

A BIOMETRIC E-VOTING FRAMEWORK FOR NIGERIA

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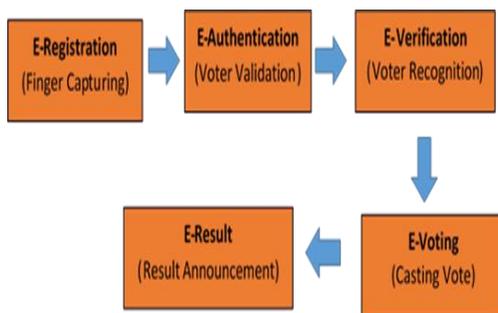
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Graphical abstract



Abstract

Nigeria as a democratic nation in Africa uses conventional paper ballot election system for more than two decades now. Enquiry with proof shows that this conventional election system has lost popularity among the people as it has drawbacks, which call for replacement. Therefore, this paper aims in introducing Biometric electronic voting system, its step-by-step operation, and define a set of requirement to achieve the operation, which are better than conventional paper ballot system in terms of accuracy, security wise, and authentication.

Keywords: E-voting, Election, Fingerprint, Nigeria, Ballots

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1.0 INTRODUCTION

An Election is a formal decision-making by which citizen of a nation chooses an individual to represent them in public office of government through voting. This shows that voting process considered to be very critical and sensitive that has to be taken with care, otherwise, the definition of democracy, which is the government of the people, by the people, and for the people will be forfeited. Therefore, election implementation must serve many requirements in order to deliver a trustworthy election. These requirements can be defined as user conventions requirements and delivery of secure voting process requirements [1].

It is well known that Nigeria as a nation in Africa Continent has been embarking on conventional paper voting system for more than 20 years now [10]. Though, there are problems with this system but voters have generally accepted it as they feel there is no better one. Moreover, if this conventional paper system is going to be replaced with any system, such system must perform better in terms of efficiency and

effectiveness. Failure of the new voting system will jeopardize democracy and trust in the system.

The recent election system in Nigeria now shows that citizens elects the federal level a candidate known as The President (a head of state) and with his assistance called Vice-President. Apart from this, the National Assembly (the legislative) has two chambers; the House of Representative, which contains 360 members, elects for a four-year term in single-seat constituencies; and the Senate has 109 members, elects for a four-year term. Each of the 36 states in Nigeria is divided into 3 senatorial districts, each of which represents one senator, while the Federal Capital Territory represents by only one senator. Nigeria has a multi-party system, with two or three strong parties [2].

From the literatures, [1], [3], we learnt that some electronic voting system were cancelled before implementation in some countries as the voters did not trust the system. This implies that not all electronic voting system have succeeded in delivering a good result. This may be as a result of mistrust towards the voting machine before going live and, for some other reasons. For example, Germany and the Netherlands

have persistently banned their voting machine from use at political elections [1]. Also, in the time past, Britain halted its trials of e-voting as a result of viruses and breaches of ballot security problems. It is only Estonia country that's currently using e-voting successfully for national elections [5].

This paper gives details requirements and design of a generic secure biometric electronic voting system where voters can cast their vote any-time, anywhere

and mainly to cast votes for their choice candidates using a number of electronic devices including private computer networks and web technology. This is to ensure that trust in the system can be maintained and still resolve most of the problems of the old paper base voting system that were formerly in use in Nigeria.



Figure 1 Eligible Voters Verification



Figure 2 Paper Ballot Insertion in Ballot-Box

1.1 The Current Voting Procedure in Nigeria

On each Election Day, according to the schedule released by the Independent National Electoral Commission (INEC), ballots are to be cast between 8.00hrs and 15.00hrs local time. Final results from all over the country are expected within two days to be total together [9]. The voter on presenting him/her identification card (digital ID card) to the Polling Official (PO), then he goes to the adjudicator to verify their names, constituency and their eligibility to vote. After all personal information and their eligibility to vote are verified and accepted by the adjudicator, the voter has to sign the register list to indicate that he or she has attended the polling station. The PO will then stamp and sign the back of ballot paper, fold the ballot paper vertically with the printed side inwards, and issue the signed, stamped ballot paper to the voter as shown in Figure 1 [4]. The voter moves to the voting cuticle, mark the ballot paper in the space provided beside the party logo of the voters' choice, and fold the ballot paper. The voter will deposit the marked ballot paper into the ballot box. While marking of the ballot paper by a voter must be done in secret, depositing the ballot paper in the glass ballot box will be in open view of all persons present as shown in Figure 2 [4]. There will be only one voter at a time to a voting cubicle.

At the end of the voting period, the election officials for each polling station within the same constituency will convey the voting ballot-boxes to the main collation centers to count all votes for that constituent. Counting of the votes is conducted by

electoral commission officials. Vote sorting, counting and tabulating are done in front party agents (candidates representatives) and security personnel. The announcement of the results is down by the Chairman of Electoral Commission on television and radio stations simultaneously so that all citizens can watch and hear the result live.

2.0 LITERATURE SURVEY

From the study, most developing countries are still in implementing stage of e-voting, and while few countries implemented the remote voting system; country like Netherlands in 2004, for instant, in European Parliamentary elections. Spain also planned its own remote election voting pilot that was run in parallel to the 2003 Elections to the Parliament of Catalonia, and 30 municipalities in Great Britain used remote election voting system in their local elections. The United States of America in 2003 had many attempts to use e-voting systems. The Voting over the Internet (VOI) project was used in the in the general elections of 2000 in four states. The Internet votes were legally accepted, but their amount was small (84 votes) [11].

Researches [12], [13], shows that voter cannot be linked to their vote from the past e-voting system due to design of the system. This propose work system is design with biometric recognition to add privacy to authentication. With the rapid enhancement in Computer technology and telecommunication world, Biometric E-voting based Systems are to be

introduced, which makes elections easier and lessens all the conventional election systems' problems. The introduction of Biometric E-Voting System will make the elections processes and social lives will be easy, efficient and low-cost. Biometric E-voting System is secure way to cast the vote as it will meet security requirements such as confidentiality, integrity, fairness, forgery attack, verifiability and so on [1], [3]. This makes E-voting system to be more vulnerable than conventional voting due to the nature of digital processing of election data, which can be easily manipulated. The E-voting system hence may control the widespread of fraud and corruption. With this rapid growth in technology, e-voting is tend to be adopted for voting system by almost all the countries in the world soonest. The main objective of the e-voting is to build an online system, which would enable voters to cast their votes on chosen candidates at minimum cost and efforts on the internet [6].

Biometric Voting System is one of the most important examples of advanced cryptographic protocols with immediate potential for practical applications. Such protocols demands security properties similar to those of conventional paper based elections, but the fact that digital communication is used may also open up new possibilities. Informally, the most important features of electronic voting system are:

Efficiency: One of the significant benefits of this e-voting system is the possibility for increased efficiency. With Electronic Voting Machines, voters can submit their votes, and be reasonably confident that their vote will count. New Electronic Voting Machines can also stop voters from common election faults, such as picking too many or no candidates, also thereby increasing the general effectiveness of voting.

Privacy: Only the final result is made public, no additional information about votes rigging or electoral malpractices.

Robustness: Electronic voting also has the ability to reduce fraud, by eliminating the opportunity for ballot tampering. However, if paper ballots are printed out as a backup in case of a recount necessity, this threat remain

Universal verifiability: After the election, the result can be verified by anyone.

To improve the conventional electoral system of using papers and ballot boxes, there have been several studies on the use of computer technologies. According to Gurchetan [7], the followings are some core properties which the researchers in the electronic voting field have reached, a consensus pack that an electronic voting system should have:

A. Accuracy:

1. It is not possible for a vote to be altered,
2. It is not possible for a validated vote to be eliminated from the final tally, and
3. It is not possible for an invalid vote to be counted in the final tally.

B. Democracy:

1. It permits only eligible voters to vote,
2. It ensures that eligible voters vote only once.

C. Privacy:

1. Neither authorities nor anyone else can link any ballot to the voter who cast it
2. No voter can prove that he voted in a particular way.

D. Verifiability:

Anyone can independently verify that all votes have been counted correctly.

E. Collusion Resistance:

No electoral entity (any server participating in the election) or group of entities, running the election can work in a conspiracy to introduce votes or to prevent voters from voting. So, this characteristic should be measured in terms of the total number of entities that must conspire to guarantee a successful interference in the election.

3.0 PROPOSED MODEL FOR BIOMETRIC E-VOTING SYSTEM IN NIGERIA

The developed Biometric e-voting system designed is proposed to allow many voters to vote simultaneously while ensuring highly availability during the election process. Authentication into the electronic voting system is by biometrics with voter identification number (voter ID) and voting code generated for each voter after registration. Poll site voting and internet voting requires a fingerprint scanner for ballot casting.

The proposed system designed mainly focuses on the following areas as shown in Figure 3. Thus, we have these modules:-

1. Module 1: Server
2. Module 2: Client
3. Module 3: Fingerprint Recognition

3.1 Module 1: Server

This module contain the following components which are to be used in the Server.

Create Account:

The voter has to fill the registration form first. In that, all information regarding voter identity is correctly fill by voter into account. After filling all necessary information the account get created at server site.

Delete Account:

They have privilege of deleting the created account.

Edit Account:

If there is any unnecessary or mistakes made, the server site can performing some editing over there.

DB worker:

DB worker can maintain the database of whole users.

Add Candidate:

After creation of voter account the server site validates that voter.

Authenticate Voter:

Server can authenticate the user's identity.

Count Server:

There is count server at server site which tally a final result as well as it count the duplication of records and maintain a log for that.

Dispatch Result:

Final step is dispatched as a result.

3.2 Module 2: Client**Create Account:**

Voters have to fill all the necessary information on the particular site. After filling the form with the necessary information the voter's account is created at server site. Then the voter can perform all operation which they have.

Login:

The voter can login into his/her account at any time. In this login, voter can check to whom he/she vote, and whether his/her vote is tally in final result or not.

Vote:

At the Election Day, all what the voters have to do is to login into his/her account which has been previously created. After login successfully, voter can cast his/her vote for their candidates having passing through module 3 successfully.

3.3 Module 3: Fingerprint Recognition**The Basics about fingerprint:**

Fingerprint recognition is the automated method of identifying or confirming the identity of an individual based on the comparison of two fingerprints. It is one of the most well-known biometrics, and it is by far the most used biometric solution for authentication on computerized systems. In terms of applications, there are two kinds of fingerprint recognition systems: verification and identification.

For this proposed framework, the pattern of voters fingerprint is very important to be verified and identified by fingerprint machine to authenticate of the voter to cast his vote. A fingerprint is the pattern of ridges and valleys on the surface of a fingertip. The end points and crossing points of ridges are called minutiae. A ridge ending is defined as the ridge point where a ridge ends abruptly. It is a widely accepted assumption that the minutiae pattern of each finger is unique and does not change during one's life. When human fingerprint experts determine if two fingerprints are from the same finger, the matching degree between two minutiae pattern is one of the most important factors.

The proposed system consist two in-built steps, which are Verification and Identification mode. In the verification mode operation, the system verifies whether the input ID (query fingerprint) is consistent with the fingerprint, the output is an answer of yes or no. In identification operation, the input is only a query fingerprint and the system tries to answer the question: Are there any fingerprints in the database that resemble the query fingerprint? The output is a short list of fingerprints [8]; however, the matching

algorithm plays a key role in a fingerprint recognition system.

The gray scale of a person is determine by his input fingerprint image, and it has intensity values ranging between 0 and 255. Hence, the ridges of fingerprint image appear as dark lines while the valleys are the light areas between the ridges. Minutiae points are the areas where a ridge becomes discontinuous. A ridge can either come to an end, which is known as termination or it can be divided into two ridges, known as bifurcation. The two minutiae types of terminations and bifurcations are of more interest for further processes compared to other features of a fingerprint image. The importance of binarization is to convert gray scale image into binary image by fixing the threshold value. Therefore, the pixel values above and below the threshold are set to "1" and "0" respectively.

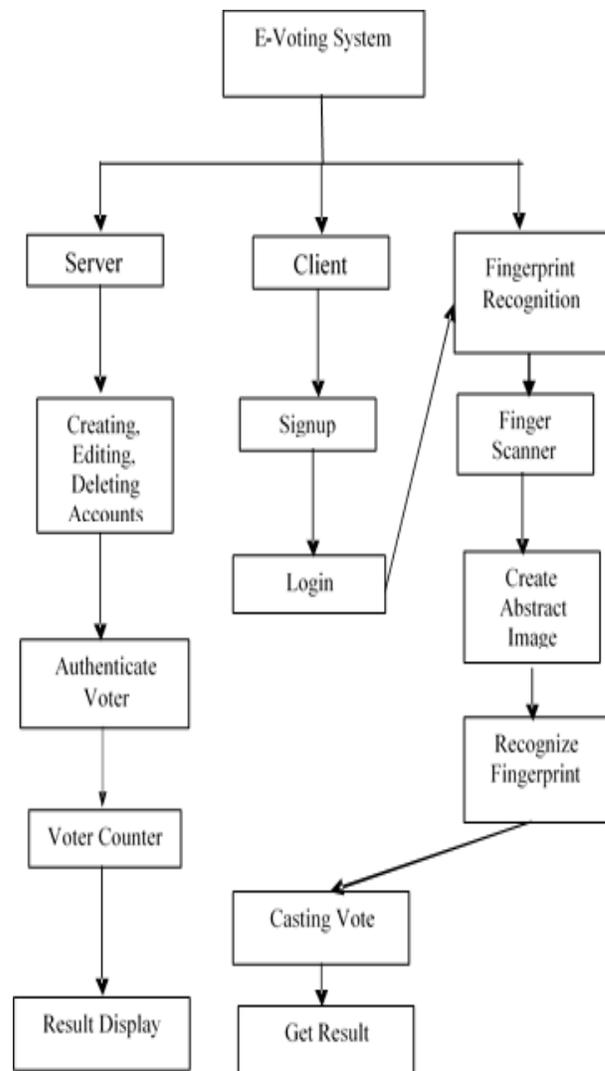


Figure 3 Proposed System Design

4.0 CONCLUSION

The E-voting system using Biometric is unique. It changes the fate of nations, influence participation and activism in politics, and deeply affect the lives and attitudes of citizens. It enables a voter to cast his vote online without going to a polling place. Also, proxy vote or double voting is not possible. Knowing voting result by any entities except for an e-voting device is not possible.

In the time memory, fingerprints have been one of the most highly used methods for recognize and identify human being; automated biometric systems have only been available in recent years with advent of computer system. Therefore, to achieve this perfect framework of e-voting system in Nigeria, there must be constant electricity power supply for 24hours and the internet facilities must be working perfectly. There is not in though out, Nigeria has many IT guru who could make uses of internet facilities. E-voting demonstrate a clear importance for other advance countries, so not only must this system work, the people of Nigeria must believe that it works.

References

- [1] Krimmer, R., and Triessnig, S. 2008. The Development of Remote E-voting around the World: A Review of Roads and Directions. Baldoni, M., Son, T.C., van Riemsdijk, M. B., Winikoff, M. (eds.). DALT 2007. LNCS (LNAI), Springer, Heidelberg. ISBN: 3-540-77492-0 978-3-540-77492-1. 1-15.
- [2] Ola Awoniyi, 2006. Elections in Nigeria. [Online]. From: http://en.wikipedia.org/wiki/Elections_in_Nigeria. [Accessed on 1 April 2015].
- [3] Phillips, D., and Von Spakovsky H., 2001. Gauging the Risk of Internet Elections. *Communication of the ACM*. 44(1): 73-85.
- [4] Editorials, Voting News. 2011. Don't Push Panic Button on E-vote. *Edmonton Journal*. Dec 14. [Online]. From: <http://thevotingnews.com/dont-push-panic-button-on-e-vote-edmonton-journal/>, (Accessed on 10th April, 2015).
- [5] Slovak, M., and Pettai, V. 2008. The Parliamentary Election in Estonia, March 2007. *Notes on Recent Election/Electoral Studies*. 27(3): 547-577.
- [6] Okediran O. O., Omidiora E. O., Olabiyisi S. O., Ganiyu R. A., and Alo O. O. 2011. A Framework for a Multifaceted Electronic Voting System. *International Journal of Applied Science and Technology*. 1(4): 135-142.
- [7] Gurchetan S. Grewal, Mark D Ryan, Sergiu Bursuc, and Peter Y A Ryan. 2013. Caveat Coercitor: Coercion-Evidence in Electronic Voting. *34th IEEE Symposium on Security and Privacy*. San Francisco, CA. 19-22 May 2013. 367-381.
- [8] Riza Aditya, Byoungcheon Lee, Colin Boyd and Ed Dawson. 2004. Implementation Issues in Secure E-Voting Schemes. *Proceedings of the Fifth Asia Pacific Industrial Engineering and Management Systems Conference, Gold Coast, Australia*. 12-15 December 2004. 1-14.
- [9] Irin, 2015. Humanitarian news and analysis. [Online]. From: <http://www.irinnews.org/in-depth/70457/30/nigeria-overview-of-the-election-pro> [Accessed on 10 April 2015].
- [10] Workers' Alternative, 2015. Nigerian General Election. [Online]. From: https://en.wikipedia.org/wiki/Nigerian_general_election_2015. [Accessed on 10 April 2015].
- [11] T. Kh Ahmed and M. Aborizka 2011. Secure Biometric E-Voting Scheme. R.Chem (Ed.). ICICIS, Springer_Verlag Berlin Heidelberg. 1(134): 380-388.
- [12] Ibrahim, S., Kamat, M., Salleh, M., and Aziz, S.R.A. 2003. Secure E-Voting With Blind Signature. In: *Proceedings of IEEE 4th National Conference on Telecommunication Technology*. Shah Alam, Malaysia. 15 Jan. 2003. 193-197
- [13] Carroll, T.E., and Grosu, D. 2005. A Secure and Efficient Voter-Controlled Anonymous Election Scheme. *Proceedings of International Conference on Information Technology: Coding and Computing, ITCC*. Las Vegas, NV, USA. 4-6 April 2005. 721-727.