The use of Blockchain Technology for e-voting

Project report submitted in partial fulfilment of the requirement for the degree of Bachelor of Technology

In

Computer Science and Engineering

By

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Under the supervision of

Dr. Ekta Gandotra

To

Department of Computer Science & Engineering and Information Technology

Jaypee University of Information Technology Waknaghat, Solan-173234, Himachal Pradesh

Certificate

Candidate's Declaration

I hereby declare that the work presented in this report entitled **"The use of Blockchain Technology for e-voting"** in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science and Engineering** submitted in the department of Computer Science & Engineering and Information Technology**,** Jaypee University of Information Technology Waknaghat is an authentic record of my own work carried out over a period from August 2020 to December 2020 under the supervision of **Dr. Ekta Gandotra,** Assistant Professor (Senior Grade).

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

Mohit Mrinal, 171236

Tanvi Sankhyan, 171234

This is to certify that the above statement made by the candidate is true to the best of my knowledge.

Ekta

Dr. Ekta Gandotra

Assistant Professor (Senior Grade)

Department of Computer Science & Engineering and Information Technology

Jaypee University Of Information Technology

Dated: 15-05-2020

ACKNOWLEDGEMENT

Besides the hard work of a group, the success of a project also depends highly on the encouragement and guidelines of many others. I take this opportunity to express my sincere and heartfelt gratitude to the people who have been instrumental in the successful completion of this project.

Our first and foremost acknowledgement goes to our supervisor and mentor, **Dr. Ekta Gandotra**, without whose help the completion of this project would not have been possible. It is because of his guidance and efforts that I was able to implement a practical idea based on my field of interest. I would also like to thank my panel for giving me an opportunity to present my project and for judging my work and providing me feedback which would certainly help me in the future.

Last but not the least I would like to acknowledge my institution **Jaypee University of Information Technology** for giving me a platform to give me life and implementation, to the various fields I have studied till date.

Mohit Mrinal

Mohit Mrinal   Tanvi Sankhyan

(171236)   (171234)

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List of Abbreviations

Abbreviation	Full Form
e- voting	Electronic Voting
php	Hypertext Pre-processor
EVM	Electronic Voting Machine

List of Images

Abstract

Building a blockchain voting platform which offers better privacy and fair results. After independence the fairness in voting schemes has always been an issue. Be it a paper ballot system or electronic voting machine. Both of the systems can be easily manipulated. The results of Electronic Voting machines could be easily tampered by little changes in the software which makes people around the world skip the voting. Just to ensure that most people voted and to ensure their faith in democracy, a new platform is needed which could provide transparency, traceability and immutability "**The use of Blockchain Technology for e-voting**". Our work is not only limited to creating that system but also to work on the fields where data security is the priority and work on the various applications of blockchain technology to understand the scope of this technology and where it can be applied in the most effective way. Because of its highly reliable characteristics it can be used in places which need to maintain highest secrecy and no interference from others. Platforms which can be accessed by everyone and manipulated by none. Platforms which work in real time to be traceable and transparent.

Chapter 1: INTRODUCTION

1.1 Introduction

In the voting sector, voting results have always been criticized by many people for being unfair and unreliable. After independence, mostly every nation adopted a paper ballot system due to lack of resources and less developed technology. Paper ballot system might have worked upto certain justifying limit but then led to manipulation.

Then came the electronic voting machine, which appeared to be the solution in the beginning but then came the consequences of using it in public when people have physical access to it and can sabotage it and can even temper the results casted beforehand.

Then blockchain technology came. Blockchain is a digital record of transactions called digital ledger and is immutable, decentralized, traceable, transparent and reliable. Blockchain is a technology that came into existence around 2008-09 by the invention of bitcoins by Satoshi Nakamoto.

As the name suggests blockchain is a combination of two words block and chain where 'block' refers to the information of transaction and 'chain' refers to the link between these blocks of information. Blocks store the information about the transactions like amount, date, time and username. To distinguish each block from one another it stores a unique code called "*hash*". Hashes are the cryptographic codes generated by blockchain algorithms.

A blockchain is a chain of blocks strung together. How does a block enter a blockchain? Lets say, for a block to enter blockchain, it should contain some digital information.

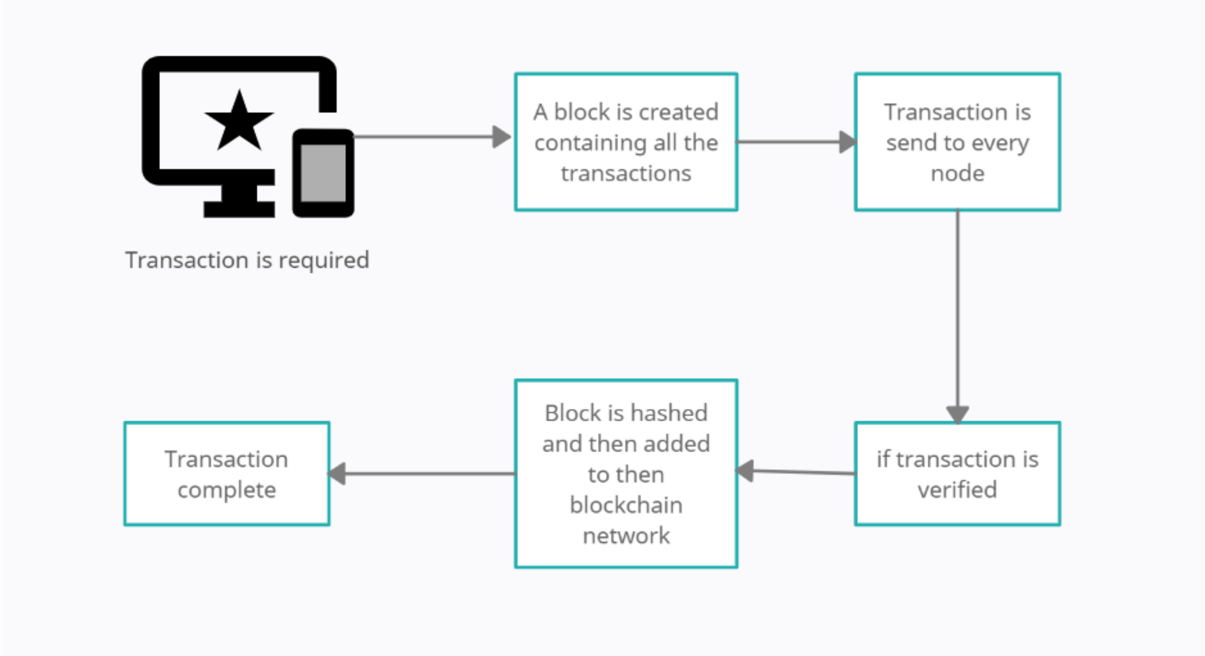

Transaction is required
A block is created containing all the transactions
Transaction is send to every node
if transaction is verified
Block is hashed and then added to then blockchain network
Transaction complete

Fig. 1.1 Blockchain Architecture

(i) First, a transaction should happen. As a block contains information of thousands of users. Your transaction information will share the same block with other users as well.
(ii) Transaction information must be verified. Transaction is validated by thousands of miners to prevent fraud.
(iii) After the transaction is verified and validated, it is stored in a block. After all the transactions are verified and stored in the block, the block is given a unique code ‘*hash*’.
(iv) And as the block is hashed, it is then added to the blockchain network.

1.2 Motivation

For every independent citizen, it is now more important than ever to know whether the voting results were fair or not. With this motivation we desire to build a system which is least prone to manipulation and system errors. A system which persuades more people to vote and honor their individual rights.

1.3 Problem Statement

The use of Blockchain Technology for e- voting. Here we will use php to create a platform for voting which saves the results after voting after verifying the individual and then adds the block to the chain.

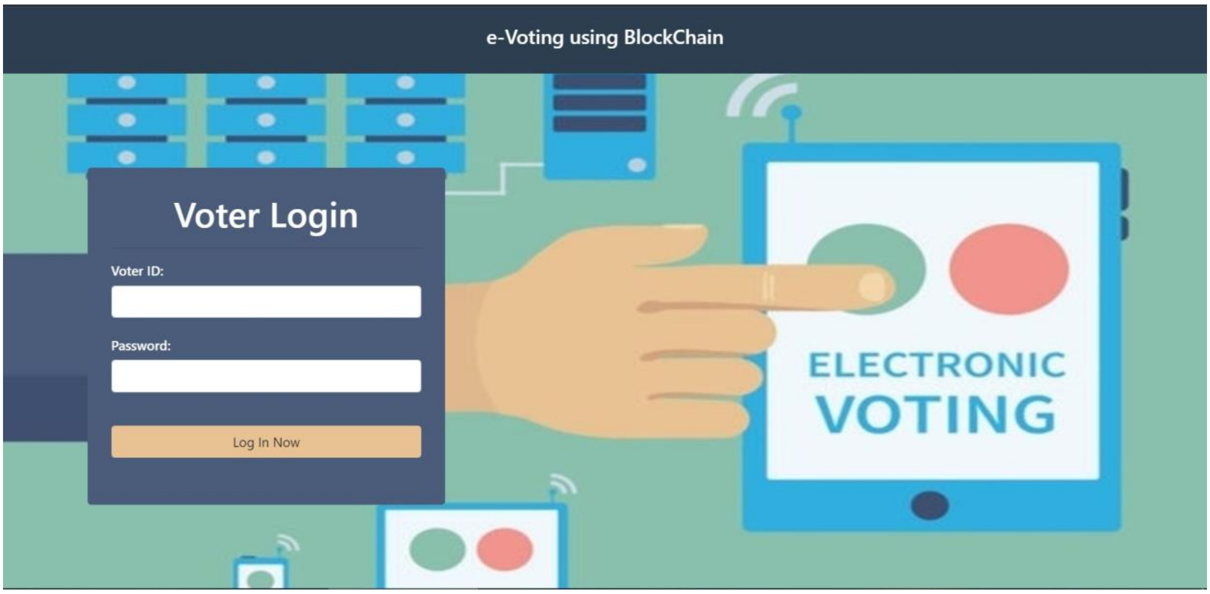


Fig. 1.2 Homepage

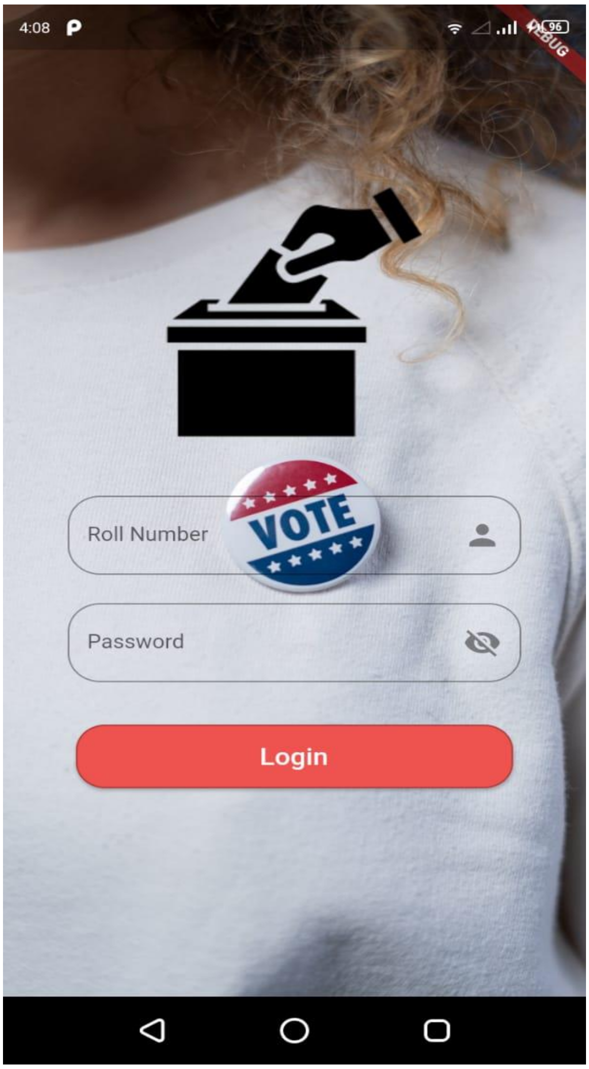


Fig. 1.3 Mobile Application

1.4 Gantt Chart

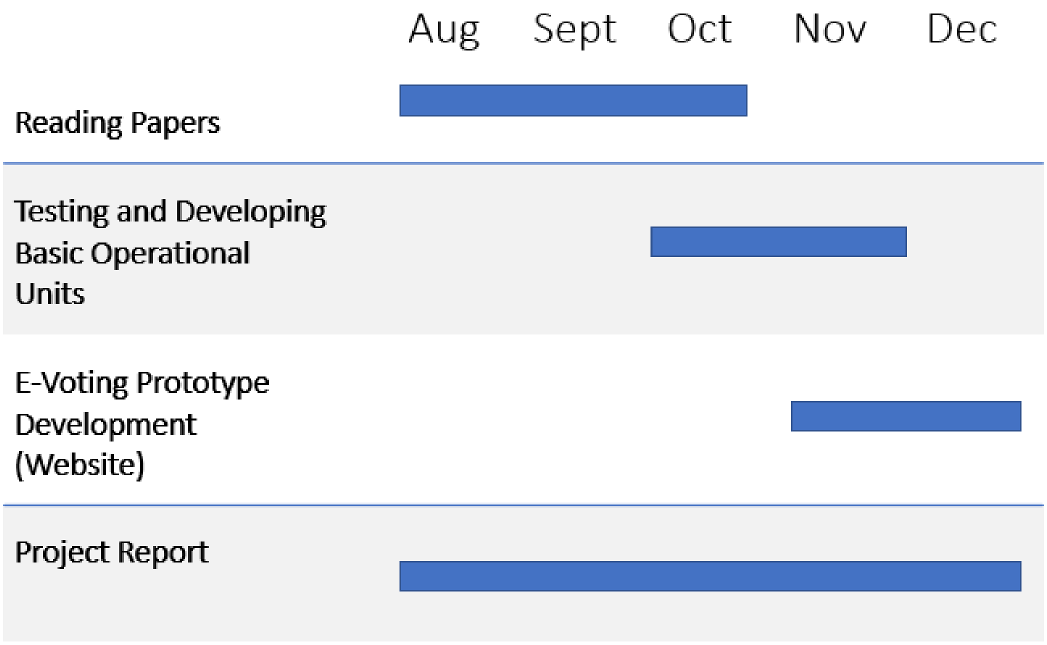


Fig. 1.4(a) Gantt Chart (Sem 7)

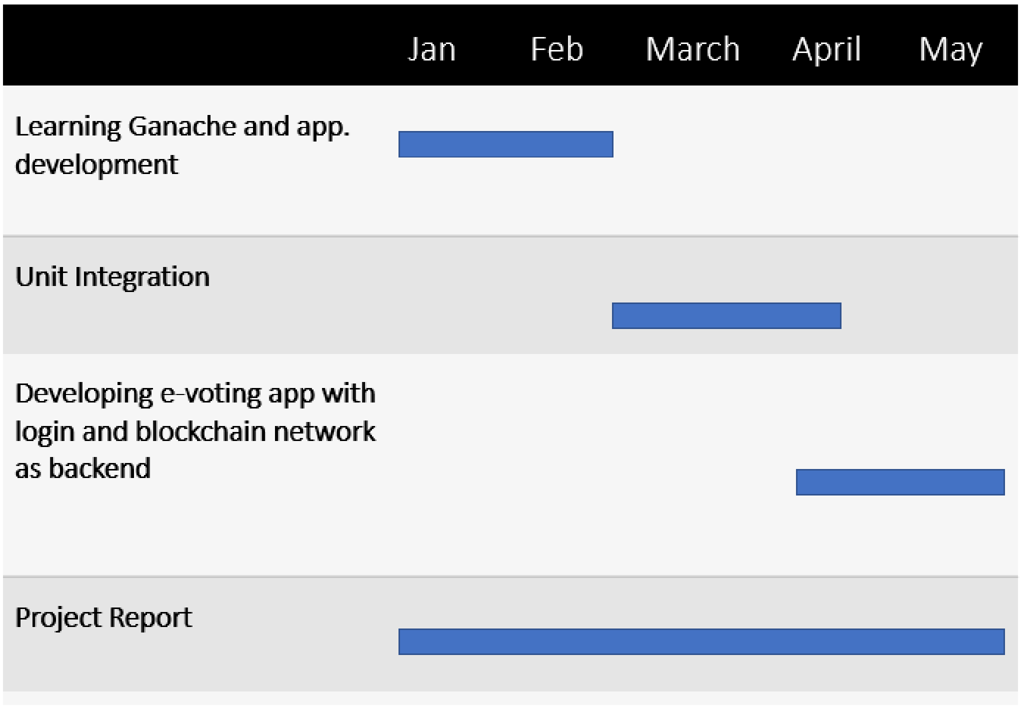


Fig. 1.4(b) Gantt Chart (Sem 8)

1.5 System Design

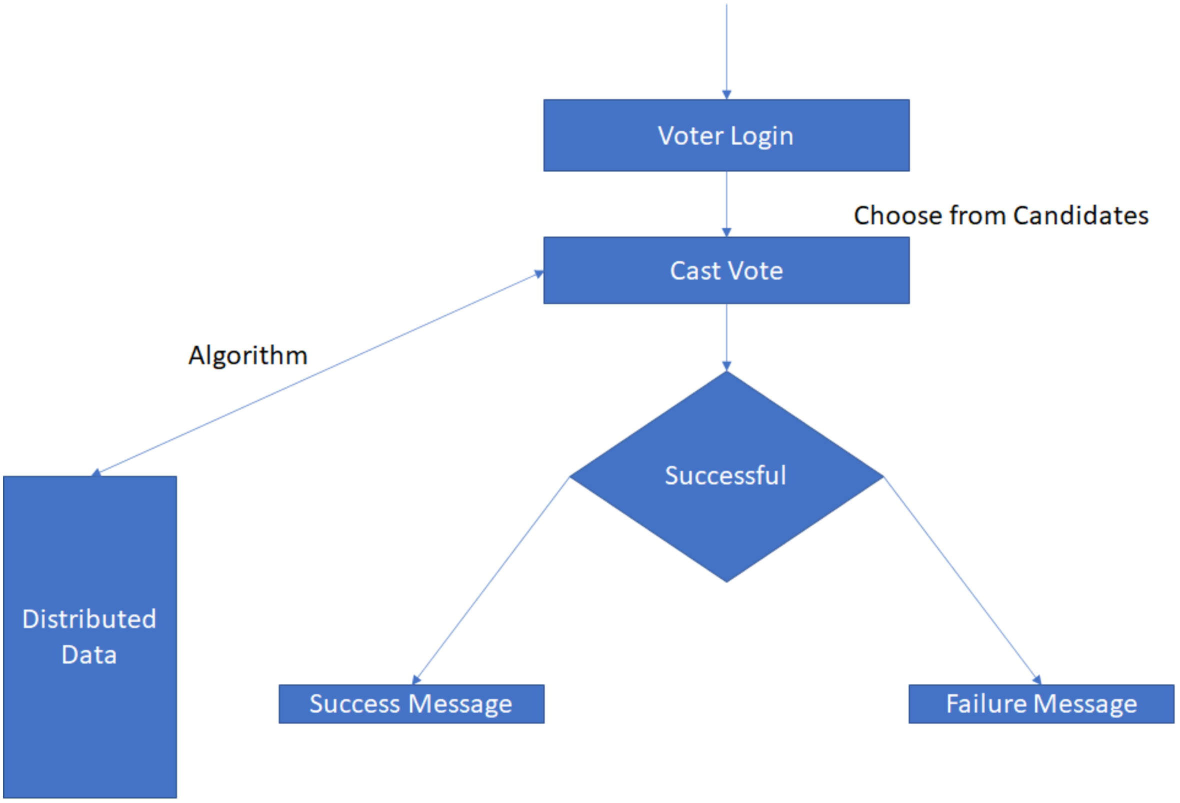


Fig. 1.5 System Design

This is a high level system design which explicitly shows how the project will work. In addition to this, below is the algorithm used in developing the system.

```
Cast_vote
{
is_valid_voter();
save_vote_block();
for all voters
{
add_block_to_chain();
}
success_msg();
}
```

Chapter 2: LITERATURE SURVEY

Many research papers were launched by many people working in this area and this is the summary of those papers.

Rumeysa Bulut, et al[2] paper titled “Blockchain-Based Electronic Voting System for Elections in Turkey”. Considering how the elections are not fair and how it is threatening the privacy and trust of the voters we learnt how elections can be carried out in a country if this system is used. There are simple steps in voting first authentication, then Voting, then counting and considering the scope of tampering, Voting part and counting parts stands out the most. They are easily manipulated areas. So most of the work is to be done on the voting and the counting part to maintain the integrity of the voters. We learnt how the elections were done in the past like the paper ballot and then what were their disadvantages and the security issues that arose that time then awesome countries adopted e- voting and they were transformed into the EVM voting system then what were their outcomes. To tackle all these problems the idea of a blockchain voting system came into existence.

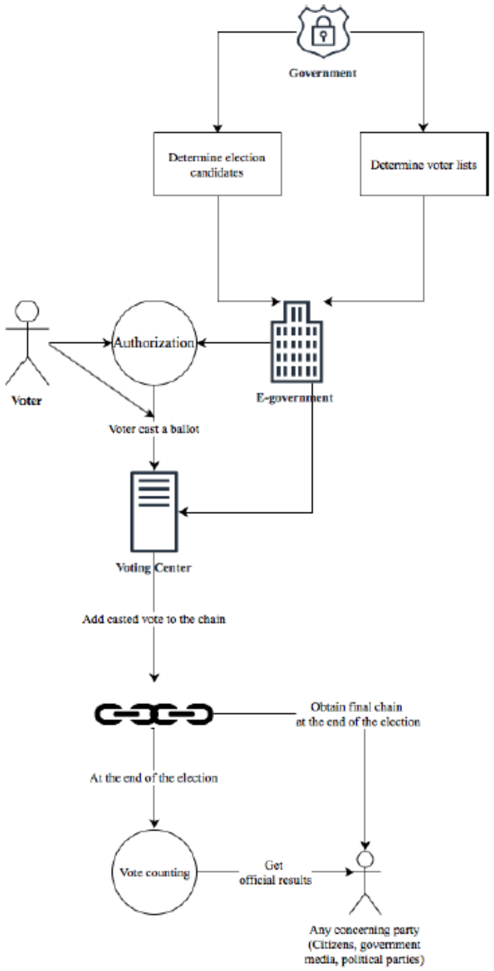

Government
Determine election candidates
Determine voter lists
Voter
Authorization
E-government
Voter cast a ballot
Voting Center
Add casted vote to the chain
Obtain final chain at the end of the election
At the end of the election
Vote counting
Get official results
Any concerning party (Citizens, government media, political parties)

Fig. 2.1 Use case of blockchain voting system[2]

Friðrik Þ. Hjálmarsson, et al[1] and described in their paper titled “Blockchain-Based E-Voting System” about the three main features of the blockchain, Immutability, Verifiability and Distributed Consensus(Distributed Consensus is used to determine the next user to add the transaction into tho the ledger, it is important before adding the block into the blockchain system).

Then we learnt about the main features to consider before making a blockchain system. They were

I. System should verify id for authentication before voting.

II. It should provide transparency means every voter should be satisfied with the voting and that their vote has been counted.

III. Should prevent the system from the tampering of results by any third party.

IV. As it is decentralized, means there is no single authority likewise voting results are not controlled by a single authority.

V. Only allow verified candidates to vote.

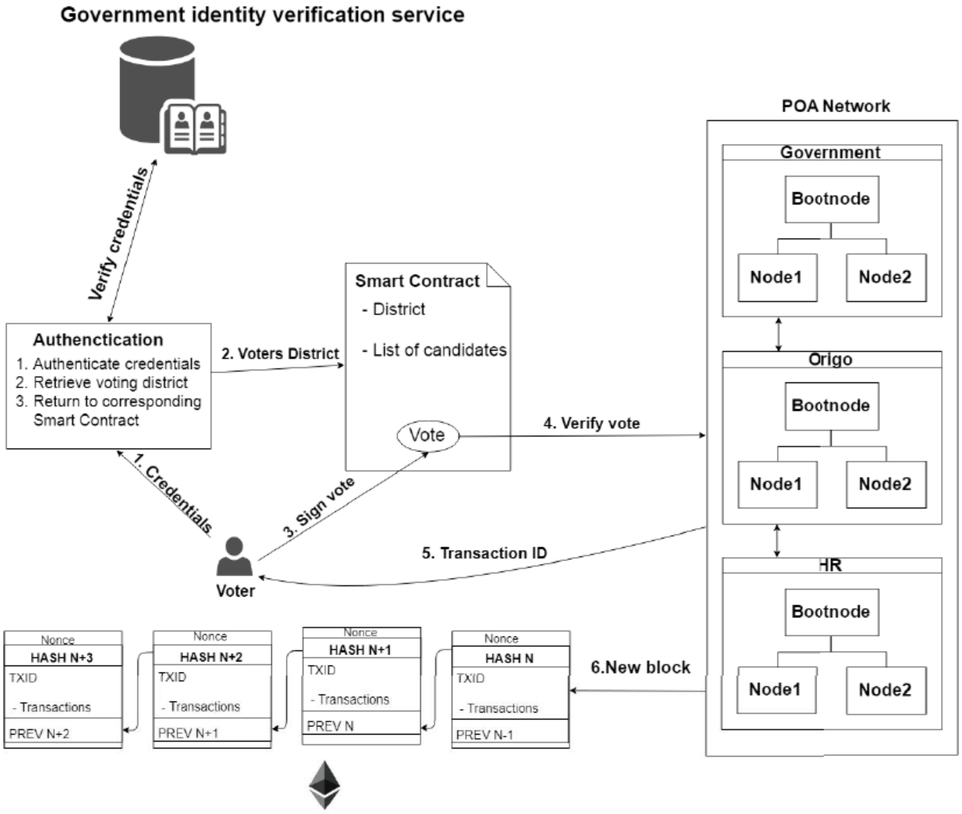


Fig. 2.2 The voting process[1]

We learnt about the government identity verification service, first either a person gets verified from the Government identify verification system or not and then sign up for voting, verify vote with POA network (Proof of Authority) and will send the transaction id to the voter and add a new block in the blockchain system.We learnt how to carry out e-voting will will be safe and fair. Ethereum's private blockchain system will help to maintain a real time ledger, will require high computation power and can support hundreds of transactions per seconds.

Julija Golosova, et al[3] described in their paper titled "The Advantages and downsides of Blockchain Technology" the benefits and therefore the disadvantages of blockchain technology.
In the following fig we will see how the block is made. It shows that every block contains the previous hash value Merkle Root, Nonce and Timestamp.

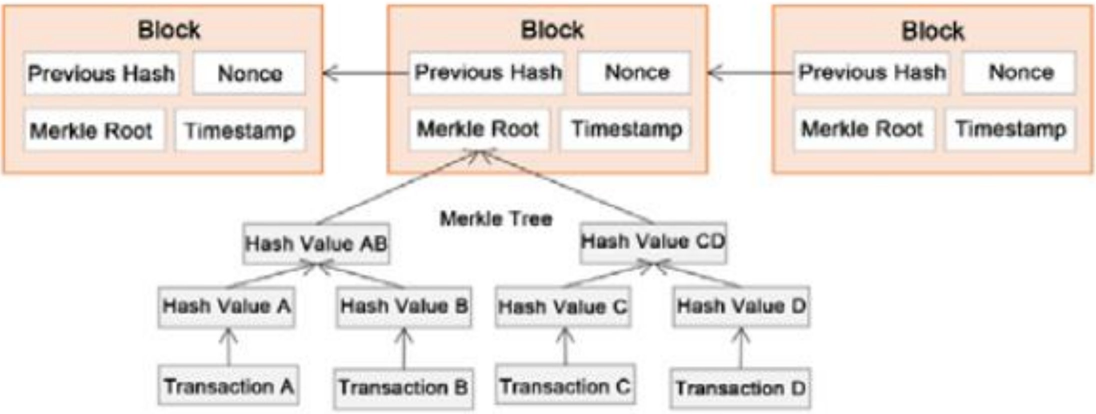


Fig 2.3 Blocks[3]

The main disadvantage of the blockchain is the high computation power requirement to keep up the zero time ledger, and least downtime to take care of the transparency for users. For this many network miners work to validate the transactions and append the blocks into the system.

A. Shanti Bruyn, et al[4] paper titled "Blockchain an introduction. Research paper" give a general view of the blockchain technology, how to implement it and which factors to consider before starting the implementation work. As the data is immutable it cannot be applied in the areas which need continuous alteration of the data. It is a decentralized system so the system is made in such a way that is impossible to alter.

Andrew Barnes, et al[5] report titled “Digital Voting with the use of Blockchain Technology” gives an outline of the issues faced in the digital voting system. It starts with the problem faced in the time back when technology was not part of the election and current voting system adopted in the world and the transformation needed today.

Chapter 3: SYSTEM DEVELOPMENT

3.1 Functionality

Website

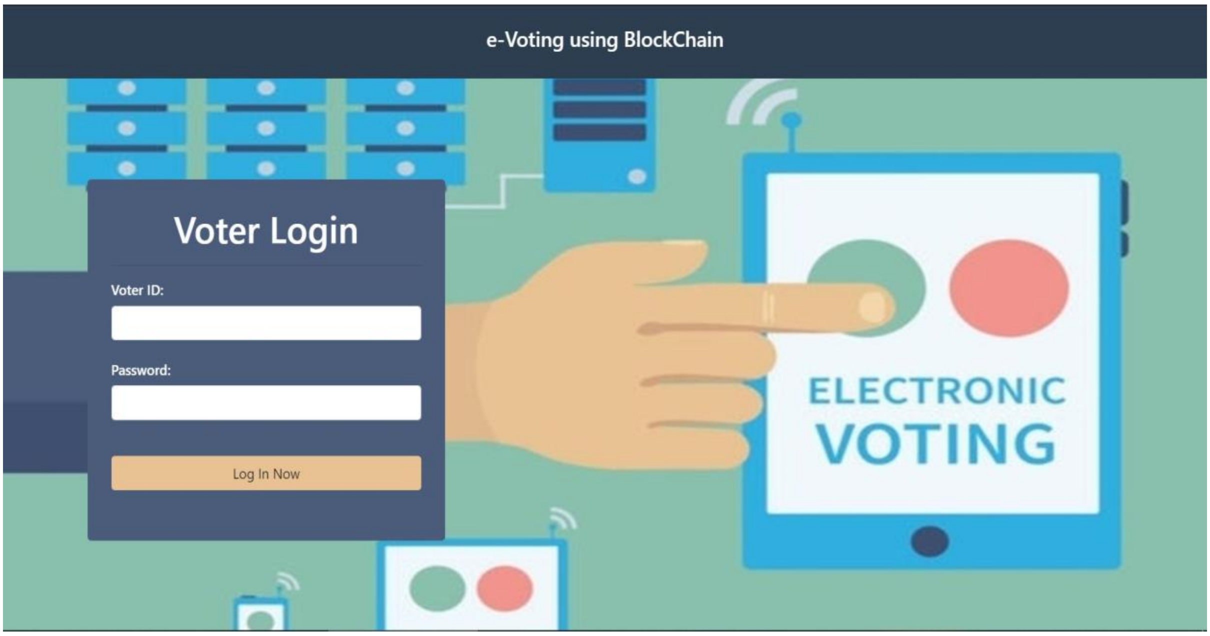
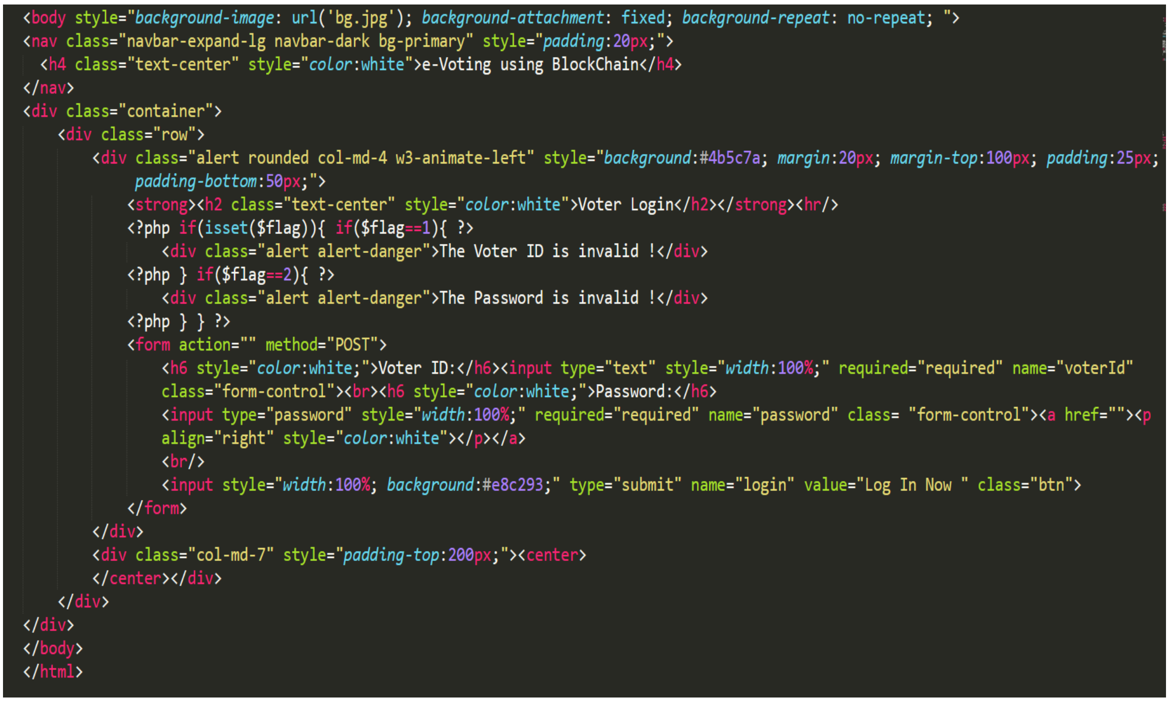


Fig. 3.1 Homepage

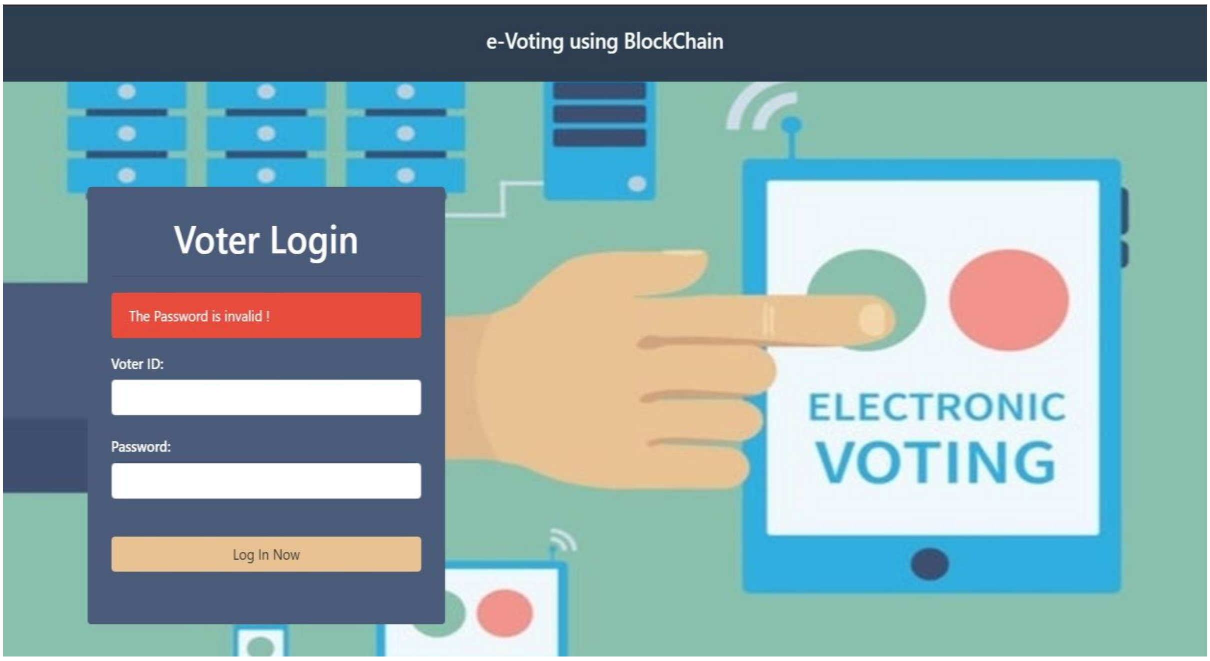
Fig. 3.a shows the homepage of the voting platform which is basically a login page, the code of this page is given in Fig. 3.a.1, we first embedded a picture and then created two input tags for Voter ID and Password and a button to submit the details.



```
<body style="background-image: url('bg.jpg'); background-attachment: fixed; background-repeat: no-repeat; ">
<nav class="navbar-expand-lg navbar-dark bg-primary" style="padding:20px;">
  <h4 class="text-center" style="color:white">e-Voting using BlockChain</h4>
</nav>
<div class="container">
    <div class="row">
        <div class="alert rounded col-md-4 w3-animate-left" style="background:#4b5c7a; margin:20px; margin-top:100px; padding:25px;
             padding-bottom:50px;">
            <strong><h2 class="text-center" style="color:white">Voter Login</h2></strong><hr/>
            <?php if(isset($flag)){ if($flag==1){ ?>
                <div class="alert alert-danger">The Voter ID is invalid !</div>
            <?php } if($flag==2){ ?>
                <div class="alert alert-danger">The Password is invalid !</div>
            <?php } } ?>
            <form action="" method="POST">
                <h6 style="color:white;">Voter ID:</h6><input type="text" style="width:100%;" required="required" name="voterId"
                class="form-control"><br><h6 style="color:white;">Password:</h6>
                <input type="password" style="width:100%;" required="required" name="password" class= "form-control"><a href=""><p
                align="right" style="color:white"></p></a>
                <br/>
                <input style="width:100%; background:#e8c293;" type="submit" name="login" value="Log In Now " class="btn">
            </form>
        </div>
        <div class="col-md-7" style="padding-top:200px;"><center>
        </center></div>
    </div>
</div>
</body>
</html>
```

Fig. 3.1.1

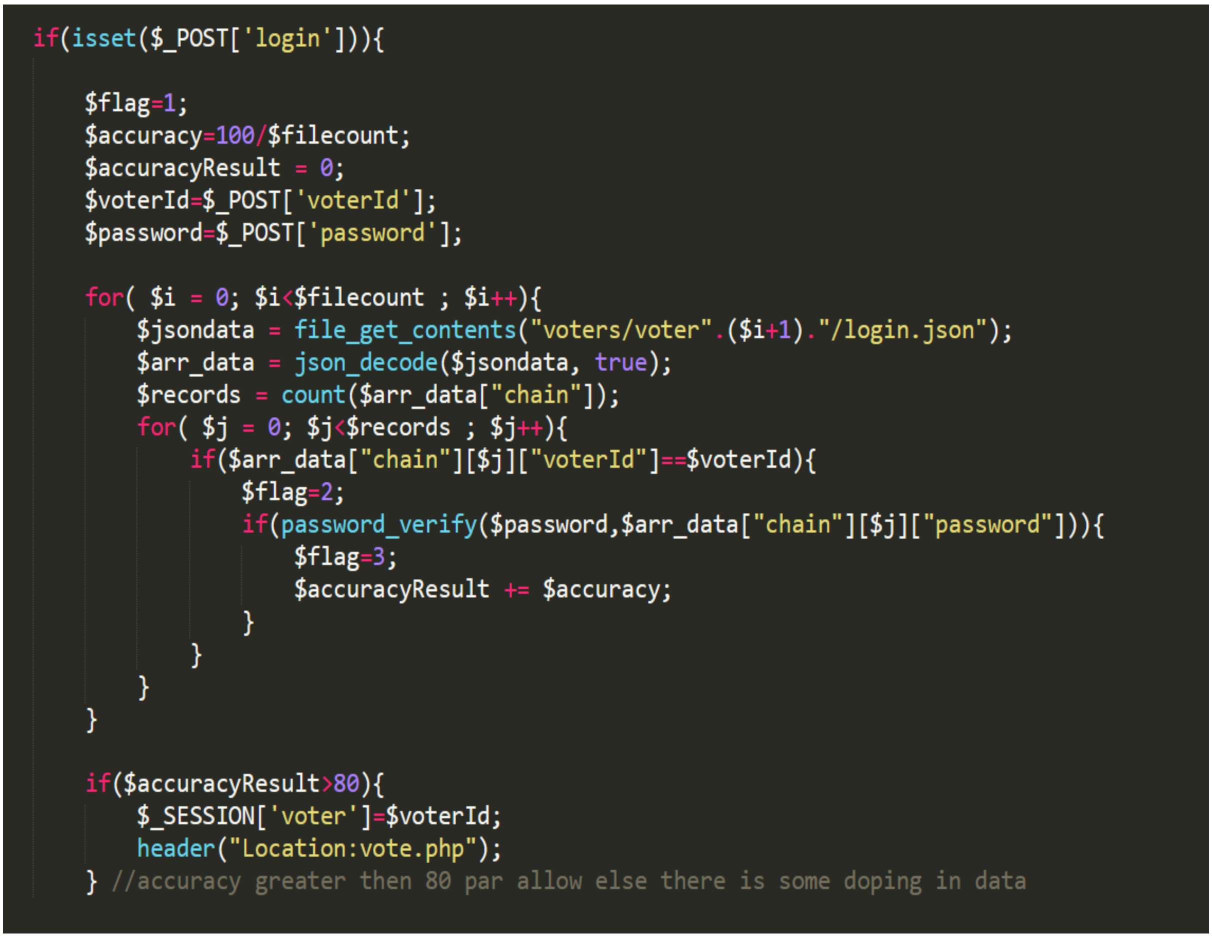
Fig. 3.a.1 is the screenshot of the code written for the homepage. After entering the Voter ID and password. We are then diverted to the next page based on the details entered.



The Password is invalid !

Fig. 3.2 Login Page

Fig. 3.a.2 shows that if the details entered does not match with the stored details then it shows that “ **The Password is invalid”**



```
if(isset($_POST['login'])){

    $flag=1;
    $accuracy=100/$filecount;
    $accuracyResult = 0;
    $voterId=$_POST['voterId'];
    $password=$_POST['password'];

    for( $i = 0; $i<$filecount ; $i++){
        $jsondata = file_get_contents("voters/voter".($i+1)."/login.json");
        $arr_data = json_decode($jsondata, true);
        $records = count($arr_data["chain"]);
        for( $j = 0; $j<$records ; $j++){
            if($arr_data["chain"][$j]["voterId"]==$voterId){
                $flag=2;
                if(password_verify($password,$arr_data["chain"][$j]["password"])){
                    $flag=3;
                    $accuracyResult += $accuracy;
                }
            }
        }
    }

    if($accuracyResult>80){
        $_SESSION['voter']=$voterId;
        header("Location:vote.php");
    } //accuracy greater then 80 par allow else there is some doping in data
```

Fig. 3.2.1

Fig. 3.a.3 code says that after collecting voterId and password and checking the details with the file, if accuracyResults>80 then we proceed to the next page given below (Initially our flag is equal to 1, if voterId is verified then the flag changes to value 2 and after that if the password is verified, it turns to value three and updates the accuracyResults. If the value of accuracyResults turns out to be greater than 80 then we are allowed to proceed further otherwise not. If the flag stays 1 then it shows the invalid id.)

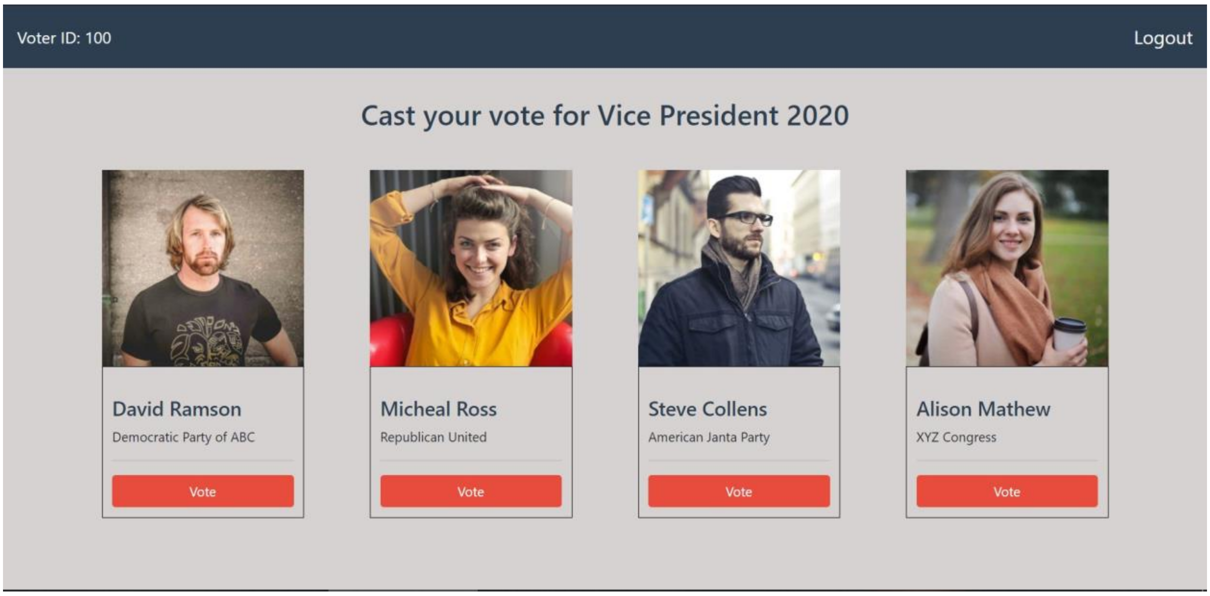
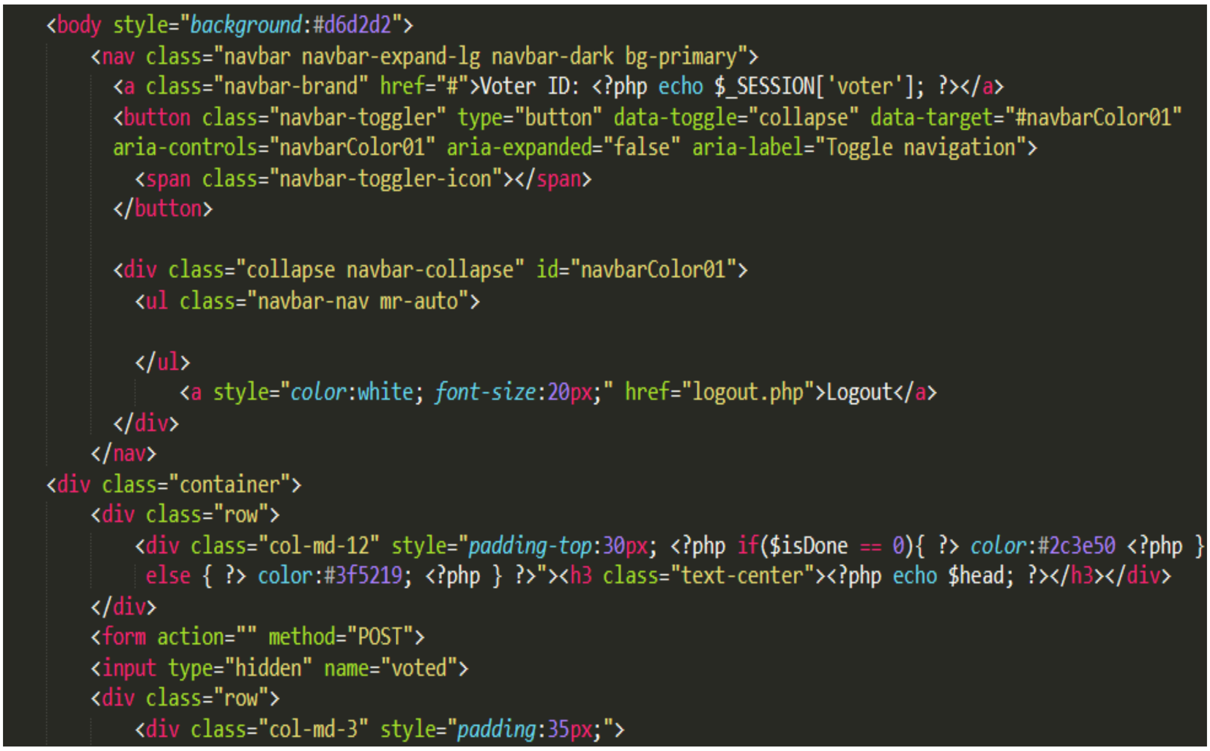


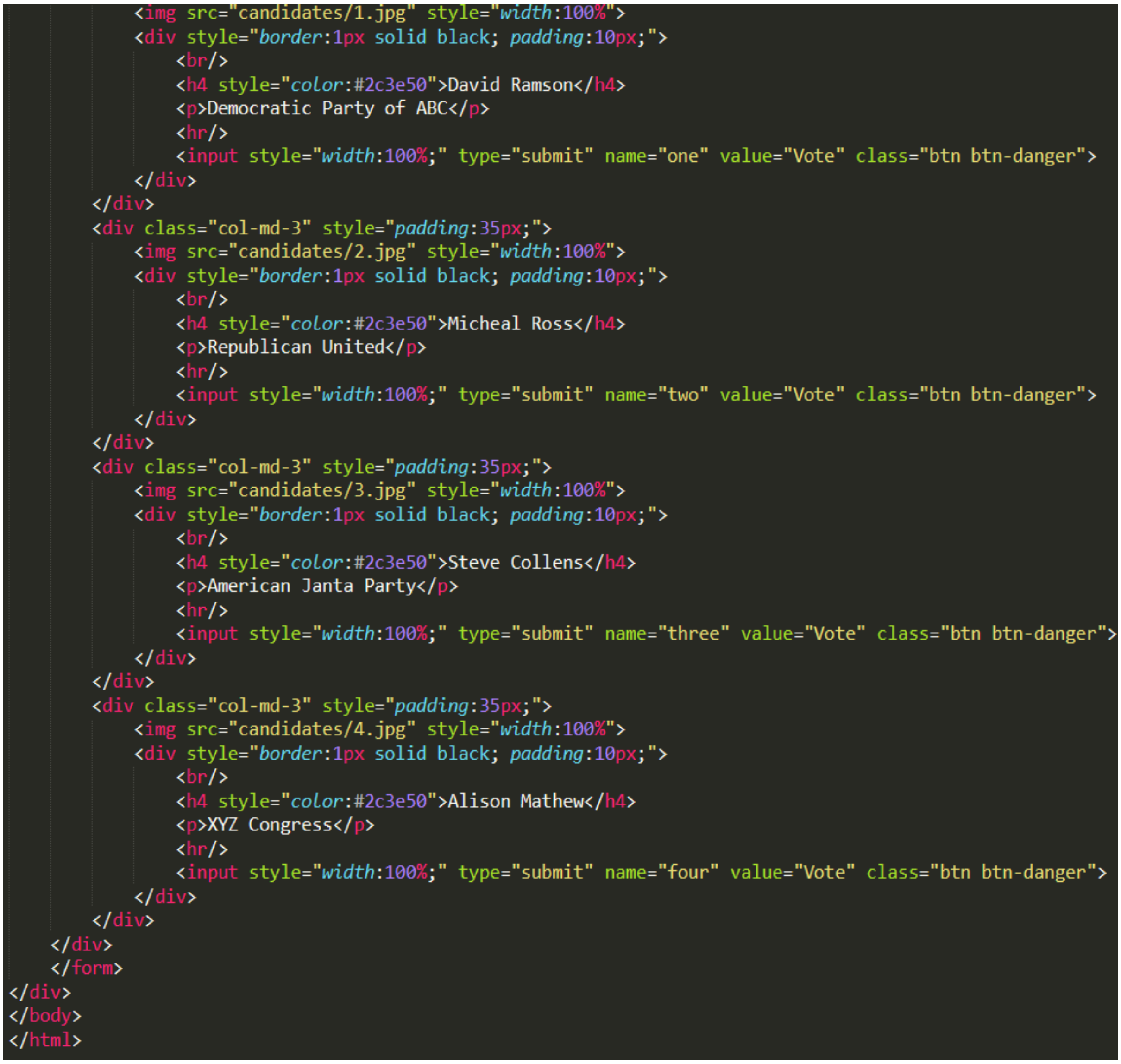
Fig. 3.3 Page appears after successful login

Fig. This is the page we see after doing our login successfully. It’s a general webpage in which we can see four candidates for the Vice Presidential election with each having a button of vote. The code for the frontend is shown in the figure below (Fig. 3.a.1 and Fig. 3.a.2)



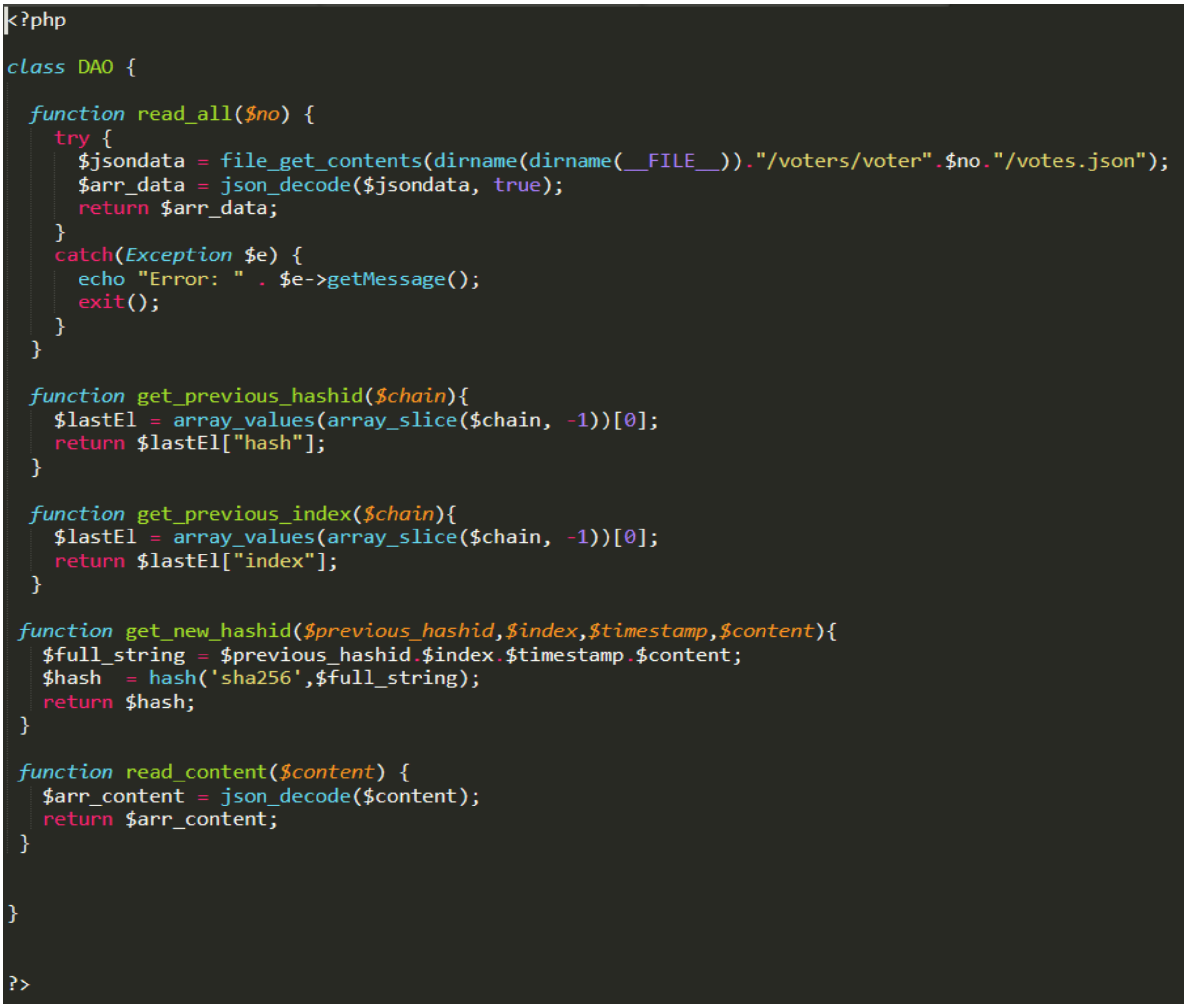
```
<body style="background:#d6d2d2">
    <nav class="navbar navbar-expand-lg navbar-dark bg-primary">
      <a class="navbar-brand" href="#">Voter ID: <?php echo $_SESSION['voter']; ?></a>
      <button class="navbar-toggler" type="button" data-toggle="collapse" data-target="#navbarColor01"
      aria-controls="navbarColor01" aria-expanded="false" aria-label="Toggle navigation">
        <span class="navbar-toggler-icon"></span>
      </button>

      <div class="collapse navbar-collapse" id="navbarColor01">
        <ul class="navbar-nav mr-auto">

        </ul>
            <a style="color:white; font-size:20px;" href="logout.php">Logout</a>
      </div>
    </nav>
<div class="container">
    <div class="row">
        <div class="col-md-12" style="padding-top:30px; <?php if($isDone == 0){ ?> color:#2c3e50 <?php }
         else { ?> color:#3f5219; <?php } ?>"><h3 class="text-center"><?php echo $head; ?></h3></div>
    </div>
    <form action="" method="POST">
    <input type="hidden" name="voted">
    <div class="row">
        <div class="col-md-3" style="padding:35px;">
```

Fig. 3.3.1



```
            <img src="candidates/1.jpg" style="width:100%">
            <div style="border:1px solid black; padding:10px;">
                <br/>
                <h4 style="color:#2c3e50">David Ramson</h4>
                <p>Democratic Party of ABC</p>
                <hr/>
                <input style="width:100%;" type="submit" name="one" value="Vote" class="btn btn-danger">
            </div>
        </div>
        <div class="col-md-3" style="padding:35px;">
            <img src="candidates/2.jpg" style="width:100%">
            <div style="border:1px solid black; padding:10px;">
                <br/>
                <h4 style="color:#2c3e50">Micheal Ross</h4>
                <p>Republican United</p>
                <hr/>
                <input style="width:100%;" type="submit" name="two" value="Vote" class="btn btn-danger">
            </div>
        </div>
        <div class="col-md-3" style="padding:35px;">
            <img src="candidates/3.jpg" style="width:100%">
            <div style="border:1px solid black; padding:10px;">
                <br/>
                <h4 style="color:#2c3e50">Steve Collens</h4>
                <p>American Janta Party</p>
                <hr/>
                <input style="width:100%;" type="submit" name="three" value="Vote" class="btn btn-danger">
            </div>
        </div>
        <div class="col-md-3" style="padding:35px;">
            <img src="candidates/4.jpg" style="width:100%">
            <div style="border:1px solid black; padding:10px;">
                <br/>
                <h4 style="color:#2c3e50">Alison Mathew</h4>
                <p>XYZ Congress</p>
                <hr/>
                <input style="width:100%;" type="submit" name="four" value="Vote" class="btn btn-danger">
            </div>
        </div>
    </div>
    </form>
</div>
</body>
</html>
```

Fig. 3.3.2



```
<?php

class DAO {

  function read_all($no) {
    try {
      $jsondata = file_get_contents(dirname(dirname(__FILE__))."/voters/voter".$no."/votes.json");
      $arr_data = json_decode($jsondata, true);
      return $arr_data;
    }
    catch(Exception $e) {
      echo "Error: " . $e->getMessage();
      exit();
    }
  }

  function get_previous_hashid($chain){
    $lastEl = array_values(array_slice($chain, -1))[0];
    return $lastEl["hash"];
  }

  function get_previous_index($chain){
    $lastEl = array_values(array_slice($chain, -1))[0];
    return $lastEl["index"];
  }

 function get_new_hashid($previous_hashid,$index,$timestamp,$content){
   $full_string = $previous_hashid.$index.$timestamp.$content;
   $hash   = hash('sha256',$full_string);
   return $hash;
 }

 function read_content($content) {
   $arr_content = json_decode($content);
   return $arr_content;
 }


}


?>
```

Fig. 3.3.3

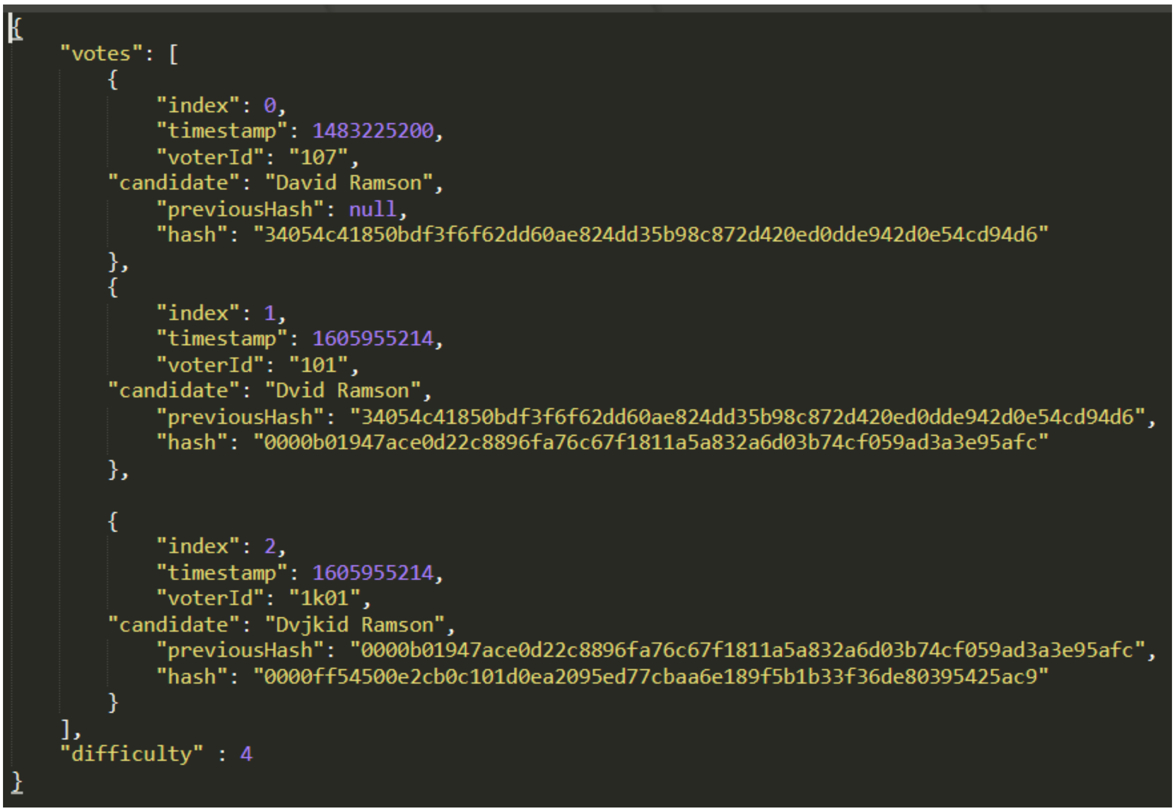
We created a class dao, in which first we imported the votes.json file and then decoded it and then returned the chain.

function get_previous_hashid($chain)
(This function will send the last element's hash id of the chain.)

function get_previous_index($chain)
(This function will send the index of the last element of the chain.)

function get_new_hashid($previous_hashid,$index,$timestamp,$content)
(This function will concatenate $previous_hashid, $index, $timestamp, $content parameters and will create a string and then it will be hashed and returned.)

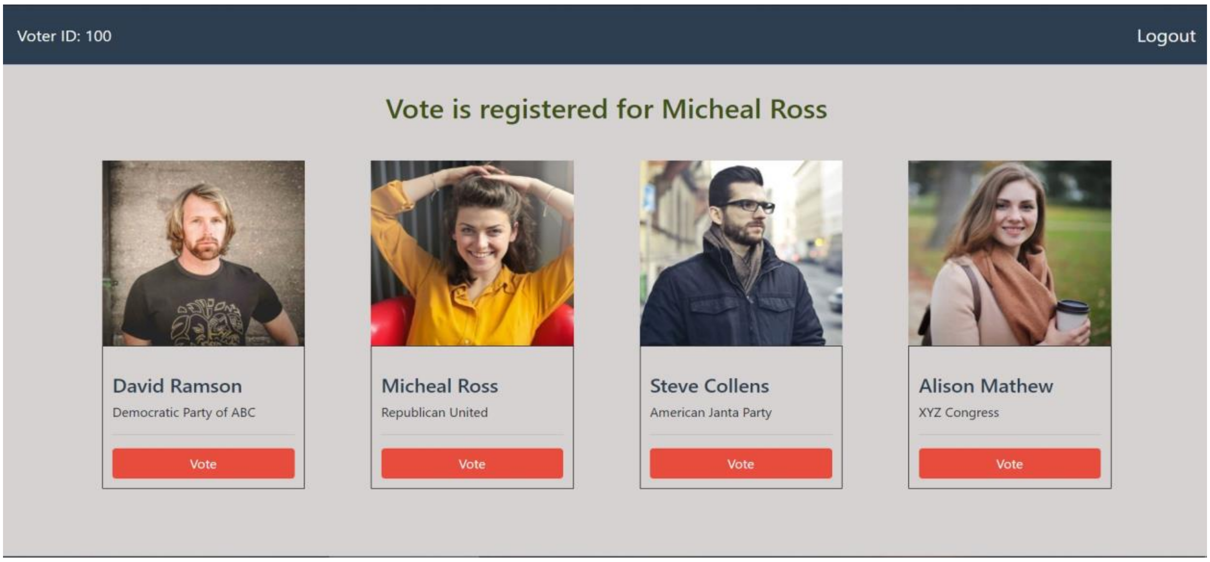
function read_content($content)



```
{
    "votes": [
        {
            "index": 0,
            "timestamp": 1483225200,
            "voterId": "107",
        "candidate": "David Ramson",
            "previousHash": null,
            "hash": "34054c41850bdf3f6f62dd60ae824dd35b98c872d420ed0dde942d0e54cd94d6"
        },
        {
            "index": 1,
            "timestamp": 1605955214,
            "voterId": "101",
        "candidate": "Dvid Ramson",
            "previousHash": "34054c41850bdf3f6f62dd60ae824dd35b98c872d420ed0dde942d0e54cd94d6",
            "hash": "0000b01947ace0d22c8896fa76c67f1811a5a832a6d03b74cf059ad3a3e95afc"
        },

        {
            "index": 2,
            "timestamp": 1605955214,
            "voterId": "1k01",
        "candidate": "Dvjkid Ramson",
            "previousHash": "0000b01947ace0d22c8896fa76c67f1811a5a832a6d03b74cf059ad3a3e95afc",
            "hash": "0000ff54500e2cb0c101d0ea2095ed77cbaa6e189f5b1b33f36de80395425ac9"
        }
    ],
    "difficulty" : 4
}
```

Fig. 3.3.4 (votes.json)

Fig. 3.b.1 (votes.json) carrying the information blocks of index, timestamp, candidate name, previous hash, hash value.



Voter ID: 100

Vote is registered for Micheal Ross

David Ramson
Democratic Party of ABC

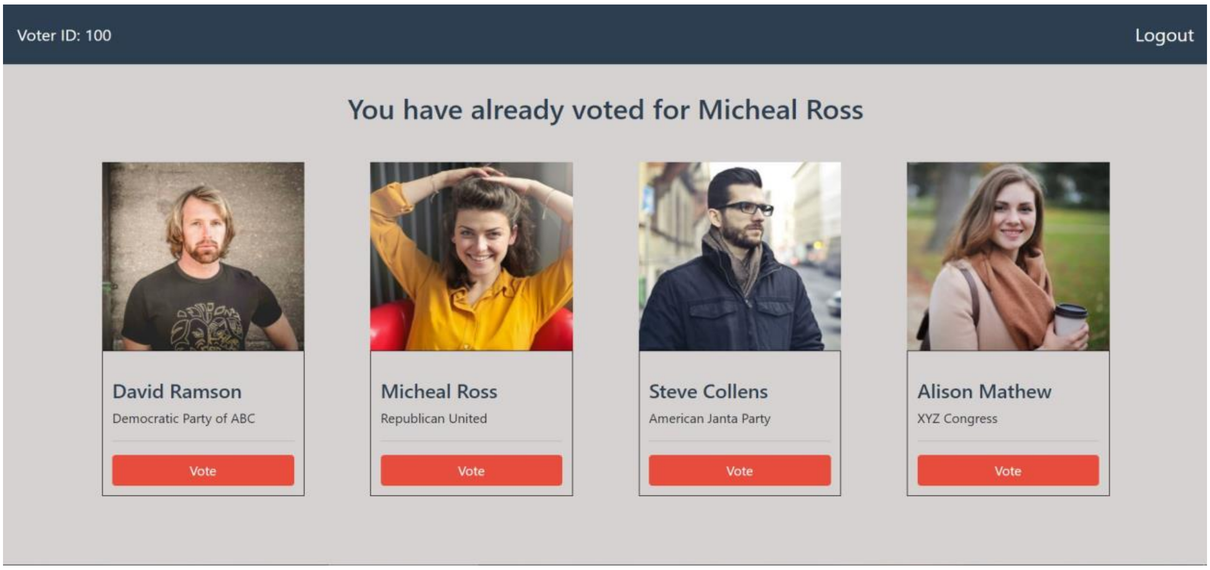
Micheal Ross
Republican United

Steve Collens
American Janta Party

Alison Mathew
XYZ Congress

Fig. 3.4 Page appears when the voting is successful

Fig. Shows that if we voted for a particular candidate then it shows that the vote is registered for Michael Ross As shown above.



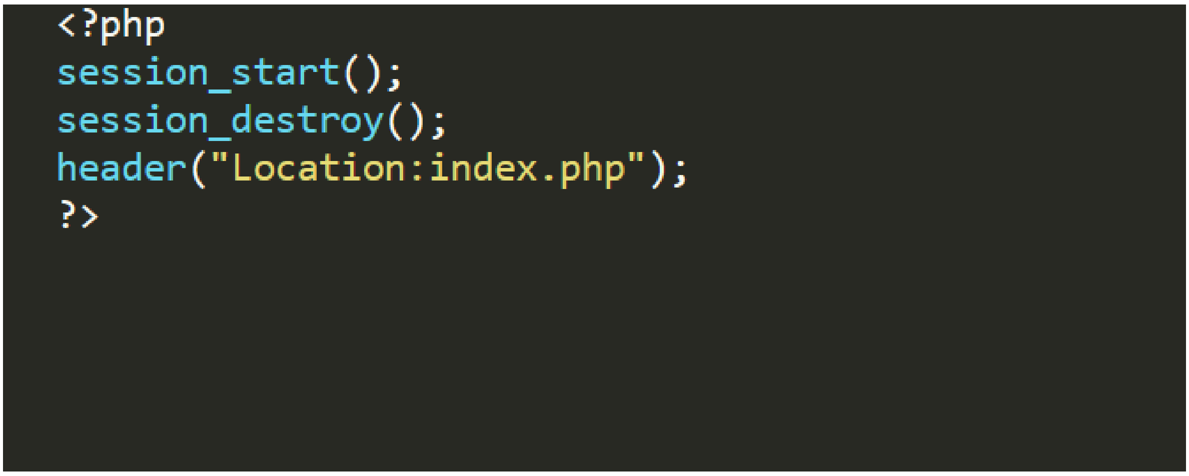
Voter ID: 100

Logout

You have already voted for Micheal Ross

Fig. 3.5 If vote is already casted

After casting your vote and pressing the logout button you are diverted to the homepage and code is given below.



```
<?php
session_start();
session_destroy();
header("Location:index.php");
?>
```

Fig. 3.5.1

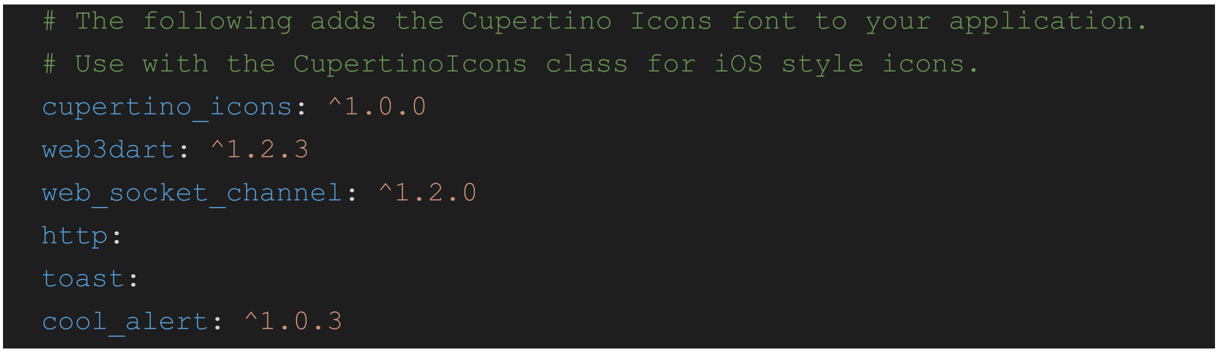
Application

We have used the Ganache Blockchain network for our backend. It provides a complete blockchain network to integrate with, and uses web3 client packages to communicate with the system. So we have created a blockchain network of eight users with an ethereum balance of 100 ETH. And while casting a vote, 80 ETH will be transferred to the candidate. Therefore enabling a user to cast a vote only once.

Result: The user with maximum ethereum balance will win the election.

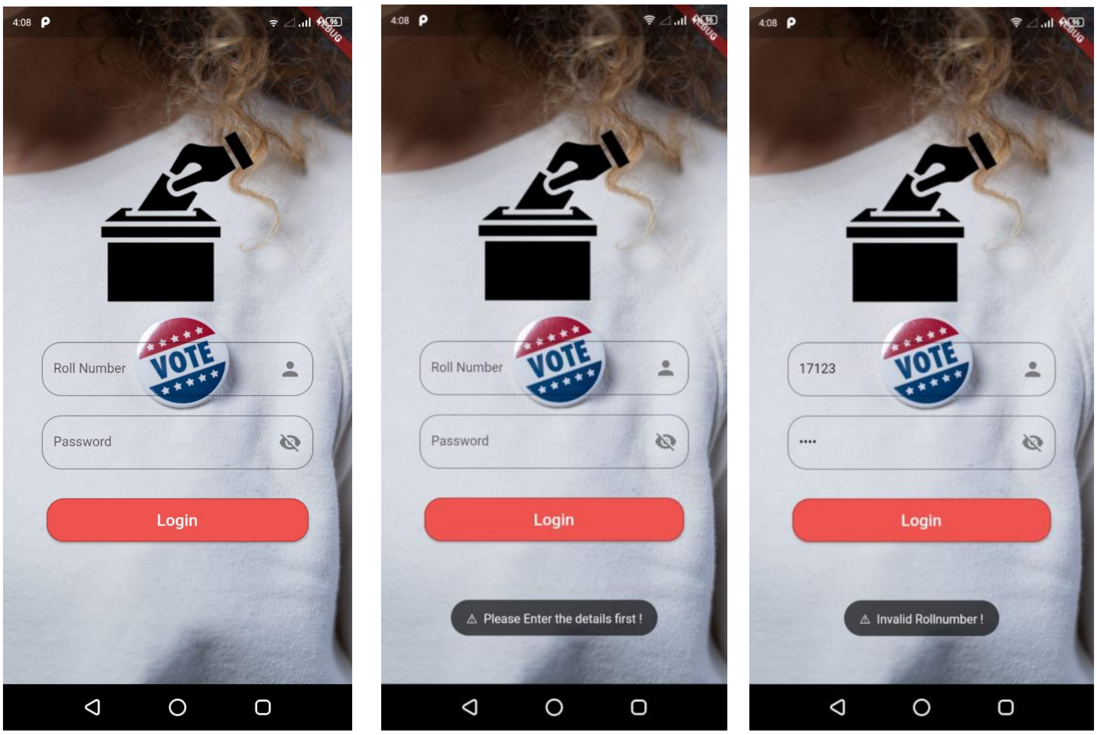
For Application Development, we have used the Flutter framework by Google. And the packages integrated for making the communication channel possible with our blockchain network are:

1. Web3dart[13]
2. Http[14]
3. Web_Socket_Channel [15]



```
  # The following adds the Cupertino Icons font to your application.
  # Use with the CupertinoIcons class for iOS style icons.
  cupertino_icons: ^1.0.0
  web3dart: ^1.2.3
  web_socket_channel: ^1.2.0
  http:
  toast:
  cool_alert: ^1.0.3
```

Login:



17123

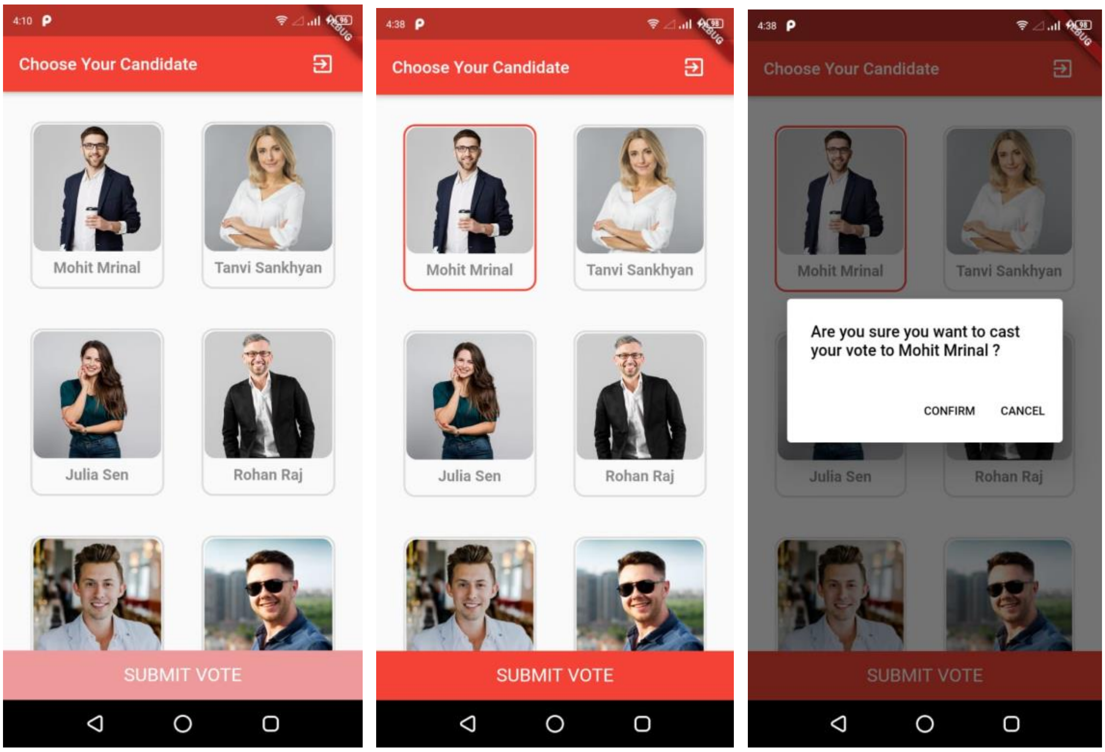
••••

⚠ Please Enter the details first !

⚠ Invalid Rollnumber !

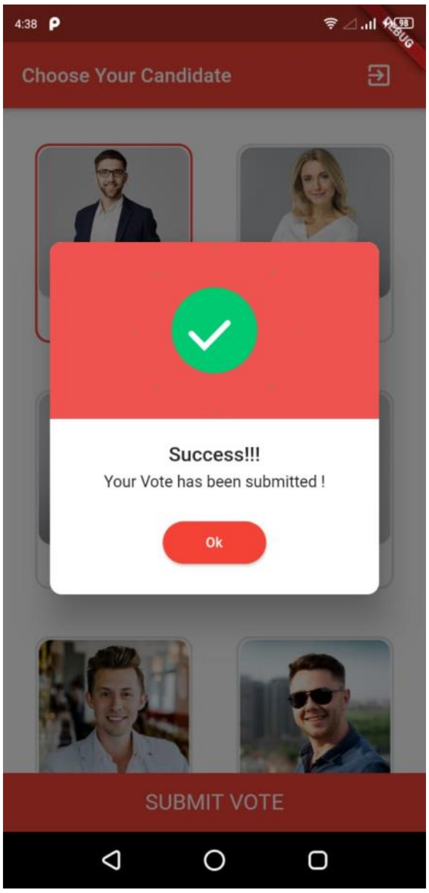
Fig. 3.6   Enter details, If data entered is invalid

UI part for selecting candidate and Casting Vote:



Are you sure you want to cast your vote to Mohit Mrinal ?

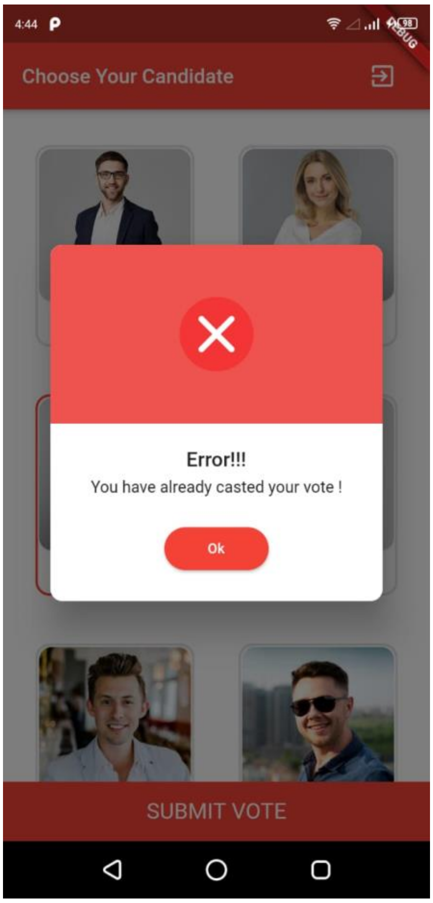
Fig. 3.7 After successful login caste vote



Success!!!

Your Vote has been submitted !

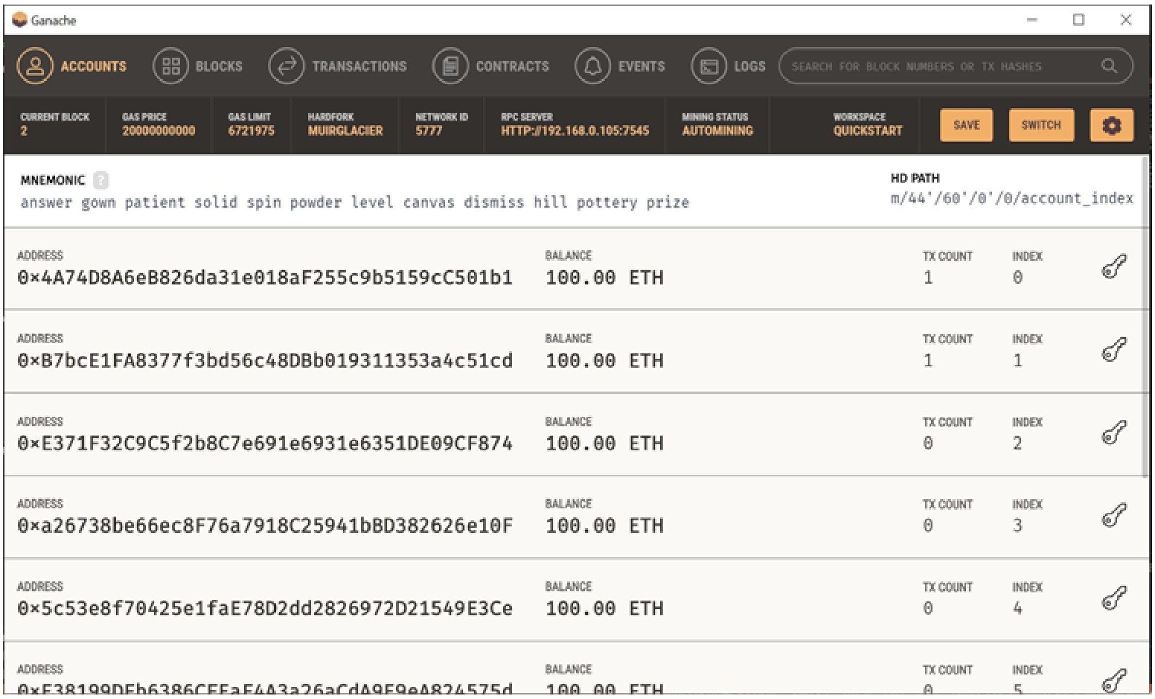
Fig. 3.8 Vote casted successfully



Error!!!

You have already casted your vote !

Fig. 3.9 Error if already casted the vote



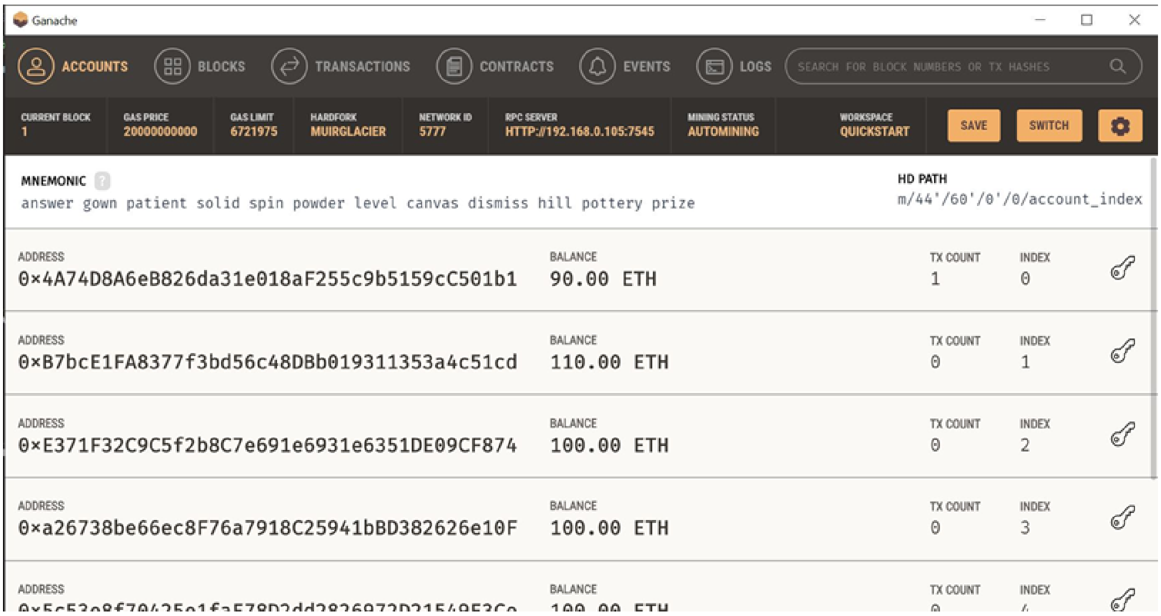
CURRENT BLOCK	GAS PRICE	GAS LIMIT	HARDFORK	NETWORK ID	RPC SERVER	MINING STATUS	WORKSPACE
2	20000000000	6721975	MUIRGLACIER	5777	HTTP://192.168.0.105:7545	AUTOMINING	QUICKSTART

MNEMONIC
answer gown patient solid spin powder level canvas dismiss hill pottery prize

HD PATH
m/44'/60'/0'/0/account_index

ADDRESS	BALANCE	TX COUNT	INDEX
0×4A74D8A6eB826da31e018aF255c9b5159cC501b1	100.00 ETH	1	0
0×B7bcE1FA8377f3bd56c48DBb019311353a4c51cd	100.00 ETH	1	1
0×E371F32C9C5f2b8C7e691e6931e6351DE09CF874	100.00 ETH	0	2
0×a26738be66ec8F76a7918C25941bBD382626e10F	100.00 ETH	0	3
0×5c53e8f70425e1faE78D2dd2826972D21549E3Ce	100.00 ETH	0	4
0×F38199DFb6386CFEaF4A3a26aCdA9F9eA824575d	100.00 ETH	0	5

Fig. 3.10 Initial state ether



CURRENT BLOCK	GAS PRICE	GAS LIMIT	HARDFORK	NETWORK ID	RPC SERVER	MINING STATUS	WORKSPACE
1	20000000000	6721975	MUIRGLACIER	5777	HTTP://192.168.0.105:7545	AUTOMINING	QUICKSTART

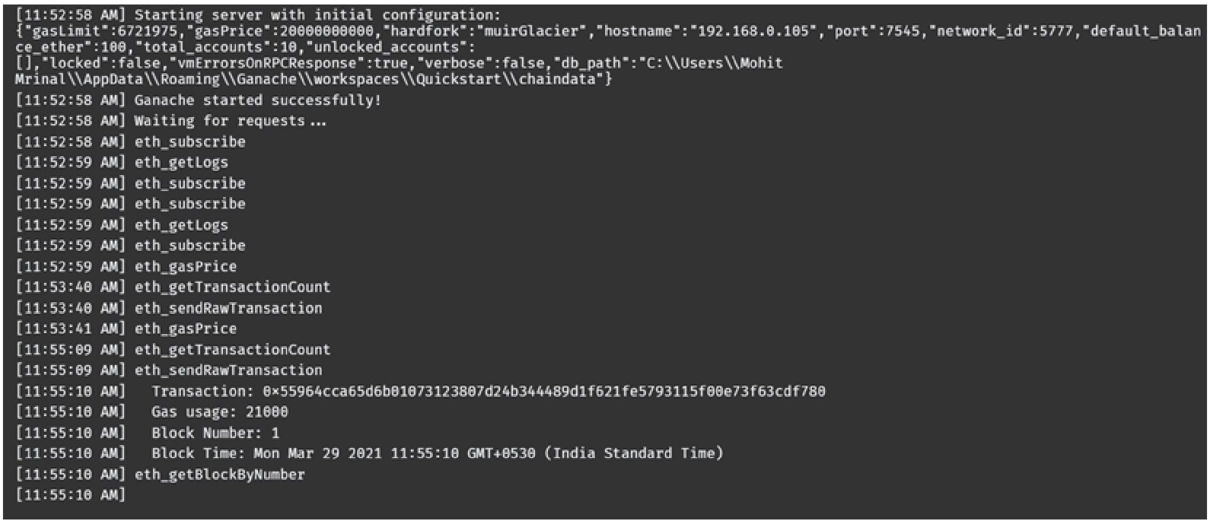
MNEMONIC
answer gown patient solid spin powder level canvas dismiss hill pottery prize

HD PATH
m/44'/60'/0'/0/account_index

ADDRESS	BALANCE	TX COUNT	INDEX
0×4A74D8A6eB826da31e018aF255c9b5159cC501b1	90.00 ETH	1	0
0×B7bcE1FA8377f3bd56c48DBb019311353a4c51cd	110.00 ETH	0	1
0×E371F32C9C5f2b8C7e691e6931e6351DE09CF874	100.00 ETH	0	2
0×a26738be66ec8F76a7918C25941bBD382626e10F	100.00 ETH	0	3
0×5c53e8f70425e1faE78D2dd2826972D21549E3Ce	100.00 ETH	0	4

Fig. 3.11 Final state ether

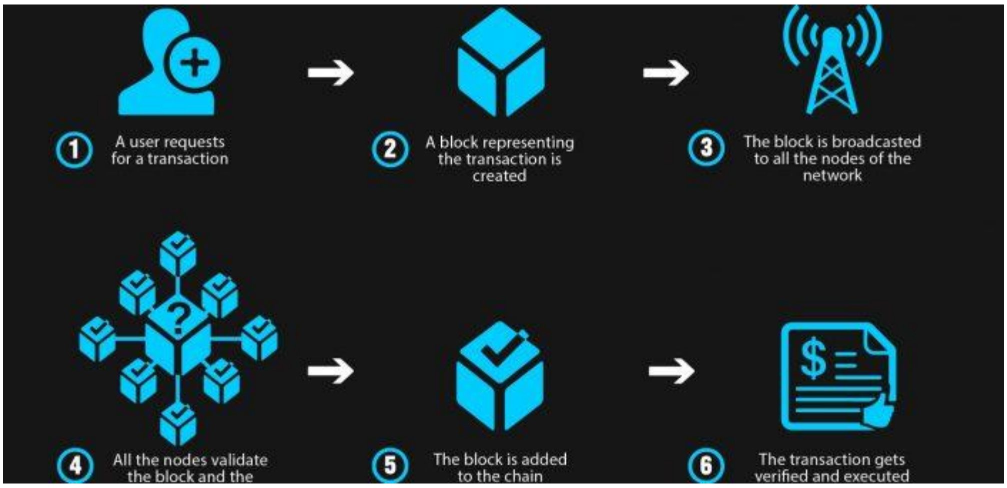
Blockchain Network Log Data



```
[11:52:58 AM] Starting server with initial configuration:
{"gasLimit":6721975,"gasPrice":20000000000,"hardfork":"muirGlacier","hostname":"192.168.0.105","port":7545,"network_id":5777,"default_balan
ce_ether":100,"total_accounts":10,"unlocked_accounts":
[],"locked":false,"vmErrorsOnRPCResponse":true,"verbose":false,"db_path":"C:\\Users\\Mohit
Mrinal\\AppData\\Roaming\\Ganache\\workspaces\\Quickstart\\chaindata"}
[11:52:58 AM] Ganache started successfully!
[11:52:58 AM] Waiting for requests …
[11:52:58 AM] eth_subscribe
[11:52:59 AM] eth_getLogs
[11:52:59 AM] eth_subscribe
[11:52:59 AM] eth_subscribe
[11:52:59 AM] eth_getLogs
[11:52:59 AM] eth_subscribe
[11:52:59 AM] eth_gasPrice
[11:53:40 AM] eth_getTransactionCount
[11:53:40 AM] eth_sendRawTransaction
[11:53:41 AM] eth_gasPrice
[11:55:09 AM] eth_getTransactionCount
[11:55:09 AM] eth_sendRawTransaction
[11:55:10 AM]   Transaction: 0×55964cca65d6b01073123807d24b344489d1f621fe5793115f00e73f63cdf780
[11:55:10 AM]   Gas usage: 21000
[11:55:10 AM]   Block Number: 1
[11:55:10 AM]   Block Time: Mon Mar 29 2021 11:55:10 GMT+0530 (India Standard Time)
[11:55:10 AM] eth_getBlockByNumber
[11:55:10 AM]
```

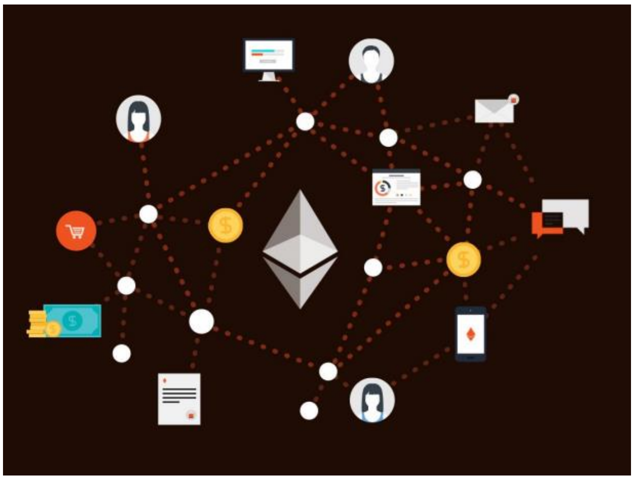
3.2 Technology Used

Blockchain is a technology that came into existence around 2008-09 by the invention of bitcoins by Satoshi Nakamoto. It is a decentralized system which makes the system more reliable, traceable , immutable, secure and transparent. As the name suggests blockchain is a combination of two words block and chain where ‘block’ refers to the information of transaction and ‘chain’ refers to the link between these blocks of information. It has the tendency to bend in any field be it voting, healthcare, cloud computing, Asset management, International transaction, Stock Market, etc.


1 A user requests for a transaction
2 A block representing the transaction is created
3 The block is broadcasted to all the nodes of the network
4 All the nodes validate the block and the
5 The block is added to the chain
6 The transaction gets verified and executed

Private Blockchain used[16]

Ethereum



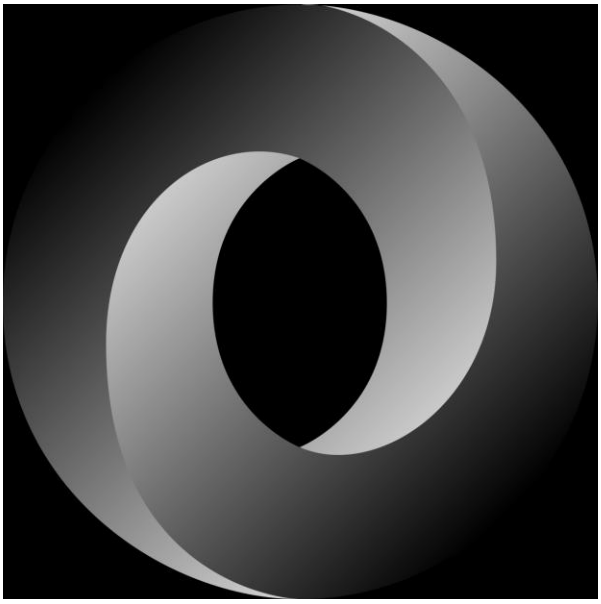
Ethereum is an open-source blockchain, decentralized platform that runs smart contracts. Ethereum is how the internet is supposed to work. Ethereum is the most popularly used blockchain.

Ethereum was crowdfunded during August 2014 by fans all around the world. It is developed by ETHDEV with contributions from great minds across the globe.

Language Used

Hypertext Preprocessor (PHP)[17]. PHP is an open source scripting language for web development. It’s embedded in HTML(Hypertext Markup language).

It is used for making interactive and dynamic websites. It can manage databases on the server and can encrypt data furthermore. Saved with .php extension. To run a .php file we need to install a web server first, the php from the official website and database also like MySQL.



JSON stands for JavaScript Object Notation. This language is used to send data from a web server to a webpage. JSON files are saved using the extension **.json** .

Dart is a programming language developed by GOOGLE for the web and mobile apps. It can also be used to build server and desktop applications. Dart is an object-oriented, garbage collected, class-based language with C language syntax.

3.3 Software used

Sublime text editor

It is a source code editor which supports many languages like python, java, C, etc. Its ability to make code lines standout and easy to read make it more suitable to use.

Flutter is created by GOOGLE. It is an open-source UI software development kit. It is mainly used to develop applications for Linux, Android, iOS, etc.

3.4 Algorithm

CHAINING IN BLOCKCHAIN:

Each new data (a transaction) is stored in a block added at the end of the chain. To be added, this last block uses some of the information of the previous block in order to ensure the integrity and connection in the ledger.

For our project, we will be using PHP with JSON. Our JSON structure is:

```
    "chain":

                                        "index":0,

                                        "hashid":"first-block-doesnt-need-it",

                                        "timestamp":1541789227213,

                                        "proof-of-work":"xyz",

                                        "content":

                                                  {

                                                  "from":"smith",

                                                  "to":"david",

                                                  "amount":1

                                                  }

                                        }]
```

Index: a simple unique numeric integer ID (increment by 1), starting at 0.

Hashid: Produced for each entry of the ledger.

Timestamp: the creation date of the block.

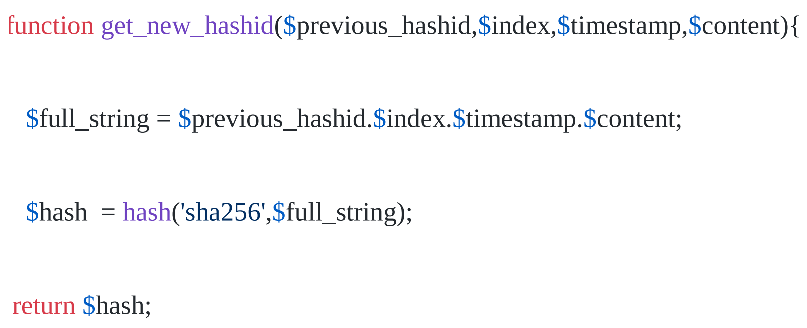
Proof-of-work: in a fully functional blockchain system, a proof of work is needed in order to create a new block in the chain.

Content: this attribute stores structured information about the transaction itself. In this example, we used a transaction from a user to a user with the amount. For e-Voting, it will be merely from-to relationship.

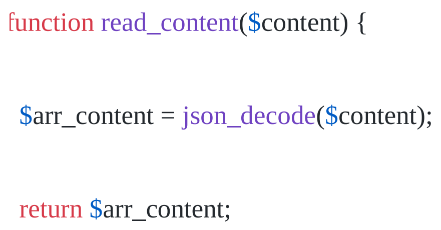
READING A BLOCK:

- **Read** our blockchain
- read data about the **last block** in the blockchain
- **calculate a valid hash** to be used by a new block, and insert it in the blockchain

```
php

class DAO {

 function read_all() {

  try {
    $jsondata = file_get_contents(dirname(dirname(__FILE__))."/chain.json");

    $arr_data = json_decode($jsondata, true);

    return $arr_data;

  }

  catch(Exception $e) {

    echo "Error: " . $e->getMessage();

    exit();

  }




function get_previous_hashid($chain){

   $lastEl = array_values(array_slice($chain, -1))[0];

 return $lastEl["hashid"];




function get_previous_index($chain){

   $lastEl = array_values(array_slice($chain, -1))[0];

 return $lastEl["index"];
```



```
function get_new_hashid($previous_hashid,$index,$timestamp,$content){
  $full_string = $previous_hashid.$index.$timestamp.$content;
  $hash  = hash('sha256',$full_string);
return $hash;
```



```
function read_content($content) {
 $arr_content = json_decode($content);
 return $arr_content;
```

.

The read_all() function reads the whole blockchain and places it in a multidimensional array. It is doable in small prototypes, but not in production environments where data size is enormous.

The functions, get_previous_hashid() and get_previous_index() will retrieve the index and hashid values of the last inserted block.

The last function, read_content() will save a multidimensional array of contents (sender-recipient-and amount)

WRITING A BLOCK:

```
?php

        // including basic configuration file and Data Access Object class

         include_once("./includes/config.php");

         include_once("./includes/dao.php");



          // initializing the class

          $dao = new DAO();



          // loading the full blockchain in an array and showing it as output on the webpage


          $full_chain = $dao->read_all();

          echo "full blockchain loaded:<br />";

          echo '<pre>',print_r($full_chain["chain"],1),'</pre>';
```

```
  echo "<hr />";

    / /reading last block’s hash id
    $previous_hashid = $dao->get_previous_hashid($full_chain["chain"]);

      echo "reading last block's hash id:<br />";

      echo $previous_hashid;

      echo "<hr />";



    // reading last block's index to calculate next index

    $previous_index = $dao->get_previous_index($full_chain["chain"]);

    $next_index = $previous_index+1;

    echo "reading last block's index to calculate next index:<br />";

    echo "Last: " .$previous_index. " | Next: ".$next_index;

    echo "<hr />";



echo "New hashid:<br />";

$timestamp = round(microtime(true) * 1000);

// example content

// $content = '{"from": "network","to": "simone","amount": 1000}';

$content = $_POST["json_data"];
```

```
$new_hashid = $dao->get_new_hashid($previous_hashid,$next_index,$timestamp,$content);


echo $new_hashid;

echo "<hr />";
```

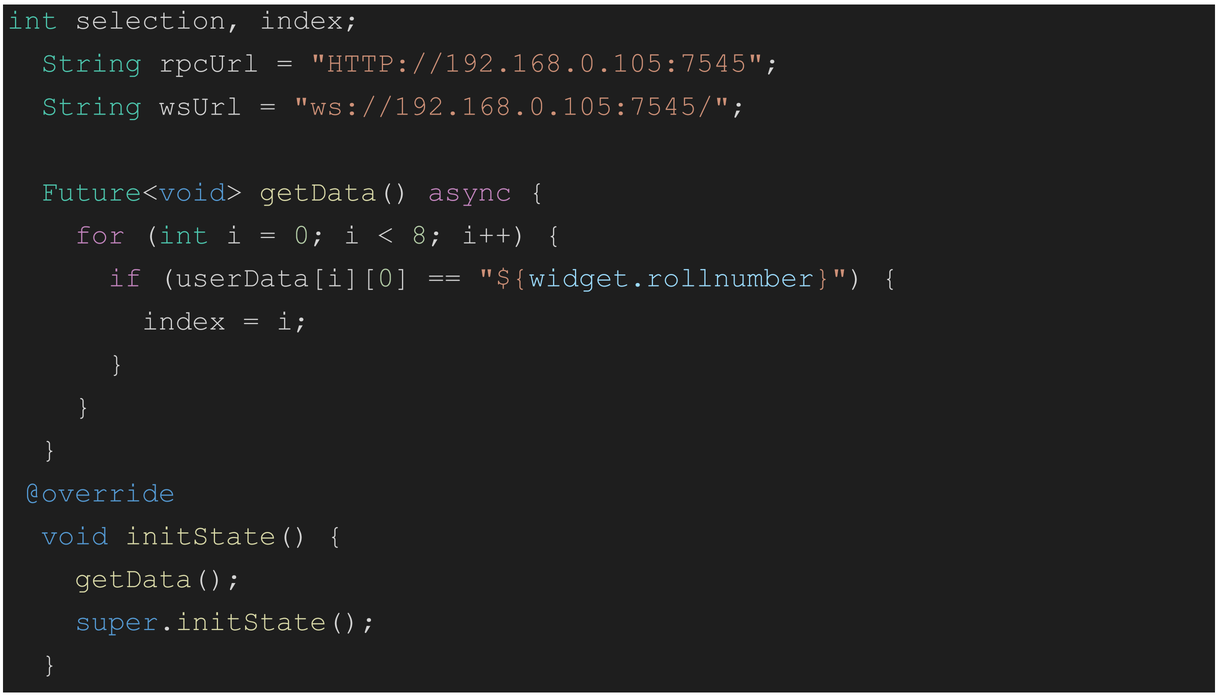
The variable *$content*, which should contain the meaningful data of our transaction, has the value of a “json_data” POST variable.

```
<form action="chain.php"
ethod="post">
<textarea name="json_data">

{

    "from": "smith",

    "to": "david",

    "amount": 1

}

</textarea>

<input type="submit">

</form>
```

As you can see, this form sends raw json data to chain.php. Changing the values of From, To, and Amount will lead to different transactions registered in our blockchain.

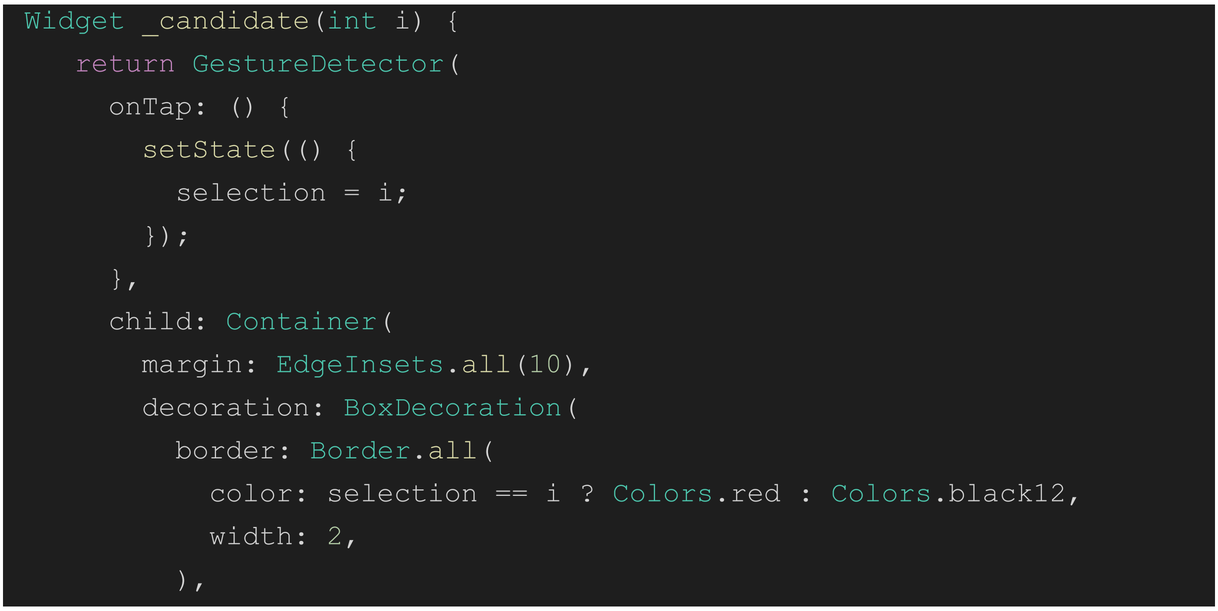
Sending an Ether

- Firstyly, we initialize a few things like the server IP, the logged in user’s security key and other variables required.



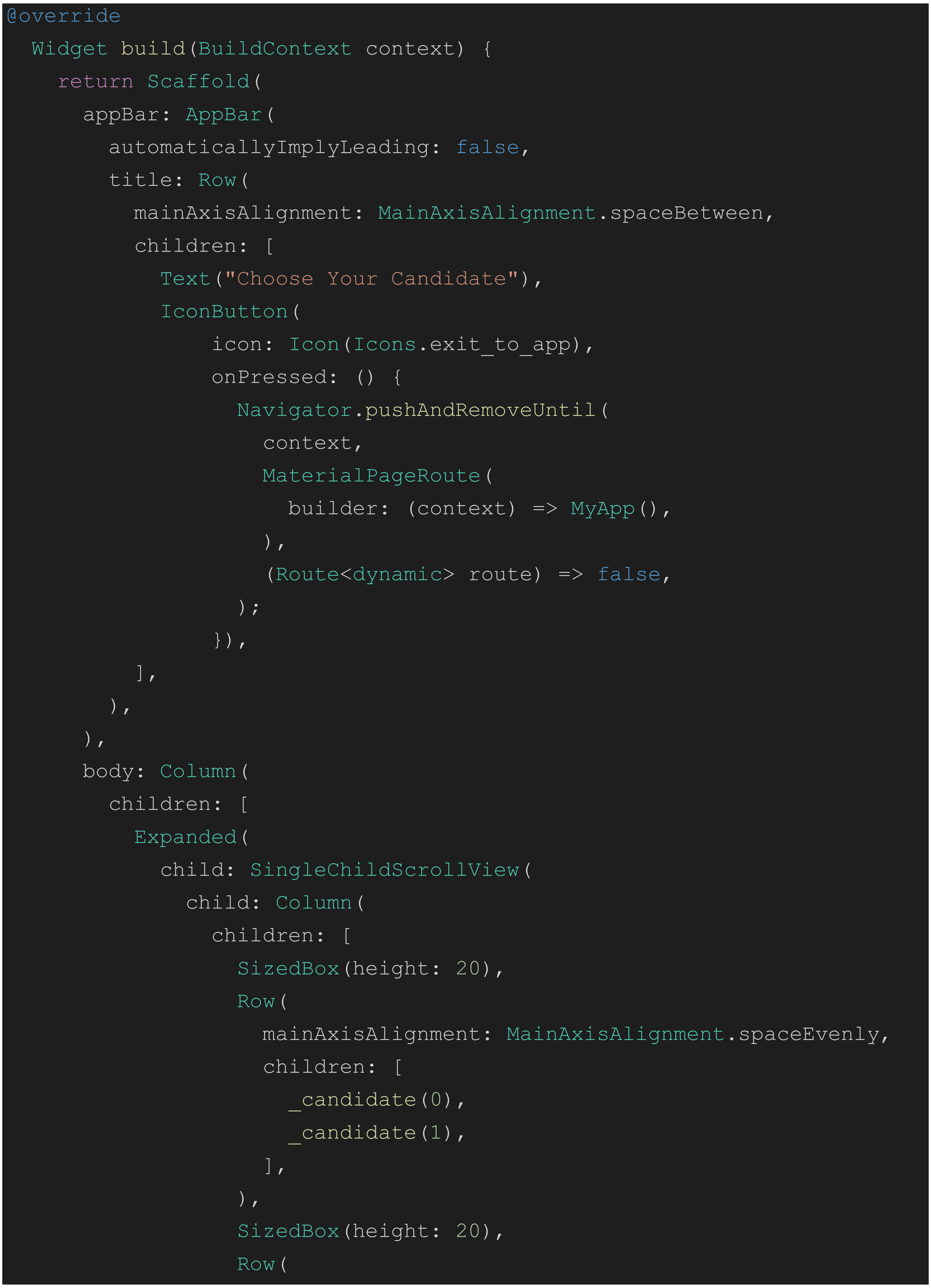
```
int selection, index;
  String rpcUrl = "HTTP://192.168.0.105:7545";
  String wsUrl = "ws://192.168.0.105:7545/";

  Future<void> getData() async {
    for (int i = 0; i < 8; i++) {
      if (userData[i][0] == "${widget.rollnumber}") {
        index = i;
      }
    }
  }
 @override
  void initState() {
    getData();
    super.initState();
  }
```

- Then the voter can make the selection by tapping on the candidate of their choice.



```
 Widget _candidate(int i) {
    return GestureDetector(
      onTap: () {
        setState(() {
          selection = i;
        });
      },
      child: Container(
        margin: EdgeInsets.all(10),
        decoration: BoxDecoration(
          border: Border.all(
            color: selection == i ? Colors.red : Colors.black12,
            width: 2,
          ),
          borderRadius: BorderRadius.circular(12),
        ),
        child: Column(
          children: [
            Container(
              width: 130,
              height: 130,
              decoration: BoxDecoration(
                image: new DecorationImage(
                  image: new AssetImage("assets/" + i.toString() +
".jpg"),
                  fit: BoxFit.fill,
                ),
                border: Border.all(
                  color: Colors.white,
                  width: 1,
                ),
                borderRadius: BorderRadius.circular(12),
              ),
            ),
            SizedBox(
              height: 4,
            ),
            SizedBox(
              height: 3,
            ),
            Text(
              userData[i][1],
              style: TextStyle(
                fontWeight: FontWeight.bold,
                fontSize: 18,
                color: Colors.black45,
              ),
            ),
            SizedBox(
              height: 10,
            ),
          ],
        ),
      ),
    );
  }
```

The User Interface



```
@override
  Widget build(BuildContext context) {
    return Scaffold(
      appBar: AppBar(
        automaticallyImplyLeading: false,
        title: Row(
          mainAxisAlignment: MainAxisAlignment.spaceBetween,
          children: [
            Text("Choose Your Candidate"),
            IconButton(
                icon: Icon(Icons.exit_to_app),
                onPressed: () {
                  Navigator.pushAndRemoveUntil(
                    context,
                    MaterialPageRoute(
                      builder: (context) => MyApp(),
                    ),
                    (Route<dynamic> route) => false,
                  );
                }),
          ],
        ),
      ),
      body: Column(
        children: [
          Expanded(
            child: SingleChildScrollView(
              child: Column(
                children: [
                  SizedBox(height: 20),
                  Row(
                    mainAxisAlignment: MainAxisAlignment.spaceEvenly,
                    children: [
                      _candidate(0),
                      _candidate(1),
                    ],
                  ),
                  SizedBox(height: 20),
                  Row(
                    mainAxisAlignment: MainAxisAlignment.spaceEvenly,
                    children: [
                      _candidate(4),
                      _candidate(5),
                    ],
                  ),
                  SizedBox(height: 20),
                  Row(
                    mainAxisAlignment: MainAxisAlignment.spaceEvenly,
                    children: [
                      _candidate(2),
                      _candidate(3),
                    ],
                  ),
                  SizedBox(height: 20),
                  Row(
                    mainAxisAlignment: MainAxisAlignment.spaceEvenly,
                    children: [
                      _candidate(6),
                      _candidate(7),
                    ],
                  ),
                  SizedBox(
                    height: 20,
                  ),
                ],
              ),
            ),
          ),
          GestureDetector(
            onTap: () {
              if (selection != null) {
                castVote(context, selection);
              }
            },
            child: Container(
              height: 50,
              width: double.infinity,
              color: selection == null ? Colors.red[200] : Colors.red,
              child: Center(
                child: Text(
                  "SUBMIT VOTE",
                  style: TextStyle(
                    color: Colors.white,
                    fontSize: 22,
                  ),
                ),
              ),
            ),
          ),
        ],
      ),
    );
  }
```

- After submission of the vote, the function call to send ether is made. It first checks the user balance and then if available then makes up the vote.

```
castVote(BuildContext context, int id) {
    Widget okButton = FlatButton(
      child: Text(
        "CANCEL",
        style: TextStyle(color: Colors.black),
      ),
      onPressed: () {
        Navigator.of(context, rootNavigator: true).pop();
      },
    );
    Widget cancelButton = FlatButton(
      child: Text(
        "CONFIRM",
        style: TextStyle(color: Colors.black),
      ),
      onPressed: () {
        sendEther();
        Navigator.of(context, rootNavigator: true).pop();
      },
    );
    AlertDialog alert = AlertDialog(
      title: Text(
        "Are you sure you want to cast your vote to " + userData[id][1]
+ " ?",
        style: new TextStyle(
          fontSize: 19.0,
          color: Colors.black,
      ),
    ),
    actions: [
      cancelButton,
      okButton,
    ],
  );
  showDialog(
    context: context,
    builder: (BuildContext context) {
      return alert;
    },
  );
}
```

3.5 Application’s Contribution

This application will be used by every nation. Every democratic country holds elections after a period of time and uses either a paper ballot system or EVM (Electronic Voting Machines) which usually consumes most time and often leads to manipulation or tampering of data. We chose this topic because we found something wrong in this world and thought how we could change it. Although many organisations are working on developing this type of platform due to the need of high computational power requirements, and because the people are not too familiar with this technology, it's taking longer to be implemented and used. An election is not the only field it can be applied to, it can contribute to the health department, stock market, asset management, international transaction, cloud computing, digital identity, law and media, etc. This technology has the capability to collaborate with any field and make it more reliable.

Pros

1. **Decentralized System -** By decentralized means that there is not a single authority to verify you and your transactions. You will be verified by several miners and information of your transaction will be stored in a block containing unie hash making it a more reliable mode of transaction. Every transaction is validated by miners.
2. **Transparent[3] -** The transactions are transparent. Anyone can use it and view information. You can track your transactions.
3. **Immutable[3] -** Once a transaction is done, validated by the miners and the block is hashed and added to the blockchain, that data can not be altered. Any alteration of data is clearly seen because of it being open source so alteration of data is very difficult for anyone.
4. **Reliable -** It's like an open source ledger. So every transaction is public, traceable and transparent. Each transaction is monitored and validated by thousands of miners working continuously. This makes the blockchain system more safe and far away from security breaches and impenetrable.
5. **Traceability[3] -** If there is any error or fraud in the blockchain system it is easily traceable and can be corrected immediately.
6. **Faster processing -** After the invention of blockchain the transaction time has reduced a lot. Before this transaction used to take a lot of time and was a very cumbersome process.
7. **Security -** Blockchain system is highly secure because each user is given a unique identity to carry out the transaction and is linked with his account. By which a person will be the only one doing all the transactions from his account.

Cons

1. **Immutable -** Data immutability has both good sides and bad sides. One a data is added it cannot be removed. What if after a time a person doesn't want the data to be there? Due to this property data cannot be changed and removed.
2. **No Government interference -** Government cannot interfere between any virtual currency. Government has no control over it. Blockchain is a decentralized ledger so it is impossible for the government to interlope in it.
3. **High computational power is required[3] -** to maintain zero downtime high computation power is required as thousands of miners are working to validate the transactions and adding blocks in the blockchain. It needs higher computational power to reduce its downtime to approximately zero so that each transaction is traceable and immutable. To maintain transparency, real time work input is required. Whenever a new block is added to the block chain and to communicate with other blocks at a real time higher computational power is required.
4. **High energy is required -** Blockchain has higher energy consumption to maintain real time ledger.
5. **Not easy for less tech savvy people -** People who are close to technology can adapt to its use and can be really comfortable with it but not in the case of less tech savvy people, they might face problems getting used to it.

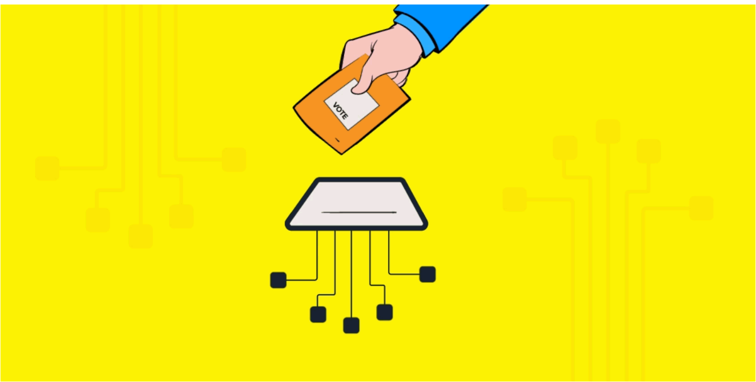
Chapter 4: CONCLUSION

4.1 Application

Blockchain has a caliber to advance in any field and collaborate with other fields.

(i) Healthcare - If blockchain is included in healthcare it will transform the society. Connecting all medical institutions and people around the world would really be revolutionary. If everything is stored in a single platform starting from taking appointments, doctor advice, test suggestion, test results, suggested medication, and healing period, all is stored in a single platform. Wouldn't it make it easier for all the doctors to advise better by checking all the medical history of the patients. And if this platform is secured by a blockchain network then there will be nothing to worry about the alteration of data.

(ii) Voting - In the 20th century we used a paper ballot system which was prone to tampering of the results. People used unethical means to win over other parties like hijacking the trucks carrying the ballots for counting and putting false votes into the ballot. Then came the EVM (Electronic Voting Machines) which was easier to tamper with. Just a little interference with the hardware and changing the algorithm, various elections were won. And there was no trace of this crime. If we could transform this method of voting with blockchain based voting things will get better and easier. Elections will be fair and people will trust more. Clearly a blockchain voting system will be more reliable than the humans. It is decentralized, immutable and traceable which makes it more faithful.



(iii) Asset Management- Asset Management is basically about transactional data and transparent and immutability is utterly important. Because blockchain provides better data security, transparency and the fact that it is decentralized makes the system less prone to security breaches. This system requires higher computation power and makes it more resilient, fast. A properly designed asset management blockchain system can provide real time performance, giving managers quick insights into data drift and changes.

(iv) Cloud Storage- Compared to the centralized cloud servers, decentralized cloud servers provide higher security. Unlike traditional cloud servers, decentralized cloud storage does not keep client's data on one particular centralized server. Instead, it uses different nodes scattered across the world, which are independent of each other. The nodes are not hosted by a sole entity They do not seem to be controlled by service providers, and anyone can run it.

As we are using centralized cloud servers, data is not encrypted and is prone to manipulations and could face breaches.

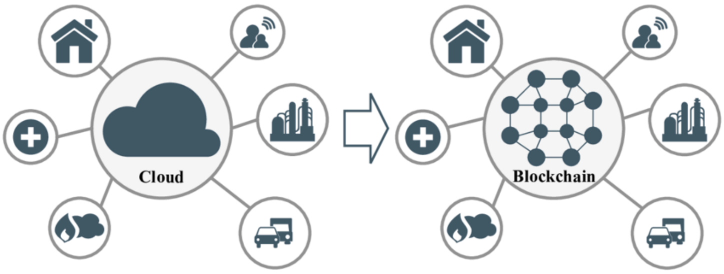


Fig. 4.1 Cloud Storage and Blockchain

(v) International transactions - When it comes to transactions, data security is the main priority. Many multinational companies who are continuously indulged in international transactions need a system which refuses manipulation attempts and it could be only possible with the decentralized system. When the system is decentralized, it provides security.

(vi) Stock market - Norbert Biedrzycki (Head of Services CEE at Microsoft) in an interview said that Blockchain has the capability to extend its branches in the World Stock Market exchanges.

He states, " Today's investor relies on a traditional system of shopping, selling and accounting for transactions that are sufficiently old to be called ossified. The system generates considerable costs and adds to the time needed to shut transactions. This can be because trading in financial assets requires multiple entities arranged in an exceedingly complex web of intermediaries, settlement systems and business partners. Whether they are investors, brokers, depositaries, exchange management or central supervisory bodies, all actors collaborating in part in asset trading – buying, selling, or transferring – are obliged to come up with messages, receive authorizations, and continuously update transaction status records."

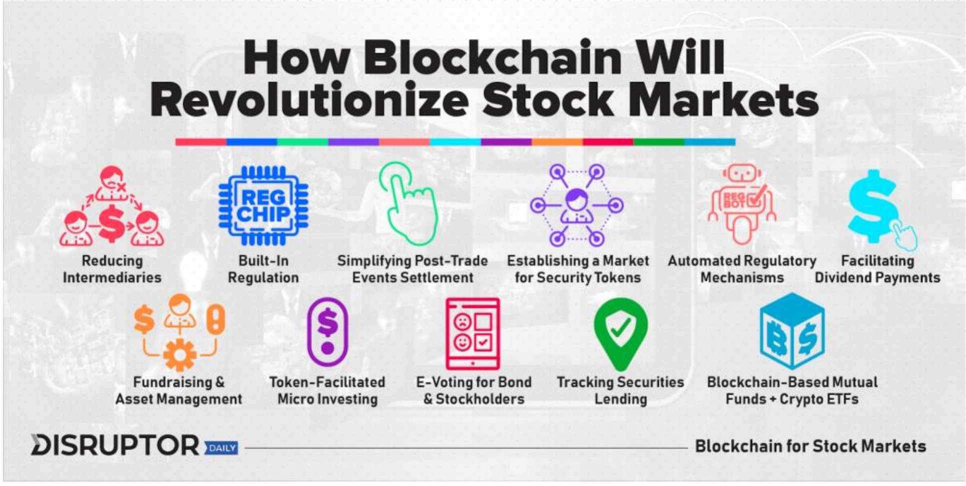
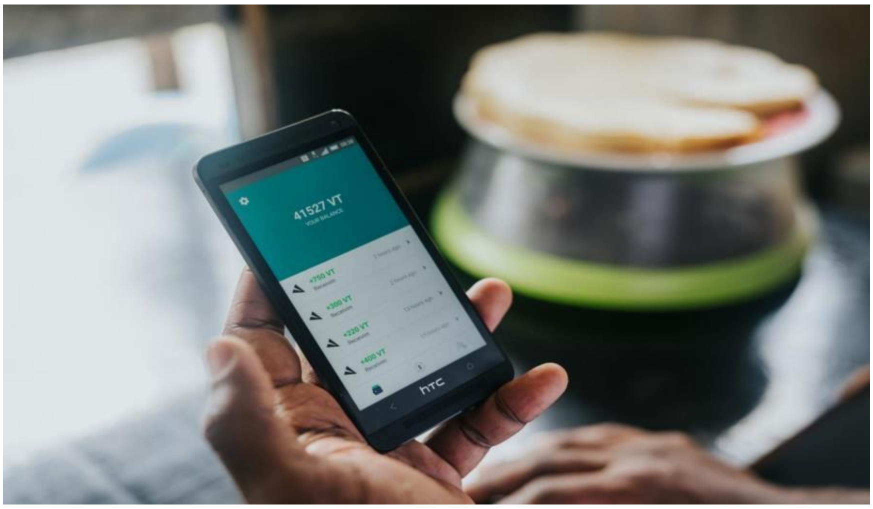

How Blockchain Will Revolutionize Stock Markets
Reducing Intermediaries
REG CHIP
Built-In Regulation
Simplifying Post-Trade Events Settlement
Establishing a Market for Security Tokens
REG BOT
Automated Regulatory Mechanisms
Facilitating Dividend Payments
Fundraising & Asset Management
Token-Facilitated Micro Investing
E-Voting for Bond & Stockholders
Tracking Securities Lending
Blockchain-Based Mutual Funds + Crypto ETFs
DISRUPTOR DAILY
Blockchain for Stock Markets

Fig. 4.2 Blockchain in Stock Market

(vii) Payments and Money: Blockchain technology allows completely creative ways of handling money and facilitating payments with no difficulty. It is guiding in a more efficient and secure global payment infrastructure. Trillions of dollars in untapped value is waiting to be unlocked through financial empowerment and operational efficiency. The crypto-currency Bitcoin, is the perfect example of this application. The blockchain technology was introduced to back the functionality of Bitcoin only, to decentralize and secure the digital payments.

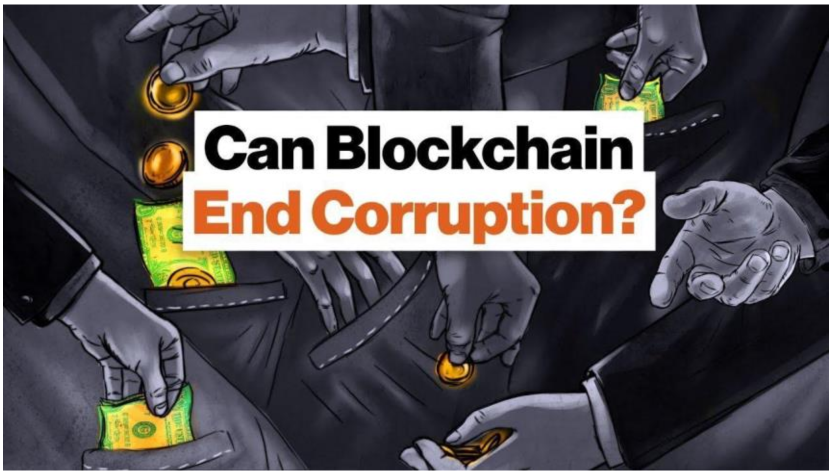


(viii) Digital Identity: A blockchain-based digital identity system provides a unified, interoperable, and tamper-proof infrastructure with key benefits to enterprises, users, and IoT management systems. The solution ensures protection against theft, assures companies storing customer information, and provides individuals greater sovereignty over their data. As the world is shifting towards digital means, and providing all ID online, their security, authentication and restricting unethical access is very crucial to maintain. Several applications nowadays let users keep all their data digitally for the ease of carrying, but not all of them are secure.

(ix) Law: An enterprise-grade blockchain solution can alleviate the heavily-manual processes of today's legal system. Enterprise Ethereum will help address the estimated 9.8% loss in total productivity that manual operations costs a law firm every year by providing accessibility, transparency, cost savings, speed, efficiency, and data integrity.

(x) Media and Entertainment: Piracy, fraud, hacking and theft of digital items cost the entertainment industry more than 71 billion dollars everywhere. Blockchain technology can create a distributed ledger to track the life cycle of any content, which has the potential to drastically reduce piracy of intellectual property, protect digital content, and facilitate the distribution of authentic digital collectibles.

(xi) Social Impact: Blockchains lend themselves to re-establishing fairness in a modern economy of continual exploitation. An estimated 20-25% of funds globally are lost to corruption at the government level, intermediaries take up to 7% of global remittances, and modern fintech solutions fail to include the 1.7 billion global unbanked adults.



(xii) Decentralized Finance: It unfolds a huge amount of economic opportunities for global citizens resulting in a more equitable, profitable, and secure global economy. It leverages the key principles of the Ethereum blockchain to enhance financial security and transparency, unlock liquidity and growth opportunities and support an integrated and standardized economic system.

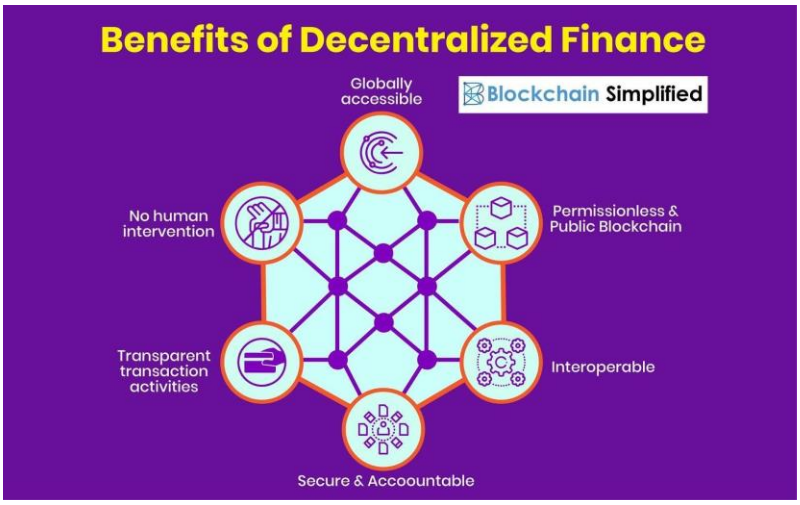

Benefits of Decentralized Finance
Blockchain Simplified
Globally accessible
Permissionless & Public Blockchain
Interoperable
Secure & Accoountable
Transparent transaction activities
No human intervention

Fig. 4.3 Decentralized Finance

Chapter 5: FUTURE DIRECTION

5.1 History and Present

Different voting methods carried out in the world are/were:

1. **Paper ballot system -** Paper ballot system have been the first step toward the fair election in democrartic country. People used to tick behind the name or write the name of the candidate they wanted to elect and then fold the paper and put them into the ballot. After the voting is done it is then sent for counting. But as time passed, people started using different tampering methods just to win the election and as a result the paper ballot system turned out to be unsuccessful considering the rights of humans. Still paper ballot systems are carried out in many different regions for voting purposes.

2. **EVM based voting -** Paper ballot system has been replaced in many countries with EVMs. Machine voting can be manual (lever machines) or electronic. In, Indian we press the button against the candidate we want to vote and the vote is registered but then it was revealed that EVMs are prone to manipulation alse just by tampering the software used, results could easily be converted.

3. **Online Voting -** In some countries people are allowed to vote online. Digital voting was first started in ESTONIA in 2005.

4. **Open Ballot -** In contrast to a secret ballot, an open ballot takes place in public and is commonly done by a show of hands. An example is the Landsgemeinde system in Switzerland, which is still in use in the cantons of Appenzell Innerrhoden, Glarus, Grisons, and Schwyz.

5. **In person** - In history we can find that there were many countries where physical presence were important for voting to count. Those were the times when technology did not exist.

6. **Voteby posting -** Many countries used and are using voting by posts, where voters get a ballot and write their vote and send them back.

5.2 Future Scope

If blockchain is adopted around the world then it will be easier for citizens to trust the country and country to promote and safeguard civil rights. Elections will be fair and people will trust more. It will increase the people's participation in elections. Most people skip voting. If it becomes transparent then people will indulge more in country issues and participate more. It is now more important than ever to know whether the voting results were fair or not. Every democratic country holds elections after a period of time and uses either a paper ballot system or EVM (Electronic Voting Machines) which usually consumes most time and often leads to manipulation or tampering of data. If a platform is developed by any organization then, it has to be accepted everywhere just to maintain the transparency. It can be used in

1. Digital Identity
2. Cloud Storage
3. Stock Market
4. E - voting by election commission
5. Healthcare department to store information
6. Asset Management,etc

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Appendices

Glossary

Following are the various extensions to references in the text. They are here to provide the reader with extra detail that may be required but was not present in the main report chapters.

Tampering[12] with the Electronic Voting Machine has never gone unnoticed by the Election Commission of India so in order tackle with this situation The election commission of india[11] is collaborating with IITmadras to build a Blockchain-Based Voting System system so that a citizen of india irrespective of the place where they are is eligible to vote and the votes remain no- manipulated.

Senior Deputy Election Commissioner Sandeep Saxena said the concept is a "two-way electronic voting system, in a controlled environment, on white listed IP devices on dedicated internet lines, enabled with biometric devices and a web camera". Blockchain voting system is not new and exists in many countries. Many states of America adopted the Blockchain voting system after the voting system was criticized by many leaders(politicians) for being rigged. In order to make the election fair and gain people's trust in the foundations of the country, the election commission decided to transform the Voting System.