

## Implement Biometric Electronic Voting System in Sri Lanka

UP Muthukumara#, RMM Pradeep

*Faculty of Computing, General Sir John Kotelawala Defence University, Ratmalana, Sri Lanka*

#urajiepunsarani@gmail.com

**Abstract:** Web applications are the most popular platforms that deliver information and services through the Internet these days. This paper introduces Web-based Biometric Electronic Voting System Software to Sri Lanka. In the past few years happen a big improvement in the technology field. Here introduce the use of technology for voting system and presents the development and implementation of the electronic voting systems. In using this system, during the registration period, candidates, political parties, and voters are registered to the system. Biometric fingerprint machines scan the fingerprints of eligible voters and save them in the system. On election day, it processes to do verifications. The fingerprint is a biometric identifier. Because fingerprints are unique for every individual. In also they do not change. Automated biometric fingerprint identification can take considered the most reliable biometric technology that is used in the present society. This system replaces the paper-based traditional voting process. The electronic voting system is the best solution according to the situation in our country. Already some democratic countries have moved to these electronic voting systems because of many defectives that happened in the traditional paper-based voting system. Sri Lankans' contiguous country India also uses this electronic voting system. Sri Lanka is a democratic, developing country. Therefore, it better to go for a web-based electronic voting system for an efficient and secure election.

**Keywords:** Biometric, Electronic Voting System, Fingerprint, Verification, and Web-based application

### Introduction

In Sri Lanka, elections take place every five years to elect a President and the members of the parliament. Additionally, the provincial council elections and local authorities' elections are taking place in Sri Lanka. The election is a globally accepted method that is used to select representatives of the general public in a democratic system. Leaders from the regional level to the national level are selecting being selected by the eligible voters in the country. This happens with the interest of the people. Therefore, the decisive factor is the right of the voter. The heart of democracy is voting. The heart of voting is trust. However in the present that trust slip from people. People are disappointed with this voting system and about election violence. Most of the democratic countries, including Sri Lanka, also happened violence because of this paper-based voting system. Biometric electronic voting technology is the best solution for a credible election. In present most of the sectors in Sri Lanka are moved to online systems to improve efficiency. Therefore, this is an introduction to implement an electronic voting system in Sri Lanka. The traditional voting system moved to the electronic voting system will become a turning point in Sri Lankan political history. That will be a challenging task to change the mindset of people about the new system.

In the new method, this biometric electronic voting system will replace the paper-based

traditional voting system. There are many of violence happened based on this paper-based voting system. The electronic voting system will minimize these issues. The electronic voting system includes processes such as voters' biometric registration, candidates' registration, political party registration, voter verification, voting, vote counting, collation and publication of results. Behavioural and biological characteristics are unique for individuals. From automated recognition can identify these behavioural and biological characteristics. Biometric means using automated recognition individual wise identify the behavioural and biological characteristics. Biometric recognition is measuring an individual's behavioural and biological characteristics.

Fingerprints are used for personal identification. It is unique to everyone. No one has the same fingerprint. Twins also have different types of a unique fingerprint. Identical twins also no carry identical fingerprint. Fingerprints do not change from time to time. Every person born as a baby, and they grow. But there are no changes in their fingerprint. So automated fingerprint identification can take as most reliable biometric technology.

Introducing a software platform that will make election fair, authentic, accurate and fast is the aim of this research. There are many advantages to the biometric electronic voting system. They are high efficiency, high accuracy, time-saving, reduce storing difficulties, reliability, convenient to use. Difficult to forge access in the third party because illegal votes and repetitions are checked in the system.

### **Research Problem**

The paper-based traditional voting system includes many of issues. The main problems are it takes a long time for the counting process and delay in publishing results. According to records of previous elections it

took more than 12 hours to publish final results. Counting starts after the all ballot boxes bring to the counting centres from polling stations all around the country. Counting process starts maximum one hour after the closing polling stations.

Personal identity is another major defective of this current voting system. This is a common problem for most of the democratic countries. According to the personal identity problem, misused the ballot papers and vote duplication are the other problems that connected with it. In the election, the department has issued blue sheets additionally to the ballot papers. They used it to maintain a peaceful and calm election. But it is a disadvantage for the real voter. If issued a blue paper to the real voter, there is a problem with the personal identity of voters. Because of there is illegal third party access.

Other defectives in this current system are too much paper works, high labour intensive, high cost, transport Difficulties and high storing difficulties. And also it is not an eco-friendly method.

### **Literature Review**

This section contains the report about background researches of biometric electronic voting systems. Research has shown there are many defects happening based on this paper-based manual voting system. It is a common problem for most of the democratic countries. These papers describe the advantages and disadvantages of both the current and proposed systems. And also described different electronic voting systems and defectives in each system.

#### **A. Paper-based Voting System**

Piratheepan (2017) mentions that there are opportunities to occurring errors because of the current paper-based voting system in Sri Lanka count votes in manually. In counting

centres can be vote duplication, completely missed to count. And also mentioned sometimes votes can use in an improper manner and change the results favour of certain candidates. That is doing by some political parties.

This paper mentions an example of the injustice of the paper-based system. In the presidential election, found the ballot boxes filled with illegal ballot sheets. Used that illegal thing to appoint the president. Because of these illegal papers, that election became an invalid election. Because of non-evidence, cannot find theft and punish for thieves. The research mentions another example of American election injustice. At that time they used a paper-based voting system. During the election, some thieves printed the new white ballot sheets and quickly completed them and put it into the ballot boxes. It is an illegal activity. That activity shows that first world countries also suffered from this paper-based voting system.

Kumar (2011) has found a paper-based voting system is an inefficient method. Traditional systems take a long process and a long time. It has stationary costs and transportation costs. There is a chance to cast invalid votes. It required high human participation. Sometimes there can be human errors. Sometimes there are foxy election mechanisms.

Djanali (2016) has mentioned the counting process in the manual system it takes a long time. It takes several hours to declare the results. And also hard to determine when the result is true or not. Data sending in between two levels take several days.

Sedky (2015) has explained, regarding indicating high cost, less accuracy, and less transparency, are some of the problems in the paper-based voting system.

Gujanatti (2015) has explained that they indicate this is the common way to cast votes.

It requires more labour-consuming. It takes a long time. But easy to print ballot papers. Can store marked ballot papers for authentication.

#### A. Biometric Identifiers

Kumar (2011) has indicated the meaning of biometrics is the automated recognition of individuals. It is based on the behavioural or biological characteristics of the person. Biometric recognitions measuring an individual's suitable behaviours and biological characteristics. It helps to identify a specific user. The system uses a fingerprint as a biometric identifier. Fingerprints are unique to each individual. Fingerprints are not changed from time to time. Identical twins also haven't identical fingerprints. Fingerprints are the most common biometric identifier that uses nowadays. Automated fingerprint identification is the most reliable biometric technology. Because it has distinctiveness, persistence, ease of acquisition, and high matching accuracy. Biometric identifiers cannot be misplaced or misuse or share easily. It has better security. As an example difficult to forge access. Also, it having high efficiency.

Yinyeh (2013) has described the use of fingerprint, iris, face, palm print, speech characteristics define as biometric identifiers. Biometric identifiers cannot share or misplace or misuse. Fingerprints are unique to the individuals and it cannot be changed.

#### B. Fingerprint-based Electronic Voting System

Piratheepan (2017) has introduced the method of developing the fingerprint-based voting system using Arduino to Sri Lanka. Fingerprint electronic voting systems use human biometrics in the system. The fingerprint is unique for individuals. It is important identity of the voter. Fingerprint-based voting systems have simple architecture. A proposed device useful to

handles reliable and accurate election. Vote counts are the most important part of the election. If there is an issue, it impacts all societies and country. If it is a wrong result, people attitude for the current government is unpleasant. For that reason, the counting process should behave to reliable, accurate, and transparent. People have to feel confident after the election. To avoid the illegal activities happen in the paper-based current voting method have to introduce the "One Person-One Vote" method, an electronic voting system. Then can avoid the vote's rejection, from the wrong details. First, have to authenticate the voter, and that name is not a name in the cemetery or obituary column. Secondly have to authenticate, that voter has not voted previously in another polling station.

The voter has to fill a form with username and password. And also the National Identity Card Number (NIC) and fingerprint have to give to the system. National Identity Card Number (NIC) and fingerprint unique to every individual. Government database saves voters all information district wise. Then the database checks these details are correct. If there are correct details voters can cast their vote. Using fingerprint and National Identity Card Number legitimate voters can cast vote. In this system ballot sheet represent on the video screen. Can get help screens clicking on a button. Basically, this system has five steps. They are fingerprint enrollment, fingerprint verification, cast votes, alert for wrong voting, and generate the final report. This is a very easy method for voting. This voting system helps to decrease the voting process time.

The advantages of the fingerprint-based voting system are, it is a very user-friendly system. It rejects invalid votes. It responds very quickly. It reduces the time of polling and also reduces the staff required for the election duties. It is easy to carry the system

to the polling station. This system provides an accurate and easy counting method without any doubts.

There is the introduction of an electronic voting system to replace the manual paper-based voting system in Indonesia. According to their experiment, this system will able to prevent fraud. It can be a double vote (duplication of the vote) or improper addition to some candidates. An electronic voting system can speed up the counting process. The system is able to handle many kinds of attacks like sniffing, replay attacks, and falsifying voting results. This system can ensure the privacy of the voter and integrity of voting data (Djanali, 2016).

They designed this proposed system to support the conventional method. They designed the system to scan and stored the ballot paper on the local server after the voting. They ensure the flexibility of voter application. Have to ensure voter privacy. Use private and public keys for encryption. This application design for scanning paper ballots, count them, and send them to upper levels. They designed to develop web-based to desktop-based applications. For that they using java and C# languages. And they used a web service for communication between servers.

They conduct functionality testing using this application. And they conduct the other four security testing. The first one is to change the votes that going to send. It means using forge votes to test the system. Proposed system designed to check the signature of cheating votes before storing it to the database. Used HTTPS for protection of the communication line. They used Wireshark to sniff the network. The third test is done for a replay attack. It means cast vote twice. So that system checking the ballot number to avoid this problem. If someone sends the same vote using several ballot numbers, the system rejects the crafted numbers. Forth test is using vulnerability assessment tools to

identify the flow of the system. Used SQL Map to checking SQL injections.

In there grants an overview of the biometric electronic voting system in Ghana. Many African countries introduced the electronic voting system for their national election. A manual paper-based voting system is the major source that encourages violence in many democratic countries such as Ghana (Yinyeh, 2013). E-voting system defines rules for valid voting and declaring results in inefficient ways. Biometric recognition through the system improves voter identification. This system avoids fraud. The biometric e-voting system is cheaper than the long term paper-based system.

The proposed system includes many processes. They are biometric registration of voter, registration of the candidate, voter verification, electronic voting, vote counting, and declaring final results.

In the phase of voter registration, registered eligible voters into the system using fingerprint. The fingerprint machine scanned the finger and stored it voter's table in the database.

- In the candidate registration step, the individual person and the political party that fulfills the requirements that eligible for election are registered to the system and that data stored in the candidate's table in the database.
- In voter verification, a fingerprint recognition operated system to identify the voter. There are five stages of verification. They are the data acquisition stage, image processing stage, fingerprint image enhancement stage, feature extraction stage, and matching stage.
- E-voting phase, it includes an electronic ballot sheet. The ballot sheet includes candidate name, passport size photograph, and logo of a political party. Can select candidate clicking or touching

candidate name, photograph, or logo of the political party.

- In vote counting and result declaration phase, calculate the percentage of vote cast and publish the vote count and positions that they determined as soon as polling station closed. The result page displays the name of the candidate, a photograph of the candidate, total vote count for each candidate, percentage of votes, and the position of each political party.
- Used Microsoft Visual Basic 2010 at the front end and SQL Server database at the back end. And used a fingerprint scanning machine.

### C. Other Biometric Voting Systems

Sedky (2015) has done an overview of some of the e-voting systems in the United Arab Emirates (UAE). UAE conducted Federal National Council election sessions of the National Assembly using voting systems with biometric-based smart cards. They used a biometric-based smart card for verification of voters' identities. Voters have to visit polling stations and cast their votes. Then they send votes manually to the Abu Dhabi site.

### Methodology

The basis of the voting system is "One Person-One Vote". The main purpose of this biometric electronic voting system is to increase the efficiency of the counting processes and preventing fraudulent voting.

There are 3 stages in this voting process. These are the basic steps that include in three-stage.

There are 3 stages in this voting process. These are the basic steps that include in three-stage.

#### 1. Pre-Voting Process:

- Registration of Candidates
- Registration of Political Party

- Create Ballot Sheet
- Registration of Voters
- Fingerprint Enrollment
- Adding Election Division and Grama Niladhari Division
- Scheduling the Election Period in System

2. Voting Process:

- Fingerprint Verification
- Issuing Ballot Sheet
- Casting the vote

3. Post-Voting Process:

- Generating Final Result Sheet and Summary Sheet
- Declaring the Results

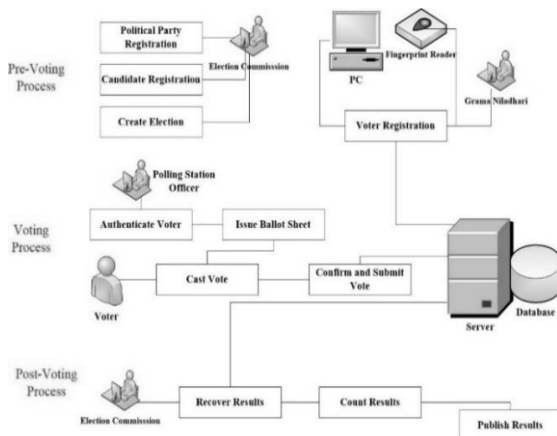


Figure 1: System Architecture

Source: Constructed by Researcher (2020)

**Registration of Candidates:** Election Commission nominated candidates will be registered to the system with name, NIC number, the image of the candidate, political party.

**Registration of Political Party:** Election Commission political parties will be registered to the system with political party name, political party leader name, and logo.

**Create a Ballot Sheet:** Election Commission will create the ballot sheet with candidate

names, political party names, and political party logos.

**Registration of Voters:** Grama Niladhari will be registered the candidates with name, date of birth, NIC number, gender, mobile number, Grama niladhari division, election division, and fingerprint. Scans the voter fingerprint using a fingerprint scanner machine. That data stored in the voter's table in the database. It will be used for verification on Election Day.

**Adding Election Division:** Election Commission will add election divisions to the system with the polling division number, polling division, electoral district, and electoral district number.

**Adding Grama Niladhari Division:** Election Commission will add with the grama sewa division number, grama sewa division, and election division to the system.

**Scheduling the Election:** Election Commission scheduling the election with election type, election date, election start time, and end time. After the end time of the election, automatically election will expire from the system. Under that reason, no one can vote after the election time from the system.

**Fingerprint Verification:** In Election Day, polling station officers verify the fingerprint of voter and issue the ballot sheet. The system will be checked about fraud voting. If there is any fraud voting, the system will block the system for that person and sends a message to the admin panel.

**Issuing the Ballot Sheet:** The polling station officer will issues the ballot sheet for the voter through the system after the verification of the voter.

**Casting the Vote:** Ballot sheet receives for voter after the verification. Voters have to click the vote button to cast the vote. If someone wants to cancel the vote, that person can verify the fingerprint. Doesn't

want to submit the ballot sheet. After the verifying fingerprint, no one can cheat using that person's fingerprint.

**Generating Result Sheet:** The result sheet will generate according to the count of the votes for each candidate. **Publishing Results:** Then Election Commission can publish the results.

Three categories have system access. Election Commission and Election Department, Grama Niladhari, and Polling Station Officer.

**Election Commission and Election Department:** Election Commission add the Grama Niladhari to the system by using the verification method. In the pre-voting process, they will be registered the candidates and political parties to the system and create the ballot sheet. Will add election divisions and grama niladhari division to the system. Then will schedule the election and add voters, candidates, and political parties to the election. The election will expire after the end of time. In the voting process, from time to time they can get a summary of the voting percentage. If there is an illegal vote, the system will block that votes. Then can identify fraud voters. In the post-voting process, can get a count of results and the system will generate the result sheet. The system will generate the count of the votes. Then they can publish the results. Result sheet publishes on web site.

**Grama Niladhari:** Grama Niladhari will add the polling station officers to the system using a verification security system. Grama Niladhari will be registering the eligible voters to the system. Among that can update the details of voters who dying and new voters to the system.

**Polling Station Officer:** Polling Station Officers verify the voters and issue the ballot sheets. If there is any person who trying to cast an illegal vote, polling station officers

can identify that person because of the system willing to block the illegal votes.

PHP, CSS, JavaScript, JQuery, and Bootstrap are technologies that will be used to implement the system. The fingerprint machine is the hardware component of the system. The fingerprint machine will store all data in the database.

### Data Analysis

Qualitative data analysis in this research. Collected information about the current voting system from the who participated in the election duty as SPO and chief accounting officer. Then interviewed employees who participate as a polling booth and counting officers. After that interviewed Grama Niladhari. SPO and chief counting officers were given details about all election procedures, rules, and regulations. What are the defectives in the current system and how to decrease these defectives within the system, what kind of actions can implement are they informed? Then collected information from voters using a questionnaire. A questionnaire distributed to several categories of people such as age group, financial status, education, and job status. The final result of that is 61.3% are not satisfied with the current system. 80.6% percentage agree for the newest system. That percentage said it is a suitable method for Sri Lanka and it is comfortable than the present system. And also they think the new system more efficient and reliable than the current system.

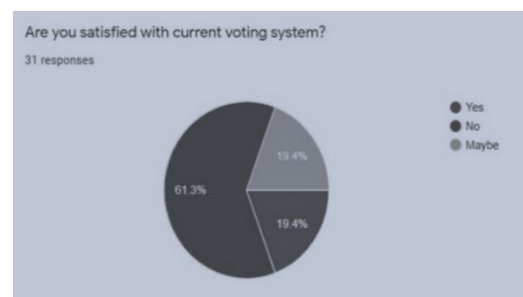


Figure 2: Feedback about current voting system  
Source: Constructed by Researcher (2020) in Google Form

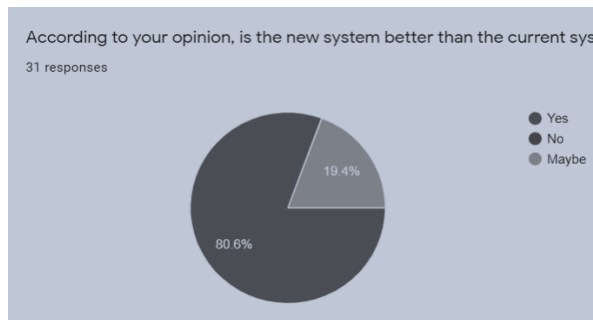


Figure 38: Feedback about Electronic Voting System  
Source: Constructed by Researcher (2020) in Google Form

## Results

The automated system is more efficient than the current system. Easy to register the voters, candidates, and political parties. The fingerprint is a more reliable technique for the voting process. The system will reduce the time and publish the results quickly. Accurate and reliable results generated by the system. The system rejects the all of illegal access and votes. After the voting period automatically system block the voting. This system provides many advantages to society.

Easy to analyze data from the output in the electronic voting system. All data will store in the database automatically. From that can filter the data very easily at any time. Can filter the data in any way. Using this system can identify the pattern of the votes easily. The comparison of the previous election results can get automatically. Quickly can get the comparison results of the elections. This system will give an efficient and secure output.

## Discussion

Biometric Electronic Voting System more efficient and secure than the manual paper-based system. Because it will reduce the counting time and biometric identifier act as a barrier to the illegal votes. It is the main advantage of this system. Votes will pass to the database and it will give the final count in quickly. The system will generate a summary of the result sheet and display it on the web site. This system introducing for the

presidential election. In a further development, can improve the system for all elections in Sri Lanka. As well as the ballot sheet can issue in Sinhala, English, and Tamil languages.

## References

- A. Piratheepan, S. S. (2017). Fingerprint Voting System Using Arduino. Middle-East Journal of Scientific Research 25 (8): 1793-1802, 2017 , 10.
- A. Piratheepan, S. S. (2017). Fingerprint Voting System Using Arduino. Middle-East Journal of Scientific Research 25 (8): 1793-1802, 2017 , 10.
- D. Ashok Kumar#1, T. U. (2011). A Novel design of Electronic Voting System Using Fingerprint . INTERNATIONAL JOURNAL OF INNOVATIVE TECHNOLOGY & CREATIVE ENGINEERING (ISSN:2045-8711) , 8.
- M.O Yinyeh, K. G. (2013). Overview of Biometric Electronic Voting System in Ghana . International Journal of Advanced Research in Computer Science and Software Engineering , 4.
- Mohammad Hosam Sedky, E. M. (2015). A Secure e-Government's e-Voting System. Science and Information Conference 2015, 9.
- Rudrappa B. Gujanatti, S. N. (2015). A Finger Print based Voting System . International Journal of Engineering Research & Technology (IJERT) , 6.
- Supeni Djanali, B. A. (2016). Design and Development of Voting Data Security for Electronic Voting (E-Voting). 2016 Fourth International Conference on Information and Communication Technologies (ICoICT), 4.
- Supeno Djanali, B. A. (2016). Design and Development of Voting Data Security for Electronic Voting (E-Voting). 2016 Fourth International Conference on Information and Communication Technologies (ICoICT), 4.

## Acknowledgement

Sincere gratitude to all the personals and institutions given me the required data for this research and gratitude for all lecturers given me the advice.



### Author Biographies



Urajie Punsarani  
Muthukumara is a student in  
Sir John Kotelawala Defence  
University, following BSc.

(Hons) Information System degree in this  
university.