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DEVELOPMENT OF NEW ONLINE VOTING METHODS FOR THE INTEGRATION OF TECHNOLOGY IN THE NIGERIA ELECTORAL SYSTEM

Okeke, P.C.

Department of Information Technology, Malaysia University of Science and Technology, Malaysia.

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Abstract: **This research paper examines the development, design, and implementation of a user-friendly online web-based voting system for use in conducting elections in Nigeria, to provide high performance and a better user experience to the voter. It also looks at the planned online voting system, which allows voters to log in using their username and password, which are retrieved from the database of the Nigeria Independent National Electoral Commission and assigned to them by the commission. This enhances user experience and prevents void votes by forcing all users to log in with their correct login details and vote for their preferred candidates. The election can be performed remotely online, allowing qualified voters to vote from anywhere in the world as long as they have internet access, and election results can be viewed in real- time while voting is still taking place. This will boost the involvement of Nigerians in the diaspora, eliminate electoral violence that typically occurs in polling units during elections, and lower the cost of conducting elections in Nigeria.**

Keywords: **database; internet; login; online; password; system; username; voting; web.**

1. INTRODUCTION

Nigeria is a developing country where new technologies are implemented day by day, such as smart systems, 3G and 4G networks, digital image processing, e-banking, etc., as well as other technologies implemented in the fields of industrial development, medical and biological sciences, and military defense. In the 21st century of the world, where modernized systems help in our social and economic lifestyles, there is still one sector where Nigeria is using its traditional system of voting by going to the polling units. Because of technological advancements, many countries now use an E-voting system, also known as an electronic voting system, for their elections.

Implementing new technology in a whole election process is very challenging because it requires many years of careful planning, a detailed structure, and lots of trusts in the entire system. E-voting provides an opportunity for solving the problems of the traditional election process, such as vote counting, missing stamps, fake voters, etc. One common reason for introducing this technology is to show the world the level of internal technological development of a country like Nigeria.

E-voting is a tool for making the whole election process more efficient. Many countries are using this technology for fair elections, time savings, and impartial results. Unlike the rest of the world, Nigeria is still using traditional paper-based voting, where each person's credentials are checked manually, and after verification with a card reader and bimodal voter accreditation, the voter is then allowed to vote on the ballot paper. E-voting not only provides solutions but there are also some challenges and concerns that are moving around this technology that should be figured out and considered when implementing the E-voting system in Nigeria.

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2. CONCEPTUAL FRAMEWORK

Elections form a critical process in democratic systems, and the application of information technologies to their management is a great milestone towards realizing effectiveness and efficiency not only in the results of the election process itself but also in the financial implications that come up with the process.

One basic feature of democratic government is the right of its eligible citizens to choose their leaders by themselves through elections. And one basic feature of democracy that cuts across all divides of people is the act of election. Democracy thus encourages individual freedom according to the rule of law, so that people can behave and express themselves as they choose. This not only gives people the chance to choose their leaders but also to air their views on issues affecting their well-being. For a democratic government, public opinion is the most important determinant in establishing a government, and voting is the process through which people display their opinions and help set up a democratic government. So the voting system should be reliable, accurate, and, above all, transparent.

In Nigeria's paper-based or manual voting system, a voter usually goes to the voting stations known as voting units. After direct person-to-person smart card reader verification with some voter cards, the voter is allowed to vote. The voter is then given a ballot paper that allows a single vote. Once the ballot paper is used, it cannot be reused. However, this ballot paper must also be anonymous, as voters do not need to display their identities.

The various drawbacks of a traditional voting system are mainly collusion between the electoral officials and contestants, the queuing time, delayed results, overworked tallying officials, and the undeniable fact of human errors. The existing voting system did not provide reliable statistics on voting history in the country, and thus campaigners lacked the grounding to apply scientific voter forecasting methods, instead resorting to trial-and-error methodologies that are error-prone and inconsistent.

Reinforcing a voter-one-vote policy in such a situation is difficult, and malpractices such as rigging are not uncommon in the manual voting system. It is impossible to completely rule out the need for technology and electronic voting, with the growing number of eligible voters and manual ballot papers involved. It was very easy or manageable in the past when Nigeria had a small number of eligible voters. But now the number of eligible voters has increased and has a high possibility of increasing further shortly. But as real as it is now, the country's population is growing beyond bounds, and the manual system of voting, which in so many previous elections had caused more than a lot of chaos. Other countries of the world have adopted information technology in various elections; the government of Nigeria should also adopt a new system of voting, which is the online web-based voting system.

3. CHAPTER LITERATURE REVIEW

According to Douglas (2003), the purpose of electronic voting technology is to provide a plain, simple, and secret voting process; speed up ballot counting; reduce the cost of paying staff to manually count votes; and improve accessibility for disabled voters.

There is an overview of electronic voting experiences in various countries at the International Status on Electronic Voting System. It also proposed the various e-voting systems that are implemented at the international level. There are some countries where the e-voting system is implemented.·

In Brazil, the electronic voting system was implemented by the Electoral Court in 1996, when a computerized election database was completely introduced. The work done on the E-voting project was held by the Aerospace Technical Center (ATC) and the National Institute for Space Research (NISR). The name of the first E-voting machine is CEV, known as the Collector of Electronic Votes. These Brazilian machines are used for voter authentication, vote casting, and calculation. A paper trail was also included in the system but was later eliminated due to technical issues with the printers. After advanced research on the system in 2011, biometric e-voting machines were introduced and started being implemented in the 2012 elections.

In INDIA, E-voting machines are used since 2002. The current voting machine consists of two units: a balloting unit and a control unit. The poll administrator handles the control unit, and voters cast their votes through the balloting unit. This electronic voting system did not provide a paper trail when it was introduced. To re-verify the votes, the election

management decided to introduce a voter-verified paper audit trail (VVPAT) system, which was used in the 2014 general elections in some constituencies. Remote internet voting also started to be tested in India in 2011 in Gujarat state.

The United Kingdom started electronic voting projects in 2002 to try out various technologies for voting and counting, such as remote voting or touch-screen voting machines, etc. They test out various systems by allowing voters to cast their votes using different electronic methods and technology (voting over the telephone), PC-based systems, and mobile devices via SMS service. They also tested kiosk voting (devices placed in public places). Although there are still concerns about many E-voting projects, they are experimenting with more secure implications in their projects and hope to implement electronic voting soon. ·

Different types of electronic voting systems are in use in America, including optical scan systems, DRE voting machines, and punch card voting systems. Since 2012, the E-voting systems in use are DRE machines and optical scan systems. Later on, these systems also provided a paper audit trail for verification purposes. Some states also used internet facilities for the vote. In the current election process, the US election site was also hacked. So, from the overall scenario, the US election government still improved their security and verifiability in the election process and also researched new projects of electronic voting.

In 2010, the Philippine government implemented an optical scan voting system. On testing of machines, it is found that 76,000 machines have faulty memory cards. The machines also have some software faults and give miscounted votes. After discovering problems, many of the machines are replaced by new ones. But at last, the election management was successful in conducting fair elections and continues to use this technology in future elections.

In Pakistan, the E-voting system was first implemented by the KPK government along with NADRA in some districts and councils of Peshawar in the 2015 local body elections. This machine can only verify the voter through a biometric print, but voting can still be done through ballot papers. Now, the Election Commission of Pakistan is working on two pilot projects, one for the EVM machine and one for the BVM machine, and is preparing to implement these machines in the 2018 general elections in some parts of different provinces.·

In Estonia, the company Cybernetica Limited was involved in the development of the e-voting system. This system includes the use of electronic signatures and smart cards for casting the vote. They also implemented an Internet voting system in 2001, which offers various ways of voter authentication such as ID card numbers, pin codes, digital ID, and mobile numbers. Remote Internet voting was also implemented and used in national elections in 2005 and onward, but there are still some security issues that need to be improved.

This research implies that since there have been a series of successes recorded with e-voting, the system surely will if adopted by the Nigeria Independent National Electoral Commission. It will eradicate total violence, high expenses, and time wasted in carrying out elections manually.

4. DESIGN AND DEVELOPMENT

The online web-based voting system is designed to give citizens of Nigeria an easy, fast, and reliable means of voting and being voted for in the Nigeria elections.

The system is a web-based system designed for the free and fair conduct of elections in Nigeria.

A. Design

The web-based online voting system will use a login window that will need thorough authentication before it can allow user access. Authentication can only be done after voters have registered with the system, with their password and username saved in the system database. The proposed system is going to use the MD5 encryption algorithm to store a user's password in the database because it is not advisable to store access codes in plain text. The proposed system is going to be divided into two main modules, the admin module, and the voter module. The admin model is granted access to the system automatically using the admin password and admin username, whereas the voter model can only allow access after their registered and saved details in the database match their input username and password.

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The proposed system is to use the three-tier display structure, which includes the model, the view, and the controller (MVC). The model interacts directly with the database, and the controller interacts directly with the view. Both the controller and the view are segments of the three-tier presentation (MVC), fully based on the CRUD (create, read, update, and delete) feature framework.

UML Class Diagram

Fig. 1 is a UML class diagram that shows and describes the structure of the app by showing the system's classes, their attributes, operations (or methods), and the relationships among objects.

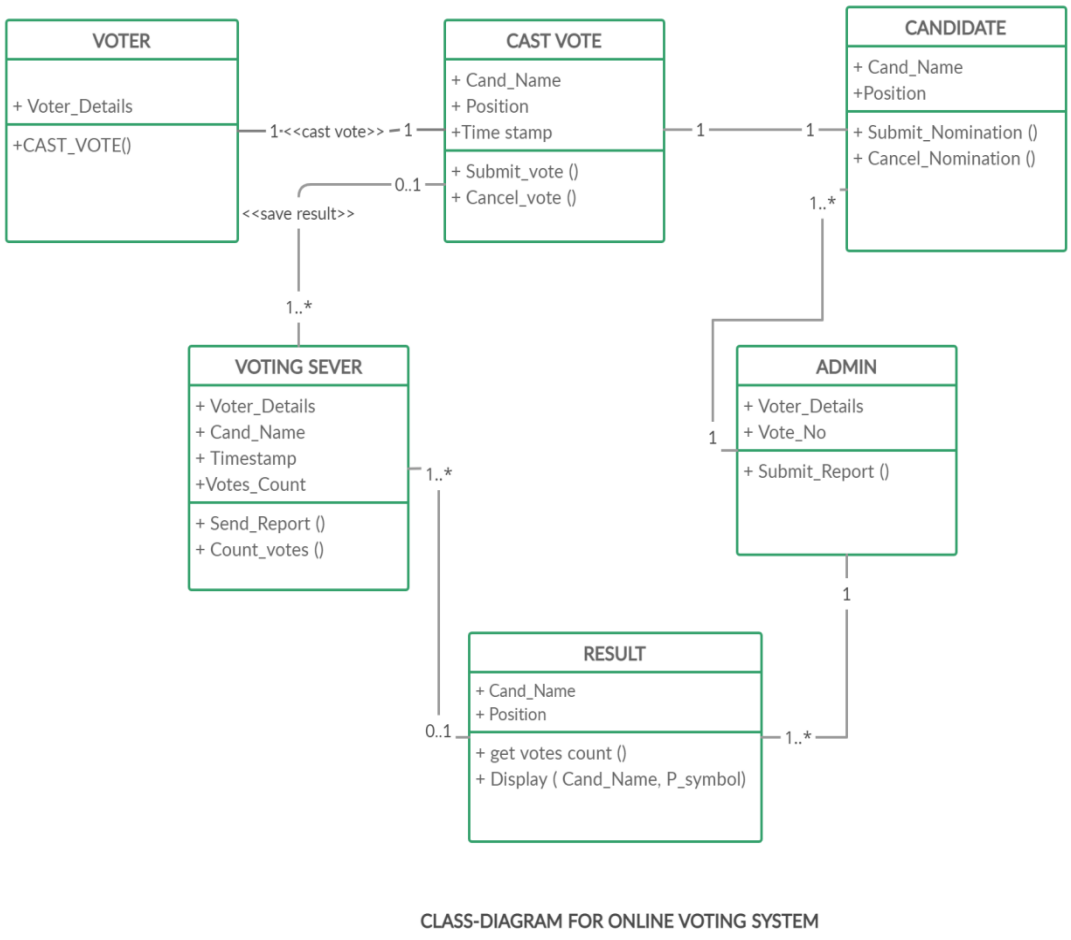

Fig. 1: Class Diagram

UML Sequence Diagram

The sequence diagram is used primarily to show the interactions between objects in the sequential order in which those interactions occur. Sequence diagrams describe interactions among classes in terms of an exchange of messages over time. They're also called event diagrams. A sequence diagram is a good way to visualize and validate various runtime scenarios. These can help predict how a system will behave and discover responsibilities a class may need to have in the process of modeling a new system.

Admin

Fig. 2 shows the process of an administrator's interaction with the system. It shows the main steps, from login to voting management, register management, candidate management, voter management, and poll management. The process through all the steps was simple and hassle-free.

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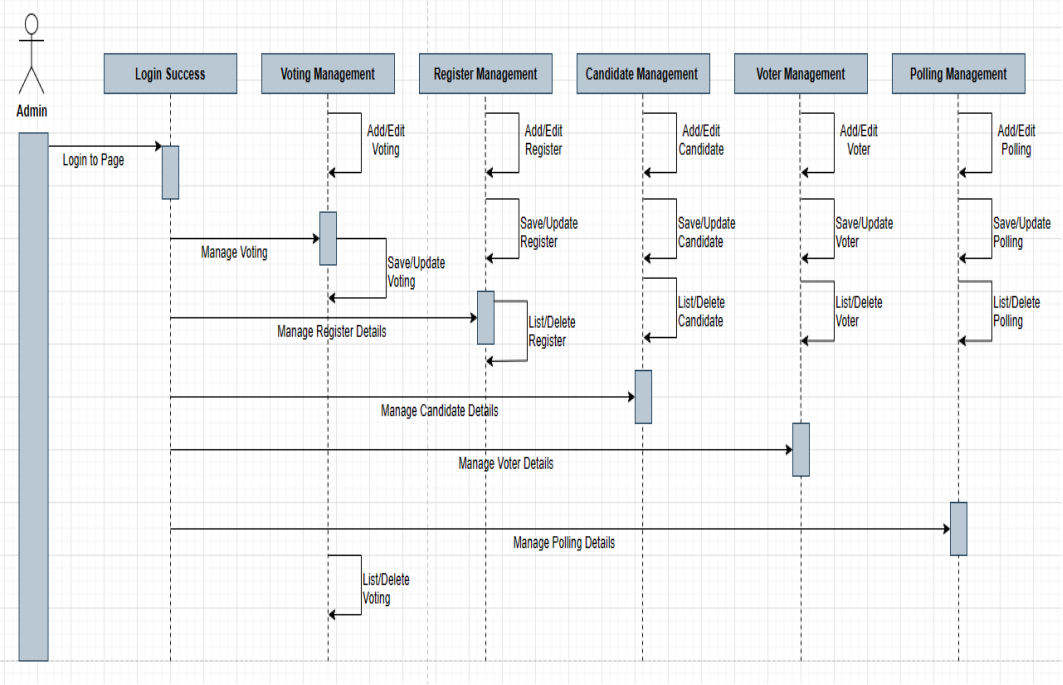

Fig. 2: Sequence Diagram Admin

Voter

Fig. 3 shows the process a voter follows while trying to vote. Choosing the candidate of their choice is important, as is being able to successfully log into the system.

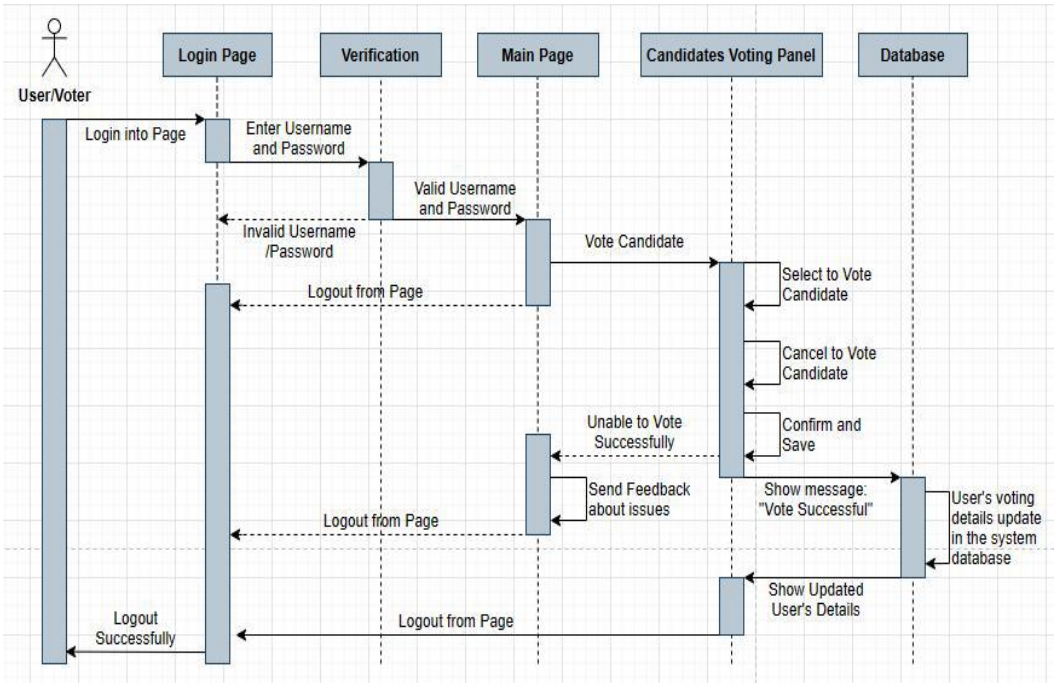

Fig. 3: Sequence Diagram Voter

Activity Flowchart Diagram

The activity diagram shows a flowchart of the application and all the steps accordingly. This furthermore explains how to navigate the application from the beginning to the end. The activity diagram gives an insight into how the application will be developed putting into consideration a simple and understandable design with the UI.

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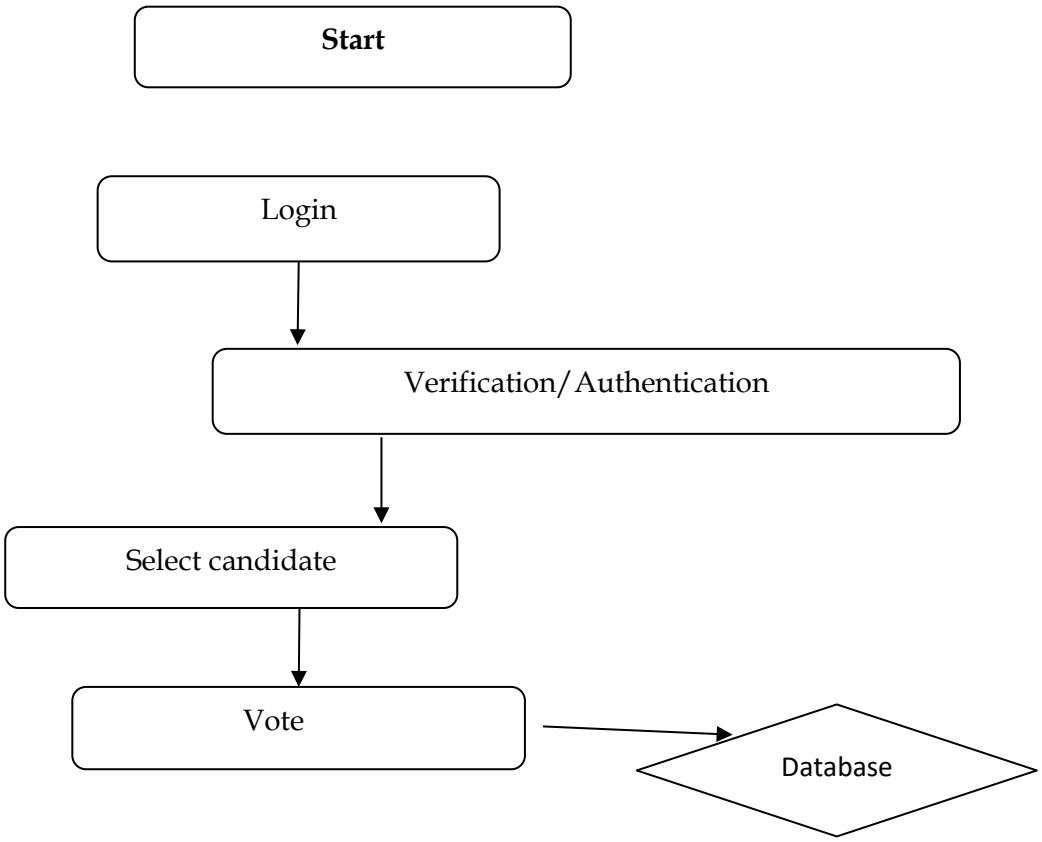

Fig. N Activity Flowchart.

B. Implementation

The implementation depends on the selection of the algorithm. In general, a web-based system is developed with the required classes to implement the algorithm.

An algorithm is very essential because it authenticates the voter's details. The matching process starts by checking of details of the voter then the algorithm intensifies the details and extracts their characteristics. These characteristics are then converted into a username and password template and then the template will be matched from the same template which is stored in a database.

Technologies to be used: -

The Online Web Based Voting System is developed using

Software Requirements

- Database Design (My SQL)
- Form Design (HTML)
- Coding (PHP, CSS, JavaScript, bootstrap.)
- Testing (XAMPP SERVER)
- Web browser(Google Chrome. Mozilla Firefox Opera, Internet Explorer)
- Reporting Tool (Data Report - Microsoft Word, Excel Spreadsheet, PowerPoint)

Hardware Requirements

Processor (800MHZ Intel Pentium III or equivalent

Disk Space (750 MB of free disk space)

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5. TESTING & EVALUATION

A. ***Testing***

1. Objectives

Ensure database access methods and processes function properly and without causing data corruption.

1.1 Purpose

This document describes the plan for testing the online, web-based voting system. This test plan document supports the following objectives:

· Identify existing project information and the features or modules that should be tested.

· Ensure the Application Under Test (AUT) conforms to functional and non-functional requirements

· Ensure the AUT meets the quality specifications

· Ensure Bugs/issues are identified and fixed before going live

1.2 Scope

This Test Plan describes the integration and system tests that will be conducted on the prototype following the integration of the components identified in the Integration Test Plan for the Prototype.

The purpose of the prototype was to test the functionality and performance of the system.

All system and subsystem interfaces must be tested as well as system performance at this early stage

The interfaces between the following modules will be tested:

1. Registration Module

2. Login Module

3. Time slot choosing a module

4. Voting module

5. History/Status Tracking Module

6. Canvassing Report Module

The most critical performance measures to test are:

1. Response time to access Module 1.

2. Response time for remote login to the voting system Module 2

3. Response time to access Module 3

4. Response time to access Module 4

5. Response time to access Module 5

6. Response time to access Module 6

2. Requirements for Test

The listing below identifies those items (use cases, functional requirements, and non-functional requirements) that have been identified as targets for testing. This list represents what will be tested.

2.1 Data and Database Integrity Testing

Verify access to the database.

Verify simultaneous record read accesses.

Verify the lockout of updates.

Verify the correct retrieval of updated database data.

2.2. Function Testing

2.3 User Interface Testing

2.4 Performance Testing

Verify the response time to access the external vote catalog subsystem.

Verify the response time for remote login.

Verify the response time for the remote submitter of voter and candidate registration.

Vision Document, Section 12.3: "The system shall provide access to the legacy Vote Catalog Database with no more than a 10-second latency."

Supplementary Specification, Section 7.2: "The system shall provide access to the legacy Vote Catalog Database with no more than a 10-second latency."

3.1 Testing Types

3.1.1 Data and Database Integrity Testing

The databases and the database processes should be tested as separate systems. These systems should be tested without the applications (which are the interface to the data). Additional research into the DBMS needs to be performed to identify the tools and techniques that may exist to support the testing identified below.

Table 1: Data and Database Integrity Testing

Test Objective:	Ensure database access methods and processes function properly and without causing data corruption.
Technique:	· Invoke each database access method and process, seeding each with valid and invalid data (or requests for data). · Inspect the database to ensure the data has been populated as intended, and all database events occurred properly, or review the returned data to ensure that the correct data was retrieved (for the correct reasons)
Completion Criteria:	All database access methods and processes function as designed and without any data corruption.
Special Considerations:	· Testing may require a DBMS development environment or drivers to enter or modify data directly in the databases. · Processes should be invoked manually. · Small or minimally sized databases (limited number of records) should be used to increase the visibility of any unacceptable events.

3.1.2 Function Testing

Testing of the application should focus on any target requirements that can be traced directly to use cases (or business functions) and business rules. The goals of these tests are to verify proper data acceptance, processing, retrieval, and the appropriate implementation of the business rules. This type of testing is based on black box techniques, that is, verifying the application (and its internal processes) by interacting with it via the GUI and analyzing the output (results). Identified below is an outline of the testing recommended for each application:

Table 2: Function Testing

Test Objective:	Ensure proper application navigation, data entry, processing, and retrieval.
Technique:	· Execute each use case, use case flow, or function, using valid and invalid data, to verify the following: · The expected results occur when valid data is used. · The appropriate error or warning messages are displayed when invalid data is used. · Each business rule is properly applied.
Completion Criteria:	· All planned tests have been executed. · All identified defects have been addressed.
Special Considerations:	· Access to other servers and the existing Vote Catalog System is required to run some of the identified system tests on the prototype.

3.1.3 User Interface Testing

User interface testing verifies a user's interaction with the software. The goal of UI testing is to ensure that the user interface provides the user with the appropriate access and navigation through the functions of the applications. In addition, UI testing ensures that the objects within the UI function as expected and conform to corporate or industry standards.

Table 3: User Interface Testing

Test Objective:	Verify the following: · Navigation through the application properly reflects business functions and requirements, including window to window, field to field, and use of access methods (tab keys, mouse movements, accelerator keys) · Window objects and characteristics, such as menus, size, position, state, and focus, conform to standards.
Technique:	· Create or modify tests for each window to verify proper navigation and object states for each application window and object.
Completion Criteria:	Each window was successfully verified to remain consistent with the benchmark version or within the acceptable standard
Special Considerations:	· Not all properties for custom and third-party objects can be accessed.

A. Summary

Execute the tests according to the test plan, the test specifications, and the defined test procedures.

Evaluation will involve estimating whether the tests have achieved their objectives, assessing the adequacy of the tests, and quantifying test coverage.

If the test has been passed, the software shall be released using the E-VOTE Release Procedure. E-VOTE Problem Reports shall be raised for any residual faults found that have not been cleared.

If the test has not been passed, either further testing and correction are conducted until it is passed, or an intermediate release is produced with markers introduced into the software to signal the execution of untested code. When such a marker is subsequently activated in use, an issue report has arisen.

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6. CONCLUSION

The system is designed and implemented to support a wide range of voting processes concerning coverage: national, local, regional, and specific sociological and behavioral characteristics. This can be achieved by providing an easy configuration of the system. This requirement is addressed by the highly modular, three-tier system architecture. The presentation tier will support, in an easy and user-friendly way, the interaction of the user with the system. The service tier will be the vote service platform together with the associated application modules; this is the tier that provides the entire system functionality. The data tier will form the storage space of the system (the database).

In correlation to the research, all of the objectives and goals of the voting areas have been positively achieved. In my research of various voting systems, I analyzed the security risk that could harm the integrity and confidentiality of the voting process. In these research exercises, I propose a testing methodology, improve new tools for security analysis, and suggest a new idea for the voting system. This online, web-based voting system can reduce fraud attempts and eliminate errors in vote counting. In addition to its scalability, this system can handle various techniques and provide enhanced efficiency and reliability for elections. This web-based electronic voting system was evaluated and implemented successfully. The final result of the voting system was amazingly comparable and significant compared to other voting systems.

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