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# Electronic Voting: A Panacea for Electoral Irregularities in Developing Countries

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**Abstract:** This study deals with the use of information technology to handle electoral processes starting from voters and candidates registration to the actual casting and counting of ballots. The study discribe, the potential benefits and risks of electronic voting technology as well as desirable characteristics of voting systems. This study concludes with the design and implementation of an electronic voting system by using cutting edge programming development tools.

**Key words:** Data flow diagram, election, electronic voting, system flow diagram, voting

## INTRODUCTION

Election is the only acceptable means of selecting representatives in a democratic setting. This is because the electoral process ensures that representatives are selected by the majority and not by a powerful few who may not represent the overall interest and aspiration of the people. Moreover, every voter is interested in ensuring that his vote, which represents his voice in the democratic process, counts in a way that agrees with his intentions. Further, the concern of every voter is to have confidence in the mechanisms by which, their votes are counted, failing, which the legitimacy of elections is called into question. However, as attractive and laudable as the electoral process is, it has been a great challenge for the developing countries of Africa, Asia and Latin America to conduct reliable elections whose results are generally accepted by their people. This had led to protests, which in some cases were violent resulting in loss of lives and wanton destruction of properties. Many promising democracies in these countries have been truncated because of crises that arose from electoral disputes. Some of these countries have been plunged into serious political unrest, which in some cases culminated in civil wars with the attendant security, social, economic and humanitarian problems. For example, the political unrests that followed the 1964 elections in Nigeria led to the military take over on January 15, 1966 and the counter coup of July 29, 1966, which triggered a chain of events, which culminated in the civil war of 1967-1970. The political crisis, which engulfed the Western part of Nigeria in 1983, also left death and loss of properties on its trail. This and other factors led to the military takeover of 1983. Some other countries of Africa also have their tales of electoral woes. In 2008, the political and economic stability hitherto enjoyed by Kenya and Zimbabwe was disrupted by a series of violent protests because of disagreements over the presidential elections, which took place in these countries during the year. The few cases presented here represent a figment of electoral challenges that is a bane of democracy in developing countries. It is therefore, imperative to evolve a reliable and generally acceptable electioneering mechanism that will boost the confidence of voters in the electoral process and ultimately guarantee the legitimacy and wide acceptability of election results.

**Electronic voting:** Electronic voting refers to the use of computers and telecommunication systems to handle an entire or certain aspect of an electoral process. Generally, e-voting systems consist of 6 main phases:

**Voter's registration:** The voter's registration is a phase that facilitates the collection of data of prospective voters and the subsequent transfer of such data into the computerized system.

**Authentication:** The authentication is a phase that verifies the voters access rights and franchise.

**Voting and votes saving:** The voting and vote saving is a phase where eligible voters cast votes and e-voting system saves the votes cast by voters.

**Vote management:** The vote management is a phase, in which votes are managed, sorted and prepared for counting.

**Vote counting:** The phase where votes are decrypted and counted and to output the final tally.

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**Auditing:** The auditing is a phase that ensures that eligible voters were able to vote and their votes count in the computation of final tally. The main reasons why electronic voting is used are:

- It produces tallies faster than the conventional manual process
- It reduces human error in generating election results and the cost of conducting an election
- Electronic voting provides the potential for voters to be alerted when they make simple mistakes in casting their vote. Examples include instances when a voter selects more candidates than are allowed, called over-voting and instances where the voter accidentally skips selections or selects fewer candidates than are allowed, called under-voting
- The electronic voting system improves accessibility, so that all eligible voters can cast their vote in privacy
- Independent and candidates from third parties can be involved in the election without being accused of spoiling the election and no voter's input is wasted
- The electronic voting system will open up the political terrain to new ideas, new people and new parties, as transparency will be obtainable

Neumann (1994) suggested that a voting system should be so hard to tamper with and so resistant to failure. However, no commercial system is likely to meet the requirements and developing a suitable custom system would be extremely difficult and prohibitively expensive. Rebecca invented the Mercuri method for electronic voting. Her philosophy and Neumann's are very similar. A critical component of this method is also very similar to the Caltech/MIT proposal: a voting machine must produce human-readable hardcopy paper results, which can be verified by the voter after the vote is cast and manually recounted later if necessary (Mercuri, 2002). Dr. Michael Shamos of Central Michigan University, however provided a sharp counterpoint to Neumann and Mercuri's views. While, his six commandments summary of requirement for a voting system is very similar to others requirements, he is less afraid of the catastrophic failures and sweeping fraud made possible by imperfections in electronic voting machines actually occurring in a real election. Shamos is also much less impressed with paper ballots than are Neumann (1994) and Mercuri (2002). He places a great deal of faith in decentralization to make fraud difficult to commit and easy to detect (Shamos, 1993). Chaum (2003) presented a very interesting scheme, whereby voters could get receipts for their votes. This receipt would allow them to know if their votes were included in the final tally or not, to prove that they voted without revealing any information about how they voted. The security of this scheme relies on visual cryptography developed by Nair and Shamir and on voters randomly choosing one of two pieces of paper. Mercuri (2002) and Neumann (1994) advocate the use of this technique in electronic voting systems.

According to Eric (2003), voting has not always been private. Prior to the use of official ballots, coercion/ intimidation and corruption were common among voters. Thus, voting results did not reflect true opinion of the voters. To eliminate this problem, private voting was enforced with voting conducted privately using paper ballots inside polling booth. However, this led to vote buying/selling where buyers hand out filled-in ballots outside polling booth to the voters to cast into the ballot box. Voters then produce an empty ballot to the buyer afterward. The use of official ballot printed and distributed by the government was enforced to alleviate this problem. Even with the deployment of electronic voting system, it is still possible for an external attacker to disrupt or manipulate voting for personal, financial, or political gain (e.g. terrorist organization). An example of threat is to block the polling sites such that voters are unable to vote during the voting period, or coerce/intimidate voters to vote according to the attacker's choice (not the voter's choice). Other possible attacks in this category include hackers compromising voting machines, tally machines, or performing a denial of service attacks, such that votes are unable to be transported for counting (Barlow, 2003).

The security experts are more skeptical about e-voting than the public. Their greatest worries are not malicious attacks against e-voting servers, but system and programming errors and the security of private computers. Adding a semi-colon in the wrong place can completely change a program. For example, a recent midterm election in Dallas, Texas used touch-screen DRE machines. Voters discovered that no matter where they touched on the democratic side of the screen, it would vote for the republican candidate. The democratic party went to court, with affidavits demonstrating that the machines were making this error. It was decided that some of the voting machines were misaligned and those machines were taken out of service. There was also a report that in one Iowa county a single

electronic voting machine miscounted by 3 million votes due to an error (MIT/Caltech, 2001). Whether, the errors in electronic voting systems are accidental or intentional, it is important to note that the door is open to misuse in all of the voting methods, not just in electronic voting systems.

Computer scientists who research on, electronic voting all seem to agree on two things:

- Internet voting does not meet the requirements for public elections
- Currently, widely deployed voting systems need improvement (Stephen, 2006)

The MIT/Caltech researchers (2001), see a promising future for electronic voting, despite its problems today. They advocate using the methods currently in use, which result in the lowest average numbers of uncounted, unmarked and spoiled ballots. Their report proposed a framework for a new voting system with a decentralized, modular design.

## MATERIALS AND METHODS

We used the top-down approach to design the proposed e-voting system. Top-down approach emphasizes planning and a complete understanding of the system. It requires that no coding should begin, until a sufficient level of detail is reached in the design of at least some parts of the system. The design tools used in this study is the data flow diagram because it is the recommended tool for designing modular top-down systems. Three types of data flow diagrams are used to illustrate the different subsystems and their relationship in the e-voting system. These are context diagram, diagram O and child diagrams. The program design uses system flow diagrams to describe the various program modules and how they relate in the overall system. The hardware and software tools used include Intel centrino duo processor (1.67 Ghz speed, 1014 MB of RAM and 120 GB hard disk), a 15 inch SVGA color monitor, compatible keyboard and mouse, Windows Vista operating system, Microsoft Access (for managing the databases), Microsoft SQL and Microsoft Visual Studio Net 2005. The programming language used for implementing the system is Microsoft Visual Basic, which is a fast and easy way to create applications for Microsoft Windows. Visual Basic is suitable for experienced and new programmers as it provides a complete set of tools to simplify rapid application development.

**The context diagram:** The context diagram is a block diagram that gives a general overview of the proposed e-voting system. It shows, the interaction between the user (regarded as an entity) interacts with the e-voting system (herein treated as a process) (Fig. 1).

**Diagram O (explosion of the context diagram):** The diagram O is the explosion of the context diagram. It gives a more description of the activities involved in the e-voting system as well as the various supporting processes such as voter's registration, contestant's registration, election and result declaration (Fig. 2).

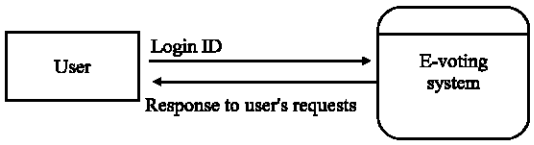


Fig. 1: The context diagram

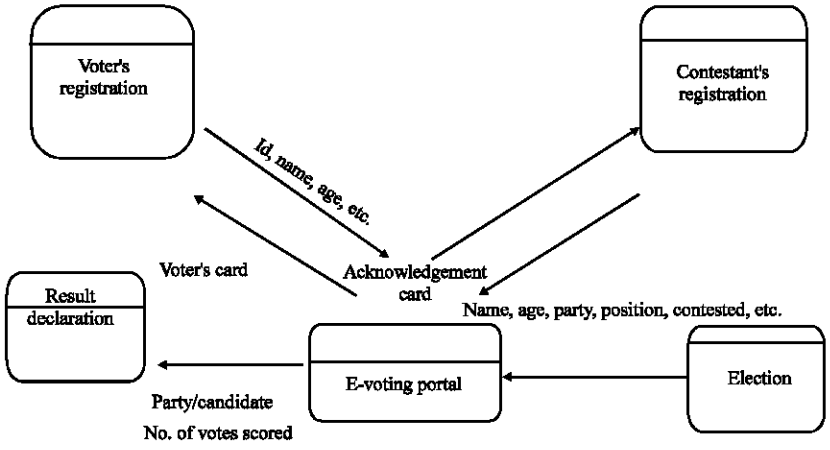


Fig. 2: Diagram O

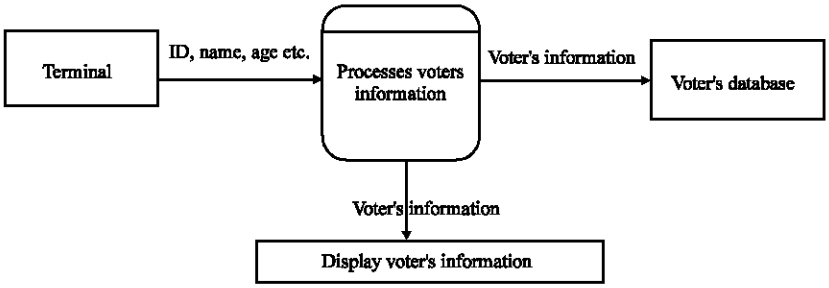


Fig. 3: Child diagram for voter's registration process

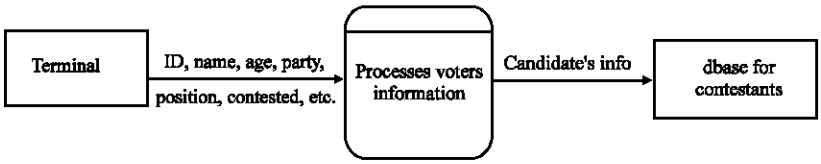


Fig. 4: Child diagram for candidates registration process

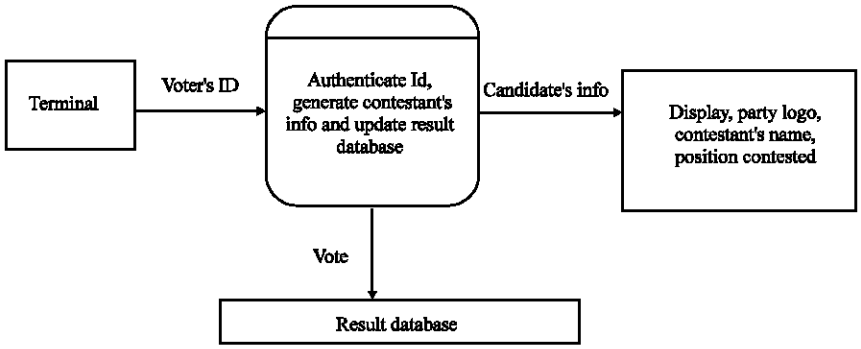


Fig. 5: Child diagram for election processs

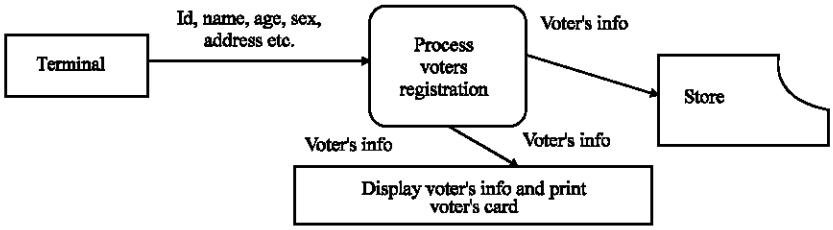


Fig. 6: System flow diagram for voter's registration

**Child diagrams:** The child diagrams in Fig. 3-7 provide a more description of the four supporting processes illustrated in Fig. 2.

**Experimentation**

**The program modules:** The program comprises of 4 modules each of which, performs a particular function. The components and functionality of each module is illustrated using a system flow diagram. These modules are.

**Voter's registration module:** This program module enables voters to register in order to be eligible to vote during the election (Fig. 6).

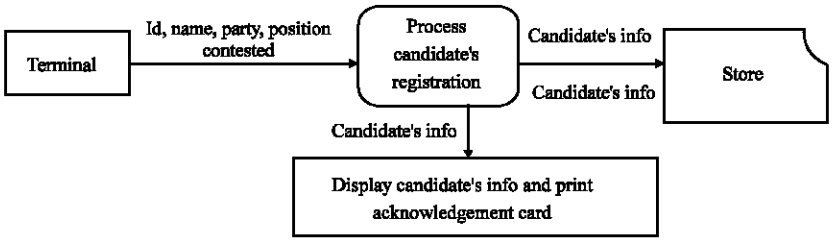


Fig. 7: System flow diagram for candidate registration

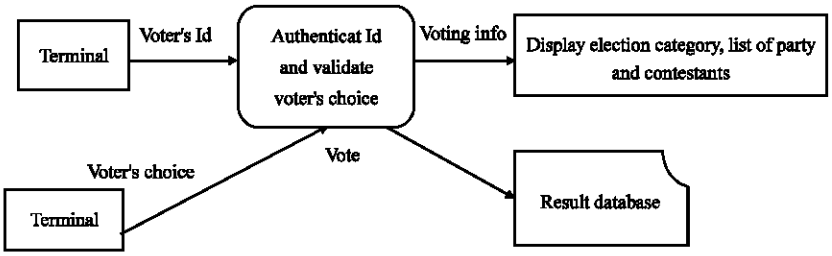


Fig. 8: System flow diagram for the election admin-istration module

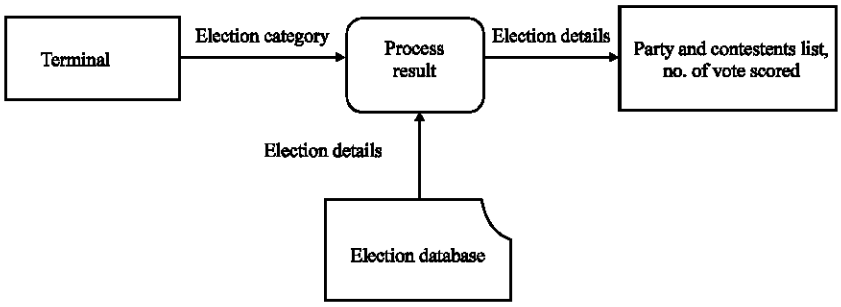


Fig. 9: System flow diagram for the Result Analysis module

**Candidate registration module:** This program module handles candidates registration for a particular position, while representing a particular political party (Fig. 7).

**Election administration module:** This program module enables voters to cast their votes for their candidates of choice (Fig. 8).

**Result analysis module:** This program module enables the result of the election to be computed and shown in Fig. 9.

## RESULTS AND DISCUSSION

The codes resultant from the compilation of the VB 6.0 code for this system is package into executable folder C:\Document\setting\saluaA\Localsetting\ApplicationData\Microsoft\E-voting system. To start the E-voting system, it is loaded from the D: \E-voting\ Administrator directory. Double clicking on the administrator folder displays the e-voting icon via, which a user can enter username and password.

**Electronic voting system:** There are 2 programs in the folder:

- E-voting system
- Election

This is illustrated using the graphical user interface shown in Fig. 10. Figure 11 shows, the main menu of the E-voting system.

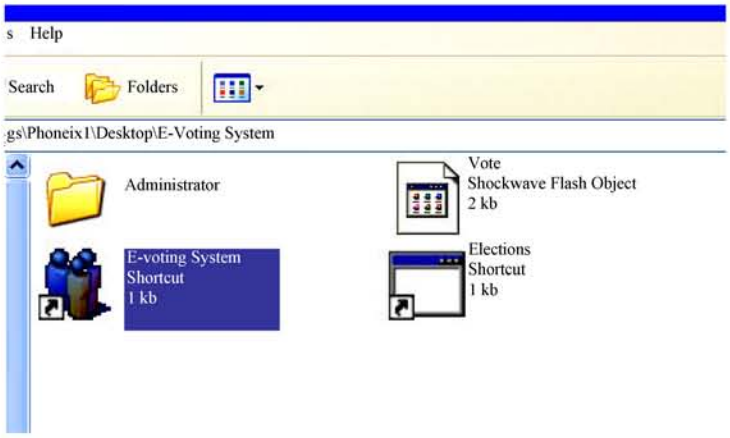


Fig. 10: Graphical user interface showing the 2 programs

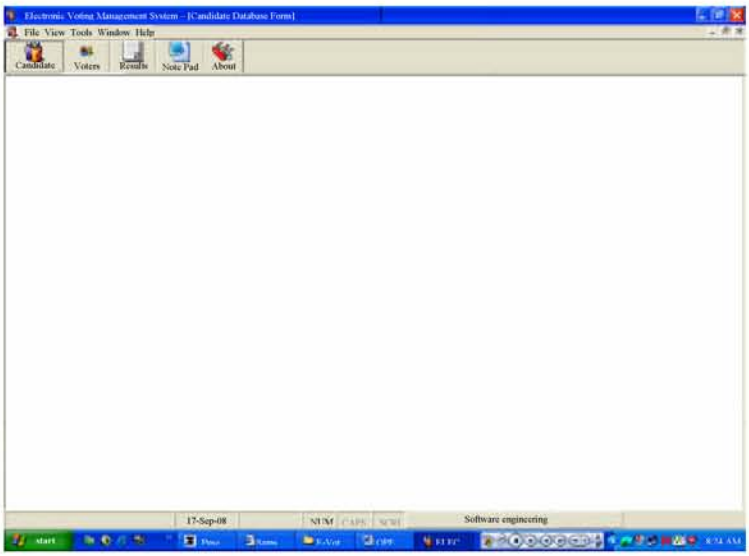


Fig. 11: Main menu for e-voting system


Fig. 12: The shortcut for the e-voting application

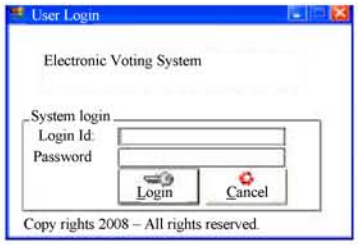


Fig. 13: User login process

The graphical interface shown in Fig. 12-14 describes the steps for logging onto the e-voting system.

- Click on the E-voting icon as shown in the Fig. 12
- Enter the User name and password

Following the login process, the welcome screen loads as shown in Fig. 14. The graphical interfaces shown in Fig. 15-19 describe, the operation of the candidate's registration subsystem. The procedure for running the subsystem as shown in Fig. 15.

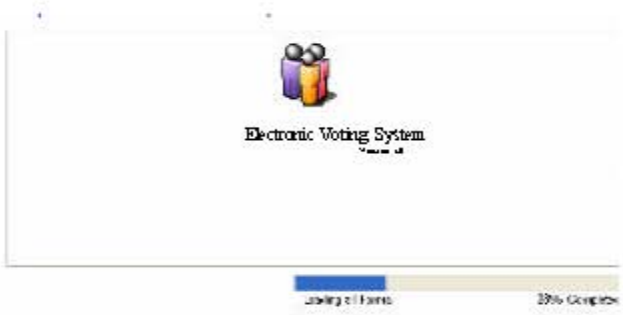


Fig. 14: Welcome screen

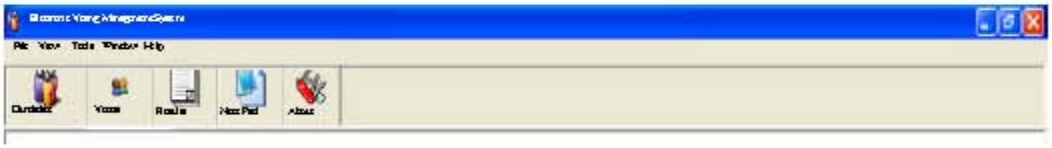

Fig. 15: Menu options

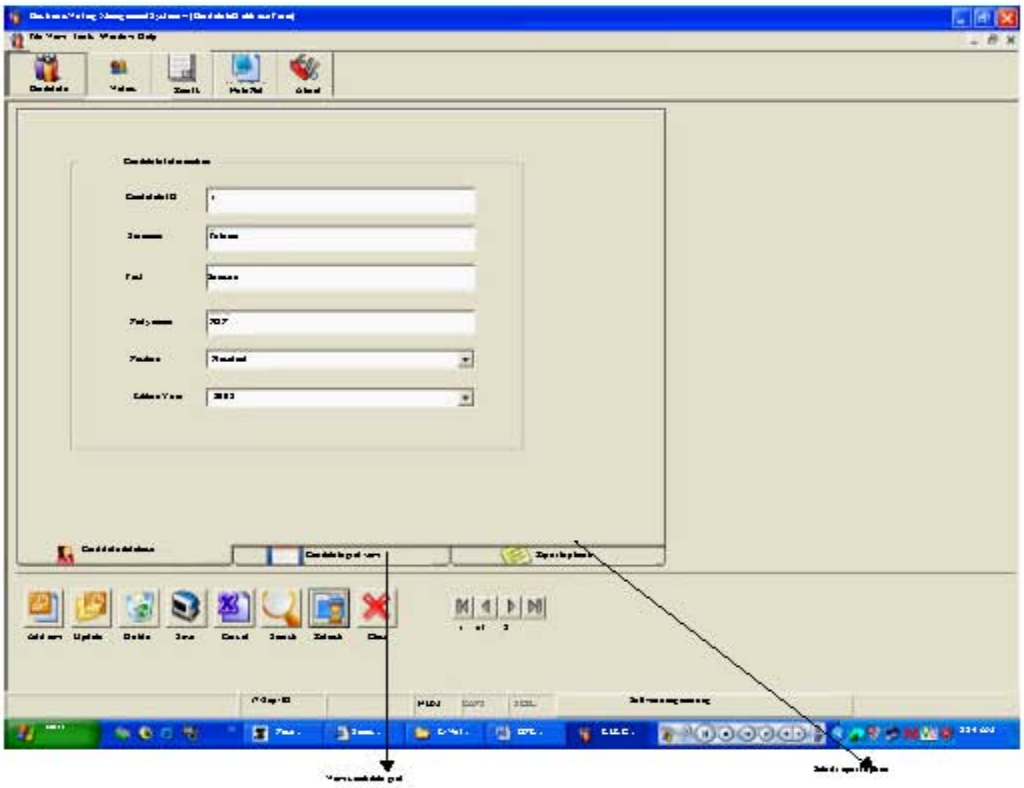

Fig. 16: Graphical user interface for contestant's registration

After clicking on the candidate menu, the graphical user interface in Fig. 16 will be displayed. This interface provides the means of entering candidate Id, surname, 1st name, party name, position contested and election year.

A click on the button captioned 'CANDIDATE GRID VIEW' enables the registration officer to view the list of candidates registered so far. The graphical user interface shown in Fig. 17.

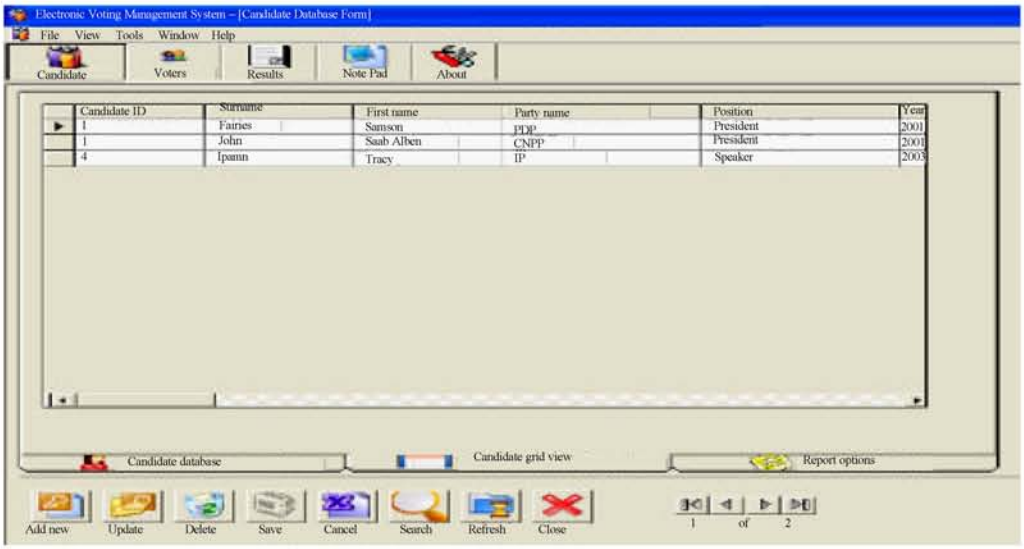


Fig. 17: Candidate's registration profile

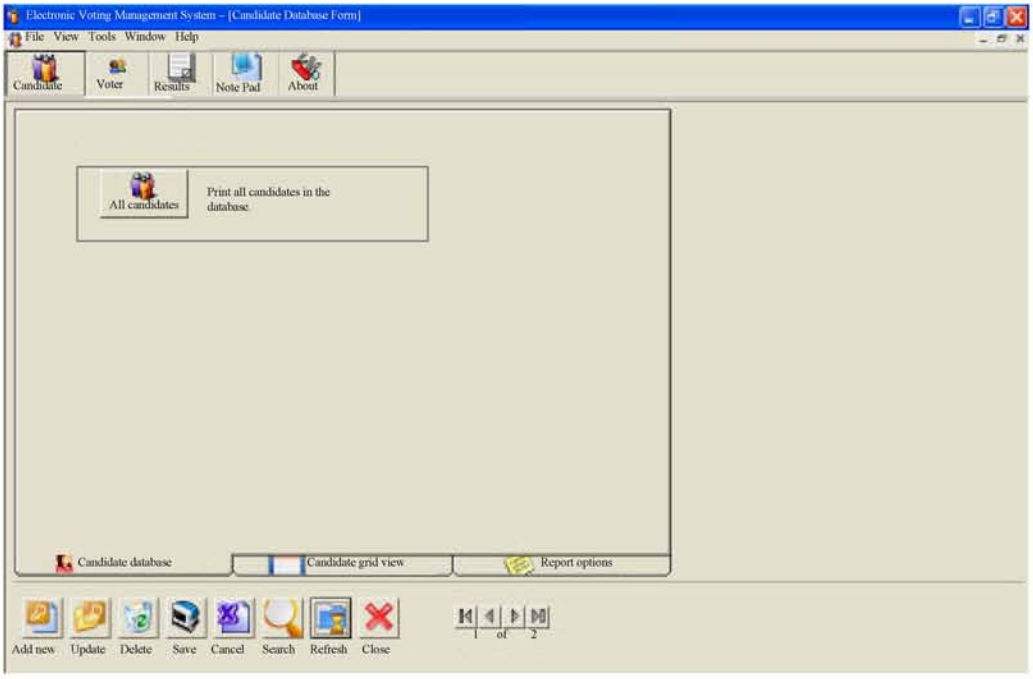


Fig. 18: Report generation for candidates' registration

On clicking on button captioned 'REPORT OPTION' it the list of candidates registered so far is made available for printing as shown in Fig. 18 and 19. Select all candidates to print candidates list.

The graphical interfaces shown in Fig. 20-22 describe the operation of the voter's registration subsystem. The procedure for running the subsystem as shown in Fig. 20.

After clicking on the voters icon, the graphical user interface in Fig. 21 is displayed. This interface provides the means of entering voter's particulars such as Id, surname, first Name, age, sex, address, etc.

A click on the button captioned 'VOTERS GRID VIEW' enables the registration officer to view the list of

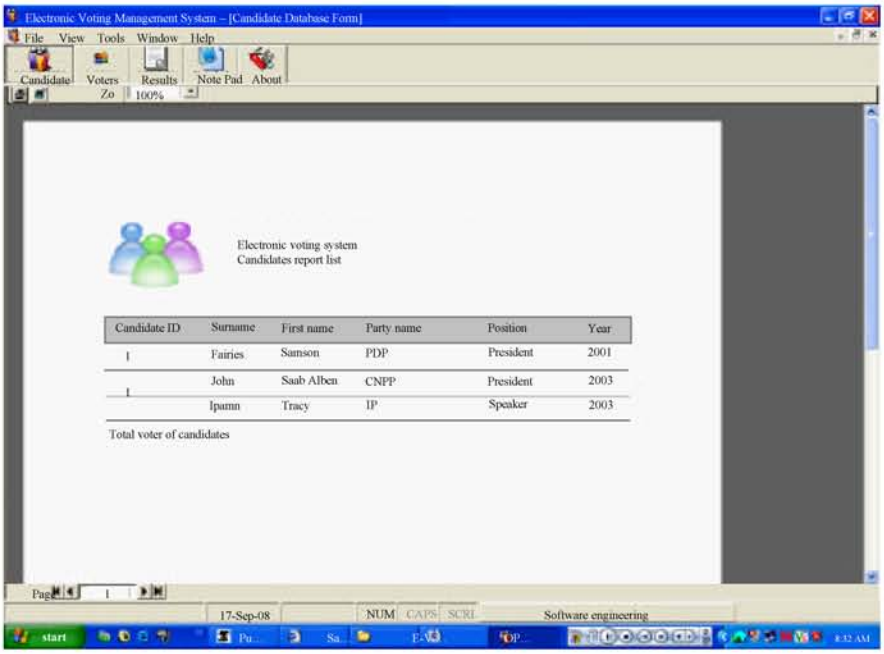


Fig. 19: Report generation for candidates' registration

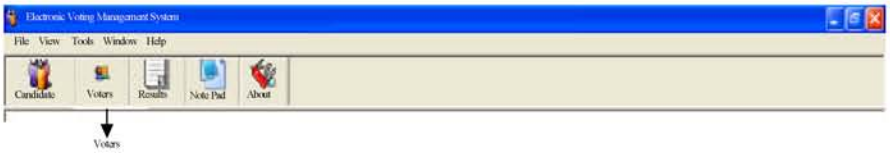


Fig. 20: Menu options

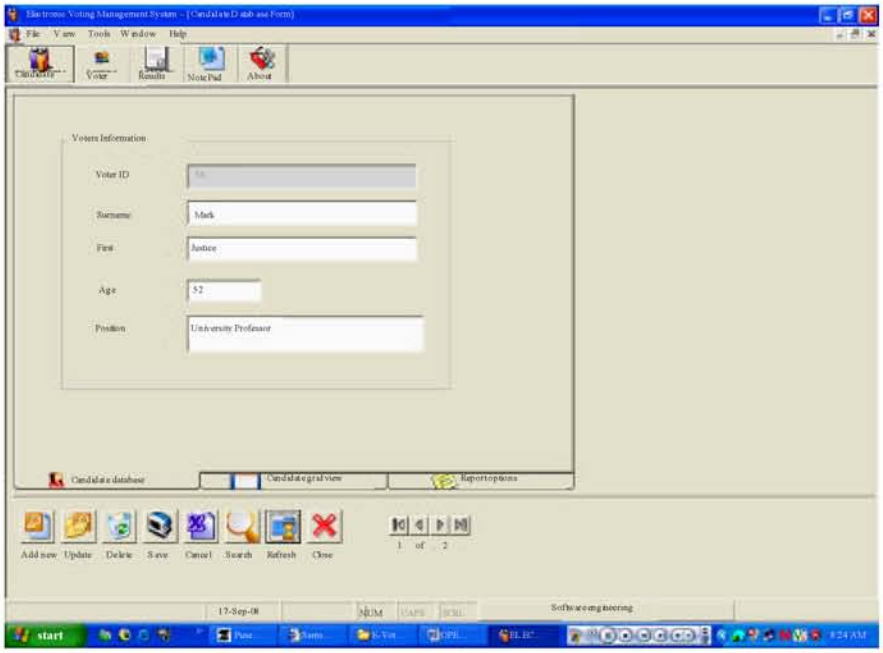


Fig. 21: Graphical user interface for voter's registration

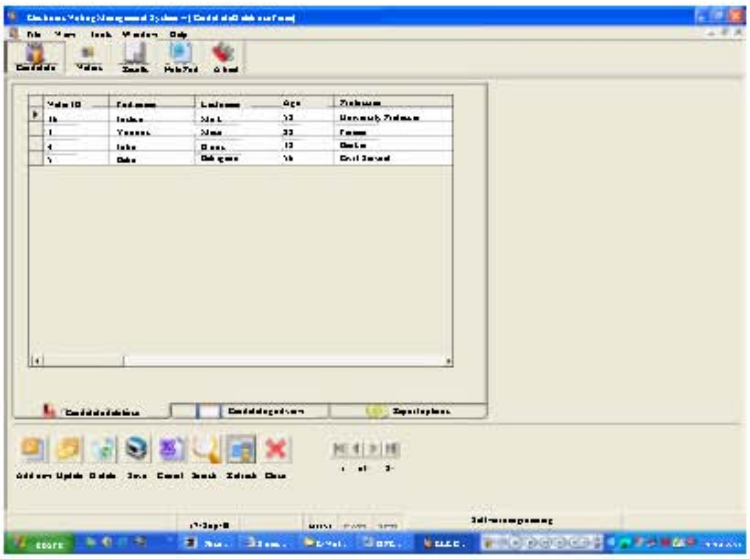

Fig. 22: Voter's registration profile

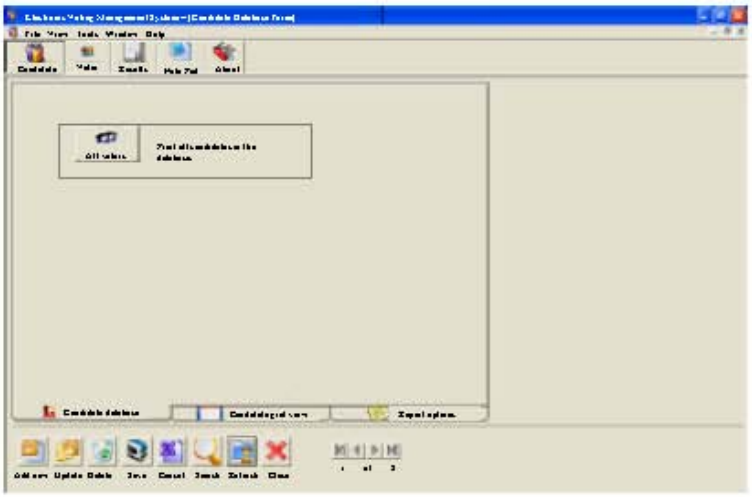

Fig. 23: Report generation for voters' registration

Electronic voting system

Voter report list

| Voter ID | Lastname | First name | Age | Profession |
|---|---|---|---|---|
| 3 | Mark | Younus | 28 | Farmer |
| 3 | Musa | Justice | 52 | University Professor |
| 4 | Doris | John | 32 | Banker |
| 5 | Babagana | Baba | 56 | Civil Servant |

Total number of voters 4

Fig. 24: Report generation for voters' registration

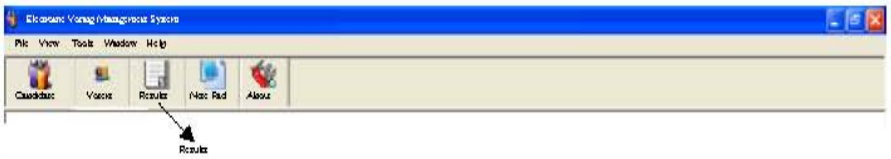


Fig. 25: Menu options

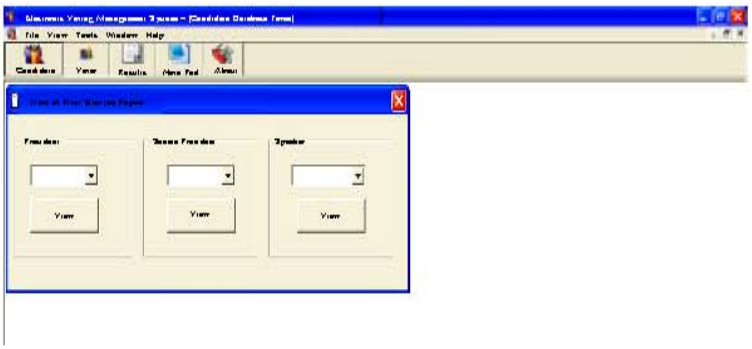

Fig. 26: Graphical user interface depicting operation of the result generation subsystem

Electronic voting system
President Election report

| Voter ID | Party |
|---|---|
| 3 | AD |
| 4 | AD |
| Total number of votes | 2 |

Fig. 27: Specimen output of result generation subsystem

prospective voters registered so far. The graphical user interface shown in Fig. 21 shows the operation.

On clicking on button captioned 'REPORT OPTION', the list of prospective voters registered so far is made available for printing as shown in Fig. 23 and 24. Select all voters report to print voters list.

The graphical user interfaces shown in Fig. 24 and 25 describe the operation of the result generation subsystem.

A click on the result menu as shown in Fig. 25 leads to the display of the graphical user interface shown in Fig. 26. The interface in Fig. 26 specifically provides the means of generating the result for each category of election conducted. Figure 27 is a specimen of a possible output of the result generation subsystem.

## CONCLUSION

The research proposed and developed software to cater for electronic voting. In view of the fact that internet has taken control of most transactions, businesses and operations carried out these days in government, education, medical institutions etc. it becomes imperative for developing countries to embrace the possibility and technology of electronic voting. Hosting the proposed electronic voting system on the Internet will facilitate online real time voter's registration, record verification, party registration as well as the actual conduct of voting electronically via internet/telecommunication services with the resultant transparency, speed and reliability of the electioneering process. This will make the entire electioneering process to be free from the limitations of the conventional voters registration and voting system, which have proven its vulnerability to unending lapses. Although, there may be challenges in the area of infrastructure such as electricity and shortage of personnel, it is possible for countries to adopt a gradual migration from conventional voting system to electronic voting. The gradual migration would allow a reasonable time to address the infrastructural and personnel problems as well as enable the citizens to adapt to the new approach. We hope that the e-voting system would speed up processes, enhance security and integrity of data files and easy accessibility and retrieval of voter's information, which will ultimately enable a transparent electioneering process across secured computer networks.

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