Curbing Political Violence in NIGERIA:

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E-VOTING IMPLEMENTATION IN NIGERIA: The Success Factors

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Abstract

The proposed adoption of e-Voting in Nigeria by the electoral body, the Independent National Electoral Commission (INEC), was resisted by the law makers and a sizeable portion of the populace. The reasons may not be unconnected with the previous unsuccessful attempts by government to implement such magnificent projects, particularly, the National ID card scheme; and lack of basic infrastructures to implement the system. This paper reviews the e-Registration exercise by INEC with a view to using it as a springboard for e-Voting implementation in Nigeria; and the experiences of some developed countries to serve as lessons. Similarly, the paper proposes solutions to some of the problems encountered in countries where e-Voting had been adopted. Finally, arising from the perceived apathy between the elect and the electorate, which has resulted to low turnout of voters during elections, an integrated voting system that incorporates an Electronic Voting Machine (EVM), Internet Voting (i-Voting) and mobile Voting (m-Voting) is proposed for enhanced participatory democracy.

Keywords: EVM, e-Voting, i-Voting, m-Voting, e-Registration, Integrated and Inter-operability.

INTRODUCTION

Since independence, Nigeria has been desirous of a credible voting system because of the irregularities that trailed previous elections. Lack of probity, accountability, transparency and trust on the part of government has been responsible for the poor turnouts in elections.

The adoption of e-Voting system is considered long overdue because of the enormity of abundant human and material resources endowed the country (Olateru_Olagbegi, 2007). The shortcomings notwithstanding, the system has the potentials of solving a lot of the electoral problems.

E-voting, like the introduction of any new technology, which must be adopted with caution, could be disastrous if rushed on the electorates without regards to the associated risks. In the developed world, its adoption was preceded by pilot schemes. In Europe: UK, Denmark, France, Spain, and Ireland had trials preparatory to its wide-scale adoption (Lemos, 2003).

In the developing countries particularly the Sub-Sahara Africa and Africa in general, elections had been marred by gross irregularities leading to wanton destruction of lives and properties (Helen 2005, Iyayi, 2004, Okoye, 2004). Thus, e-voting is seen as a saviour from the horrible experiences of the past as it promises free, fair, transparent, convenient, and confidential elections as well as the speedy processing of results (Boutin, 2004, Iwu, 2005).

Mobile devices have been the most widely used electronic gadgets with over two billion users world wide, hence, it offers a good platform for enhanced participatory democracy. Mobile government, referred to as mobile e-Government, involves the deployment of government's services and administration on mobile devices (Pierre, et al., 2006). This concept would definitely result to fostering closer link between government and the electorates with the resultant effect of enhanced participation in the polity. Similarly, on the Internet platform, there are a number of nations that had experimented with the possibility of adopting it. Particularly, in Geneva, Switzerland where plans are in advanced stage of adopting it (Chevallier, et al., 2006). With the rate of diffusion of mobile devices, other voting media can be sought such as m-Voting as well as SMS texting for better governance and administration (Griffin, et al., 2006).

The rest of this paper is organized as follows: Section 2 presents the general overview of e-Voting and the experiences of countries that have adopted it. Section 3 and 4 present the research objectives and methods respectively. In section 5, the paper presents the e-Registration exercise in Nigeria. Section 6 presents the systems design: the party system and e-ballot design. It also describes the integrated technologies involved (Internet, mobile, and electronic voting machine) as well as the proposed system architecture. Section 7 presents systems implementation as well as recommendations. Finally, the conclusion of the paper is presented in section 8.

OVERVIEW OF E-VOTING SYSTEM

The term "electronic voting" has been used for a large variety of systems, ranging from hand-held infrared devices, kiosk systems with touch screens machines used in polling stations to remote voting via the Internet. e-Voting is the preferred platform for future elections in the developed and developing nations of the world. It is a system that has modernized the electoral processes and electorates are able to cast their votes through an electronic device as against the traditional manual system.

The three types of e-Voting include: (a) Polling station e-Voting: where voters cast their votes electronically on an electronic machine within the polling booth; (b) Kiosk e-Voting: where voters cast their votes at pre-selected stations through ATM-like terminals; and (c) Remote e-Voting: where voters cast their votes anywhere, and anytime, there is Internet access; as well as voting through mobile devices.

2.1. Lessons from Developed Countries

E-voting system has been subjected to practice and trials across several nations of the world but trailed by both success and failure stories. The experiences are recounted below:

2.1.1. The US Experience

The US is referred to as mixed system because the types of e-Voting system adopted vary from one county to another (Ansolabehere, et al., 2005). Thus, it is a combination of the Punched Card Machine (Votomatic); Diebold Machine; Electronic System and Software (ES&S); Optical Scan System; Manual System etc. (Andreu, et al., 2003, Steve, 2004).

The encountered problems include: over-voting; broadcast storms arising from simultaneous transmission of results from polling booths to the headquarters; equipment malfunction during elections and taken off-site for repairs; poorly implemented security measures; and election rigging through code manipulation from proprietary software developers among others.

This array of problems notwithstanding, it is believed that if the system is properly deployed, it has several advantages over the conventional methods.

2.1.2. The Brazil Experience

Brazil was the first country in the world to have a complete e-Election through an indigenous technology called the Brazilian Voting Machine. The machine was developed through partnership among OMNITECH, Microbase and Unisys do Brazil (Whitney, 2000). The country had won a lot of accolades for its affordable and uniform electronic voting machine (EVM) called Urna which was used by its 115 million voters (Leslie, 2004, Lusiano, 2004).

The machine was used with printers in some elections to produce paper receipts for audit trail, but in the last presidential election, printers were not used and the country was able to save over $100 million. There were a lot of savings through the use of indigenous technology, while Diebold costs $3000 in the US, Urna (non-touch screen) costs $420 on the average (Leslie, 2004).

However, before its adoption, there was a series of road shows, it was set-up in bus and train stations, and other public places for all and sundry. The machine has been exported to other countries like Argentina, Mexico, and the Dominican Republic.

2.1.3. The India Experience

India is the world's largest democracy, where most voters are poor rural dwellers. The country developed its electronic voting machines (EVM) through an indigenous technology. It was designed by Bharat Electronics Ltd, and the Electronics Corporation of India Ltd, with the microchip imported from Japan (Whitney, 2000, Habib, 2004).

The country developed over 1 million EVMs for its 668million voters. It would have cost them a great deal of money if imported. The machine was able to cater for 64 candidates per election, in pages of 16 candidates each.

The technology was able to solve a lot of problems associated with the traditional voting system. However, before its adoption there were pilot schemes in five (5) states to familiarise the voters with the technology.

Developing nations, particularly Nigeria and Africa, in general have a lot of lessons to learn from Brazil and India.

OBJECTIVES OF RESEARCH

The objectives of this research include among others to:

i. review the e-Registration exercise conducted by INEC with a view to proffering solutions to the problems witnessed and making it a springboard for e-Voting implementation;
ii. review the associated problems with e-Voting implementation in the developed world and proffer solutions appropriately;
iii. design an integrated voting system that encompasses EVM, i-Voting and m-Voting; and
iv. recommend some success factors.

RESEARCH METHODS

The research instruments are two-fold: exploratory and empirical. That is:

i. a survey of relevant literature is conducted to obtain the state-of-the-art of e-Voting implementation and the associated snags; and

ii. to design an integrated voting system that are interoperated based on eXtensible Markup Language (XML) and eXtensible Stylesheet Language (XSL) to cater for the various classes of voting devices.

THE NIGERIAN E-REGISTRATION EXERCISE

The registration system adopted for the 2007 general elections was an electronic innovation to the previous systems. It involved the use of direct data capture machines (DDCMs) to capture the records of voters electronically with a view to eliminating most of the problems associated with elections.

The exercise was scheduled for 70 days: October 7th to December 14th, 2006, but at the expiration of the period, only 10 million voters were registered nationwide. Hence, the exercise was extended by two months to register more voters. However, it was evident from the problems encountered during the exercise that government was not well prepared. It was marred by poor logistics, prominent among them were the shortage of the data capture machines and the power to support the machines (Mojeed, 2007). It is most embarrassing that the Commission commenced the registration exercise with only 1,000 machines out of the estimated 33,000 machines earmarked for the assignment. This was responsible for the poor take-off of the exercise.

Beside the logistics problems, there were all manner of irregularities reported. The political leaders connived with INEC officials to perpetrate irregularities aimed at rigging the elections (Sanni, 2007). At the end of the exercise, only 61,566,802 voters were registered amidst the various sensitization programmes which include: "No voters' cards, no Holy Communion in Churches" (Ugwoke, 2007); "No voters' cards, no salaries in some States" (Shittu, 2007); and "No voters' cards, no medication in hospitals" (Orih, 2007). The result represents a marginal increase (1.22%) over the previous year, as against 4.74% increase of 2003 figure over the 1999 figure. This is an indication that the exercise was not very successful, as some voters were disenfranchised because of the shoddy preparations.

E-Government projects were reported to have either ended up in partial or total failure in Africa because the concepts and designs had their origins in the West and were significantly alien to African cultures and realities (Heeks, 2002). Therefore, considering the level of literacy particularly in the area of ICT, a complete one-time change from the traditional voting system to an electronic base may spell doom.

SYSTEM DESIGN

Party System and e-Ballot Design

The e-Ballot is the only interface an electorate interacts with in the process of an election. Hence, it must be simple, informative and detailed with no ambiguities so that voters can cast their votes with little or no assistance regardless of the educational background. However, there has not been any uniform design adopted all over the world. In the US for example, some precincts made use of punched cards from Votomatic, and the design includes the parties and candidates. The design spanned two pages with columns of punched holes like the wings of a butterfly hence the name butterfly ballot. The design was reported to be confusing (Whitney, 2000). Also in some precincts in the US where the Diebold equipment was used, the design was purely based on the names of the candidates.

Furthermore, for simplicity, efficiency, effectiveness and voters' satisfaction, the number of political parties or candidates used in the design should be considerably minimal. This is to avoid scrolling up and down the ballot by the illiterate populace. Table 1 shows the history of party systems in Nigeria pre and post-independence.

Table 1. Party registration (pre and post-independence) for elections in Nigeria.

S/N	Election Dates	Number of Parties	Number of prominent parties (having at least a seat in previous elections)
1	1959	26	3
2	1964/65	26	2 (Coalition)
3	1979	5	5
4	1983	6	5
5	1993	2	2
6	1999	3	3
7	2003	30	8
8	2007	50	6

Source [http://www.nigeriabusinessinfo.com/]

In Nigeria, going by the literacy level of 47%, the number of parties winning at least a seat in elections (table 1), and the fact that majority of the populace are rural dwellers; we recommend a 5-party ballot design. The ballot would incorporate only the party flag or logo and name.

Thus, the 5-week elections as previously conducted can be conducted in a day. Voters only have to scroll through the screen once per elective office.

Integrated Voting System

The proposed integrated voting system is composed of three major platforms: an e-Voting machine (EVM); wired Internet; and mobile Internet. The traditional paper-based ballot is not considered. An e-Ballot designed with usability concepts offers an enhancement over the manual ballot. An e-Ballot reduces the chances of multiple voting arising from multiple thumb-printing that may result during folding of the paper or erroneous thumb-printing. With a manual ballot, voters are only entitled to one ballot and once marred, there is no replacement. However, with an e-ballot, voters have the chances of correcting mistakes before submitting the ballots. In Nigeria, for example, in the 2003 presidential election, there were 2,538,246 invalid votes recorded, representing 6.04% of the total votes. This is substantial; hence an outright elimination of the traditional manual process is recommended.

Electronic Voting Machines (EVMs)

The configurations of electronic voting machines showed low-end processors: Diebold-400MHz Intel PXA-255; ES&S IVOTRONIC- 25MHz Intel 386; SEQUOIA VS-300 MHz; Urna (BVM)-386 IBM compatible etc. The machines run on a variety of proprietary operating systems: VirtusOS, Windows CE and Linux. They equally have a variety of other peripheral devices: screens (touch and non-touch), flash memory, backup battery and PCMCIA-smartcard removable memory (Whitney, 2000, Lusiano, 2004, Jason, 2003).

The advantages of these configurations include the fact that the machines can be networked to interoperate with other ones; they can transmit data from one node to another; and can be designed and customized to meet the local/ cultural needs of the various countries.

Internet Voting (i-Voting)

The use of the Internet all over the world is monumental and is still enjoying wider acceptability. It has been proved to be more widely patronised than the personal computers. i-Voting offers a remote voting system that involves casting votes through the web, most likely through a web browser, from the comfort of ones home, or possibly any other location where there is Internet access (Rubin, 2001).

The acceptability of the web for communication and education makes it a good platform for voting. It is voter verifiable and open to public scrutiny (Burton, 2005). I-voting has a lot of benefits but its security is in doubt because of its public nature, however, there are concerted efforts geared toward securing this medium.

Mobile Voting (m-Voting)

Bringing computing power to a wireless device opens an avenue for mobile commerce, particularly as mobile devices (smart phones, PDAs, cell phones and notebooks) are equipped with browsers (Gonzalez, 2003). If all the available mobile phones could access the Internet then the population would have surpassed the wired Internet. Thus, for enhanced participation in elections, it offers a good platform for voting anywhere, anytime, and at ones convenience (Dennis, et al., 2002).

However, creating wireless or mobile applications differs greatly from Internet applications. Internet applications are based on hypertext transfer protocol (HTTP) and the Internet markup language called hypertext markup language (HTML). Thus, HTTP/HTML assumes that all devices have similar display sizes, memory and software capabilities, hence they are considered to be relatively static.

Mobile applications are based on wireless application protocol (WAP) and wireless markup language (WML). This is because of the inherent nature of mobile devices such as: small screen format with limited display and navigation capabilities; limited data-entry capability due to the size of the key-pad; low bandwidth and high cost of data transmission; and network latency and other delays. Thus the HTTP/HTML features will not work well on WAP/WML devices (Duford, et al., 2004).

Therefore, deploying applications to the mobile devices calls for simplicity, usability and user-friendliness, and the learning curve should not be too steep in order to encourage or attract more users.

Interoperability Issues

Interoperability between the wired and wireless Internet can be achieved in two ways (Duford, et al., 2004):

i. Using extensible markup language (XML) and extensible stylesheet language (XSL) to target multiple devices. That is, rather than creating multiple sites for the various devices, data can be extracted as XML and XSL templates and used to generate both HTML and WML documents for the various devices.
ii. The use of Aether systems' Scoutweb to WAP-enabled devices in a web-based application. It offers interfaces for websites and mobile devices. Scoutweb supports over 30 different devices and helps translate HTML to mobile content on the fly given a set of rules.

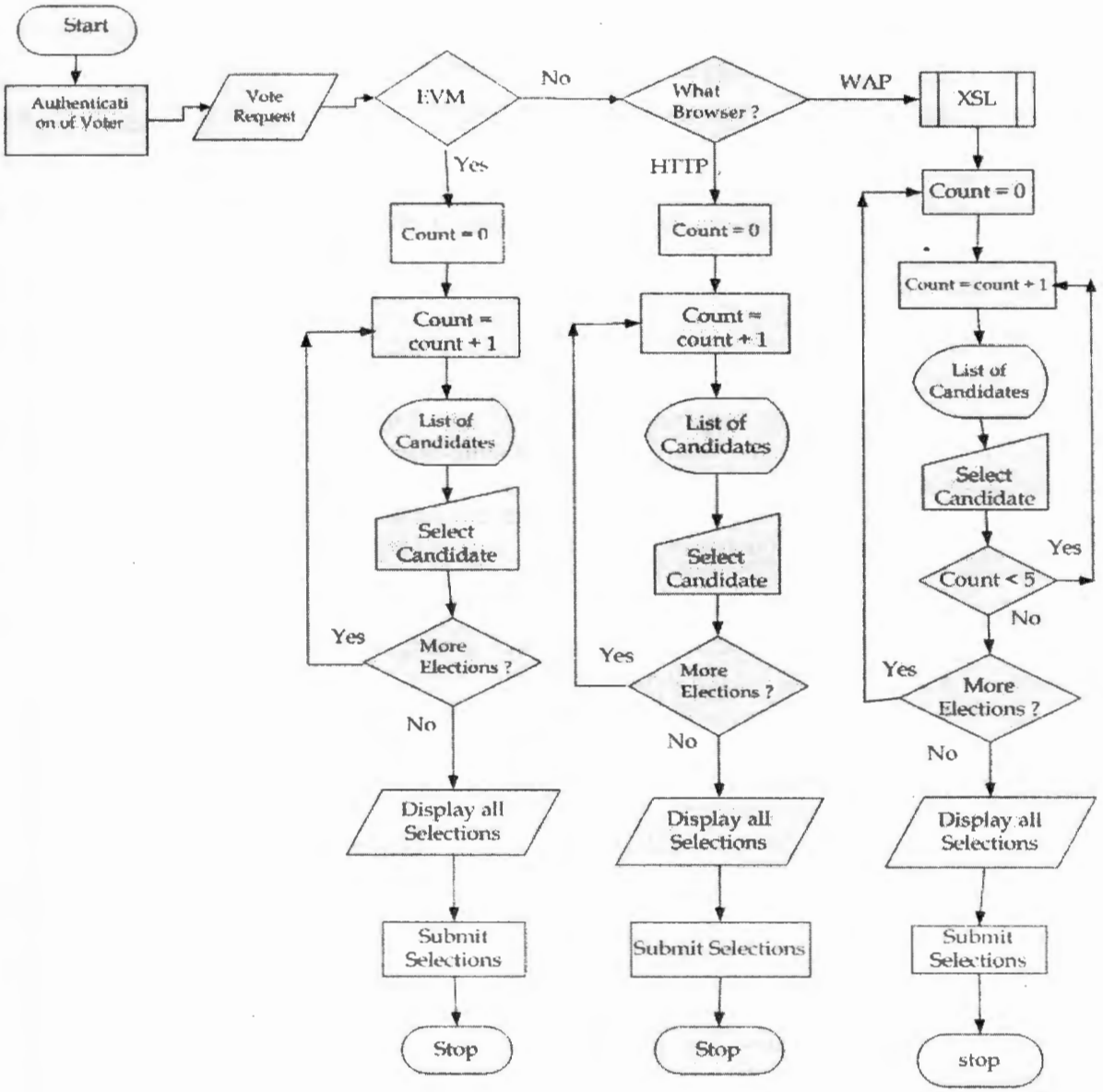

Fig. 1 Integrated Voting System

PROPOSED SYSTEM IMPLEMENTATION AND RECOMMENDATIONS

The overall objective of this paper is to design an efficient and effective system that satisfies the desires of the electorates. An electorate can vote through any of the three options: EVM; i-Voting; or m-Voting. The EVM is an example of a polling station e-Voting, that displays the e-Ballot and electorates go through the user-friendly procedures to cast their votes. Similarly for i-Voting or m-Voting, once the medium of voting is ascertained, the appropriate format is displayed on the respective devices. For i-Voting, the HTML equivalent of the e-Ballot is displayed for the electorates. However, for mobile devices, the WML format is displayed, which is a function of the size of the screen. In some, it could be the five candidates per screen for Palm devices or a single candidate per display screen depending on the size of display.

Assumptions and Proposals

i. We propose five (5) candidates (parties) for each election. The candidates can be displayed at once on the PC and EVM, but display one single or all candidate(s) per screen, depending on the mobile device.
ii. Several elections (presidential, gubernatorial etc) can be conducted a day. After each election, the next elective office and parties are displayed for selection/voting until all elections for the day are concluded.
iii. Before submitting the votes or selections to the web server. the list of selected candidates is displayed for confirmation after which it is posted to the server and the voter leaves.
iv. We propose a smart card-based voter's card with biometric authentication for enhanced security and integrity. This prevents multiple registrations. The choice is based on the fact that its microchip would store significantly larger information; it can be password-protected to prevent unauthorized use; it can run RSA encryption as well as being programmed to generate a pair of public/private keys for authorization and authentication.
v. After each election, the voter's card is blocked to prevent further use on the day of the election, nor can it be used through another medium to vote. Thus, over-voting is prevented.

Recommendations

E-voting implementation all over the world is fraught with a number of problems begging for solutions. These include: a voter verifiable audit trail; multiple voting; over-voting (rigging); security; and confidentiality. We therefore propose the following recommendations:

i. Voter Verifiable Audit Trail

Most authors have recommended the provision of printers connected to each machine in order to create a physical record of each vote, verifiable in real-time and useful for recount purposes.

However, this calls for caution as the privacy and confidentiality of the individual is being infringed upon. Thus, voters' anonymity is important and votes should not be traceable to the actual voter.

Therefore, we recommend that the flash drives of the various machines be copied and forwarded to each Local Government Area for collation. Thus printers can be provided only at the Local, State and National headquarters rather than at each polling booth. This method reduces cost as well as guarantees privacy, anonymity, and confidentiality of the electorates within their domains.

ii. Multiple Voting

Multiple voting is an issue that is prevalent with the traditional manual ballot system. A reasonable number of voters were observed to thumbprint more than one candidate for a particular election thus rending the ballot invalid. In Nigeria, in the last presidential election, over 6% of the votes were recorded as invalid arising from such mistakes.

The proposed system, by virtue of its electronic nature, simplicity of design, and the user-friendly concept introduced, allows the electorate to have a final look at the various choices made before casting the votes. Thus, the problem is non-existent.

iii. Over-Voting/Rigging

The problem of over-voting or rigging was traced to either the developers' proprietary software or multiple registrations by voters. Thus. stakeholders should scrutinize the software (open source) before use. to tie-up all loose ends. Similarly a smartcard-based voter's card with biometric authentication

would reduce multiple registrations. Also during any election, each voter can vote only once after which the voter's card is temporarily blocked (unusable for some period of time).

iv. Disabled Voters

The proposed system equally caters for certain class of the disabled electorates, particularly the sight-impaired and the physically disabled. These voters require that more than one biometric feature be used during registration. Provision should be made for both fingerprint and face, or voice, or iris, or signature etc.

Thus, for the sight-impaired, voice or another biometric feature can be used and additionally the audio equivalent of the contents of the ballot would be played through an earphone. Therefore, with minimum assistance, they can cast their votes.

Similarly for other classes of disability, once authentication is done, then voting can equally be done with minimum help.

v. Rural Dwellers and Illiterates

Like in India, most Nigerians are peasant farmers, rural dwellers, and may be illiterate. However, regardless of the place of domicile, quite a lot of them are literate in their local dialects. Therefore, we propose a multi-lingual ballot design in English and the three major tribes (Igbo, Hausa, and Yoruba) in the country; this feature will further enhance usability.

vi. Security

The public nature of both the Internet and mobile voting calls for concerted efforts against possible hackers, fraudsters, deliberate non-repudiation of transaction, domain name service attack, malicious software, denial of service, and the man-in-the-middle attacks.

Therefore the use of open source software, an Internet Protocol Security (IPSec), employment of a virtual private network (VPN), a secure security layer (SSL), a transport layer security (TLS), and the introduction of firewalls, would go a very long way to guarantee the needed security for e-voting (Lui, 2000). All these put together are likely to be sufficient as a security measure. Furthermore, a third party security firm can be engaged to foster security of transactions.

CONCLUSION

The marginal increase in the number of registered voters between the 2003 and 2006 exercise may be an indication that the Nation is not ripe for technology-based innovations without providing the basic infrastructure, and proper sensitization. Furthermore, it is high time government started looking inward for the production of such technologies locally, where possible, rather than being completely sourced abroad.

The proposed system is simple, indigenous, and secure. It attempts to proffer reasonable solutions, to existing problems in the various countries of use, with a view to guaranteeing a successful e-Voting implementation in Nigeria without necessarily repeating their mistakes.. It eliminates the moribund activities associated with the manual system and reduces drastically the duration of elections as the whole exercise can be concluded in a day, thus, resulting in huge financial savings.

The success factors include: making adequate preparations and get the electorates familiarized with whatever electronic devices to be adopted before being put to use; employing the use of biometric-based voters' card to solve the problem of over-voting; provision of multilingual ballot to cater for the teaming illiterate population. Similarly, the number of political parties is reduced to a manageable size (5) for simplicity, efficiency, effectiveness and for voters' satisfaction in line with the concept of usability.

There is provision for disability as well as the outright elimination of invalid votes arising from multiple voting.

Finally, the integrated system would avail the electorates the opportunity of casting their votes using the most convenient medium among the EVM, i-voting and m-voting. The adoption of the integrated system is likely to increase the level of participation in the polity because of the ease of voting and its tendency to eliminate electoral fraud.

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