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## Design and Implementation of E-Voting System: A Study of the Uniport Student Union Government

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**Abstract** The process of electing the executive body of students union government of university of Port Harcourt has become a herculean task, due to the fact that the election is characterized by various forms of malpractice. Indeed there should be a mechanisms that must be adopted since the upsurge of new technologies that will be void of all form of negative tendencies. To achieve this, electronic voting is actually a sure way to obtain a perfect results void of compromise. Therefore, online voting definitely reduce the direct human activities that may tend to manipulate the process since the electorates exercise their franchise from their Comfort zones.

This paper give a detail parameters which encompasses the all forms of electronic voting that enable students of university of Port Harcourt to participate in election void of rigging of any kind but transparent to the conviction of all and sundry. The quest for this platform is to inculcate values thereby promoting democracy that will be accepted by all irrespective of diverse interest. The process actually undertaken to achieve development of electronic voting system to promote free, fair and transparent electioneering process, it is actually in form of a portal which is embedded on university of Port Harcourt website so as to query authenticity of a bonafide student of the institution integrated with sms application. The efficiency of the entire process has numerous benefits which will relatively reduce university cost of organizing via ELECO mechanisms.

**Keywords** E-voting, MySQL, Microsoft visual studio, web based, sms base

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### 1. Introduction

Election is a process by which members of an organization or a society select people to hold offices of authorities. It may be conducted by ballots, rising of hands, oral voting and now the use of electronic voting system. Voting could also be used award prizes, to select between different plans of actions [1]. Advancements in Information and Communications Technology (ICT) have greatly changed how we live our day-to-day lives and carryout critical operations and activities today. One critical aspect of human activity today is the process whereby people select people or leaders and representatives as the case maybe who will preside over their affairs. This they do by voting, voting to select the leadership of the student union government is important owing to the fact that it would ultimately have far reaching effects on the economy, growth and socio-economic development of the student union.

In other to utilize and maximize the ICT provisions, the term “**e-voting**” became a necessity. “**e-voting**” is used, in variety of different ways mainly and it encompasses all voting techniques involving electronic voting equipment, including voting over the internet, using booths in polling stations (e-booths) and sometimes even from remote sites (e.g. via SMS). Electronic voting encompasses several different types of voting embracing both electronic means of casting votes and electronic means of counting votes.



Contemporarily, end users have dealt with electronic transactions or e-transaction and it is gradually becoming a part of daily life e.g. the online or mobile banking.

However, e-voting is not yet an obvious method for voting, using University of Port Harcourt Students Union Government as our case study. There is however a slight difference in the modus operandi of an e voting system when it is compared to an e-transaction system. In an e-transaction there is always a possibility to dispute about the content of transactions. Users get printed notifications to prove their participation in transactions but in E-voting, there must be no printed notification to indicate your choice.

### **1.1. Problem Statement**

Due to the fact that there are a lot of vulnerabilities in the current voting scheme used by the University of Port Harcourt Students Union Government to conduct her elections. There is a need to develop a cheap, secure and reliable means of voting based on biometric phone number and matriculation number. So as to reduce the vulnerabilities associated with voting, increase flexibility and security as well as reducing the cost of elections by carrying out all the operations electronically.

### **1.2. Research Aim and Objectives**

The aim of this research is to design and implement an electronic voting (e-voting) system for the University of Port Harcourt's Student Union Government elections on biometric phone number and matriculation number. The university of Port Harcourt students presently run a biometric Identification Card system, which has already embedded their Matriculation number and phone number into the database.

### **1.3. Scope of Work**

In this seminar, emphasis is explicitly laid on electronic voting techniques for student union government in the University of Port Harcourt, whereby students vote to elect their leaders from the comfort of their homes no matter the location of the voters to achieve a robust and secure electronic voting scheme.

### **1.4. Significance of Work**

Given the high rate electoral fraud and malpractices in Nigeria University's Student Union elections and its aggregate on the perception towards voting, the use of electronic voting techniques and secured communication channels to transmit voting results would reduce these problems to the barest minimum, save time for students. This proposed model would permit students to vote from the comfort of their homes and privacy concerns of the electorate and also ensure one student one vote.

## **2. Literature Review**

### **2.1. Voting Mechanisms**

The ways of administering elections may vary with the voting system adopted by different universities and even in different elections within one university. Therefore, various equipment have been developed by respective universities to cater for their voting needs. There are a few variables such as budget, campus life and traditions, which would affect universities' choices of a particular voting technology [1].

#### **2.1.1. Paper Ballots**

Ways in which people have voted throughout the years have changed from verbal expressions to the placement of small balls in a box to the use of paper ballots. Paper ballots were used during the mid-nineteenth century where voters were able to write the name of their chosen candidates on a piece of paper or use a pre-printed ticket from a political party where they just simply signed their names. Voters would then deposit their ballots in a designated area for counting [2].

#### **2.1.2. Lever Machines [3]**

The lever machine is one of the earliest forms of mechanical voting which requires voters to pull selected levers assigned to their preferred candidate (See Figure 2.1). After each voter has made his/her choice, the levers return to their original position, while the internal counter in the machine advances immediately to record the vote.





Figure 2.1: Lever voting machine displayed at National Museum of American History

### 2.1.3. Punched Cards [3-4]

Punched cards were used during the US Presidential elections in 2000. With punched cards, the voter inserts a card into a machine under a ballot label, then uses a stylus to punch through the space assigned for the preferred candidate, hence removing a 'chad' or the rectangular shape from the card.

### 2.1.4. Supervised Electronic Voting (E-voting) [3-5]

There are generally two types of supervised E-voting systems adopted by modern countries in the West, such as the United States: optical scan and direct recording electronic (DRE). Other than this, there are also a few other, relatively older voting technologies, as used in the 2000 US elections: punched card and mechanical lever voting.

**E-voting** is an encompassing term referring to technologies adopted by countries all over the world which use advanced technologies as the core of the entire voting process. E-voting makes use of technologies from the basic punched cards up to the most advanced DRE systems and optical scan. On the other hand, unsupervised Internet Voting (I-voting) makes use of a broad range of electronic telecommunication technology in which telephones, cables, satellite television and computers serve as the means by which citizens can cast their votes. Unlike E-voting, that requires citizens to vote in specific and designated areas of voting using stand-alone machines, I-voting allows citizens to vote using almost any means of technology made available: personal computer, mobile phone and even television sets.

### 2.1.5. Optical Scan Ballots

The Optical Scan System is a technology developed almost three decades ago for scoring standardized tests. It was not until 2000 that this technology was used in US elections to tabulate paper ballots. The optical scan system is made up of computer-readable ballots, marking devices, privacy booths and a computerized tabulation device.

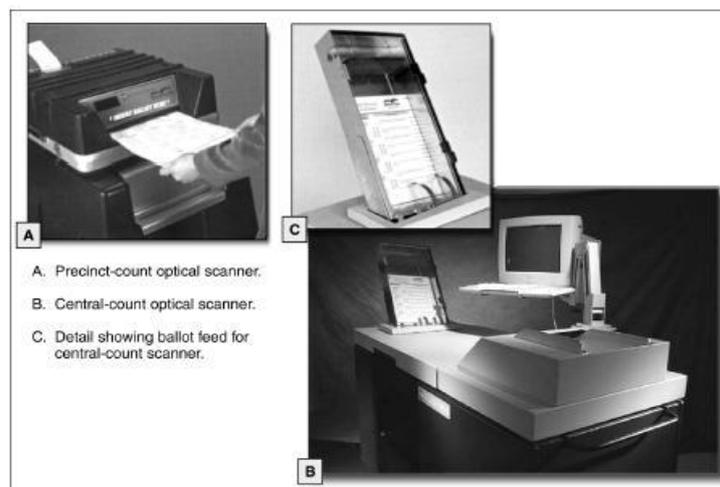


Figure 2.2: Precinct-Count and Central-Count Optical Scan Tabulator



This technology instructs the tabulation equipment to assign each valid mark on the ballot to the chosen candidate. Such technology also allows the identification of particular contests and candidates and configuration to capture a straight party voting and votes strictly to a particular number of contests. Over-votes [e.g. voting for two candidates where there should be one] and under-votes [e.g. voting for one candidate where should be more than one] can also be identified by using precinct-based optical scanners; in addition, a specific response can be provided for the two scenarios mentioned

#### 2.1.6. Direct Recording Electronic Systems (DREs)

A DRE is a voting technology which captures votes without the use of paper ballots, but rather tallies them in an electronic manner. It was introduced in the 1970s and used in the 2000 US elections by almost 12 per cent of voters. It should be noted that the ballot information is connected to electronic storage which eventually updates a central database with the votes cast.

#### 2.1.7. Internet Voting (I-Voting)

I-voting is a sub-type of electronic voting where votes are cast in a secure and secret electronic ballot and transmitted to the officials over the Internet. I-voting is therefore a technology which works through a broad range of electronic telecommunications technology using telephones, cables, satellite television and computers. According to Internet Policy report [5]. I-voting systems are categorized according to the sitting of the voting terminals.

- **Poll Site.** The E-voting system is in a polling station in a safe, supervised environment. If implemented, it would replace existing voting equipment such as paper ballots or punched cards.
- **Kiosk.** The unsupervised E-voting system is located in specific locations such as shopping Centre or libraries similar to ATM machines. However, such a system was found to be easily hacked if physical access to the machine is obtained even though it is protected and configured against security issues. I-voting might suffer from hacker attacks targeting the weakest link, voters' computers, especially insecure ones.
- **Remote Internet Voting (RIV).** This is a system where voters are allowed to vote online and remotely from any digital device connected to a network or to the Internet. It could be conducted from PCs, mobile phones, games machines and other technologies which can access the Internet. This requires less effort and cost from the authorities and provides more flexibility for voters to cast their vote.

**e-voting** is any voting method where the voter's intention is expressed or collected by electronic means.

The following electronic voting approaches here being identified in this literature, viz;

- **Kiosk voting** (e-booths) means the use of dedicated voting machines in polling stations or other controlled locations. In this scheme, voters mark their choice electronically (on the electronic voting machine) rather than on paper ballot. The votes are counted on individual machines, known as **Direct Recording Electronic (DRE)** machines, and the votes cast are transferred to the central tallying point by unspecified means.
- **Remote electronic voting** is the preferred term for voting that takes place by electronic means from any location. This could include the use of text message, multimedia message, interactive digital TV or touch tone telephone.
- **Internet voting** (I-voting) is a specific case of remote electronic voting, whereby the vote takes place over the Internet such as via a web site or voting applet. Sometimes also used synonymously with Remote Electronic Voting.

In an Electronic Voting System, the main components of the process [6]

- **The Electronic Voters Register-** which is a comprehensive database of eligible voters.
- **Authentication-** which is done prior to balloting. This is based on the use of a secure biometric identification algorithms and schemes.
- **Voting, Collation and Transmission-** the election results directly from each of the polling stations are sent to designated collation centers in **REAL TIME**. In this case, it would involve the use of some of Direct Recording Balloting Machines (Electronic Voting Machines) connected over a VPN (secure internet facility), this will completely eliminate the cost associated with the printing of several million ballot papers.



## 2.2. Limitations / Challenges of the existing voting system

- Actual vote casting is not done electronically, hence too much of human interference and making it highly vulnerable to manipulations causing a lack of trust and integrity for the electoral process.
- Vote and Voter Authentication process was still not adequate and efficient as there were cases of multiple voting, multiple thumb printing and vote manipulation.
- Vote Recording, Results Collation and Display is inefficient
- The process is time consuming and there is massive cost associated with the printing of several millions ballot papers.

## 3. Research Methodology [7]

The methodology adopted for the Electronic Voting by student union government of the University of Port Harcourt is divided into two major parts; the software architecture and Application and the hardware architecture layout. The Software Application involves coding in C# language using and database management using MYSQL.

### 3.1. Research Design

The input design involves the design of the sub-system through which the bona fide students provide the required data such as name, department, matriculation number and phone number. The data is then processed by querying the school data base to confirm the studentship of the student. If the student is a bona fide student and has paid school fees for the section, then his name will be saved in the Students Union Government election database.

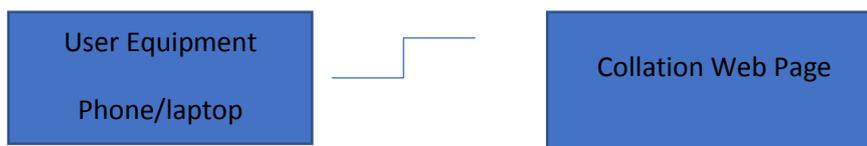


Figure 3.1: System Design Block Diagram

#### 3.1.1. Software Requirements

The software architecture will include the Software Application for Database, android or windows Operating Systems of the user equipment. It is responsible for data collection.

- Microsoft Visual Studio 2010 (This is needed for the development and design of the new system).
- Infragistics (This software adds newer tools for displaying election results on the Grid i.e. ultrawebGrid).
- Microsoft Office Suit (The election results will be exported from the database via ultraweb Grid into MS Excel for printing and documentation).
- MS SQL Server 2008 R2 (The Microsoft SQL Server is the secured database engine that handles the database creation, table creation, stored procedures for Database manipulation, and storage of voters and election records).
- Windows 7 or higher operating system to be installed on the computers.

#### 3.1.2. Database Design

The database will be implemented using MySQL sever. It is an open source relational database management system (RDBMS). This Structured Query Language (SQL). The operating system recommended is Linux / UNIX OS. It has the potential to store very large data with little configuration. This is where the voter's details would be stored by the software. The data would not be stored in plain text but would be encrypted. The database application that is used in conjunction with the software application should include the following technologies.



### Table partitioning Relational Database

Partitioning is the database process where very large tables are divided into multiple smaller parts. By splitting a large table into smaller, individual tables, queries that access only a fraction of the data can run faster because there is less data to scan [8].

#### 3.1.3 Application Software

The application program will be developed with the Microsoft C# (C sharp) programming language using Microsoft Visual Studio framework. It will build both android compatible mobile application and windows compatible. Any of these could be used to capture the required student's data.

#### 3.1.4 Web Page Application Software

This is designed with as a web page where the results will be collated. Every person who logs on will be able to access the real time voting result as it is being collated.

#### 3.4 System Flowchart [9,10]

This section shows the step wise algorithm of how the process flow. These steps of the system registration operations are presented in figure 3.4

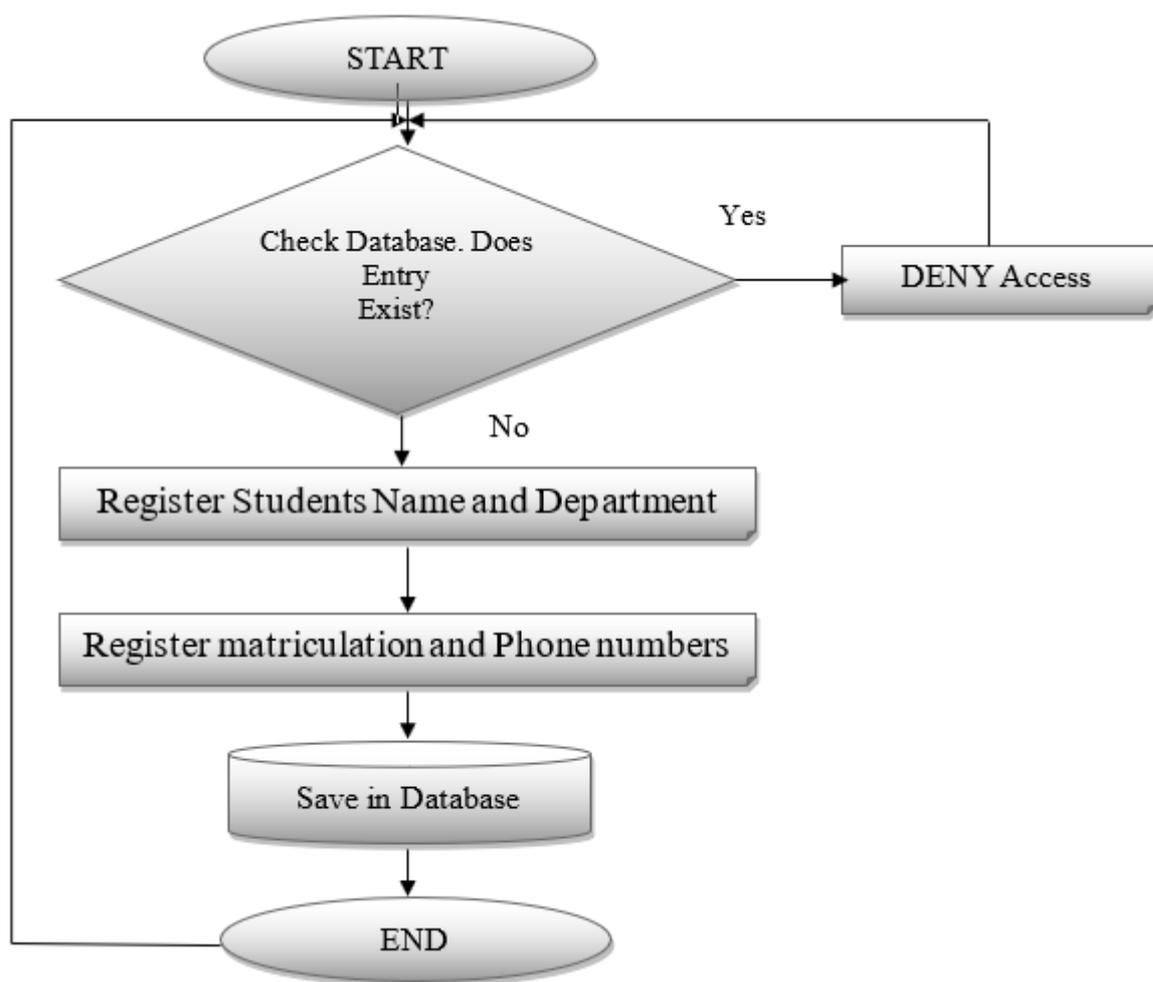


Figure 3.4: System Flowchart

### 4. Results and Discussion

This section presents and discusses the overall results of the design of the e voting system of the university of Port Harcourt's Student Union Government. The voting process and interface is simple and user-friendly. The electronic platform was designed to be user friendly in both windows, Android and even SMS based system for the actual voting and touch screen enabled. Figures 4.1 to 4.9 are snapshots of some of the pages of the Electronic Voting Application System [4].



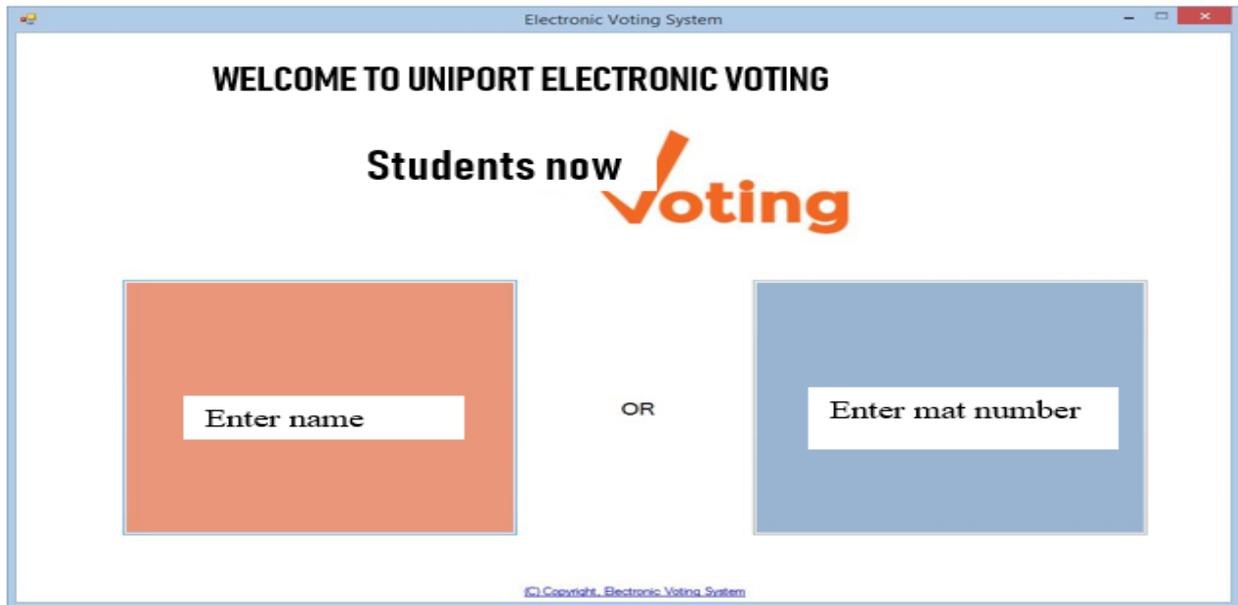


Figure 4.1: First Voting Page

As shown in figure 4.1, during the enrollment process, the student enters his name or matriculation number, this queries the school student's database to ensure the student is a bona fide student and has paid school fees for up to the session of the election. If the student is not found in the school database of bona fide students, his application to vote will be discarded. But if found in the database, he will be allowed to access into the next level of voting process.

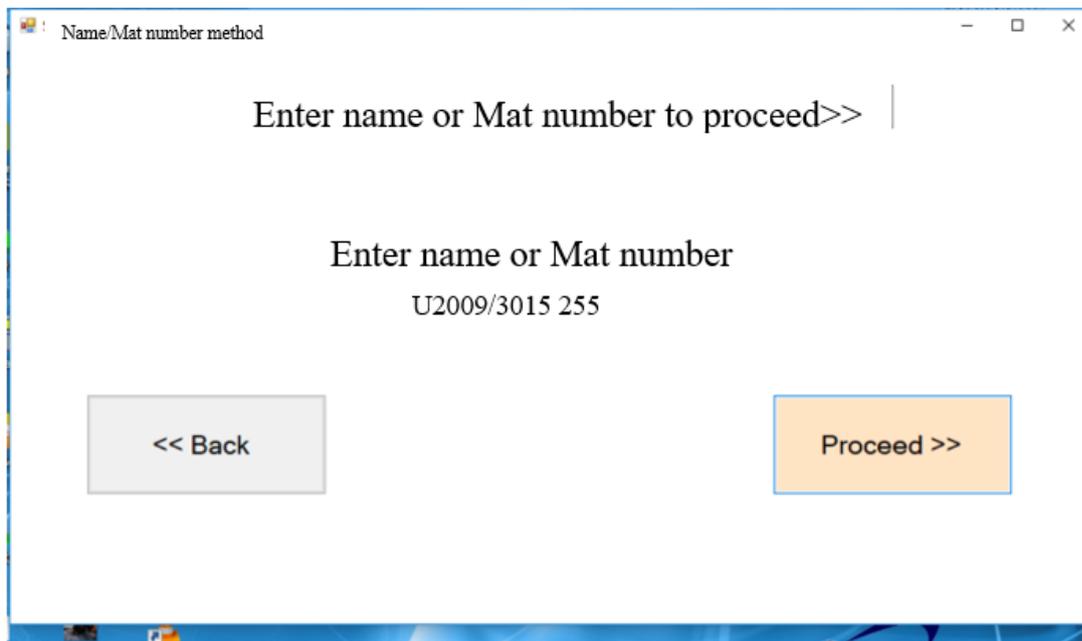


Figure 4.2: Second Voting Page

#### 4.1.1. Studentship Authentication and Verification Interface [4,7]

To authenticate and verify voter, his studentship has to be validated to affirm him as true voter, her must have paid school fees up to the session of the election. Where student verification fails, either for not being a student or defaulting in fees payment, access is denied vote. Where Voter (student) passes confirmation, his biodata will be pulled up from the school database. See figures 4.3 and 4.4.



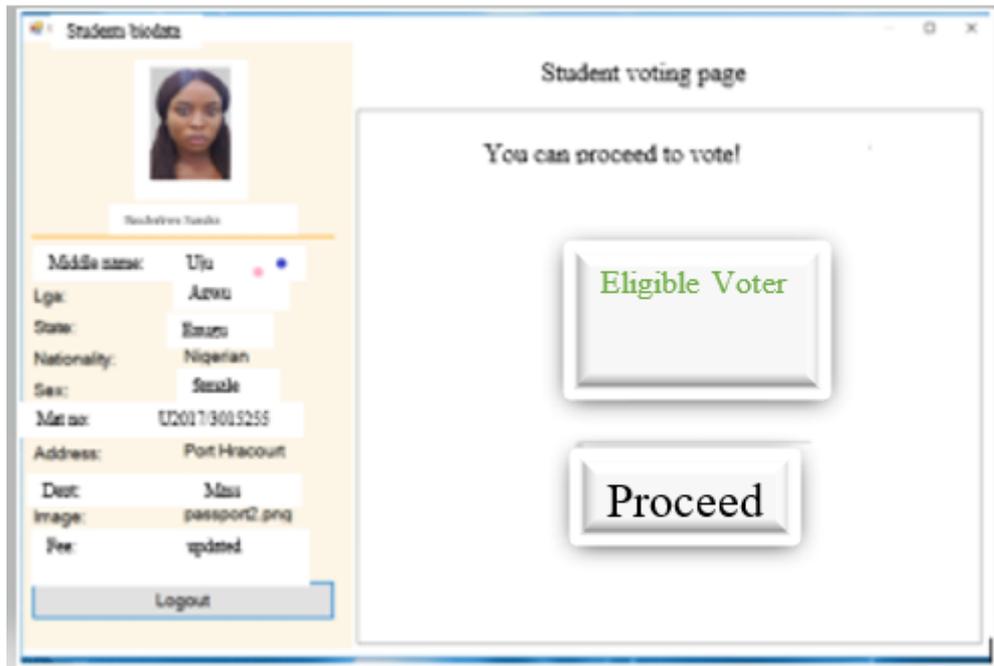


Figure 4.3: Studentship Confirmation Page [10]

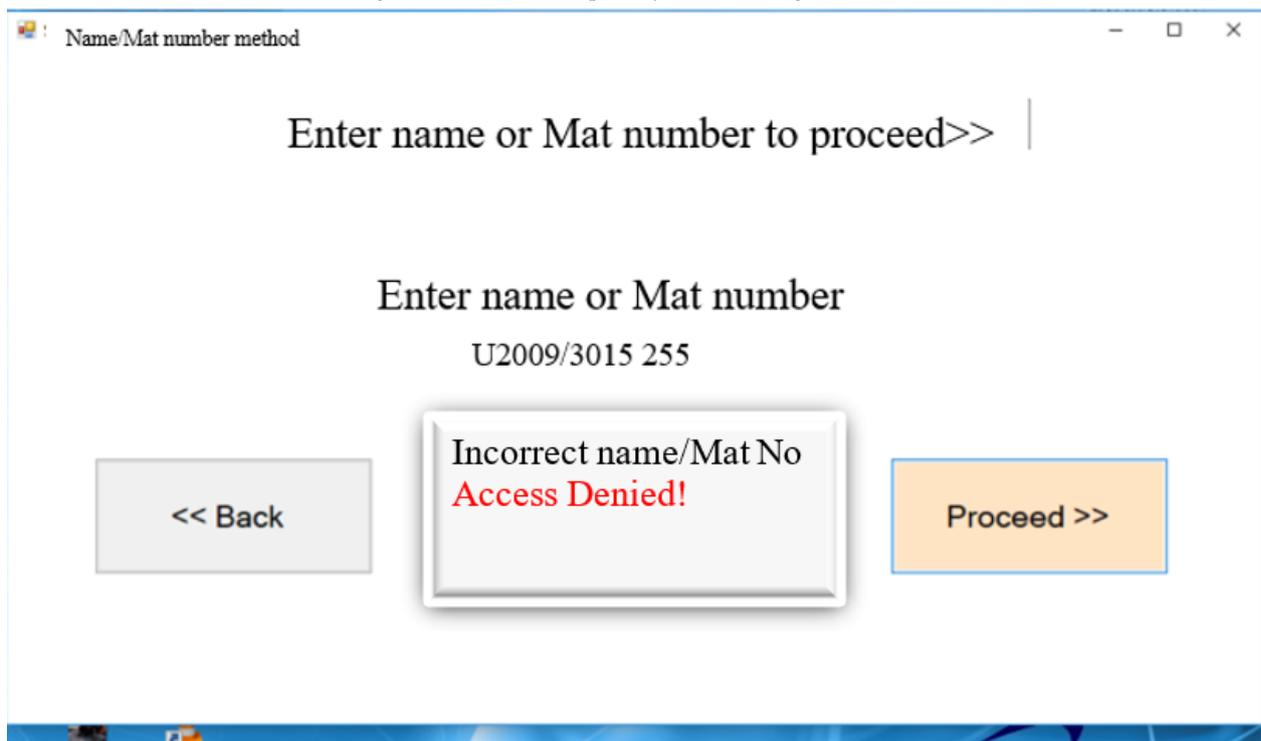


Figure 4.4: Studentship Confirmation Page, access denied

#### 4.1.2. Voters validation interface [3,4,7]

If the voter's (student's) data is correct and fee up to date, the student is allowed access to vote by select from the picture and name of his preferred candidate, see figure 4.5. but if data does not match the records in the database or student fee history is not updated, access is denied see figure 4.6. Supposed voter has voted before, he will not be allowed to vote a second time see figure 4.7.



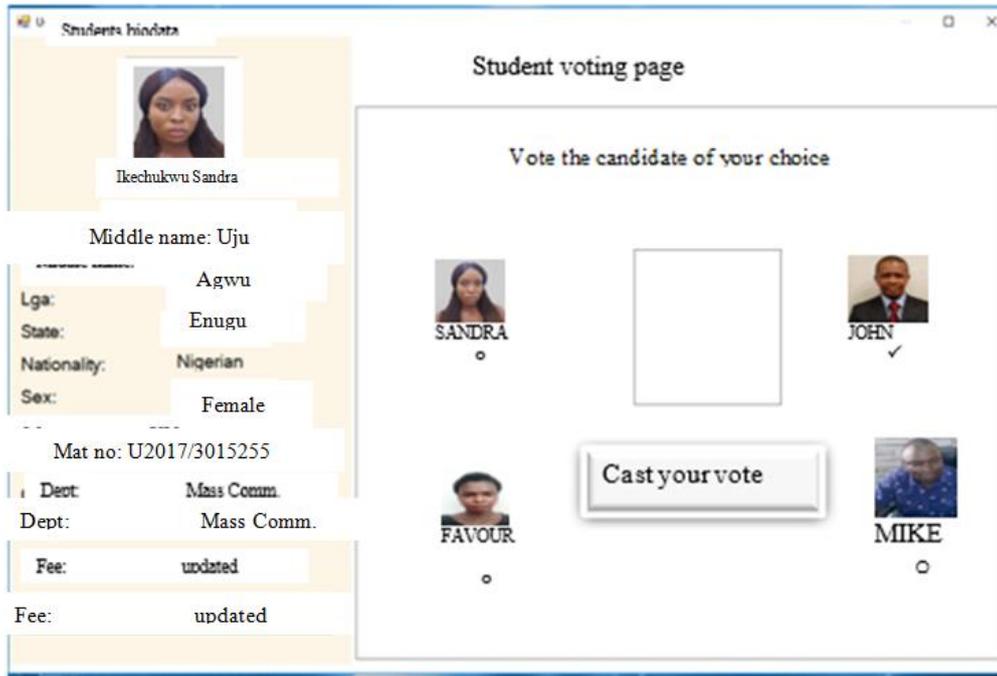


Figure 4.5: Voting for Your Choice Candidates



Figure 4.6: Successfully Voted



Figure 4.7: Voting Twice not Permitted

**4.2. Data Base Implementation [7,11,12]**

The implementation of the database is done in MYSQL database management studio. This manually creating a table clicking create database, name the data base, create table, name the table and enter the column and field parameters and their data types necessary for the work as shown in figure 4.11, while the complete system is

shown in figure 4.8 below. The database used is Microsoft SQL Server 2008 R2. The name of the database is ‘e-Voting’. The following tables were created for the e-voting system platform:

1. CANDIDATE\_TBL
2. ELECTION\_TYPE\_REF
3. E\_VOTING

Column Name	Data Type	Allow Nulls
CANDIDATE_ID	int	<input type="checkbox"/>
CANDIDATE_NAME	varchar(50)	<input checked="" type="checkbox"/>
PARTY_NAME	varchar(50)	<input checked="" type="checkbox"/>
PARTY_LOGO	image	<input checked="" type="checkbox"/>
ELECTION_TYPE	varchar(50)	<input checked="" type="checkbox"/>
ELECTION_DATE	date	<input checked="" type="checkbox"/>
YEAR	int	<input checked="" type="checkbox"/>

Column Properties	
<b>(General)</b>	
(Name)	CANDIDATE_ID
Allow Nulls	No
Data Type	int
Default Value or Binding	
<b>Table Designer</b>	
<b>(General)</b>	

Figure 4.8: MySQL Database Management Platform

Column Name	Data Type	Allow Nulls
SN	int	<input type="checkbox"/>
FIRSTNAME	varchar(50)	<input checked="" type="checkbox"/>
SURNAME	varchar(50)	<input checked="" type="checkbox"/>
FULL_NAME	varchar(100)	<input checked="" type="checkbox"/>
ADDRESS	varchar(200)	<input checked="" type="checkbox"/>
SEX	varchar(10)	<input checked="" type="checkbox"/>
Matric no	varchar (10)	<input type="checkbox"/>
LGA	varchar(50)	<input checked="" type="checkbox"/>
Dept	varchar(50)	<input checked="" type="checkbox"/>
REG_DATE	datetime	<input checked="" type="checkbox"/>
PASSPORT	varchar(500)	<input checked="" type="checkbox"/>
FINGERPRINT	varchar(500)	<input checked="" type="checkbox"/>

Figure 4.9: Database showing tables

## 5. Conclusion and Recommendation

A model of an e-voting system for the student union Government of the University of Port Harcourt leveraging on matriculation number and fee payment status as eligibility status. This model of e-voting system has been able to minimize the vulnerabilities associated with the conventional voting schemes that has been used by the student union government of the university of Port Harcourt.

### 5.1. Recommendation

A further work can be done on the network deployment and connectivity of this model of the electronic voting platform for the student union government of the university of Port Harcourt proper implementation. This method will save money, time and also enable eligible students to vote for the candidates of their choice from the comfort of their homes.

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