Electioneering Process In Africa: A Proposed General E-voting Model (Case Study- Nigeria)

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Abstract: The incessant post election crisis that has plagued most of the elections in Africa has led to voters' apprehension and apathy, hence the need for a better electoral system to ensure free and fair elections. The aim of this paper is to present an electronic voting system (E-Voting), optimistically, to be applied to the Nigeria electoral system and possibly other African countries elections. This paper wish to dissect the conventional system of voting in Nigeria, points out the merits and the demerits of the system, highlights the prospects of e-voting, thereby, propose an alternative e-voting model that will take care of the flaws in the conventional system. Several social and cultural issues peculiar to Nigeria system will also be integrated into the E-VS model in order to achieve an enhanced, speedy and accurate performance. It is about time that conventional voting in Nigeria gives way to E-Voting and hence simplifies the task for Electorates and the Legal constituted body responsible for conducting election in the country (that is INDEPENDENT NATIONAL ELECTORAL COMMISSION, INEC).

Keywords: conventional voting, e-voting, election model, e-voting model, design issues, Nigeria, Security

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INTRODUCTION

Electronic voting (E-Voting) is a type of voting that includes the use of a computer rather than the conventional use of ballot at polling centers or by postal mail. It is also an electronic voting (e-voting) system in which the election data is recorded, stored and processed primarily as digital information. It encompasses various types of voting: kiosks, the Internet, telephones, punch cards, and mark sensor or optical scan ballots. All these types of E-Voting have shown accurate and speedy performances. Despite the advantages of E-voting, the range of its use worldwide is still, however, limited as it has a downside on many levels such as: legislative, social, political and technological levels "[15], [8],[13]". This paper underlines the political and social aspects of Nigeria's case for they are the main factors to influence the government's decision concerning the use of the E-Voting system in Nigeria.

The implementation of the E-voting system raises several issues related directly to elections such as legal, social, technical, political, administrative and financial issues. However, benefiting from the positive aspects of E-Voting requests the implementation of security measures in order to repair the lack of transparency and to regain the trust of electorates and liable Authorities [15]. Due to the peculiar case of Nigeria, in terms of conduct of elections, several elements should be held into account during the processing of the E-voting system and they are: Functionality, Privacy and Security.

Meanwhile, E-Voting remains unpopular and limited to few countries. The United States of America is considered the leading country in implementing E-Voting system [10]. However, some E-Voting systems are complex leading to a lengthy voting process "[1],[16]". In Europe, E-Voting was introduced to Belgium's elections November 24th 1991.Amongst provinces in Belgium; two were chosen to try the E-voting system. In 1999, the system was extended to 44% of the population. However, authorities still aim to achieve 100% coverage by future elections [6].Geneva had been using E-Voting ever since 2000through the internet. However, E-Voting did not replace two other types of voting already in use there: postal and conventional voting [5]. This paper presents E-Voting system model that can be used for conducting elections in Africa countries that are practicing democracy and Nigeria is no exception. The E-voting system aim to satisfy the above listed conditions: functionality, privacy and security. The E-voting system is meant to be designed for electorates through computers programmed with friendly Graphical User Interfaces. The complex treatments and features are achieved at the levels of applicative layer and database. Several security measures will be integrated into the E-voting system in order to achieve an enhanced, speedy and accurate performance. The E-voting system should replace the conventional voting in Nigeria and hence simplifies the task for Electorates and the organizing body (INEC)

Overview of the conventional voting system and the related challenges in Nigeria

Nigeria which is the most populous black nation in the world, practice the presidential system of government, which are divided into three arms: Executive, Legislative and Judiciary. Elections are conducted for the first two arms, except the judiciary, whose appointments are based on the two arms for ratifications, after recommendations from the NJC (Nigeria Judicial Council).Most of the elections conducted in the country so far have been plagued with one issue or the other, some of which are: fraud, disenfranchisement and voters apathy. This issue of election crisis has generated lots of debates from various quarters and various suggestions have been made on how to implement a credible voting system in our electioneering process.

Political pundits believed that until we get it with our elections, we would be in perpetual crisis and this could also lead to some uprising from the aggrieved quarters, just like what we are witnessing in some African countries recently.

The conventional system of voting, which the country is using up till now is regarded as "Open-Secret Ballot System". This system involves the use of ballot papers to cast vote. Experts' views on elections in Nigeria showed that elections conducted so far were flawed with a number of problems which affected the effectiveness and efficiency of elections in the country. Education and training campaigns were put under the spotlight, noting that their programs were insufficient in providing adequate information about the voting procedures. The credibility of the INEC was also emphasized, despite its perceived independency. In this regard, some problems that were cited included inefficient audits at the polling stations, poor logistics, and late opening of the voting stations. Opinions showed that many voters were encountering poor access to voting stations in some areas, i.e. in remote areas. That is why some voters were exposed to having to walk long distances. This has led to long queues; however, long queues have been noted in urban areas as well. It has also been observed that there were a number of key issues and challenges that should be addressed to ensure improved voting stations in Nigeria. The major key issues and challenges that were cited included the late opening of voting stations, education, and political intimidation. Experts on elections noted voters' arrival at wrong polling stations. Interestingly enough, public opinions showed that government should also be criticized because of the ineffectiveness and inefficiency of elections in Nigeria. Delays in issuing voter's card by INEC were also emphasized. Even those who had voters' cards did not vote because of wrong names, surnames and even outright omission from the voters register.

Suggested solutions on the above key issues and challenges suggested the introduction of electronic voter's card at polling stations and smart cards with voters' fingerprints. Project planning and effective election management was also emphasized without forgetting the involvement of all relevant stakeholders. Emphasis in this regard was placed on the participation of the grass-root level. This would bring constructive views on how elections should be run effectively and efficiently. Funding should be made available to address transport problems. This would help those voters who have difficulties travelling long distances. Hence the need for E-voting, a better system relatively free of fraud and manipulations.

E-voting and the associated benefits

Electronic voting has been considered to be an efficient and cost effective alternative / complement of the conventional voting procedure. This paper noted the necessity of e-voting in Nigeria, because of its effectiveness and efficiency. The key issues that need to be addressed when planning and designing a future e-voting system for Nigeria. Measures to prevent fraud and measures to ensure that a voter can vote once should be in place. It must have standardized operating features for national use. It must be simple to operate and user-friendly to physically handicapped. It must provide printed audit trials and be battery-operated in areas that do not have electricity. It must have a back-up in case of mechanical failure/electricity outage. It must able to provide prompt corruption-free results. Access to Internet and computers to all voters in the country should be looked at. voting enables all eligible voters to cast their votes electronically, via cyberspace, from different location and with different apparatus. The apparatus includes personal computers in homes/business/community facilities such as libraries, cell phones, etc. Once more, the level of computer literacy of all potential voters must be considered"[9],[14]".

The major advantages of e-voting to the country elections include: easy access, effectiveness and efficiency, potential accuracy, fast results, saving time and money, reducing long queues, reducing political intimidation, reducing fraud and corruption, reducing human error, and reducing travelling long distances. It is note-worthy to know that E-voting has some shortcomings as well, among which are: too great costs, being highly sophisticated, attacks from computer hackers, electronic breakdown, lack of audit transparency, not all voters having online facilities. In addition, intensive computer training will have to be done. It can also lead to decreased participation from the public.

Interestingly enough, there are suggestions on how to deal with the above disadvantages. In this regard, experts' were of the opinion that government should be committed to providing electronic access to disadvantaged communities through schools and multi-purpose centers. There should be the introduction of legislation that will deal with electronic voting. This legislation should focus on how e-voting should be budgeted for. It should also deal with fraud and corruption. There should be stakeholders' buy-in. In this regard, political parties and senior managers should be consulted. This will make it easier for the acceptance of an e-voting system. International best practices should also be considered. This will help the INEC in acquiring more information about challenges and alternatives involved on e-voting. New recruitment procedures for staff for an e-voting system should also be looked at. In this regard, the INEC should recruit those employees who have skills in technology as well experience in e-voting. Emphasis should also be made on extensive voters' education and training. Smart cards with voter ID fingerprints should also be established. E-voting should provide a printed audit trail.

Proposed Model for E-voting in Nigeria

The e-voting system must satisfy the following key features:
All votes cast are from valid voter, Only valid voters can cast votes, All valid votes are counted, Only valid votes are counted and Keep log of cancelled ballots
The following under listed requirements should be considered in the development of the e-voting system:

- Configurable Options: All the options should be configurable. Adding a new candidate or a voter's identity should be very easy.
- Secure Voting, Central authority and ensure a proper management of theVoters' Database
- Automatic Result Announcement and Compliance with the existing legal framework
- Roles or privileges of the participating actors should be clearly defined
- Organizational details of the conventional voting processes.

Design criteria of the proposed system:

For the electronic voting system to comply with the constitutional and legal requirements of the country, it must exhibit specific security properties aiming at protecting the Democracy, Accuracy, Privacy, Integrity, Verifiability, Robustness, Non-coercibility, Fairness, Verifiable Participation, Transparency, Flexibility, Convenience, Reliability, Voter Mobility, and Efficiency

All the above requirements are termed non-functional requirements for the proposed e-voting system and all must be met in order to ensure reliability of the system.

GENERAL DESCRIPTION OF THE E-VOTING SYSTEMS

Generally, e-voting model consist of six main phases:

- **Voters' Registration;** This is a phase to define voters for the e-voting system and give them authentication data to log into the e-voting system.
- **Authentication;** The authentication is a phase to verify that the voters have access rights and franchise.
- **Voting and Votes' Saving;** The voting and vote's saving is a phase where eligible voters cast votes and e-voting system saves the received votes from voters.
- **Votes' Managing;** The votes' managing is a phase in which votes are managed, sorted and prepared for counting.
- **Votes' Counting;** The votes' counting is the phase to decrypt and count the votes and to output the final tally.
- **Auditing;** The auditing is a phase to check that eligible voters were capable to vote and their votes participate in the computation of final tally. Additionally there are some other e-voting specific rules verified in this phase.

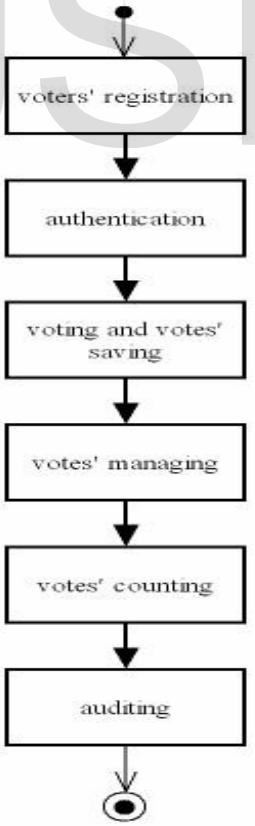

Figure 1. Phases of e-voting.

There are many other relating phases, which were not mentioned. To list some: storing and managing the list of candidates, key

generation and management, storing and managing the list of eligible voters, the installation of system initial position, taking down and archiving the system. For the sake of simplicity, we assume that all these phases are secure, and work properly.

Generally, it is possible to divide the e-voting system into three main components of infrastructure:

Voter Applications, Network Sever and Back-office.

Figure 2 depicts communications between these components.

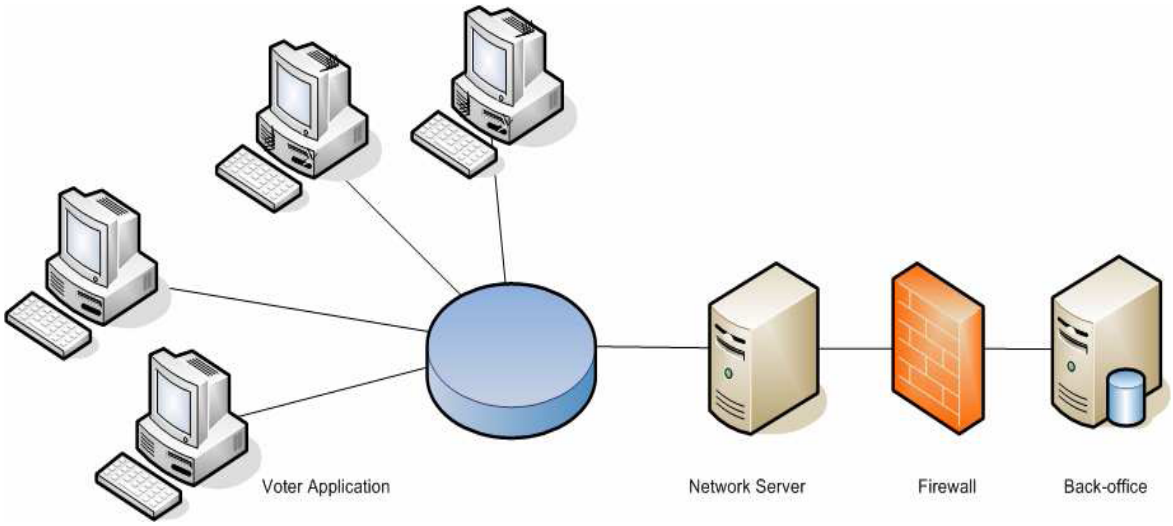

Figure 2. The components of e-voting.

Voter Application is a web application or an application in voters' personal computers for casting votes. Voter application connects to Network Server. Usually, encryptions and authentications methods secure the communication between these components.

Network Server is an online server that provides voters a necessary interface for casting votes. Network Server connects to Back–office server and transfers the received votes to it.

Back–office consists of servers to save and maintain votes and to count a final tally.

In e-voting systems there are many Voter Applications, Network Servers and Back-office servers, but for the sake of simplicity and generalization we consider only one.

In the following, we describe the process of e-voting systems. It starts with a voter connection to Network Server. Next, the voter provides his personal data for authentication. An authenticated voter makes one's choice by using the list of candidates transferred from Network Server. Next, the voter generates a random number *r*, concatenates it to the vote and encrypts created ballot by using a public key *PK* of the e-voting system. It guarantees that without knowing *r* the voter's choice is hidden. Without a randomized component in the plaintext, it would be possible for an adversary to create ballots for all possible votes, because the encryption key *PK* is public. It depends on the specific system, if it uses the voter's signature technology or not. Therefore, the voter's signature on the cipher text of ballot *Enc*(*v*, *r*, *PK*), is optional in the model of the system. In e-voting general model we consider that voters sign encrypted ballots by using their signature private keys.

Network Server receives signed encrypted ballot *Sign* (*Enc*(*v*, *r*, *PK*), *SK*[*i*]) and transfers the accepted signature to Back-office. In order to guarantee that only eligible voters can vote, the processes of Back-office checks the signatures of the ballots and verifies whether voters already voted. If a voter had already voted the systems sends to the voter a signed receipt of voting *Sign*(*ID*, *SK*[*0*]). Votes' managing process saves every cast vote *v*and voter's personal data *ID* in Back–office servers. Back–office process replies to each correctly cast vote with a signed receipt *Sign*(*ID*, *SK*[*0*]), which is a confirmation of the voting system that the vote of the *i*-th voter has been correctly cast. Receipts do not contain any information about the corresponding votes. The voter can verify the signature *Sign*(*ID*, *SK*[*0*]) with public key *PK*[*0*] that corresponds to *SK*[*0*].

When the voting period is ended, Back–office's votes' counting process computes the final tally. Back-office outputs the signed final tally and the signed list of voters.

Figure 3 depicts the process of e-voting systems. The abridgements is in Table 2 below:

Table 2. Data items and their abridgements of general e-voting model.

PK	the public key of the e-voting system which is used to encrypt ballot
SK	the secret key of the e-voting system, which is used to decrypt encrypted ballot in the back-office server
SK[i]	the private signature key of eligible voter
PK[i]	the public signature key of eligible voter
SK[0]	the private key of back-office for signing the voting confirmation
PK[0]	the public key of back – office for verifying the signature of the voting confirmation *v* a voter's choice, vote *r* randomly generated number
ID	voter's personal data file

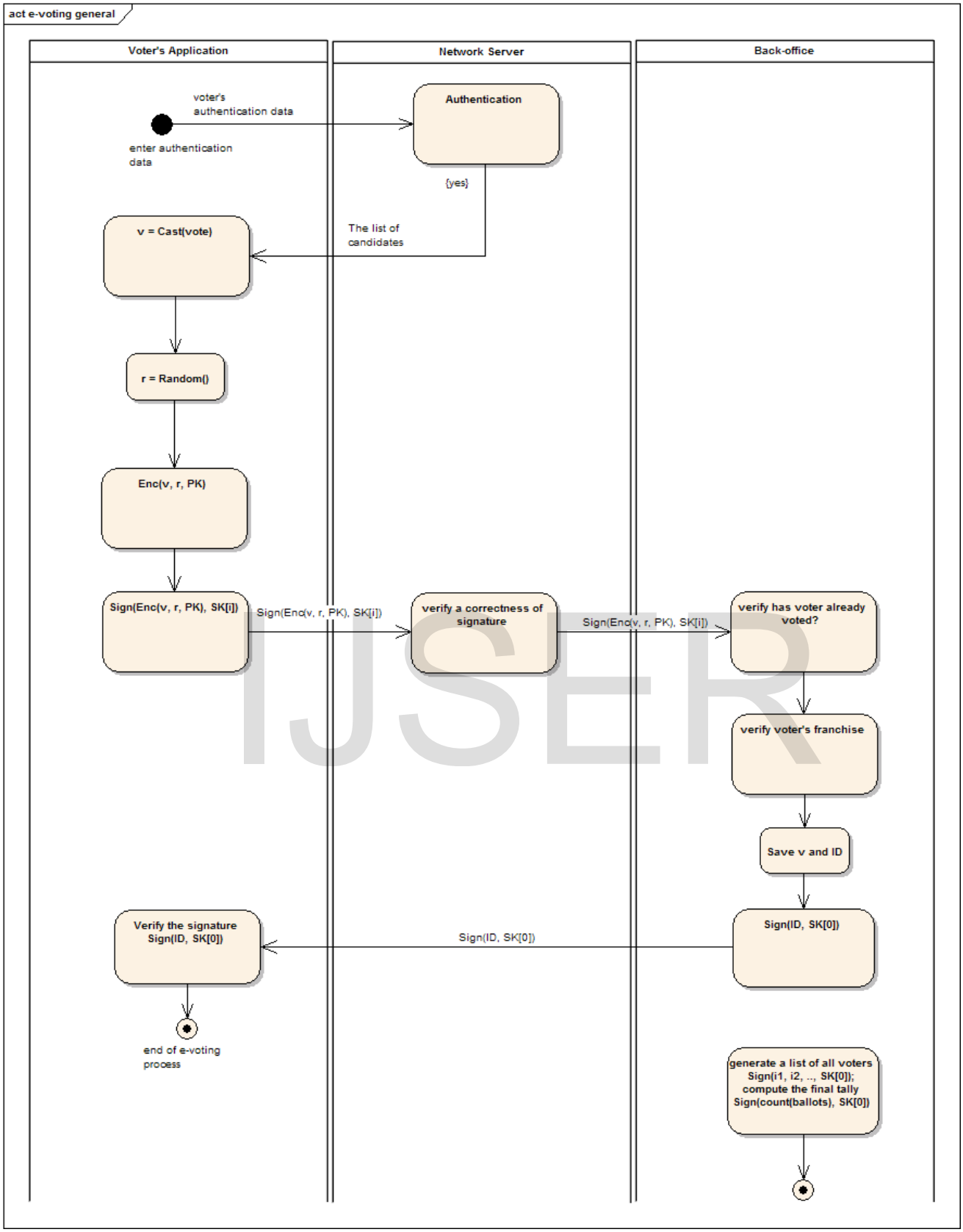

Figure3. The description of the e-voting model.

SECURITY PROPERTIES OF THE E-VOTING MODEL

High security is essential to elections. Democracy relies on broad confidence in the integrity of elections. There has been a lot of attention to an electronic voting by cryptographers. Many scientific researches have been done in order to achieve security, privacy and correctness in electronic voting systems by improving cryptographic protocols of e-voting systems. Currently, the cryptographic schemes are not the main problem. The main interest is the practical security in e-voting systems. Which properties must be justified in a way we could say that the system is secured for implementing? One of the main interests is seemingly contradicting security properties. On the one hand, voting must be private and the votes anonymous. On the other hand, voters must be identified in order to guarantee that only the eligible voters are capable to vote. Hence, e voting should be uniform, confidential, secure and verifiable.

Conclusion

The electronic voting is an automated voting system that enables all eligible voters to cast their votes electronically, via cyberspace, from different location and with different apparatus. The apparatus includes personal computers in homes/business/community facilities such as libraries, cell phones, etc. Electronic voting has been considered to be an efficient and cost effective alternative or complement of the conventional voting procedure. They could lead to increased voter turnout, thus supporting democratic process. This paper appraised the electronic voting concept, its benefits over the conventional voting method in relation to elections in Africa, its benefits in Nigeria electoral system and also proposed a model to be adopted in order to ensure a safe and credible electronic voting system.

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