

# Real-Time Election Voting and Results Display System (REVORDS)

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**Abstract** – Advancements in Information and Communications Technology (ICT) should be leveraged to provide requirements for secure, real-time voting and results processing/distribution in any democratic society that craves for free, fair and credible elections. Traditional voting systems frequently fraught with issues of fraud, processing of votes cast as well as delays in release of election. The aim of this paper is to have credible elections by creating a comprehensive and secure system that enables voters to cast their ballots online, while also simultaneously providing real-time access to election results. The system's key components include an easy-to-use online web application that enables voters to safely cast their ballots, a reliable backend system for processing and verifying votes, and a platform for displaying results in real time that is available to the general public and relevant authorities. To protect the security and integrity of every vote, the voting process uses multi-factor authentication and encryption measures to reduce the possibilities of manipulation, and prevent unauthorized access. Additionally, the system uses cutting-edge data analytics and visualization capabilities to give voters and election officials access to dynamic, real-time election results.

**Keywords**—component; democratic; traditional voting; multi-factor authentication; verifying vote; revords; bvas;

## I. INTRODUCTION

That elections have not been free, fair, and credible in Nigeria is evident from the number of election petitions in courts, that usually follow the declaration of election results by the electoral umpire in the country—the Independent National Electoral Commission (INEC). These petitions seek generally to challenge the authenticity of the results due to perceived or outright lack of transparency in the electoral process and/or disregard for the electoral laws during voting time. The introduction of the Bimodal Voters Accreditation System (BIVAS), which was believed would enable the electronic transmission of results into the electoral process in real-time, was conceived as a means to end election malpractices experienced in the past; thus, protecting democracy.

According to [1], voters and other election stakeholders worldwide have shown interest in and

concern about introducing Information and Communications Technologies (ICTs) into electoral processes. The Nigeria experience in the 2023 elections and the foul cries that accompanied the processes motivated this study that leverages ICT to design a system that would curb the reported anomalies associated with the said elections: thus, assuring a free, fair and credible future elections. However, setbacks in election results uploaded to INEC portal from the field using the BIVAS were perceived to have been grossly compromised. According to [2], voters and other election stakeholders throughout the world have shown interest in and concern about the introduction of Information and Communications Technologies (ICTs) into electoral process. The Nigeria experience in 2023 elections and the foul cries that accompanied the processes motivated this study that leverages ICT to design a system that would curb the reported anomalies in the said elections; thus, assuring a free, fair and credible future elections.

The purpose of Bimodal Voter Accreditation System (BVAS) was to protect democracy [2]. It performs the dual task of enlisting voters during the voter registration phase and delivering the results to the electoral umpire through a Results Viewing Portal (REV) during the voting phase. BVAS and REV were intended to lessen the potential for manipulation by employing fingerprint and face identities to prevent multiple voting and by providing a secure method for results transmission.

The very intriguing aspects of the BVAS is the guarantee that results from polling units around the nation would be uploaded in real time for voters and the broader public to see. This openness of polling unit-level results boosts process transparency and public confidence, but this did not happen in the general elections that were held in Nigeria on February 25th 2023.

To use the BVAS the officials are required to scan or photograph the Polling Unit election results before uploading them in locations with networks. But this is

not an effective way of showing results, as the results are only shown in an image format. However, all the listed problems were taken care of by the BVAS except for the electronic voting process, because it cannot be used by voters to cast their votes.

This paper focuses on real-time uploading of every vote cast. The system here reported, when used in an election process, will capture and automatically record all votes cast, as well as process and upload the results in real-time, such that all parties and stakeholders will be able to access results simultaneously on the Portal. This is aimed at reducing all forms of electoral malpractice.

It is important to note that accreditation must be transparent as only registered voters can have access to vote on the proposed system. This is to increase the accuracy, openness, and credibility of the electoral process, while reducing human error and delays in the results collation.

The objective is to design a system that does the following:

1. Registration and accreditation of voters to be able to vote online
2. Generation of voters slips that show the votes cast by voters during the elections.
3. Uploading and updating of votes cast in real-time

## II. REVIEW OF RELATED WORKS

[3] Designed an Electronic Voting machine used to count poll results during voting period and temporarily stored for a later time when results will be transferred through a signal transmitter for the receiver of the counting module. The work is of high consideration because it adopted wireless and real-time result display during voting process.

[4] Proposed a system called “Secure election room corridor” which advocates for some shift from conventional electoral process to automated voting procedures. The system provides a small display unit (in a hallway) that enables a voter to verify his/her vote, while some observers in a corridor, who do not see the voter, also see the latter’s vote cast through a display on a wall in a corridor. Each new vote cast is recorded by the observers/watchers, thus updating the records.

Through an improvement on the manual voting process, this system does not provide for a completely automated process as it employs the use of watchers in a corridor who observe and count the votes.

In his work on “Advancing Electronic Voting Systems in Nigeria’s Electoral Process” [5] reveals the ugly state of disenfranchisement of Nigerians in foreign countries, who would want to take part in the election processes back home, because the current voting system does not support absentee voting. There is,

therefore, a need for a robust system that can cater for these groups of Nigerians and provide them the enabling environment to exercise their legitimate right to vote in the nation’s electoral processes.

Some of the lapses identified with the manual voting system include double voting, voting by ineligible people, voter intimidation, and manipulating the results during the lengthy time interval between end of polls and results announcement, etc.

The lack of transparency in collating and counting procedures is another major issue highlighted by [5] as a flaw in the present Nigeria voting system.

Since votes cast during elections are manually collated and counted, the method is, therefore, susceptible to the risk of human errors and intentional manipulation by unscrupulous electoral officials and their allies. This can result in covertly rigging of an election at any level without anybody noticing it. Given this, [5] proposed counting of votes using receipts with barcodes—a component of election that will raise the transparency bar for elections and allow the authorities to begin counting votes as soon as the election begins.

An ideal electronic voting system, according to [6], would enable access to the voting process over a public communication medium, such as the internet. This would encourage more voters to vote remotely and boost voter turnout. [6] designed an electronic voting system that can be used by voters to vote online. Voting would become possible and easy for even working folks in any part of the globe, who could take out time to exercise their voting franchise. Even people who live overseas can vote. E-voting needs to provide a very high level of security, including privacy and integrity.

In their work on a “technological framework for transparent e-voting solution”, [7] proposed a framework that integrates various e-voting technologies to produce an automated voting system with the least amount of oversight and the most transparency and accuracy possible. The framework aims to increase voter turnout and foster a climate of trust in Nigeria’s political process. The framework offers a real-time, cost-effective electoral process with accurate outcomes. Real-time election uploading technologies are put into use, and this transforms the way election results are reported.

[8] Proposed a biometrics-driven voting device that can be used to scan a voter’s eye pattern to check his eligibility to vote in an election. The device also has the capacity to remotely store on a server, the total vote cast, by converting it to radio waves rather than on the device itself. In this case, no one is able to manipulate the programmed machine-counted votes (data). The election process will proceed without interruption, even in the event of intentional or accidental damage to the voting apparatus.

[9] In their study titled "Deploying Electronic Voting System Use-case on Ethereum Public Blockchain" investigates the implementation of a secure and cost-effective electronic voting system utilizing blockchain technology. The authors propose a framework that leverages the Ethereum public blockchain to address key challenges in traditional voting systems, including security, accuracy, and organizational expenses. The proposed model is structured into three phases: the admin phase, responsible for election lifecycle management without voting rights; the voter phase, ensuring user-friendly and secure ballot casting; and the registration phase, which authenticates voter identity and facilitates their system registration. Their Key technical implementations include the use of the Solidity programming language for smart contract development and an RPC server for network interactions. The system incorporates a consensus mechanism to enhance the security and integrity of the Ethereum blockchain. The model was tested on the Rinkeby test network, demonstrating its feasibility and robustness in a simulated environment.

[10] explores the design and implementation of an online voting system aimed at simplifying the electoral process for Indian citizens. The system enables eligible voters—Indian citizens aged 18 and above—to cast their votes online without the need to visit physical polling stations. The Election Commission of India maintains a centralized database that securely stores voter information. Voter registration involves submitting a form and authenticating through a user ID and dynamic password. The database server cross-verifies this information with its existing records to ensure legitimacy, rejecting any discrepancies.

This system is particularly beneficial for voters residing far from their home constituencies, allowing them to participate in elections from any location in India. The primary advantages of the system include increased voter turnout, reduced costs and time associated with traditional voting methods, and an expedited and secure voting process. The study highlights the potential of such systems to enhance accessibility and efficiency in electoral practices, addressing challenges related to geographical and logistical barriers.

[11] Presents a biometric-based approach to enhancing the security and efficiency of electoral processes by addressing the limitations of conventional ballot systems. The proposed system integrates fingerprint recognition technology as the primary method for voter authentication. During the voter registration process, individual details, including fingerprints, are stored in a serial monitor that function as the system's database. At the polling station, voters place their fingers on a fingerprint module, which captures and transmits the fingerprint impression to a microcontroller for verification.

The microcontroller cross-checks the captured data against the stored records from the voter registration phase. Upon successful authentication, voters are permitted to cast their votes manually using pushbuttons, with instructions and party information displayed on an LCD screen. This system ensures the accuracy and legitimacy of voter identity, reducing the risk of impersonation and fraudulent activities. By leveraging biometric technology, the study demonstrates a secure and innovative approach to modernizing electoral practices while maintaining simplicity in execution.

[12] Introduces a real-time face recognition-based authentication system designed to address delays and limitations in existing systems. The system integrates hardware and software components, utilizing NI MyRIO and LabVIEW, alongside the OpenCV library and NI Vision toolkit, to achieve efficient and accurate face recognition. Parallel processing techniques and modules such as NI MyRIO FPGA are employed to enhance performance and minimize delays in real-time environments.

The authors conducted a comparative analysis of performance using MATLAB, Raspberry Pi, LabVIEW, and FPGA to optimize the system's design. The proposed system is tested in real-world scenarios, demonstrating its feasibility and adaptability. The study suggests that the developed authentication application could be tailored for use in electronic voting systems by integrating it with the National Database and Registration Authority (NADRA) database. This research highlights the potential of combining advanced biometric authentication with robust hardware-software frameworks to enhance security and efficiency in critical applications like electronic voting.

### III. PROPOSED SYSTEM

The system proposed in this study, called REVORDS, is a real-time electronic voting system. Leveraging on the rapid growth in technology, especially the internet, it is aimed at replacing the conventional manual voting procedure. The suggested approach attempts to use technology to speed up election vote casting, collation and announcement of results, improve accuracy, and streamline the voting process. To ensure a smooth and secure transition to real-time electronic voting, it is crucial to critically evaluate the features, advantages, and potential obstacles of this new system, which has the potential to revolutionize election processes. This paper, therefore, presents a new system that will enable voters to cast their votes electronically, and the votes are captured real time. Without the need for any human intervention, the vote cast are automatically collated, adding up every new vote cast to the existing total in the system's database. As the results are automatically updated by the system with every vote cast. The system also provides for voters and all stakeholders to follow the trend of the results since all updates are available on the

Internet real-time. This will build high level of confidence in the voters that their votes count, while the contestants will be convinced that the results produced by the system and announced are true reflection of their performances in the field. The system will eliminate the present practice that requires the scanning of results sheets manually, and uploading scanned documents to a central server in the nation's capital city through the BIVAS (Biometric Voter Accreditation System) machines, before results are announced by the nation's electoral umpire. This will increase transparency and reduce the errors that are alleged to have been deliberately or wistfully introduced into results uploaded through the BIVAS machines in electoral processes where they have been deployed.

The BIVAS has already implemented the Voters registration, and verification process, so the new system will focus on voting and results processing.

- **Accessibility:** All eligible voters, including those with some physical impairments, would be able to use the REVORDS system to cast their votes.

## System Design

The entire election process, from voter registration through real-time vote counting and result distribution, is made easier with REVORDS. The architecture of the system, made up of a number of connected modules, each of which carries out a specific task, is shown in Figure 1.

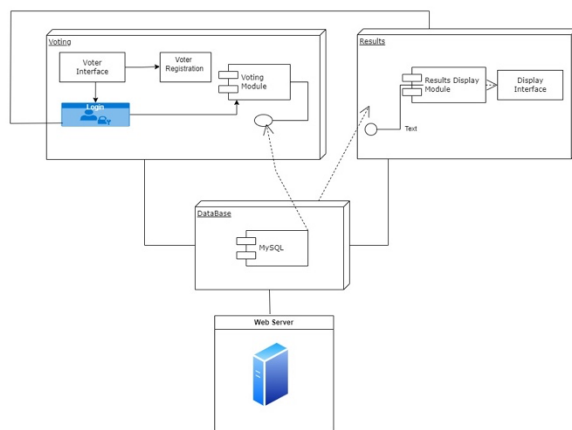


Figure 1: System Architecture

### A. Database Structure

The design and development of a real-time voting system involves a strong and scalable database management system that can efficiently handle huge volumes of data, offer real-time updates, and assure data integrity. MySQL, a renowned open-source relational database management system, appears as an appealing solution for such projects due to its numerous advantages and features. In this work, the viability of MySQL Database Server was objectively

assessed for real-time voting system development; stressing its advantages, performance capabilities, security features, and overall impact on the democratic process.

Figure 2 depicts the database structure designed to manage an election process. The "Voter" table stores information about voters, the "Candidates" table stores information about candidates, and the "Votes" table records the actual votes cast by voters for specific candidates. By establishing relationships between these tables, the database can efficiently store and retrieve data related to voter registrations, candidate information, and voting records. This structure enables tracking which voter voted for which candidate and provides insights into election outcomes.

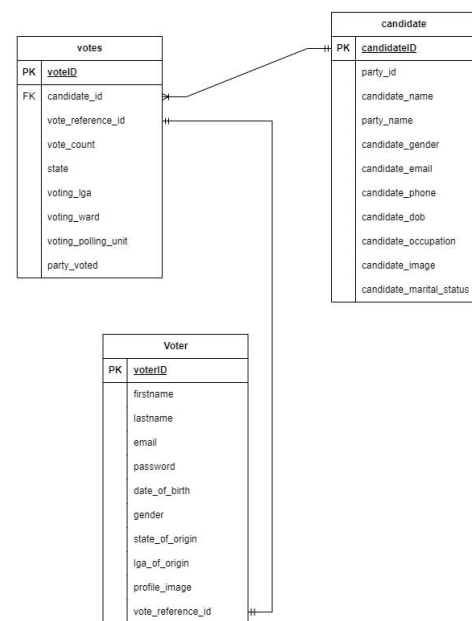


Figure 2: Database Structure

- **Voter Information and Registration:** The "Voter" table captures crucial details about each registered voter, including their names, ages, addresses, and registration dates. This information aids in verifying voter eligibility and maintaining an updated voter register.
- **Candidate Profiles:** The "Candidates" table houses comprehensive profiles of candidates participating in the election. This includes their names, party affiliations, and campaign slogans. These details enable voters to make informed choices and provide a centralized location for candidate information.
- **Vote Recording and Tracking:** The heart of the system lies in the "Votes" table. It records the act of voting by linking each vote to a specific voter and the candidate they voted for. This linkage is established through foreign key relationships with the "Voter" and "Candidates" tables. The "Votes" table also captures the time when each vote was cast. This structure ensures the integrity

of the voting process and enables auditing of votes.

- **Election Outcome Analysis:** By storing votes in the "Votes" table with references to voters and candidates, the database enables the calculation of voting statistics, including the number of votes each candidate receives, voter turnout, and the winner of the election. This data supports comprehensive analysis and reporting of election outcomes.

#### IV. USE CASE DIAGRAM

From the use case diagram in Figure 3, all the modules are itemized, from voters' registration to voters' login and authentication. After voting, voters can login to view election results in real-time. Consider the following use case scenario to gain a better understanding of the capabilities and advantages of REVORDS.

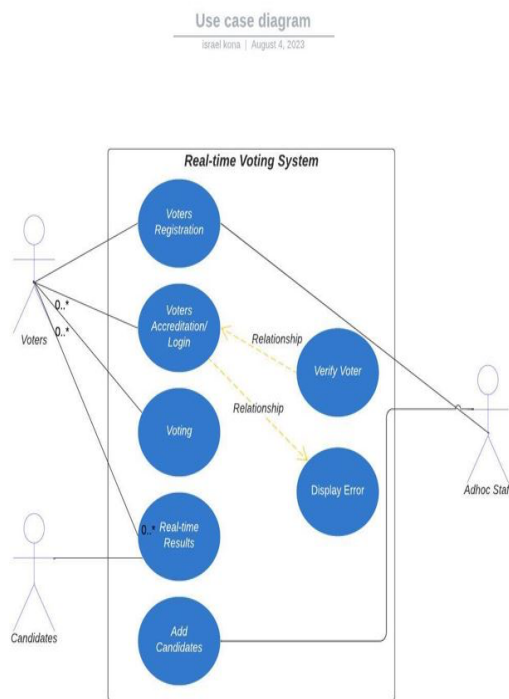


Figure 3: Use Case Diagram

A nationwide election is currently taking place, and REVORDS is being used by millions of voters to exercise their franchise. Voters can register to vote online and at physical registration locations, among other methods.

- **Functionality:** The Voter Registration Module successfully manages the registration procedure and makes sure that every voter receives a special identification number. The Ballot Generation Module creates safe electronic ballots for each registered voter, and the Voter Authentication Module makes sure that only eligible voters can participate in the election.

- **Scalability:** To ensure a flawless and responsive voting experience for all users, the system distributes the load across numerous servers and data centers, which allows it to accommodate the high volume of voters.
- **Security:** Cutting-edge encryption methods and strong authentication procedures protect the validity of the voting process, thwarting attempts to tamper with or manipulate votes.
- **Reliability:** The system runs with a high degree of dependability. For this, redundant servers and data backups are set up to provide uninterrupted operation in the event of unanticipated breakdowns.
- **Accessibility:** To meet the preferences and accessibility requirements of various users, REVORDS offers a variety of interfaces, including web-based and mobile applications.

#### System Evaluation

- **Usability:** The real-time voting system accomplishes its main goal of automating the election process, doing away with the necessity for manual ballot counting and lowering the possibility of fraud. Real-time participation is made possible, assuring prompt outcomes and boosting public confidence in the voting process.
- **Scalability:** The system is made to manage elections of all magnitude and complexity. It is scalable enough to support many simultaneous votes from many registered voters without sacrificing performance.
- **Security:** In electoral processes, security is of utmost importance. Encryption, authentication, and audit trails are just a few of the layers of security components that are embedded into REVORDS as a guard against unauthorized access, tampering with, and manipulation of votes and outcomes.
- **Accessibility:** All eligible voters, including those with some physical impairments, would be able to use the REVORDS system to cast their votes.

#### V. RESULTS

Some tests were conducted on REVORDS to ascertain its ability to achieve the aim of its design.

##### A. Voters Registration

Voter registration is handled by the Voter registration module as done by the BVAS, where it captures voters registration information and their Biometrics which also ensures that each qualified voter has a unique identification number and is able to participate in the electoral process, after accreditation.

### B. Voter Authentication Module:

To guarantee the accuracy of the voting process, the module authenticates voters via Biometrics, this is already taken care of seamlessly by the BIVAS, already in place.

### C. Voting Module

Using internet platforms or electronic voting equipment, the Voting Module enables voters to cast their ballots in real-time. Figure 4. shows the various tabs that enable voters to select the party they want to vote for, and confirm the same, as well as selecting the state, local government, ward, and the polling unit where they registered to vote. It guarantees that each voter can only cast one ballot and that it is correctly recorded in real-time and automatically prints a receipt immediately after the vote is cast.

Figure 4: Voting Module

### D. Ballot Generation Module

The ballot generation module in figure 5. creates distinct and secure electronic ballots for every registered voter, protecting the privacy and confidentiality of their votes. Once a voter casts his vote, the system automatically prints a ballot paper, as shown in Figure 5, as evidence that he/she has cast a vote. An e-copy of this ballot paper is sent to the database as a backup copy.

Voted Candidate	PARTY A ROMEIO SCALE
Voters ID	6764e4dc8e29
Election Type	Presidency
State	EDO
Local Government	OREDIO
Ward	OGBE
Polling Unit	OIB UZEBU   GARRICK MEM. COMP. PRIMARY SCHOOL

Figure 5. Voting Receipt/Ballot

### E. Vote Counting Module

The vote counting module counts the votes in real-time, assuring accurate and transparent results and to protect the confidentiality and integrity of vote counts. Figure 6 shows a sample of the display from the vote-counting module. The Figure represents the results of a general election, showing Party Names, Party Reference Numbers, Party Candidates, the number of votes gained by each of these candidates, and the total number of votes cast at the entire election nationwide.

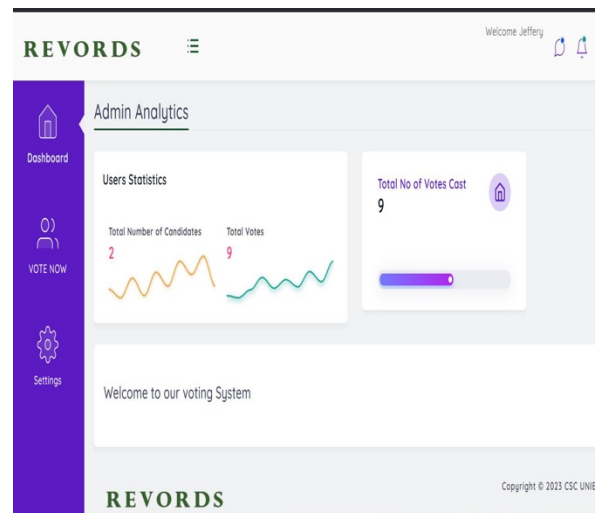


Figure 6: General Result Module

## CONCLUSION

The implementation of Real-Time Voting Technologies, as demonstrated by the Real-Time Election Voting and Result Display System (REVORDS), represents a significant advancement in modernizing the electoral process. REVORDS, developed using the V-Model technique, ensures a systematic and rigorous approach to software development, enhancing both the reliability and efficiency of the system. The integration of the four key modules—voter registration, voting, ballot printing, and real-time result viewing—enables a seamless and transparent voting experience. By allowing real-time access to election results for both voters and the general public, REVORDS fosters a more informed and engaged electorate. The tools utilized include database systems, secure authentication protocols, and web development technologies (such as Hypertext Markup Language HTML, Cascading Style Sheets CSS, JavaScript, Hypertext Preprocessor PHP, and Structured Query Language SQL).

However, despite the technological advancements, the requirement for voters to physically attend polling stations remains a notable limitation. This stipulation, while necessary to ensure the integrity of the voting process, suggests areas for future development and refinement.

To further enhance the efficacy and accessibility of the Real-Time Election Voting and Result Display System (REVORDS), it is recommended to explore the integration of secure remote voting capabilities. This would involve the development of robust authentication mechanisms to ensure the integrity and security of votes cast remotely. Additionally, extensive pilot testing in diverse electoral settings should be conducted to identify and address potential challenges and vulnerabilities. By continually refining and adapting the system, REVORDS can potentially offer a more inclusive and flexible voting process, ultimately strengthening democratic participation and trust in the electoral system.

The analysis of existing literature reveals several gaps and areas for enhancement that could significantly improve the efficacy of systems like REVORDS:

**Comprehensive Security Measures:** Current studies, such as those focused on blockchain-based voting systems, emphasize the importance of integrating advanced security features like consensus mechanisms and robust encryption protocols. Incorporating such measures into REVORDS could address potential vulnerabilities and ensure data integrity throughout the voting process.

**Decentralized Systems:** Blockchain frameworks have shown promise in enhancing transparency and reducing the costs associated with traditional voting systems. Adopting decentralized technologies within REVORDS could provide a more tamper-resistant and auditable voting process.

**Remote Voting Solutions:** As highlighted in literature on online voting systems, enabling voters to cast their ballots remotely can significantly increase accessibility, especially for individuals residing far from their constituencies. Future iterations of REVORDS should explore secure remote voting mechanisms to enhance participation rates.

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