

# Avoiding Voting Anomalies and Inconveniences in Jamhuriya University Students Association Elections Using A Mobile Voting System

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## Abstract

Election is a formal decision-making process by which a population chooses an individual to hold public office. Jamhuriya University Students Association (JUSA) use hand-counted paper ballot for electing their representatives, this technique is quite complex and time consuming. The main contribution of this work is to establish a Mobile Voting System for Jamhuriya University Students Association (JUSA), which provides important features including mobility feature, convenience, authentication, verifiability, confidentiality, non-repudiation, transparency, ease of use and time saving platform. Mobile Voting System Reduces time and expense consumption and offers increased convenience to the voter, encourages more voters to cast their votes remotely, and increases the likelihood of participation. This work also provides intelligent anomalies detection and automatic reply mechanisms.

## Keywords:

*Mobile Voting, JUSA Elections, Electronic Voting System, Paper Ballot.*

## 1. Introduction

Election allow the populace to choose their representatives and express their preferences on the way they will be governed (Magomelo et al, 2013). Election not only gives people a chance to choose their leaders, but also to freely express their views on issues (Dwumfuo &Paatey, 2011).

Kumar et al. (2013) stated voting is an essential part of any government, and right for every citizen. As such, the efficiency, reliability and security of the technologies involved are critical.

Voting has existed for several years and the process of voting has progressed over the years. The earlier process of elections was quite complex and time consuming; people were waiting in queue for long time (Dipali et al., 2015).

Kuye et al. (2013) confirmed that election malpractices put into question the credibility of the voting process. To improve this and eliminate election complexity and time

consumption, voting has migrated in some countries from voice and hand ballot to electronic voting systems.

Electronic voting systems have the potential to improve traditional paper-based voting procedures by providing convenience and flexibility to the voter (Okediran, 2011).

Kamaraju et al. (2013) acknowledged that, there is great demand for electronic remote voting procedures that are easy to access, transparent and most importantly secure. The most common way for remote voting today is postal voting, where voters cast their votes by post. However, it lacks proper authentication and involves a time-consuming procedure.

Steyn & Greunen (2014) points out that now days Mobile voting System which is a subset of electronic voting is continuously gaining popularity, because it creates mobility feature, convenience, verifiability, reliability, confidentiality, transparency, non-repudiation, efficient, effective, privacy, error-free, and time saving platform.

Mobile voting systems reduce the materials required for printing and distributing ballots, the number of errors made by both the voters and the electoral administrators, the amount of time spent tallying votes and delivering results. It also offers increased convenience to the voter, and encourages more voters to cast their votes remotely (Kumar et al., 2013).

Mobile Voting is implemented to simplify for students to participate university elections by sending short message from their registered mobiles via Mobile Network Operator System.

The Mobile voting system can be implemented anywhere where there is a telecommunication network coverage, and can work on any Mobile phone (Magomelo et al., 2013).

Election is a formal decision-making process, which allows a group of individuals to make decisions. These decisions could be political, social or public. (Dwumfuo &

Paatey, 2011). Election enables certain formal decisions to be made through participation of a given population (Rexha et al, 2012).

Kumar et al. (2013) mentioned, nationally a government is chosen by voting, so the technologies involved in the election process are critical. A voting system is a procedure which enforces rules to ensure valid voting, and how votes are counted and aggregated to yield a final result (Magomelo et al, 2013).

Researchers indicate that voting systems started from the oral voting, famous raising of the hand and paper based voting systems to electronic voting procedures (Rexha et al, 2012).

Steyn & Greunen (2014) stated the goal of any voting system is to establish the intent of each individual voter and translate those intents into a final tally. The traditional voting platform over which voting is carried out today goes a long way in determining the convenience requirements they can achieve. Traditional voting systems also have its shortcomings in terms of lack of voter's mobility, flexibility and accuracy. In addition to its complexity and time consumption.

Salomonsen (2005) points out, to eliminate above motioned problems and in response to the 1948 Universal Declaration of Human Rights which puts weight on the necessity of free elections, nations aim at new and improved voting procedures which are of relevance to elections in the 21<sup>st</sup> century.

According to Shinde et al. (2013), in order to achieve long-term objective, numerous electronic voting technologies that provide an easily accessible voting mechanism were proposed, but most of them have failed to provide voter authentication in an efficient and transparent way.

Herselman & Britton (2002) mentioned, because of the development and widespread use of mobile phones has completely changed the way we connect to the world and has made our life more convenient.

Mobile voting System, is a subset of electronic voting and continuously gaining booming. Mobiles have completely changed the way we connect with the world and have made our life more convenient (Herselman & Britton, 2002).

Mobile phones exhibit some unique characteristics that distinguish them from the online medium, these global devices are portable, affordable and in widespread use today (Little & Duncan, 2011).

According to Bansal et al. (2012) since the early 1980s, the Global System for Mobile Communication has been the

most popular standard for mobile phones in the world. It has become the most used worldwide wireless standard and issued by the peoples in more than 200 countries.

Verma & Ojha (2014) declared that a unique feature of GSM which is not found in older analog systems is the Short Message Service.

According to (Scourias, 1996) Short Message Service (SMS) has become a very popular way for mobile phone users to send and receive simple text messages to each other using their mobile phones.

## 2. Methods and materials

Mobile Voting System is an efficient and effective procedure which allows voters to cast their vote remotely, without the limit of time and place. This application facilitates users to spontaneously and timeously vote using registered mobile phone networks and technologies. Mobile Voting System consists of three steps: Registration of voters, voting phase, and vote collecting and reporting phase.

Below figure is a pictorial of Mobile Voting system architecture.

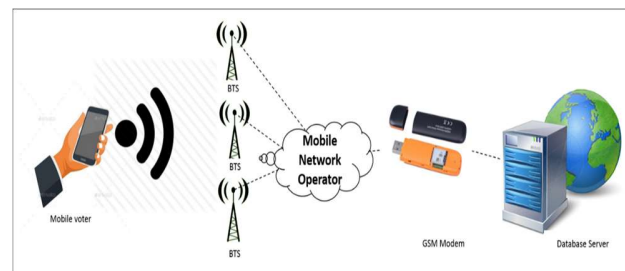


Figure 1: Mobile Voting System architecture

**Figure 1** A pictorial of Mobile Voting system architecture.

### 2.1 Requirements

- a) Hardware requirements: The proposed system development required the following hardware devices:
  - i. Desktop Computer (Intel Core i5 processor, 8 GB RAM, 1 TB Hard Drive, Windows operating system).
  - ii. GSM Modem: GSM Modem (Manufacturer: Huawei, Model N0: K3760).
- b) Software requirement: The following software packages are required for the development of our system:
  - i. Microsoft SQL server: this is used as backend database to register information in the database server.

- ii. Visual Studio: this is the environment used for application development and web services.
- iii. ASP.NET and C# Programming: this is mainly used for front-end interface programming.
- iv. Hypertext Markup Language (HTML): this is used to place text, images and other contents on a webpage.
- v. Cascading Style Sheets (CSS): this is used for controlling the style and appearance of HTML documents.
- vi. Java Script: which is used for client-side scripts to interact with the user and make dynamic pages.

### 3. Analysis & Design

#### 3.1 Current system and limitations

Jamhuriya University Students’ Association (JUSA) uses manual hand-counted paper ballot, which is time-consuming processes, and limited voters are chosen from every class for electing union leaders.

#### 3.2 Mobile Voting System Requirements

To provide convenience, Efficient, Mobile, and transparent Voting system, the proposed system has some requirements including functional requirements that define what a system is supposed to do, and non-functional requirements define how a system is supposed to be.

#### 3.3 Functional Requirements

Functional requirements are visible tasks or processes that must be performed by the system under development. The functional requirements of Mobile Voting System include Send and Receive SMS, Authentication before voting, Registration, Reporting, Verifiability to voters and vote uniqueness.

#### 3.4 Non-Functional Requirements

Non-functional requirements, also called qualities of a system, refer to qualities or standards that the system under development must have or comply with, but which are not tasks that will be performed by the system.

The Non-functional requirements of Mobile Voting System include: to provide convenience to the voter, Voter anonymity, reliability of voting procedure, Fairness for candidates and election process transparency.

### 3.5 System Design

This figure describes activities involved in how the purposed system will actually operate.

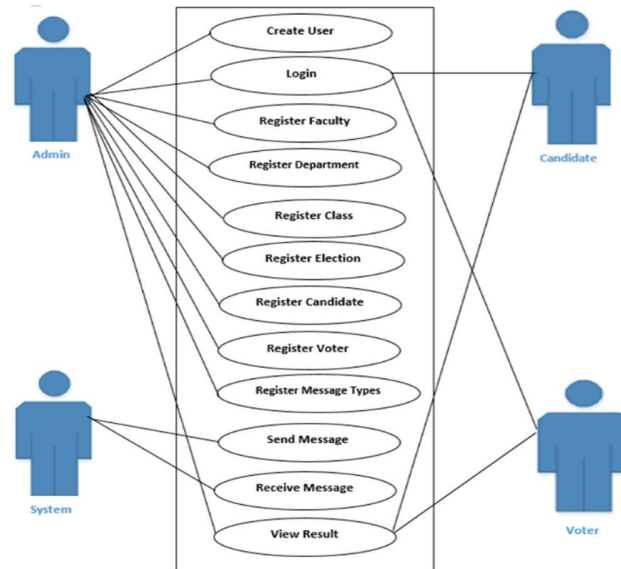


Figure 2: Use case diagram of Mobile Voting System

Figure 2 Use Case Diagram of Mobile Voting System

### 4. Implementation

Once the system is accessed, the Home Page is displayed first, the user can navigate common system menus without credential authentication. If the user wants to access the election process, an authentication will be requested.

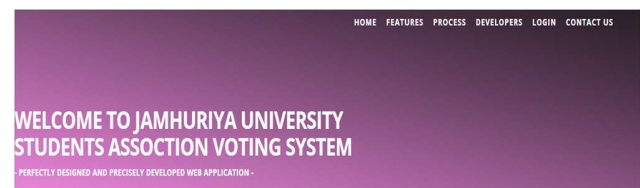


Figure 3: Mobile Voting System Home page

Figure 3 Mobile Voting System Home Page

If the user provides Standard credentials, the current election process will be displayed.



Figure 4: Mobile Voting System Current Election Process

Figure 4 Mobile Voting System Current Election Process

If the User provides Administrative Username and Password, the User is directed to the Administrator’s Panel, Where he can register Faculties, Departments, Classes, Elections, Voters, Candidates and User Accounts. The administrator can also view Incoming and Outgoing Messages and reports.

In the voting phase, message senders are automatically replied with an intelligent anomalies detection mechanism.

<p>If the Sender is registered and did not already vote, the following reply message will be sent.</p>	<p>If the Sender is registered and have already voted, the following reply message will be sent.</p>	<p>If the Sender is not registered, the following message will be sent.</p>	<p>If the Sender is registered and send Unrecognized Message, an error informing message will be sent.</p>
<p>Figure 5: Successfully voted Sender reply message</p>	<p>Figure 6: Already voted Sender reply message</p>	<p>Figure 7: Unregistered Sender reply message</p>	<p>Figure 8: Unrecognized Sender reply message</p>

Figure 5 Mobile Voting System with an intelligent anomalies detection mechanism

## 5. Discussion

As result of academic research responsibilities we have taken, tolerance and efforts we have paid and hardworking, eventually we have successfully finished Mobile Voting System, which is implemented to handle the election of Jamhuriya University Students association (JUSA).

Mobile Voting is implemented to simplify for students to participate University elections by sending Short Message from their registered mobiles via Mobile Network Operator System.

### 5.1 Recommendations

Many enhancements can be made on Mobile voting system in the future, in terms of adding new features or improving features it already had.

- In this work, registered Voters can participate only one active election each time; this means more than one election cannot be performed simultaneously. Thus, it would be beneficial if the voter can participate in any number of active elections.
- In terms of Integrity, when delivering a message from sender to recipient, a Short Message Serving Centre

(SMSC), which is owned and run by the telecommunication operator, is responsible for the routing and delivery of the Message. Once an SMS message is delivered to the SMSC, a store-and-forward message mechanism is implemented, whereby the message is temporarily stored in the SMSC, and then forwarded to the recipient's phone. In this point, the Mobile Network Operator system employees have the ability to read, delete and modify the contents of the message. Hence, it is good to implement a cryptographic mechanism to encrypt the message contents to protect against unauthorized access.

- Because of the private telecommunication competition and lack of centralized governmental telecom policy, the Mobile Network Operators in Somalia do not have interconnection, and this system supports just one Simcard, so if one of the voters use distinctive telecom company and try to vote, the system will not receive that message, even if he/she has been already registered. In this point, the researcher recommending to enhance this work, either to increase the number of GSM Modems, or to implement another alternative solution to receive every registered student's message regardless the sender's Mobil Network Operator.
- In this work, the researcher have used Huawei 3G Modem for sending and receiving incoming messages. Due to the synchronization and hand shaking processes between the application server and GSM Modem, it takes about 30- Seconds to receive and send reply message to the voter, this may lead to message delay or message queue. Technically, in some cases if the message delay time exceeds the message delivery time configured in the Mobile Network Operator's SMSC, the message will be rejected and it will not be delivered to the recipient. Hence, it is useful to get an advanced GSM Modem, which is free from this limitation, or to get another solution to skip this problem.
- In this work, the voter's information is registered, but its identity is the mobile phone number, which is registered before election starts, in the registration phase; a unique Username and Password are automatically generated for each voter to access the System Online, and view the voting process. Therefore, it is useful to give the voter another option to vote online by using his/her username and password instead of Sending Message through his/her Mobile phone number.
- The core functional requirements of this work include Voter verification; any message sender will be replied automatically regardless the previous logs. To make this system more intelligent, we will recommend to implement a procedure which prevent Chaos messages.

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