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Design and Implementation of a Web-based Voting System for Unions use in Abia State College of Education, Arochukwu

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Abstract- ***Presently, both Students' and Staff unions elections in Abia State College of Education (Technical) Arochukwu are being conducted manually and using paper ballots. This manual method is costly, stressful and time consuming. To mitigate these problems, the researchers developed a web-based voting system for both students and staff unions use. With this system in place, staff and students can vote the candidates of their choice. The system has a mechanism for not allowing double election by a voter and declares winners immediately after the last voter casted his/her vote. In addition, user can view and print election results. The system was implemented using html, PHP, CSS and Javascript web technologies.. The developed system was tested by some staff and students of the College using real data. Thereafter, a questionnaire designed to measure user's satisfaction with the use of the developed system was administered to 12 staff and the students that tested the developed system. The data was then collected from the questionnaire and analyzed. The result of the analysis shows that the evaluators are satisfied with the performance of the developed system. Furthermore, the evaluators recommended that the developed system can be used by the College for purpose of unions' elections.***

Keywords: Design, Development, Voting, Election result, Electronic Voting System, Unions, Abia State College of Education (Technical) Arochukwu

I. INTRODUCTION

In modern world, leaders occupy political offices usually through election. Election according to U.S. Election Assistance Commission (2021) is a formal process of selecting a person for public office or of accepting or rejecting a political position by voting. In election, two or more persons compete to a position in which one become winner and others become losers. Elections in political scene fall into two broad categories; primary and general. Primary election is a type of election in which voters choose their party's nominees to run in the general election by casting ballots. In primary election, only party members are allowed to vote. The candidate that scored the highest votes become the winner and by implication become the party's candidate. The party's candidate will then go on to run in general election (Commonwealth of Pennsylvania, 2024). In general election, all citizens that registered and are eligible for election cast their votes to the candidates of their choice. In Nigeria, general election can be presidential election, senatorial election, house of representative member election, gubernatorial election, state house of assembly member election, local government chairman election and councillor election respectively. Election also takes place in organizations and institutions where union members contest directly into various offices.

There are two main approaches to elections; paper-based and electronic-based election. In paper-based electoral system (also known as manual system) voters manually mark the paper ballot, election officials count the votes by hand and then declare winners and losers based on the votes scored by each candidate. In electronic electoral system on the other hand, electronic voting machines are used for the whole of the electoral process. Electronic electoral voting system has the advantages of eliminating the cost and logistics involved with paper ballots; improved voter identification mechanisms, improved accessibility to voting, easy conduct of complex elections; increase in voter turnout, eliminating invalid ballots, faster, more accurate and standardized counting of ballots; and prevent certain forms of fraud (Goldsmith & Ruthrauff ,2013).

Electronic election system consists of many components which includes voter registration, accreditation, voting, counting and declaration of winner(s) among others. Electronic voting and counting is classified in different ways depending on what one used as a basis of classification. Using the

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type of device (eg. machine) used in election, electronic voting and counting system fall into remote voting and non-remote voting. In remote voting, an electronic device is used for casting votes and then transmits the ballot choices across a communication channel. The ballot choices are then recorded in a central location, e.g. Internet voting and SMS voting. However, in non-remote voting, an electronic device is used for casting votes. The device then records the ballot choices made on a local medium, e.g. the machine itself or a printed ballot. Sometimes the type of voting environment is used as a basis for classification. This leads to the concepts of supervised and unsupervised voting environments respectively. In supervised voting environment, a voting machine used in a location where election staff is present to manage the voting process, such as a polling station while in unsupervised voting environment, a voting device used in a location where no election staff is present to manage the voting process, such as any computer the voter uses for internet voting (Goldsmith & Ruthrauff ,2013). To leverage on the numerous advantages of electronic voting system stated above, the researchers set out to design and implement a remote and unsupervised electronic voting system (web-based) for unions use in Abia State College of Education, Arochukwu.

II. PROBLEM STATEMENT/JUSTIFICATION

Abia State College of Education (Technical) Arochukwu has a number of unions that conduct election periodically. Each time a union wants to conduct an election, the union has to plan and use both human and material resources during the election. This makes election costly. Furthermore, often at times some candidates that lost election use to accuse that organizers and winners for electoral mal-practice. This often results to mistrust among members and leadership problem after election. But with the advent of electronic voting system, the above mentioned problems have greatly reduced. In specific, with electronic voting system on ground, there is no need for printing of ballot papers and other recording sheets as well as employment of large number election officials. This in turn reduces election cost. Furthermore, it takes less time for result to come out compared with the manual voting system. Above all, the results of elections through electronic voting system are more transparent and credible than those elections conducted using manual voting system. It is with these overwhelming advantages that the researchers set out to design and implement and electronic voting system(web-based) for unions use in Abia State College of Education (Technical) Arochukwu.

III. OBJECTIVES OF THE STUDY

The major objective of this study is to design and implement an electronic voting system(web-based) for unions use in Abia State College of Education (Technical) Arochukwu. Specifically, the study will:

1. Determine the software requirement specifications for the electronic voting system;
2. Design the electronic voting system;
3. Develop the electronic voting system;
4. Test the developed electronic voting system and
5. Determine user's satisfaction with the performance of the developed electronic voting system.

IV. LITERATURE REVIEW

This section began with presentation of different types of electoral system. This was followed by the advantages and disadvantages of electronic voting system. The section ended with the review of three electronic voting systems developed.

Types of Electoral Systems

Election consists of various components, giving rise to electoral system. International Institute for Democracy and Electoral Assistance, IDEA (2008) classified electoral systems into three types, namely, majority/plurality system, proportional representative system and mixed system. The distinguishing feature of majority/plurality systems is that they usually use single-member districts. The system include; (i) First Past The Post (FPTP);(ii) Block Vote and Party Block Vote; Alternate Vote(AV) and (iii)Two Round (Wall, Undated). Some advantages of majority/plurality includes (i)easy to understand, easy to vote and easy to count and (ii) makes it more likely that one party will have an overall majority of legislature members. However, the disadvantages of the system are (i) the number of people elected for each party is unlikely to reflect the proportion of votes cast;(ii) a winning candidate may have only a minority of votes cast and the more candidates there are, the more this is likely to happen;(ii) similarly, a party may gain power in a legislature with a majority of seats but not a majority of votes;(iii)those who voted for a losing candidate

are not represented in any way and their single preference means that they had no further say in who was elected and a voter cannot choose between candidates within a party(UNO,2003).The rationale underpinning all PR(Proportional Representative) systems is to consciously reduce the disparity between a party's share of the national vote and its share of the parliamentary seats; if a major party wins 40 per cent of the votes, it should win approximately 40 per cent of the seats, and a minor party with 10 per cent of the votes should also gain 10 per cent of the legislative seats. The system include ;(i) List Proportional Representation(LPR);(ii) Mixed Member Proportional(MMP) and Single Transferable Vote(STV). PR has the following advantages (i) depending on the system used, the result in terms of who is elected will reflect to a greater or lesser extent the proportion of votes cast and mean that each vote counts and (ii) voters who support minority parties and candidacies are more likely to be represented. The establishment of a threshold of a proportion of votes to be gained before a seat is allocated will protect to some extent against a proliferation of very small parties: for example, a party might be required to gain at least 5% of the vote before it can be allocated seats. The disadvantages of PR includes (i) It is more complicated to vote and to count and (ii)It will make it more likely in a legislature that there is no clear majority for any party. This may lead to deals between parties, and voters may not end up with the arrangement and policies for which they voted (UNO, 2003).The mixed system as the name implies, used both elements of majority/plurality and proportional representative. These systems include (i) parallel ;(ii) Single Non Transferable Vote(SNTV) and Limited Votes(LV) (Wall, Undated).

Paper-based Vs Electronic Voting System

The paper-based voting system (also known as manual system) involves a voter manually marking the paper ballot, election officials counting vote by hand and declaring winners and losers based on the votes scored by each candidate. Electronic voting system on the other hand makes use of electronic voting machine for the whole of the electoral process. Goldsmith and Ruthrauff (2013) advanced some advantages of electronic voting system over paper-based voting system. Such advantages include;

- eliminating the cost and logistics involved with paper ballots; improved voter identification mechanisms;
- improved accessibility to voting;
- easy conduct of complex elections; increase in voter turnout
- eliminating invalid ballots;
- faster, more accurate and standardized counting of ballots; and
- prevention of certain forms of fraud.

Although, electronic voting system has a lot of benefits or rather advantages over paper-based voting system, but the former is associated with some challenges. Such challenges according to Goldsmith and Ruthrauff (2013) include;

- lack of transparency;
- negative impact on confidence in the process;
- confusion for the illiterate or uneducated voters on process;
- need to conduct widespread voter education, how to use it and its impact on the process;
- difficulties in auditing results;
- secrecy of the ballot;
- security of the voting and counting process;
- cost of introducing and maintaining the technology over the lifecycle of the equipment;
- potentially losing control over the process to outside technology vendors; recruitment of staff with specialized IT skills;
- added complexity in the electoral process and the ability of the EMB(Election Management Body) to deal adequately with this complexity; and
- consequences in the event of equipment or system malfunction.

Some Developed Electronic Voting Systems

This sub-section reviewed some developed electronic voting systems. The knowledge gained from this sub-section will guide the researchers in the development of the electronic voting system under consideration.

Mikail ,Abiodun ,Mohammed and Abdusalam (2015) designed and developed a secure electronic voting system using radio frequency identification and enhanced least significant bit audio steganographic technique. The developed e-voting system adopts two levels of security: authentication of voters for whom they are using radio frequency identification technique and protection of casted votes in transit using enhanced least significant audio

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steganographic for credible electronic decision making. The results obtained from the testing and qualitative evaluation using both human psychoacoustic and histogram analysis of the audio cover and stego- audio of the system demonstrated an effective level of security from pre-election phase, election phase and post-election phase of the electioneering processes. Figure 1 shows the architecture of the system.

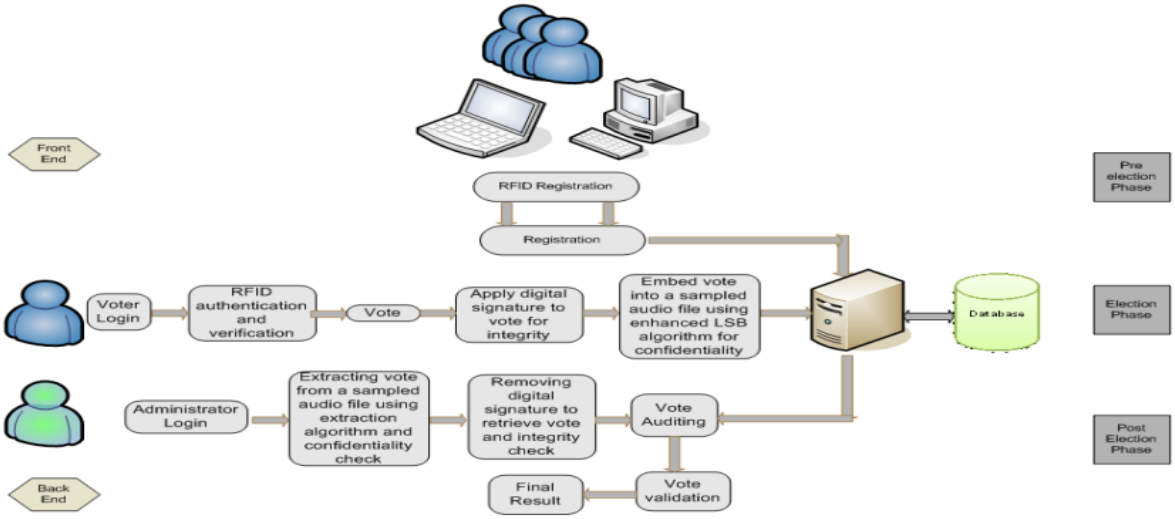

Figure 1: System Architecture of the Secured Electronic Voting System

Darmayunata, Syam and Afriansyah(2020) developed an E-voting system for election of student council chairperson of SMP Negeri 10. The developmental process began with analysis and planning stages. These stages were followed by implement stage. Figure 2, 3 and 4 shows some interfaces of the system.

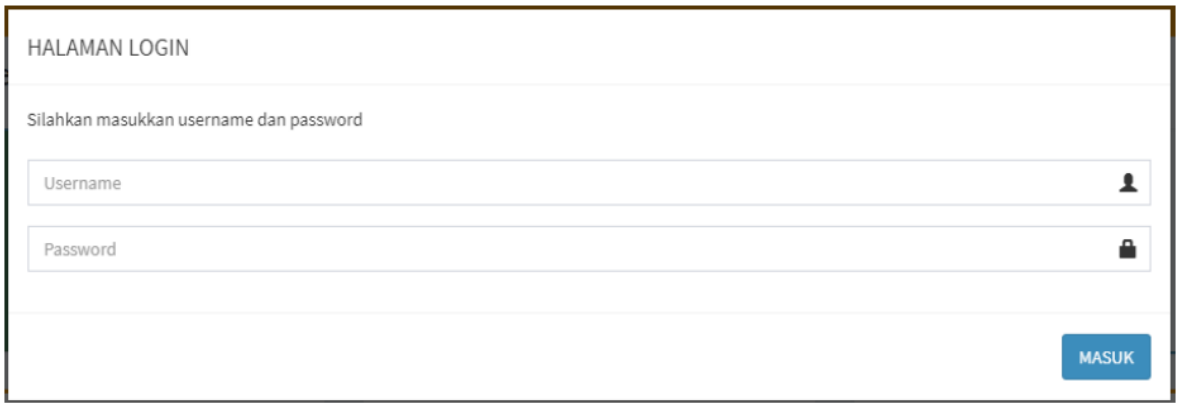

Figure 2: System Login Interface

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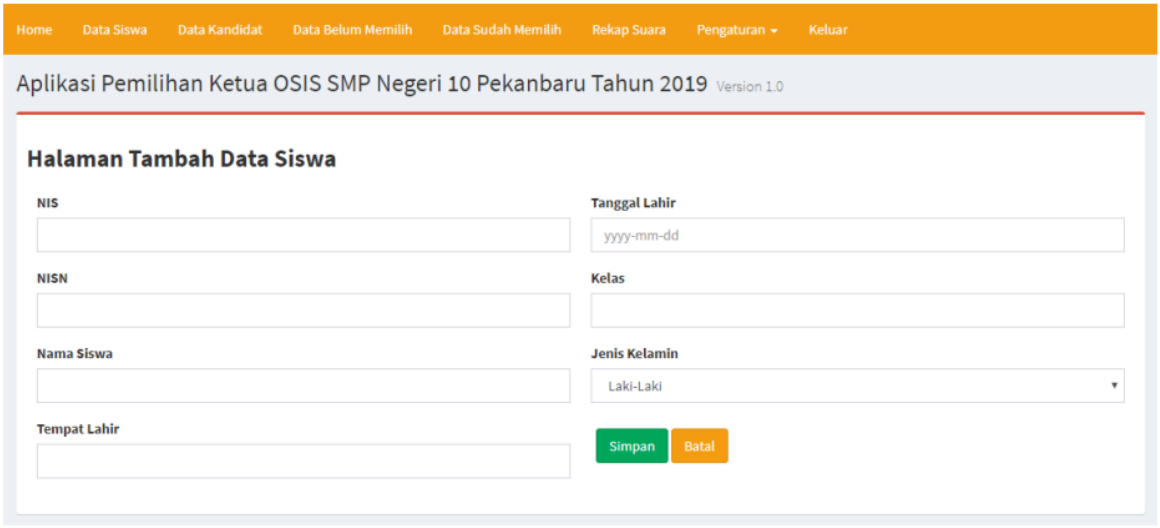

Figure 3: Add Student Data Interface

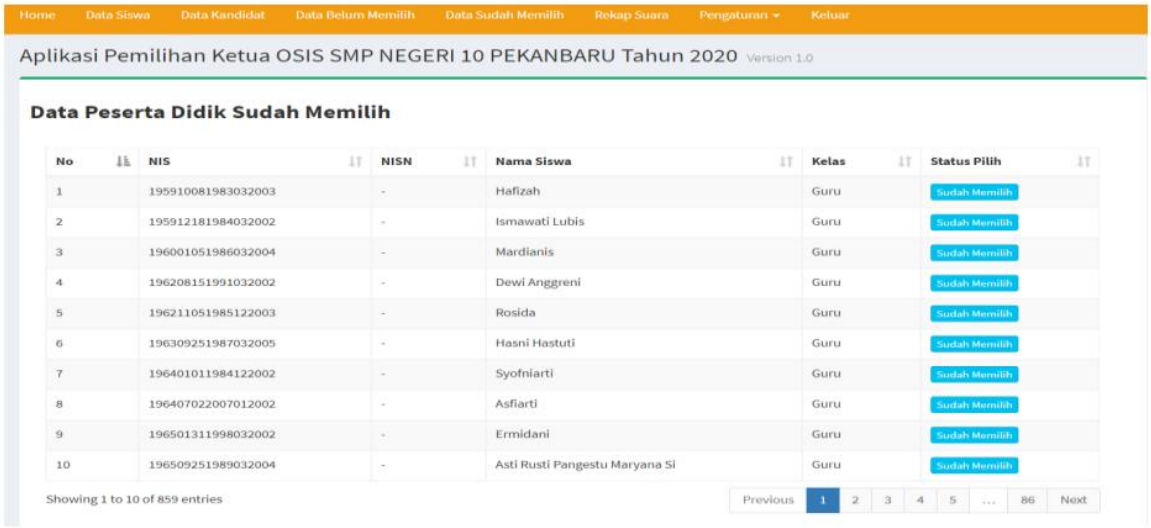

Figure 4: Voted Data Display

In another related study, Njoku, Ekwowune and Ikechukwu (2023) developed an E-voting system using IBM Blockchain technology and users National Identification Number (NIN). 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 web-technologies 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 realtime as they are casted. Figure 5 and 6 shows the home page and admin dash board.

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Figure 5: Home Page Interface

Figure 6: Admin Dash Board

V. METHODOLOGY

This study will adopt the methodology used by Nnabuko, Iroegbu, Ugwuoke, Eteng and Okoronkwo (2013) .The methodology involves three aspects: object-oriented analysis (OOA), which deals with the design requirements and overall architecture of a system, and is focused on describing what the system should do in terms of key objects in the problem domain; object-oriented design (OOD), which translates a system architecture into programming constructs (such as interfaces, classes, and method descriptions); and object-oriented programming (OOP), which implements these programming constructs

Hardware Requirements

(a) RAM: 1 GB or above
(b) Hard disk: 4 GB or above
(c) Processor: 2.4GHZ or above

Software Requirements

The following specification are needed

(a) Window 10
(b) MySql
(c) Microsoft visual studio
(d) XAMPP
(e) phpMyAdmin

System Users

1. Admin

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2. Student
3. Visitors

Functional Requirement Specifications

Admin

1. Login and logout
2. Add username and password
3. View, add, delete, update and print student/staff records
4. View election result
5. View winner result
6. Print election result

Student/Staff

1. Login and logout.
2. Vote candidate
3. View election result
4. View winner result

Visitors

1. View information about the College
2. View Voter education page

Non-Functional Requirement Specifications

1. Provide data security
2. Be efficient during operations
3. Be portable
4. Be reliable
5. Accommodates more than 10,000 records
6. Be Scalable
7. Be robust
8. Maintainable

Design

System Architecture

The project adopted client-server architecture with three layers; the presentation, application and the database. The presentation layer consists of the browser. The application layer is the, Graphical User Interface (GUI) while the database layer serves as the database system (MySQL). The system architecture is shown in figure 7.

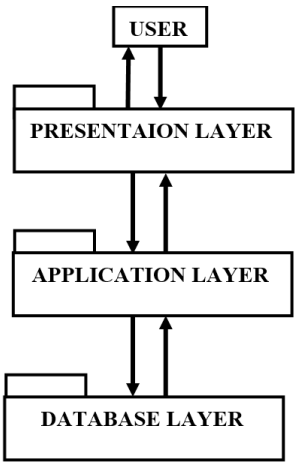

Figure 7: Three Layer Architecture

Use Case

The Use case diagram that shows the major functions of the users using UML (Unified Modelling language) is shown in figure 8.

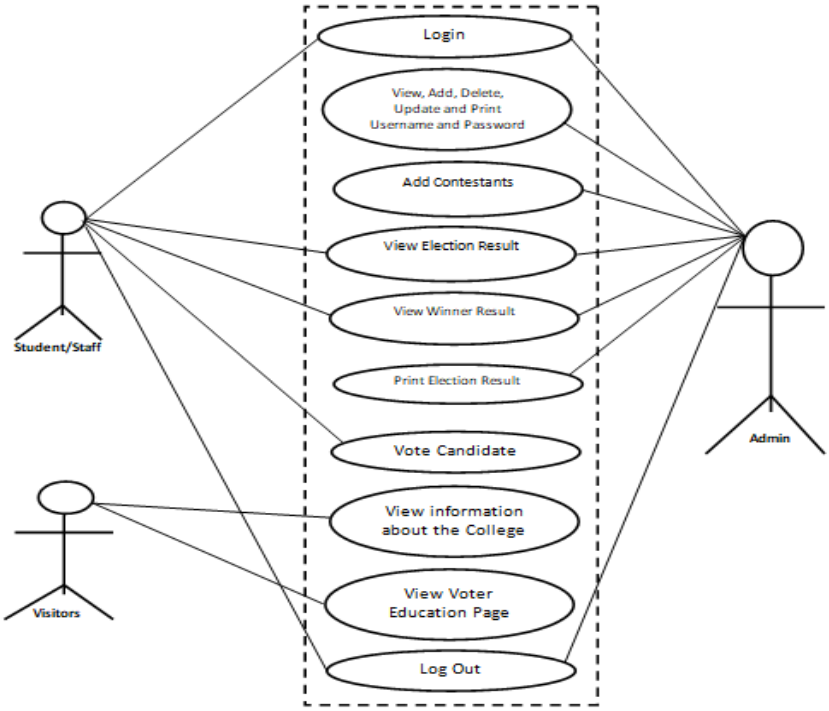

Figure 8: Use case

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Database Design

This project made use of MySQL database to store all the information required by the system to function. The database named electronic voting_db contain eleven tables, namely, admin password_ tb, auditor_tb, financial secretary_tb, President_tb, registration_tb, secretary_tb, treasurer_tb, user login_tb, Vice president_tb and voted user _tb. The database and its tables were created using *phpMyAdmin* . Figures 9 shows three of the eleven tables along side with their respective columns.

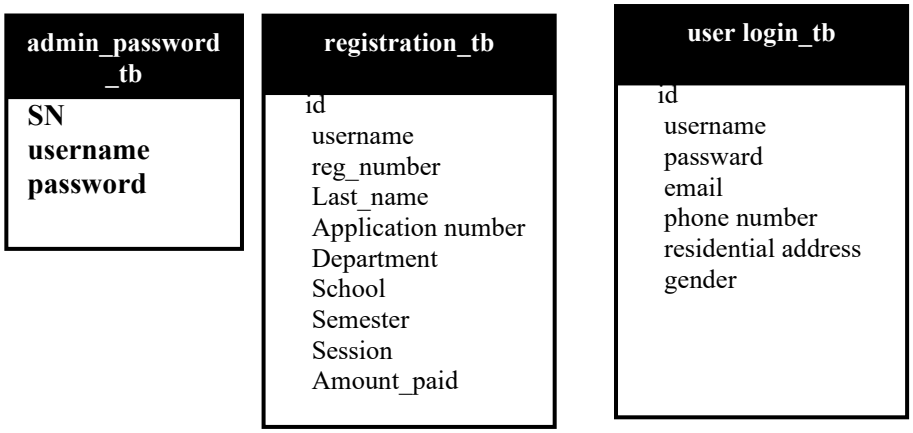

Figure 9: Database tables

VI. IMPLEMENTATION

Writing Program Code

The project was implemented using PHP and javasript programming languages. The database and its tables were constructed using *phpMyAdmin* The codes were written under Microsoft visual studio.

Sample Outputs

The following are a sample of the outputs of the system when running.

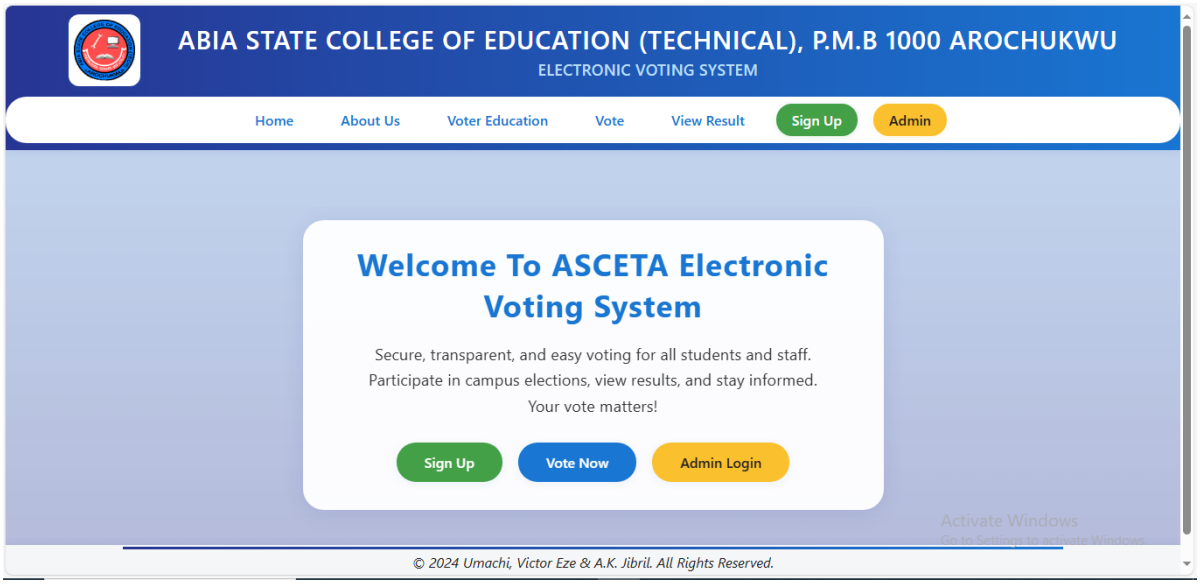

Figure 10: Home Page

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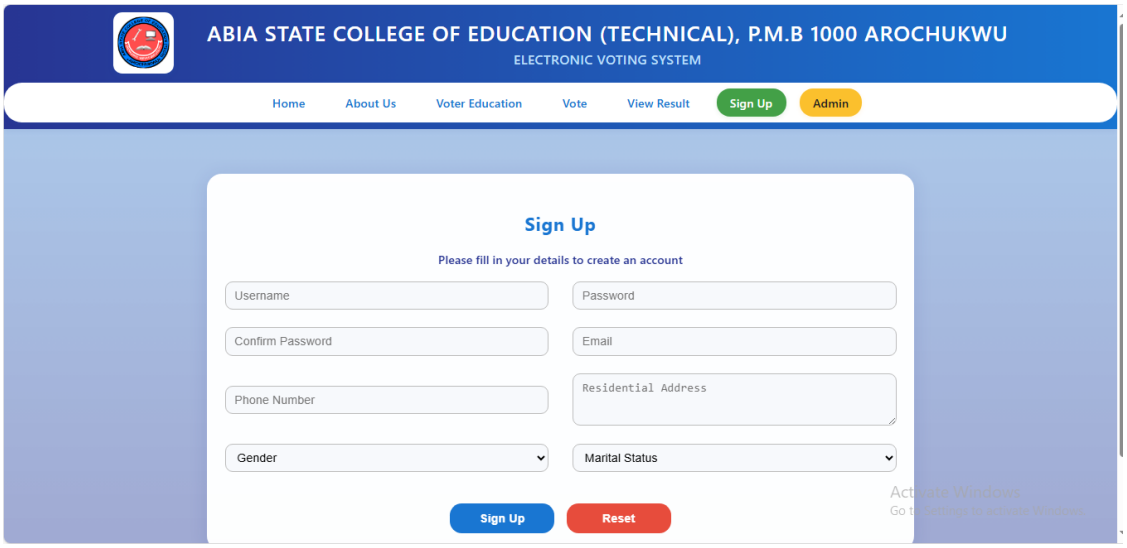

Figure 11: Sign up page

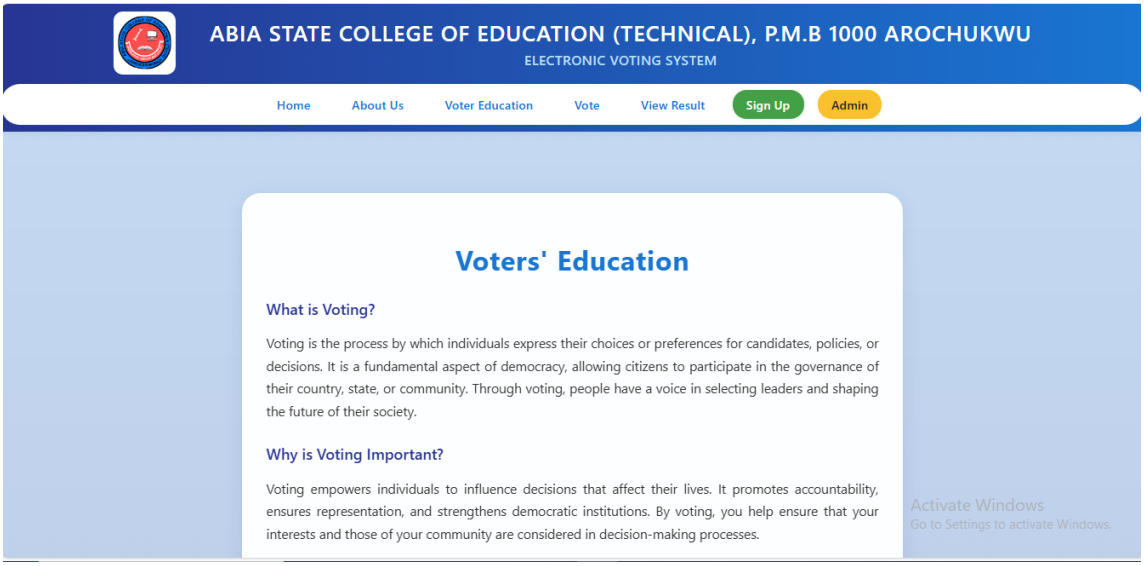

Figure 12: A sample of voters' education

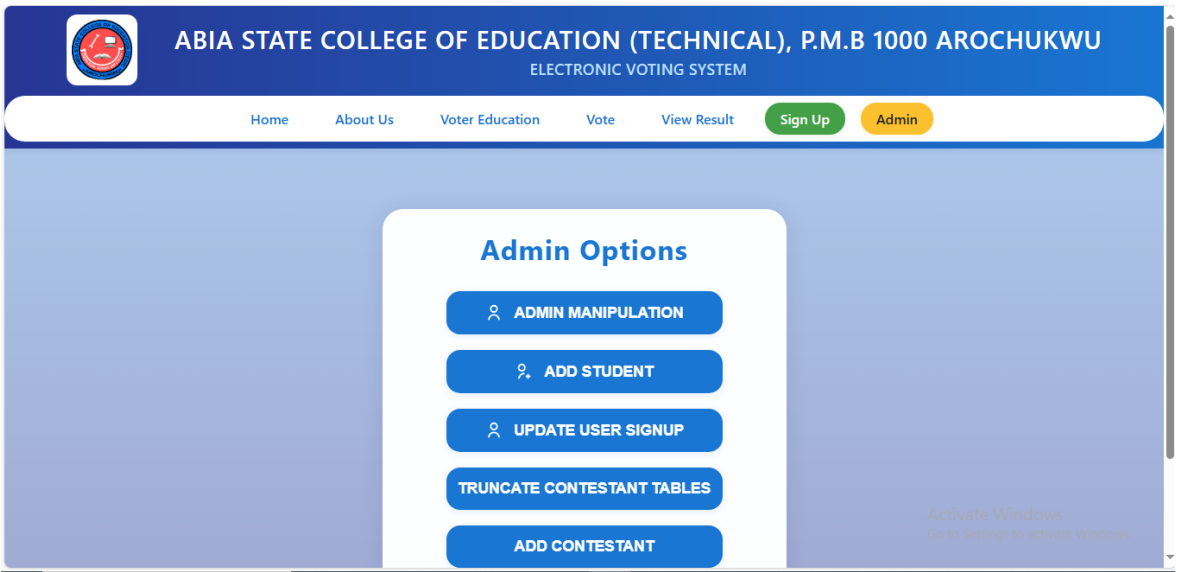

Figure 13: Admin option

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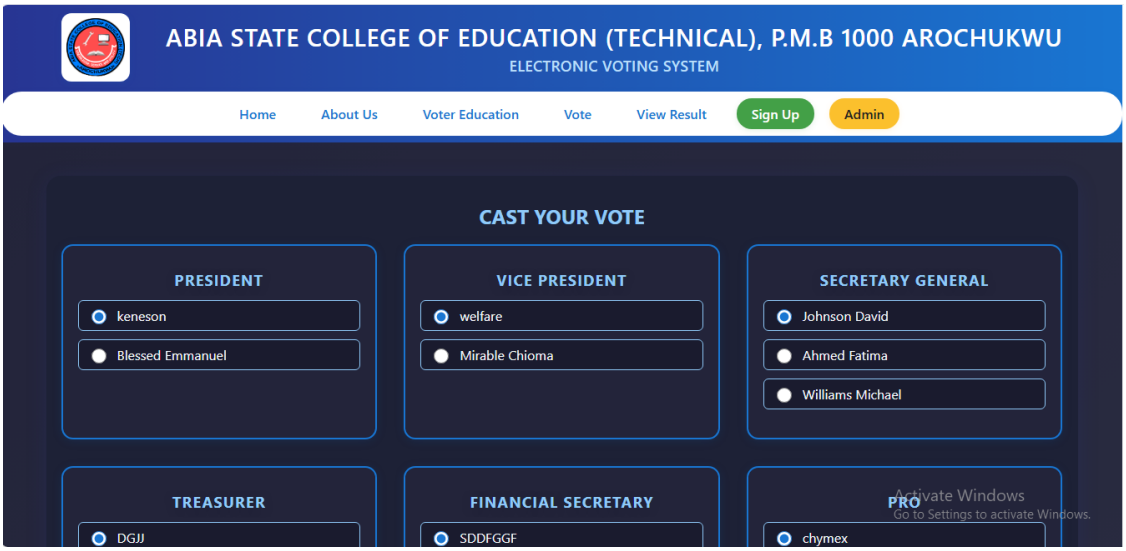

Figure 14: Voting page

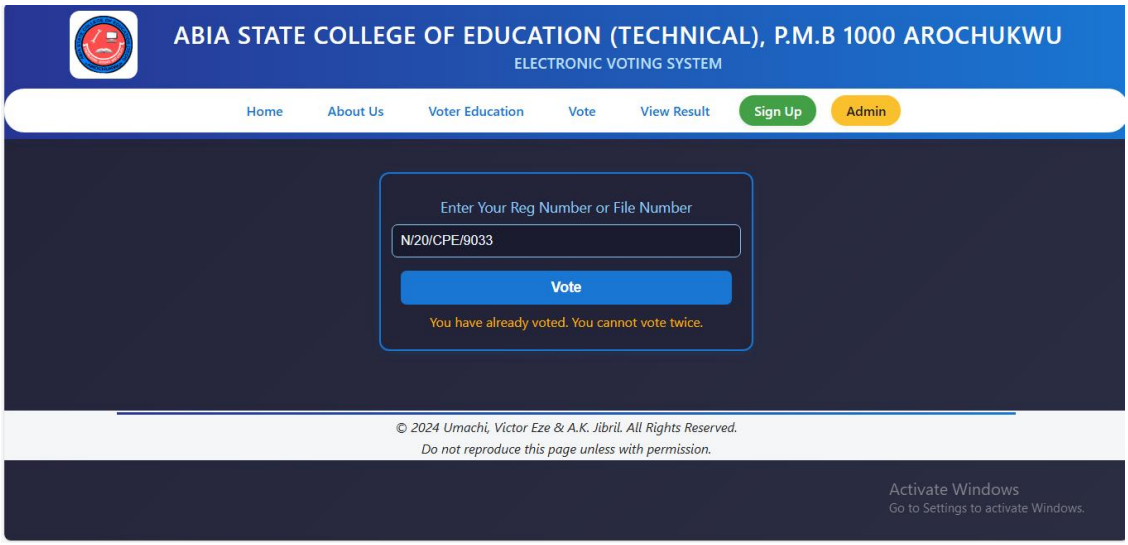

Figure 15:Preventing double voting

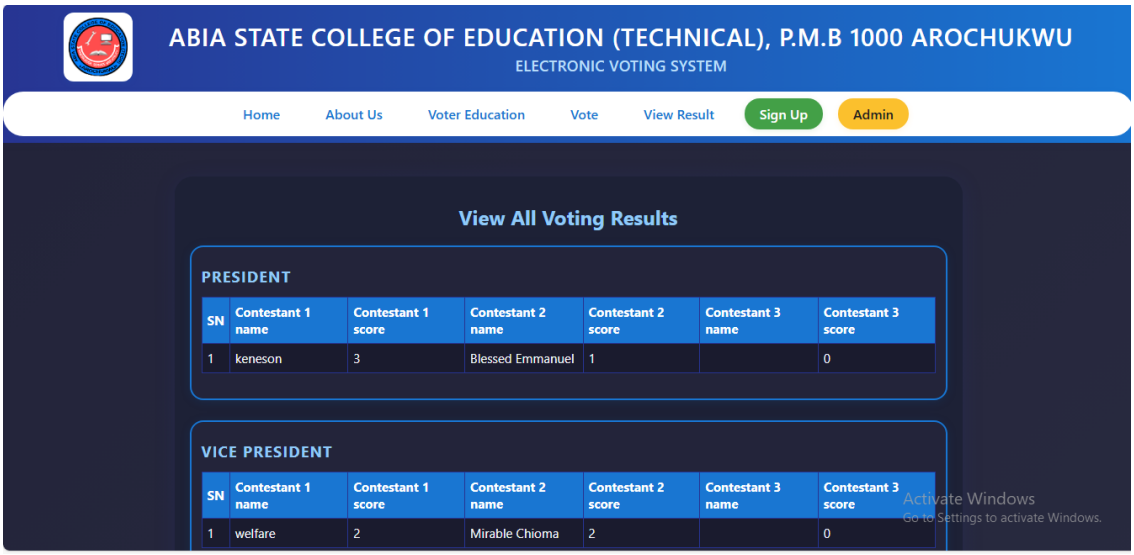

Figure 16:Election result view page

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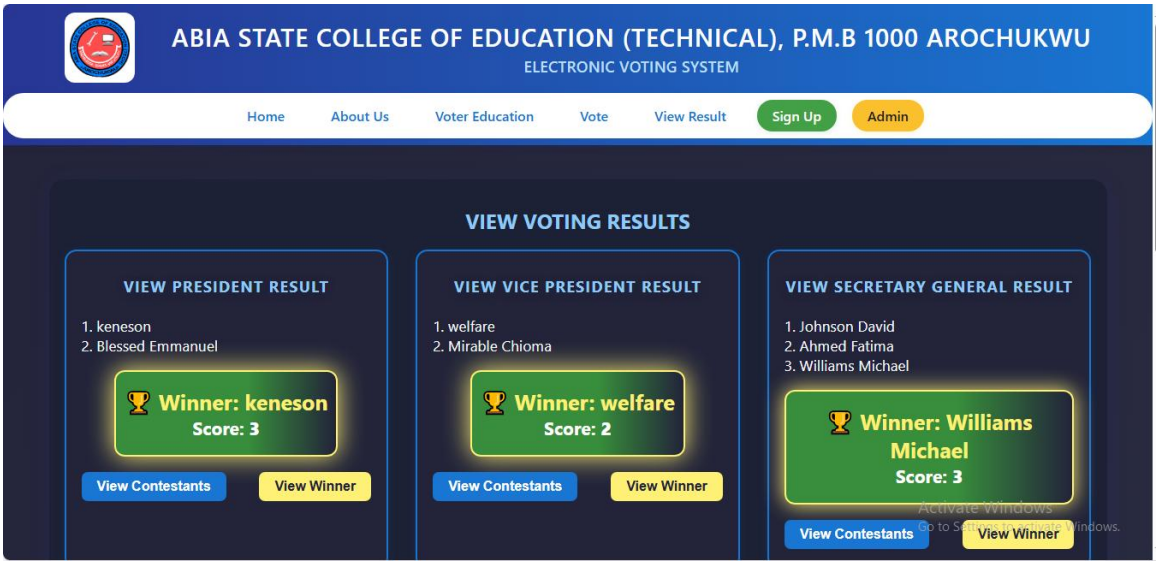

Figure 17:Winner view page

Testing and Evaluation

The developed system was presented to 12 staff and students of the College for testing and evaluation. The 12 staff and students tested the developed system and thereafter filled copies of questionnaire designed to measure users' satisfaction with the system. The data collected from the questionnaire was organised and analysed. The result of the analysis is shown in table 1.

Table 1: Mean and Standard Deviations of the responses of the Staff and Student

N=12

S/N	Item	$\overline{X}$	SD	Remark
	Functional Software Requirements			
	Admin			
1	The software enables admin to add username and password	3.75	0.45	Agree
2	The software enables admin to login	3.50	0.17	Agree
3	The software enables admin to logout	3.60	0.67	Agree
4	The software enables admin to update and delete user record	3.67	0.49	Agree
5	The software enables admin to view the records of all students/staff	3.67	0.49	Agree
	Student/staff			
6	The software enables student/staff to signup	3.75	0.45	Agree
7	The software enables student/staff to know more about voter education	3.67	0.49	Agree
8	The software enables students/staff to update their login details	3.67	0.21	Agree
9	The software enables student/staff to contest for a particular post	3.50	0.67	Agree
10	The software enables student/staff to cast their vote	3.58	0.51	Agree
11	The software enables student/staff to view election result	3.75	0.45	Agree
	Visitor			
12	The software enables a visitor to view information about the College	3.25	0.87	Agree
	Non-Functional Software Requirements			
13	The software is well organized	3.67	0.21	Agree
14	The Software window environments are attractive	3.75	0.45	Agree
15	The software buttons are responding to mouse click quickly	3.67	0.49	Agree

16	The feedback massages provided by the software are self-explanatory	3.67	0.49	Agree
17	The software has data security	3.75	0.45	Agree
18	I felt comfortable when using the software	3.42	0.67	Agree
19	It is easy to navigate to different parts of the software Recommendation	3.67	0.49	Agree
20	The developed software can be used for online voting system in the College	3.50	0.90	Agree

N=Number of respondent SD=Standard Deviation $\overline{X}$ *=Mean*

The data from table 1 shows the means and standard deviations of the questionnaire items. A close look at the values of the means in the table indicated that all the means have values not less than 2.50 being the cut-off point. This implies that the respondents are satisfied with the performance of the web-based system. Another close look at the table shows that the values of the standard deviations (SD) are small, implying that the respondents' opinions on the items were very close. Finally, the mean value of item 20 (3.50) indicated that evaluators agreed that the developed web-based voting system can be used for unions election in the College.

VII. CONCLUSION/RECOMMENDATION

Presently, unions elections in Abia State College of education (Technical) Arochukwu are being conducted manually and using paper ballots. This mode of election is stressful, costly and time consuming as well. To mitigate these problems, the researchers designed and developed a web-based voting system. With this system, staff and students can vote during unions' elections from anywhere. In addition, voters can view and print election results. Performance evaluation concerning the developed voting system shows that it is effective and efficient. The evaluators then recommended the use of the developed voting system for staff and students use during unions' election in the College.

VIII. ACKNOWLEDGMENTS

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REFERENCES

[1] Commonwealth of Pennsylvania (2024). Types of Elections. Retrieved on 9th October, 2024.

[2] Darmayunata,Y , Syam, F.A.& Afriansyah(2020). Implementation and Development of E-voting System for Election of Student Council Chairperson of SMP NEGERI 10 Pekanbaru. *Journal of Applied Engineering and Technological Science*, 1(2) 2020 : 150-161

[3] Goldsmith, B. & Ruthrauff, H. (2013).Implementing and Overseeing Electronic Voting and Counting Technologies. International Foundation for Electoral Systems(IFES) and National Democratic Institute for International Affairs(NDI). Retrieved on 13th Octorber,2024.

[4] IDEA(2008). Electoral System Design: The New International IDEA Handbook. Retrieved on 9th October, 2024.

[5] Mikail,O.O. , Abiodun,F.T. , Mohammed, A.I. & Abdusalam, A.K.(2015).Design and Development of Secure Electronic Voting System Using Radio Frequency Identification and Enhanced Least Significant Bit Audio Steganographic Technique. *IOSR Journal of Computer Engineering (IOSR-JCE).* 17(6),86-97.

[6] Njoku,T.S., Ekwowune,E.& Ikechukwu,O.(2023). Development of an E-Voting System Using IBM Blockchain Technology and Users National Identification Number (NIN). *Iconic Research and Engineering Journals (IRE),*6(9),221-227.

[7] Nnabuko,U.C., Iroegbu ,I.O. Ugwuoke,C.I., Eteng, I.E. & Okoronkwo, M.C. (2013). An object based result processing system. *International Journal of Natural and Applied Sciences (IJNAS)*, vol. 8(1& 2), 27 – 34.

[8] UNO(2003). Elections and the Electoral Process: a Guide to Assistance. Department for International Development Foreign &

Commonwealth Office. Retrieved on 9th October,2024.

[9] U.S. Election Assistance Commission (2021). Glossary of Election Terminology. Retrieved on 9th October,2024.

[10] Wall, A. (Undated).Electoral Systems Briefing Paper. Retrieved on 9th October,2024.