

Electronic Voting For Ghana, the Way Forward. (A Case Study in Ghana)

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Abstract - The purpose of this research work is to find solutions to the problems associated with the paper base voting system of Ghana through the introduction of Electronic voting system.

The research has found out that to solve the electoral questions after the 2012 general election (whose outcome was challenged at the Supreme Court of Ghana), we need a system that will reduce human involvement in the election process as much as possible. Since each of the above criticism pointed to somebody somewhere trying to or manipulating electoral process to the benefit of a particular candidate. An electoral system that reduces human involvement in the electoral process drastically is the Electronic voting system (Yinyeh and Gbolagade, 2013).

Quantitative and qualitative are the two main research approaches used in this work. The difference between the two is that qualitative research gains a deeper understanding of a situation or phenomena while quantitative research is to find an explanation to a situation or a phenomena (Leedy et al, 2005).

A voting method which we use electronic means to express and or collect the voters intention is known as Electronic voting (E-voting). Some requirements of E-voting are; it must be comprehensible to the voters entirely, it must be user friendly regardless of infirmity, disability or age. When electronic voting is well engineered it is surely a better improvement of over the current paper based voting system. However a faulty designed E-voting system will also produce bad results.

This research work has produced software that can be used to conduct an electronic voting in Ghana during elections. This research work was necessitated by some delays in declaring our election results, human interventions and tampering with election results, high cost of conducting results and so on.

Keywords: Elections, Electronic voting-voting.

1. INTRODUCTION

Though Ghana has had successful democratic elections, there have been disagreements when it comes to the fairness or accuracy of the results. The software from this research will produce a free and fair election results. An

electronic voting system is one where the voter's intentions are express and collected through an electronic means. The electronic voting system will make up for the weaknesses of the current document (paper) based voting system.

2. PROBLEM STATEMENT

The current document based system of voting in Ghana is fast losing its popularity since Ghanaian elections results are challenged in one way or the other. The 2012 election results even had to be challenged in our supreme court. There is there for the need for another method of conducting our elections. An electoral system that reduces human involvement in the electoral process drastically is the Electronic voting system (Yinyeh and Gbolagade, 2013). Thus, this research work has produced an electronic voting system for Ghanaian elections. Electronic voting refers to a voting method where the intentions of the voter is expressed and or collected using electronic gadgets. (Srikeerthi ∞ Kumara,2014). E-voting technology includes the following; voting through punched cards, voting through optical scan voting and voting through systems and specialized voting kiosk and so on. (Dhanlimbu, 2007). It also includes remote internet voting. This refers to the transportation of votes using private networks such as MAN, WAN etc. Broadly speaking, there are two main types of E-voting:

3. RELATED WORK

Three main issues in the paper-base voting system that the E-voting system is able to solve are; voting from any location and time, security related issues and identifying every voter accurately to avoid double voting and identity stealing.

To solve the above problems we reviewed the E-voting systems of the USA and Estonia. With regards to voting from any location and time of your comfort, in the US An attempt to establish a type of voting system using the Internet known as Secure Electronic Registration and Voting Experiment (SERVE)) meant primarily for military stationed abroad was met with serious resistance from the public and finally abandoned.

Some states allow oversea voters including military to return their voted ballots using e-mail, web portal or by fax. Now there are host of new options for the US citizens to request or return their ballots. The US passed a military and overseas act in 2009. Under this act states are to provide an absentee ballot in one electronic format. Also an online electronic voting support wizard programs are also available to facilitate online voting.

With regards to correct identity, Estonians use voter ID cards that come in the form of smart cards for their votes. It contains keys and pin integrated into it. The card could be use for any other transaction that needs user identification as in E-voting. Also Estonia runs the largest internet voting system in Europe. This is because Estonians have a computer readable national ID cards equipped with a computer-readable microchip and it is these cards which they use to get access to the online ballot. With s card reader, an ID card, a computer and a pin a voter can vote from any location in the world (Donovan ∞ Suresh, 2012).

With regards to security, there are arguments in the US and elsewhere about how to scrutinize the software of DRE. Some venders don't want their software to be scrutinized by inspectors. They prefer 'security by obscurity' (a closed source). Kohno et al. (2003) recently identified flaws in publicly available source codes. According to (Cranor, 2002) weakness of open source software voting systems is conceived because they have produced wrong outcomes previously. As we speak, Ireland and Holland have issues with open source systems (Libbenga, 2004).

Though most Estonians are in favor of internet voting others are against it saying that not observing voters as they vote could result in votes selling. In 2007 about 5percent of Estonians voted through internet voting. But in 2009 this figure tripled to 15percent. In the parliamentary elections of 2011, 24 percent voted through remote E-voting (Estonia National Electoral Commission, 2011).

4. METHODOLOGY:

4.1 Data Collection

The research was carried out by using some E-voting works done by other countries (case studies). The data was collected using questionnaires and observations.

4.2 Research Process

Since human behavior is uncertain, the research needed to know Ghanaians attitude and feelings about the new voting system to be introduced. So the variables are; do we

need the E-voting system at all, how much should be invested in it and at what speed do we need to introduce the new system.

4.3 Software Tool

One of the software tools used in this research is Active Sever Page (ASP). This is a Microsoft Technology that runs inside Internet Information Services (IIS). IIS comes as a free component with Windows 2000; it is also a part of the Windows NT 4.0 Option Pack. The Option Pack can be downloaded from Microsoft.

ASP use for the following:

- I. Dynamically edit, change, or add any content of a Web page
- II. Respond to user queries or data submitted from HTML forms
- III. Access any data or databases and return the results to a browser
- IV. Customize a Web page to make it more useful for individual users
- V. The advantages of using ASP instead of CGI and Perl are those of simplicity and speed
- VI. Provide security - since ASP code cannot be viewed from the browser
- VII. Clever ASP programming can minimize the network traffic

MYSQL Server

The MYSQL server provides a database management system with querying and connectivity capabilities, as well as the ability to have excellent data structure and integration with many different platforms. It can handle large databases reliably and quickly in high-demanding production environments. MYSQL server also provides a lot of functions such as its connectivity, speed, and security that make it suitable for accessing databases.

The MYSQL server works in a client and server system. This system includes a multiple-threaded SQL server that supports varied backbends, different client programs and libraries, administrative tools, and many applications programming interfaces (API).

SPSS

his program is base in windows. It is has been used to further analyze the results that were analyzed using graphs and tables .

5. IMPLEMENTATION

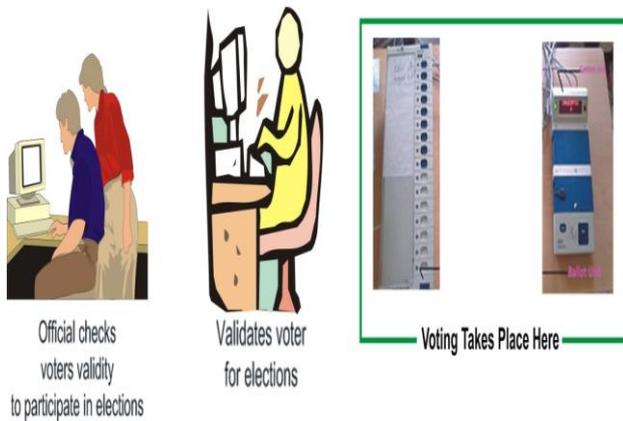


Fig.1 A design of the voting stages.

5.1 User Interface

The user interface serves as a link between the user and the system. At the various levels of the voting system; registration, voting, results declaration and be it district, regional or national level, there is an interface in the E-voting software that will link the user to the voting system. Below are pictures of the various interfaces from start to finish as far as the E-voting system is concern.

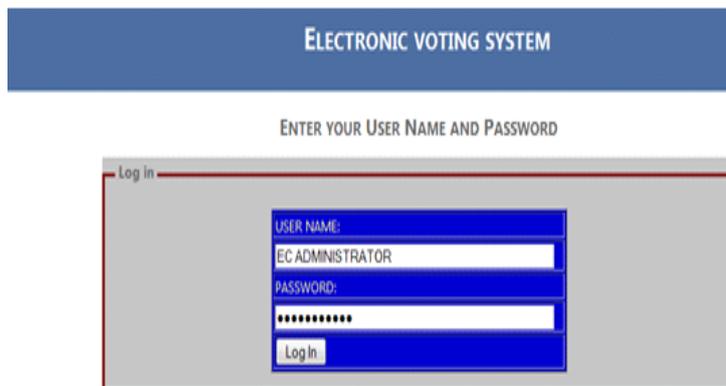


Figure 2. Administrator login page of the E-voting system.

You need a user name and a password to login into the main interface of the e-voting software. This part of the software is for electoral commissions' officials. After login successfully, you would have to indicate the election year, title, start date and time as well as end date and time.

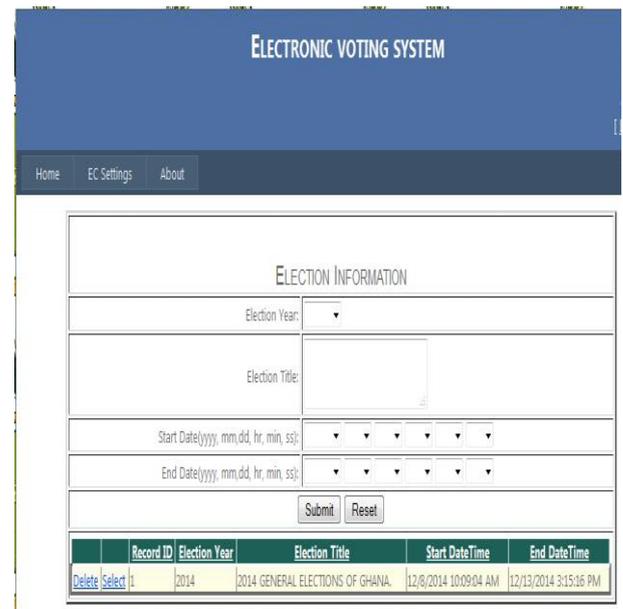


Figure3. Information Setting Screen of the E-voting System

Though the software is for a nationwide election, there is the regional setting form that helps to identify voters per their regions.

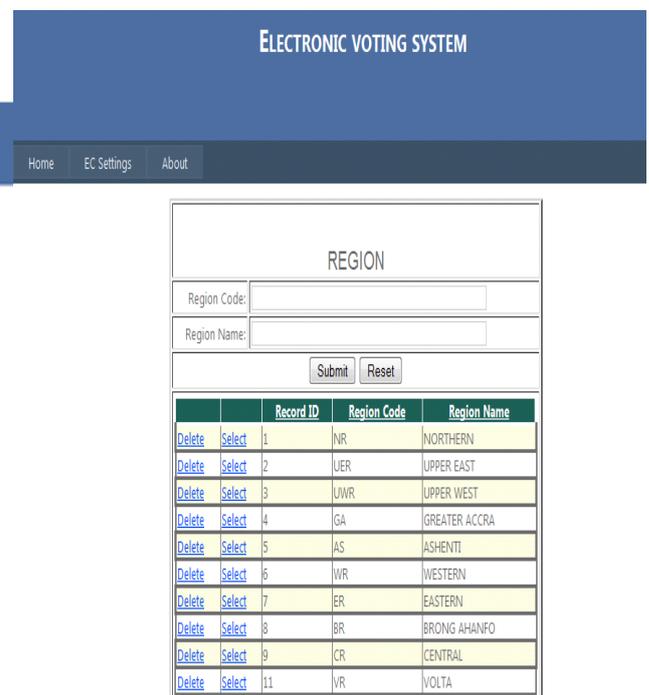
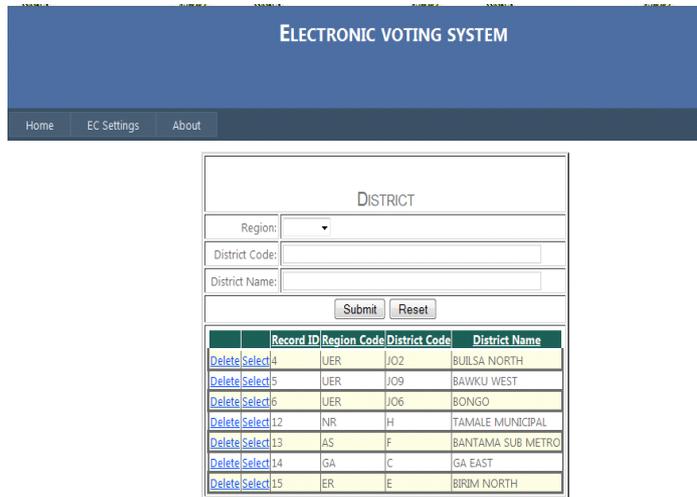


Figure4. Regional Setting Screen of the E-voting System.

A constituency and or a polling station is located in a district. All districts in Ghana are indicated in the district setting form of our e-voting system. This is done to restrict a voter to a polling station, a polling station to a

constituency and a constituency to a district. Below is a sample of the district setting form.

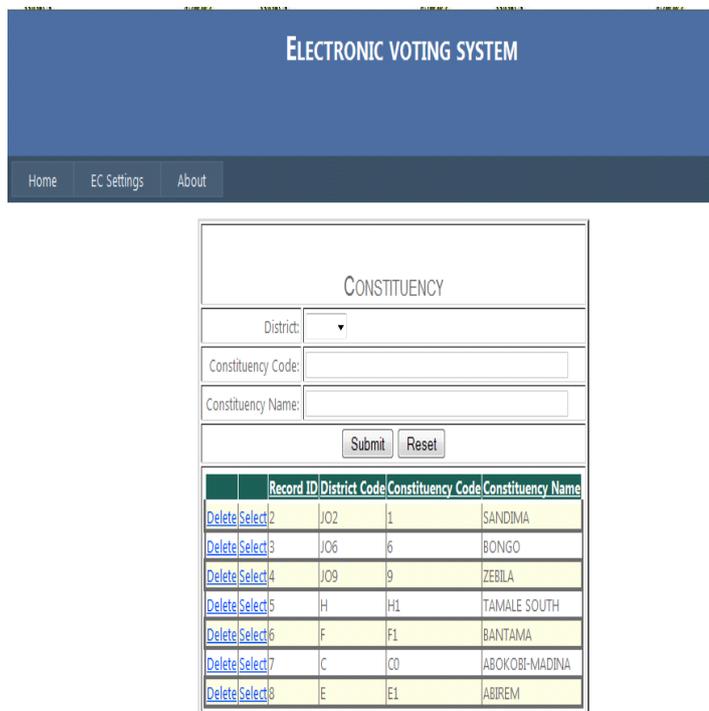


Record ID	Region Code	District Code	District Name
Delete Select 4	UER	JO2	BULSA NORTH
Delete Select 5	UER	JO9	BAWKU WEST
Delete Select 6	UER	JO6	BONGO
Delete Select 12	NR	H	TAMALE MUNICIPAL
Delete Select 13	AS	F	BANTAMA SUB METRO
Delete Select 14	GA	C	GA EAST
Delete Select 15	ER	E	BIRIM NORTH

Figure5. District Setting Screen of E-voting System.

To also keep track of all constituencies in a district, there is a constituency setting form that captures the constituencies in a district.

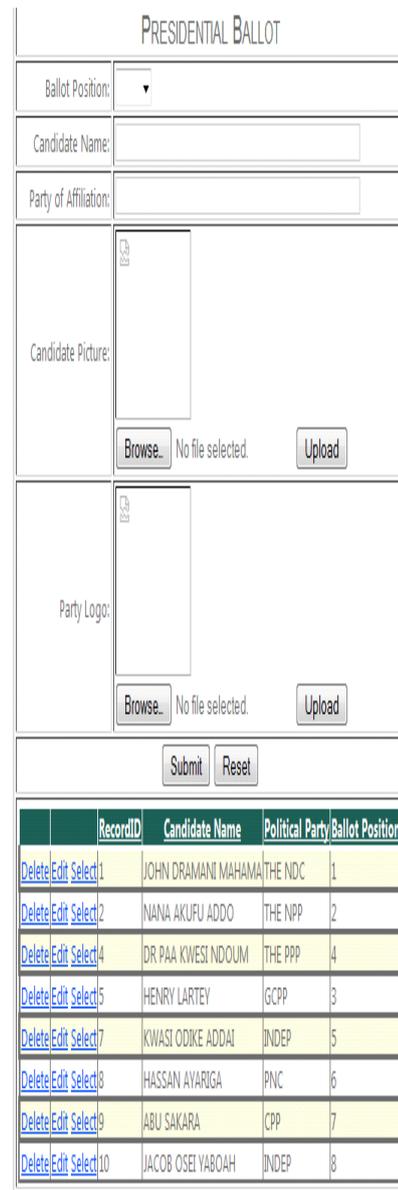
Figure 4.15 is a sample of the constituency setting form.



Record ID	District Code	Constituency Code	Constituency Name
Delete Select 2	JO2	1	SANDIMA
Delete Select 3	JO6	6	BONGO
Delete Select 4	JO9	9	ZEBILA
Delete Select 5	H	H1	TAMALE SOUTH
Delete Select 6	F	F1	BANTAMA
Delete Select 7	C	CO	ABOKOBI-MADINA
Delete Select 8	E	E1	ABIREM

Figure6. The Constituency Setting Screen of the E-voting System.

Votes are casted through electronic ballots in the e-voting system. Below is the design interface use by electoral commission to prepare electronic ballots for the presidential elections.



Record ID	Candidate Name	Political Party	Ballot Position
Delete Edit Select 1	JOHN DRAMANI MAHAMA	THE NDC	1
Delete Edit Select 2	NANA AKUFU ADDO	THE NPP	2
Delete Edit Select 4	DR PAA KWESI NDOUM	THE PPP	4
Delete Edit Select 5	HENRY LARTEY	GCPP	3
Delete Edit Select 7	KWASI ODIKE ADDAI	INDEP	5
Delete Edit Select 8	HASSAN AYARIGA	PNC	6
Delete Edit Select 9	ABU SAKARA	CPP	7
Delete Edit Select 10	JACOB OSEI YABOAH	INDEP	8

Figure7. The Presidential Ballot Setting Screen of The E-voting System.

Our elections usually involve both the presidential and parliamentary ballots. A design of the parliamentary ballots is also shown below.

PARLIAMENTARY BALLOT

Ballot Position:

Candidate Name:

Constituency:

Party of Affiliation:

Candidate Picture:
 No file selected.

Party Logo:
 No file selected.

Record ID	Candidate Name	Political Party	Constituency	Ballot Position
Delete Edit Select 1	JHON INDEBUGRE	THE NPP	9	1
Delete Edit Select 2	CLETUS AVOKA	THE NDC	9	2

Figure8. Parliamentary Ballot Design Screen of the E-voting System.

The electronic voting system has an electronic voter registration form. This is use to register Ghanaians that are at least 18 years and are of sound mind for the voting purposes. Below is a sample of the electronic voter registration form.

VOTER REGISTER

Voter ID:

Surname:

Middle Name:

Other Names:

Gender:

Date of Birth(mm/dd/yyyy):

Place of Birth:

Father Name:

Mother Name:

Religion:

Home Town:

Residential Address:

Telephone No.:

Region:

District:

Constituency:

Picture:

Figure9. Electronic Voter Registrations Screen.

For one to be able to vote on an election day, one must first be registered as a voter, one will be given an ID number and an access code. The ID and the access code would enable one to login into the voting portal in an election day. Our access code will be alphanumeric in nature for security purposes and has a minimum of six characters. Figure 4.19 is a design of the access code generating form.



Figure10. Electronic Voting Access Code Generating Screen

When elections are closed it should be possible to check a candidate’s results be it presidential or parliamentary ballot. Figure 4.20 is the result checking form of the e-voting system.

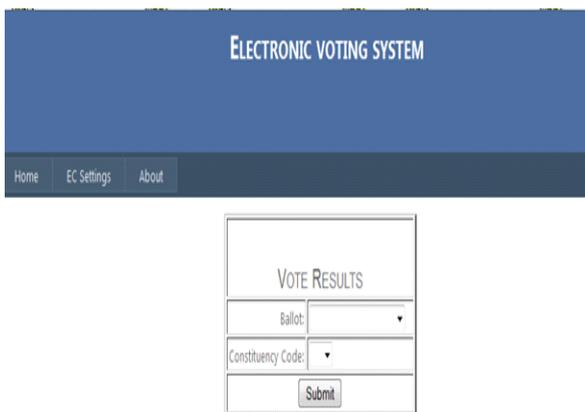


Figure11. Results Checking Screen of the E-voting System.

Figure 11. Presents the screen with which the voting officials will use to check the results of any candidate participating in the elections contest

When all is said and done it should also be possible to generate a report on the elections. May be a candidate’s

number of votes and the percentage it is to the total votes. The report could also be generated before the votes are casted to be sure no votes are hidden for any candidate. The picture below indicates a sample of report before votes are casted for presidential ballots.

Below is also a sample results report for Figure 4. 22 shows a sample of a results report for parliamentary ballots.

5.2 Database

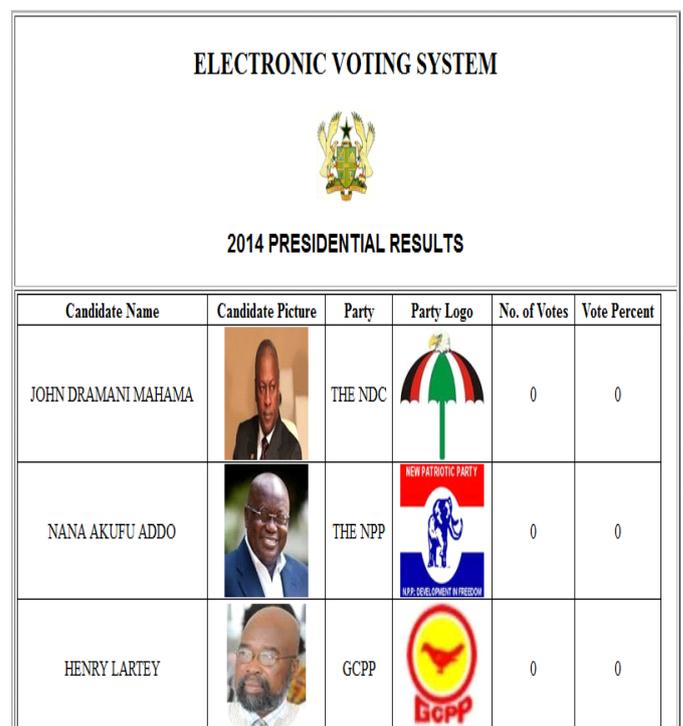
The database contains information about every candidate and his or her party and the names of the parties taking part in any election and their logo. The database also contains information about every voter such as their name, voter ID, polling station number, region, district, etc.

5.3 Rule (knowledge) Base

The rule base refers to various rules and regulations guiding the performance of the E-voting system. There are a lot of such rules and regulations that determines the smooth operations of the e-voting system.

6. EXPERIMENTATION

The system was implemented with ten (10) registered voters who made choices amongst eight (8) presidential and two (2) parliamentary candidates. The outcome of this experimental vote was successful.



Candidate Name	Candidate Picture	Party	Party Logo	No. of Votes	Vote Percent
JOHN DRAMANI MAHAMA		THE NDC		0	0
NANA AKUFU ADDO		THE NPP		0	0
HENRY LARTEY		GCPP		0	0

DR. PAA KWESI NDOUM		THE PPP		0	0
KWASI ODIKE ADDAI		INDEP		0	0
HASSAN AYARIGA		PNC		0	0
ABU SAKARA		CPP		0	0
JACOB OSEI YABOAH		INDEP		0	0

Figure13. Presidential Results Report Screen of the E-voting System.

ELECTRONIC VOTING SYSTEM					
					
2014 PARLIAMENTARY RESULTS FOR ZEBILA					
Candidate Name	Candidate Picture	Party	Party Logo	No. of Votes	Vote Percent
JHON NDEBUGRE		THE NPP		0	0
CLETUS AVOKA		THE NDC		0	0
<<BACK					

Figure12. Parliamentary Results Report of E-voting System.

6.1 COMPARATIVE ANALYSIS OF EXISTING AND NEW SYSTEM:

Table 1: Comparing Analysis of Existing and New System.

THE PAPER BASE VOTING SYSTEM	THE ELECTRONIC VOTING SYSTEM
I. Register voters using papers	Register voters using an E-voting software
II. Vote using a paper ballot	Voting through an electronic ballot
III. Doesn't update a candidate's vote automatically	Automatically updates a candidate's votes.
IV. Total votes by counting paper ballots.	Get total votes by clicking or pressing on the total key or button respectfully.

6.2 Disadvantages of the existing (document/paper base) voting system.

The disadvantages of the paper/document (which is the current) voting system of Ghana include; it is expensive in the beginning, it is slow (usually takes at least 72 hours) to declare results, there is usually a high incidence of spoilt ballots and un trusted results due to human interventions in the voting process.

6.3 Benefits of the new (electronic voting) system.

The benefits of the E-voting system includes the following: it is cheaper in the long run because of the absence of paper production, trusted results since no human interventions, faster since election results could be declared immediately after voting.

7. CONCLUSION

This research came about as a result of the problems faced by the paper/document base system of voting. Such problems include; mistrust in the results due to human involvement in the voting process, spoilt ballots, delay in results, declaration, etc.

7.1. Summary of findings

The findings includes the fact that; Ghanaians prefer the E-voting system than the paper base voting system, Ghanaians prefer both the Internet and polling station E-voting system, Ghanaians using other E-government services already are more willing to use the E-voting system.

8. FUTURE WORKS

Future works should research on how private voting can be carried out by voters without vote selling.

9. REFERENCES

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