Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 06, June-2020

Input Control Collation System

A Step Towards Full Digitization of Electioneering Process in Nigeria

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***Abstract*— Two decades after return of democratic rule in Nigeria, collation of election results still gets tarnished with different forms of irregularities. Incredulity over integrity of every election creates a feeling of distrust and erodes confidence of electorates in the electioneering process. While this study acknowledges the large literature proposing a total digitization of electioneering process as the only solution to eliminating election fraud. It argues that, due to numerous factors peculiar to Nigerian dogmatic setting, the collation process needs to restrict freedom of election officials in manipulating the result sheets. The study proposes a transparent and verifiable system that controls collation inputs of officials by highlighting inconsistent figures and forcefully iterating stages that need review. The paper further shows that the ability of the system to control the inaccuracies from the grass root level ensures a smooth transition of collation activity across all collation units. Consequently, election results collation, presentation and pronouncement will be accurate, precise and prompt.**

Keywords*— *Electronic Voting System (EVS); Electronic Voting Machine (EVM); Independent National Electoral Commission (INEC); Election; Internet Voting

I. INTRODUCTION

The democratic system of governance is still trying to get a grip in numerous African countries. After witnessing a series of progressive starts, many African countries and the Africans are becoming more interested in the western-style of governance. Though, the African democratic countries are working hard to adapt the western-ruling system, some of these countries have been enmeshed with innumerable forms of challenges including corruption, election rigging, banditry and terrorism, arms, drugs and human trafficking, armed and ethno-religious conflicts. The presence of these security threats in the continent has been labelled as a major factor that limits the growth of democracy in some of parts of African countries [1]. This paper has chosen to improve the electioneering process, with specific reference to Nigeria's election, in order to lessen the fraudulent acts involved in the process. This is because one of the most important factors used in evaluating the augmentation of every democratic system is the transparency of its electioneering process. [2] state that credible elections are a salient indicator of democratic consolidation and the principal institutionalized means of forming and changing democratic governments.

To be more specific, this paper chooses to focus directly on the Nigerian election collation procedures. This is because, two decades after the return of democracy in Nigeria, collation processes still get tarnished with different forms of irregularities. A number of past researchers have identified distrust over integrity of electioneering process as one of the major factors that cause violence [3]–[5]. A salient factor that questions credibility of several elections is delay in announcing the outcome of the elections. A practical experience that jeopardized the peacefulness of Ethiopia's 2005 election was the delay in announcing its outcome [6]. Emergence of Direct Recording Electronic (DRE) Voting Machines in Brazil stems from the frequent reports of frauds during transporting and collating of results [7]. In a similar circumstance, Nigeria's election is characterized by a prolonged delay in announcing its outcome [8]. Often election officials take days collating results from one stage to another before the results reach declaration stage. Conventionally, election fraud, erroneous calculations, election materials theft, obliteration and fabrication of result sheets occur in this period of fretfulness [9]. While some of these wrongdoings happen with intent other immoralities occur inadvertently due to the flaws associated with the system being used in collating results.

Election officials at different collation stage deliberately fabricate or speciously write contradicting results which are either not acceptable or, at a larger view, not presentable. Most of these fabrications and mistakes originate from the polling units or ward levels where the officials, at that point, have no system to control the numbers they record in the given collation sheets, which are further submitted to higher collation units. Majority of these bogus results are not, in reality, obtainable when compared with the figures in the voters' register or number of accredited voters in the unit. These errors become more complicated when such results move to a higher collation unit, thus complicating the work of higher collation officers at a stage where resolution is likely impossible. Rather, cancellation of results may likely be the only option at such stage, which in turn leads to inconclusive elections at a declaration stage.

This article presents an exhaustive review of the existing collation procedure and suggests a technical framework that would address such irregularities at every collation stage for future elections.

The objective of this framework is to provide a system that would help collation officers collate and present election results accurately, precisely and within the shortest time

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 06, June-2020

possible. The data accuracy would be achieved based on the proposed system's regulatory feature which controls user's input at every data entry level. The system design provides users with a guided information at the end of each segment of data entry. This information tells the user the summary of their input, its consistency and correspondence with the previous data fed into the system. Instantaneous alerts warn users whenever one of their inputs appear to be inconsistent with the previous entries, thus ensuring a high level of precision in result collation. An accurate and precise data collated in the result sheet ensures a smooth and fast collation at higher collation units. Consequently, pronouncement of results can be made within the shortest period possible.

The paper is organized as follows: Section 2 presents previous research works related to election in Nigerian context and foreign countries, the section also discusses the factors that both inhibit and favor the use of digital solutions in addressing election challenges. It then compares the existing realities in Nigeria with the countries where these solutions were implemented. In section 3, we describe our proposed framework that will suitably work for Nigerian setting based on the comparative study above. Section 4 focuses on the functionality of the proposed system and how the functionality rhymes with the paper's objectives. Conclusion of the paper and suggestions for some future research directions occupy the fifth section.

II RELATED WORK

Disparity among election results, such as inconsistent figures, over-voting, wrong calculations, and fabricating of results, is a common phenomenon in Nigerian electoral collation processes [10]. In the past two decades, the Nigerian electoral body has not put any technical system in place that would change the conventional method of collating election results in the lower collation units. On the contrary, a smart card reader (SCR) was introduced in Nigeria's 2015 general election. This was to complement the electronic voters register captured in 2011 general elections. SCR is an electronic device that authenticates and, at the same time, accredits voters with their respective voter's card [11]. Despite this effort, the 2011 general election and the subsequent elections did not control the irregularities associated with many of the electioneering process. All it does was highlighting the inconsistency of figures if the total votes cast become higher than the number of accredited voters.

Consequently, many scholars have attempted introducing technological solutions with specific aim of getting rid of the challenges associated with Nigerian Election procedures [8], [10], [12]. For instance, reference [10] suggest an electronic voting solution for Nigerian electoral system. These scholars have designed a framework which allows electorates to vote candidates of their choice using Automatic Teller Machines (ATMs), mobile devices and standalone SCRs. The authors have made a coherent explanation on why the proposed framework is designed to perform on these three different electronic devices. Parts of the reasons are to intensify the number of available options and increase voter-participation in the election. Other reasons these researchers considered were the prevailing infrastructural challenges including poor electricity supply, poor internet connectivity and lack of access road to remote areas in some parts of the country.

While the authors' concept of improving the electoral standards in Nigerian electoral system is commendable. There are, however, other important aspects their study failed to address which may likely thwart the success of the electronic voting system (EVS) in Nigeria. One of the main weaknesses of this study was failure to compare the existing realities in countries where these EVSs failed and the existing realities in Nigeria. A number of studies have investigated the success and failures of EVSs in different countries across the globe. [13]–[17] outline several countries which have experimented EVS and later revert to paper balloting. A quick mention of few of these countries include Germany, Paraguay, Netherland, Ireland and so on and so forth. Recent research shows that only 20 countries are still using electronic voting machines (EVMs) out of 31 countries that have experimented the machines [16]. Reference [18] study reveals that while some countries discontinued use of EVMs other countries got on board. The research shows at least 15 countries are still using EVSs which exposes a decline from the figure quoted in 2013 above.

It is clear that Nigeria share similar, in some cases has extended number of, factors that led to the abolishment of EVMs in these aforementioned countries. It appears that [10] EVS technological solution overlooks a number of important factors that are key to its success. A thorough comparison of Nigerian milieu with respect to these countries will be discussed later in this section.

On the other hand, it is worth noting that a number of countries record a huge success in electronic voting [12]. For instance, Estonia, Canada, France, and Switzerland remain the four core countries which have been using EVS over the course of several elections and referenda. As at 2012, only Estonia, out of these four, offered a full EVS to the entire electorates [17]. A counter report reveals that Brazil's DRE voting machines were introduced in 1996 and electronic voting became fully implemented in 2000 [7]. Other countries that recently offered a full EVS to the entire electorates include United Arab Emirates, Venezuela, India, Namibia [14], [17]. There are, however, a number of reliable reports that show a significant number of these countries implemented their EVS to only a portion of the electorates. For example, France EVS experimental journey started in 2001 at Voisins-le-Bretonneux using a kiosk, which was set up in the polling station. In 2002, further experimental piloting was conducted in Vandoeuvre-les-Nancy and Issy-les-Moulineaux in the presidential and local elections respectively. Paper balloting was also used as the former were only mock elections which did not count towards results collation. Despite the huge success of the mock elections, the French authorities only implemented internet voting for the election of the Assembly of French citizens living abroad [17]. Other countries that partially implement EVS in some of their districts' election include USA, Belgium, Argentina, Russia, South Korea, Philippines, and Iran [14], [15].

Another laudable effort towards perfecting Nigerian electoral process was attempted recently. [8] came up with a mobile based solution aimed at transmitting election results to a central server. While the objectives of their study differ from

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 06, June-2020

ours, their aim appear to be almost similar to ours. The scholars have developed an android application for collating, transmitting and publishing results to a central server. One interesting aspect of their application is; it is designed to run on android mobile phones and INEC's SCRs, which are richly available at every polling unit in the country. Further collation, tabulation and transmission are done via short message services, SMS, of the devices. The collated result is then published in a result portal after being subjected to some administrative verifications.

It can be noted, however, that the authors have attempted to transform part of the election process to EVS. This was due to the increasing concern of many analysts about possible resistance full implementation of electronic voting encounters from both electorates and the opposition. Another nerve-wracking issue associated with [8] system is it automates and virtualizes the most critical and sensitive part of the electoral processes. Virtualization of this part will no doubt trigger a feeling of suspense from the angle of the opposition and other electorates. Additionally, any outcome that does not appear to favor the opposition may likely be rejected. This is because EVS, unlike the paper balloting, does not provide the public with platforms that could be explored to verify results [12].

An essential component of election credibility is ensuring open and accurate counting of votes. It is a common attitude among Nigerian candidates, contesting for different public offices, to preach to their followers on the importance of protecting their votes [19]. This is usually done through assigning party representative/agent by each contesting party to monitor the conduct and report the outcome of the election at their centers. All these efforts are attempts to ensure the electorates votes count and the conduct of the election is fraud-free.

In recent years, party agency has changed focus from a mere oversight function to collation network. Recently, many strong political parties establish collation centers, in form of situation rooms. Practical experience reveals that situation rooms collate result faster than the official results. This is because most of the collation by these centers is done electronically. Copy of result sheets are scanned and sent, some representatives use SMS to send figures only. The single most striking observation to emerge from these centers' effort is their outcome, often, reflect the exact outcome of the official figures. This was one of the reasons that triggered the famous Orubebe saga in 2015 General Elections at National Collation Center (International Conference Center, Abuja). Mr. Godsday Orubebe, a former minister of Federal Republic of Nigeria, accused the then INEC Chairman, Prof. Attahiru Jega, of conniving with the opposition and fabricating results [20], [21]. Mr. Orubebe claimed the result being declared at the official center were not in any way different from what was trending in the social media handles of the opposition [8].

Moreover, there have been several claims that demonstrate failure of party agents to track and protect their votes results in abysmal manipulation of election results. It is in this regard, that some aspirants utter some inciting statements in an attempt to prevent election rigging and ensure that all votes count. In 2011, one of Nigerian presidential aspirants was believed to have ordered his followers, at one of his campaign grounds, to kill any person who attempt to change the election results [19]. Though Sheikh Ahmad Lemu led-committee, a Presidential Committee on the 2011 Election Violence and Civil Disturbances, reports that a strong desire for change of Government and bad governance were the major causes of the 2011 post-election violence [4], [22] . Many analysts argued that the violence may directly be linked with the inciting statements uttered by some high-profile politicians during the 2011 election campaigns [4]

It can thus be argued that any attempt to conceal any sensitive part of the voting process or fully virtualize the process may not only be resisted by the public or opposition but may create political unrest and increase the tendency of disputing the outcome of the election. A practical example that may be used to support the above claim is the Brazilian e-voting system. As noted above, Brazil successfully implemented its EVMs in 2000. There have been, however, several criticism on the system that are majorly associated with public trust and public confidence [23].

A comprehensive survey of relevant research reveals that successful adoption of EVS requires public trust and confidence [7], [10], [18], [24], [25]. It is, therefore, argued in this paper that a gradual application of smart electronic devices (SEDs), that will improve the Nigerian electioneering process, would be more acceptable and successful than the earlier proposed EVSs. In this regard, this study completely changes the focus from e-voting frameworks to the usual voting process with a SED controlling the human-aided-fraud. This research has considered so many angles that influence the success and failure of adopting information system (IS). Part of these facets, however, are the myriads factors that trigger human resistance to any form of innovative IS introduced to ease and improve productivity and efficiency of any organization [26] It is a common habit among users or people to resist any new IS due to their culture and adaptation to the old system [26]. A crucial factor that is peculiar to Nigerian electorates and opposition is the prevailing mistrust between the followers and the government. This wariness between the duo and the different political interests that exist among them would result in an increased resistance to the system. Additionally, though election fraud may be curbed due to the physical presence and electorates' effort in protecting votes, however, the electorates believe election fraud occurs despite their cautiousness. This is majorly the reason why we need to first introduce devices that will improve the entire electioneering process thus establishing trust and confidence in the system. We strongly believe the success of our proposed system would boost the confidence of the public in the process and increase the level of electronic devices' acceptability.

A. Existing Realities in Nigeria in Comparison with Factors that Inhibits EVS Success in Countries across the Globe

Table 1 shows a number of countries experience with EVS. The table highlights year of implementation of EVS in each of the countries and points out the time it takes before abandonment. The fifth column of the table summarizes the factors that led to the discontinuity of the system. A careful examination of those factors reveals the main concern across all the countries can be categorized into two. First and a major concern raised in majority of these countries is transparency and verifiability issue. Paraguay, Belgium, Netherland and

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 9 Issue 06, June-2020

Ireland are some of the countries in which anti-EVS activist capitalized majorly on the transparency requirement of every voting process. [25] highlight one of the main challenges associated with EVSs is the security due to the uncontrolled and unsupervised internet environment. There are, however, ongoing research to provide a system that is verifiable by the electorates [18], [25].

Table 1: Factors that Inhibit EVS Success in Countries across the Globe

Country	Year of Implementation	Year of Discontinuity	Reason for Abandonment	Source
Ireland	Early 1990's	2006	Security flaws in the machines Concern over transparency and verifiability issues	[17]
France	2001	2017	Authority developed security fears after reports of hacking in the US national elections in 2016 emerged	[14]
Norway	2011	2013	Public perception on security of the votes	[15]
Paraguay	Early 2000	2008	Issue of Distrust	[17]
Netherland	1994	2007	Security flaws in the machines Anti-e-voting activist experimentally hacked the system	[15], [17]
Germany	2005	2009	Court order declared the in-use EVMs as unconstitutional, lacks transparency. Security flaws in the machines	[17], [27]
Belgium	1999	2012	Council of Europe recommendations which are based on transparency requirement. EVMs discarded and a modified improved paper-based voting system was introduced.	[28], [29]
United Kingdom	2002	2007	Security complains from opposition parties	[10]

Based on empirical facts, the issue of verifiability of votes may generate relatively higher concern in Nigeria than it generated in other countries. This claim appear to be supported by [9], [30] report and study respectively. The duo labels the Nigerian atmosphere during General Elections as bizarrely tense. A clear message that can be construed from this portrayal is any technology that attempt to shield the public from accessing and verifying their votes stands to be vetoed.

The second and final concern raised in a number of these countries is issue of security. Norway, France, Ireland, Netherland and Germany are some of the countries that have considerably noted the security flaws in the EVMs and succumbed to paper balloting [10], [17]. It is important to note that some of these issues were raised by opposition parties and some anti-EVMs activists. For instance, German Constitutional Court declared the use of NEDAP voting machines (an EVM manufactured by a Dutch company) as unconstitutional in 2009. The ruling was due to a case raised by two voters on two aspects regarding the 2005 German election. The first argument was use of EVMs was unconstitutional and the second was that it was possible to hack the machines [14]. They further argued that, based on these concerns, the results of 2005 election could not be trusted.

Furthermore, a commission was established by Irish Government on Electronic Voting to report on the secrecy and accuracy of the selected electronic voting system (NEDAP). The mandate of the commission was to review the tests conducted on this system and to make a recommendation on the suitability of the system for use in the June 2004 elections. Major concerns raised in the Commission's Interim Report include questions on the system's accuracy. This was due to insufficient testing time and the fact that changes were still being made to the system. The second concern was an observation made on the voting machines which shows the EVMs lack voter verified audit trail. The third concern were about possible violations of vote secrecy caused by the beeping of the machine and plans to publish full details of all votes cast. Irish authorities were left with no option rather than to succumb to paper balloting [17].

Similar concerns were raised in Netherland after Irish decision to abandon the electronic voting. A pressure group (dubbed "We don't trust voting computers") questions the suitability of using same machines for Dutch election in 2006. The group identified several security flaws in NEDAP voting machines. The most perilous of those flaws was ability to easily replace program chips allowing the results to be changeable. Such maneuvers could go unnoticed as the machines lack verification mechanisms. These claims were investigated by an Advisory Committee established by the authority to inspect the allegations and provide recommendations. The committee's report affirms the authenticity of those allegations concerning the security flaws of the EVMs. This finding was the reason that led Dutch Government to terminate the use of EVMs in favor of paper balloting in 2007 [17].

In regard to the above security concern and the counteract responses it generated from various opposition and activist groups, there have been similar groups in Nigeria that are ever ready to oppose similar modernization. This study argues that the notion that the EVS has failed in several developed countries will significantly inhibit its acceptability in developing countries like Nigeria. Another point worth-noting is the cost of procuring the system is enough to generate a heated debate between the warring parties. In 2004, Irish

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ISSN: 2278-0181
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Government spent €53million for the voting machines procurement alone. Another €28million was demanded in order to upgrade the machines to meet Irish Commission on Electronic Voting standards [17]. The magnitude of these amounts alone is enough to save us from further comparing Irish requirements with Nigeria's. There is, however, a need to swiftly state the estimated population of the two countries at this point. This is for the sake of presumably estimating the cost Nigeria would part with in order to register herself as a country that gambled its resources for EVS. Trading Economics (2019) estimates Irish population at less than 4.6 and 4.9 million in 2010 and 2020 respectively. Nigerian population is estimated at 200 million as at 2019 [32]. The number of registered voters in Nigeria as at 2017, as announced by INEC, is 84,004,084 [9]**.** Additionally**,** the prevailing economic challenges, the opposition, the large number of political activists, the procedures needed to change Nigerian electoral laws to accommodate EVS are unfavorable factors for EVS in Nigeria. This argument is consistent with [17] who state that African countries would find hard the required fund for EVS take-off.

B. EVS Performance in Countries where it is still in Use

As noted above, a quite number of countries have been using EVS for more than a decade or two. These countries have stuck to the EVS not because they do not experience challenges associated with the system. Rather, the benefits these countries derive in using the system cannot be ignored. [28] outline some of these advantages including eliminating the tendencies of obtaining invalid votes, which majority of election controversies, inconclusiveness and petitions arise from them. Another penciled advantage is speeding up the counting and tabulation of results. This additionally decreases significantly the large volume of papers printed which in turn saves cost and consequently makes the process eco-friendly. Furthermore, [18] add that a salient advantage of e-voting is the voting rate gets increased. The consequence of which reflect public opinion more accurately.

Predominantly, EVS has recorded a huge success in these countries. Nonetheless, numerous details have captured a considerable scenarios where EVS/EVMs encountered baneful glitches [7], [17], [28]. In 2009, a hacking challenge, organized by Superior Court of SEC, exposed the numerous vulnerabilities of Brazilian EVM software. The cumulative loopholes detected in the software could compromise the main security properties of the equipment [7]. Moreover, the system has encountered several challenges from different groups within the country. While one party reports that the system fails to gain public trust and confidence. Another group adjudges the system as one that fails to raise public involvement in politics and the delivery of public services despite the vast investments made to generate public trust. Other critics criticize government's decision of engaging the technology while millions of Brazilians are suffering from poverty and illiteracy [23].

Another embarrassing reports show that a disconcerting hitch befell Belgium electoral electronic devices during 2003 Election. [28] report that close to 500 power and EVMs failed during the election. The only solution employed was resorting to paper balloting in the affected regions.

Indian election commission had to review the current EVMs after allegations of rigging emerged in 2009 election [33]. There have been numerous complaints and court cases regarding ECI's (Electoral Commission of India) EVMs by several groups including NGOs, Individuals, and other Political Parties since 2001. Most of the grievances raised were implying that the machines could be tempered. The growing number of complaints reached its peak in July 2010 when 13 political parties submitted a joint document to the ECI demanding a review of the EVMs use. While the ECI kept thwarting those claims over this period, the courts kept dismissing the cases [17].

Similarly, a judge ruled in favor of Maryland state of USA in 2004 after receiving lawsuit against Maryland's EVMs concerning their compliance with law of both Federal and the State. The Complainants were not satisfied with the ruling and appealed to a higher court. In 2007, the ruling was upheld by the state Appeals Court [17].

C. The success history of INEC's Smart Card Readers

Though SCR have failed to entirely eliminate election fraud, it has convincingly agreed that its introduction has improved the electioneering process and yielded a fruitful result. Anecdotal evidence reveals that SCRs success was because it does not change the physical method of voting, collating and transmission of results. The concept of SCR does not, in any way, affect votes counting or virtualizes the process. Rather, SCR controls the number of votes cast in a particular election unit. It achieves that by physically authenticating the number of electorates who participate in the election. Its significant impact in 2015 mock elections led opposition and electorates to protest its abandonment plans by the ruling party in the general elections of the same year [34].

There is clear evidence to conclude that SCR success and its wide acceptability to both the public and the opposition parties are attributed to its transparent and verifiable mode of operation.

It is therefore argued in this study, that Nigerian political atmosphere is not yet ripe for EVS rather it requires a simple system that improves the transparency and credibility of its electioneering process.

III. PROPOSED FRAMEWORK

A. Sample choice and Source of Data

The research sample was majorly tertiary institutions' staff whom the Nigerian electoral body always use as its ad-hoc staff in conducting its elections. This group includes both academic and senior non-academic staff. The lower ranking staff are deployed to lower collation units and the higher-ranking staff take charge of higher collation units with majority of Professors serving as collation/returning officers at different levels of results declaration. A good number of this group also serves as supervisors (Supervisory Presiding Officers, SPO) at ward levels. Another sample set used, in this study, was a group of ex-corps members (National Youth Service Corps, NYSC) who took part in 2019 Nigeria's General Elections. Corps Members are usually used, by INEC, as Presiding Officers in every election. The final and a salient sample set used for this research was the INEC officials. These include the electoral officers (EOs) at Local

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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Government Area level, Resident Electoral Commissioners (REC) at State Level and the Heads of Information Technical Units from a number of states offices. The RECs and EOs are responsible for the conduct and supervision of the elections across all states including Federal Capital Territory and across all Local Government Areas respectively.

Most of the information needed for the development of the new framework was extracted from the interview transcripts of the above sample. Other sources include the 2019 general election manual, 2019 general election result/collation forms for all the various election types and election procedures and downloadable forms freely available on INEC's website.

B. System Process Flow

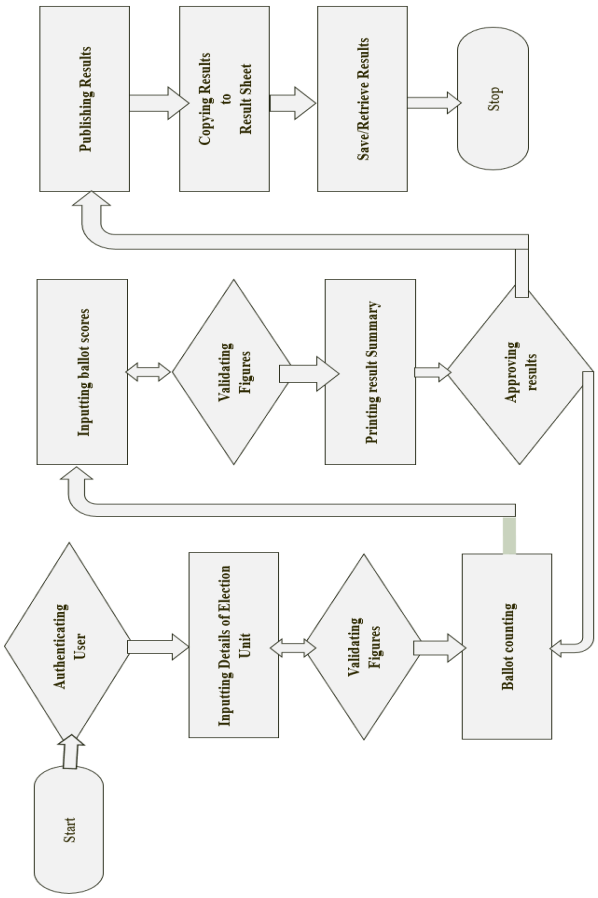

Figure 1: ICCS Process Flow

Recall that the whole idea behind the proposed INPUT CONTROL COLLATION SYSTEM (ICCS) framework is to control users' (INEC Officials) inputs while collating election results. Users would be using the ICCS to input all the results before penning it down to result sheets. The system would be monitoring the inputs to ensure that they neither violet rules of the election nor disagree with mathematical realities. An inbuilt data would be fed to the system that is specific to every collation unit. This data contains the number of registered voters (NRV) in the election unit. This particular information is necessary as it would be used to control the number of accredited voters (NAV) an election official could input. Any figure above the NRV would be rejected and a user would be asked to input a correct figure for NAV.

After the election concludes, the sorting, counting and other activities related to result collation at polling units would be done in the presence of all the stakeholders (INEC officials, Security personnel and Party Agents) present in the unit. An election official is expected to use the system to input results prior to writing any figure on the result sheet. Immediately the user finishes inputting the result on the system, the system would publish the result in an orderly and organized format that corresponds to the templates of the result sheet. At this point, the user would just be copying the published result from the system's screen to the result sheet for submission to higher collation unit. All the stakeholders, at the unit, should be given a right to ensure the published result corresponds to the written result on the result sheet.

C. System Design

This section explains the principle of operation of the system. As stated in section 3.2 above, each system is designed for a particular election unit which makes customization of NRV possible. Customization can be done at LGA or State level. This means only officials at such level have super administrative privileges to input the NRV for a particular ward or polling unit. At that point, another user (Presiding Officer, PO or Ward Collation Officer, WCO) with administrative privileges is created. This user can only write, read edit, and save what he/she inputs.

a) Regulatory Feature

The election official at polling unit level calls for the system help when counting was about to start. A user would be prompted to fill in his/her given credentials for authentication the moment the system starts. If user is successfully authenticated, the system gives the user access to enter the election result. User inputs the number and names of parties that contested in the particular election they are collating. The system then asks the user to input the number of votes obtained by each party that was recorded in the previous step. Immediately the user inputs the last party's number of votes obtained, the system takes the sum of all the votes obtained by each party and displays it as the total number of valid votes (VV) of the election at that particular election unit. The proposed system then compares NAV with VV. If the former is found to be less than the later, the system asks user to crosscheck the inputs and re-enter the votes obtained by each party, otherwise the user should also check the NAV. This is because, realistically, NAV could not be greater than VV. This step iterates until VV becomes less than NAV. The system then asks the user to enter the number of rejected votes (RV). Automatic summation of VV and RV is taken to produce the total number of votes cast (TVC) by the proposed system. Similarly, a quick comparison of TVC and NAV is conducted. The system iterates this step only if TVC is higher than NAV otherwise a summary of the election result is generated for presentation. The summary is subsequently saved in the system and could be retrieved whenever the need arises. This summary is what the PO copies to the result sheets for further submission to WCO at ward level.

System module at Ward Level would be designed to interface with polling unit's module for WCO. The WCO would collect the result sheets from various POs under his/her

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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ward. WCO would request PO to retrieve the save result from their device and compare it with the one on the result sheet. If the results correspond, WCO collects the device and the result sheet for further collation to ward's collation system and subsequently ward result sheet.

At the end of any result display, the user, together with other stakeholders at the election unit, will approve the displayed result on the device. The approved result would be the one to copy to result sheets after which such user cannot alter the entries in his/her device. This result can only be retrieved for reading at this level at higher collation unit. If a user wants to take another input, the user would have to take fresh entries and save it as second election result. This is to safeguard the initial outcome of the result and ensure no fraudulent activities distort the exact figures earlier obtained. In such case, the election official would have to explain to the higher collation officer the reason behind collating more than one result for the same election unit. A clear explanation and strong evidence would help the higher collation officer make an informed decision regarding the different computed results.

b) flexibility and usability

Strong flexibility and usability are expected in the system design. This would give users several options in case the system's input forces iteration. This flexibility would allow users to decide from which of the previous steps the iteration begins. Other features include clearing and deletion of wrong inputs. It is important to remember that one of the core objectives of this study is to reduce, significantly, the time taken to collate and declare election results. Therefore, user friendliness of the system would play a vital role in pulling off the objectives of the study.

D. Security and Encryption

Among the plausible concerns of majority of past researchers, in development of any technical framework, is the security of the system. The present framework may not be exempted from the generic challenges associated with past systems. There are, however, peculiar challenges associated with any system with respects to its mode of design, its technical operation and physical handling. Contrary to other technical systems in the previous studies, cyber-crime does not seem to be a security-threat to the current work. One reason why the present work does not consider cyber-crime as a threat was because it is proposed as a standalone system.

Major issues of concern in this regard are physical security threats. Nigeria's election is often characterized with physical violence as highlighted in section one of this work. Thus, theft and other aggressive physical attacks are the most likely security threats that may hinder absolute smoothness of the system's processes. It is, therefore**,** very necessary to put in place sturdy measures to ensure these anticipated threats are contained. Consequently, in addition to hard encryption techniques incorporated in the proposed framework, there is strong need for policing in the election unit. While the electronic authentication system (such as passwords and biometrics) and proof-casing play an important role in preventing unauthorized use, the physical security personnel provides peaceful atmosphere for the conduct of the exercise. Furthermore, the presence of security personnel at any election unit provides the election officials with the needed serenity to conduct their collation with high level of precision. Thus, easing the entire chain of the collation processes.

IV. PROPOSED SYSTEM FUNCTIONALITY

As noted in section one above, it is evident that delay in announcing election results sends a suspicious intuition to electorates, opposition parties, political activist, and election observers. It is also clear, from above, that a significant amount of these delays stem from the error-prone way of collating election results. The aim of this framework was to provide a system that would help collation officers collate and present election results accurately, precisely and within the shortest time possible. The single most striking observation to consider from the proposed framework is the collation inaccuracies are addressed from the grass-root level to higher collation units. As discussed in section 1.2 above, once the root level collation is infiltrated with incorrect figures the complexity of the collation boo-boo increases as the results move from one unit to a higher collation unit. The system ability to control the inaccuracies from the grass root level ensures a smooth transition of collation activity across all units. Consequently, the long period of time wasted by the officials trying to resolve inconsistent figures is put away, thus reducing the delays in election outcome pronouncement. Though the aim of the current study emphasizes on only three main aspects, accuracy, precision and promptness, the benefits of the proposed framework cannot be limited to the trio alone. A number of researchers have adequately explained the inconveniences, risks and wastefulness of resources that stem from the inefficient conventional collation system [5], [8]. This study, however, tries to look at some of these issues and provides a convincing proof on how the framework mitigates or completely stamps out the hitches.

A. Restoring public confidence

To infer if our framework could restore public confidence in electioneering processes, we look at the factors that influence public perceptions. The most obvious factor that restores public confidence is the transparency of the election. One of the aspects that inculcate optimistic perception in the mind of the electorates is when it becomes open to each and every voter that his/her vote counts [35]. This is one of the reasons why the Nigeria electoral body introduced pasting of copy of result sheets at each polling or collation unit after tabulation in 2011 general elections. A significant number of voters are very keen to know what transpires in higher collation through their party agents or media channels. The moment a voter understands the result presented at higher collation unit conforms to what she/he knows at their immediate election unit their hope for transparency gets a boost. As the result moves to higher collation unit with similar pattern the positive perception of electorates increases. The political atmosphere reaches its peak intensity immediately voting closes prior to announcing results. At this point, every political group would be anxious to know the outcome of the election. The public apprehension, at this period of uncertainty, is generally seen as a factor that strongly interprets any delay as an attempt to manipulate the election outcome. One of the more significant findings to emerge from our framework is the smooth transition that takes place between lower collation units and the higher ones. The hitch

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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free transition eliminates all delays attributed to sending election official back to resolve his/her inconsistencies. The evidence from this study suggests that more delays in declaration of election outcome dwindles voters' confidence. This finding is consistent with findings of past studies by [3] who conclude delays in election results declaration hassle and demoralize the electorates.

B. Time utilization

There were a significant number of tertiary institution staff who deliberately reject the INEC offer to participate as ad-hoc staff in the 2019 Nigeria General Elections. An inquisitive investigation with such staff reveals that they would not participate in any future Nigerian election if the conduct and the processes do not change. One of the major inconveniences associated with the exercise is the large amount of time it takes to collate results. This group describes INEC's ad-hoc offer as unworthy for the amount of time, work and risk associated with the exercise.

This study was spawned to address, and in some cases mitigate, these concerns through easing the overall processes as explained earlier. It is apparent from the findings of this research that the lesser the time it takes to collate results the lesser the cost of managing all the stakeholders and resources involved in the process. This is clear because the electoral body spend a huge sum, to provide light, security, ad-hoc staff, their feeding (a times in monetary form), media teams, which increases with time increase.

Implementation of the present framework, therefore, would increase the participation of both competent personnel and voters as shown above and because of the credibility of the system respectively. Moreover, participation of competent personnel in the Nigerian election exercise would better the system through easing the processes, reducing risks involved in it and saving time due to their precision in undertaking their activities.

C. Conclusion

There is voluminous literature proposing different technological solutions towards improving different electoral processes across the globe. In most of these attempts, the objectives circle around building trust and public confidence, increasing voters' participation, saving cost and having a fair, transparent and peaceful election. However, this study limits its scope to a section of the electoral processes.

It is argued in this paper that the current Nigeria's electoral setting is not yet ripe for EVS rather it can be bettered with an Input Control Collation System. This claim is based on the prevailing challenges in the country's dwindling economy, infrastructural dearth, low literacy level among electorates, and a high concern about public trust and confidence. This finding is consistent with [17] study who emphasize that if such challenges are not well addressed it may lead to a failed projects after Millions of Euro investment.

This study further argues that the Nigerian electoral set up needs a gradual introduction of digital devices that will improve the system and consequently increase public trust and confidence in both the electoral board and emerging technologies. The claim was compared with the SCR scenario in Nigerian election. It was shown that SCR success and its wide acceptability to both the public and the opposition parties were attributed to its transparent and verifiable mode of operation.

The third and final argument raised in this study was that counting, collation, tabulation and pronouncement of results are the most critical processes in the Nigerian electioneering processes that require an overhaul. The conventional process allows much freedom to electoral officers which many a times results in misrepresenting the actual figures obtained in the election. To put an end to this electoral scandal, our study proposes a framework that completely changes the procedure of collating the election results. It was shown that election officials will first be required to use the proposed system to enter figures obtained at each collation unit. The system will then generate a summary of the election result in a format that correspond to the result sheet template. At that point, the official will just copy the summary to the result sheet if no alarm is raised by the system. Otherwise the user will be required to re-enter the correct figures while highlighting the points with possible inconsistencies.

As far we know, no study has been conducted by any researcher on EVS that has fully gratified all the electoral requirements of all nations in the world. As proposed in this study, however, future researchers would need to consider the electoral requirements of each country and come up with particular solution specific to the country's peculiarities. Similarly, this work can be further enhanced by providing a functionality that would enable automatic synchronization between one device and the device in the former's immediate higher collation unit.

DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this work.

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