Online Voting System (OVS)

G.P.D. Thilakshika

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A thesis submitted for the Degree of Master of Information Technology

G.P.D.Thilakshika
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Declaration

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge it does not contain any material published or written by another person, except as acknowledged in the text.

Student Name: G.P.D.Thilakshika

Registration Number: 2018/MIT/078

Index Number: 18550786

Signature: Date: 2021/11/27

This is to certify that this thesis is based on the work of Ms. G.P.D.Thilakshika under my supervision. The thesis has been prepared according to the format stipulated and is of acceptable standard.

Certified by:

Supervisor Name: Dr. Ajantha Atukorale

Signature: Date: 29/11/2021

Abstract

Online voting is a more convenient way for voting process which use less resources with compare to manual voting process. Access online voting system through internet is more convenient way for the most of the voters with rapid development of the technology. This may be good solution for increasing the voter turnout at polls. Even so the security is the most challenging aspect when consider about online voting.

This study is about a software solution for voting through the internet. This system provides a way to record election data, process data and store them as digital information. Both casting a vote and counting votes provide through this online voting system. Other than voting, this system also able to create and handle voter, political party and candidates details.

This project report is intended to include the first segment of the project which is the introduction of the problem, its significance, scope, and other important points such as purpose of the project and objectives of this study. Also first chapter state limitations of the project scope.

The second segment will contain the software problem analysis where a comprehensive literature review will be discussed. Functional and non-functional requirements also stare in this chapter.

Then next segment includes the system design where numerous notation details would be given as well as the representation of the various flowcharts, uses cases, dataflow diagrams and structure charts.

As the next segment, an overview on the project implementation will also be discussed. Testing and Evaluation is state as next segment. It provide detail description of test-cases and results achieved through the testing process.

Finally summarization of project work and achievement through entire work clearly defined as last section of the report.

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List of Acronyms

CSS - Cascading Style Sheets

E vote - Electronic Vote

GS - "Village officer (Sri Lankan public official appointed by the central government to carry out administrative duties in a Grama Niladhari division, which is a sub-unit of a divisional secretariat.)"

GN Division – "Grama Niladhari division. (Sub-unit of a divisional secretariat)"

GSM - "Global System for Mobile Communications"

HTML – "Hypertext Markup Language"

NIC - National Identification Number

OTP – "One Time Password"

OVS - Online Voting System

PHP- Hypertext Preprocessor

RIES - Rijnland Internet Election System

SMS- Short Message Service

Chapter 1 - Introduction

1.1 Overview

Most of the countries use their governing system of democracy. Main activity in democracy is select the representative through electoral process. Most of the countries use paper ballots until now. But with the rapid development of technology most of the services provide through internet. So these voting procedures should also change accordingly. Money transactions and many more critical services handled using internet. Therefore voting via internet can be considered also. The internet voting may be next revolution in our life.

This study is about a software solution for voting through the internet. This system provide a way to record election data, process data and store them as digital information. Both casting a vote and counting votes provides through this online voting system. Online voting may become quickest, cheapest and most efficient way to held elections and count votes, since it only consist of simple process and require a few worker with in the process. This online voting system is accessible to every eligible voter with simple user friendly interfaces.

1.2 Motivation

When consider percentage of voting last few years, it clearly shows vote casting is limited to nearly 75%.That shows 25% voters do not cast their vote. The one of a main purpose of this study is increase the voting percentage though out the country. Here we need to consider all aspects that make voting percentage decrease. People who are outside their city do not wish to come to their city just for voting because of expenses and transportation problems. Some people who works in different cities may not be able attend the voting although they wish to attend. Some people who are on duty during the election they may not get the chance to attend for voting. Peoples with disabilities also may not attend for voting. Disable people cannot access to polling booths easily, but they can easily access online voting system through internet from anywhere. And also by using online voting system voters can vote their own free time within given time period without worrying polling centers. This system will lead to increase the participation to election voting with use of internet.

Another main purpose of this study is reduce expenditure for election. For every election government has to spend huge amount of money. During the election government has to hire lot of staff for election duties such as security, vote counting and so on. The government has to spend considerable amount of money for printing paper ballots. But the online voting system will able to reduce expenditure by reducing staff members. The

printing cost of ballot sheets also eliminated though this online voting system. Voting via internet is also decrease the manual work load.

Speed up the counting process and release result quickly is another main target of this study. Manual voting process is time consuming and it takes more than 12 hours to release results. In Online voting, counting is done by system itself. When a voter cast his/her vote, system increments vote count automatically. Then the system can published final result as soon as election time period over.

This study also address the counting errors. In manual voting process counting is done by humans. It may lead to counting errors. But in this online system there is no room for errors in vote counting.

Another purpose of this online voting system is reduction of cheating on elections. There are many people who registered more than one area to cast their votes multiple times. By using online voting system, it is possible to eliminate those kind of situations.

After considering those factors carrying out voting through internet will be the best way for the voting process in the future. This study address each and every aspect of above mentioned problems.

1.3   Statement of the problem

In democracy, representatives are choose by electoral process. These representatives are the ones who operates the country behalf of public. Because of that the voting results need to calculate accurately.

Our history shows that the manual voting process had a problem with security. Other than that there are other problems with the manual voting process.

- Speed - Hand counting votes are time consuming.
- Access – Disable people cannot easily reach for polling booths.
- Transparent – Can easily manipulate election results.
- Cost – Different type of expenses throughout manual voting process such as voter registering cost, vote counting cost and so on.

When considering all over the world, lots of e- voting systems have been using now. But political electoral systems rarely used because of several issues. Most of the countries still use manual voting process because of lack of technology resources and resource persons. Sri Lanka still uses manual voting process. Online voting systems are available for download from web sites freely (phppoint, 2017). But these online systems cannot use in our country. Because system should be unique and well planned proper system for all Sri Lankan voters

1.4 <u>Objectives</u>

The main objective of this study is providing a better voting mechanism for people to cast their vote using the internet.

The electoral of Sri Lanka still remains as manual. The manual electoral process carry out different problems. Online voting system is mainly design as an effective solution to overcome problems arises in manual voting process. This online voting (e-voting) system suggest to provide electronic way of choosing representatives via web application.

This system is design to improve the current voting process in the following ways.
- In manual voting system, voters have to attend their polling centers in person. By using this online voting system people can cast their votes through online without attending any polling booth to cast their votes.
- Although manual process counting is done by humans online voting system calculates vote count through system.
- Online voting speed the counting process while manual counting is time consuming.
- Online voting system reduce election cost by considerable amount.
- Online voting system provide security that makes more difficult to commit cheating during the election

1.5 <u>Scope of the study</u>

The online voting system is a web based system that provides an electronic way to vote casting.

Main features of this program can be listed as follows.

- An administrative dashboard (Admin Login)
- An election officer dashboard (Election officer Login)
- An Grama Niladhari(GS) dashboard (GS Login)
- Register voters
- Registered voter login
- Update/Delete Voters
- Register Political Party
- Update/Delete Political Party
- Register Candidate
- Update/Delete Candidate
- Voting process
- Check/Display Results

- Generate Reports

Limitations of this study are listed below.

- The scope of the system is limited to the presidential election. This system not covers parliament and other elections.
- English is the target language of e-voting system at initial development.
- Providing login password via SMS consider as secure as initial development. Although it is needed to use multi factor authentication. Those mechanisms will not handle in this study.

1.6 Feasibility Study

1.6.1 Financial Feasibility

When designing web application, it is needed to consider web hosting cost. Since the system should access the voters in given period of time (may be within 8 hours 21 million population, the system required high bandwidth for the operations of the application. This system is critical system so the cost for security and maintenance will be high. At the initial stage the system build only for presidential election and the system further developed for other elections.

Besides associated cost there will be many benefits for all citizens of our country. Because using this system, election cost can be reduced greatly. So it is clear that this online voting system financially feasible.

1.6.2 Technical Feasibility

While developing this online voting system, it is needed to consider technical aspect. Some of the technical tools and technologies are listed below.

- PHP
- My Sql
- HTML
- CSS
- Bootstrap
- Net Beans IDE
- SMS gateway
- Diagram drawing tools
- Reporting Tools

Most of the tools and technologies mentioned above are freely available. Initially this web application runs on the local host. So it is clear that this online voting system technically feasible.

1.6.3   Resources Feasibility

The most important aspect of feasibility study is, consider the resources that needed while developing the software product. Main resources needed for this system developments are listed as follows.

- Programming device (Laptop or desktop)
- SMS Gateway
- Programming tools (freely available)

1.6.4   Risk Feasibility

It is necessary to identify all the requirements in the early stages. The requirements change only if new functions added to the system. The system designed for all voters so this system design while maintaining low complexity. Usability highly improved by help documents and making GUI easy to use.

1.7   Structure of the dissertation

This dissertation consists of the following sections. Section 2 is about system requirement analysis and review of similar systems. Section 3 provide design of the online voting system by using database table structures, structure charts and important pseudo codes. Section 4 give a critical evaluation of the system. Finally conclude in section 5 indicating a summary of the results of the project.

Chapter 2 - Background

2.1 Introduction

Traditional voting needs to follow different steps for preparing the elections, such as setting a list of candidates, print ballot sheets, provide a better way to check voter identification, provide a secret way to vote casting and so on. It is necessary to include these features when developing the online voting system.

This chapter discussed about existing voting system and technologies of those systems. An analysis of requirements of the system also discusses.

2.2 Review of Similar Systems

This section is discusses about similar electronic voting mechanism use to vote casting. Some of the electronic voting systems and their features are listed below.

2.2.1 Voting via ballot sheets

"Paper based electronic voting systems" are voting systems that provide an electronic procedure to count votes. The voters cast their votes through ballot sheets. The vote counting is done through an electronic device. This mechanism reduces the counting mistakes. These systems use optical scanning systems. (Antonyan, 2010)

2.2.2 Electronic Vote Casting Systems

There are different type of electronic vote casting systems. Some electronic voting systems locate inside of the polling site. Some electronic vote casting is done using the internet. The voters are cast their votes from a remote location by using electronic devices such as mobile phone and tablets. Some of the systems using above mentioned mechanism described below.

2.2.2.1 "Direct-Recording Electronic Voting System"

A more recent invention used for election is called direct-recording electronic voting system (DRE). The DRE voting system is a computer screen to display ballot sheet with push button or touch screen. The machine processes data with computer

software and records voting data and ballot images in memory component. This machine not only used for casting votes it also used to get print a ballot for tallying if other electronic tabulation techniques like optical scanning is used. (Fischer, 2007)

2.2.2.2 "Public Network DRE Voting System"

As explained, a DRE voting system is an electronic system which records votes directly into the memory storage. A public network DRE voting can use a DRE machine at the polling station for casting of the vote, but after the vote is cast the system will transmit the voting data from polling place to another location over a public network. The vote data may be transmitted as individual ballots or as a batch after the casting period over. (Nwogu, 2016)

2.2.2.3 "Remote Voting"

Here the vote casting is done using a computer which is connected to the internet. After casting vote, the voting details are transmitted to the remote database through internet. These systems allow the voter to log in to the system by providing a secure PIN or any other secure method. After logging to the system, voter is able to cast their votes. The votes will be sent to the remote database. (Krimmer & Volkamer, 2014)

Another remote voting method is vote casting though GSM network. The voting is done using SMS. These methods can be considered as growing areas under remote voting.

2.3 Comparison between online voting system and similar systems

Voting System	Characteristics
Direct-Recording Electronic Voting System	• Voting via electronic ballot sheet. • Need to visit voting site for vote. • Print each ballot for tallying. • Vote count using optical scanner.
Public Network DRE Voting System	• Voting via electronic ballot sheet. • Need to visit voting site for vote. • Transmit the voting data from polling place to another location over a public network. • Vote count using optical scanner.

Remote Voting	• Voting details are transmitted to the remote database through internet. • Voters need to provide PIN to login to the system.
Online Voting System (OVS)	• Voting via electronic ballot sheet. • No need to visit voting site for vote. • Voters need to provide PIN to login to the system. • Voting details are transmitted to the remote database through internet. • Real time update vote count.

Table 2. 1 Comparison characteristics of similar systems

2.4 Existing E-Voting Systems

2.4.1 E-voting in Brazil

In Brazil, e-voting done by using voting machines which placed in different locations. This voting machines help to voter identification and secure voting. For cast their vote people have to go to a voting machine. There need to locate plenty of voting machines all over the country. This leads to spending huge amounts of money for voting machines. (Goldsmith & Ruthrauff, 2013)

By using this system, voters can cast their votes from any location. It will lead to reduce cost and time. It will also increase the voting percentage.

2.4.2 Electronic voting systems in Belgium

In 1991 Belgium tested two types of electronic voting systems. One is based on touch panels and other is electronic ballot sheets which are marked by using a light pen. For these e-voting mechanisms they have to spend a considerable amount of expenditure.

After that they use OMR technology to mark ballot sheets. It becomes successful and give no problems. Although this method successful, it only address vote counting.

In 2003, they introduce another electronic voting mechanism. Here votes can cast their votes through the electronic voting system. The system includes a printer

which will provide a receipt. Voter need to approve paper receipt and put the receipt into the box. After the election is over, all paper votes' count and compare with the electronic vote count. This method shows accuracy of vote count. But this method leads to considerable amount of money for an election. (Cock, 2010)

But using this online voting system which cast vote through internet, it can reduced the cost considerable amount. Because there is no need to spend money for voting machines and other equipment.

2.4.3   Electronic voting in Estonia

Estonia become the first nation to hold legally binding general election over the internet. Estonian ID card is a regular and mandatory smart card which has secure remote authentication and legally binding digital signature.

Voter can change their electronic vote unlimited number of times. It also possible to vote through internet or polling stations.

Estonia develop their e-voting system by implementing verification of the vote for any individual voter. Smartphone application use to scan QR code from desktop screen to displays the name and number of the candidate the vote was cast. There are individual verification stored for the voter to verify that the vote cast was stored on vote collecting server. But there is no direct way to verify that the vote was also tallied as cast.

2.4.4   Electronic voting systems in USA

Electronic voting in the United States involves several types of machines such as touch screens for voters to mark choices, scanners to read paper ballots, scanners to verify signatures of non-voted ballots, and web servers to display tallies to the public. Apart from that, there are also computer systems to maintain voter registration.

In an optical scan voting system each voter's choices are marked on pieces of paper, which then go through a scanner. The scanner creates an electronic image of each ballot, interprets it, creates a tally for each candidate, and usually stores the image for later review (Herrnson, et al., 2008)

2.4.5   Summary of existing e-voting systems

Similar System/Country	Methodology/Features	Strength of Method	Limitation
E-voting in Venezuela (NDI, 2013)	Touch screen direct recording use which produce a paper receipt. Biometric authentication devices used.	Voters can compare paper receipt match the selection they had made	Voters have to go for location where voting machine installed
E-voting in the UAE (UAE mGovernment, 2020)	To verify voters' identity ,use biometric technology based smart cards	accuracy of identification	Complexity
Electronic voting in Switzerland (Gerlach & Gasser, 2009)	Voting over internet.	Reducing process costs, Increasing participation, Increasing efficiency	Complexity and missing transparency. High investment costs
Philippine general election, 2019 Technology (Wikimedia Foundation, 2021)	Automated election system	High rate of accuracy	Security issue
Rijnland Internet Election System (RIES) (Gonggrijp, et al., n.d.)	Voting over internet	Handling a million votes or more	Security issue
"Voter - verified paper audit trail (VVPAT) system in India" (Bhuyan, 2019)	Votes via e-system vote receipt also produce.	Confidence in the voting results	High cost

Table 2. 2 : Summary of existing e-voting systems

2.5   Requirement Analysis

Prior to online voting system design, it is need to analyze system requirements. Requirement analysis is the process of identify expectation from new software being built. Requirement analysis critical to the success or failure of the system. Identifying functional and nonfunctional requirements are necessary to produce successful system.

2.5.1   Functional Requirements

Identifying functional requirements and design and develop the system to achieve these requirements are very important. Some of the functional requirements need to achieve through the system shows below.

- **An administrative dashboard (Admin Login)** - Admin can login to the system and provide different user levels. Admin can monitor voting process through the dashboard.

- **Register voters –** By using this feature new voter can register to the system. After Successful registration username and password send to the registered users via SMS.

- **Registered voter login** – Registered voters can log in to the system by providing username and password. Registered users can view details and registered users can update basic information like phone number. Changing other critical details done by election department. Registers voters can request for make changes.

- **Update/Delete Voters –** Update and delete information done by election department or GS according to user requests.

- **Register Candidate-** Candidate can register with the system by providing required details.

- **Voting process** – Voter log in to system by providing NIC and password. (Password is providing by election department by sending SMS to registered phone number). After log in to system voter can vote to desired party through simple interface.

- **Check Results -** Any person can view result through result display interface.

- **Generate Reports –** Generate different types of reports (vote count district vise and provincial vise, Vote count of each candidate)

2.5.2   Non-Functional Requirements

These are basic requirements any online voting system must satisfy.

- **Scalability** – The system must able to expand for future requirements.
- **Flexibility** – The system should cope with other technologies without any hesitation.
- **Mobility** – Ability of the system to provide a way to cast their votes without any restriction of the location.
- **Democracy** – Any voter cannot vote more than one time.
- **Security** – Votes should not be manipulated during the voting process.

2.6   Related Design Strategies

When developing the online voting system it should consider different design strategies and need to carefully select the best design strategy for implementation.

There are many open source software projects which are similar to this online voting system, is freely available on the internet. Other than that many source codes also available in web. The system should unique to Si Lankan society and people. Therefore this system needs to address all aspects relevant to Sri Lankan manual voting system. Develop a system from scratch makes the system more secure.

While developing the system, it is need to consider the hardware environment. If the system developed as standalone application it may be secure but the cost will be increased by considerable amount. Because it need to set up standalone application on each and every personal computer at all the polling booths in all over the country. There's no need to set up personal computers or pooling booths in online voting. In online voting, voter needs to consider only about stable internet connection. With the growing of internet coverage the internet voting is cheaper than other voting methods.

In online voting it is need to consider servers. Because servers able to handle all the request of voters. Otherwise system becomes fails.

Linux environment more secure if the e voting system developed as standalone application. But the software solution is target for online voting it will not depends on system software. It can access through any device as long as good internet facility provided.

To achieve good design strategy it is need to consider cost, security, accuracy, performance and so on. Internet voting is the best way to achieve cost effectiveness. Because government no need to hire huge election duty staff and no need to print ballot sheets. It will lead to reduce electoral expenses with considerable amount. But in online voting, it is need to consider all the security threats. Public trustworthiness very important to the voting system.

This web based online voting system will provide vote casting at any place at any time. So the vote casting percentage will be eventually increasing with the system. When consider above facts, voting system design as web based solution will be the best choice.

Chapter 3 - Design

3.1   Introduction

Online voting system is designed for Sri Lankan voters. This system needs to address all aspects relevant to Sri Lankan manual voting process. Design a system from scratch makes the system more convenient and secure.

The online voting system is basically design for voting over internet using electronic ballots. Online voting system includes preparations before the poll, the actual voting process, counting of votes and provide results after closed the poll.

3.2   System Architecture

This study is mainly focused to develop a voting system which can access from any location at any time through the internet.
 This application designed as a web application. Any eligible voter who is connected to the internet can access this system by providing user name and password. All the voter details will store in a central database. The basic architectural diagram of the system is shown in Figure.3.1.
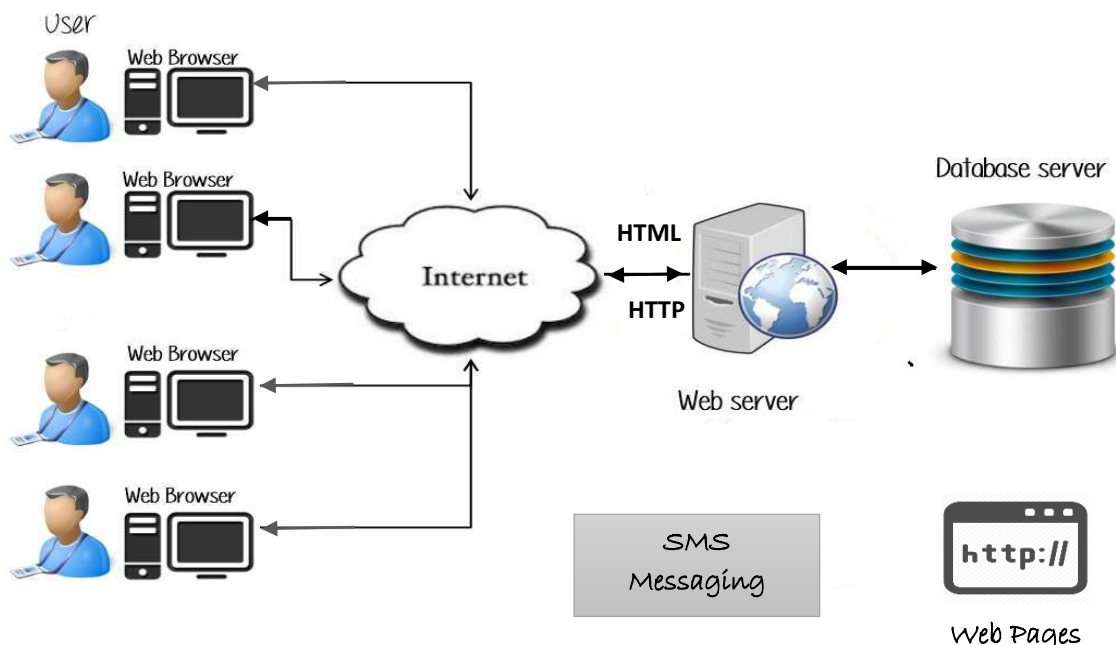

Figure 3. 1 System Architectural Diagram

3.3   System Design

The system design will show the overall architecture of the system. The following block diagram indicates basic components and their interaction among the components. Each component capable of providing one or more functionalities.
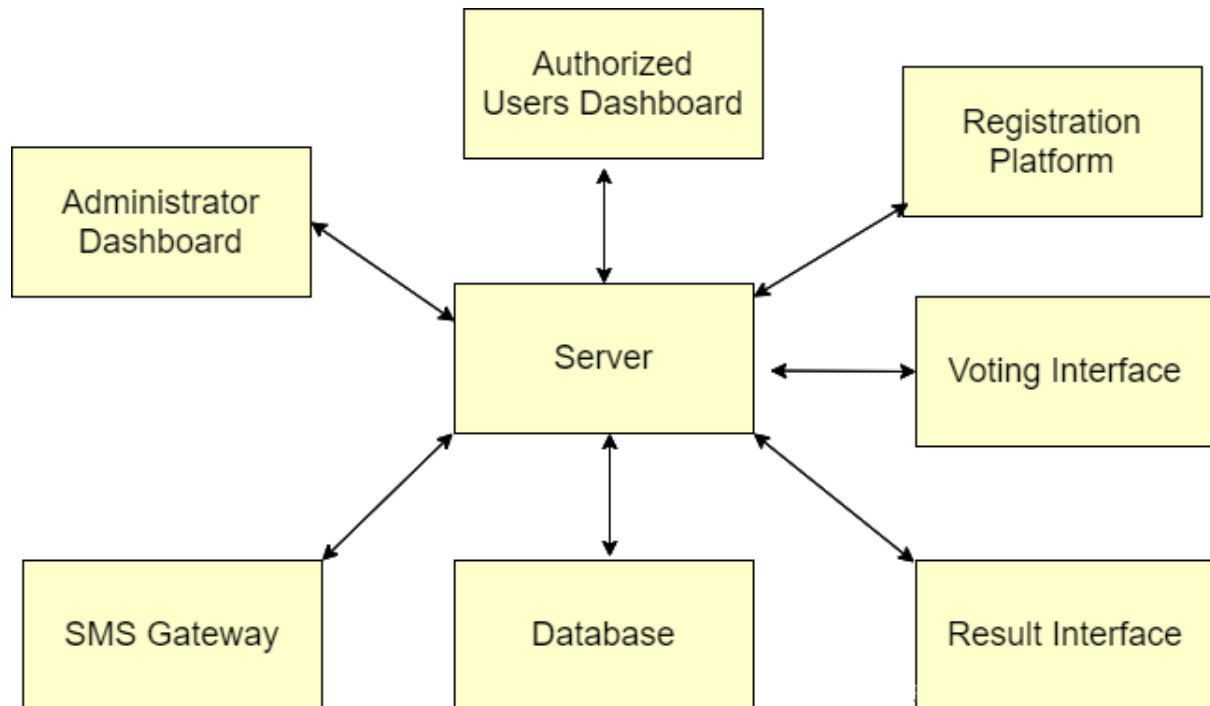
Figure 3. 2   Block Diagram for Software Interaction

<u>**Administrator Dashboard**</u>

The administrator dashboard is software application that manage entire system functions. It provides basic CURD (Create, Update, Read and Delete) operations for monitoring and managing voters, system users and administrators. It also manage the voting process. The administration dashboard provides login page to restrict unauthorized access to the dashboard. The flowchart for administration dashboard is shown below.

The admin user need to login to the system by providing required details. If details are correct admin panel will open for the admin user. User can perform administration tasks like provide user levels, manage voting process and generate reports.

Figure 3. 3   Flowchart for Administration Dashboard

Registration Platform

This is where the voters, candidates or political parties registered prior to an election.

The voter can register with the system by providing the necessary details. The voters request will be sent to the GS dashboard of voters Grama Niladhari division. The GS needs to accept the voter's registration request to complete regis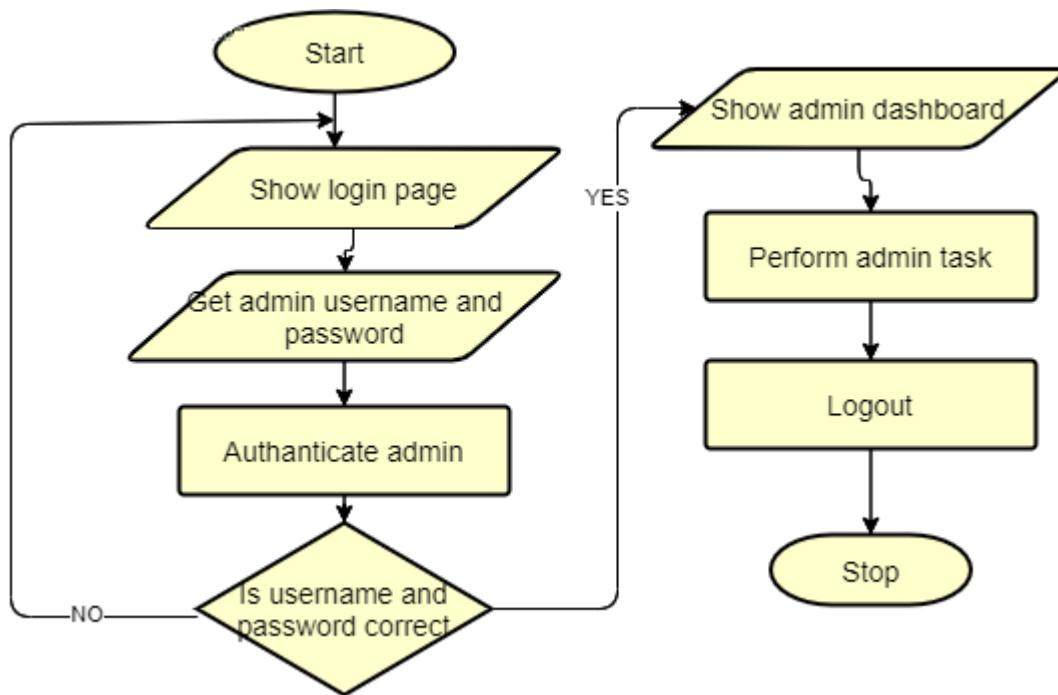tration. After registration completed, username and auto generated password sent to the voter's registered mobile number. A voter should use this username and password to login to the online voting system. The voter also need to use this username and password to voting for election. If a voter needs to change any information he/she needs to request for change with valid evidence.

Candidates and political parties also need to register with the system.

Voting Interface

The voter can log in to the election portal by providing username and password. Authenticated user who login to the system can view the ballot sheet. After login, a voter can cast their votes by selecting relevant political party and submit the ballot sheet. Voter get a SMS message to their mobile number after completing their vote casting successfully. Flowchart for voting process is shown below.
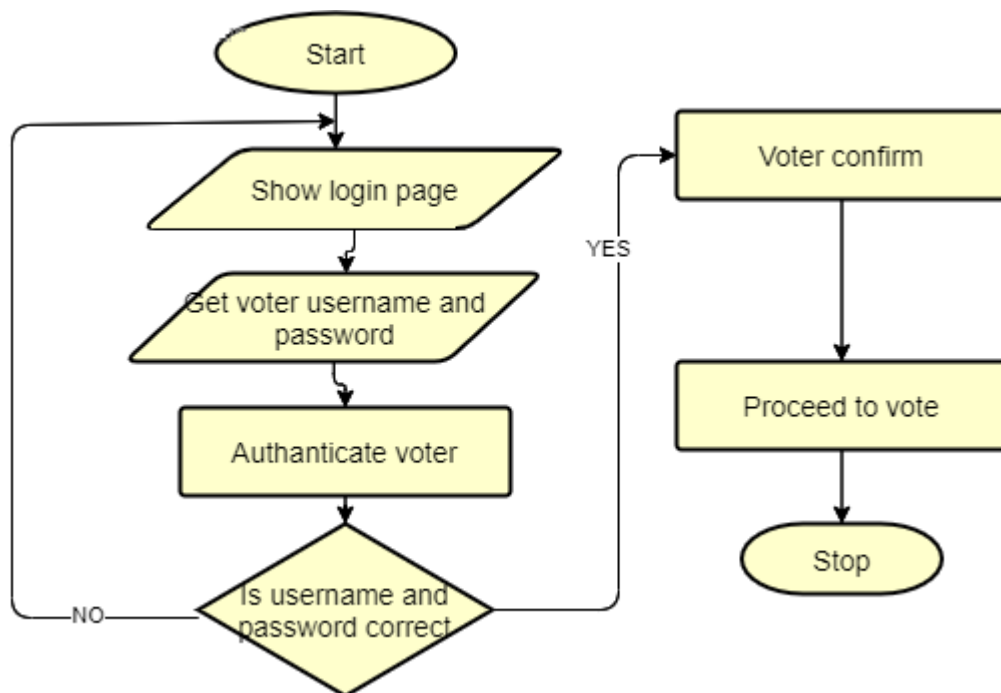
Figure 3. 4 Flowchart for Voting Process

Tallying Phrase

Vote counting is done by automatically. The vote count can view, while voting on process. The public can view number of votes acquired for each party Result can view anyone using a web application. Administrators and authorized system users of election commission are responsible to generate necessary reports.
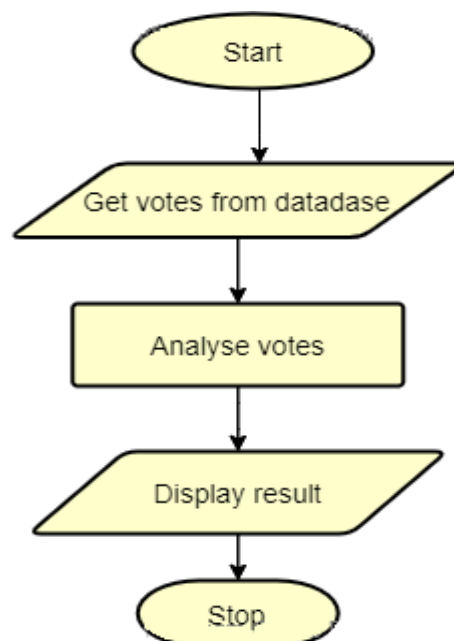
Figure 3. 5   Flowchart for Tallying

Database

The design of the database is one of a main activity of a software development process. The relational model database design of the online voting system shows below.
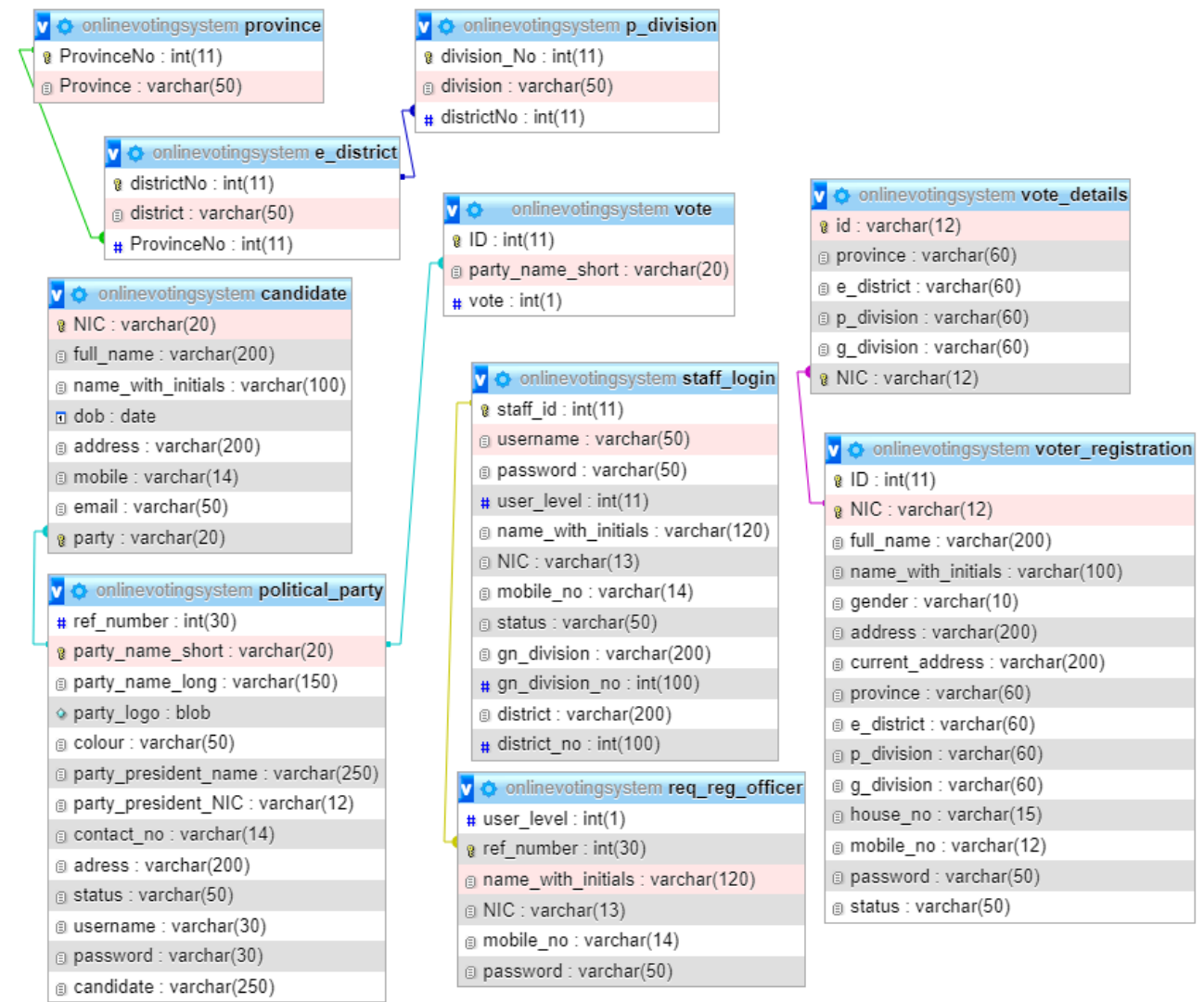
Figure 3. 6 Database Design

3.3.1   <u>**Data Flow Diagram (DFD)**</u>

The information flow throughout the system can view via DFD. (Bangerter, 2010) This DFD specify the software and people involved in the information flow. Voter, political party, candidate and admin are external entities to the system. System has main processes and some are divided in to sub processes.

Admin is an entity who responsible for many processes of the system. Admin responsible for managing voters, handling voting process, generate reports and publish election results. Registering voter is done by admin. Manage voter has three sub processes which are add voter, update voter and delete voter.

After candidate is register with the system, manage candidate is take place. Manage candidate is decompose in to three sub processes. Those are add candidate, update candidate and delete candidate. All the information store and retrieve from the central database throughout system processes.

Figure 3. 7   Data Flow Diagram for Online Voting System

3.3.2 Use case Diagram

The actions are performed by the different users can view through the use case diagram. Following use case diagram represent the functionalities of the online voting system. System mainly deal with four actors' names voter, admin, and candidate and system user. Each actor interacted with one or more use cases.

Voter can perform four action through system which are view registered details, request for update details, vote for candidate and view election results. To perform each action voter must to log in to the system.

Candidate is another important actor of the system. Candidate need to register with the system to perform other actions like view registered details and request for update details.

System user is another actor who deals with the system. System user need to log in to the system to perform any action. Voter registration, update/delete voter details, approve candidate registration and update/delete candidate are actions perform by the system user.

Admin is an actor who can perform all the system user actions. Other than those actions manage voting process, provide user levels and manage full application is up to admin user.
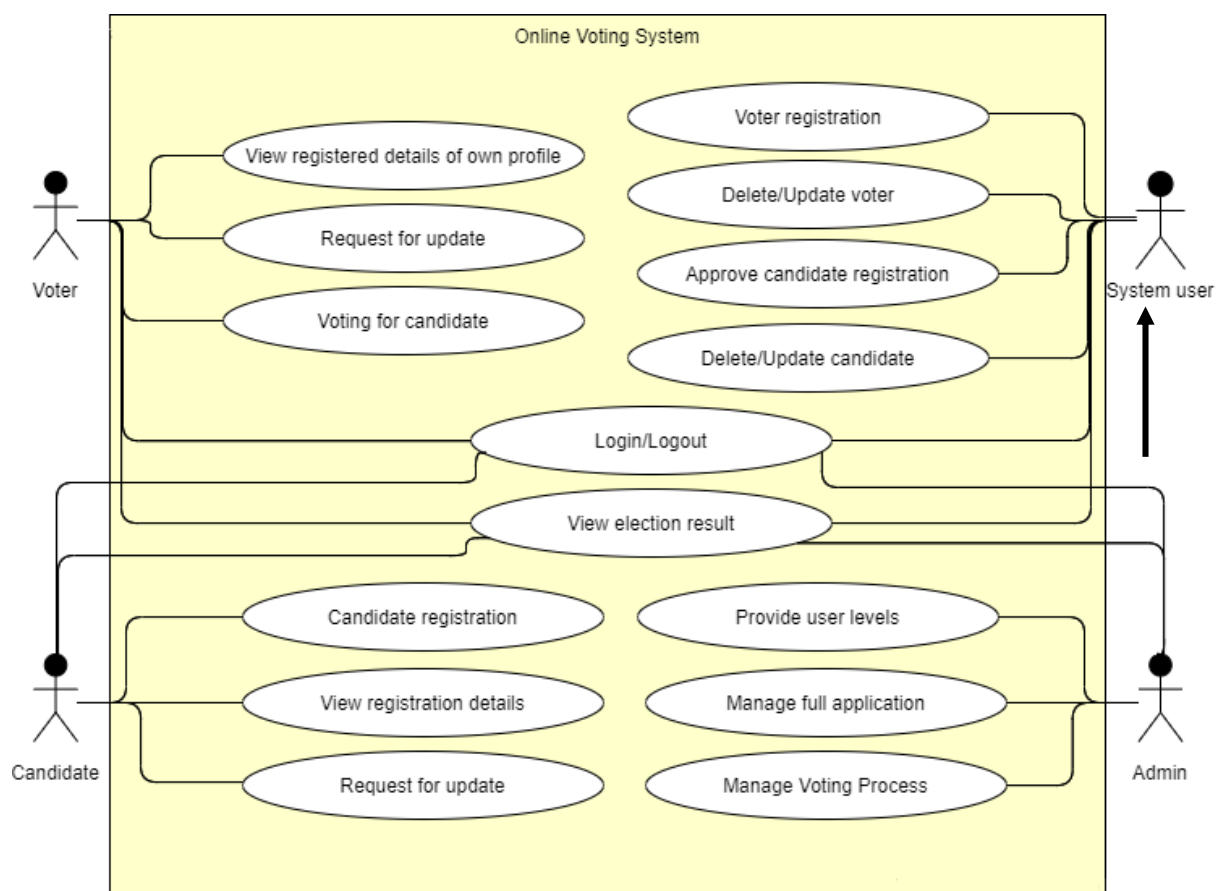
Figure 3. 8   Use Case Diagram for Online Voting System

3.3.3   Use Cases Scenario

Table 3. 1   Request for register the voter

Use case name: Request for register the voter	ID:1
Primary actor: Voter	**Priority :** medium
Brief Description: To register with the system voter need to send registration request by providing necessary information.	
Pre-Conditions: None	

Basic Flow:
1. Voter need to access to the voter registration portal of the system
2. Voter clicks the "Registration" button
3. The system prompts the voter registration user interface.
4. Voter fills the necessary information
5. Voter submit the registration request by click on submit button.
6. If request correctly placed to the system user
    a. It prints successful message.
    b. Registration request details save into the database
    c. Send SMS to voter's mobile no with the reference number of the request.
7. Otherwise
    a. It prints appropriate error message	

Table 3. 2   Request for Update Critical Voter Details

Use case name: Request for Update Critical Voter Details	ID:2
Primary actor: Voter	**Priority :** medium
Brief Description: Voter should edit requited field to update and make request for update.	
Pre-Conditions: Registered voter should login to the online voting system	
Basic Flow: 1. Voter need to login to the voting system 2. Voter clicks the "Change details" button 3. The system prompts the details of relevant voter 4. Voter clicks on edit button 5. Voter edit the necessary information 6. Voter submit the request by click on Submit button.	

Table 3. 3 Update of Voter Details

Use case name: Update of Voter Details		ID:3
Primary actor: System User	Priority : high	
Brief Description: System should update necessary voter details.		
Pre-Conditions: System user should log in to the online voting system. System user should get update request from voter.		

Basic Flow:
   1. System user login to the voting system.
   2. Search for the voter that need to update.
   3. Check the relevant voter details is correct
   4. Click on update button		

Table 3. 4 Delete Voter

Use case name: Delete Voter		ID:4
Primary actor: System User	Priority : high	
Brief Description: System should delete unnecessary voter details.		
Pre-Conditions: System user should log in to the online voting system.		

Basic Flow:
   1. System user log in to the voting system.
   2. Check the voter that need to delete.
   3. Select the relevant voter
   4. Click on delete button		

Table 3. 5 Political Party Registration

Use case name: Political Party Registration	ID:5
Primary actor: Secretory of the political party	**Priority :** medium
Brief Description: In order to name a candidate, political party needs to register.	
Pre-Conditions: None	

Basic Flow:
   1. Political Party access to the home page of the system
   2. Clicks on "Political Party Registration Button"
   3. The voting system will prompts the political party registration user interface
   4. Secretory of the political party fills required political party information
   5. Submit the request by click on Submit button
   6. If request correctly placed to the system user
      a. It prints successful message.
      b. Registration request details save into the database
      c. Send SMS to registered mobile no with the reference number of the request.
   7. Otherwise
      b. It display error message	

Table 3. 6 Approve Political Party

Use case name: Approve Political Party	ID:6
Primary actor: System user	**Priority :** high
Brief Description: This describes how system user approve political party application and generate new account	
Pre-Conditions: Political party should submit application System user log in to system	

Basic Flow:
   1. System user select the request of the political party
   2. System user checks the request of the political party
   3. If the information is correct,
      a) Approve the form by pressing "Approve" button
      b) System user generate new user account to the political party
      c) Account username and password send to the registered phone number
   4. If given information incorrect,
      a) System user inform about misinformation via registered phone number	

Table 3. 7 Candidate Registration

Use case name: Candidate Registration	ID:7
Primary actor: Candidate	**Priority :** high
Brief Description: In order to become candidate user must register with the system	
Pre-Conditions: Candidate's political party must register with the system.	

Basic Flow:
    1. Candidate access to the home page of the system
    2. Candidate clicks on "Candidate Registration Button"
    3. Candidate need to login to the voting system as a member of the political party by providing political party username and password
    4. The system will prompts the candidate registration user interface
    5. Fills the appropriate candidate information
    6. Save candidate details
        c. If information correctly entered the system display successful message.
        d. Otherwise, system display error message	

Table 3. 8 View/Update Political Party Registration Details

Use case name: View/Update Political Party Registration Details	ID:8
Primary actor: Political Party	**Priority :** medium
Brief Description: Political party should edit required field to update and make request for update.	
Pre-Conditions: Registered political party should log in to the system	

Basic Flow:
    1. Political party log in to the voting system
    2. Clicks the "View Party Details" button
    3. The system prompts the details of relevant party
    4. Political party clicks on edit button
    5. Political party edit the necessary information
    6. Political party submit the request by click on Submit button.	

Table 3. 9 Update Candidate Details

Use case name: Update Candidate Details		ID:9
Primary actor: Political party secretory	**Priority :** medium	
Brief Description: System should update necessary candidate details.		
Pre-Conditions: Political party secretory should log in to the system.		

Basic Flow:
   1. Political party secretory log in to the voting system.
   2. Click the "Change candidate"
   3. Update candidate details
   4. Click on update button		

Table 3. 10 Delete Candidate

Use case name: Delete Candidate		ID:10
Primary actor: Political party secretory	**Priority :** high	
Brief Description: System should delete candidate details.		
Pre-Conditions: Political party secretory should log in to the system.		

Basic Flow:
   1. Political party secretory log in to the voting system.
   2. Click the "Delete candidate"		

Table 3. 11   Log in/Log out

Use case name: Log in/Log out	ID:11
Primary actor: System User/Candidate/Voter	Priority : high
Brief Description: This describes how system user/candidate and voter login and logout	
Pre-Conditions: The user opens login page. User should enter username and password	

Basic Flow:
    1. The voting system user enter username and password to login interface
        (1) If username and password valid, user redirect to relevant page
        (2) If username or password not valid, user redirect to login page again with an error message
    2. The voting system user clicks on log out button
      i) User logout from system and redirect to the home page.	

Table 3. 12   Vote Online

Use case name: Vote online	ID:12
Primary actor: Voter	Priority : high
Brief Description: This explains the voting process	
Pre-Conditions: Voter should log in to the online voting system.	

Basic Flow:
    1. Voter log in to the voting portal
    2. Voter clicks the "Vote Now" button
    3. Voter should provide username and password to the textbox
    a) If Voting operation verified
      (i)   System prompt ballot sheet
      (ii)   Voter select the political party/candidate
      (iii) Voter should click on submit button
      (iv) Success message display and send success message send to voters registered mobile number.
      (v) Voter redirect to the home page
    b) If Voting operation is not verified,
      (i) Online voting system displays an error message.	

Table 3. 13   View Election Results

Use case name: View Election Results		ID:13
Primary actor: General Public(Admin,Voter,System User, Candidate)	**Priority :** high	
Brief Description: Public or other system users view election results		
Pre-Conditions:		

Basic Flow:
 	
1. Users access to the home page of the system
    a) If user is general public(Voter/Candidate)
        (i)   User clicks on e-data button on the home page
    b) If user is admin
        (i) Admin login to the voting system.
        (ii) click the "Reports" Button
        (iii) Select the required report to view
        (iv) The voting system shows the relevant report with result		

Table 3. 14   Provide User Levels

Use case name: Provide user levels		ID:14
Primary actor: Admin	**Priority :** high	
Brief Description: This describes the how admin provides different user levels		
Pre-Conditions: Administrator should log in to the online voting system.		

Basic Flow:
   1. Admin login to the voting system.
   2. Add different user levels
   3. Send user id and passwords to system user		

Table 3. 15 System User Registration

Use case name: System User Registration		ID:15
Primary actor: System user(GS/District Officer)		Priority : medium
Brief Description: In order to access the online voting system users needs to register with the system according to different user level.		
Pre-Conditions: None		

Basic Flow:
    8. System user access to the home page of the system
    9. Clicks on "Registration Button" on officer's portal.
   10. The voting system will prompts the system user registration user interface according to the user level.
   11. System user fills required information
   12. Submit the request by click on Submit button
   13. If request correctly placed to the admin
        a. It prints successful message.
        b. Registration request details save into the database
        c. Send SMS to registered mobile no with the reference number of the request.
   14. Otherwise
        e. It display error message		

Table 3. 16 Approve System User

Use case name: Approve System User		ID:16
Primary actor: Admin		Priority : high
Brief Description: This describes how system user approve system user application and generate new account		
Pre-Conditions: System user should submit application Admin log in to system		

Basic Flow:
   1. Admin select the request of the System user
   2. Admin checks the request of the System user
   3. If the information is correct,
        d) Approve the form by pressing "Approve" button
        e) Admin generate new user account to the System user
        f) Account username and password send to the registered phone number
   4. If given information incorrect,
        b) Admin user inform about misinformation via registered phone number		

3.3.4 Sequence Diagrams

3.3.4.1 Sequence Diagram for Administrator Dashboard

Sequence diagrams shows interaction among various parts of the system. (Athuraliya, 2013). In a sequence diagram, messages between actor and user interface indicate the action taken by the user. The following diagram outlines the sequential order of the interaction in the online voting system admin dashboard with actor who is admin.

First admin must insert 'login details' to Log in interface. Login interface communicate with database and check login details are valid or not. If login details are valid, admin can log in to the admin panel. Admin need to provide different user levels to system users. The system user details are saved in to database.

When election time comes, admin need to interact with start election process user interface by click on 'start election process' button. The user interface communicate with the database and send a message to admin indicating whether action is successful or not.

To view voting result admin need to interact with view result user interface. User interface send message to database and fetch results and display in admin panel 'view result' interface. As last step of voting process admin need to interact with stop voting user interface.

After completing relevant actions, admin should sign out from the online voting system by using logout button located on the navigation bar on user interface.
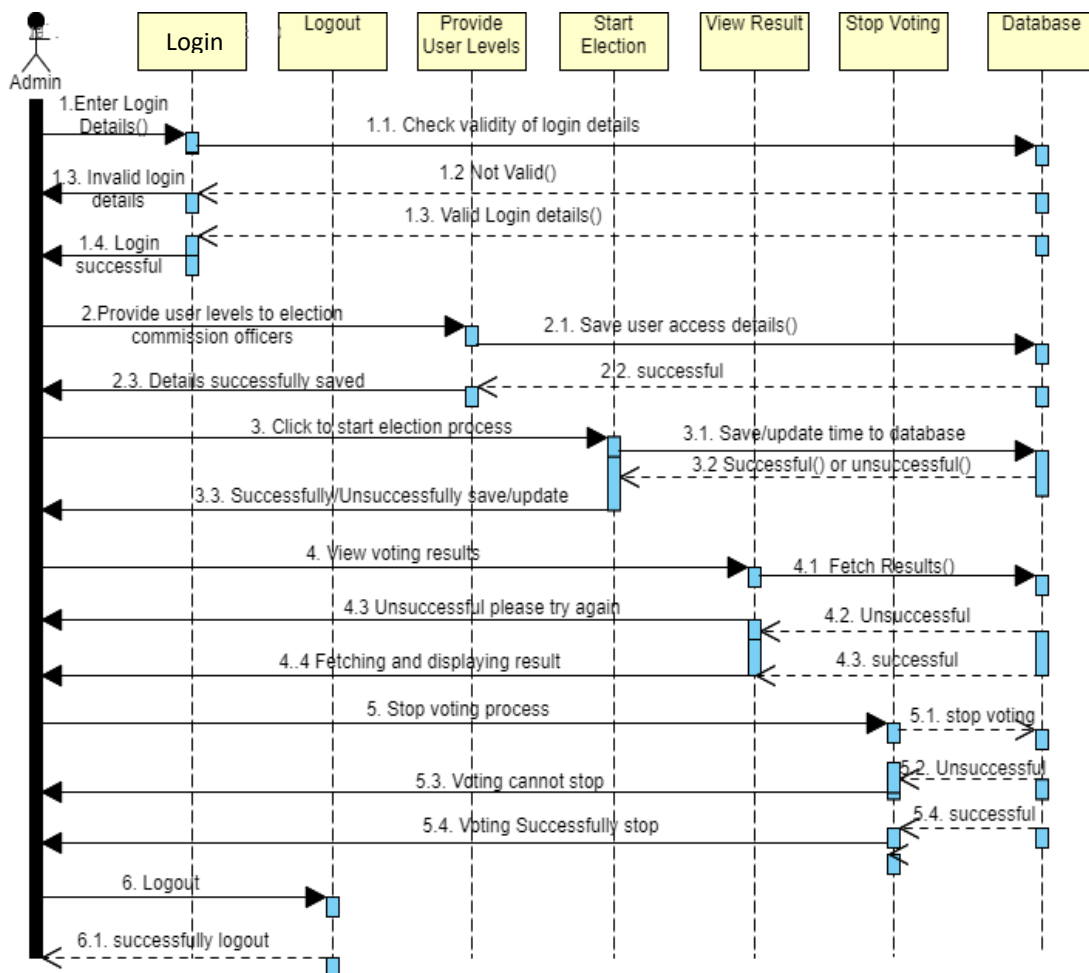
Figure 3. 9   Sequence Diagram for Administrator Dashboard

3.3.4.2   <u>Sequence Diagram for System User Dashboard</u>

The following diagram outline the interaction among system user and system user dashboard. System user need to perform different actions through online voting system. Add new voter, update/delete voter, accept candidate registration and update delete candidate are main action need to perform by system user. To perform those tasks system user need to login with login interface. Login interface communicate with database and check login details valid or not. If login details are valid, system can login to the system user dashboard.

System user need to interact with 'Register voter' interface to add new voter to the system. System user need to fill necessary information of relevant voter and click on insert button on user interface. UI will communicate with database and save voter details. If details are successfully inserted to the database user can view success message through interface. System user need to interact with 'update/delete voter details' UI to update or delete voters. System user need to select voter through UI and send message to the database to

update/delete voter. The database send message to user interface indicating operations' success or failure.

After candidate register with the system, system user need to accept candidate according to guidelines. To carry out this task system user need to interact with accept candidate registration UI. After check validity of provided information, user interface communicate with the database and send message indicating success or failure of the registration process. This message can view through 'accept candidate registration' user interface.

System user need to interact with 'update/delete candidate details' UI to update or delete candidates. System user need to select candidate through UI and send message to the database to update/delete candidate. The database send message to user interface indicating operations' success or failure.
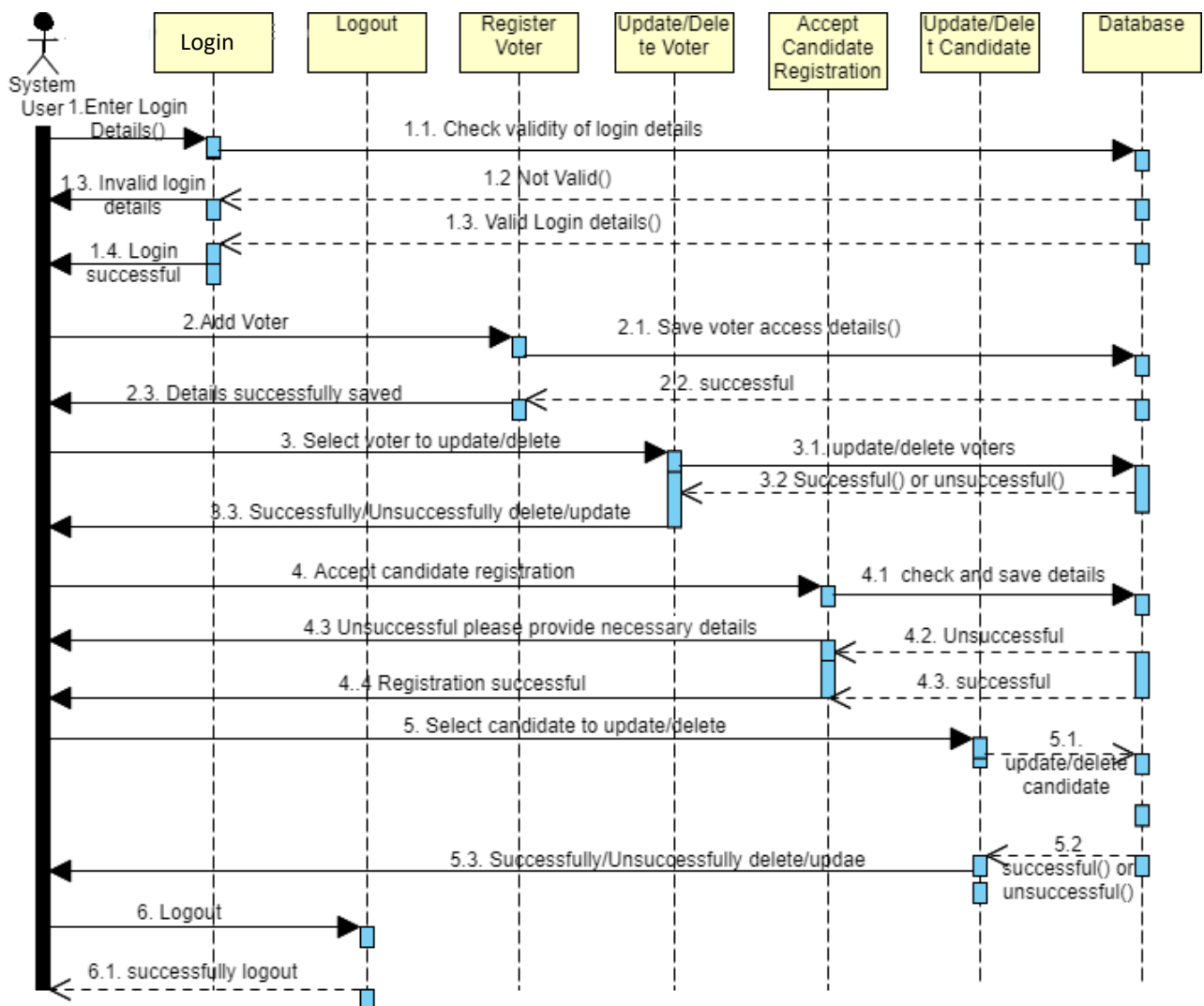

Figure 3. 10 Sequence Diagram for System User Dashboard

3.3.4.3   Sequence Diagram for Voting Process

The following diagram outline the interaction among voter and voting process. To cast a vote voter need to login with login interface. Login interface communicate with database and check login details valid or not. If login details are valid, voter can view main voting panel.

Voter need to interact with 'Main voting panel' interface to vote for a candidate. Voter need to select candidate he/she need to vote and click on vote now button on user interface. The user interface communicate with the database record the choice. Database send a message to voter and user interface indicating success of the action.

After completing voting, voter need to logout from the system by using logout button on user interface.
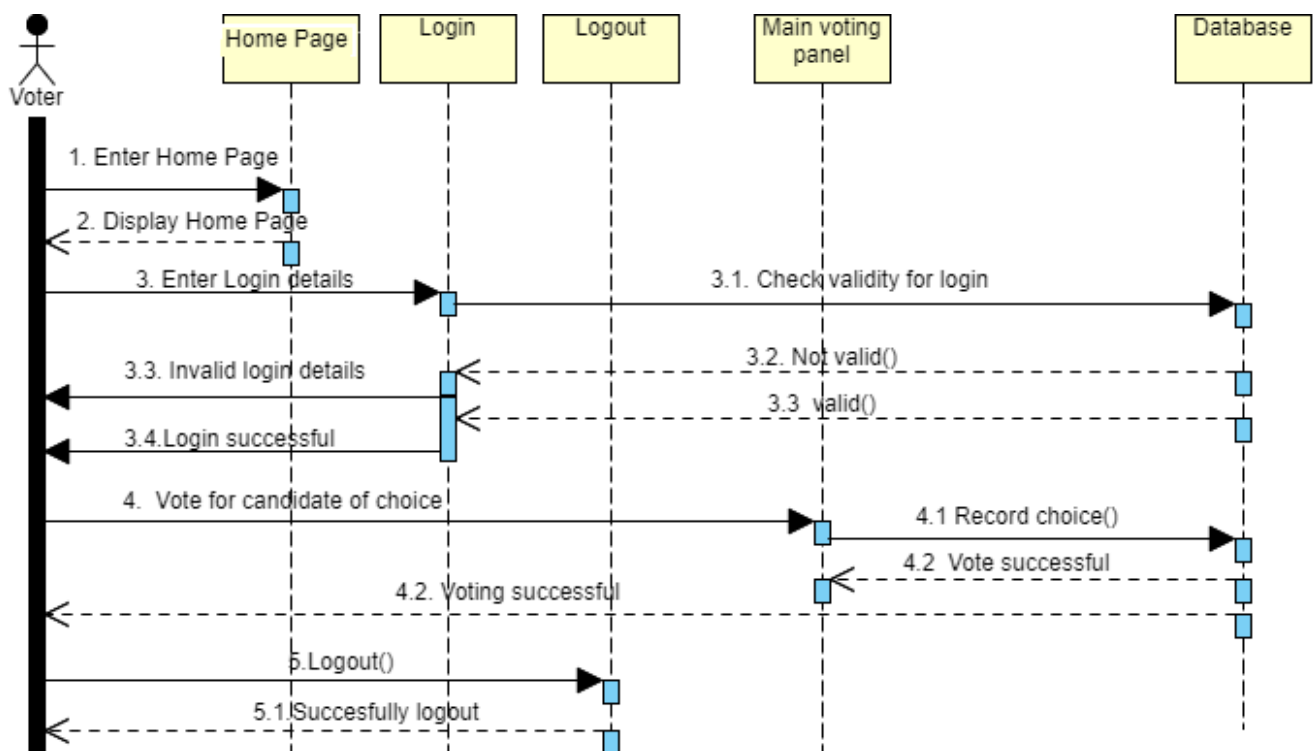

Figure 3. 11   Sequence Diagram for Voting Process

Chapter 4 - Implementation

4.1   System Implementation

The system design convert into the working product is the main goal of system implementation.

This online voting system is implemented using Net Beans IDE, PHP, MySQL database, HTML, CSS, Bootstrap and JAVA Script. Bootstrap is toolkit for UI design. FPDF report generating tool use to report generating in this study.

As mentioned above Net Beans IDE use as the software development application that provides good facilities for software development. Net Beans is open source software IDE which can work on many platforms such as Windows and Linux. Net Beans is great tool which is very easy to use. It provides great compatibility to other software tools.

The Language used in coding is PHP. PHP is an open source language which is mostly used for web application development. PHP also support for html, JavaScript. Most of the web servers support for PHP installation. It is available open source language pack which means any user can use this without making any payment.

MySQL is database management system which is widely use all over the world. MySQL databases are typically use these type of web applications and accessed using PHP

4.2   System Modules

This System consists of several modules such as admin panel, voter's portal, candidate's portal, and voting process, result generating process and displaying results. Interfaces use to connecting one module to another. Below diagram shows routine of each and every module in system

Implementation comprises of different modules or web forms and other supporting files such as the style sheet, and a master page. Below shows them one after the other.
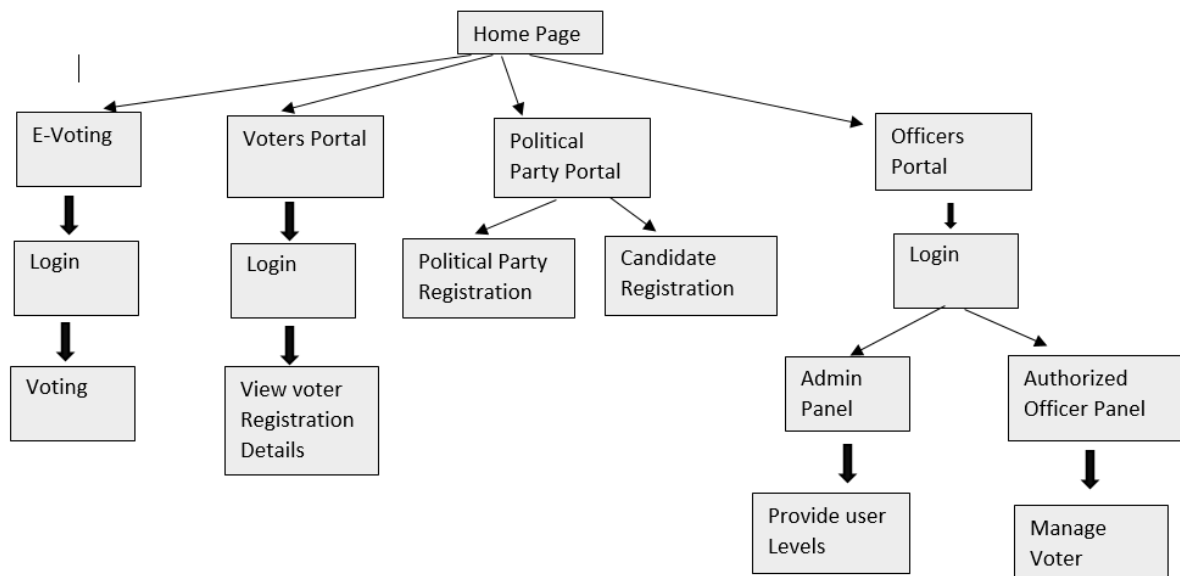
Figure 4. 1 Module Interaction of the System

- **config.php**

This file is created in such a way that it has a single connection string which is used by all the modules. See the code below.

```php
<?php
$dbHost='localhost';
$dbName="online_voting_system";
$dbUsername='root';
$dbPassword='';

$conn= mysqli_connect($dbHost,$dbUsername,$dbPassword,$dbName);
if(!$conn)
{
    die("connection fail".mysqli_connect_error());
}
```

- **Home page**

  The Home is a provide links to most of the other pages. See design below

Figure 4. 2   Home Page

- **Login Page**

  Every system user need to log in to the system. After inserting login details system decide relevant user group and direct to the relevant page accordingly. See design and major code below.
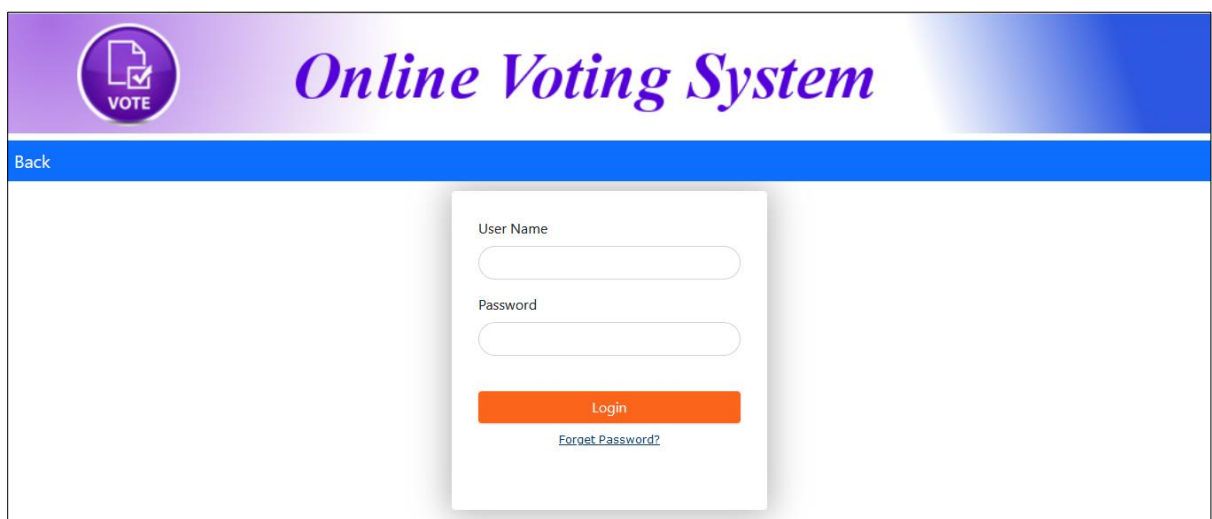

Figure 4. 3   User Login Page

This code segment check whether username and password correct and if provided details valid this code segment also differentiate user level according to database values and redirect to relevant page.

```php
session_start();
if(isset($_POST['login'])){
//get the values pass from login.php file
$username=$_POST['user'];
$password=$_POST['pass'];
//to prevent sql injection
$username= stripcslashes($username);
$password= stripcslashes($password);
$sql= "SELECT * FROM staff_login WHERE username='$username' AND password='$password'";
$result= mysqli_query($conn, $sql);

if (mysqli_num_rows($result) > 0) {
    $_SESSION[username]=$username;
    $row = mysqli_fetch_assoc($result);
    if($row['username']==$username && $row['password']==$password)
        {
         if($row['user_level']==1) {
             header("location:Admin/dashboard.php");
             echo "<script> window.location.assign('Admin/dashboard.php'); </script>";
         }
        if($row['user_level']==2) {
            header("location:officer_home.php");
            echo "<script> window.location.assign('officer_home.php'); </script>";
        }
        }
 }
else {
    $msg = 'Login Failed!<br /> Please make sure that you enter the correct  details ';
    echo "$msg";
```

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- **Voting Page**

This page provides voter to cast their vote. After submitting their vote system increased the vote cast accordingly. See design and major code below

Figure 4. 4   Voting Page

Below code segment use to send ballot sheet data to database.

```php
if (isset($_POST['submit'])) {
    $PartyNameShort = $_POST['selected_value_hidden'];
    $PartyNameShort_trim = trim($PartyNameShort);

    $sql = "INSERT INTO vote(party_name_short) VALUES('$PartyNameShort_trim')";
    $query = "INSERT INTO vote_details( NIC, province, e_district,p_division, g_division )"
           . "SELECT `NIC`,`province`,`e_district`,`p_division`,`g_division` from voter_registration "
           . "where NIC='$NIC'";

    if (mysqli_query($conn, $sql)) {
        if (mysqli_query($conn, $query)) {
            $_SESSION['status_success'] = "Data inserted successfully";
            header("Location: index.php");
        }
    }
}
mysqli_close($conn);
```

- **Admin dashboard panel**

    Admin user is responsible for most of the system tasks.
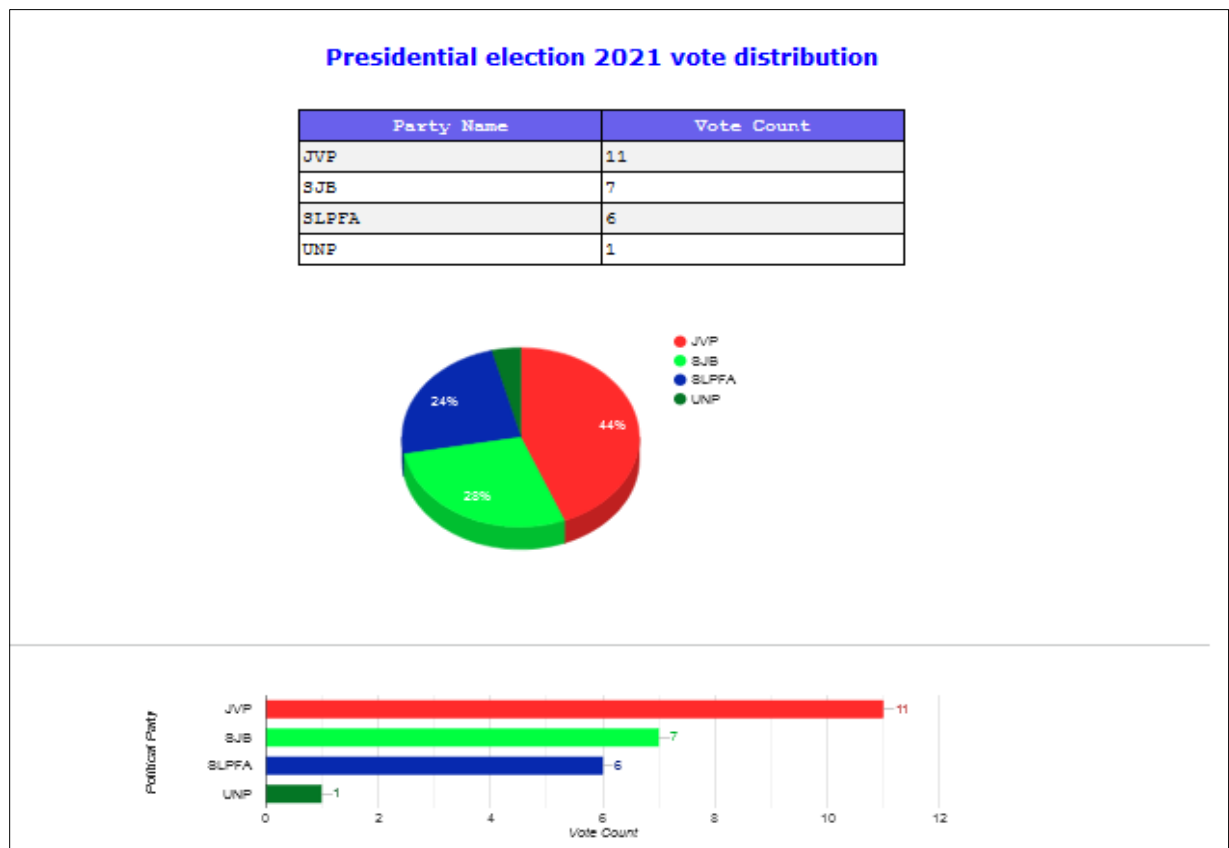

Figure 4. 5   Admin Dashboard

- **Display Results**

Figure 4. 6   Election Result UI

```php
<?php
$query = "SELECT party_name_short as Political_Party,counts as Votes ,colour FROM v_vote_count_all ";
$result = mysqli_query($conn, $query);

$resultCount = $result->num_rows;
$php_data_array = Array();
foreach ($result as $voteData) {
    $color[] = $voteData['colour'];
    $political_party[] = $voteData['Political_Party'];
    $vote_count[] = $voteData['Votes'];
}
echo "<table>
    <tr> <th>Party Name</th><th>Vote Count</th></tr>";
while ($row = $stmt->fetch_row()) {
    echo "<tr><td>$row[0]</td><td>$row[1]</td></tr>";
    $php_data_array[] = $row; // Adding to array
}
echo "</table>";
?>
<div id="pie-chart" class="chart-div"></div>
```

This code segment help to draw pie chart according to vote count.

```
<script>
    google.charts.load('current', {'packages': ['corechart']});
    google.charts.setOnLoadCallback(drawPieChart);
    function drawPieChart() {
        var data = new google.visualization.arrayToDataTable([
            ["Political_Party", "Votes"],
<?php
for ($i = 0; $i < $resultCount; $i++) {
    ?>[<?php echo "'" . $political_party[$i] . "', " . $vote_count[$i] ?>],
<?php }
?>
        ]);
        var options = {
            width: '700',
            height: '400',
            is3D: true,
            colors: [
<?php
for ($i = 0; $i < $resultCount; $i++) {
    echo "'" . $color[$i] . "',";
}
?>
            ]
        };
        var chart = new google.visualization.PieChart(document.getElementById('pie-chart'));
        chart.draw(data, options);
    }
    google.charts.load('current', {packages: ['corechart', 'bar']});
    google.charts.setOnLoadCallback(drawBarBasic);
</script>
```

Chapter 5 - Testing and Evaluation

5.1 Introduction

System testing is used to find the weakness of the integrated system. Main purpose is testing is capture the errors and checking the system is working well according to the parameters established for it. System testing usually begins at the earlier stage of system development life cycle. Testing plan starts immediately after requirement analysis which lead to identify weaknesses before the design phase begun. During design phase, it is possible to come up with different testing approaches like unit testing, integration testing and system testing. Doing different testing approaches at the earlier stage gives the ability to explore some of weakness and mistakes such as poor naming convention of variables, data connectivity issues, inconsistencies in fixing the requirements and so on.

5.2 Test Plan

A test plan like any other plan is defined as a series of tests activities that will be conducted during test. It also serves as a checklist which is used to determine which testing step is to be done first and which is to be done last and with which tool and methodology is to be implemented. It is important to understand that a test plan is nothing but a piece or collection of document which is organized in a well-structured form by following a specific defined standard. In this project, the following criteria were set as part of the plan for conducting a successful testing on the system.

1. Black-box testing should be implemented on each and every module. This is to ensure that all modules have meet their specification requirements. Hence, the type of testing to be conducted here is unit testing.
2. White-Box testing should be implemented on the program source codes to ensure that no logical errors are found. Therefore, all Graphic user interfaces should be checked carefully by checking how responsive they are to mouse and keyboard events. This will enable the tester to know whether the interfaces are communicating with one another efficiently or not.
3. The next plan is to test the flow or exchange of data between the different modules. This is to be supported by the use of DFD diagrams and simulators.
4. Requirement testing should also be carried out towards the end of the project before implementing. This will ensure that the requirements and specifications were dully followed during development.

5.3   Test cases

5.3.1   Administrator Dashboard

Test	Steps	Expected Results	Test Results
Check for successful login	Enter admin's user name Enter admin's password Click on "login" button	Display admin panel with username of admin	Display admin dashboard.
Check for login failure	Enter admin's user name Enter admin's password Click on "login" button	Display error message indicating username or password invalid	Display error message indicating username or password invalid
Check for all the data relevant to admin displayed	Select the data relevant to admin form database. Display relevant data	Display admin data	Admin data displayed
Check for successful logout	Click on "logout" button	Session clear and redirect to home page	Redirected to the home page

Table 5. 1   Unit Test for Administrator Dashboard

5.3.2 <u>Authorized Officer Dashboard</u>

Test	Steps	Expected Results	Test Results
Check for successful login	Enter officer's user name Enter officer's password Click on "login" button	Display officer panel with username of the officer	Display officer dashboard.
Check for login failure	Enter officer's user name Enter officer's password Click on "login" button	Display error message indicating username or password invalid	Display error message indicating username or password invalid
Check for all the data relevant to officer displayed	Select the data relevant to officer form database. Display relevant data	Display officer data	Officer data displayed
Delete Political Party	Login to officer dashboard Search for political party details from server Delete political party details	Delete political party details	Political party details are deleted
Update Political Party	Log in to officer dashboard Search for political party details from server Update political party details	Update political party details	Political party details are updated
Delete voter	Search for voter details from database server Delete voter details	Delete relevant voter details	Voter details are deleted
Update voter	Search for voter details from server. Update voter details	Update relevant voter details. Send message to voter's mobile number if password or username updated.	"Voter details are updated" message shown.
Log out	Click log out button	Redirect officer to home screen	Redirect officer to home screen

Table 5. 2   Unit Test for Authorized Officer Dashboard

5.3.3 <u>Voting</u>

Test	Steps	Expected Results	Test Results
Login Pass	Input voter user name Input voter password Click the login button	Show ballot sheet with welcome message with voter's username.	Ballot sheet shown.
Login failed	Input officer user name Input officer password Click the login button	If password or username incorrect display message showing "username or password invalid". Otherwise show the message "You already voted"	Display messages showing "username or password invalid" or "You already voted"
Display ballot sheet	Automatically query the data from the server and show ballot sheet	Show ballot sheet	Show ballot sheet
Voting	Select political party name Click the submit button	Vote count increased accordingly. Send successful message to the voters registered phone no and redirect to the home page	Vote count increased. Successful message send to the voters registered phone no and redirected to the home page

Table 5. 3   Unit Test for Voting Process

5.3.4 <u>View Result</u>

Test	Steps	Expected Results	Test Results
Check the result page loaded correctly	Access online voting system home page Click on e-data button	Display voting results	Voting results shown
Check for result page loading speed	Access online voting system home page Click on e-data button	Result page loading time should less, at least 2 seconds	Result page load within 1.45 seconds

Table 5. 4   Result Interface

5.3.5 <u>Voter Registration</u>

Test	Steps	Expected Results	Test Results
Register voter	Get all voter details Check for input validity Click register Insert voter details Send details to server Send login details to voter via SMS	Display message voter registered. Send Username and password to voter's mobile number.	"Voter Registered". Message shown. Username and password sent to voter's mobile number.

Table 5. 5   Voter Registration

5.3.6 <u>Political Party Registration</u>

Test	Steps	Expected Results	Test Results
Register Political Party	Insert political party details Click on register button Send details to server Send registration details to the registered mobile number	Display political party registered. Send successful message to the registered mobile number via SMS	"Political party Registered" message shown. Send successful message to registered mobile number

Table 5. 6   Political Party Registration

5.3.7 <u>Candidate Registration</u>

Test	Steps	Expected Results	Test Results
Register candidate	Insert candidate details Click on register button Send details to server Send registration details to the registered mobile number	Display political party registered. Send successful message to the registered mobile number via SMS	"Candidate Registered" message shown. Send successful message to registered mobile number

Table 5. 7   Candidate Registration

5.3.8   Change Voter Details

Test	Steps	Expected Results	Test Results
Change voter details	Log in to voter's portal Change details Click on request change details button.	Send notification to officer's dashboard.	Notification send to officer dashboard.

Table 5. 8   Change Voter Details

5.3.9   Change Political Party Details

Test	Steps	Expected Results	Test Results
Change political party details	Log in to political party's portal Change details Click on request change details button.	Send notification to officer's dashboard.	Notification send to officer dashboard.

Table 5. 9   Change Political Party Details

5.3.10 Change Candidate Details

Test	Steps	Expected Results	Test Results
Change candidate details	Log in to candidate's portal Change details Click on update button.	Update candidate details	Candidate details updated.

Table 5. 10   Change Candidate Details

5.4 Tests conducted on system testing

5.4.1 Unit Testing

This begins as soon as starting the system design. The modules were tested one after the other in order to detect any irregularities such as errors or mistakes. And based on that, every single interface tested as soon it was created.

5.4.2 Integration Testing

After all the modules were completely tested as per unit testing, the next thing was to begin testing those modules which have to be integrated with others for them to be able to produce the expected result. In this point connectivity between the front end and the back end was tested. This is very important at this stage because having an integral part communicating with the other part is what shows a sign of success in the testing. Other system interfaces were also tested to ensure that the mouse and keyboard events such as clicking, scrolling and typing are having effects on the respective interfaces.

5.4.3 System Testing

At this point, all elements were put together under one roof to ensure that there is constant flow and exchange of data within all the components and without any error small or big.

5.4.4 Usability Testing

In this testing segment, the system was able to prove how easy and understandable it is to its users. The interfaces were made easy, so much so that any person can operate it. However, different use scenarios were involved, all in ensuring good atmosphere for operation.

5.4.5 Compatibility Testing

This is a very crucial aspect to tackle as compatibility is one of the major concerns for many users. Different people are having different devices with different architecture and platforms. In that regard, we had to ensure that the system could cater for all the needs of the users. Especially issues related to browser. This project is a web based application. Therefore, there is a serious concern for users who would

want to access the site using mobiles and other types of handheld devices. And in response to that, we made sure that the voting system is operate with the bootstrap platform which makes it easier to manipulate by all form of browsers. And all the tested devices gave a very good and positive results.

As mentioned above, below shows some user interfaces that use to access voters portal though smart phone. It proves that most of the required interfaces are working fine with mobile devices.

Figure 5. 1 Supports multi device compatibility

5.4.6 <u>Security Testing</u>

As a matter of fact, security is one of the major concern of our users. This includes the questions like are our votes secured and safe from any illegal alteration? And in tackling that, the system ensured that proper login system is provided, and also, system ensured that both the voters and admin have restricted access to the voting environment. Nevertheless, we cannot deny the fact that not much have been done under security testing, but with time, we hope to achieve a better security infrastructure by considering better ways to improve the system security wise.

Chapter 6 - Conclusion

The electronic voting is a challenging field. Electronic voting rapidly developed in past few years. The reason for that is development of new technologies. The detailed analysis of this study shows it has both positive and negative aspects.

Here, the election administrators can provide election results easily and quickly when compare with manual voting. The online voting system allows voters to cast their votes through internet without attending to polling booth. Therefore by using this type of method for voting process will be lead to increase voting percentage. There are many benefits of such a system like fast accessing, improved security, easiness of maintain voting information and reduction of utilization of resources. According to the facts of this study emphasis, the online voting has more advantages when compare with manual voting.

This system provides anonymity which means the voter's identification is impossible. If the system not able to achieve this, it will definitely lead to voter manipulation. On the other hand the system has no proper way to detect any un-matching result. This is a negative aspect of the system. This issue needs to address the future development of the study.

Most challenging part of this system is security handling. Online voting has many security threats. To overcome some of the security issues, here the system use SMS facility. The system sends user name and password to the voter as SMS. But it maybe not sufficient to address these type of critical system. So the system need to use different type of cryptographic technology to send those messages. But this system not use that technology for implementation. For future development of this study need to address security issues thoroughly.

The system only developed for presidential election processes of Sri Lanka. This system need to extend for parliamentary elections as future work. This system also need to improve security as mentioned earlier. The system need to improve web accessibility for disable people. It is also need to provide different language platform for system users.

List of References

Antonyan, T., 2010. State-Wide Elections, Optical Scan Voting Systems, and the Pursuit of Integrity. January.p. 15.

Athuraliya, A., 2013. *What is Sequence Diagram? Complete Guide with Examples.* [Online]
Available at: https://creately.com/blog/diagrams/sequence-diagram-tutorial/
[Accessed 10 March 2021].

Bangerter, J., 2010. *Data Flow Diagram Symbols, Types, and Tips.* [Online]
Available at: https://www.lucidchart.com/blog/data-flow-diagram-tutorial
[Accessed 10 March 2021].

Bhuyan, D. J., 2019. Effectiveness of Electronic Voting Machine in the Electoral System of India: New Opportunities and Challenges. 2 July, 8(2), p. 8.

Cock, D. D., 2010. *Electronic Voting in BelgiumPast and Future.* s.l., s.n., p. 38.

Fischer, E. A., 2007. *The Direct Recording Electronic Voting Machine (DRE) Controversy: FAQs and Misperceptions,* s.l.: Congressional Research Service.

Gerlach, J. & Gasser, U., 2009. *Three Case Studies from Switzerland:,* s.l.: Berkman Center Research.

Goldsmith, B. & Ruthrauff, H., 2013. *Case Study Report on Brazil Electronic Voting: 1996 to Present.* s.l., United States Agency for International Development (USAID).

Gonggrijp, R., Hengeveld, W.-J. & Hotting, E., n.d. *RIES - Rijnland Internet Election System:a cursory study of published source code.* [Online]
Available at: http://wijvertrouwenstemcomputersniet.nl/images/4/41/VoteID_2009_-_RIES.pdf
[Accessed 8 Febuary 2021].

Herrnson, P. S., Niemi, R. G., Hanmer, M. J. & Bederson, B., 2008. The Current State of Electronic Voting in the United States. p. 25.

Krimmer, R. & Volkamer, M., 2014. *The Development of Remote E-Voting Around the World: A Review of Roads and Directions.* s.l., s.n., p. 16.

NDI, 2013. *E-voting Audits in Venezuela.* [Online]
Available at: https://www.ndi.org/e-voting-guide/examples/e-voting-audits-venezuela
[Accessed 8 February 2021].

Nwogu, E., 2016. Supervised Public Network Direct Recording Electronic Voting (PNDRE Voting) on Existing Global System for Mobile Communication Infrastructure; a Panacea for Cheap E-voting System Implementation in Nigeria. 3(2), p. 9.

phppoint, 2017. *Online Voting System.* [Online]
Available at: https://www.youtube.com/watch?v=iuN4h2_v6AI&feature=emb_logo
[Accessed 29 January 2021].

UAE mGovernment, 2020. *eVoting in the UAE.* [Online]
Available at: https://u.ae/en/about-the-uae/the-uae-government/evoting-in-the-uae
[Accessed 8 February 2021].

Wikimedia Foundation, 2021. *Vote counting in the Philippines.* [Online]
Available at: https://en.wikipedia.org/wiki/Vote_counting_in_the_Philippines
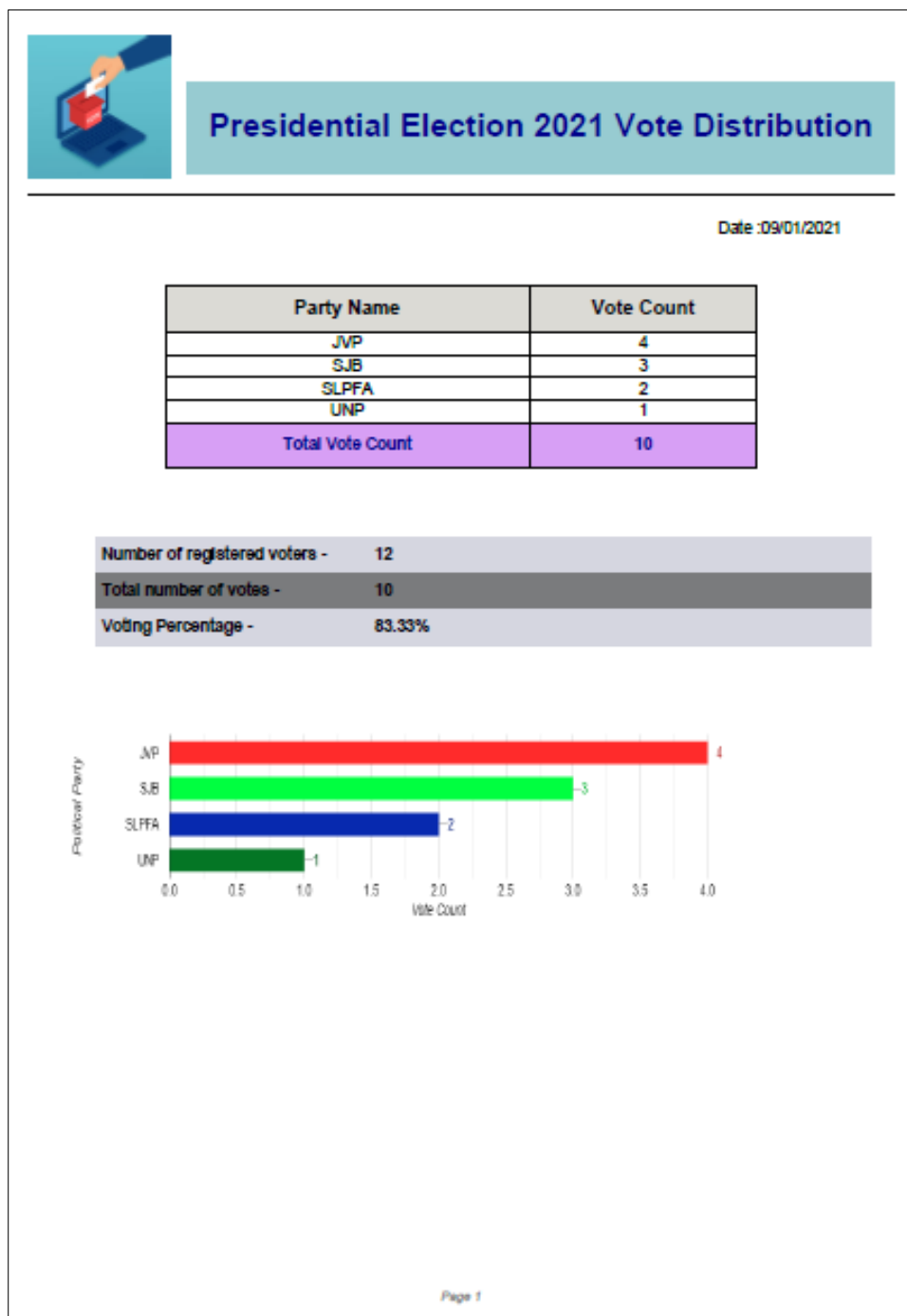[Accessed 8 February 2021].

Appendices

MIS Report Module

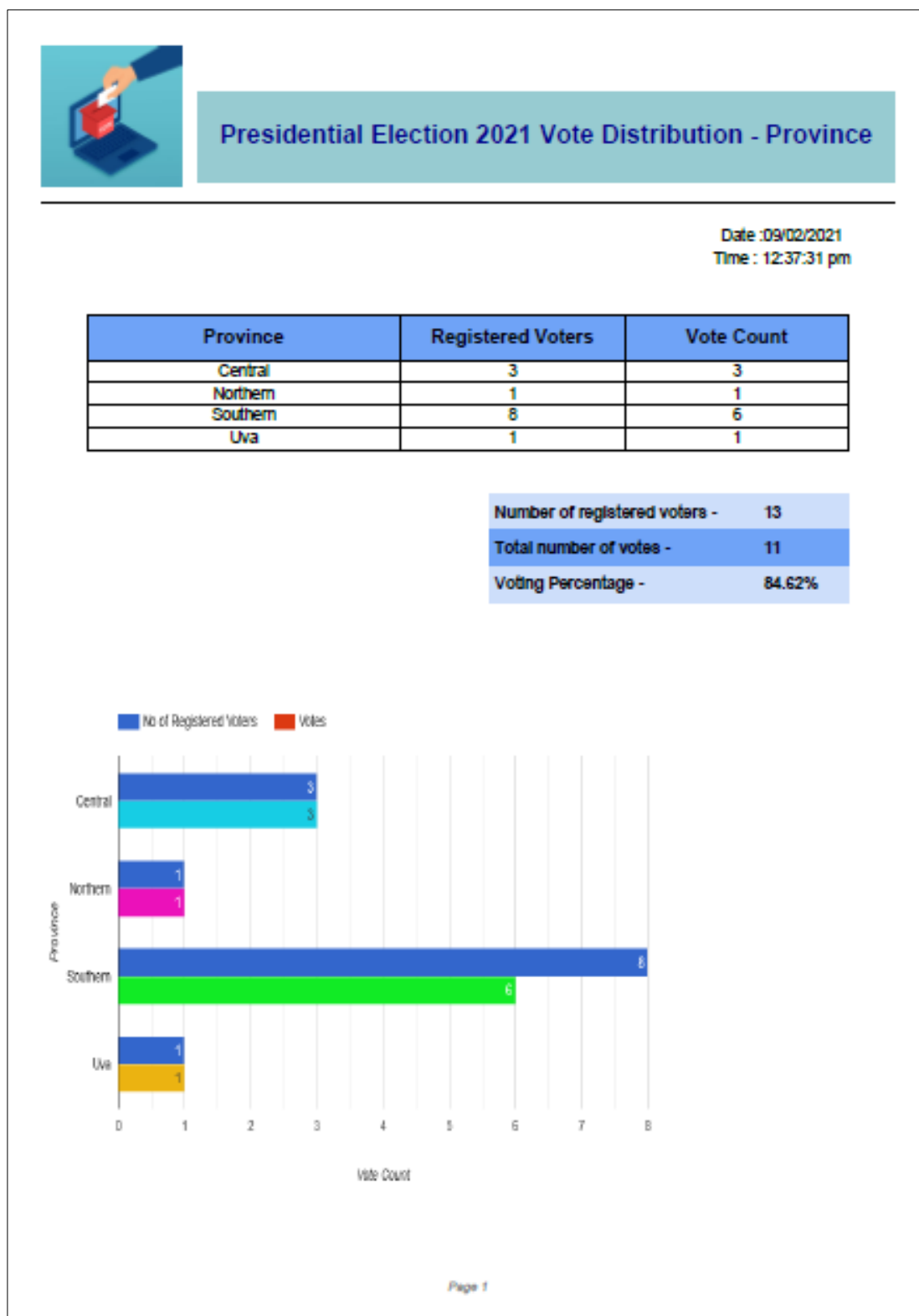The system provides different type of reports based on election results.

Vote count report

The administrator and the any person can view vote distribution report. This report shows vote count for each political party.

The administrator can view reports which are vote count based on each province, district or polling division vice.

Vote count report based on province vice

Presidential Election 2021 Vote Distribution - Province

Date :09/02/2021
Time : 12:37:31 pm

Province	Registered Voters	Vote Count
Central	3	3
Northern	1	1
Southern	8	6
Uva	1	1

Number of registered voters -	13
Total number of votes -	11
Voting Percentage -	84.62%

Vote count report based on district vice

Presidential Election 2021 Vote Distribution - District

Date :09/02/2021
Time : 12:04:39 pm

District	Registered Voters	Vote Count
Badulla	1	1
Galle	8	6
Jaffna	1	1
Kandy	3	3

Number of registered voters -	13
Total number of votes -	11
Voting Percentage -	84.62%

Page 1
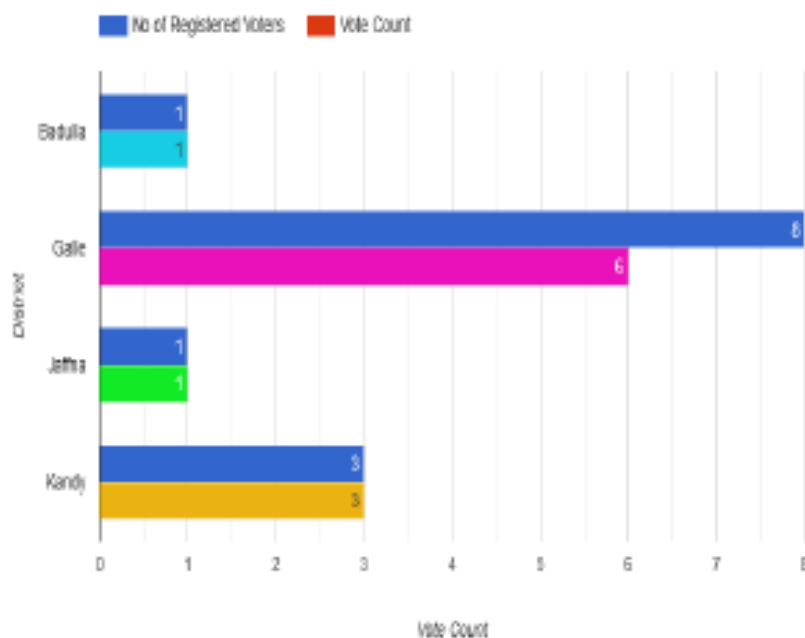
Vote count report based on polling division vice

Presidential Election 2021 Vote Distribution - Polling Division

Date :09/02/2021
Time : 01:10:32 pm

Polling Division	Registered Voters	Vote Count
Akmeemana	2	2
Galagedara	3	3
Galle	1	1
Hiniduma	4	2
Karandeniya	1	1
Viyaluwa	1	1
Waddukkoddai	1	1

Number of registered voters -	13
Total number of votes -	11
Voting Percentage -	84.62%

54
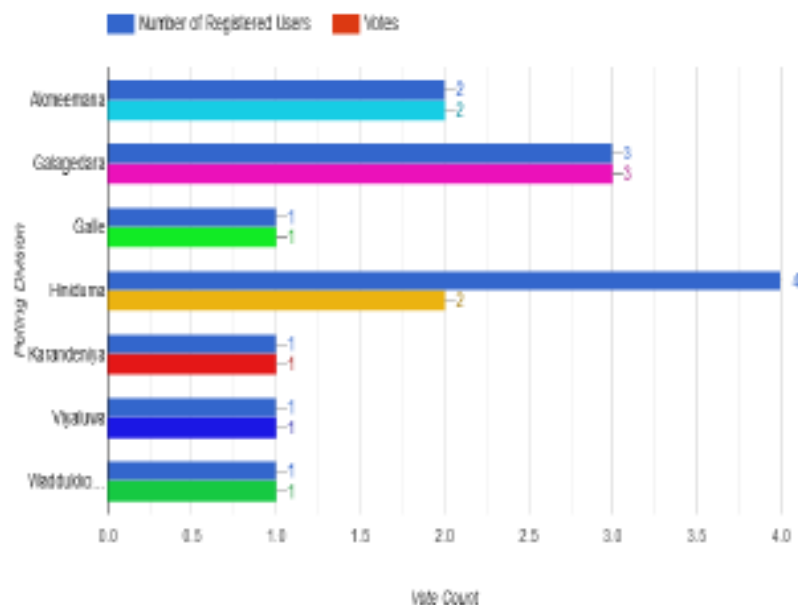
Through system admin can get a report about percentage of voters used their votes in each province.

Presidential Election 2021 Vote Distribution - Province

Date :09/02/2021
Time : 01:39:25 pm

Province	Registered Voters	Vote Count	Vote Percentage
Central	3	3	100.0%
Northern	1	1	100.0%
Southern	8	6	75.0%
Uva	1	1	100.0%

Through system admin can get a report about percentage of voters used their votes in each district.

Presidential Election 2021 Vote Distribution - District

Date :09/02/2021
Time : 01:45:31 pm

District	Registered Voters	Vote Count	Vote Percentage
Badulla	1	1	100.0%
Galle	8	6	75.0%
Jaffna	1	1	100.0%
Kandy	3	3	100.0%

Through system admin can get a report about percentage of voters used their votes in each polling division.

Presidential Election 2021 Vote Distribution - Province

Date :09/02/2021
Time : 01:50:36 pm

Polling Division	Registered Voters	Vote Count	Vote Percentage
Akmeemana	2	2	100.0%
Galagedara	3	3	100.0%
Galle	1	1	100.0%
Hiniduma	4	2	50.0%
Karandeniya	1	1	100.0%
Viyaluwa	1	1	100.0%
Waddukkoddai	1	1	100.0%
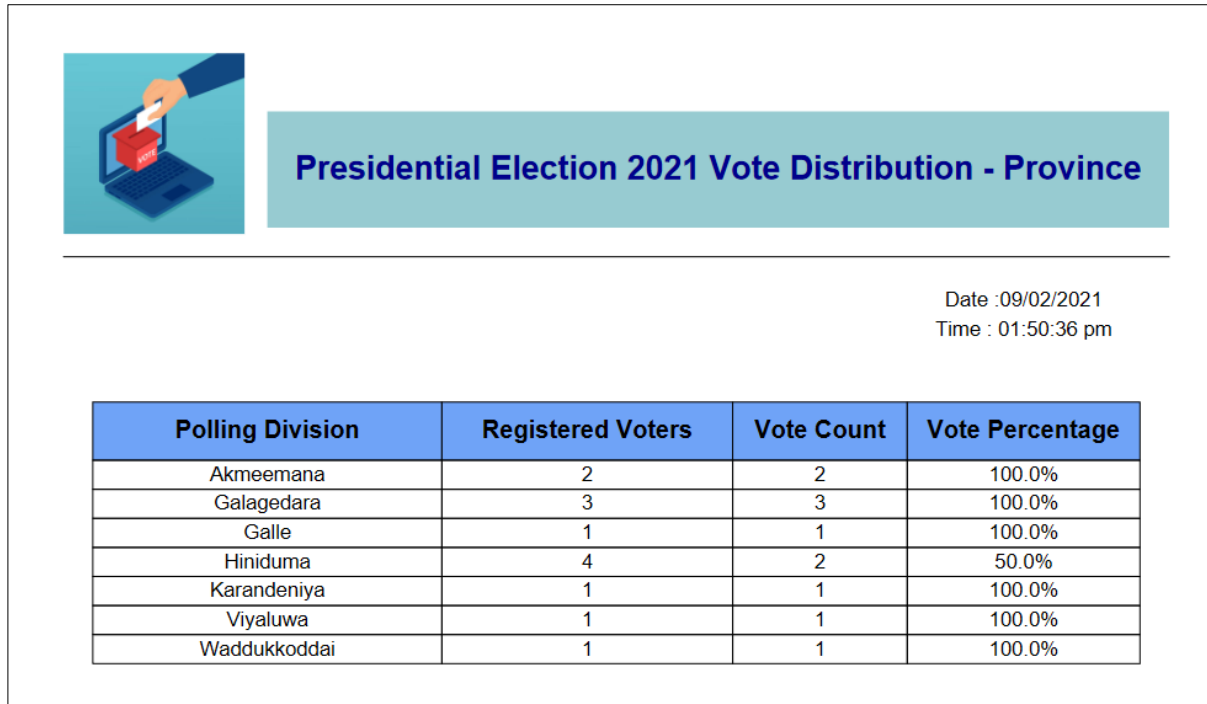
Through system admin can get a report about vote count for each political party based on each province.

Presidential Election 2021 Vote Distribution

Date :09/02/2021

Vote Distribution - Southern Province

Party Name	Vote Count
SJB	2
SLPFA	1
UNP	1
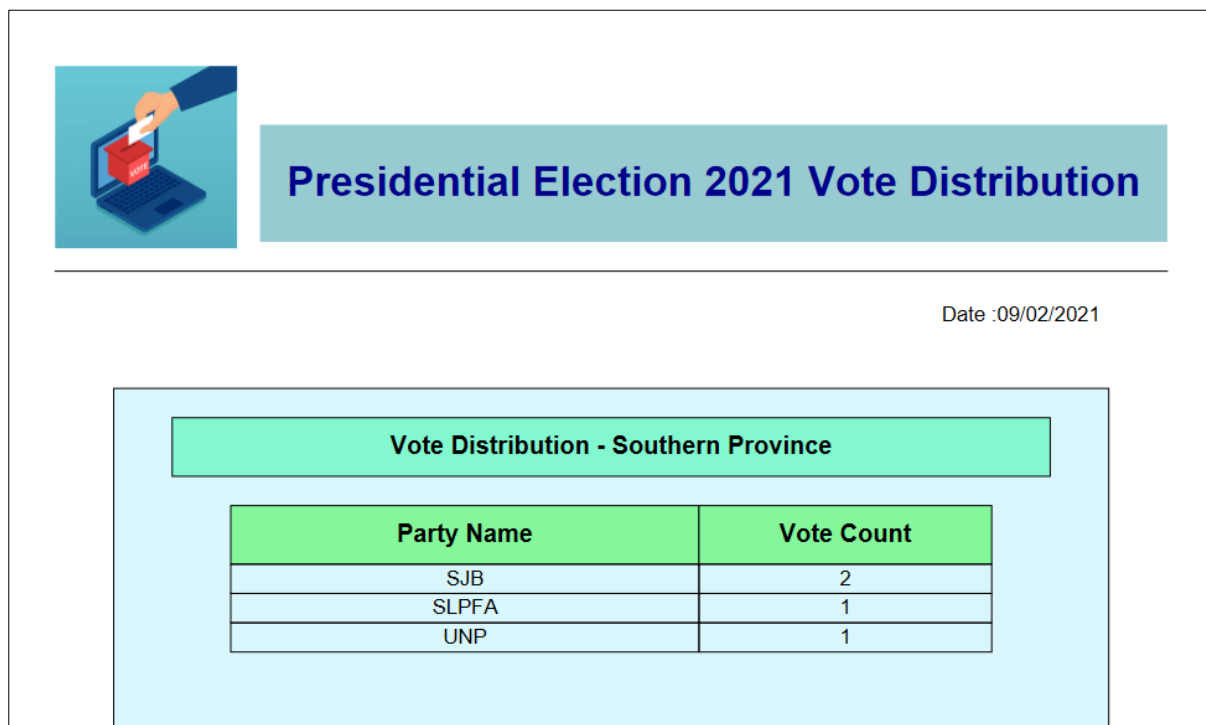
User Guide for Voters

1. <u>Voter Registration</u>

After you access to the home page, you can see the following screen. Then you have to click on the voter's portal.
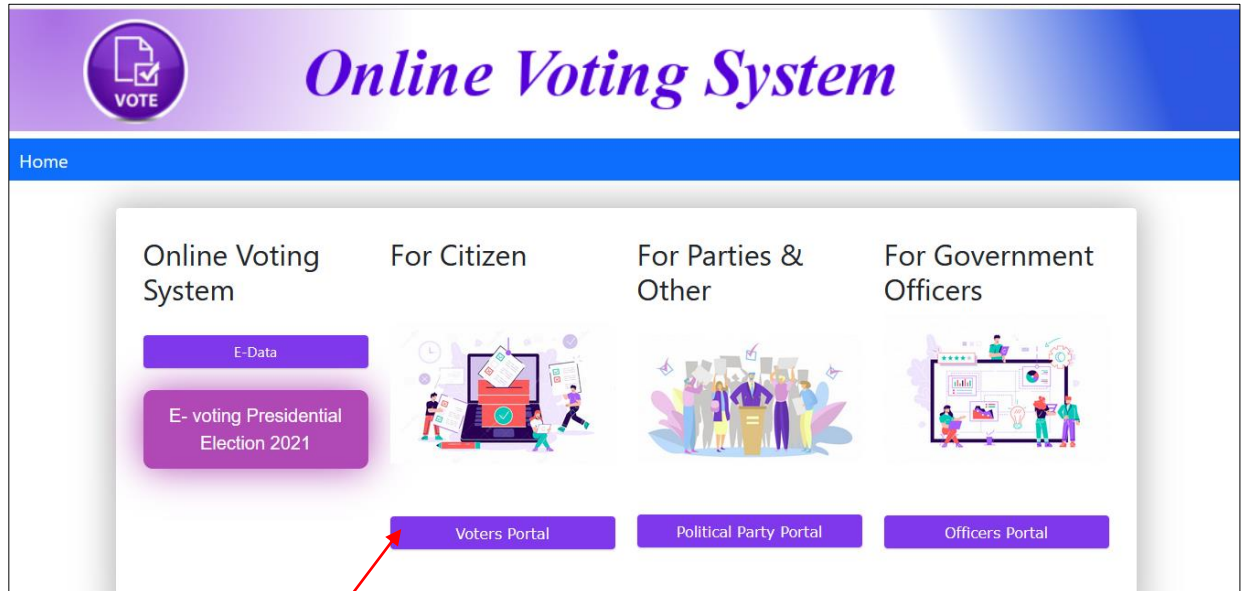
Click on "Voters Portal"

Then click on "Voter Registration" button.
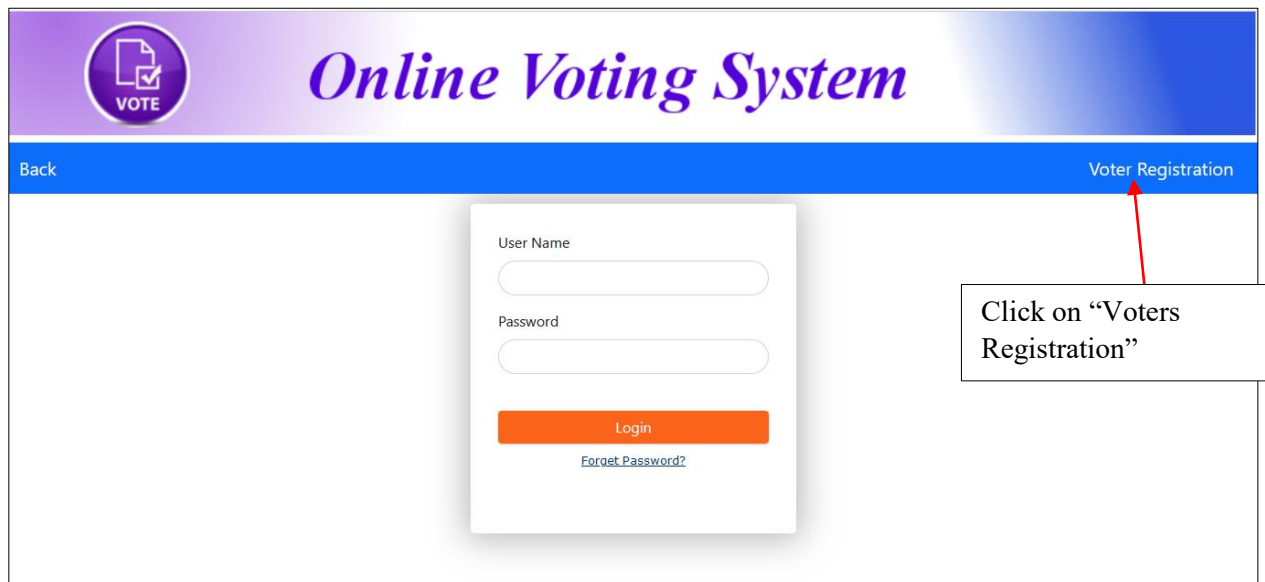
Click on "Voters Registration"

Then you can view following window. Fill the information correctly and click on "Register" button. Then you will get a SMS to your registered phone number. After accepting your registration request by GS of your village you will get the username and password to the registered mobile number. If you not get any response within a week you can contact GS of your village

After filling the form click on "Registration" button

2. <u>Change Voter Details</u>

After you access to the home page, you can see the following screen. Then you have to click on the voter's portal

Click on "Voters Portal"

To login to the system, enter your username and password through following window.

Then you can view your information. To change information click the "Change Details" button.

Click on "Change Details"

Then you can see following window. Change the details and click on submit button. To change critical information click on the link in red color.

To change other details click here

First click on "Change Basic Details"

After changing details click on "Submit" button

3. <u>Vote for Election</u>

After you access to the home page, you can see the following screen. Then you have to click on the "E-voting presidential election 2021"

To login to the system, enter your username and password through following window.
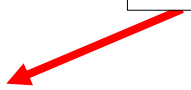
Then click on "select" button and Then click on submit button.

Symbol	Political Party Name	Vote
	JVP	Select
	SJB	Select
	SLPFA	Select
	UNP	Select

You Choose: [   ]   Click on "Submit"

Are You sure about your choice ?.
Then click on Submit button

Submit

You will receive SMS indicating success of your voting.