KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY
Deemed to be University U/S 3 of the UGC Act, 1956
Established : 1997
SCHOOL OF COMPUTER APPLICATIONS

A PROJECT REPORT
ON
ONLINE VOTING SYSTEM

SUBMITTED BY :

SHRUTIREKHA SRICHANDAN
(2147044)

A Project Report on

"ONLINE VOTING SYSTEM"

Submitted in the partial fulfilment for the award of degree for

Bachelor of Science (Computer Science)

Submitted By

Shrutirekha Srichandan

2147044

Under the Guidance of:

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KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY (KIIT)

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CERTIFICATE OF ORIGINALITY

This is to certify that the project report entitled "**Online Voting System**" submitted to the **School Of Computer Application, KIIT Deemed to be University, Bhubaneswar** in partial fulfillment of the award of the degree of **Bachelor of Science in Computer Science** ,by **Shrutirekha Srichandan** with **Roll No. 2147044** and **Registration No.21183078968** Under my guidance.

The matter embodied in this project is genuine work done by the student and has not been submitted whether to this University or to any other University / Institute for the fulfilment of the requirements of any course of study.

She worked on this project from 1st Jan 2024 to 1st April 2024 at Online Voting System.

Signature of the Student

Date:

Signature of the Internal Guide

Name: Dr.Bishnupriya Panda

School of Computer Applications
KIIT University, Bhubaneswar

CERTIFICATE

This is to certify that the project work entitled "**Online Voting System**" Submitted by **Shrutirekha Srichandan** bearing roll no. **2147044 ,** is an authentic and original work.

Signature

(Internal Examiner)

Date.....

Signature

(External Examiner)

Date.....

DECLARATION

I hereby declare that the project entitled - "**ONLINE VOTING SYSTEM**" which being submitted as Mini Project of 6th Semester in **Bachelor of Science in Computer Science** to the **School Of Computer Application, KIIT Deemed to be University, Bhubaneswar** is an authentic record of my genuine work under the guidance of **Dr. Bishnupriya Panda**.

Signature of the student

Date.....

ACKNOWLEDGEMENT

I would like to covey my heartfelt gratitude to faculty-in- charge **Dr. Bishnupriya Panda** for her tremendous support and assistance in the completition of my project . We would also like to thank for providing me with this wonderful opportunity to work on making a software on “Online Voting System”.

I express my thanks to **Professor Veena Goswami, Director Of General, KIIT School Of Computer Applications**, for her extending support.

Finally, I would like to express my gratitude to my family and friends, who supported us through the ups and downs of the project and provided us with motivation and encouragement.

Thank you all for your support and encouragement throughout the development of this software project. I would like to acknowledge that this project was completed by me and not by anyone else.

Signature of the student

Shrutirekha Srichandan
2147044

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.

TABLE OF CONTENT

CHAPTER-1
INTRODUCTION

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.

1.4 Objectives :

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

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 Scope:

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

- Increasing number of voters as individuals will find it easier and more convenient toVote.
- Less effort and less labor intensive, as the primary cost and focus primary on creating,managing, and running a secure web voting portal.
- The system can be used anytime and from anywhere by the Voters.
- No one can cast votes on behalf of others and multiple times.
- Saves time and reduces human intervention.
- The system is flexible and secured to be used.
- Unique Identification of voter through Aadhar number.
- Improves voting with friendly Interface.
- No fraud vote can be submitted.

1.6 Limitations:

Despite the particular advantages to electronic voting system, there are also drawbacks to the system. The cons of the electronic voting system should be considered seriously by all concerned before taking any kind of random decision on e-voting. These are:

- Security Concerns: Online voting systems may be vulnerable to hacking, fraud, or other cyber attacks, potentially compromising the integrity of the election process.

- Accessibility Issues: Not everyone has access to the internet or may not be comfortable using online platforms, which could disenfranchise certain demographics, such as older adults or those in rural areas.

- Privacy Risks: There's a risk that personal information could be compromised or privacy infringed upon through online voting systems, raising concerns about data security and confidentiality.

- Technical Challenges: Online voting systems require robust infrastructure and software that can handle large volumes of traffic without crashing or experiencing glitches. Technical issues could lead to delays, confusion, or even the loss of votes.

- Trust and Perception: Some people may lack trust in online voting systems due to concerns about security, transparency, and the potential for manipulation. This could undermine confidence in the electoral process and legitimacy of election outcomes.

- Legal and Regulatory Challenges: Implementing online voting may require changes to existing laws, regulations, and electoral procedures, which can be complex and time- consuming. Ensuring compliance with legal requirements and addressing regulatory concerns is essential but challenging.

CHAPTER-2
BACKGROUND

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 Existing Systems:

The Existing System of Election is running manually. The Voter has to Visit to Booths to Vote a Candidate so there is wastage of Time. The Voter has to manually register into the Voter List. Also Vote counting has to be done manually. All the Information of the Voter or Candidate is to be filling in manually. Voter must be present in his/her Constituency to give his/her Vote. There are Electronic Voting Machines used which Takes More Cost. The voting system previously being used by the Government is a paper based system, in which the voter simply picks up ballots sheets from electoral officials, tick off who they would like to vote for, and then cast their votes by merely handing over the ballot sheet back to electoral official. Some of the existing systems are:

- Paper-based voting
- Direct recording electronic voting machine
- Punch card

2.3 Existing E-Voting Systems:

2.3.1 E-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.

2.3.2 E-Voting in Switzerland:

Switzerland has implemented e-voting systems in certain cantons, allowing eligible voters to cast their ballots electronically in federal, cantonal, and municipal elections. The system underwent extensive testing and pilot projects to ensure security, transparency, and accessibility.

2.3.3 E-Voting in Brazil:

Brazil has implemented electronic voting machines (EVMs) nationwide, allowing voters to cast their ballots electronically in federal, state, and municipal elections. The machines are equipped with security features and encryption mechanisms to safeguard against tampering and ensure the accuracy of election results.

2.3.4 E-Voting in United States:

The United States has experimented with e-voting systems in certain states and localities, particularly for absentee and overseas voting. However, the adoption of e-voting has been uneven across the country, with concerns about security, privacy, and reliability influencing decision-making at the state and federal levels.

These examples illustrate the diverse approaches and experiences of countries in implementing e-voting systems, each facing unique challenges and considerations based on their electoral processes, technological infrastructure, and regulatory frameworks.

CHAPTER-3
SOFTWARE & HARDWARE REQUIREMENTS

Chapter 3 - SOFTWARE & HARDWARE REQUIREMENTS

For any software development to be successful there is need for hardware and software.During the implementationof our project, we used the following hardware and software tools.

3.1 Software Requirements :

3.1.1 Designing Tools:

- Figma
- Dia

3.1.2 Frontend Software:

- HTML
- CSS
- Java Script
- Bootstrap

3.1.3 Backend Software:

- XAMPP
- APACHE
- PHP

3.1.4 Database:

- MySQL

3.2 Hardware Requirements :

- Windows 11
- Processor: 800MHz Intel Pentium III or equivalent
- Memory: 512 MB
- Disk space: 750 MB of free disk space

3.3 Justification For Perticular Software :

3.3.1 Designing Tool :

3.3.1.1 FIGMA:

Figma is a web-based design tool that is used to create and share user interface (UI) designs. The use of Figma in an online voting system project can be justified as follows:

- Prototyping: Figma allows designers to create interactive prototypes of their designs, which can be used for user testing and feedback.
- Design consistency: Figma provides tools for creating and maintaining design systems, which ensure consistency across different parts of theUI and reduce design errors.
- Easy sharing: Figma makes it easy to share design files with other team members, stakeholders, and clients,which helps to keep everyone on the same page and reduces intercommunication.

3.3.2 Frontend Tools :

3.3.2.1 HTML:

HTML is the basic building block of any web application. In an online voting system project,HTMLis used to define the structure and content of the webpages. HTML can be used to create different types of content, such as text, images, videos, and links, and can also be used to define the layout and styling of the webpages. HTML is a simple and widely-used language that can be easily understood and maintained by developers.

3.3.2.2 CSS:

CSS (Cascading Style Sheets) is a front-end technology that is used to define the styling and layout of the webpages. In a online voting project, CSS can be used to define the colors, fonts, borders,

and spacing of the different UI elements, such as buttons, forms, and tables.CSS can also be used to create responsive designs that adapt to different screen sizes and orientations. CSS is a powerful and flexible technology that can help to enhance the visual appeal and usability of the web application.

3.3.2.3 Bootstrap:

Bootstrap is a popular front-end framework that provides pre-designed templates, components, and styles for building responsive and mobile-friendly web applications. In an online voting project, using Bootstrap can help ensure that the web application is accessible on different devices, such as desktops, laptops, tablets, and mobile phones, without compromising on the user experience. Bootstrap also provides arange of UI elements, such as forms, buttons, and typography, which can help to speed up the development process and ensure consistency across the application.

3.3.3 Backend Tools :

3.3.3.1 XAMPP:

XAMPP is a software package that includes Apache, MySQL,and PHP, which are essential components for developing dynamic web applications.

3.3.3.2 Apache:

Apache is a widely used web server that can host web applications and serve web pages. Apache is a key component of XAMPP and is used to serve webpages in the online voting system.

3.3.3.3 PHP:

PHP is a server-side scripting language used for creating dynamic web pages. With PHP, you can handle form submissions, manage user authentication and authorization, and interact with

databases like MySQL. PHP is perfect for building the back-end of online voting system, such as managing user accounts.

3.3.4 Database :

3.3.4.1 MySQL:

MySQL is a widely-used relational database management system that is used to store and retrieve data in web applications. In online voting project, MySQL can be used to store the information about users, votings, and other entities. MySQL provides arange of features, such as data indexing, transaction support, and backup and recovery, that can help to ensure the reliability and scalability of the database. MySQL is also a cost-effective and open-source solution that can be easily integrated with other technologies.

3.4 User Requirements Analysis:

Processor	**Desktop/Laptop :** ● Intel core processor or better performance **Mobile/Tablet:** ● Any Mobile processor with Good Performance
Memory	**Desktop/Laptop :** ● 4GB Ram or More **Mobile/Tablet:** ● 2GB Ram or More

Operating System	**Desktop/Laptop :** ● Windows (7,10,11) ,Linux, Mac OS **Mobile/Tablet:** ● IOS or Android
Browser	**Desktop/Laptop :** ● Chrome , Mozilla or Any latest browsers **Mobile/Tablet:** ● Chrome ,Safari

The different Software can be used across various devices such as Computer,Laptop,Tablets and Smart phones.

CHAPTER-4
FUNCTIONAL & NON-FUNCTIONAL REQUIREMENTS

Chapter 4 - FUNCTIONAL AND NON-FUNCTIONAL REQUIREMENTS

4.1 Functional Requirements :

User Management:
The system has an authentication and authorization mechanism to manage the users of the system.Admins and Voters as users.

- **Login:**
  The system provides a login mechanism for users. The login mechanism verifies the user's credentials and redirects them to the appropriate dashboard.

- **Sign up:**
  The system requires the users to input their personal details as stated and later a user id will be generated and assigned to the user.

- **Roles and Permissions:**

  - **Admin:**
    - Login
    - Can Add Elections
    - Can Add Candidates
    - Can View Result
    - Can Delete Elections
    - Can Delete Candidates

  - **Voters:**
    - Sign up
    - Log in
    - Can Vote

4.2 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.

CHAPTER-5
DESIGN

Chapter 5 - DESIGN

5.1 Introduction :

Online voting system is designed for Indian voters. This system needs to address all aspects relevant to Indian 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.

5.2 ER Diagram :

Entity-Relationship(ER) Diagram is used to analyze the structure of the online voting management system Database. It shows relationships between entities and their attributes.

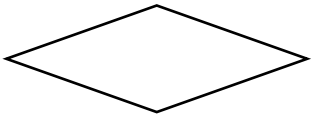
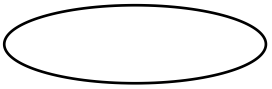
The three main components of an ER diagram are:

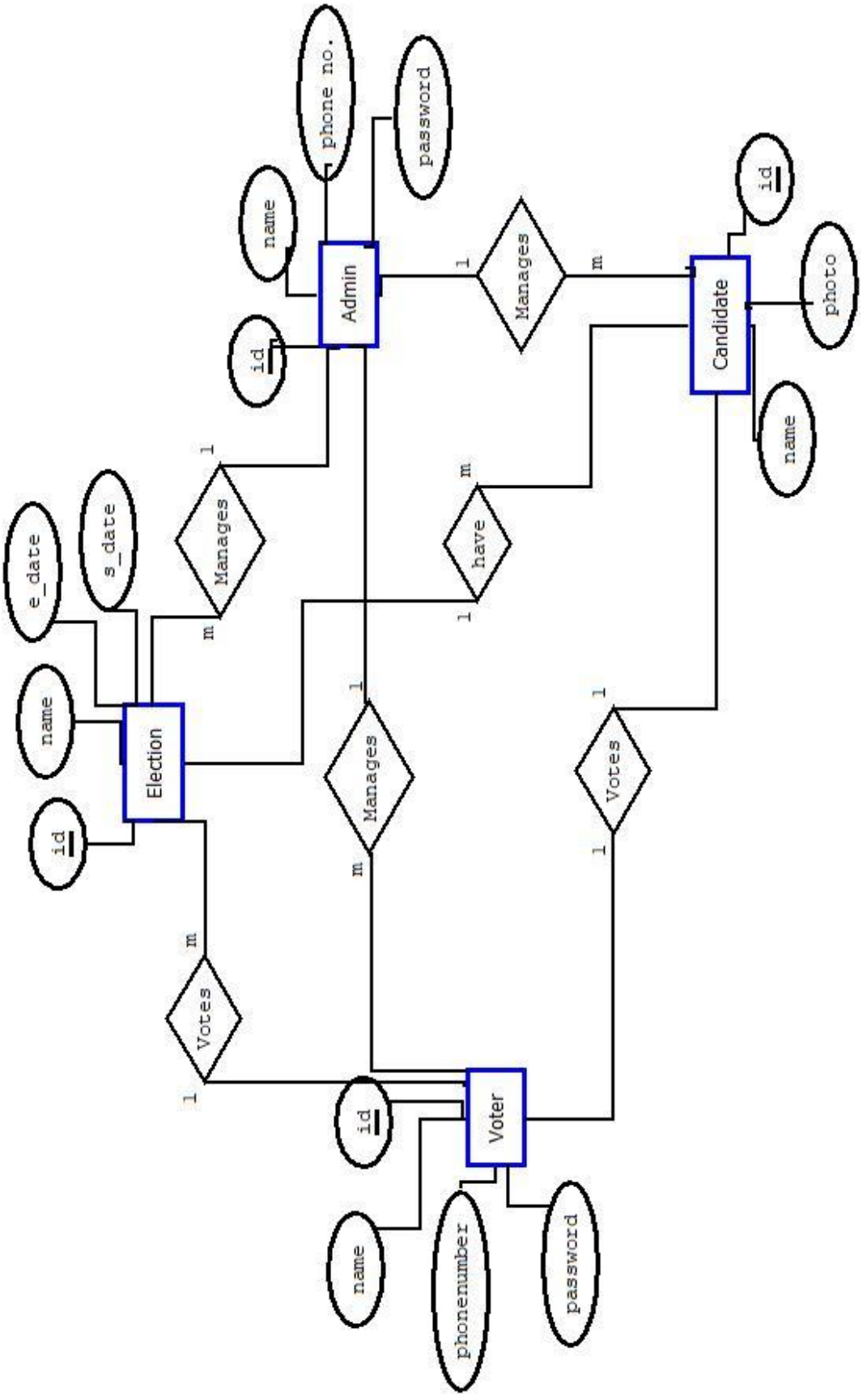
- **Entity:** The entity is a person, object, place or event for which data is collected. The entity is represented by a rectangle and labeled with a singular noun.

- **Relationship**: The relationship is the interaction betweenthe entities. A relationship may be represented by a diamond shape, or more simply, by the line connecting theentities. In either case, verbs are used to label the relationships.

- **Cardinality:** The cardinality defines the relationship between the entities in terms of numbers. The three main cardinal relationships are:
  - one-to-one, expressed as 1:1
  - one-to- many, expressed as 1: M
  - many-to-many,expressed as M: N

Shapes Used :

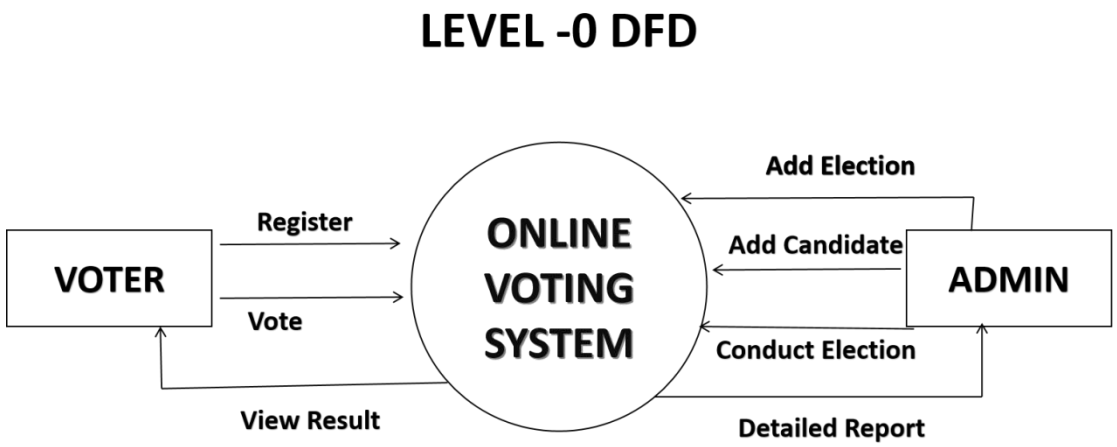
Entity	
Relationship	
Connector	
Attribute	



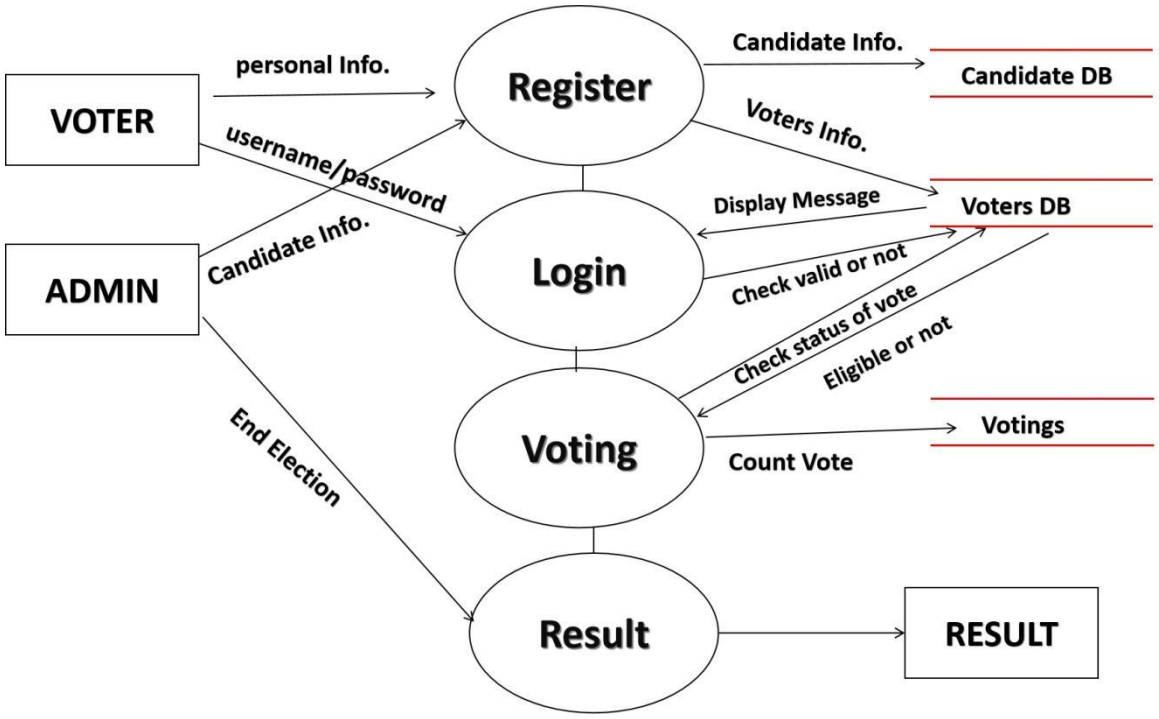
Entity Relationship Diagram

5.3 DataFlow Diagram :

The Data flow diagram(DFD) graphically describes the project processes and flow of information that passes among them.The DFD also describes inputs and outputs of the process and where the data will be stored. The DFD contains components like the entities,process,data storage and Data Flow.

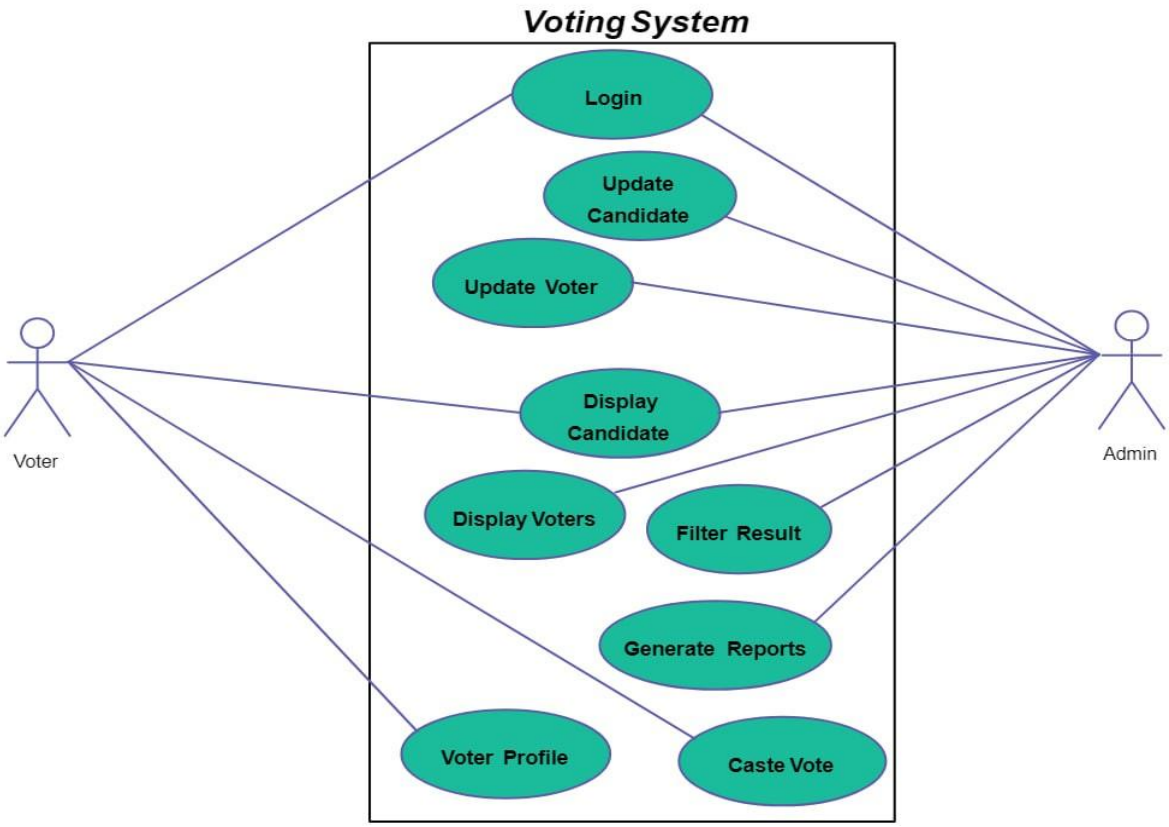


LEVEL -1 DFD


VOTER
ADMIN
personal Info.
username/password
Candidate Info.
End Election
Register
Login
Voting
Result
Candidate Info.
Candidate DB
Voters Info.
Voters DB
Display Message
Check valid or not
Check status of vote
Eligible or not
Votings
Count Vote
RESULT

5.4 Use Case Diagram :

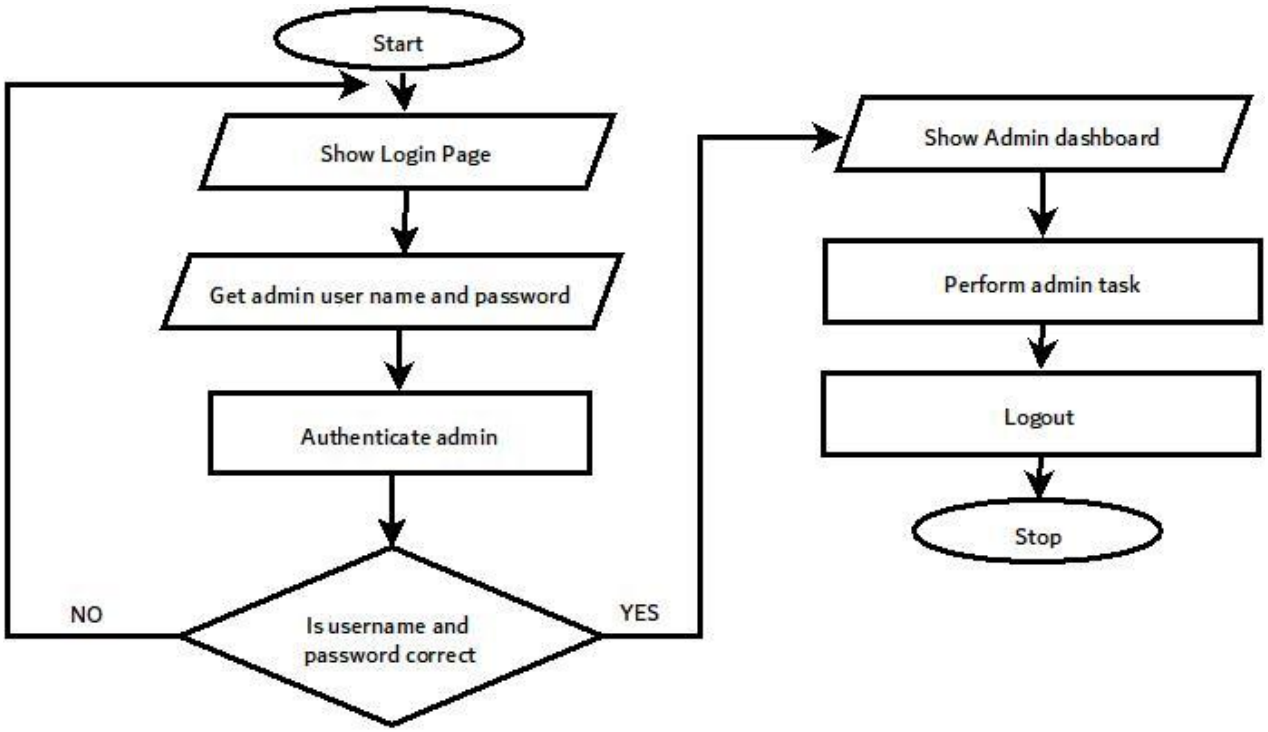
Usecase diagram represents the user interactions with the system.It shows customer relationship with different usecases. It helps in designing a system from users perspective.It also shows the different functionalities provided by the system.



5.5 Flowchart Diagram :

5.5.1 Administrator Dashboard:

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.



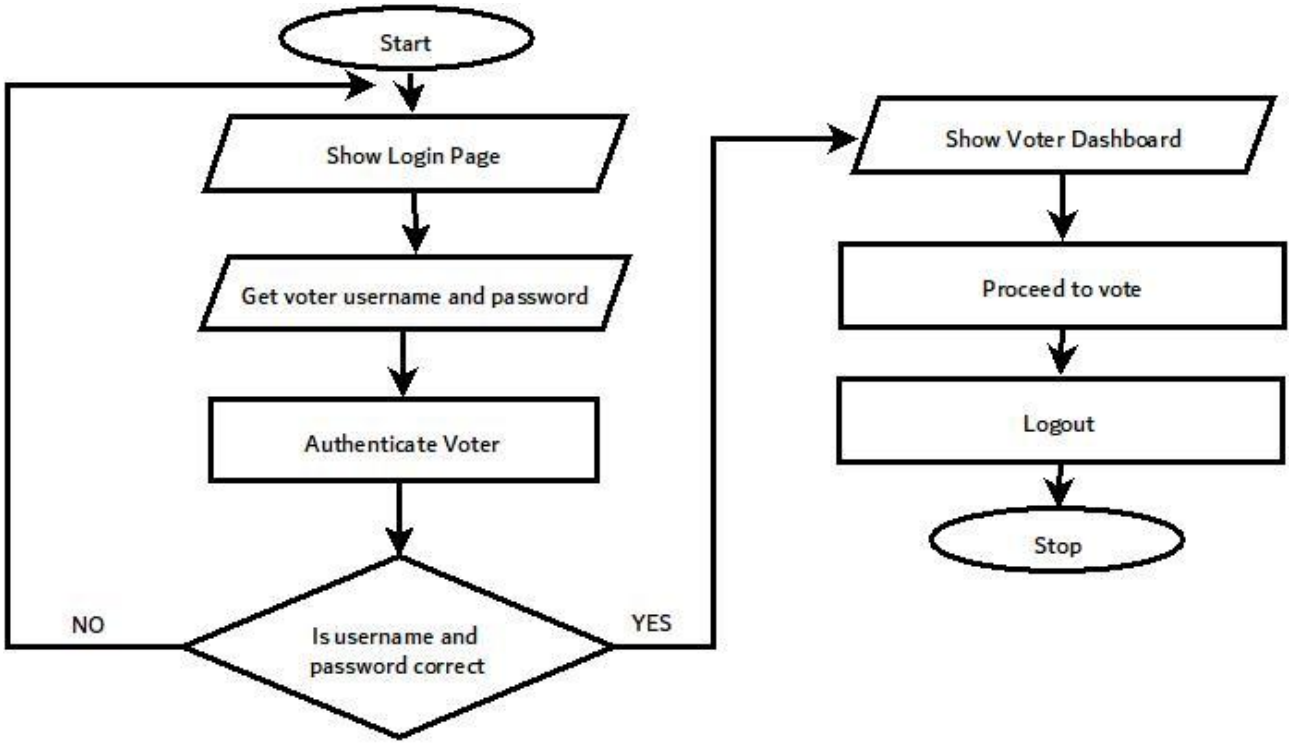
Flowchart for Administration Dashboard

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.

5.5.2 Voting Process :

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.

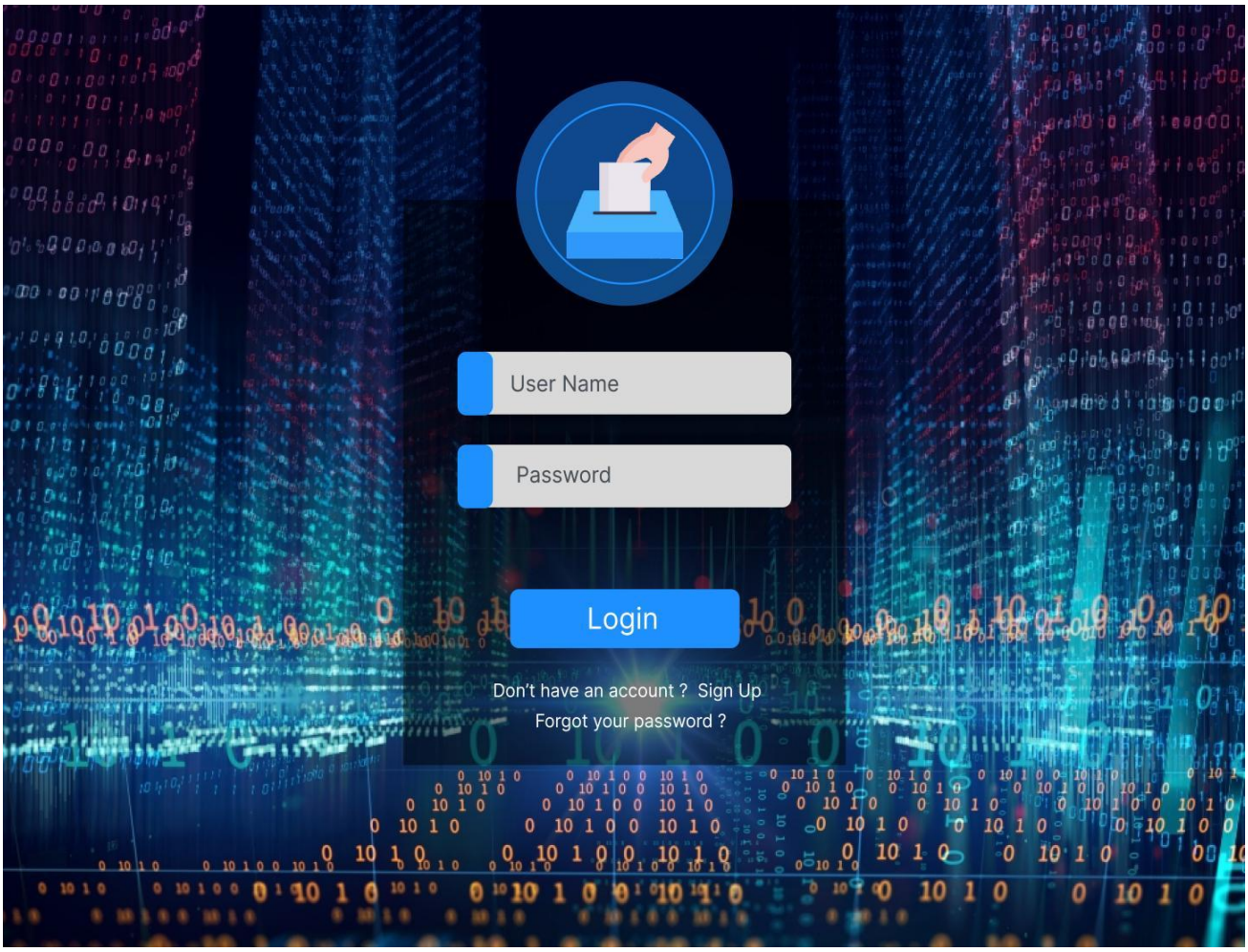


Flowchart For Voting Process

5.6 Project Templates :

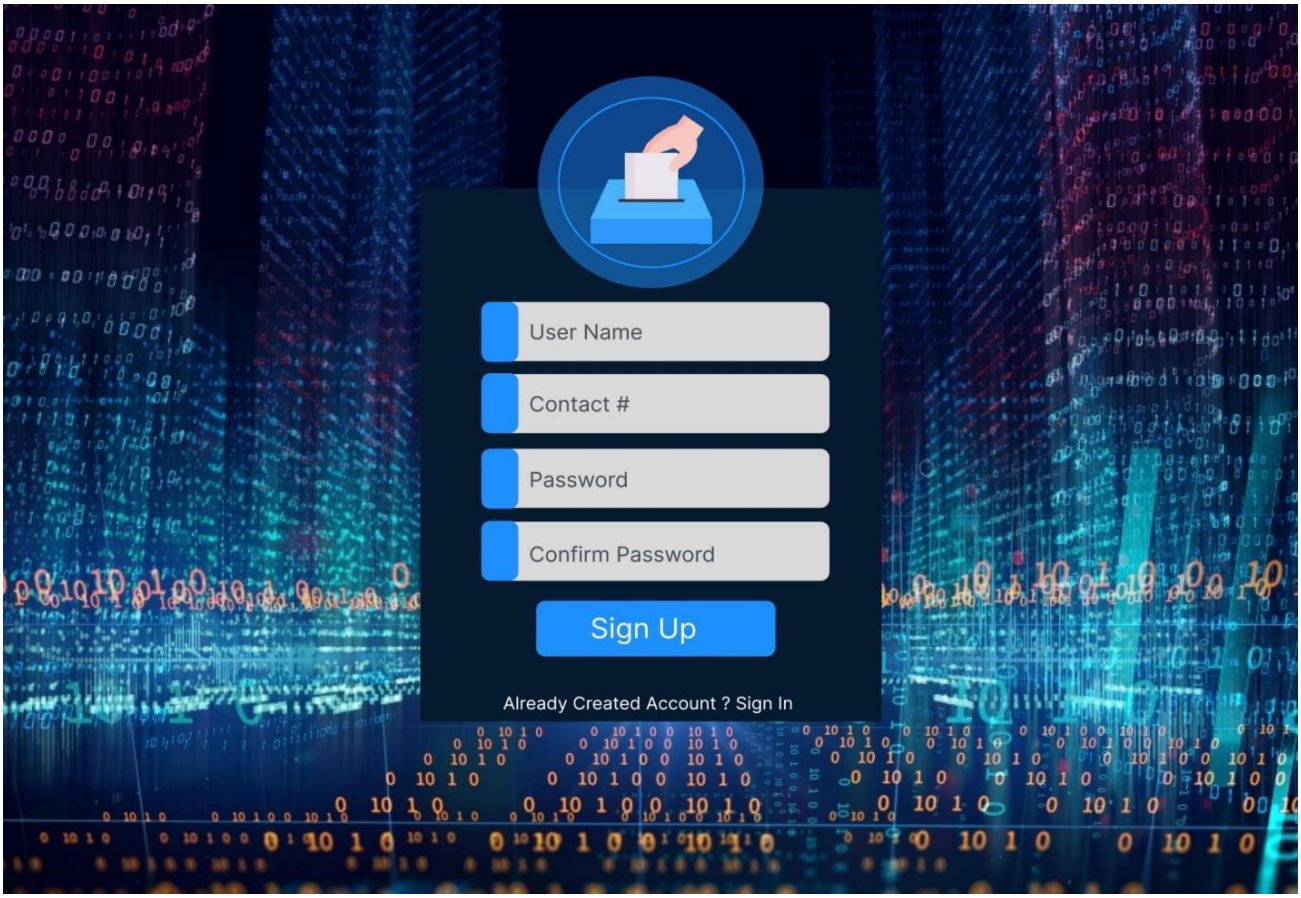
Here is a pictorial representation of how really online voting management system is viewed over the web by the user.

Login Page :



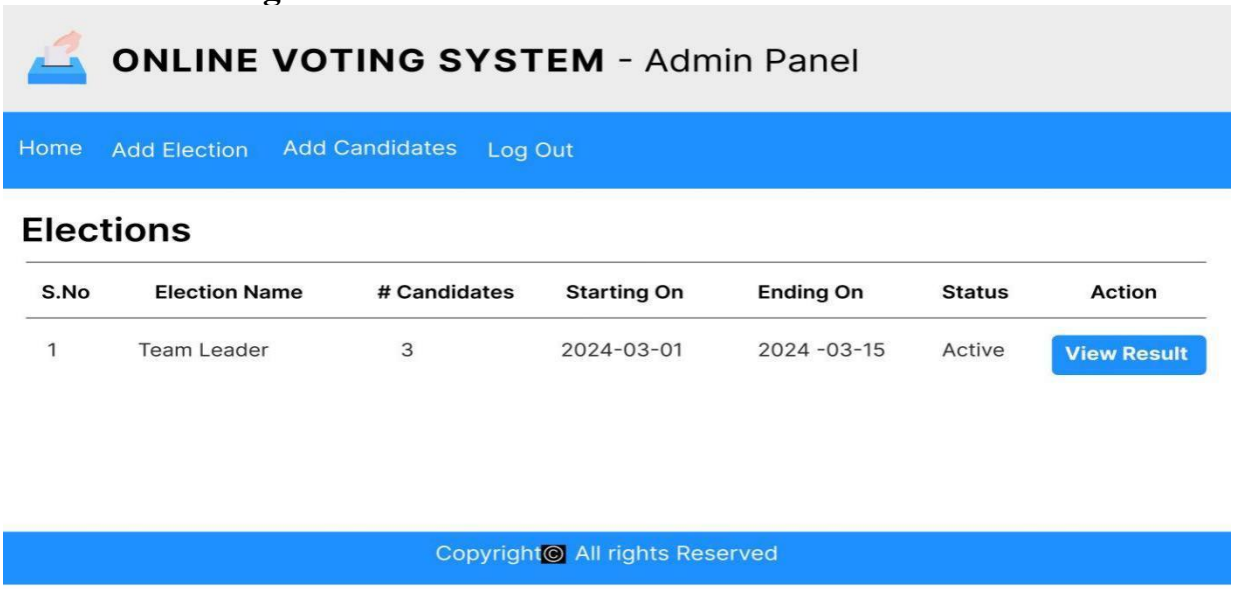
Every system user need to log in to the system. After inserting login details system decide relevant user group and direct to the relevant page accordingly. See design and major code below.

Signup Page :

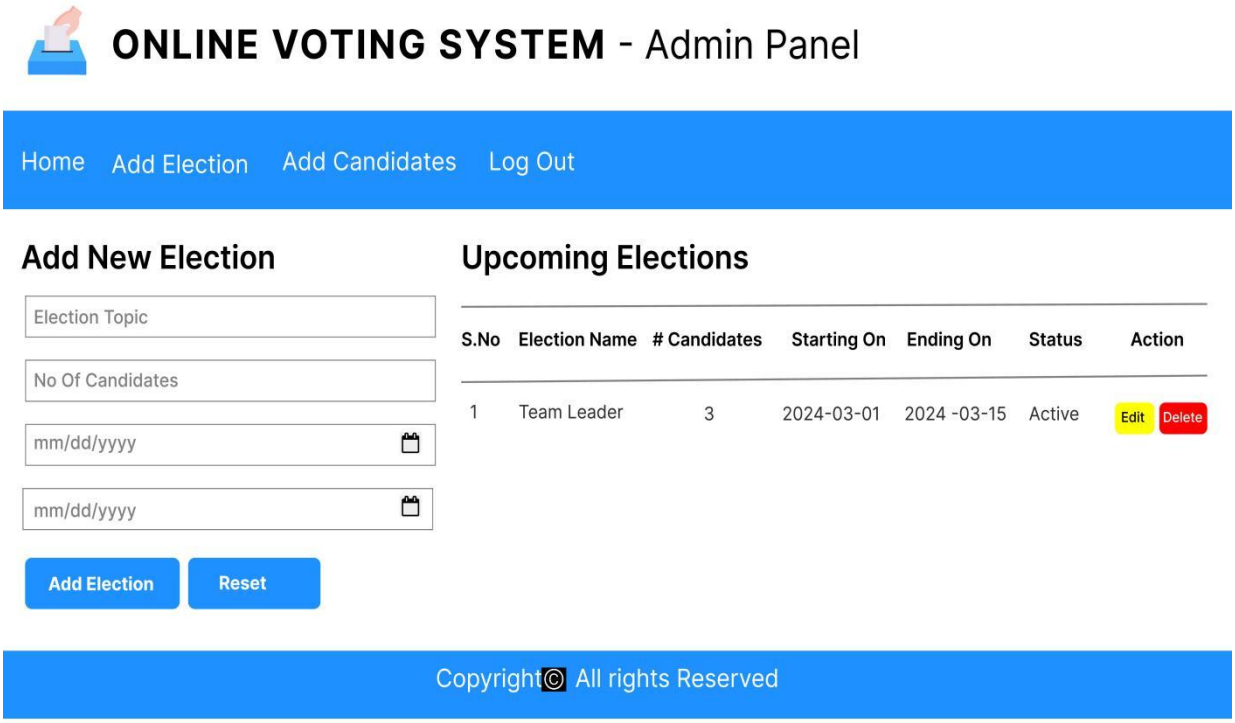


If the user is new to the system , personal details of the user are required such as name, mobile number , and the password that will be used to access the services.

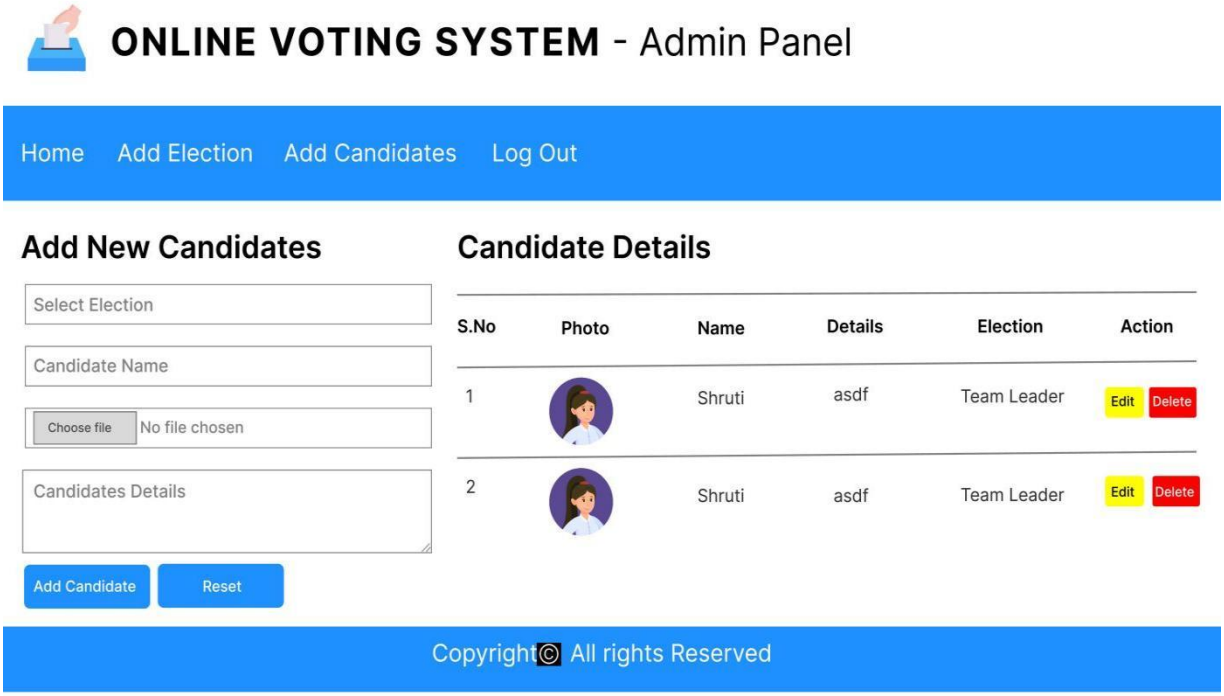
Admin - Home Page :



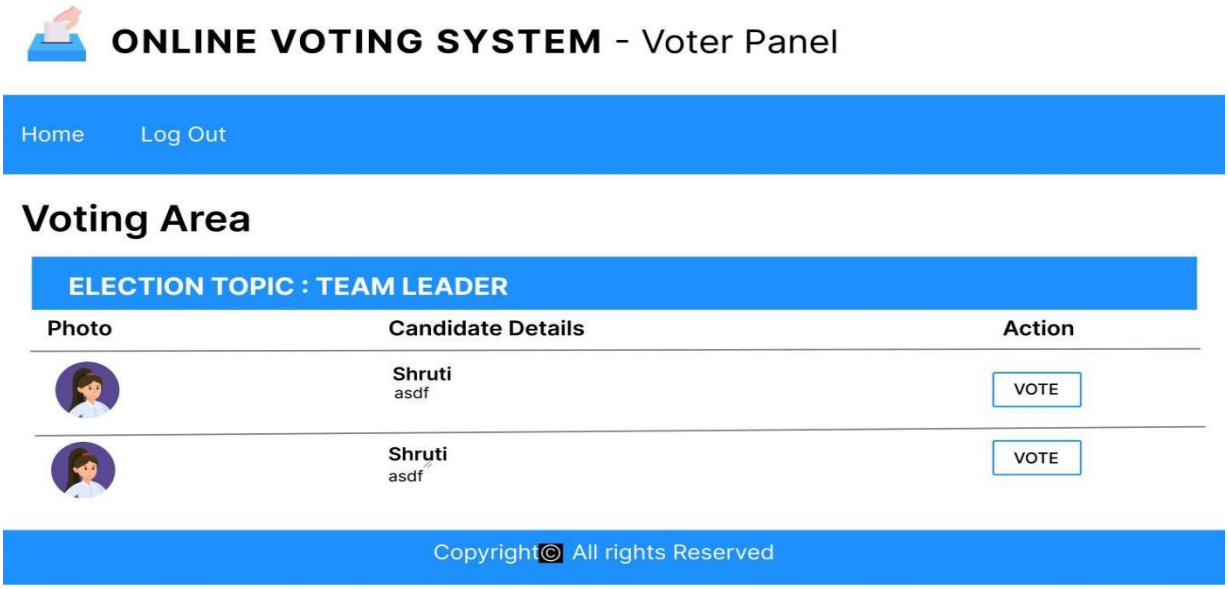
Admin - Add Election Page :



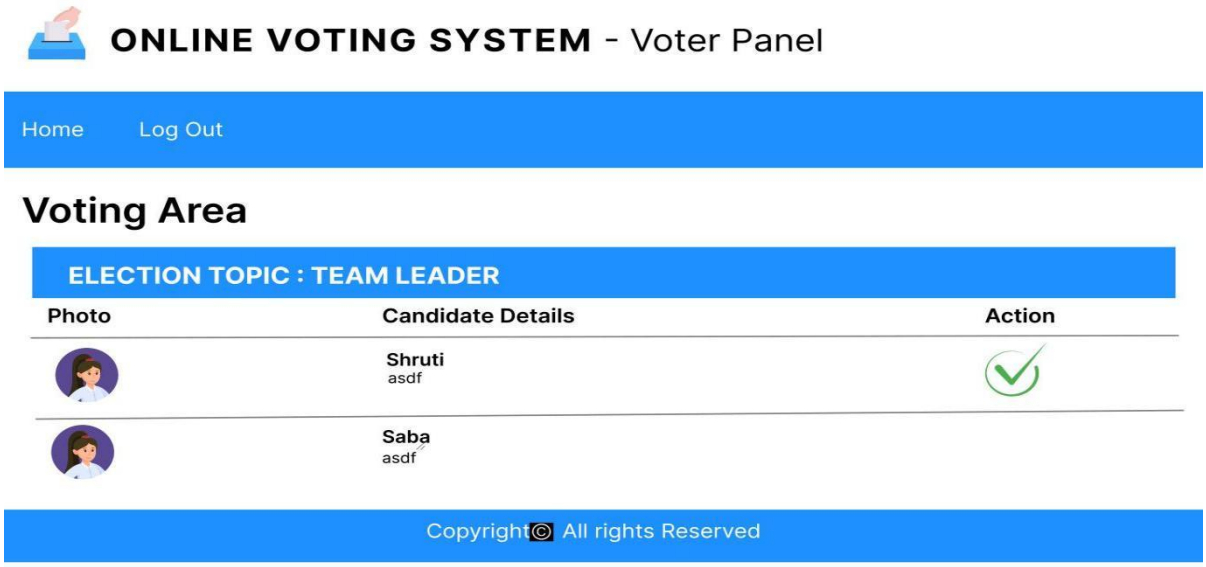
Admin - Add Candidate Page :



Voter's Page :



Voter's Page :



This page provides voter to cast their vote. After submitting their vote system increased the vote cast accordingly.

Result Page :

ONLINE VOTING SYSTEM- Welcome 2147044

Home Add Election Add Candidate Log Out

Election Result :

ELECTION TOPIC : TEAM LEADER

Photo	Candidate Details	#no of votes	Result
	**c1** candidate1	0	
	**c2** candidate2	2	
	**c3** candidate3	1	

Voting Details :

S.No	Voter Name	Contact No	Voted To	Date	Time
1	2147001	1111111111	c2	2024-03-10	04:48:45
2	2147002	9937975292	c2	2024-03-10	04:48:57
3	2147003	3333333333	c3	2024-03-10	04:49:09

CHAPTER-6
CODING

Chapter 6 - CODING

Index.php

```
<?php
    require_once("admin/includes/config.php");

    $fetchingElections = mysqli_query($db,"SELECT * FROM elections") or die(mysqli_error($db));
    while($data = mysqli_fetch_assoc($fetchingElections))
    {
        $starting_date = $data['starting_date'];
        $ending_date = $data['ending_date'];
        $current_date = date('y-m-d');
        $election_id = $data['id'];
        $status = $data['status'];

        // active-expire-endingdate
        // inactive-active-starting date
        if($status=='Active')
        {
            $date1=date_create($current_date);
            $date2=date_create($ending_date);
            $diff=date_diff($date1,$date2);


            if( (int)$diff->format("%R%a")<0)
             {
                // update status
                mysqli_query($db,"UPDATE elections SET status = 'Expired' WHERE id ='".$election_id."' ") OR die
(mysqli_error($db));
             }

        }else if($status == 'InActive')
        {
            $date1=date_create($current_date);
            $date2=date_create($starting_date);
            $diff=date_diff($date1,$date2);

      echo (int)$diff->format("%R%a");
            if( (int)$diff->format("%R%a")<=0)
             {
                mysqli_query($db,"UPDATE elections SET status = 'Active' WHERE id ='".$election_id."' ") OR die
(mysqli_error($db));
             }

        }
        else{

        }

    }
?>


<!DOCTYPE html>
<html>

<head>
    <title>Online voting system</title>
    <link rel="stylesheet" href="assets/css/bootstrap.min.css">
    <link rel="stylesheet" href="assets/css/style.css">
    <link rel="stylesheet" href="assets/css/signup.css">
</head>
```

```
<body>
<?php
                    if(isset($_GET[ 'registered' ]))
                    {
                    ?>
                   <div  class="alert alert-success" role="alert">
  <strong>SUCCESS</strong> Your Account has been created successfully!
  </div>



                    <?php
                    } else if(isset($_GET[ 'invalid' ]))
                    {
                    ?>
                      <div class="alert alert-danger" role="alert">
  <strong>FAIL</strong> Password Mismatched, Please Try Again!</div>

                    <?php
                     }  else if(isset($_GET[ 'not_registered' ]))
                     {
                     ?>
                       <div class="alert alert-warning " role="alert">
   <strong>Sorry</strong> You are not registered!! </div>
 <?php
                     }  else if(isset($_GET[ 'invalid_access' ]))
                     {
                     ?>
                       <div class="alert alert-danger " role="alert">
   <strong>Fail </strong>Invalid user name or password ! </div>
                  <?php
                     }
                    ?>

<!-- signup session -->
    <div class="container h-100">
        <div class="d-flex justify-content-center h-100">
            <div class="user_card">
                <div class="d-flex justify-content-center">
                    <div class="brand_logo_container">
                        <img src="assets/images/logoicon.gif"  class="brand_logo" alt="Logo">

                    </div>
                </div>
                <?php
                 if(isset($_GET['sign-up']))
                    {
                ?>
                 <div class="d-flex justify-content-center form_container">
                            <form method="POST">
                                <div class="input-group mb-2">
                                    <div class="input-group-append">
                                        <span class="input-group-text"><i class="fas fa-user"></i></span>
                                    </div>
                                    <input type="text" name="su_username" class="form-control input_user" minlength='7'
maxlength='7'  placeholder="Username(Roll Number)" required/>
                                </div>
                                <div class="input-group mb-2">
                                    <div class="input-group-append">
                                        <span class="input-group-text"><i class="fas fa-key"></i></span>
                                    </div>
                                    <input type="text" name="su_contactno" class="form-control input_pass" minlength="10"
maxlength='10' placeholder="Contact (+91)" required/>
                                </div>
                                <div class="input-group mb-2">
                                    <div class="input-group-append">
                                        <span class="input-group-text"><i class="fas fa-key"></i></span>
                                    </div>
                                    <input type="password" name="su_password" class="form-control
input_pass"  placeholder="Password(4-13 character)" minlength='4' maxlength='13' required/>
                                </div>
                                <div class="input-group mb-2">
```

```
                                    <div class="input-group-append">
                                        <span class="input-group-text"><i class="fas fa-key"></i></span>
                                    </div>
                                    <input type="password"  name="su_confirmpassword" class="form-control
input_pass"  placeholder="Confirm Password" required/>
                                </div>

                                    <div class="d-flex justify-content-center mt-3 login_container">
                            <button type="submit" name="sign_up_btn" class="btn login_btn ">Sign Up</button>
                        </div>
                            </form>
                        </div>
                        <div class="mt-4">
                            <div class="d-flex justify-content-center links text-white">
                                Already Created Account ?<a href="index.php" class="ml-2 text-white">Sign In</a>
                            </div>
                        </div>

                <?php

                    }

                //  <!--- login page --->
                 else
                    {
                ?>
                            <div class="d-flex justify-content-center form_container">
                            <form method="POST">
                                <div class="input-group mb-3">
                                    <div class="input-group-append">
                                        <span class="input-group-text"><i class="fas fa-user"></i></span>
                                    </div>
                                    <input type="text" name="username" class="form-control input_user"  placeholder="User"
required/>
                                </div>
                                <div class="input-group mb-2">
                                    <div class="input-group-append">
                                        <span class="input-group-text"><i class="fas fa-key"></i></span>
                                    </div>
                                    <input type="password" name="password" class="form-control input_pass"
placeholder="password" required/>
                                </div>
                                <div class="d-flex justify-content-center mt-3 login_container">
                            <button type="submit" name="loginbtn" class="btn login_btn">Login</button>
                        </div>
                            </form>
                        </div>

                        <div class="mt-4">
                            <div class="d-flex justify-content-center links text-white">
                                Don't have an account? <a href="?sign-up=1" class="ml-2 text-white">Sign Up</a>
                            </div>
                            <!-- <div class="d-flex justify-content-center links">
                                <a href="#" class="text-white">Forgot your password?</a>
                            </div> -->
                        </div>
                        <?php
                    }
                    ?>

            </div>
        </div>
    </div>
    <script src="assets/js/bootstrap.min.js"></script>
    <script src="assets/js/jquery.min.js"></script>
</body>
</html>

<?php
   // su_username    su_contactno   su_password   su_confirmpassword   sign_up_btn
        require_once("admin/includes/config.php");
        if(isset($_POST['sign_up_btn']))
```

```
        {
            $su_username =mysqli_real_escape_string($db,$_POST['su_username']);
            $su_contactno =mysqli_real_escape_string($db,$_POST['su_contactno']);
            $su_password =mysqli_real_escape_string($db,sha1($_POST['su_password']));
            $su_confirmpassword =mysqli_real_escape_string($db,sha1($_POST['su_confirmpassword']));
            $user_role="Voter";
            if($su_password==$su_confirmpassword)
            {
                //Query to Insert
                mysqli_query($db,"INSERT INTO users(username,contact_no,password,user_role)
VALUES('".$su_username."','".$su_contactno."','".$su_password."','".$user_role."')")or die(mysqli_error($db));

    ?>
           <script>location.assign("index.php?sign-in=1&registered=1");</script>

    <?php


            }else{

     ?>
            <script>location.assign("index.php?sign-up=1&invalid=1");</script>
<?php
            }
        }
        // username   password
        elseif(isset($_POST['loginbtn']))
        {
            $username  =mysqli_real_escape_string($db,$_POST['username']);
            $password   =mysqli_real_escape_string($db,sha1($_POST['password']));

            //Query for fetching
            $fetchingdata= mysqli_query($db,"SELECT * FROM users WHERE username= '". $username."'") or die(mysqli_error($db));

            // echo $data['username'];

            if(mysqli_num_rows($fetchingdata)>0)
            {
                $data = mysqli_fetch_assoc($fetchingdata);
                if($username == $data['username'] and $password == $data['password'])
                {
                    session_start();
                    $_SESSION['user_role']=$data['user_role'];
                    $_SESSION['username']=$data['username'];
                    $_SESSION['user_id'] = $data['id'];




                    if($data['user_role'] == "Admin")
                    {
                        $_SESSION['key'] ='AdminKey';
                        ?>
<script>location.assign("admin/index.php?homepage=1.php");</script>


<?php
                    }else{
                        $_SESSION['key']='VotersKey';
                        ?>
<script>location.assign("voters/index.php");</script>

<?php
                    }

                }else{
                    ?>
                    <script>location.assign("index.php?invalid_access=1");</script>

                    <?php
```

```
                }

            } else{

                ?>

<script>location.assign("index.php?sign-up=1&not_registered=1");</script>

                <?php
            }


        }


?>
```

Add Election.php

```
<?php
if(isset($_GET['added']))
{
    ?>
<div id='my-alert' class="alert alert-success m-3" role="alert">
  Election has been added successfully.
</div>
<script>
      const alert = document.getElementById('my-alert');
      setTimeout(() => {
         $('#my-alert').alert('close')
      }, 2000)

   </script>
    <?php
}else if(isset($_GET['delete_id']))
{
    $d_id = $_GET['delete_id'];
    mysqli_query($db,"DELETE FROM elections WHERE id ='".$d_id."'") OR die(mysqli_error($db));
    mysqli_query($db,"DELETE FROM candidate_details WHERE election_id ='".$d_id."'") OR die(mysqli_error($db));
    mysqli_query($db,"DELETE FROM votings WHERE election_id ='".$d_id."'") OR die(mysqli_error($db));
    ?>
    <div id='alert' class="alert alert-danger m-3" role="alert">
  Election has been deleted successfully.
 </div>
    <?php
}
?>
<script>
      const alert = document.getElementById('alert');
      setTimeout(() => {
         $('#alert').alert('close')
      }, 2000)

   </script>


<div class="row my-3">
    <div class="col-4 pl-4">
        <h3>Add New Election</h3>
        <form method="post">
            <div class="form-group">
                <input type="text" name="election_topic" placeholder="Election Topic" class="form-control" required/>
            </div>
            <div class="form-group">
                <input type="number" name="no_of_candidates" placeholder="Number Of Candidates" class="form-control"
required/>
            </div>
```

```
            <div class="form-group">
                <input type="text" onfocus="this.type='date'" name="starting_date" placeholder="Starting Date" class="form-
control" required/>
            </div>
            <div class="form-group">
                <input type="text" onfocus="this.type='date'" name="ending_date" placeholder="Ending Date" class="form-
control" required/>
            </div>
         <input type="reset" value="Reset" name="reset" class="btn btn-outline-primary"/>
         <input type="submit" value="Add Election" name="addelection" class="btn btn-outline-primary"/>
        </form>
    </div>
    <div class="col-8">
        <h3>Upcoming Elections</h3>
        <table class="table">
            <thead>
                <tr>
                    <th scope="col">S.no</th>
                    <th scope="col">Election Name</th>
                    <th scope="col">#Candidates</th>
                    <th scope="col">Starting On</th>
                    <th scope="col">Ending On</th>
                    <th scope="col">Status</th>
                    <th scope="col">Action</th>
                </tr>
            </thead>
            <tbody>
                <?php
                    $fetchingData= mysqli_query($db,"SELECT * from elections") or die(mysqli_error($db));
                    $isanyelectionadded=mysqli_num_rows($fetchingData);

                    if($isanyelectionadded > 0)
                    {
                        $sno=1;
                        while ($row=mysqli_fetch_assoc($fetchingData))
                         {
                            $election_id = $row['id'];
                          ?>
                          <tr>
                            <td><?php echo $sno++ ?></td>
                            <td><?php echo $row['election_topic']; ?></td>
                            <td><?php echo $row['no_of_candidates']; ?></td>
                            <td><?php echo $row['starting_date']; ?></td>
                            <td><?php echo $row['ending_date']; ?></td>
                            <td><?php echo $row['status']; ?></td>
                            <td>
                                    <button class="btn btn-sm btn-danger" onclick="DeleteData(<?php echo $election_id; ?>)">
Delete </button>
                                </td>
                          </tr>
                          <?php
                        }
                    }else{
                        ?>
                        <tr>
                            <td colspan="7">No Elections Available</td>
                        </tr>
                        <?php
                    }
                ?>
            </tbody>
        </table>
    </div>

</div>
<script>
    const DeleteData = (e_id) =>
    {
        let c = confirm("Are you really want to delete it?");

        if(c == true)
        {
```

```
            location.assign("index.php?addelectionpage=1&delete_id=" + e_id);
        }
    }
</script>

<?php
    // election_topic no_of_candidates starting_date ending_date

    if(isset($_POST['addelection']))
    {
        $election_topic = mysqli_real_escape_string($db,$_POST['election_topic']);
        $no_of_candidates = mysqli_real_escape_string($db,$_POST['no_of_candidates']);
        $starting_date = mysqli_real_escape_string($db,$_POST['starting_date']);
        $ending_date = mysqli_real_escape_string($db,$_POST['ending_date']);
       $inserted_by = $_SESSION['username'];
       $inserted_on =date("y-m-d");

       $date1=date_create($inserted_on);
       $date2=date_create($starting_date);
       $diff=date_diff($date1,$date2);


       if((int) $diff->format("%R%a")>0)
        {
            $status="InActive";
        }else{
            $status="Active";
        }

        //inserting into database
        mysqli_query($db,"insert into
elections(election_topic,no_of_candidates,starting_date,ending_date,status,inserted_by,inserted_on) values('".
$election_topic."','". $no_of_candidates."','". $starting_date ."','". $ending_date."','". $status."','". $inserted_by."','".
$inserted_on."')")or die(mysqli_error($db));
        ?>
        <script>location.assign("index.php?addelectionpage=1&added=1")</script>
        <?php
    }

?>
```

Add Candidate.php

```
<?php
if(isset($_GET['added']))
{
    ?>
<div id='my-alert' class="alert alert-success m-3" role="alert">
  candidate has been added successfully.
</div>
<script>
      const alert = document.getElementById('my-alert');
      setTimeout(() => {
         $('#my-alert').alert('close')
      }, 2000)
   </script>
    <?php
}
else if(isset($_GET['largefile']))
{
    ?>
<div class="alert alert-danger m-3" role="alert">
  candidate image is too large (You can upload image upto 2mb size).
</div>
```

```
    <?php
}
else if(isset($_GET['invalidfile']))
{
    ?>
<div class="alert alert-danger m-3" role="alert">
    invalid type of image (only .jpg ,.png,.jpeg allowed)
</div>

    <?php
}

else if(isset($_GET['failed']))
{
    ?>
<div class="alert alert-danger m-3" role="alert">
    Image uploading failed,please try again.
</div>

<?php
} else if(isset($_GET['delete_id'])){
    $d_id = $_GET['delete_id'];
    mysqli_query($db,"DELETE FROM candidate_details WHERE id ='".$d_id."'") OR die(mysqli_error($db));
    mysqli_query($db,"DELETE FROM votings WHERE candidate_id ='".$d_id."'") OR die(mysqli_error($db));

    ?>
    <div id='alert' class="alert alert-danger m-3" role="alert">
  candidate has been deleted successfully.
 </div>
    <?php
}
?>
 <script>
      const alert = document.getElementById('alert');
      setTimeout(() => {
         $('#alert').alert('close')
      }, 2000)
   </script>

<div class="row my-3">
    <div class="col-4 pl-4">
        <h3>Add New Candidate</h3>
        <form method="post" enctype="multipart/form-data">
            <div class="form-group">
                <select name="election_id" class="form-control" required>
                    <option value="">Select Election</option>
                    <?php
                        $fetchingElections = mysqli_query($db,"select * from elections") or die(mysqli_error($db));
                        $isanyelectionadded = mysqli_num_rows($fetchingElections);

                        if($isanyelectionadded > 0)
                        {
                            while($row = mysqli_fetch_assoc($fetchingElections))
                            {
                                $election_id =$row['id'];
                                $election_name = $row['election_topic'];
                                $allowedcandidates = $row['no_of_candidates'];
                                //Now checking how many candidates are added in this election
                                $fetchingcandidate = mysqli_query($db,"select * from candidate_details where election_id=
'".$election_id."'") or die(mysqli_error($db));
                                $added_candidates =mysqli_num_rows($fetchingcandidate);

                                if($added_candidates < $allowedcandidates)
                                {
                                     ?>
                                    <option value="<?php echo $election_id?>"><?php echo $election_name?></option>
                                <?php
                                }
```

```
                        }

                    }else{
                        ?>
                        <option value="">Please Add Election First</option>
                        <?php
                    }

                ?>
            </select>
        </div>
        <div class="form-group">
            <input type="text" name="candidatename" placeholder="Candidate Name" class="form-control" required/>
        </div>
        <div class="form-group">
            <input type="file" name="candidatephoto"  class="form-control" required/>
        </div>
        <div class="form-group">
            <input type="text"  name="candidatedetails" placeholder="Candidate Details" class="form-control" required/>
        </div>
      <input type="reset" value="Reset" name="reset" class="btn btn-outline-primary"/>
      <input type="submit" value="Add Candidates" name="addcandidatebtn" class="btn btn-outline-primary"/>
    </form>
</div>


<div class="col-8">
    <h3>Candidate Details</h3>
    <table class="table">
        <thead>
            <tr>
                <th scope="col">S.no</th>
                <th scope="col">Photo</th>
                <th scope="col">Name</th>
                <th scope="col">Details</th>
                <th scope="col">Election</th>
                <th scope="col">Action</th>
            </tr>
        </thead>
        <tbody>
            <?php
                $fetchingData= mysqli_query($db,"SELECT * from candidate_details") or die(mysqli_error($db));
                $isanycandidateadded=mysqli_num_rows($fetchingData);

                if($isanycandidateadded > 0)
                {

                    $sno=1;
                    while ($row=mysqli_fetch_assoc($fetchingData))
                     {
                        $candidate_id = $row['id'];
                        $election_id =$row['election_id'];
                        $fetchingelectionname=mysqli_query($db,"select * from elections where id = '".$election_id."'")or
die(mysqli_error($db));
                        $fetchingelectionnamequery = mysqli_fetch_assoc($fetchingelectionname);
                        $election_name =$fetchingelectionnamequery['election_topic'];
                        $candidate_photo = $row['candidate_photo'];

                     ?>
                     <tr>
                       <td><?php echo $sno++ ?></td>
                       <td><img  src="<?php echo $candidate_photo; ?>"
                       class = "candidate_photo" /></td>
                     <td><?php echo $row['candidate_name']; ?></td>
                       <td><?php echo $row['candidate_details']; ?></td>
                       <td><?php echo $election_name; ?></td>
                       <td>
                         <button class="btn btn-sm btn-danger" onclick="DeleteData(<?php echo $candidate_id; ?>)"> Delete
</button>
                       </td>
                     </tr>
                     <?php
```

```
                    }
                }else{
                    ?>
                    <tr>
                        <td colspan="7">No Elections Available</td>
                    </tr>
                    <?php
                }
            ?>
        </tbody>
    </table>
</div>

</div>

<script>
    const DeleteData = (c_id) =>
    {
        let c = confirm("Are you really want to delete it?");

        if(c == true)
        {
            location.assign("index.php?addcandidatespage=1&delete_id=" + c_id);
        }
    }
</script>

<?php
//  candidatedetails candidatephoto candidatename
    if(isset($_POST['addcandidatebtn']))
    {
        $election_id = mysqli_real_escape_string($db,$_POST['election_id']);
        $candidatename = mysqli_real_escape_string($db,$_POST['candidatename']);
        $candidatedetails = mysqli_real_escape_string($db,$_POST['candidatedetails']);
        $inserted_by = $_SESSION['username'];
        $inserted_on =date("y-m-d");

        //photograph logic starts
        $target_folder="../assets/images/candidates_photo/";
        $candidatephoto =
$target_folder.rand(1111111111,9999999999)."_".rand(1111111111,9999999999).$_FILES['candidatephoto']['name'];
        $candidate_photo_tmp_name = $_FILES['candidatephoto']['tmp_name'];
        $candidate_photo_type = strtolower(pathinfo($candidatephoto, PATHINFO_EXTENSION));
        $allowed_types = array("jpg","png","jpeg");
        $image_size = $_FILES['candidatephoto']['size'];

        if($image_size < 2000000) //2mb
        {
            if(in_array($candidate_photo_type,$allowed_types))
            {
                if(move_uploaded_file($candidate_photo_tmp_name,$candidatephoto))
                {
                    //inserting into database
                    mysqli_query($db,"insert into
candidate_details(election_id,candidate_name,candidate_details,candidate_photo,inserted_by,inserted_on) values('".
$election_id."','". $candidatename."','". $candidatedetails ."','". $candidatephoto."','". $inserted_by."','".
$inserted_on."')")or die(mysqli_error($db));
                    ?>
                    <script>location.assign("index.php?addcandidatespage=1&added=1")</script>
                    <?php

                }else{

                    echo"<script>location.assign('index.php?addcandidatespage=1&failed=1');</script>";

                }

            }else{
                echo"<script>location.assign('index.php?addcandidatespage=1&invalidfile=1');</script>";
            }
```

```
        }else {
            echo"<script>location.assign('index.php?addcandidatespage=1&largefile=1');</script>";
        }


        // photograph logic ends


    }

?>
```

Voter.php

```
<?php

    require_once("includes/header.php");
    require_once("includes/navigation.php");
  ?>

        <div class="row m-2">
            <div class="col-12">
                <h3>Voters Panel</h3>
            <?php
                $fetchingActiveElections=mysqli_query($db,"select * from elections where status='Active'") or
die(mysqli_error($db));
                $totalActiveElection= mysqli_num_rows($fetchingActiveElections);

                if($totalActiveElection > 0)
                {
                    while ($data =mysqli_fetch_assoc($fetchingActiveElections))
                    {
                        $election_id= $data['id'];
                        $election_topic = $data['election_topic'];
                        ?>
                     <table class="table">
                        <thead>
                         <tr>
                                <th colspan='3' class="bg-primary text-white"><h5>ELECTION TOPIC : <?php echo
strtoupper($election_topic);?></h5></th>
                         </tr>
                         <tr>
                             <th>Photo</th>
                             <th>Candidate Details</th>
                             <th>Action</th>

                          </tr>
                        </thead>
                        <tbody>
                            <?php
                               $fetchingCandidates = mysqli_query($db,"select * from candidate_details where election_id=
'".$election_id."'") or die(mysqli_error($db));

                               while($candidatedata = mysqli_fetch_assoc($fetchingCandidates))
                               {
                                   $candidate_id = $candidatedata['id'];
                                   $candidate_photo = $candidatedata['candidate_photo'];

                                   ?>

                                   <tr>
                                       <td><img src="<?php echo $candidate_photo ?>" class="candidate_photo"></td>
                                       <td><?php echo"<b>".
$candidatedata['candidate_name']."</b><br/>".$candidatedata['candidate_details']; ?></td>
                                       <td>
```

```
                                    <?php
                                     $checkIfVoteCasted = mysqli_query($db, "SELECT * FROM votings WHERE voters_id = '".
$_SESSION['user_id'] ."' AND election_id = '". $election_id ."'") or die(mysqli_error($db));
                                     $isVoteCasted = mysqli_num_rows($checkIfVoteCasted);

                                    if($isVoteCasted >0)
                                    {
                                        $votecasteddata=mysqli_fetch_assoc($checkIfVoteCasted);
                                        $votecastedtocandidate =$votecasteddata['candidate_id'];
                                        if($votecastedtocandidate == $candidate_id)
                                        {
                                            ?>
                                            <img src="../assets/images/voteicon.avif" width=100px></td>
                                            <?php
                                        }



                                    }else{
                                        ?>

                                <button class='btn btn-md btn-outline-primary' onclick="castvote(<?php echo
$election_id;?>,<?php echo $candidate_id;?>,<?php echo $_SESSION['user_id'];?>)" > vote </button></td>
                                        <?php
                                    }
                                    ?>

                                </tr>
                                <?php
                            }
                        ?>
                    </tbody>
                </table>

                <?php
                }

            }
            else {
                echo"No Elections Active!";
            }
        ?>



            </div>
        </div>


<script>
    const castvote =(election_id,candidate_id,voters_id)=>
    {
            $.ajax({
            type : "POST",
            url:"includes/ajaxcalls.php",
            data:"e_id="+election_id+"&c_id="+candidate_id+"&v_id="+voters_id,
            success: function (response) {
                if(response=='success')
                {
                    location.assign("index.php?VoteCasted=1");
                }else{
                    location.assign("index.php?VoteNotCasted=1");
                }
            }
        });
    }
</script>
  <?php
    require_once("includes/footer.php");
      ?>
```

CHAPTER-7
TESTING

Chapter 7 - TESTING

7.1 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.

7.2 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.

7.3 Tests conducted on system testing :

7.3.1 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.

7.3.2 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.

7.3.3 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.

7.3.4 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.

CHAPTER-8
CONCLUSION

Chapter 8 - CONCLUSION

This is an alternative voting system besides the conventional voting system . Since , todays world has become very familiar with internet and people don’t find time to go out for voting. With the advent of technology and Internet in our day to day life, we were able to offer advanced voting system to voters both in the country and outside through our online voting system.Security is the major concern in Online Voting System still it can be overcome through technologies.

CHAPTER-9
FUTURE SCOPE

Chapter 9 - FUTURE SCOPE

9.1 FUTURE SCOPE:

- It will increase the overall voting percentage
- It will reduce election expenditure
- It can be made more secure by using the advance security methods like biometrics.

9.2 FUTURE ENHANCEMENT :

- Fingerprinting
- Cornea Detection

CHAPTER-10
REFERENCES

Chapter 10 - BIBLIOGRAPHY

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