

Developing an M-Voting System for Political Party Elections in Kenya

A thesis submitted in partial fulfilment of requirements for the award of the Degree of Master of Science in Information Technology, Department of Information Technology, Moi University

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DOI: 10.29322/IJSRP.10.08.2020.p10447
<http://dx.doi.org/10.29322/IJSRP.10.08.2020.p10447>

Abstract- Elections world over represent the opinions and the voice of the people (Pettit, 2004; Dave, 2011), and there is always the need to put in place a system promotes public participation on election processes and present the outcome of the voting exercise accurately and timely (Keeter et al., 2002). The current voting systems have numerous issues, such as usability, accessibility and security with limited alternatives (Hodges, 2014). The use of a printed ballot remains one of the oldest and the most popular voting methods across the world, but it has faced significant challenges over time, with issues such as lack of mobility, susceptibility to voting booth mistakes, and human manipulation, (Runbeck et al., 2008). The aim of this study was to evaluate the current voting systems used by political parties in Kenya with a view to developing a mobile (SMS) based voting system for party elections to complement the existing systems. The research revealed various limitations that confirms the existing literature. The system was modelled and tested for efficiency, using one hundred volunteers who were able to cast their votes through text message. The system demonstrated that a mobile phone based voting system is viable and can provide an alternative channel during voting in democratic elections, with greater efficiency.

Index Terms: e-voting: electronic voting, GSM: Global System for Mobile communication, m-voting: mobile voting, OMR: Optical mark recognition, PVC: paper based voting system, SIM: Subscriber identity module, SMS: short message service

I. INTRODUCTION

The main voting system used in Kenya is the Printed ballot. This method of voting have in the past been marred with various challenges such as very long queues at the polling centres, missing names from the voter register, standing long hours during voting at the polling station and very slow voting process (Andreassen et al., 1993; BBC, 2013). In Uganda, during Electoral Commission's voter register display in 2015, one hundred and nine (109) polling centers were missing from the voter register, and in another center, the names of people with disabilities (PWDs) appeared in the main registers while those without disabilities appear in the PWDs' register (Daily Monitor, 2015). The above problems clearly bring out the serious limitations of paper ballot voting system that should be addressed in order to make voting exercise less cumbersome and stress free. Mobile technology is another technique that has been tested to enhance voting efficiency. E-voting voting systems can be deployed to complement the inefficient and error-prone manual voting systems (Kohno et al., 2004). Different democracies have implemented different forms of electronic voting (e-voting) systems, and such systems have evolved over time, to counter the emerging challenges (Gold, 2012). Such systems include Biometric Voter Registration, Lever Voting Machines in India, Punched Cards for Voting in United States, and Direct Recording Electronic (DRE) voting (Breckenridge, 2010). Paper based voting system is expensive, vulnerable to natural or human phenomenon and inefficient (Kumar & Srivastava, 2010); considering the above problems and opportunities, a lot of research has been on-going and should be encouraged, in order to come up with a voting mechanism which is cost effective, secure, and convenient to the voters (Kumar & Suresh, 2011).

In the last decade, there has been a widespread growth of mobile wireless networks, applications, and services (Demombynes & Aaron, 2012). This has ushered in the era of mobile computing, where handheld computing devices have become the predominant choice for users. Low-cost affordability of portable devices such as cell phones, palmtops and their widespread usage are motivating various industry players to provide various services to mobile users (Demombynes & Thegeya, 2012). A very consistent trend has been witnessed in the banking sector where mobile phones have been used to perform financial transactions, a clear indication that mobile phones have become part of modern life, and can be explored further as a primary tool for voting during elections (Au & Kauffman, 2008).

Elections And Voting In Kenya

Electoral and voting processes in Kenya have undergone significant transformation over time (Branch, & Cheeseman, 2009). In 1988 for instance, the then Kenya ruling party KANU instituted the *mlolongo* (queuing) system of voting, in which voters lined up publicly behind an image of their chosen candidate or party (Sjögren et al., 2014, East African Standard, 24th 1988). This denied voters a secret voting and even the right to abstain. According to the previous national election in Kenya, statistics revealed that a voting system has direct impact on voter turnout. The voter turnout in 1988 for instance was a record low of only 32.5 per cent, as compared to 45.9 per cent in 1983 and 67.3 per cent in 1979, a factor that could directly be attributed to the queuing system in 1988 (Jones, 2003; Muriungi, 2005). In the last decade the most predominant voting system has been the paper ballot voting. It involves casting the vote using paper ballot where each voter writes in the name of a candidate or select the candidate of their choice from the pre-printed sheets with names of the candidates, and inserts into the ballot box one vote at a time (Mayur Patil, 2013). The manual voting is usually marred with very many challenges such as long queues at the polling centers as was witnessed in 2013 general election (British broadcasting corporation (BBC), 2013).

Mobile Phone Technology

The mobile phone technology has evolved significantly in Kenya over the last two decades. The revolution has transformed the lives of Kenyans, providing not just communications but also basic financial access in the form of phone-based money transfer, led by the M-PESA system introduced in 2007 (Thegeya, 2012). By end of 2014, the mobile phone penetration rate in Kenya was 80.5 per cent, with majority of mobile phone owners comfortable using their phones to perform financial transactions on M-PESA and mobile banking (Demombynes & Thegeya, 2012). Due to the popularity and ease of use of these mobile devices, it would be necessary to take advantage of the technology and develop a prototype mobile voting system that would significantly enhance the existing paper based voting systems.

It is evident that traditional voting systems have significant challenges that cannot be left unaddressed, at the same time, there is a clear indication that the available technologies can and have been used to improve the voting process. In view of the foregoing, the researcher found it necessary to investigate the challenges faced in the current voting systems in Kenya, in order to provide an ICT based solution that would improve the voting experience.

Voting Systems

Voting method can be classified into two broad categories, paper based, and electronic voting. The paper voting systems include paper ballots and, punch cards; while electronic voting includes mobile voting and internet voting systems (Dimitris, 2012).

Mobile Phone Voting

Mobile voting refers to a voting process that involves casting of votes through mobile devices such as mobile phones, tablets, or personal digital assistant (PDA). Mobile voting (m-voting) is considered to be an electronic voting system which removes the inherited limitations of the traditions and the e-voting systems that required, in many cases, the physical existence of the citizens, and polling officials in the polling location (Ekong, 2010). With the mobile technology, voters who for different reasons, may not be able to go to the voting booths physically, are able to use mobile technology to cast votes remotely (More, et al., 2015), and vote tallying done through computer systems (Galal, 2012). Figure 1 below presents a mobile phone voting system architecture using GSM infrastructure.

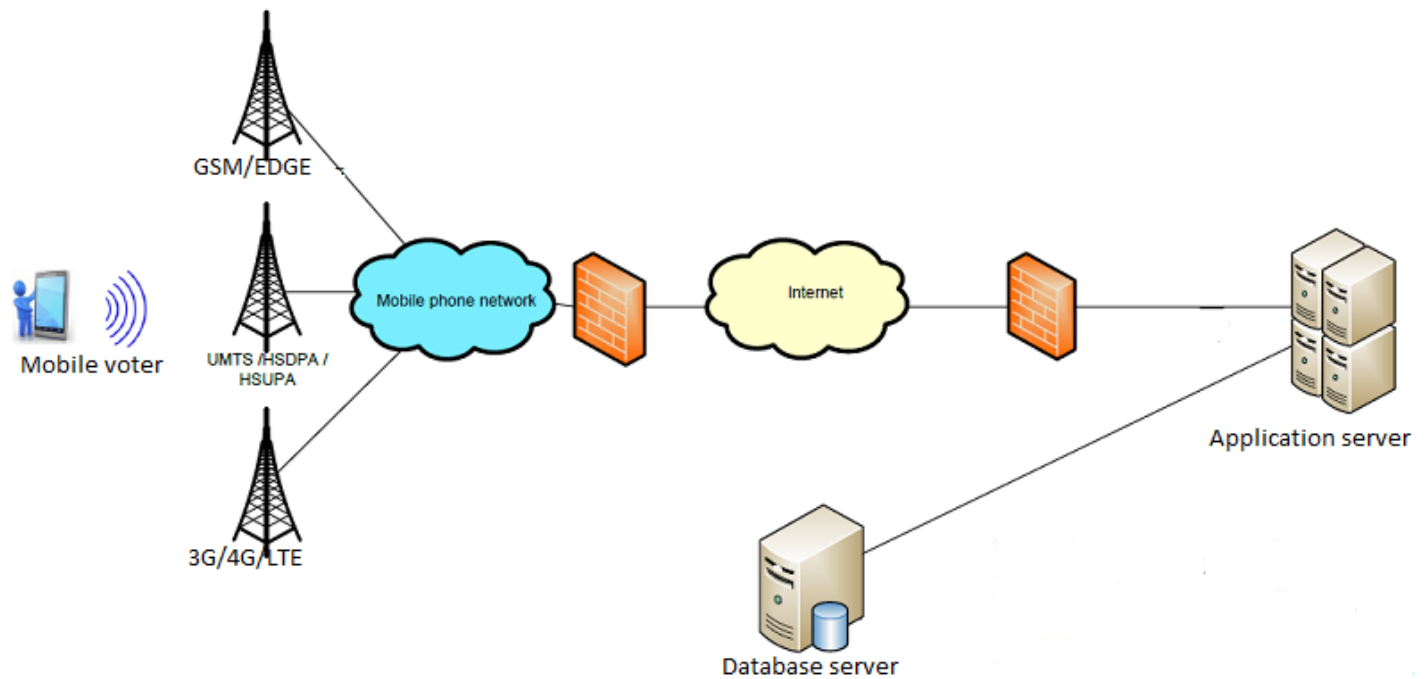


Figure 1: M- Voting architecture; source: www.researchgate.net

Mobile voting provides an additional platform to the electronic voting systems. It is an initiative with tremendous potentials to enhance democratic participation and also serve as an enabler and a convenient way to involve citizens in political decision making, as well as providing a cheaper, convenient and a simple system to administer (Ekong, 2010).

Benefits of Mobile Voting

Mobile phone based voting system have a range of advantages that benefits the citizen, the political players and the government. Some of benefits that can be obtained if voting is conducted through mobile phones are: Possibility for increased efficiency, flexibility and reduced cost; at the same time the system can be used alongside other voting systems (Bouras et al., 2003; Brücher & Baumberger, 2003). Mobile voting could give elections new potential by providing ballots in multiple languages, accommodating lengthy ballots, facilitate early and absentee voting, thus enhancing democratic process (Dimitris, 2003); It has the ability to reduce fraud, by eliminating the opportunity for ballot tampering, ballot stuffing, and ballot miscount (Rubin, 2002; Panda, et al., 2013). People with disabilities gain a new alternative for voting privately, independently, and with dignity, at their own pace; at the same time, it would increase the ease of voting for citizens who are otherwise geographically isolated from election centres (Gamatié, 2014).

Research findings

The system was considered in two main modes, before election (normal mode) and during election (Election mode), as described in Figure 2 below. The normal mode entails all activities undertaken by the system users and the system before the actual casting of votes; such as voter registration, registration of candidates, and verification of voter list as well as creation of elections. The contestants are also issued unique public ID that will be used to cast votes on their favour at this stage. The election mode entails events that occur during voting exercise such as casting of ballots, voter authentication, and tallying.

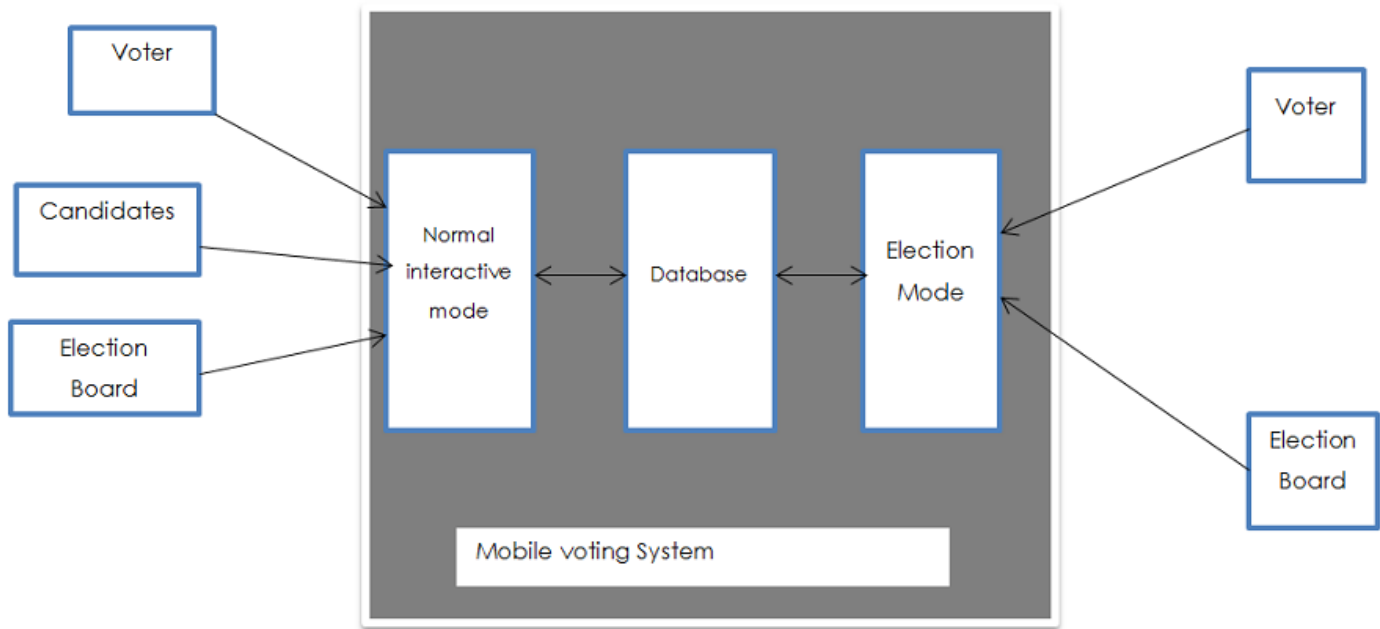


Figure2: Block diagram showing interaction between users and the system

The normal mode provides a web interface through which users interact with the system to enrol voters and contestants and perform all pre-election operations. Once the system is turned into election mode, the database is locked for any editing and the system is ready to receive, validate, and tally voted and display the results through a web interface in real time.

The screen captions below displays the output of mock election conducted by the volunteers; over one hundred votes were cast to different candidates within five minute, where all the votes cast were processed and results displayed instantly an evidence of great efficiency and flexibility when using mobile phones to cast votes.

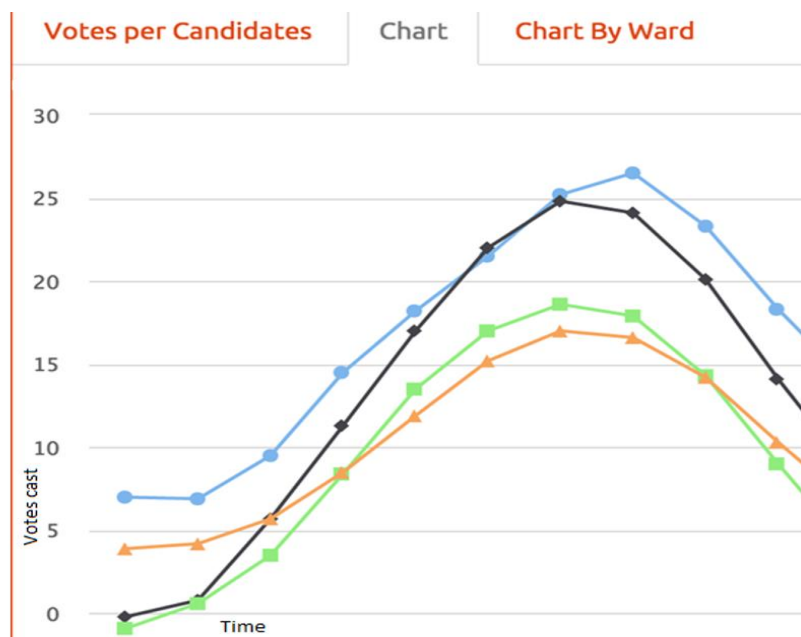


Figure 3: Real time voting results within five minutes in a mock election in a Constituency for four candidates

Majority of voters, admit that the current paper based voting system has its own limitations such as slowness especially when voting for several candidates, missing records and difficulty to use among the illiterate voters. Voters were also dissatisfied with the current vote tallying process where votes are collected and counted in a central tallying center. The main concerns raised are slow tallying process, mistrust of the vote tallying officials due to deliberate human errors and voting booth mistakes. All the respondents confirmed to be in possession of a working mobile phone and would be excited to use a mobile phone based voting system. The study revealed that many voters still face challenges with manual voting system, where over 50% of respondents complain of the efficiency in terms of speed. Another major issue that comes out is trust on the manual tallying process with voters, where human error and tallying speed have come out as the main concerns to the voters. The availability of the mobile phones and ease of use was evident among most voters; typically, all the voters interviewed own a mobile phone. Majority of the voters (60%) would use their mobile phones to cast votes if concerns such as voter manipulation by system administrators and election officials are addressed. The main concerns to the electorates about mobile voting are security of the system against both external and internal threats, as well as lack of understanding on the technology. A mock election conducted by the volunteers who were requested to cast votes randomly in favour of different candidates within a period of five minutes showed that that over 100 votes could be processed within one minute, demonstrating great efficiency, accessibility and convenience of mobile phone voting as compared to traditional voting systems.

REFERENCES

1. Abdelghaffar, Hany, and Lina Galal. "Assessing Citizens Acceptance of Mobile Voting System in Developing Countries: The Case of Egypt." *International Journal of E-Adoption (IJE)* 4.2 (2012): 15-27.
2. Olanyi Mikail, Oluwatosin, Bashorun & Arulogun Tayo. "Framework for Multilingual Mobile E-Voting Service Infrastructure for Democratic Governance" (2011).
3. Alvarez, Michael, Gabriel Katz, and Julia Pomares. "The impact of new technologies on voter confidence in Latin America: evidence from e-voting experiments in Argentina and Colombia." *Journal of Information Technology & Politics* 8.2 (2011).
4. Anderson, David "'Yours in Struggle for Majimbo'. Nationalism and the Party Politics of Decolonization in Kenya," *Journal of Contemporary History* (2005).
5. Au Yoris, and Robert Kauffman. "The economics of mobile payments: Understanding stakeholder issues for an emerging financial technology application." *Electronic Commerce Research and Applications* 7.2 (2008): 141
6. Barkan, Joel. "Technology is not democracy." *Journal of Democracy* 24.3 (2013)
7. Bederson Benjamin, Bongshin Lee, Robert Sherman, Paul Herrmson, and Richard Niemi. "Electronic voting system usability issues." In *Proceedings of the SIGCHI conference on Human factors in computing systems*, (2003).
8. Blais André. "What affects voter turnout?" *Annu. Rev. Polit. Sci.* 9 (2006).
9. Blanc Jarrett. "Electronic voting." *Challenging the Norms and Standards of Election Administration* (2007)
10. Bouras, Christos, Nikolaos Katris, and Vassilis Triantafillou. "An electronic voting service to support decision-making in local government." *Telematics and Informatics* 20.3 (2003).

11. Branch, Daniel, and Nic Cheeseman. "Democratization, sequencing, and state failure in Africa: Lessons from Kenya." *African Affairs* 108.430 (2009).
12. Breckenridge, Keith. "The world's first biometric money: Ghana's e-Zwich and the contemporary influence of South African biometrics." *Africa* 80.04 (2010).
13. Brücher, Heide, and Petra Baumberger. "Using mobile technology to support eDemocracy." *System Sciences; Proceedings of the 36th Annual Hawaii International Conference on. IEEE*, (2003).
14. Buchsbaum, Thomas M. "E-voting: International developments and lessons learnt." *Electronic Voting in Europe Technology, Law, Politics and Society* (2004).
15. Bui, Tung, Siva Sankaran, and Ina Sebastian. "A framework for measuring national e-readiness." *International Journal of Electronic Business* 1.1 (2003).
16. Campbell, Bryan A., Chad C. Tossell, Michael D. Byrne, and Philip Kortum. "Voting on a Smartphone Evaluating the Usability of an Optimized Voting System for Handheld Mobile Devices." In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, vol. 55, no. 1, pp. 1100-1104. SAGE Publications, (2011).
17. Cheeseman, Nic, Gabrielle Lynch, and Justin Willis. "Democracy and its discontents: understanding Kenya's 2013 elections." *Journal of Eastern African Studies* 8.1 (2014)
18. Cheeseman, Nic, Gabrielle Lynch, and Justin Willis. "Democracy and its discontents: understanding Kenya's 2013 elections." *Journal of Eastern African Studies* 8.1 (2014)
19. Cheeseman, Nic. "The Kenyan elections of 2007: An introduction." *Journal of Eastern African Studies* 2.2 (2008): 166-184.
20. Cheng, V, *Online and Mobile Voting: Accessibility for all* (2014),. Accessed on 12/3/16 from <https://openideo.com/>
21. Chung, Lawrence, Brian, Nixon, Eric Yu, and John Mylopoulos. "Non-functional requirements in software engineering". Vol. 5. Springer Science & Business Media, (2012.)
22. Cranor, Lorrie Faith, and Ron Cytron. "Sensus: A security-conscious electronic polling system for the internet." *System Sciences, 1997, Proceedings of the Thirtieth Hawaii International Conference on. Vol. 3. IEEE*, (1997).
23. Cranor, Lorrie Faith. "Electronic voting: computerized polls may save money, protect privacy." *Crossroads* 2.4 (1996): 12-16.
24. Dada, Danish. "E-Readiness for Developing Countries: Moving the focus from the Environment to the Users." *The Electronic Journal of Information Systems in Developing Countries* 27 (2006).
25. Daily Monitor, "Voters frustrated by missing names on register", (2015); accessed 12/11/15 from <http://www.monitor.co.ug>

26. Dave Monali, Jai Karan Singh, Mukesh Tiwari, and Anubhuti Khare. "Implementation of intelligent polling system using GSM mobile." *International Journal of Computer Technology and Electronics Engineering (IJCTEE)*, (2008).
27. Davis III, John M., and Shelby Thomas. "Direct recording electronic voting machine and voting process." U.S. Patent No. 5,583,329. 10 Dec. 1996.
28. Demombynes, Gabriel, and Aaron Thegeya. "Kenya's mobile revolution and the promise of mobile savings." World Bank policy research working paper 5988 (2012).
29. Egli, Marcel. "E-Voting in Switzerland (2011)."
30. Ekong Uyinomen, and Victor Ekong. "M-voting: a panacea for enhanced e-participation." *Asian Journal of Information Technology* 9.2 (2010).
31. Fishkin, James "The voice of the people: Public opinion and democracy". Yale university press, 1997.
32. Gamatié, Abdoulaye, ed. *Computing in Research and Development in Africa: Benefits, Trends, Challenges and Solutions*. Springer, 2014.
33. Gentles, Donovan, and Suresh Sankaranarayanan. "Application of biometrics in mobile voting." *International Journal of Computer Network and Information Security* 4.7 (2012): 57.
34. Gentles, Donovan, and Suresh Sankaranarayanan. "Biometric secured mobile voting." *Internet (AH-ICI)*, 2011 Second Asian Himalayas International Conference on. IEEE, (2011).
35. Gerlach, Jan, and Urs Gasser. "Three case studies from switzerland: E-voting." *Berkman Center Research Publication No 3* (2009): 2009.
36. Gibbins, R. *History of elections*; (2015). website: <http://www.britannica.com/>
37. Gold, Steve. "Preventing electoral fraud using biometrics." *Biometric Technology Today* 2012.9 (2012): 5-6.
38. Gritzalis, Dimitris "Secure electronic voting. Vol. 7: Springer Science & Business Media,"(2012).
39. Gyimah, Nana Afua Boamah, and Bertrand Asongwe Tita. "Electronic Voting; A Possible Solution for Sub-Saharan Africa? A focus on the Ghanaian Electoral System." (2010).
40. Hassan, I. *Biometric Voter Registration (BVR) to Enhance Credibility of Elections*; (2012). accessed on 10/11/2015 from www.iebc.co.ke
41. Hornsby, Charles, and David Throup. "Elections and political change in Kenya." *Journal of Commonwealth & Comparative Politics* 30.2 (1992): 172-199.

42. International Institute of Democracy & Electoral Assistance. Introducing Electronic Voting, Essential Considerations, (2011).