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M-Voting: A Panacea for Enhanced E-Participation

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Abstract: Majority of voting techniques have been employed over the years in elections. Each of these techniques had attendant short comings. The existing manual voting system has been subjected to gross abuse and irregularities. The electronic method, though highly promising is not completely free of irregularities. The mobile devices have been the most adopted means of communication both in the developed and the developing countries with its penetration more than all other electronic devices put together. Thus, it can be considered a good candidate for voting platform the world over. Therefore, this study investigates the prospects of M-voting as a panacea for enhanced participation and convenience of voters using Nigeria as a case study. This study equally considers the possibilities of integrating M-voting to the existing platforms for wider acceptability and patronage. We developed a prototype m-Voting system using WML (Wireless Markup Language) PHP (Hypertext Preprocessor) with MySQL Server as the database server and tested using the mobile explorer emulator (Openwave V7 Simulator).

Key words: E-democracy, E-government, E-voting, M-government, M-voting, WAP

INTRODUCTION

E-government is the use of Information and Communication Technology (ICT) in public administration combined with organizational change and new skills to improve public services and democratic processes and to strengthen support for public policies. ICT has been adopted in Europe, particularly at all levels of administration as a veritable tool for modernising public services, re-engineering administrative processes and empowering citizens.

Mobile devices have been the most widely used electronic gadgets with over two billion users world-wide, thus making it a good platform for enhanced participatory democracy. Mobile government, referred to as mobile E-government or M-government involves the deployment of government's services and administration on mobile devices (Rossel *et al*., 2006). This concept would definitely result to fostering closer links between government and the electorates with the resultant effect of enhanced participation in the polity. Similarly on the Internet platform, there are many nations that have experimented with the possibility of adopting it. Particularly in Geneva, Switzerland plans are in advanced stage of adopting it (Chevallier *et al*., 2006). In the UK, it was observed that voter's turnout has been on the decline from 83.6% five decades back to <50% participating presently (Liptrott, 2006). With the rate of diffusion of mobile devices other voting media can be sought such as M-voting as well as Short Message Service (SMS) texting for better governance and administration (Griffin *et al*., 2006). Voting in any democratic society is an important tool to collect and reflect citizens' opinion and choice (Feng *et al*., 2006). In recent times, participation in political election in developed and developing countries have experienced a dramatic decline (Ekong, 2006). In Nigeria, averages of about 50% of registered voters do not participate in most of the elections (Umobong, 2006). There is increased rate of apathy between the electorate and the elect. This is attributed to the lack of transparency, accountability and probity on the part of existing governments. The electorate do not see the need to spend long hours in polling booths to exercise their civic rights which would subsequently be rubbished through malpractices and falsification of results (Ekong and Ayo, 2007).

Mobile voting (M-voting) can be seen as an additional platform to the electronic voting systems. It is an M-government initiative with tremendous potentials to enhance democratic participation (Heide and Baumberger, 2003). It will also serve as an enabler and a convenient way to involve citizens in political decision making. It is a cheaper, convenient and a simple to administer voting alternative. Mobile phone users can subscribe to GSM

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operators that will incorporate an M-voting system service which will enable them to participate in choosing political candidates into government seats. M-voting is not a replacement for E-voting but rather a complement. The use of mobile devices in political participation simplifies and eases access to and the integrating of persons and institutions in political processes. With SMS, Multimedia Message Service (MMS) and emerging applications offered by mobile computing, M-voting can enhance the citizen's input to political decision-making and increase their democratic participation.

Objectives of research: Since independence in Nigeria, only about 50% of registered voters participate in elections due to reasons attributed to lack of probity, accountability, transparency and trust in the whole electoral process and government in general. Every manual process is prone to manipulation and this study attempts to present an electronic system with a view to addressing the menace for increased trust and transparency which would lead to increased participation. The primary objectives of this research include among others:

- Exploring the prospect of M-voting as a platform for enhanced participatory democracy
- Designing a prototype system that can be tested for usability among a selected audience

MATERIALS AND METHODS

The research instruments employed are two-fold. A questionnaire was designed and administered to 1,500 prospective electorates within Lagos metropolis the commercial nerve centre of Nigeria. About 1,359 of them responded, which represented 90.6%. The audience was randomly selected and such questions as: possession of mobile phone, participation in the registration exercise for the April 2007 elections, preference for the use of M-voting and M-government were asked.

A prototype M-voting system was developed using WML, PHP and MySQL software tools and tested among some selected few. The findings are reported.

RESULTS AND DISCUSSION

The following questions were solved through the questionnaire:

The number of respondents that have mobile phones: Out of the 1359 respondents, 1352 of them possess mobile phones which represent 99.5% (Fig. 1). This is expected as most people within lagos metropolis have mobile phones. However, >50% of the mobile phones do not have the WAP facility for internet access but they all have access to SMS facility which can be used to communicate between the electorate and the elect. It follows therefore that there is a high tendency for M-government, M-democracy and M-voting to thrive in Nigeria.

The number of respondents that participated in the voters registration exercise for the April 2007 election: About 590 of the 1359 respondents representing 43.4% registered for the April 2007 election (Fig. 2). About 768 representing 56.6% could not register and only one of the respondents did not respond to the question. The reasons for the poor turnout are two-folds:

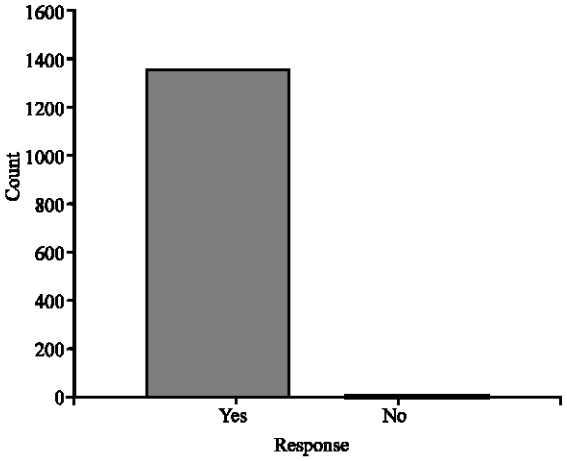

Fig. 1: The number of respondents that have mobile phones

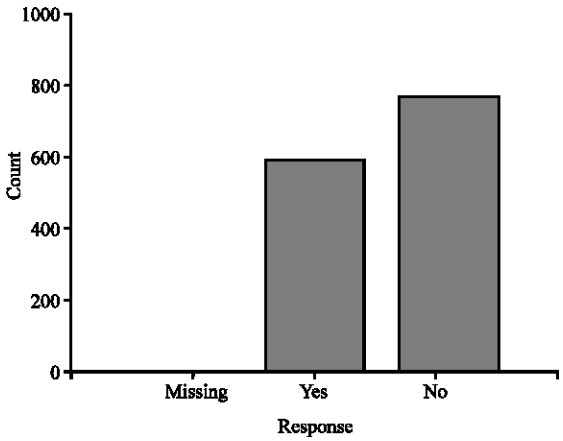

Fig. 2: The number of respondents registered for the election

- Poor preparation for the registration exercise. Within the stipulated period of the exercise, few voters were registered because of the inadequacy of materials and facilities
- Lack of trust and confidence in government. People are disenchanted and disillusioned. This is a negative trend which must be checked

Mobile phone owners willing to use mobile phones to cast their votes: About 910 of the 1359 respondents representing 67.0% of the mobile phone owners said they are willing to use their mobile phones for voting (Fig. 3). About 372 respondents representing 27.4% do not prefer using mobile phones. About 77 respondents representing 7.7% did not respond to the question. The reasons giving by the mobile phone owners who prefer casting their votes with the mobile phone include:

- It is faster and less stressful for the voters
- It is convenient, since voting can be performed from anywhere and any place within the voting period
- Disabled persons and persons in hospitals can also cast their votes

Willingness to embrace M-democracy as a way of bridging the gap between the elects and the electorates: About 1049 of the respondents representing 77.2% are willing to adopt M-democracy as shown in Fig. 4. This is encouraging going by the number of mobile phone ownership in the Lagos metropolis. M-democracy based on SMS would go a long way to give a sense of belonging to the electorates with the possibility of increasing the level of participation in the polity.

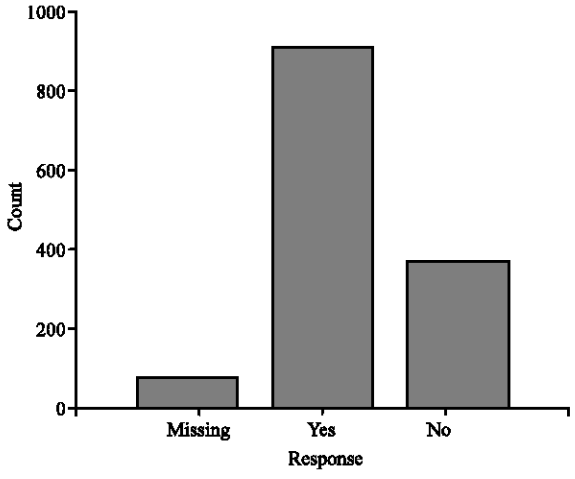

Fig. 3: Mobile phone owners willing to use their phones to cast their votes

Design and implementation of M-voting prototype

Design architecture: The architecture is a 3-tier architecture that is composed of the presentation tier, business logic tier and database tier. The presentation tier offers an interface through which the voter is authenticated and ballot rendered on the mobile phone for voting. Voters gain access to the application from various handheld devices from all locations within the wired and wireless infrastructural coverage in the country. The application's user interface allows voters to submit their votes to the appropriate database via the application server. The presentation tier communicates with the business and database tiers. Any update is written back to the database tier. The system has application code that is able to render WML and PHP pages to the mobile devices. The pages are viewable through the use of a WAP browser. The business logic tier contains most of the application logic, it translates client request into database queries and translates query results to the clients' device at appropriate times.

To ease congestion, the architecture is scaled horizontally and vertically by providing servers at several geographical locations. The business logic tier contains the Web and application server that provide access to the database tier (Fig. 5). It implements business logic and data validation. The database tier is responsible for the systems database transaction handlings (Adeyeye, 2005).

Implementation of the prototype: Currently there are a total of 48 political parties in Nigeria. The nature and size of mobile devices may pose a serious constraint considering the level of literacy. The fewer the number of parties, the more convenient the M-voting platform. For the purpose of this study five parties were used to design the prototype.

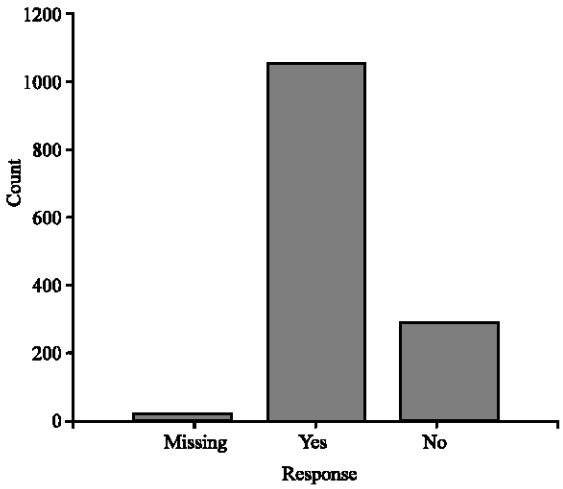

Fig. 4: Willingness to embrace M-democracy

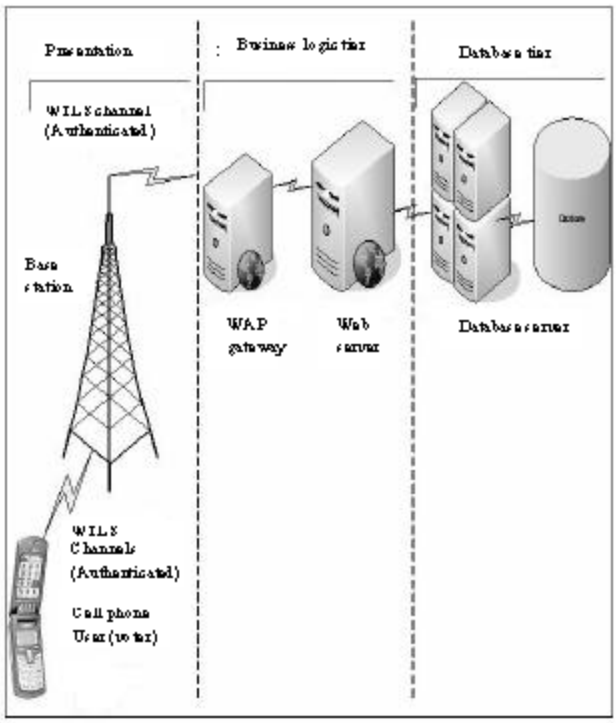

Fig. 5: The N-tier architecture of M-voting implementation

At the voting stage the voter is authenticated from a page which contains the username and PIN-code obtain a priori during the registration process. A password is entered to enable the voter to gain access to the voting network. Every registered voter is authenticated before he or she is granted access by the system to cast a vote. Once access is granted, the list of positions to be voted for is shown: Presidential, Gubernatorial, Senatorial and Chairmanship election. At this stage the voter selects from the list of options.

If the presidential election option is selected, the window that contains the various parties is displayed, which allows the voter to select the party he wishes to vote for. Once the OK button is pressed the name of the candidate is displayed and the voter presses the OK button again ("vote now") to cast his vote. When the OK button is pressed again, a confirmation message is displayed on the voter's mobile device. The process is repeated for other elective offices. The system will compute the summaries of all the votes' details. At the end of the election, the result is automatically sent to the voters' mobile devices showing the list of the election positions and the number of votes cast for each party.

Security considerations: Securing and improving remote voting procedures are an important aspect in the design of any electronic voting system. The roposed M-voting scheme is implemented using GSM (Fig. 6). According to the GSM specification 02.09, the security functions put in place are:

- Subscribers identity confidentiality
- Subscriber identity authentication
- User data confidentiality on physical connections
- Connectionless user data confidentiality
- Signaling information element confidentiality

By exploiting these functionalities the components of the proposed M-voting scheme will consist of:

- A mobile voting device or Mobile Equipment (ME) with platform to run the voting application (GSM SIM (subscriber identification module) card, GSM phone, GSM enabled PDA or a laptop with GSM enabled reader)
- A trusted Authentication Centre (AC) within the GSM network that will also serve as a distribution server for transferring messages to the voting authority's database servers
- A Verification Server (VS) and a collecting and Counting Server (CCS) located at the voting authority's network site for verifying the legitimacy of voters (issuing voting tokens, publishing the list of voter information and for collecting and counting of the votes to give the final results). Their activity is subject to auditing by all candidate parties

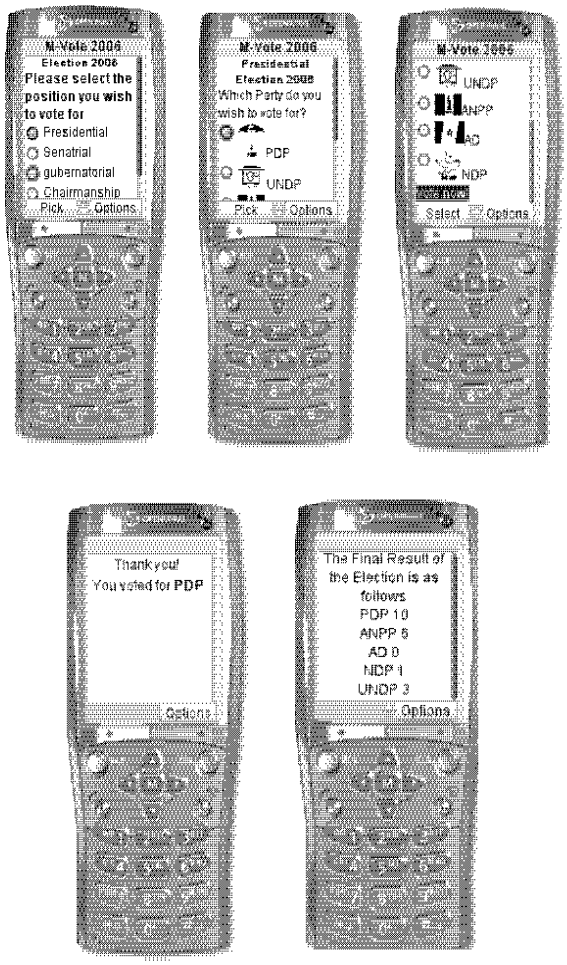

Fig. 6: M-voting implementation interfaces

The system will be based on a number of assumptions coherent with the security specifications for electronic voting systems as reported by Chevallier *et al.* (2006) and Feng *et al.* (2006).

- Voters are physically registered GSM subscribers having their real names, addresses and other eligible credentials presented to mobile operators at the time of registration
- We assume the GSM operator is trusted to authenticate the mobile users for purpose of voting and sends the correct information to the VS and CCS at the voting authority's network
- There are means of authenticating a user to access the voting application on the ME for instance, password protection for barring unauthorised use of the voting application, tracking of multiple GSM SIM using registered voters GSM number and biometric encryption of thumb prints captured electronically during the registration exercise
- The integrity of the voting application on the ME is maintained throughout the voting process. To achieve this, a trusted platform module is employed on the ME to provide a secure platform for running the application and enhancing end-user security
- The VS and CCS are connected to the GSM network only during the election and they will be housed in a safe room only a few operators (having undergone a security screening) are allowed access but never alone
- The representatives of political parties will be allowed to cast a number of test votes that will be recorded by the system. We will use this to ascertain that the system yields the expected outcome

CONCLUSION

The rate of diffusion of cell phones within Lagos metropolis, a mega city in Nigeria, is high, which makes the possibility of M-voting and M-government very

promising. If the advantages are weighted with the disadvantages, M-voting seems to be more acceptable than the traditional method of voting. From the analysis, we discovered that respondents preferred to use this system because of some of the following reasons: convenience, stress-free, anywhere anytime access gives opportunity to disabled persons and those in hospitals the ability to perform their civic responsibility. However, the question of apathy and lack of trust is still an issue. The total number of registered voters for the 2007 elections is 61,000,000, while it was 60,832,022 for 2003. This represents a very marginal increase despite all entreaties from government and churches such as no voter's card no salary and no voter's card no taking of the Holy Communion. Thus if a less cumbersome platform of voting is employed such as M-voting, the electorates may just decide to cast their votes. A very vital issue is the level of literacy. Scrolling through 50 political parties could be very cumbersome and confusing. Thus, M-voting may be very ideal where the number of the political parties is few (<6).

Security is a vital aspect of the voting system that may dissuade electorates from patronizing it. The parties involved are the voter, the wireless GSM mobile service provider and the electoral commission's secure infrastructure. The traffic among the parties are wireless between the mobile voter and the GSM operator and wired from the GSM operator to the electoral commission's secure infrastructure. Thus the security of votes can only be guaranteed through a trusted third party involving the GSM operator and the electoral commission.

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