Systemic Evaluation of Semi-Electronic Voting System adopted in Nigeria 2015 General Elections

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Abstract   Nigeria's experience with paper-based balloting has produced challenges to election such as the snatching of ballot boxes and alteration of election results. Full-flesh Technology-based election most especially the use of Electronic Voting Machines will go a long way to arrest some of these electoral crimes. Therefore, in this research work, we review the tedious electioneering processes, voting technologies, foot note and solution to the rising perspective as a result of low turnout of voters during elections in all the six geo-political zones with a proper documentation. Hence, a proposed web-enabled voting system which inculcates the features and characteristics of electronic voting machine (*e*VM), Internet Voting (*i*-voting) and mobile voting (*m*-Voting) is proposed for enhanced participatory democracy that has attributes of free, fair and credible election in Nigeria and Africa as a whole.

Keywords: *Nigeria, internet, i-voting, m-Voting, INEC, democracy*

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1. Introduction

"A system is said to be democratic in nature if, it permits only eligible voters to vote and it ensures that each eligible voter can vote only once [4]". There is a wide variety of different voting systems that are based on traditional paper ballots, mechanical devices, or electronic ballots [2,3]. In order to determine whether a system performs these tasks well, it is useful however, to develop a set of criteria for evaluating system performance. The criteria to be developed are such as accuracy, democracy, convenience, flexibility, privacy, verifiability and mobility [5]. Election is a process in which voters choose their representatives and express their preferences for the way that they will be governed. In this regard, voting refers to the actual process of casting ballots (on the assigned day of voting). Therefore, correctness, robustness to fraudulent behaviors, coherence, consistency, security, and transparency of voting are all key requirements for the integrity of an election process and also integrity, impartiality, transparency, professionalism, gender sensitivity are principles guiding the election officials to conduct free and fair election. [1]. People all over the world including the local and foreign observers started taking a hard look at their Independent National Electoral Commission (INEC) authentication equipment, long procedures to follow by the officials and ad-hoc staff, and trying to figure out how to improve on the issue of voting fraud and challenges such as deceased people voting,

voter impersonation, voting by proxy, voter suppression, voting not count, election rigging, snatching of ballot boxes and ballot papers, results being prevaricated and to cap it all the litigation after the election. All these challenges summed up to irregularity and instability in electoral process which tends to make the people to lose confidence in the electoral system of Nigeria.

The flaws of electoral act in most countries lead to election rigging, which constitutes a serious threat to democratic values in any liberal democracy. These flaws are inherent in most African States' Electoral Acts. These flaws affect Nigeria democracy with six Geo-political zones as shown in Figure 1.

Figure 1. the map of Nigeria indicating the Six Geo-political zones

Nigeria's democracy is the most populous democracy in Africa with population of about 160 million. Nigeria is so giant that people say that as Nigeria goes, so goes

Africa. Therefore, much is expected from Nigeria in all ramifications. On 28 March 2015, after 4 years of tremendous preparation, Nigerians experienced its first Nigeria Semi-Electronic General Elections in which the country tapped partly from breakthrough of Information and Communication Technology (ICT) in part of the electoral process. The Semi-Electronic election process in this context is the act of using an electronic device for verification of eligibility of voters, vote with the use of ballot paper based system and counting manually, and then collation at top levels can be done with the use of e-collation platform. Nigeria 2015 Election, closely and keenly contested by two giant parties brought about the whole world turned and watched the electoral drama unfolding itself. Nigerians started wondering, "Wouldn't all our problems be solved if they just used Traditional based paper system, Semi-Electronic voting or full flesh Electronic voting systems?"

2. Literature Review

According to Macintosh which started that the most powerful symbol of a democracy is the citizen's involvement in the free and fair election of representatives to govern them. Macintosh continues to state that voting is seen as the act that currently defines the relationships between citizens, governments and democracy. Today, the internet has become a part of the daily life of many people around the world; no one could have foreseen how it would transform society three decades later [6]. Owing to the fast progress of computer and communication technologies, many advanced services have been developed to take the advantages of the techniques. Among these services, electronic voting is a popular one since every voter can finish her/his voting process securely and rapidly but here in Nigeria, the electoral process is termed as Semi-Electronic voting system with following activities and processes as shown in Figure 2.
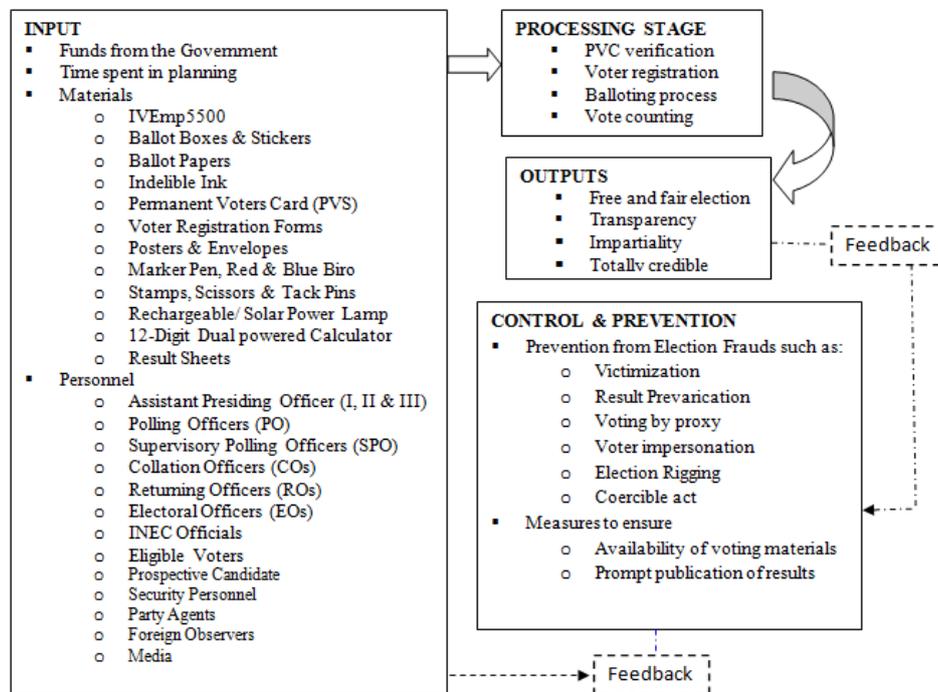

Figure 2. Nigeria Semi-Electronic Voting System

In [9,11], the author specified mainly on securing the voting system, by comparing the insecurities that exist in the manual voting system to that of the electronic voting system. Since the 1959 elections, which were the last to be supervised by the colonial authorities, all but one election has had its result contested. The only exception to this pattern was the June 12 1993 presidential election won by Chief M. K. O Abiola which was annulled by the Ibrahim Babangida military administration [7]. All the previous elections from 1999 till 2011 are purely manual but that of 2015 embraced some elements of ICT in action.

General Muhammadu Buhari, who contested the 2003 presidential polls on the platform of All Nigerian Peoples Party(ANPP), describes the election as "a dark period in our history" (Buhari, 2006) and Akume (2006) contends that the elections were "characterized by large scale malpractices including rigging at all levels" Given the massive irregularities that attended the 2003 elections and the consequent legitimacy crisis they engendered, the

2007 and 2011 polls presented an opportunity for both the government and the election authorities to restore public confidence in the election process [16,17]. The opportunity to make amends in 2007 was, unfortunately, squandered by the Obasanjo presidency and INEC. While the former exploited its control of state administrative resources (including using anti-graft agencies and the court to undermine the electoral ambition of opposition candidates), and the latter arbitrarily deployed its regulatory powers to exclude certain candidates from the ballot [7]. The process that led to the 2007 elections and their actual conduct was massively flawed. Thus, the outcome of the elections could hardly be regarded as representing the true wishes of the Nigerian voters.

Local and foreign election observer groups that monitored the 2007 and 2011 elections documented the irregularities and manipulation that attended the elections. The Transition Monitoring Group, a consortium of domestic observer groups, reported that the elections

"were seriously marred by egregious irregularities and malpractices to the extent of not only compromising the integrity of the ballot in many states.

3. Review of Voting Technologies

a. Paper-Based Process: The process is a rigorous one because the process of validation before voter's ID will be issued involves a lot of paper work, appropriate training and time used to get the polling unit/station arranged according to specification. After voting, the counting of ballots will be looked after by another group of officers [14]. With all these steps, groups and procedures that are involved, the process can prove to be tedious, error prone and costly. Some introduction of technology currently in the Nigerian and Jamaican system, however, makes the process semi-electronic, but this is far from what could be really accomplished by a fully ICT integrated and driven process.

b. E-Voting: Electronic voting encompasses both electronic means of casting votes and counting of votes which can include punched cards, optical scan voting systems and specialized voting kiosk, transmission of ballots via telephones, private computer networks or the internet [12]. There are different types of electronic voting systems with the advent of technology to avoid electoral frauds like paper based electronic voting.

c. Direct Recording Electronic Voting System (DRE): This 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 touch screen [13]; that processes data with computer software; and that records voting data and ballot images in memory components which produces a tabulation of the voting data stored in a removable memory component and as printed copy.

d. Public network DRE voting system: Internet voting systems have been used privately in many modern nations and publicly in the United States, the UK, Switzerland and Estonia. 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 as they are cast, or periodically as batches of ballots throughout the Election Day, or as one batch at the close of voting exercise.

e. Smart Card Voting(Token): With the use of the smart cards and kiosk there was a significant leap in voting technology, as persons were able to vote within their own comfort zone or that was the intension. The need for the various human security bodies was eliminated. This system however, has flaws on security aspect and voters could vote multiple times.

4. Nigeria 2015 General Elections

The just concluded 2015 Election propounded the laid down voting procedure follow [1]:
- Accreditation and verification of eligible voters using Emp5500 machine in the morning between the hours of 8 am and 1 pm.
- After accreditation and verification, followed strictly by the election proper at exactly 1:30 pm. The voters will line up to cast their votes by thumb printing for the candidate of their choice based on party logo. The Presiding officer (PO) will count the number on the line and a security personnel will stand as the last person to avoid people joining unnecessarily
- After the last voter has voted, then voting process is said to be concluded, the Presiding officers in polling centers count the votes in the presence of all the party agents and some voters that are present.
- Following the completion of counting and recording of the votes on Forms EC. 8A and/or EC. 8A (I) and (II), the PO shall put the original completed form (statement of Result of Poll from the Polling Unit) in a tamper-proof envelope(s)
- The PO proceed immediately to the Collation Centre where election results shall be done at the levels depending on the type of election in the following order:
  - ♣ Registration Area/Ward (RA/Ward) – Collation for all Elections
  - ♣ Local Government Area – LGA (Collation for all Elections)
  - ♣ State Constituency (Collation and Declaration of State House of Assembly Elections)
  - ♣ Federal Constituency (Collation and Declaration of House of Representatives Elections)
  - ♣ Senatorial District (Collation and Declaration for Senatorial District Elections)
  - ♣ Governorship (Collation and Declaration for Governorship Elections)
  - ♣ Presidential (Collation and Declaration for Presidential Election)
- At state level, E-Collation may be employed where election type and date is selected, delimitation parameter such bas State, LGA, Ward and PU is allowed to be selected too before entering publishing result after confirmation.

After carefully check through all the procedures involved listed above, we concluded that this is purely manual electoral processes with element of electronic voting in the areas of accreditation, verification and e-collation.

5. Hardware: IVAS (Emp5500)

The hardware of IVAS is the physical component of the system that we can feel and touch. The acronym IVAS means INEC Voters Authentication System.

Figure 3. IVAS (Emp5500) device

This is a device designed purposely for electronic authentication of voters, supports both touch and keyboard input and configure to red contactless card and output (display) same on the LCD. The specification of the hardware adopts the following specifications [1]:

- Dual Core Cortex – A7 Central Processing Unit (CPU)
- ARM Ultra-Low Power Consumption
- Single core frequency of 1.2GHz
- Baseband Version – MOLY.WR8.W1315.MD.WG.V23
- System Version – ALPS.JBS.MP.VI.46
- Software Version – 14.1220.1
- Android Version – 4.2.2

The components/features include:

- Fingerprint Window
- Speaker and Indicator
- Display and Touch Pad
- Main Key Area
- Card Reading Area
- Battery (320mAh)
- USB Interface

Voter's cards are scanned along with the voter's fingerprint. The emp5500 machine compares both the fingerprints, if there is a match, indicates that the bearer of the card owns the card, and the converse if not true; before storing the voter Identification Number (VIN) with the authentication status.
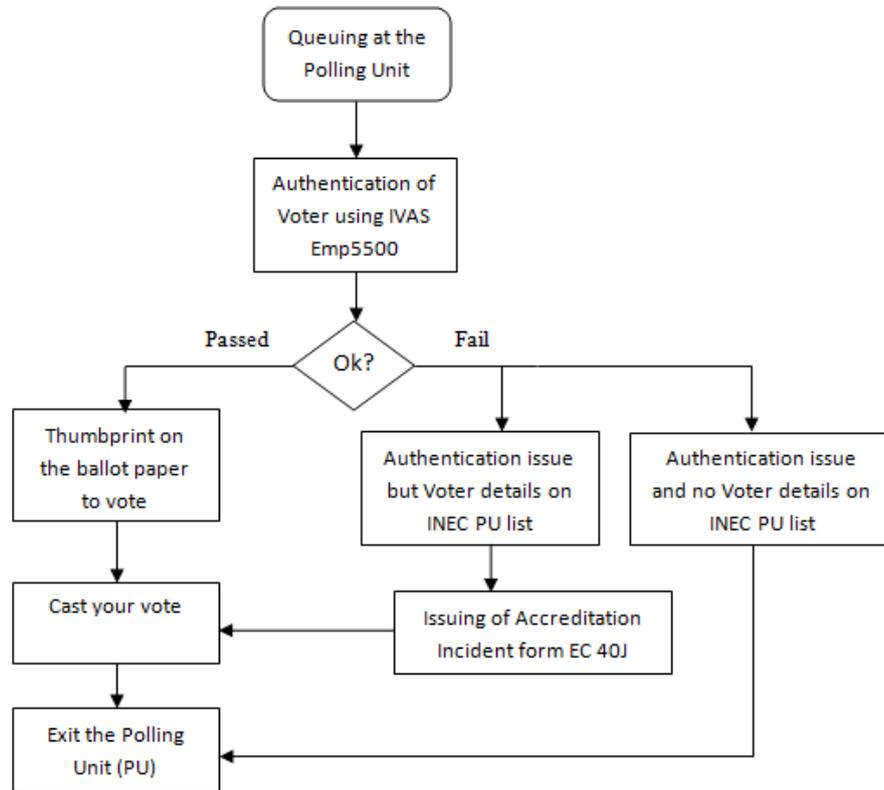

Figure 4. Semi-Electronic Process flow diagram

6. Data Analysis, Result and Finding

6.1. Data Analysis

The Data was based on 2015 General election in Nigeria across the six geo-political zones. The summary of the data obtained during 2015 election was presents in Table 1 of which the total number of eligible voters was Sixty-Six million, Eight Hundred and Seventy-Eight Thousand, and Four (**66,878,004**). The number of accredited voters and the total vote casted were Twenty-nine million, Five hundred and Eighty-Five Thousand, and Six hundred and Fifty-Two (**29,585,652**) and Twenty-Seven Million, Four Hundred and forty-Two Thousand, and Six hundred and Eighty-Four (**27,442,684**) respectively.

Table 1. The summary of the data obtained during 2015 election across the 6 geo-political zones

Geo-Political zone	Eligible Voters	Accredited Voters	Total Votes Casted
South-East	7,028,560	3,060,403	2,824,348
South-West	14,298,356	4,886,261	4,539,707
South-South	8,937,057	5,552,925	5,226,291
North-Central	7,675,369	4,293,232	3,970,735
North-East	10,038,119	4,083,354	3,783,920
North-West	18,900,543	7,709,477	7,097,683
	66,878,004	**29,585,652**	**27,442,684**

Table 2. Eligible Voters

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7028560	7028560	10.5	10.5	10.5
	7675369	7675369	11.5	11.5	22.0
	8937057	8937057	13.4	13.4	35.3
	10038119	10038119	15.0	15.0	50.4
	14298356	14298356	21.4	21.4	71.7
	18900543	18900543	28.3	28.3	100.0
	Total	**66878004**	**100.0**	**100.0**	

Table 3. Accredites Voters

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3060403	7028560	10.5	10.5	10.5
	4083354	10038119	15.0	15.0	25.5
	4293232	7675369	11.5	11.5	37.0
	4886261	14298356	21.4	21.4	58.4
	5552925	8937057	13.4	13.4	71.7
	7709477	18900543	28.3	28.3	100.0
	Total	66878004	100.0	100.0	10.5

Table 4. Total Votes Cast

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2824348	7028560	10.5	10.5	10.5
	3783920	10038119	15.0	15.0	25.5
	3970735	7675369	11.5	11.5	37.0
	4539707	14298356	21.4	21.4	58.4
	5226291	8937057	13.4	13.4	71.7
	7097683	18900543	28.3	28.3	100.0
	Total	66878004	100.0	100.0	

Table 5. Summary of Statistical Report

	EligibleVoters	AccreditedVoters	TotalVotesCast
N	66878004	66878004	66878004
Valid Missing	0	0	0
Mean	12718984.19	5392762.13	4995356.40
Median	10038119.00	4886261.00	4539707.00
Std. Deviation	4543676.170	1594649.594	1461747.619
Range	11871983	4649074	4273335
Minimum	7028560	3060403	2824348
Maximum	18900543	7709477	7097683

7. Results and Discussion

From the summary table in Table 1, it was clearly observed and showed that the number of eligible voters is far higher than the responses during election period. The graphical representation of Table 1 is shown in fig 5(a), Figure 5(b) and Figure 5(c).
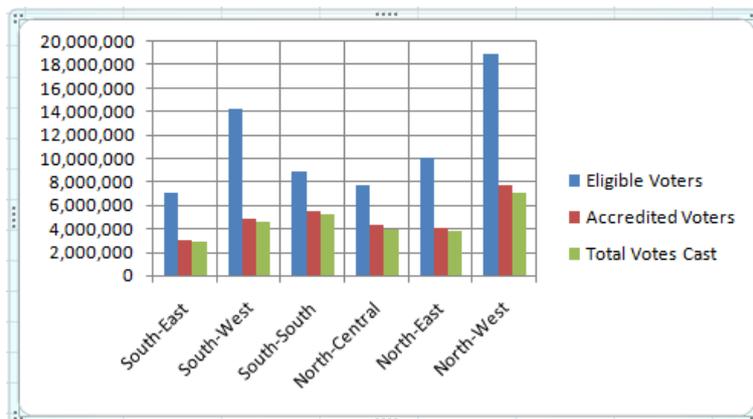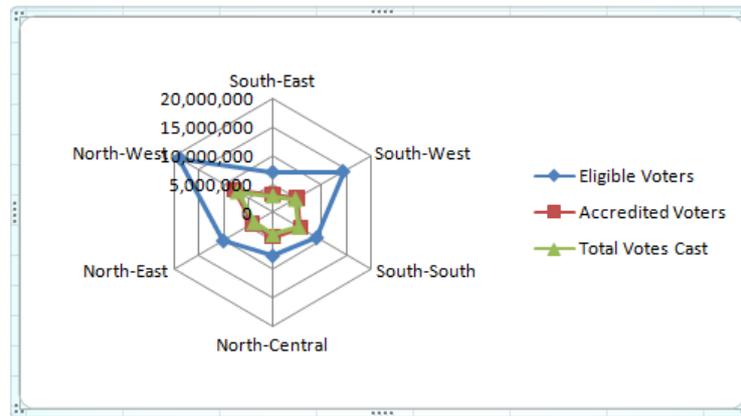

Figure 5(a). clustered column graph equivalent

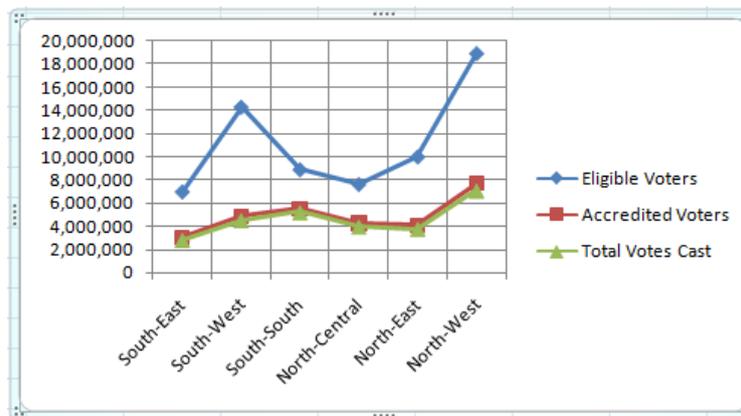**Figure 5(b).** Radar graph equivalent

Figure 5(c). Line graph equivalent

8. Findings

From the result of data analysis, we arrived at the following conclusions:

- The voting procedure was cumbersome as voters had to be accredited first, and came back to vote later.
- Late arrival of election materials often trail elections conducted negatively.
- Manipulation of results in order to influence their outcome, manual counting error, allegations of violence, intimidation, ballot stuffing, under-age and multiple voting and complicity of the security agencies often trail elections conducted negatively.
- Too much money spent in conducting of 2015 general election.
- Some people believed the results were rigged in some states which resulted to post-election violence in some state.
- Majority of the eligible voters preferred alternative way of voting for future elections.
- Majority of the eligible voters believed that manual voting was not good enough for Nigerian elections.
- Majority of the eligible voters wanted an alternative to manual voting (electronic voting system)

Consequent to the findings above, we concluded that Nigeria needs alternative means of voting that will bring sanity into electoral processes such as follows:

- Cast-as-Intended, Counted-as-Cast and Verifiability
- One voter, One vote and Coercion Resistance
- Elimination of post-election violence in Nigeria
- Reduction of money spent on ballot papers and other materials
- Prevention of the use of hooligans, ballot hijacking, and imposition of candidates
- Reduction of staff to the minimal to avoid human errors as a result of manual counting

9. A Proposed Web-Enabled Voting System

A web-enabled voting system which inculcates the features and characteristics of electronic voting machine (EVM), Internet Voting (*i*-voting) and mobile voting (*m*-Voting) on a single module is proposed for enhanced participatory democracy that has attributes of free, fair and credible election in Nigeria. The proposed system in question inculcates electronic voting machine (EVM), Internet Voting (*i*-voting) and mobile voting (*m*-Voting) technologies into a single module using sophisticated and integrated software and hardware. The purpose of literature review conducted so far is to create an insight and technical solution that satisfies the functional requirements for the system. The functional specification produced during system requirements analysis is transformed into a physical architecture through system modeling and database design. Based on to the literature review conducted, the design of proposed web-enabled voting system must satisfy a number of competing criteria. This competing criterion gives an avenue for a free, fair, credible and confidential election as highlighted below:

- **Fairness**: No person can learn the voting outcomes before the tally.
- **Eligibility**: Only eligible voters are allowed to cast their vote.

- **Uniqueness***:* No voter is allowed to cast their vote more than once.
- **Uncoercibility**: No voter can prove how he voted to others to prevent bribery.
- **Anonymity**: There should be no way to derive a link between the voter's identity and the marked ballot.
- **Robustness**: A malicious voters cannot frustrate or disturb the election.
- **Accuracy**: All the valid votes should be counted correctly with tolerable extent of error
- **Efficiency**: The counting of votes can be performed within a minimum amount of time.
- **Confidentiality**: Ensuring that no one can read the message except the intended receiver.
- **Authentication**: Only the eligible and authorized voters can vote through the system
- **Integrity**: Votes should not be able to be modified, forged or deleted without detection
- **Audit Trail**: The system should provide the mechanism for audit trail which helps to verify that the votes are accounted correctly in the tally.
- **Transparency**: The election process should be transparent to the voters. Voters can clearly understand the mechanism of the electronic voting system and know whether their votes have been correctly counted.
- **Simplicity**: The system should be designed user friendly. It should also meet the need of the disabled and illiterate.
- **Democracy**: Permits only eligible voters to vote only once
- **Security**: Votes should not be manipulated during the whole process of voting.

10. Conclusion

To sum up the discussion above, this paper clarifies the requirements and key elements of cumbersome procedure lay by INEC, the review of voting technologies, the footnote associated with the existing voting system and argues for pro-active reforms to improve the quality of electoral politics in the country which in turn impacts on the quality of governance. Since, the legitimacy of electoral process and of the post-election regime is heavily contingent on the fairness and transparency of the transition process. Therefore, consequent to carefully subjecting the data to various analytical and quantitative tests, it is audible to the deaf and seeable to the blind that our recent elections have prompted calls for a reform of the voting system. Many ideas have been put forward and one of the recommendations is a web-enabled voting system, which tends to reduce the chaos that often ensues on Election Day.

11. Recommendations

1. The need to discard paper-based election should be included and not to be taken with the hand of levity in the reform agenda of electoral processes.

2. In this age of advanced communication technology, human elements in election management should be reduced to a barest minimum.
3. Another issue worthy of being on the reform agenda is that of enfranchising Nigerians resident outside the country.

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