

## A CLOUD BASED E-VOTING SYSTEM USING NIN AUTHENTICATION MECHANISM FOR ELECTORAL PROCESS IN NIGERIA

Umejuru Daniel<sup>1</sup> & Jumbo Promise<sup>2</sup>

<sup>1</sup> Department of Cyber Security, University of Port Harcourt, Choba, Nigeria.  
[daniel\\_umejuru@uniport.edu.ng](mailto:daniel_umejuru@uniport.edu.ng); <https://orcid.org/0009-0007-9843-2248>

<sup>2</sup> Department of Information Technology, University of Port Harcourt, Choba, Nigeria  
[promise.jumbo@uniport.edu.ng](mailto:promise.jumbo@uniport.edu.ng); <https://orcid.org/0009-0007-6921-0419>

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### ABSTRACT

### RESEARCH ARTICLE

Lack of transparency has led to a failure to deliver voters assurance, agitations of suspicions and mistrust from opposition political parties. This has also led to fear of voter's insecurity, secrecy and possibility of verified results with the electronic systems that corrupt the electoral process in Nigeria. The gap observed is one that could aid the economy, government; individual and corporate organizations to improve on the state of life and develop better working systems which cannot be overemphasized. Therefore, there is need to design a transparent, trusted and secured cloud based electronic voting system that will be used during elections in Nigeria. The proposed system was built using Dynamic System Development Methodology (DSDM), Java programming language was employed at the frontend while MYSQL was used as backend for relational database and SQLite Maestro for INEC admin backend. The built model was tested with a sample dataset collected from Independent National Electoral Commission (INEC) office Port Harcourt. The proposed model was evaluated and performance ranking of testing voting results using parameters such as state, electorate, and turnout in percentages showed excellent system efficiency. The proposed model performed better than other existing models and showed that it can be used to achieve transparent and trusted result during and after the election.

**KEYWORDS:** Cloud, E-voting, Verification, NIN, Authentication, Mechanism

### INTRODUCTION

The study focused on the application of an improved E- voting system using NIN authentication mechanism for electoral process in Nigeria. In a democratic system of governance, election is very crucial and the integrity of the electoral process is sacrosanct. Election is a repetitive operation that occurs every specified period of time. Adding to that is the fact that there are different types of elections or different scopes of elections and the need to support multiple elections system [11].

Democracy thus encourages individual freedom according to the rule of law, so that people may behave and express themselves as they choose. This not only gives people a chance to choose their leaders, but also to freely express their views on issues confronted [2].

Voting through an election form is an important part of democracy and for democracy to be sustainable; the voter's participation is a key consideration. Apart from voters being encouraged to exercise this democratic right, the election that facilitates the function must be credible, transparent, auditable, watertight and free of bias [5]. In addition to providing for the orderly transfer of power, it also cements the citizen's trust and confidence in an organization or government when it operates efficiently. Society is becoming more and more web inclined and collaboration oriented, so citizens are becoming used to the high degree of flexibility in the services provided by the private sector and the Internet in particular and are now beginning to set demanding standards for the delivery of services by governments using modern electronic delivery methods[15].

The key concerns of elections and essence of voting system is transparency: ordinary voters should be able to understand and observe the vote casting and counting process, even with relatively nominal education as well as trust [1].

The implementation of electronic or weblog voting would allow increased access to the voting process for millions of potential voters. Higher levels of voter participation will lend greater legitimacy to the electoral process and should help to reverse the trend towards voter apathy that is fast becoming a feature of many democratic societies. It is also recognized that more traditional voting methods will exist for some time to come, so a means is needed to make these more efficient and integrate them with the newer weblog or electronic methods [3].

## **2.0 Concept of Elections and History**

The Council of Europe recommendations defined electronic voting (e-Voting) as “the use of electronic means in at least the casting of the vote”. The purpose of Electronic voting technology is to provide a plain, simple and secret voting process, speed up the counting of ballots, reduce the cost of paying staff to count votes manually and can provide improved accessibility for disabled voters [6].

However, there has been contention, especially in the United States, that electronic voting, especially DRE (Direct Recording Electronic) voting, could facilitate electoral fraud and may not be fully auditable. In addition, electronic voting has been criticized as unnecessary and expensive to introduce.

Several countries have cancelled e-voting systems or decided against a large-scale rollout, notably the Netherlands, Germany and the United Kingdom. Yet electronic voting system has been practicing widely for last two decades [12]. But historically it is seen that it has been using more than last 150 years. The first concept of electronic voting ideas comes from de Brettes. He develops an electronic decision-making telegraph in 1849. But first electronic vote recorder was invented by Thomas Edison in 1869. In this system, a signal to a central recorder, listed the names of the members in two columns of metal type headed ‘Yes’ and ‘No.’ (Vote Recorder, 2020), and was introduced first automated voting system in 1886. In the following sections, “Road Map to Electronic Voting System Development” is categorized into seven phases: Electronic voting is a term encompassing several different types of voting, embracing both electronic means of casting a vote and electronic means of counting votes [10, 14]. Electronic voting systems are complex distributed systems, whose components

range from general-purpose PCs to optical scanners and touch-screen devices, each running some combination of commercial off-the-shelf components, proprietary firmware, or full-fledged operating systems [4]. It is a fundamental demand of countries to enhance their election system. Now due to rapid emergence of technologies in computer and telecommunication world e-Voting based systems are to be introduced that lessens all the traditional manual election systems' problems. With the introduction of e-Voting systems our elections processes and social lives are going to be easy, efficient and low-cost. Now in this system voters can cast their votes from anywhere in world. E-voting system must meet security requirements such as confidentiality, integrity, fairness, forgery attack, verifiability and so on. This is because E-voting system is more vulnerable than traditional voting due to the nature of digital processing of election data which can be easily manipulated, hence may result in widespread fraud and corruption [7]. Voting is getting to be seen a next generation approach of election in almost all countries. The ultimate aim of e-Voting is to provide voters a good environment so that voters can cast their votes with minimum cost and efforts on the internet. Up to now there are so many properties have been proposed to make the e-Voting secure process, among them some are the below given must be satisfied [13].

## 2.1 Components of Electronic Voting Systems

The components of an electronic voting system are:

- i. DRE: Direct Recording Electronic voting machine is a device to record the voter's choices. The DRE is usually a touch-screen device where the voter casts his/her vote.
- ii. VVPAT: Voter-Verified Paper Audit Trail is a paper-based record of the choices selected by the voter. The VVPAT printer is hooked to the DRE and the paper record is viewable by the voter, but it is under a transparent cover so that it cannot be modified other than through the normal voting process [8].
- iii. EMS: Election Management System is the system responsible for the initialization of the components that collect the votes and also for the final tallying of the votes. The EMS is usually located at election central and it is often implemented as software running on a commodity PC.
- iv. Optical Scanner: is an optical reader that counts votes cast on paper ballots. There is usually one scanner at each polling site and one at election central (e.g., for the counting of absentee ballots [9].
- v. DTD: Data Transport Device - is a storage device to transfer data between different components of the systems. These devices are used to transport ballot information to the DREs and optical scanners at the polling site and to transport voting results to the EMS.

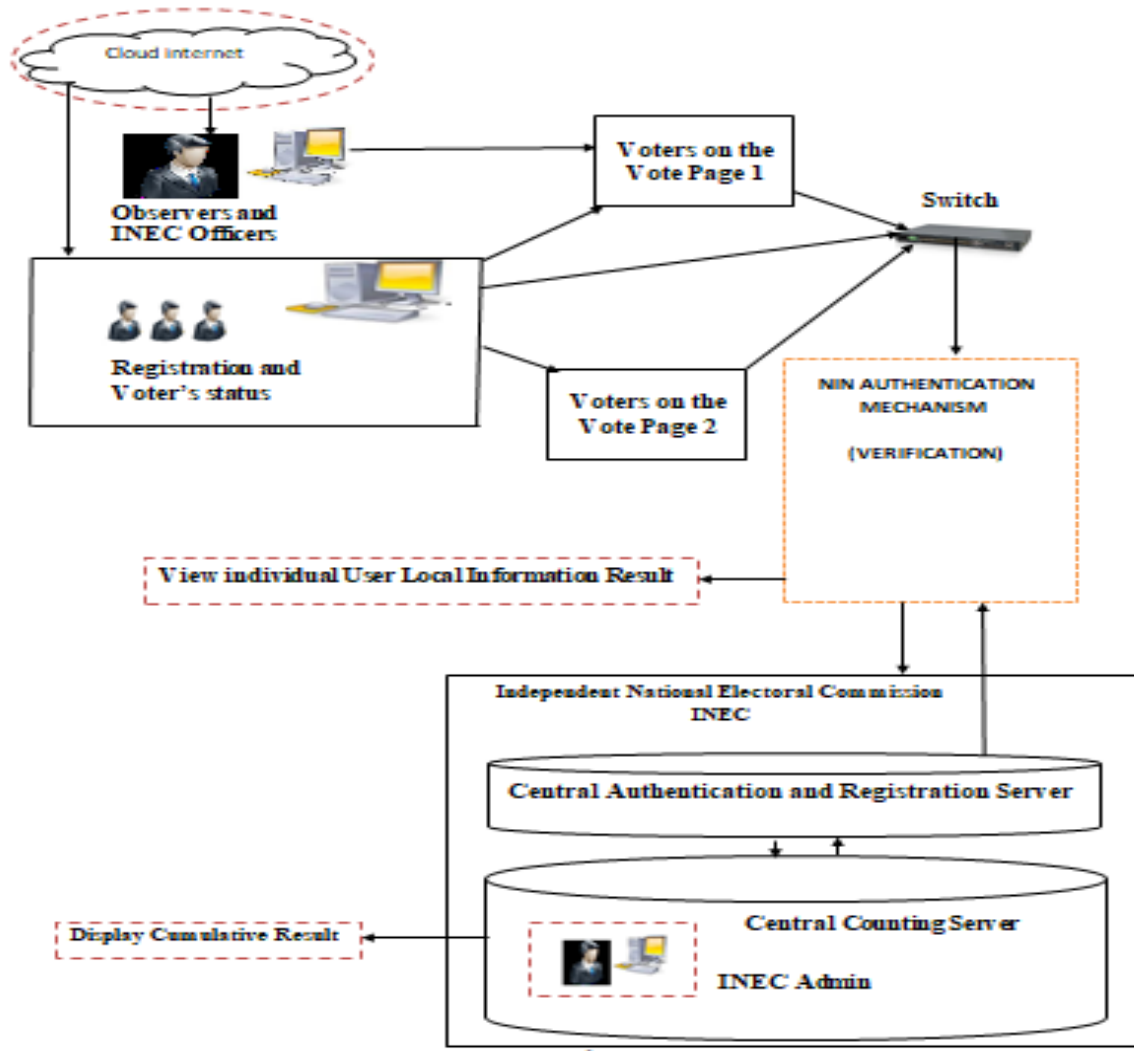
## 3.0 Methodology

Dynamic System Development Methodology (DSDM) is preferable for this research; it enhances the standard framework and controls or edifies the smooth prediction and performance involved. It helps the new developed system in maintenance for acquiring the requirement. Its elimination is time constraints and rigid preferred to the other.

### 3.1 Analysis of the Proposed System

The proposed uses the implementation of NIN authentication mechanism. It is used to match with your biometric data and other details information in the national identity database during verification and authentication. The number consists of 11 non-intelligible numbers as the main unique component of the national ID card issued on completion of enrolment. The

system parameters include the aspirant, state, voters and their details. The parameters were collected from the INEC portal. The new system operates in an identification mode and performs some basic functions which include capturing of National Identification Number (NIN), it extracts the features and stores it in the database of the system and sends it through the switch to the INEC administrators to apply authentication on each voters. The system also verifies the identity of the voter at login time by comparing the numbers on the voter’s card or NIN that has been pre-stored in the database with the one being supplied at login. It provides an interface for the user to cast votes if a match is found and provides an interface for viewing the results of the election.



**Figure 3.1: Architecture of the Proposed System**

### 3.1.1 Description of the Proposed System Component

**i. The Cloud Internet Portal or Home page:** At the cloud portal, all the players of the system will login to access any function specified. It contain the home page interface for all the participating state for the election, it also contain an interface where voters view result at the end of the voting period. It also displays the entire candidate, parties and the total vote cast at the end of the election.

**ii. Observers:** The function of the observer is to observe and monitor the voters. The observers log into the portal and start view each user's registration and status. They also view the voters at their voting point and monitor how the voters are conducting their self throughout the process. The observer's report any impurity through sending sms to the INEC officers.

**iii. Registration and voter's status:** This component enables the voters to register before voting commences. Voters are expected to enter and fill all his or her details as required using the National Identification Number (NIN) as the basic requirement for the registration. All users' details after registration go to the NIN verification portal to verify each voters NIN. After verification, it goes to the Central Authentication and Registration Server for authentication and recognition purposes. Registration or Accreditation allows voters to register all their details before voting. This accreditation allows the voter to participate fully in the election. All the voters' details are store in the database. The system checks the information of the voter in the database and relates it with the login details, if the detail are the same it grants voting permission else nullify the voter. Some of the components of this page include first -name, last-name, valid means of authentication, state of origin, gender.

**iv. Voters on the Vote Page:** This component enables the voters to cast their votes. In this proposed model, there is no predefined polling station where voters link to exercise their franchise. Every voter is expected to stall at his or her convenience location with his or computer and login to the portal irrespective of distance and position of the voters. At this point, the voters are expected to rekey in his or her detail use in the registration before permission will be given to vote. The rekey details will be compared with the original registration details and the NIN number, if it does not match, it denied access to vote. At the voting process, the system will nullify twice vote, which emprises that any voters that cast twice, the system will reject or nullify instantly. At instance voting, the voters can view their result on the View individual User Local Information Result

**v. Switch:** The switch is component used to connect all voters' details to the Central Authentication and Registration Server for verification. INEC the independent national electoral commission is the body controlling the entire election process. It comprises of the Central Authentication and Registration Server, and the central counting server. The function of INEC is to regulate voter's details and the system.

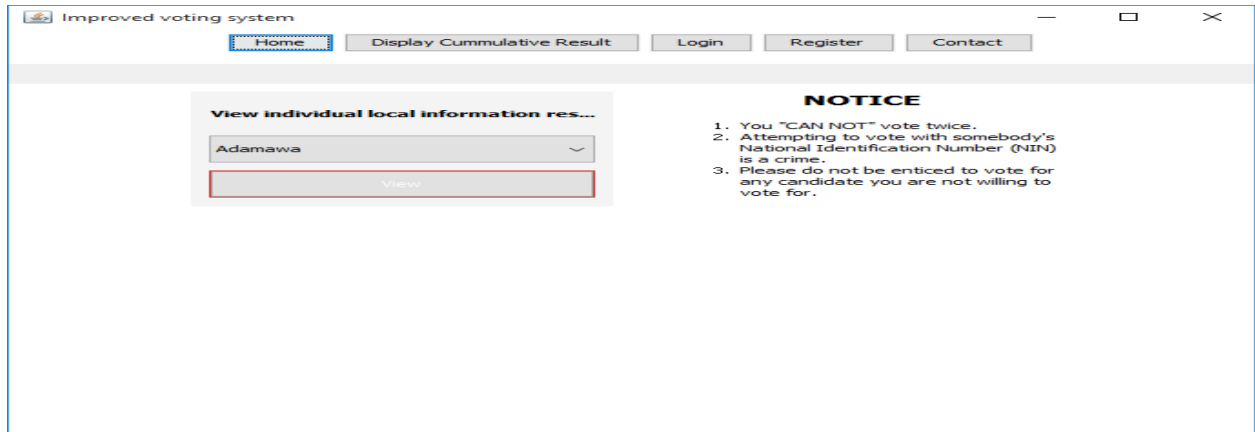
**vi. Central Authentication and Registration Server:** The Central Authentication and Registration Server received the voter's details and store them for future use during voting. It authenticates the details of each user. During voting, it will check and verify that each detail correspond to its user before voting can take place.

**vii. Central Counting Server (CCS):** The Central Counting Server serves as a medium for the announcement of results and statistics during voting. Central Counting Server has a digital X and its private key is stored in a smart card. But now after voting exercise the collation is done by the Central Counting Server (CCS) through downloading from the portal and displays cumulative result at the end of the voting exercise

**viii. Contact INEC:** the contact INEC portal gives room to any voter whom have any electoral challenge or report on the voting update and want to complain or give report update to INEC or anyone who wants to give advice or suggest possible solution and even recommendation. The interface allows them to do so by clicking on the contact INEC and fill in the details including typing in the message needed in each interface and click on send message. These messages go directly to the INEC portal.

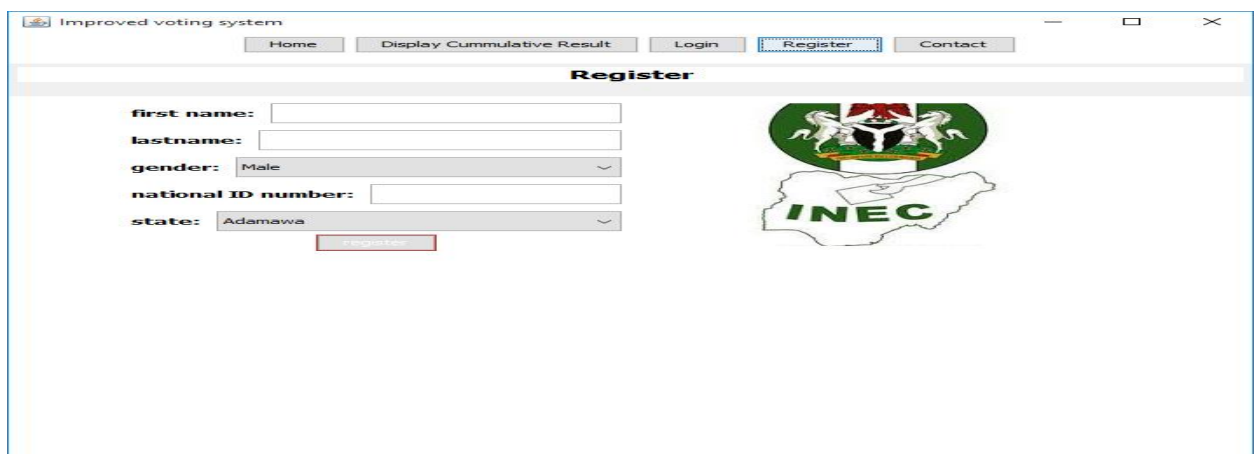
**ix. INEC Admin:** the INEC Admin oversees the performance and condition of the server used by INEC in other to achieve an efficient result. He alone sees the back end of the overall function of the proposed system with the use of SQLite Maestro.

## 4.0 Results and Discussion



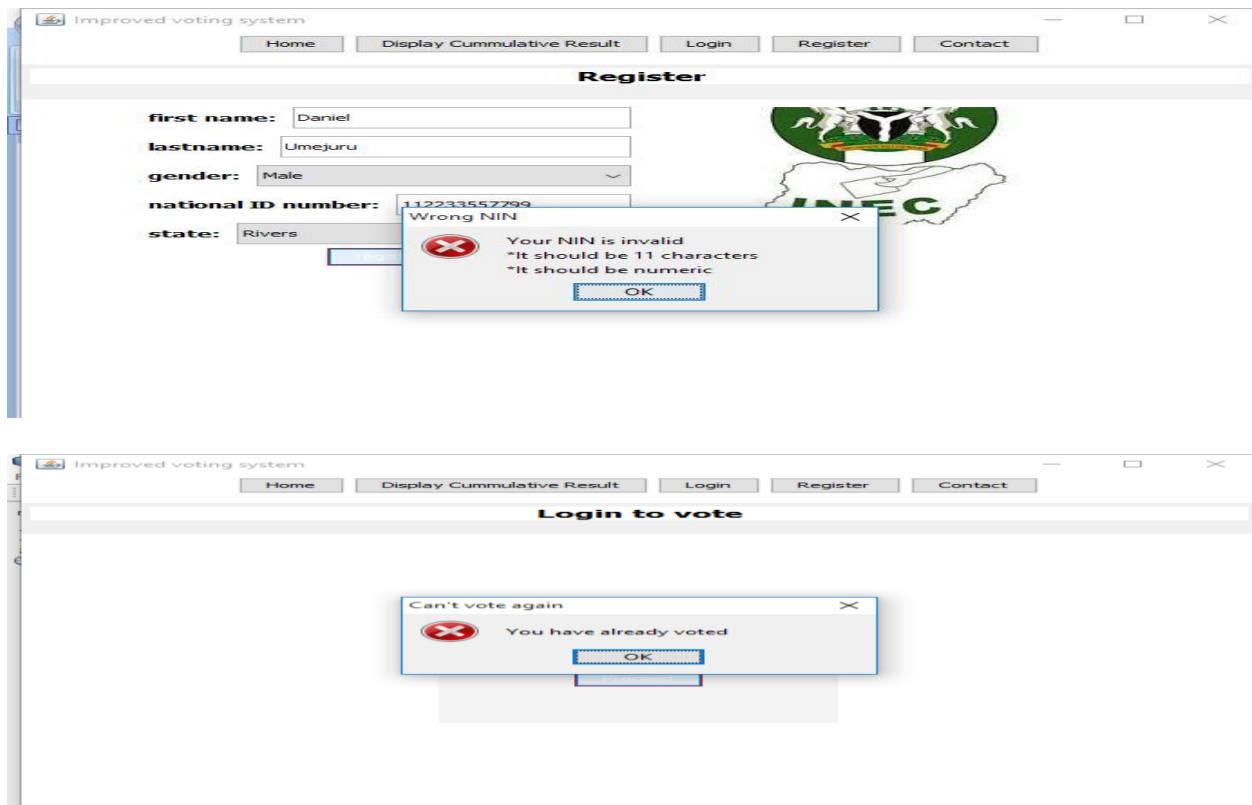
**Figure 4.1:** Voting Home Page

Figure 4.1 shows the home page and interface on the voting portal, which allows voters to choose the option intended. Every voter will click on the registration option on the home page for registration containing all personal details. The home page contains the interface for vote, registration; contact INEC, including viewing of result by each state. The home page contains an interface for all the participating state for the election, it also contain an interface where voters view result at the end of the voting period. It also displays the entire candidate, parties and the total vote cast at the end of the election.



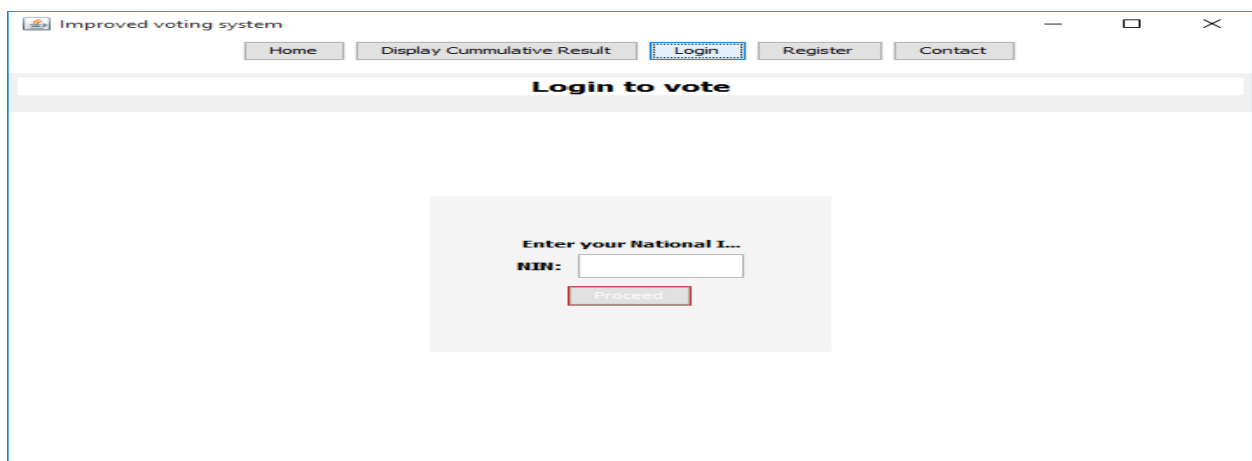
**Figure 4.2:** Registration Page

Figure 4.2 shows the vote portal in the voting environment. This page entails the NIN and the voters ID number. In this page the voters enter the register number on the vote and NIN number, is the number use for accreditation. Then click on proceed to access the voting portal. At this point the voter can vote for the candidate of his/her choice.



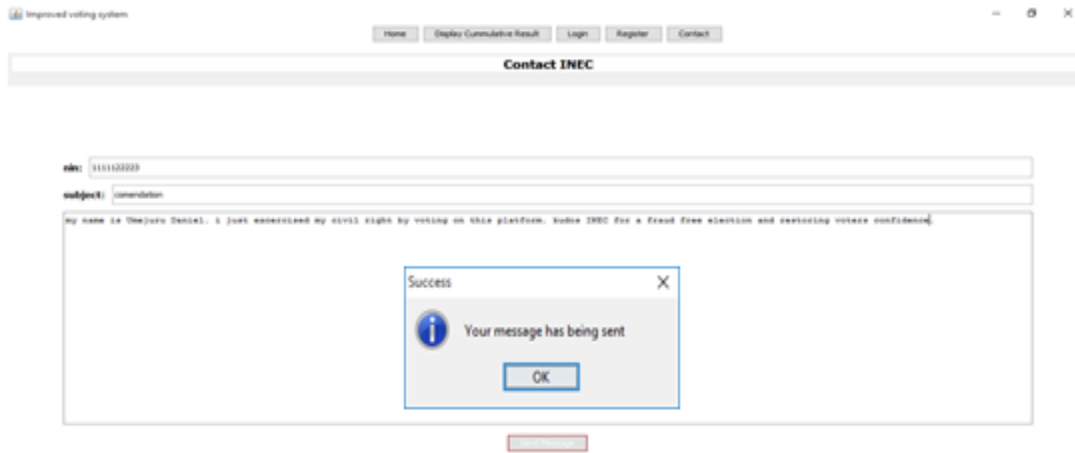
**Figure 4.3:** Testing NIN Authentication Mechanism

Figure 4.3 shows the registration or the accreditation interface. This accreditation allows the voter to participate fully in the election using voters detail is stored in the database. The system checks the information of the voters in the database and relates with the login detail, if the details are the same it grants voting permission else nullify the voter.



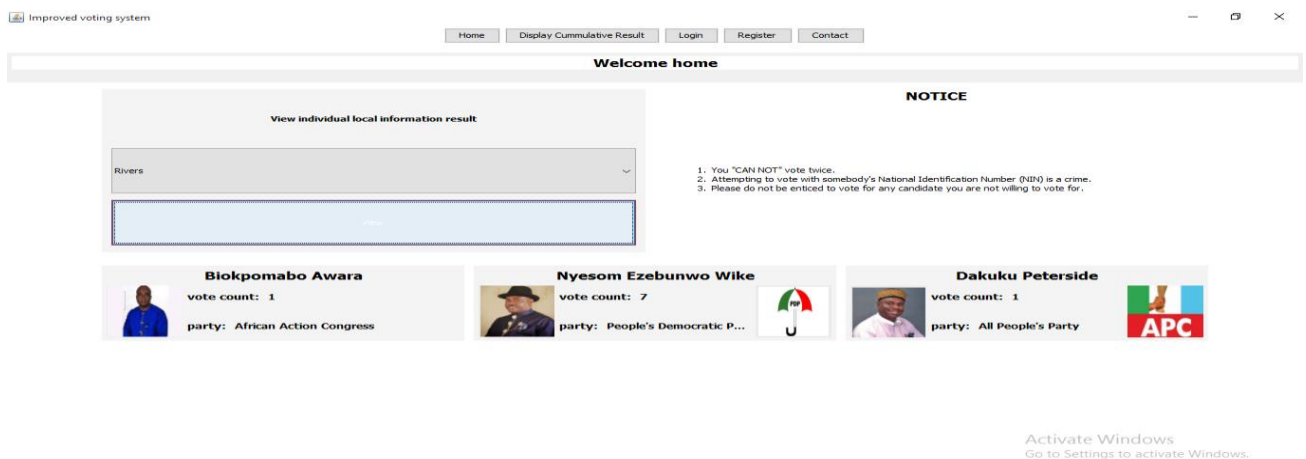
**Figure 4.4:** Vote Page

Figure 4.4 shows the login interface using NIN after the user must have registered. The NIN used to login must be same 11 non intelligible digits used during the registration phase in other to grant user access to vote and even check results per time or cumulatively at the end of the exercise.



**Figure 4.5: Contact INEC Interface**

Figure 4.5 the contact INEC portal give room to any voter to express different views ranging from electoral challenge, report on the voting update, complaint or give report update or even suggest possible solution . This message goes directly to the INEC portal for review. INEC at the same time responds by sending information relating to the voter question or suggestion to their email addresses.



**Figure 4.6: View Individual User Local Information Result Page**

Figure 4.6 shows view individual user local information result interface for different candidates in each state. At instant voting, any voter can check the result of the current winner of any state of voter's choice. This is done by clicking on the button where all the states will be out highlighted in a vertical row.



**Figure 4.7:** Display Cumulative Result Page

Figure 4.7 shows voter can however only check cumulative result at the end of the entire voting exercise nationwide to get the accurate final result by clicking on the Display cumulative result button; which will display all the registered parties and their candidate's states nationwide and will also show the total number of votes of each party even in tabular form.

State	Candidate	Party	Vote Count	Other
<b>Imo</b>				
Imo	Uche Nwosu	Action Alliance	2	no
Imo	Hope Uzodinma	All People's Party	0	no
Imo	Ihedioha Emeka	People's Democratic Party	2	no
<b>Benue</b>				
Benue	Emmanuel Jimé	All People's Party	0	no
Benue	Samuel Ortom	People's Democratic Party	0	no
<b>Rivers</b>				
Rivers	Biokpomabo Awara	African Action Congress	1	no
Rivers	Nyesom Ezeburwo Wike	People's Democratic Party	7	Yes
Rivers	Dakuku Peterside	All People's Party	1	no
<b>Sokoto</b>				
Sokoto	Ahmed Aliyu	All People's Party	0	no
Sokoto	Aminu Waziri Tambuwal	People's Democratic Party	0	no
<b>Borno</b>				
Borno	Mohammed Alkali Inam	People's Democratic Party	0	no
Borno	Babagana Zulum	All People's Party	0	no

**Figure 4.8:** Display Tabular Cumulative Result Page

Figure 4.8 displays the tabular cumulative result page which is used to view results in a tabular form showing the states, details of contestants, party of contestants and no of votes gotten.

Table 4.1: Performance ranking of testing voting results for the Proposed System

State	Electorate	Turnout	Percentage (%)
Lagos	2,967,342	1,803,796	85.50%
Rivers	2,467,687	1,321,543	80.30%
Bayelsa	1,167,754	983,996	75.10%
Kano	1,867,650	1,763,796	79.70%
Imo	1,467,548	993,986	68.20%
Abia	1,532,875	873,998	79.00%
Enugu	1,367,697	903,749	58.50%
Sokoto	1,577,211	999,976	78.50%
Cross River	1,767,696	923,596	59.50%

The table above shows the performance ranking of the voting results ranking of the proposed system. The numbers in the rows indicate improvement in electorate and voter turnout of the governorship election. It shows that the proposed system has a very great speed in term of voter turnout computation and also shows that election is transparent.

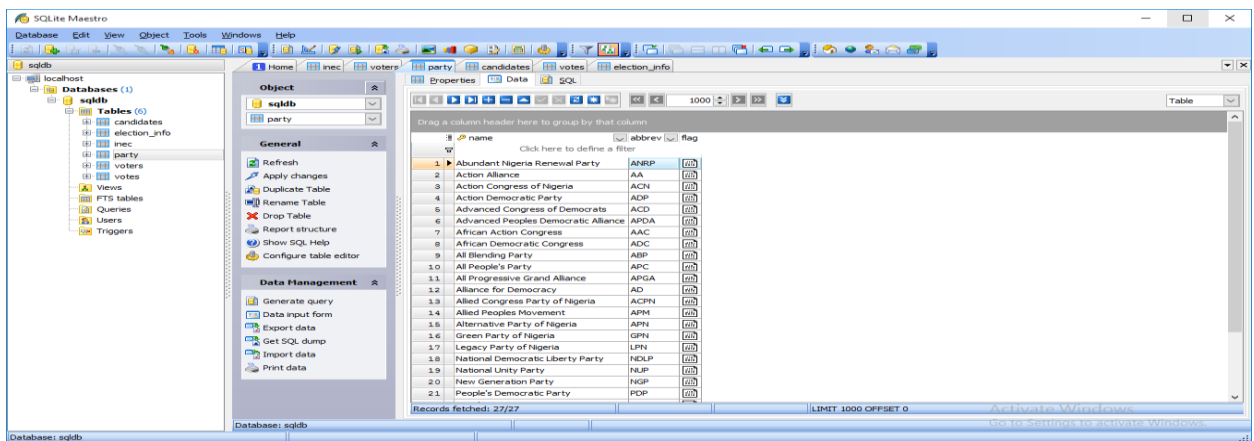
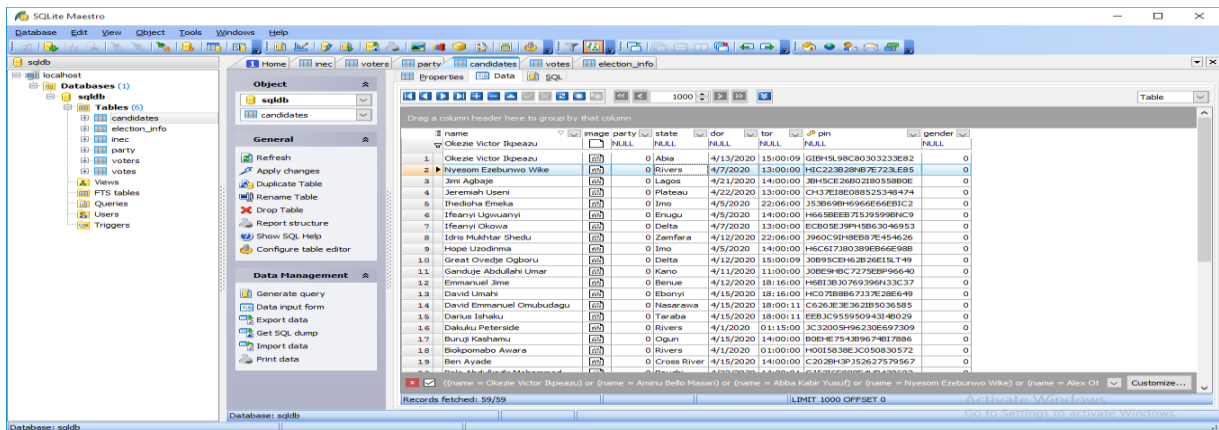
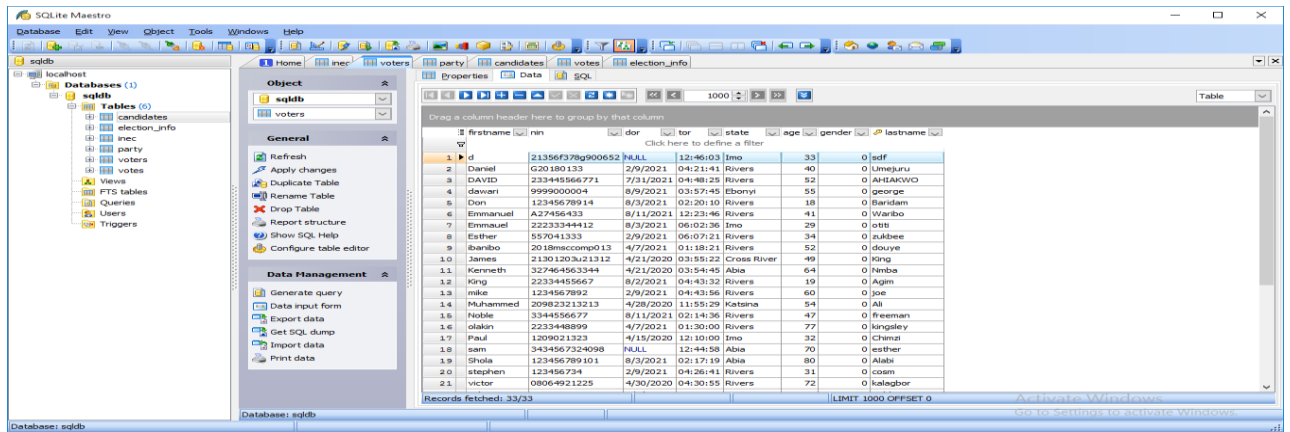


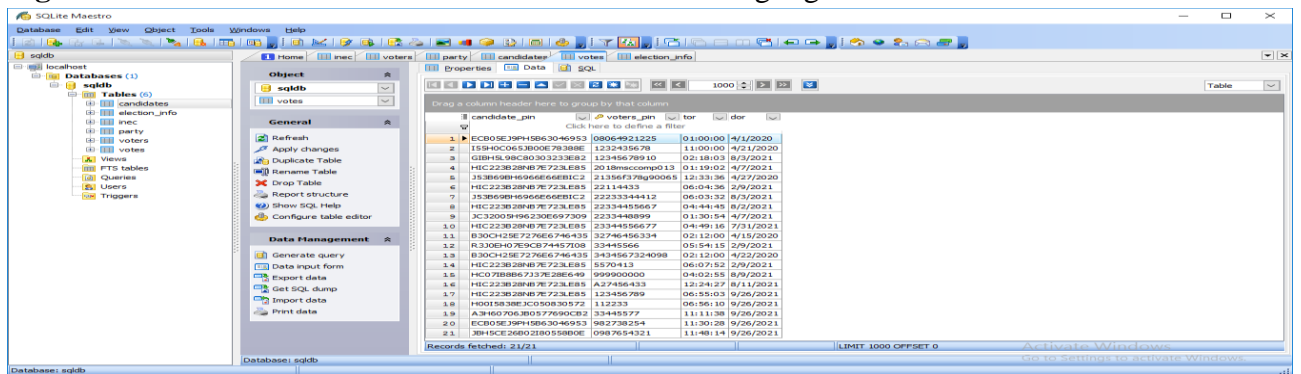
Figure 4.9: INEC Admin database backend view showing registered parties



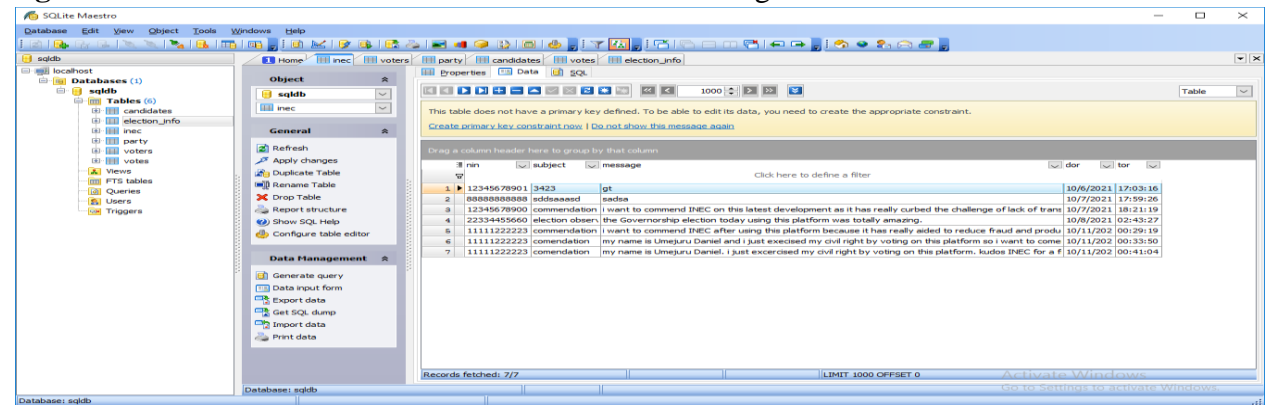
**Figure 4.10:** INEC Admin database backend view showing registered candidates



**Figure 4.11:** INEC Admin database backend view showing registered voters



**Figure 4.12:** INEC Admin database backend view showing casted votes



**Figure 4.13:** INEC Admin database backend view showing contact INEC messages

## 5.0 Conclusion

The study focused on the application of an improved NIN authentication mechanism for electoral process in Nigeria using gubernatorial election as a case study. The NIN used to login must be same 11 non intelligible digits used during the registration phase in other to grant user access to vote and even check results per time or cumulatively at the end of the exercise. The integration of NIN biometric authentication ensures the one man one vote mantra and is also an efficient way to cast votes transparently and promptly as well from location using any smart device. Summarily, an enhanced E-voting model using NIN authentication mechanism which enables cloud storage of voters and transformation to user-friendly platform has been achieved.

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