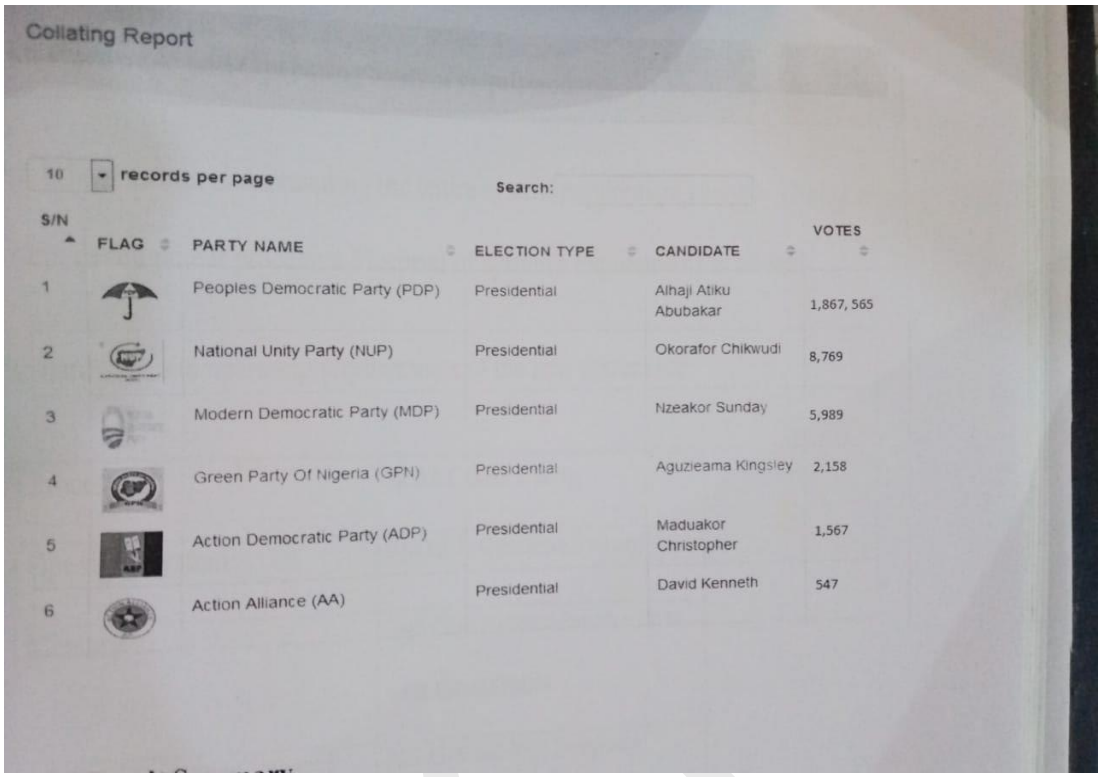


Figure 4.5 Confirmation page

Figure 4.5 Result Summary

The result summary is the automated summary of all the votes cast by the voters sorted in ascending order. From the result summary, it can be seen that Alhaji Atiku Abubaka of People



Democratic Party PDP is the winner of the just concluded presidential election, Nzeakor Sunday of Modern Democratic Party MDP emerged second in the presidential election, Aguzieama Kingsley,Maduakor Christopher emerged third position, David Kenneth emerged fourth.

4.1.2 Hardware and Operating System requirements

This brings us into understanding the entire system requirement analysis. During a system development process, a blueprint of system's requirements is created.

The hardware and operating requirements of the new system are:

Processor	M.O.S.T. Card® C Series
Operating system	M.O.S.T. Operating System
Memory	High Capacity User Memory – Up to 144k Bytes EEPROM
Advanced Encryption Standard	AES 2576 and 3DES Encryption
Mutual Authentication & eSignatures	SHA-256 HMAC for Mutual Authentication
Internet Protocol	Protocol: T=0

4.1.3 Software requirements

ACS Reader Monitor Program: This program can be used to silently monitor ACS PC/SC smart card readers used in a system and to automatically connect to the smart cards when they are inserted into the reader.

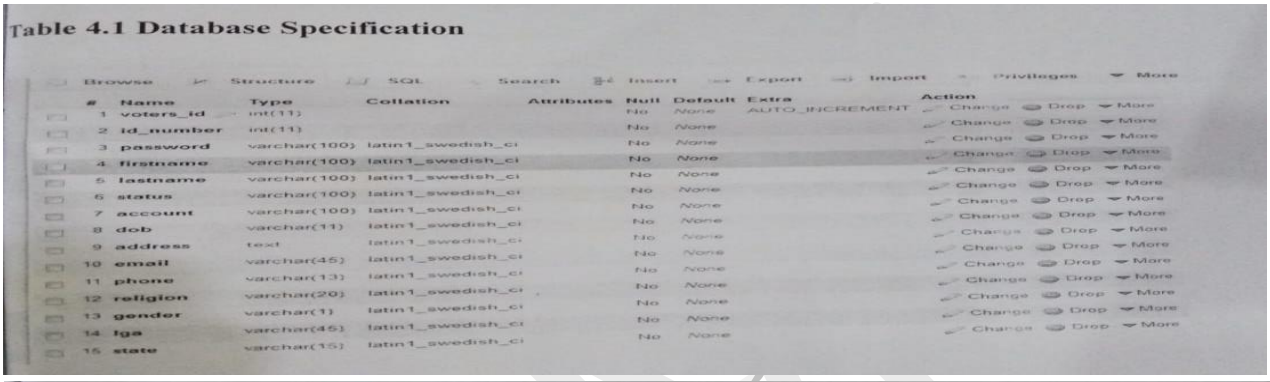
OS Support: Win 2000, Win XP, Win Vista, Win 7, Win 8, Win 8.1, Win 10, Win Server 2003, Server 2003 R2, Win Server 2008.

4.2 Database Specification

The database system used for the design of this project consists of several tables with columns and rows integrated to give a meaningful design for the different users of the proposed system. MYSQL was used to design the database of this project. MYSQL is an Oracle-backed open source relational database management system (RDBMS) based on Structured Query Language (SQL) that virtually runs on all platforms, used to create desktop applications, enterprise and web-based applications.

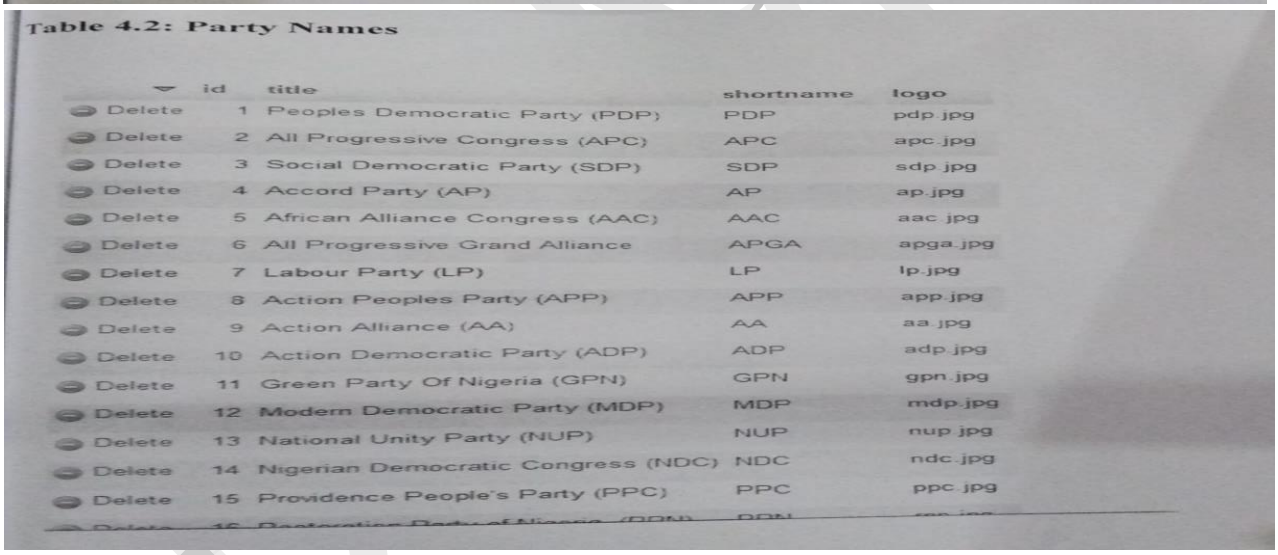
The basic structure of the tables composing the database for this system is shown below:

Table 4.1 Database Specification



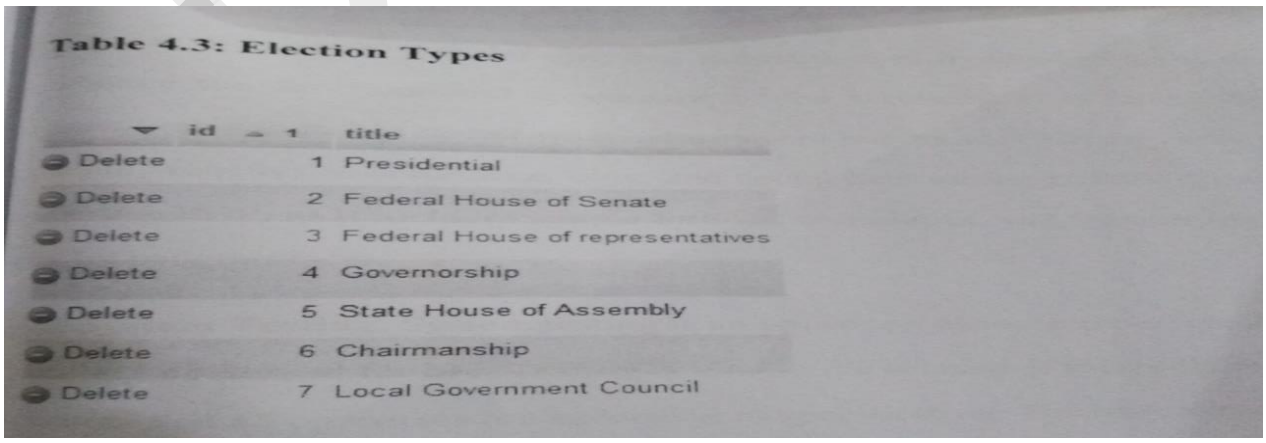
#	Name	Type	Collation	Attributes	Null	Default	Extra	Action
1	voters_id	int(11)			No	None	AUTO_INCREMENT	Change Drop More
2	id_number	int(11)			No	None		Change Drop More
3	password	varchar(100)	latin1_swedish_ci		No	None		Change Drop More
4	firstname	varchar(100)	latin1_swedish_ci		No	None		Change Drop More
5	lastname	varchar(100)	latin1_swedish_ci		No	None		Change Drop More
6	status	varchar(100)	latin1_swedish_ci		No	None		Change Drop More
7	account	varchar(100)	latin1_swedish_ci		No	None		Change Drop More
8	dob	varchar(11)	latin1_swedish_ci		No	None		Change Drop More
9	address	text	latin1_swedish_ci		No	None		Change Drop More
10	email	varchar(45)	latin1_swedish_ci		No	None		Change Drop More
11	phone	varchar(13)	latin1_swedish_ci		No	None		Change Drop More
12	religion	varchar(20)	latin1_swedish_ci		No	None		Change Drop More
13	gender	varchar(1)	latin1_swedish_ci		No	None		Change Drop More
14	lga	varchar(45)	latin1_swedish_ci		No	None		Change Drop More
15	state	varchar(15)	latin1_swedish_ci		No	None		Change Drop More

Table 4.2: Party Names



	id	title	shortname	logo
Delete	1	Peoples Democratic Party (PDP)	PDP	pdp.jpg
Delete	2	All Progressive Congress (APC)	APC	apc.jpg
Delete	3	Social Democratic Party (SDP)	SDP	sdp.jpg
Delete	4	Accord Party (AP)	AP	ap.jpg
Delete	5	African Alliance Congress (AAC)	AAC	aac.jpg
Delete	6	All Progressive Grand Alliance	APGA	apga.jpg
Delete	7	Labour Party (LP)	LP	lp.jpg
Delete	8	Action Peoples Party (APP)	APP	app.jpg
Delete	9	Action Alliance (AA)	AA	aa.jpg
Delete	10	Action Democratic Party (ADP)	ADP	adp.jpg
Delete	11	Green Party Of Nigeria (GPN)	GPN	gpn.jpg
Delete	12	Modern Democratic Party (MDP)	MDP	mdp.jpg
Delete	13	National Unity Party (NUP)	NUP	nup.jpg
Delete	14	Nigerian Democratic Congress (NDC)	NDC	ndc.jpg
Delete	15	Providence People's Party (PPC)	PPC	ppc.jpg

Table 4.3: Election Types



	id	title
Delete	1	Presidential
Delete	2	Federal House of Senate
Delete	3	Federal House of representatives
Delete	4	Governorship
Delete	5	State House of Assembly
Delete	6	Chairmanship
Delete	7	Local Government Council

Choice of Programming Environment

➢ Test Editor. Example Notepad ++

➢ Compiler. Example PHP Programming Language

➢ Interpreter. Xampp Server

4.2.2 Language Justification

PHP is considered to be a foremost and a highly accepted website development technology. Therefore, PHP web development is highly in demand, and also it is the developer's first choice.

PHP is now a famous server-side scripting language that runs on a web server; it is just because PHP as a web development option is secure, fast and reliable and offers numerous advantages. It is a very popular scripting language used by most of the website developers to enhance the functions and appearance of the websites. It is mainly known to create dynamic web pages. No matter what industry you belong to, PHP can serve you for making corporate websites, e-commerce, blog, and social networking portals. Moreover, it is quite easy to use PHP, as it includes simple formats, techniques, and features that can be grasped easily by programmers.

System Testing

The system testing is an important phase without which the system cannot be released for use. Testing is vital to the success of this program. System testing ensures that all processes are according to specification. The logical and physical design is continuously examined to ensure that test data are verified for correctness and accuracy. During testing, two kinds of errors are likely to occur; they are Syntax errors and Logical errors. Syntax errors occur when a program statement violates one or more rules of the language in which the program is written, these errors have to be corrected before the program is finally executed. The compilation of the program does not show any error if syntax errors are corrected. But when the program is run, and the desired output does not appear this is due to logical errors. These errors occur due to incorrect handling of data, improper sequence of program statement, etc. These errors can be corrected by tracing the program, asking the program to display the number of message statements. Different modules would be tested individually and are made error free.

Test Plan

In the programming, backend was created for the administrator who can be INEC registration officer who be responsible to be creating and registering voters in the system.

Here, I created users in form of voters who can login to cast their votes and their vote will be transmitted to another location which can serve as INEC collation office. In the plan, a laptop computer will be used in form of smart card reader and a login details will be created for the users to view ongoing elections, select the election type and the party of choice and confirm vote and logout.

This plan will be demonstrated to the supervisor and the project supervisors to see how the written program of automated voting system will work.

Test Data

The data/program was tested by using friends that I registered in the database and friends that does not have account in the database.

On the user login page, the users that have account in the database were able to login, select ongoing election and cast their vote and their votes being transmitted to another system sharing the same network while the users that does not have account in the database were not able to login while the system reported "Not Registered"

The test data/program showed that the database is well secured against intruders and hackers from manipulating the stored data. It showed that the users that already have an account were able to login and cast their vote, while the users that do not have account in the database were not able to login and cast their votes.

Actual Results versus Expected Test Result

After the programming, the following are the actual result which is also the expected result
- The registered voters will be able to login
- The registered voters will be able to view all the ongoing elections
- The registered voters will be able to select party choice and cast vote
- The registered voters will be able to confirm votes and submit
- The voted users will be denied from voting again
- Unregistered voters will be denied by the system from login
- Votes submitted must be transmitted electronically to the collation Centre
- Collation centres must be able to receive all submitted votes

Performance Evaluation

DOMAIN – Automated Voting
PLATFORM – Microsoft Visual Studio and Microsoft SQL server management studio.
PROGRAMMING LANGUAGES – PHP programming language, SQL and http://ASP.net.
OS PLATFORM – (.NET Framework 4) Microsoft Windows 7.

Limitation of the new system

The new system will not be able to allow finger print machine to be added and used but can allow Smart Card readers to be added and used for reading voters details contained in the voter's card. However, this smart card reader will not be available during testing.

System Conversion

The System Conversion Approach that is well suitable for this design will be a Parallel conversion approach. In this approach, both the old and the new system will be allowed to operate simultaneously for some time. The outputs from both the systems are compared and difference is reconciled. The advantage of this conversion is that it gives a high degree of protection to the organization from the failure in the new system and has gained a wide spread popularity.
In parallel conversion a target data should be set to indicate when this conversion can be withdrawn and the new system will operate on its own.

Changeover Procedures

The changeover procedure that is well suitable for this design will be Parallel Changeover.
In a parallel changeover, the new system runs simultaneously with the old for a given period of time. Of all the procedures, this tends to be the most popular, mainly because it carries the lowest risk. If something goes wrong at any point, the entire system can be reverted back to its original state. A primary disadvantage in running two systems at the same time is higher costs. The parallel changeover process also can be quite time-consuming.

Recommended Procedures

The recommended procedure that will be well suitable for this design will be Parallel Changeover.
In a parallel changeover, the new system runs simultaneously with the old for a given period of time. Of all the procedures, this tends to be the most popular, mainly because it carries the

lowest risk. If something goes wrong at any point, the entire system can be reverted back to its original state. A primary disadvantage in running two systems at the same time is higher costs. The parallel changeover process also can be quite time-consuming.

System Security

The voting system must prevent tampering with the election, the voting results, and the system's functionality. The voting system must withstand power-source failure and use a reserve battery to avoid poll closure. The DRE must detect any error or malfunction, report it to the election official and to the voter, and correctly record any such incident in the internal audit log. Finally, the US cryptographic module validation program must test and approve all voting system cryptographic software.

➢ WPA2/AES Encryption Security

Wi-Fi Protected Access 2 is a network security technology commonly used on Wi-Fi wireless networks for data encryption.

The WPA2 is enabled in this system with its strongest encryption option, anyone else within the range

of the network might be able to see the traffic but cannot be able to connect to it.

➢ Vote Record Security

The voting systems can protect the electronic vote record by using digital signatures, which identify and authenticate the vote records, and error-correcting codes, which can help detect barcode read errors. The vote record should be fully recoverable in the event of malfunction or tampering

Training

Training is essential in this system as it is a new technology that will be using for the voting exercise. The personnel will be responsible to handle the machine will be trained on how to use, manage and direct voters on to use the machines. Training is teaching or developing personnel that will be responsible to operate the new implemented technology.

Documentation

The documentation must contain carefully prepared manuals for the election staff and for the voters.

The manufacturer shall deliver detailed, consistent and understandable program documentation.

This documentation must contain test documentation.

The manufacturer shall deliver a correct and understandable manual for the election staff.

The manual must describe how the software identification is checked, how the voting machine's identification and the identification of additional parts is checked, how the programming of constituency and community is checked, and how the correspondence to the type approval model is checked. The manual must describe how the functions of the voting machine are checked and how the voting machine is prepared for work.

The manual must describe what should be done in the case of power loss, hardware and software failures (e.g. failures of displays, buttons, and printer, checksum problems), or system failure. The manual must contain a list of all possible error, warning, and informational messages which may occur. The list must contain hints how to continue work. If the election must be continued by other means (other device, ballot box) the manual must describe how the defect voting machine and its additional parts must be handled.

The manual must describe how the counter for the number of voters or the number of votes must be checked during election process.
The manufacturer must deliver a correct and readable introduction for voters. The introduction must contain a picture of the device and a picture of the machine's ballot paper. The introduction must contain the declaration that the voter is allowed to select an invalid vote (abstention).
The printout of the election result must contain at least: the name of the election, election date, constituency and community, identification of voting machine, software, and additional parts, and for each election: number of votes, number of invalid votes (abstentions), number of votes per list entry (candidate or party).

5.1 Summary

This project is geared at bringing solution to the existing problems of Nigerian election system which are mainly seen in the manual system of ballot paper method used for voting. The solution to the manual system as itemized in the statement of the problem remains the major reason for this research. The new computerized voting method, all the processes of voting will be done electronically ranging from authentication of voters to vote casting and collation of result will be done electronically to avoid rigging and vote buying by the politicians. This method will eradicate anomalies, irregularities, bribery, and hijacking of ballot boxes and will make elections free and fair.

5.2 Conclusion

The incorporation of ICT in Nigerian electoral system has really modernized the system and improved election management in the country. Results revealed that the introduction of Electronic Voters Register (EVR), Automatic Fingerprints Identification System (AFIS) and Smart Card Reader (SCR) have reduced the incidence of multiple registration and multiple voting to the barest minimum while the introduction of e-voting, e-collation support platform will drastically reduce incidence of manipulations of ballot papers and results at the collation centres because voting will be electronic and results are transmitted in real time. Hence, the incorporation of Information communication
Technology in all election processes in Nigeria will curb excessive electoral fraud to the barest minimum, foster credible elections and added credence to INEC transparency.

5.3 Recommendation

It is believed that INEC will overcome the challenge of delay in the final collation of results if the use of electronic collation is fully implemented with all necessary legal frameworks. It will save collation officers the risk of travelling in the dead of the night to get results submitted for final collation. It would also save INEC some costs.
The current electronic register needs to be updated due to the fact that some of the voters on the register are dead; many permanent voters' cards are yet to be collected while issues of multiple registrations have not been fully resolved.
Trying to clean the register further may be very expensive and may not eventually yield the desired results. The weak business rule adopted which requires at least two fingerprints for inclusion in the register needs to be reviewed. Also, the high number of card readers' authentication failures calls for serious concern. In the light of all these issues raised, the call for outright abandonment of the current voters' register is imperative.
It is recommended that the current register be discarded while a fresh voter's registration is conducted with more sophisticated electronic machines that would easily capture potential voter's fingerprints in a jiffy just as the ones used for the recent banks verification numbers

(BVN) exercise. A licensed AFIS should be procured to rid the new registers of any occurrences of multiple registrations.

In addition, Collection of voters' cards should be tracked online to ensure the cards get to the owners and to allow INEC to keep proper record of those who have collected their cards up to date. Voters who refuse to collect their cards before any major election should not be included in the register for such election. Since no one is allowed to vote without a permanent voter card; anyone whose card is with INEC some weeks to any general election is definitely not ready to vote and should be removed from the register to minimize cases of inconclusive elections. This will ensure that only voters who are willing, ready and qualified to vote is only included in the register.

Register update and voters' revalidation exercise should be done before any general election. This will enable INEC to detect and remove dead voters from the register. In addition, enough time should be allocated to ICT-based activities e.g.: computer purging and installation for Continuous Voters Registration (CVR); Smart Card Reader purging and configuration; and printing of registers. Eleventh hour rush will always give room for avoidable mistakes which might generate unnecessary tension and problems. It will also reduce the stress of technical support staff.

Furthermore, ICT staff of INEC should be made to undergo certification courses and training both in Nigeria and oversea. This will reduce the cost of outsourcing ICT-related jobs to consultants. It will also minimize security risk. It is also recommended that the operating system on card readers should be upgraded or another set of devices should be procured which will be able to detect and authenticate fingerprints easily.

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