Development of an E-Voting System Using IBM Blockchain Technology and Users National Identification Number (NIN)

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Abstract- *The aim of this research is to adopt IBM Blockchain Technology in designing an e-voting system using voters National Identification Number (NIN), the objective is to provide an e-voting system to assist voters maintain social distancing during elections, to use national identification number NIN so that only valid voters can vote, to develop an application that will allow valid voters cast their vote with their smart phones from any location using their NIN number, a system that can provide a distributed system that could enable every party representative to be connected together as a participant on the network, and a system that could not allow alteration of data unless fully endorsed by all participants on the network. This work was motivated by the current situation and electoral processes in Nigeria, where after election the last person could be the first and other electoral crimes and activities. The Structured System Analysis and Design Methodology (SSADM) was used for the system design while applying the IBM hyperledger fabric architecture and Proof-of-Work algorithm, the programming language used for the implementation of the proposed system includes: hypertext markup language (HTML), cascading stylesheet (CSS), hypertext preprocessor (PHP), Javascript (JS) and Mystructural Query Language (MYSQL) software for the database design. The result after design was an online voting platform, which was achieved using the IBM Blockchain Technology to ensure adequate security of votes during election. The voting system was an online system which allows voters cast votes remotely by using their Nigerian national identification number (NIN). The results of the election are displayed real-time as they are casted.*

Indexed Terms- *IBM Blockchain Technology, E-Voting System, Hyper-Ledger fabric Algorithm, and Online Voting Using NIN*

I. INTRODUCTION

Electronic voting system (EVS) also known as e-voting is a term encompassing several different types of voting embracing both electronic means of counting votes. Technopedia defines e-voting as "the process that involves a voter casting his/her votes through a digital system, instead of a paper". It can also involve the process of collating and transmitting an election result electronically via telephones, private computer networks, or the internet. Electronic voting technology can include punched cards, optical scan voting systems and specialized voting kiosks (including self-contained direct-recording electronic voting systems or DRE). Nevertheless, for every county to fight against high rate of transmitting infectious disease doing an election process requires a computer base approach. The outbreak of this deadly COVID-19 pandemic witnessed by the whole world is an example why an automated e-voting system must be fully looked and implemented so as to control the rate at which infectious disease spread. During election process here in Nigeria, some many people are crowded in one room trying to cast their votes, touching and sneezing and sometimes fighting are witnessed during this process which might cause the transmission of one or two infectious disease to one another. An electronic voting system is not just

important in providing accurate and adequate voting and counting but rather it will also provide access for people to cast their vote remotely without coming in contact to each other and hence spreading various kinds of infections to one another.

II. LITERATURE REVIEW

Elections are understood to be the key mainstay of democracy all over the globe and voting is one of the electoral routes that ensure the sustenance of democratic system in any civilization. Voting is the process that allows the public or the people to choose their leaders and articulate views on how they will be governed. The veracity of democratic system is primary to the veracity of election itself consequently the election system must be satisfactorily secured to survive a range of fraudulent behaviors and must be sufficiently translucent and comprehensible that voters and candidates can accept the outcome of an election. Real-time voting alludes to the utilization of PCs, information, communication and technological equipment or modernized voting machines to cast, collate, and display election results in real-time (as it is happening). Similar voting process was in use since the 1960s when punched card systems debuted. Their first widespread use was in the USA where seven (7) counties switched to this method for the 1964 presidential election. Estonia became the first country to have legally binding general elections using the Internet as a means of casting the vote, when the country voted for her generation election in October 2005. Since then, countries have taken to a partial electronic voting and counting, while others have fully adopted an electronic voting system. In order to reduce the cost of human and materials involved in traditional election, offer an acceptable electioneering process, enhance efficiency in vote casting, deliver a free and credible election, restore the dwindling confidence of the masses in our elections, Real-time voting has to take the place of traditional voting in Nigeria.

2.1 Impact of ICT in the Conduct of Elections in Nigeria
The importance of Information and Communication Technology in human societies can never be relegated. According to Kroeker and Yonck, the uses of information and communication technologies in

recent times have become inevitable and fundamental to operations and activities of organizations and societies. Research reveals that the usage of ICT in election has eliminated the incidents of multiple registrations, which had been one of the main political tools for rigging elections by unscrupulous and savage elements. Although, it was reported that Nigeria is yet to meet up with international standard for the provision of viable, successful and generally accepted electoral system of democracy, due to lack of full implementation of the required electronic voting system in the county looking at the 2023 general election results where the people are requesting and demanding a more clear tools to be adopted for the election process. This entails combining electronic voters register and smart card readers with election result devices that would be self-auditing and fully equipped with real time facilities. It is believed that the full implementation of the required electronic voting system in Nigeria would improve election management in the country thereby meeting up with international standard.

2.2 Blockchain Ledger
A Blockchain distributed ledger is a type of database, or system of record, that is shared, replicated, and synchronized among the members of a network: The distributed ledger records the transactions, such as the exchange of assessor data, among the participants in the network. This shared ledger eliminates the time and expense of reconciling disparate ledgers. The IBM Hyperledger is shown in Figure 1 below. Every record in the distributed ledger has a time stamp and unique cryptographic signature, thus making the ledger an auditable history of all the transactions in the network. In the context of Hyper-ledger Fabric, the ledger is composed of two components: The blockchain itself, and the world state database [1].
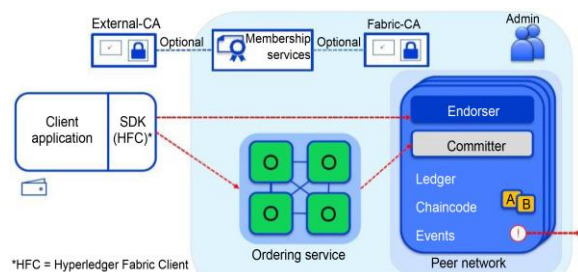

Figure 1: IBM hyperledger fabric architecture[2].

2.3 Review of related Literatures

According to [3] proposed that cryptographic techniques are employed to make sure that the security of voting systems in order to increase its wide adoption.However, in such digital e-voting systems, the public bulletin board that is hosted by the third party for publishing and auditing the voting results must be trusted by all participants. Currently, a number of Blockchain-based solutions have been proposed to address this issue which was why Blockchain has been rated as one of the best technological approach in maintain stronger security to devices.However, these systems are not the main idea of cryptographic voting schemes is to provide transparency while protecting the ballot secrecy and to enable a fast tallying function. In their research, they address three major issues of cryptographic voting schemes. [4] proposed that the first implementation of a voting system as a smart contract running on Ethereum that uses threshold keys and linkable ring signatures to provide a robust and transparent system that could be implemented for medium size elections. Each voter is responsible for his/her vote and can monitor his/her vote while remaining anonymous amongst a set of users. The protocol minimizes the existing centralization by the use of threshold cryptography, allows the voting to be tallied by anybody and does not require each user to vote for the tallying to be exact. On same note, [5] states that building an electronic voting system that satisfies the legal requirements of legislators has been a challenge for a long time. Distributed ledger technologies are an exciting technological advancement in the information technology world. Blockchain technologies offer an infinite range of applications benefiting from sharing economies. Their paper aims to evaluate the application of Blockchain as service to implement distributed electronic voting systems. Their research elucidates the requirements of building electronic voting systems and identifies the legal and technological limitations of using Blockchain as a service for realizing such systems.[6] states that current electronic voting protocol requires a centralized system to control the whole procedure from ballot inputs to output results and election monitoring. Meanwhile, blockchain provides a decentralized system which opens across the whole network of untrusted participants. Applying Blockchain into

electronic voting protocol through a proper architecture can instill characteristics such as data confidentiality, data integrity, and data authenticity. In their paper, they discuss a proposed method on how to leverage the advantages of Blockchain into an electronic voting protocol. Their Blockchain-based electronic voting protocol promises to provide a secure electronic election process given the proposed system works.[7] worked on a decentralized E-Voting System. The main concept of their work was to combine the technology of Blockchain with Cryptographic Hash Function and Digital Signatures in order to realize the decentralized e-voting system with all the requirements of voting process without a trusted third party developing E-voting protocol that utilizes the Blockchain as a transparent ballot boxes linked using cryptographical techniques to solve the issue of unauthorized altering of data. Their work implemented a voting system as a smart contract deployed on Remix IDE using Solidity language running on Ethereum and node server which creates nodes for every user to store encrypted vote details in each block and thus providing a transparent and robust system for medium size elections.
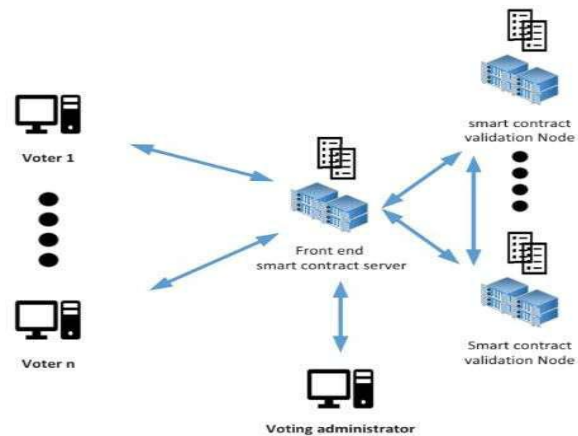

Figure-2:Blockchain e-voting system (Source: www.irjet.net)

III. METHODOLOGY/ANALYSIS

The proposed system will be build based on web platform using Structured System Analysis and Design Methodology (SSADM). The SSADM follows a linear sequential flow in which each phase must be completed before initializing the next. SSADM divides an application development project

into modules, stages, steps, and tasks, and provides a framework for describing projects in a fashion suited to managing the project. SSADM's objectives are to: Improve project management & control, Make more effective use of experienced and inexperienced development staff, Develop better quality systems, Make projects resilient to the loss of staff, Enable projects to be supported by computer-based tools such as computer-aided software engineering systems and establish a framework for good communications between participants in a project

3.1 System Analysis

The goal of a system study is to identify the needs for the system's purchase, creation, and installation. The system study cannot be deemed finished without a thorough investigation of the problem. A problem is rigorously examined in its current state by being broken down into smaller problems in system analysis. Any study of requests must collect data because doing so enables the detection of problem areas. This analysis must familiarize the designer with the organization's objectives, procedures, and functions before the system can be constructed.

3.1.1 Analysis of the Existing System

The existing system of voting system across all states in Nigeria are done in a traditional settings, which is to say for voting to take place, the voters must firstly acquire their voters card before they are able to vote. This traditional process has been found with a lot of issues. Voters go through stress on long queue during the collection of their voters card; sometimes it takes them days before they finally get their voters card. When the day of the election comes the voters looks for the nearest voting center to cast their votes, in the voting center, they are given ballot paper. And from the analysis of the existing voting System employed by Nigerians, the study was able to identify the following issues: voting centersare crowded by voters, there are high increase of omission of voters from the register, result manipulation such as using correction fluid to wipe casted vote by operator as experienced in the just concluded Nigerian 2023 election, poor network even when BVAS electronic system was employed during 2023 Nigerian election as reported by voters, results are manipulated and other illegal issues experienced during the conduct of the election.

3.1.2 Analysis of the proposed system

This study proposed to design an E-Voting System using IBM Blockchain Technology and Users National Identification Number (NIN) which will enable voters to visit the platform at the comfort of their home which will required them to vote by using their National Identity Card Number. Once the NIN number is entered, and the voter selects his/her preferred candidate, then hit on vote button the database will store the votes and result shown at once on the winning candidate.
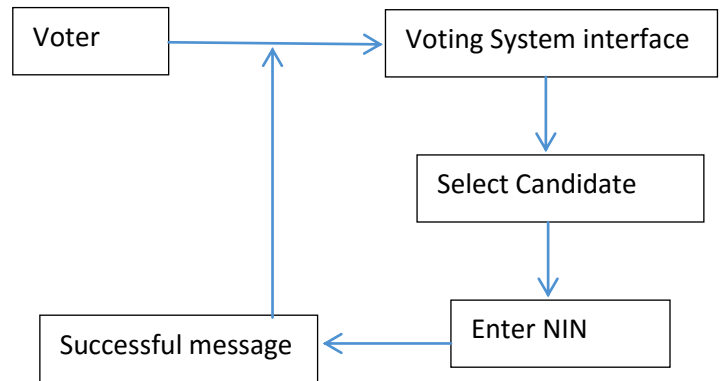

Figure 3: Analysis of the proposed system

3.1.2.1 Analysis of the proposed system using the IBM Blockchain Technology
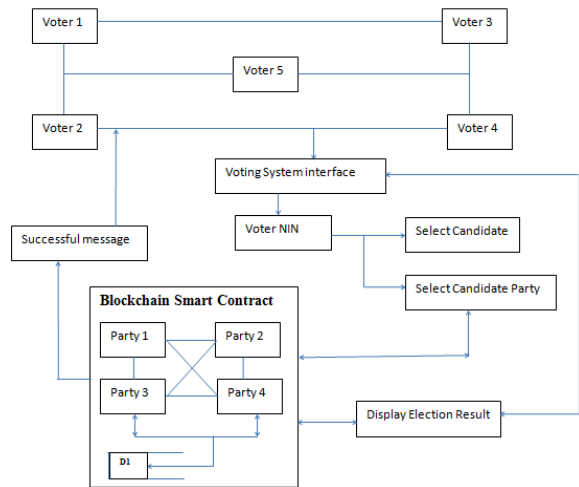

Figure 4: Diagram of the proposed model

The IBM smart contract technology was used in the analysis and design of the e-voting system where all the participants in the Blockchain smart contract represents each party agent and all must give consensus before any uploaded casted vote could be

manipulated according to the proof of work algorithm. Critical view of the proposed e-voting system is shown in figure 3 and 4 respectively.

IV. RESULT

The result of the proposed e-voting system is shown below with the various interfaces to enable voter cast his/her vote remotely.

Figure 5: Home interface serves as the landing page for the election platform
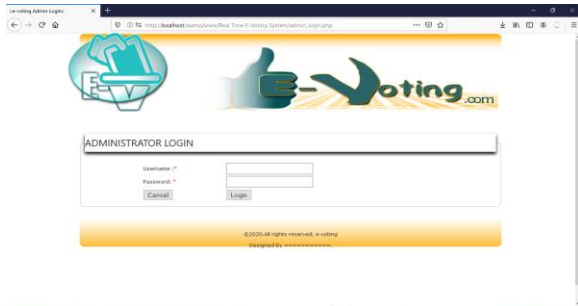

Figure 6: Admin Login Page: The interface enable the administrator's to login into the dashboard for either registration of official members, party agents and proper management of the platform.
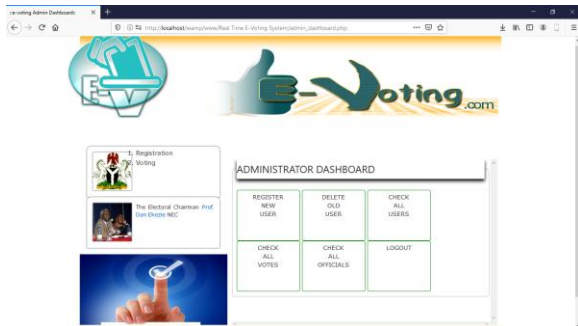
Figure 7: Administrator dashboard.
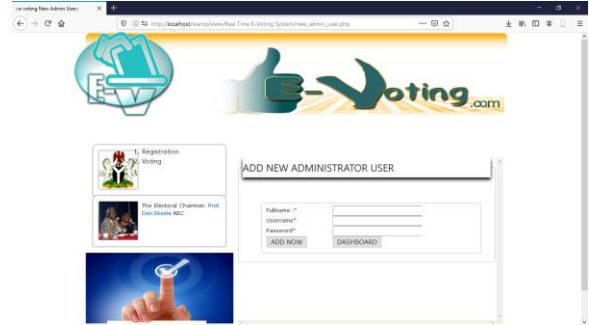
Figure 8: Interface for adding new administrator user into the platform
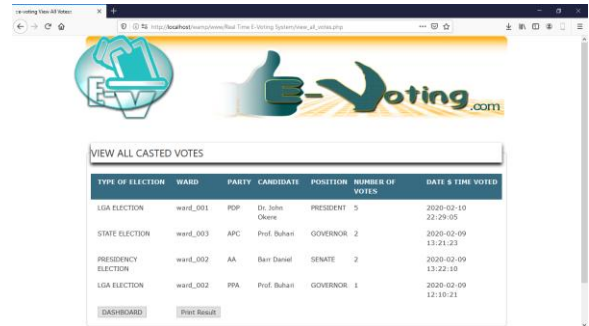
Figure 9: This platform displays all casted vote showing the various party, ward, candidates, number of casted votes, type of election and date and time of the election.

Figure 10: View all Electoral officials: This interface shows the information of the electoral officials and the ward and state posted for the election.
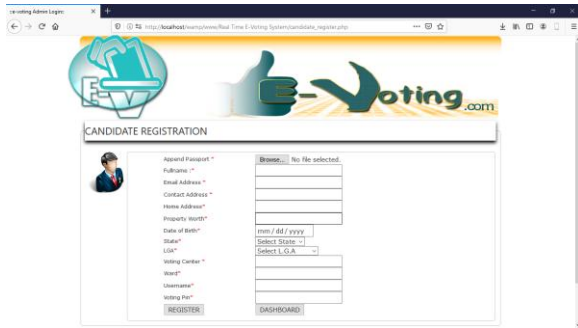
Figure 11: Candidates Registration interface: For any candidate to participate in the election, he/she must be registered using the platform, this platform provides such registration to take place.
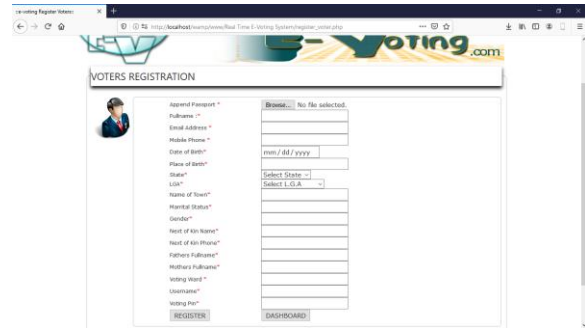

Figure 12: LGA Result Posting: This is the interface for result posting of the local government area election.

Figure 13: Presidential Election Result Posting: This is the interface for result posting of the presidential election.

Figure 14: Voters Registration Page: This is the interface for voters registration, during this process, all voter must include his/her NIN and other required information for documentation and fast and accurate verification during election proceedings.

Figure 15: Voting page, this is the interface for voters to cast their votes by selecting the type of election, ward, party, candidate name, and position to vote for after a successful verification of the voter through the NIN.
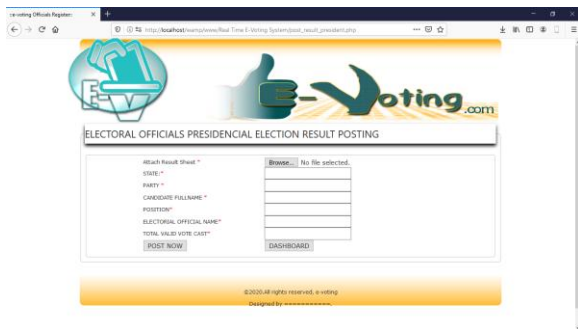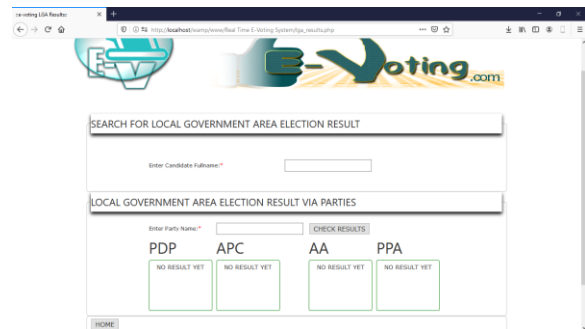

Figure 16: Election result screen: This interface shows how the election results are shown to the general public. To check for the result can be through the candidate party name or candidate name.

Figure 17: Election Results: Display of the result

CONCLUSION

The study has established that the Development of an E-Voting System using IBM Blockchain Technology and Users National Identification Number (NIN) especially in this COVID-19 era would require fewer resources for it to be fully implemented and work as expected; therefore the system will require the help of the Nigerian government to look to the demand and plea of her citizens towards the conduct of free and fairelection that will reflect the mind of the entire citizens by adopting reliable tools and technologies for a better election. It is also noted in this study that implementation of this new system will aid various organizations, development countries to pick candidates to represent them wisely and to have a free and fair election in the country.

RECOMMENDATION

The researchers would like to emphasize that the system should be adopted not just for anything else but because it is develop mainly for the purpose of the Electronic Voting System for any organization with application of Blockchain algorithm for more advance security. It was also suggested that having enough equipment in constructing hardware system and reaching the aimed system, should be enough advanced technology that would support the system. Also, both the federal, state and local government should adopt the system as it will help in keeping peace and harmony during and after election processes in the nation and that of the developing countries like Nigeria. The system will also make people to understand the importance of NIN registration and also give the government electronic information of all voters in the country.

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