BLOCKCHAIN BASED VOTING SYSTEM

PROJECT REPORT

For

Technical Answers for Real World Problems (TARP)
CSE3999

Slot: TB1

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Blockchain based voting system

1. ABSTRACT

As we as a whole realize that casting a ballot extortion is basic in India and furthermore in many created nations as well. There have been a few activities to lessen casting a ballot misrepresentation, for instance utilization of EVM machines in India.What in the event that we can utilize some innovation to ensure against something similar. Here comes the utilization of Blockchain, a blockchain is a protected conveyed record which is constant and utilizes cryptographic techniques to execute the given properties.In this task we plan a proposition for setting up the best answer for a blockchain casting a ballot dApp that consolidates citizen self-sovereign-ID and undeniable voting form arrangement. We will utilize brilliant agreements to execute the standards set up by the Election commission of India. Our proposition tends to the essential standards and shows key capacities and contemplations for a completely supported drive and improved elector end up, progressing commitment, and tremendous expense investment funds by limiting blunders and manual information passage and framework organization for heritage frameworks. We accept that an electronic democratic dApp ought to be reason driven, local area situated, in view of open guidelines for blockchain advancements, citizen protection and security as a goal, and autonomous check and straightforwardness for polling form organization.

Keywords—Blockchain,Dapp,smart contract,Multi-factor authentication, truffle suite

2. INTRODUCTION

Across democracy, electoral security is an issue of national security.The computer security field has been working on the possibilities of electronic voting system,with an aim of reducing the cost of election and increasing the security of the election.From the beginning of the democratic elections,the voting system was based on pen and paper.Instead of pen and paper currently the Indian election uses evm machines,which are vulnerable to voting fraud and machine tampering.Electronic voting machine are considered invalid and anyone with physical access to that machine can tamper with the machine ,thus affecting all votes casted.
Enter blockchain technology. A blockchain is a distributed, immutable, incontrovertible, public ledger. This new technology works through four main features:

(i)The Blockchain ledger is distributed and no single party controls it:the distributed ledger and no single point of failure.
(ii) Once a transaction is added to the ledger it cannot be edited or deleted.
(iii) Any proposed “new block” to the ledger must reference the previous version of the ledger, creating an immutable chain from where the blockchain gets its name, and thus preventing tampering with the integrity of previous entries.
(iv)The majority of the nodes must reach a consensus before a transaction is added to the block.

2.1 E-voting

The E-Voting system mainly involves the implementation of two of the most talked about input and counting services in the educational and commercial world. In order to have a secure vote the following structures should be considered and should be well maintained.
Fairness: Voting results should not be announced before the end of the voting process. This will ensure that the remaining voters will not be influenced to vote.

- Eligibility: Ensure that only eligible voters should be allowed to vote.
- Confidential: Once a voter has voted, the details of the entered vote should not be disclosed to other users.
- Verification: This asset helps voters to ensure that the entered vote is counted or not. There are two types of verification: individual authentication and standard[7]. Individual verification checks the weather votes cast by people selected for the calculation process or not. And if possible universal verification any user can verify the election results once they are published.
- Exemption: The power of voters to change or convert voters to vote after inclusion.

2.2 Public vs Private Blockchain Network

Public blockchain network consists of 'N' number of multiple nodes, any user can join the network and perform transaction operations and can participate in consensus process, so this type of network is completely trust-less. Public blockchain network are completely decentralized and nodes must be properly synchronized and if the blockchain is very big then it takes huge amount of time and energy to perform the operations . In private blockchain user or nodes need to take permission to join the blockchain network then only the nodes can read the current state of block chain. Compared to public blockchain private blockchain are much faster, safe and efficient, in this case all the permissions are carried out centralized so there is no decentralization.

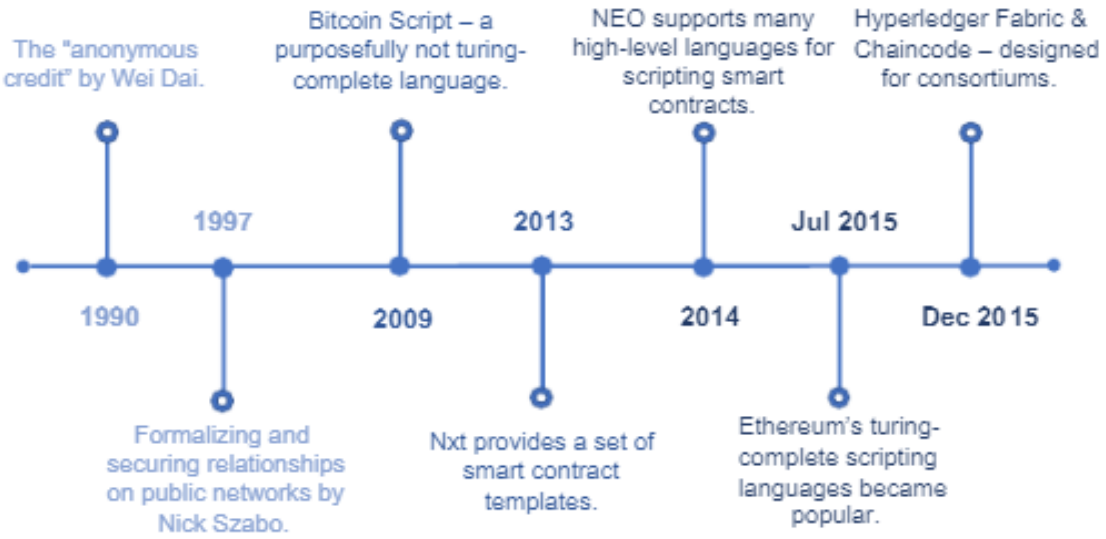
2.3 Blockchain as a Service

The blockchain innovation was presented in 2008 when Satoshi Nakamoto made the main digital money called Bitcoin. The Bitcoin blockchain innovation utilizes a decentralized public record joined with PoW(Proof-of-Work)based stochastic consensus convention, with monetary motivations to record a completely requested succession of squares, the blockchain. The chain is imitated, cryptographically marked and freely verifiable at each exchange so nobody can mess with the information that has been composed onto the blockchain. The blockchain structure is an affix just information structure, with the end goal that new squares of information can be kept in touch with it, yet can't be adjusted or erased. The squares are fastened so that each square has a hash that is an element of the past block, giving the affirmation of permanence. Though the Bitcoin blockchain distributes all components of the whole chain, in everyday different sorts of blockchain can be public, private or consortium based. Public blockchains award admittance to peruse and capacity to make an exchange to any client in that organization. This sort is for the most part utilized for cryptographic forms of money (e.g., Bitcoin, Ethereum, Dogecoin and Auroracoin). Consortium blockchain is a "incompletely decentralized" blockchain, where the agreement interaction is constrained by a pre-chosen set of hubs. Envision a consortium of 15 monetary organizations, every one of which works a hub of which 10 should sign each block all together for the square to be legitimate. The option to pursue the blockchain can be public or confined to the

members. Private blockchain limits the compose access as well as the read access also, to explicit members who can check their exchange inside. That makes the exchange on a private network less expensive, since they just should be confirmed by not many hubs that are trusted and with ensured high handling power. Hubs can be trusted to be all around associated and shortcomings can rapidly be fixed by manual intercession, permitting the utilization of agreement calculations which offer absolution after much more limited square occasions.

2.4 Smart Contracts in Blockchain

Smart contracts can be created and sent to various blockchain platforms (e.g., Ethereum). Different platforms offer a variety of features to build smart contracts. Bitcoin, Ethereum and Hyperledger Fabric are some of them. Bitcoin is a blockchain platform that supports cryptocurrency transactions. Bitcoin uses a bytecode scripting language based on a very limited set of computer terms.Bitcoin writing language can support the creation of complex agreements that contain logical understanding.Like Bitcoin, Ethereum, it is a blockchain and cryptocurrency. In addition, the ability to transfer money supports the construction and implementation of complex systems based on smart contracts in the blockchain. The basic unit of the Ethereum system is an account. At Ethereum there are two types of accounts: outsourced accounts and contract accounts. The first is controlled by the corresponding private key holder and maintains balance. It can also be used for transactions to transfer money or to enter into a smart contract. Later logic code logic is controlled and has balance, retention and status. At the heart of Ethereum is the Ethereum virtual machine, which makes smart contracts. The smart contract source code is compiled into a bytecode form that can be translated by a visual Ethereum machine. Each Ethereum node operates the same command to simplify smart contracts and block blockchain protocols. Smart Ethereum contracts are built in different Turing languages such as Solidity.



3. RELATED WORKS

We are utilizing blockchain technology. Blockchain is a safe and lasting appropriated approach that can record exchange movements between clients. Blockchain was made by Satoshi Nakamoto in 2008 who is known in the Bitcoin exchange information base framework. Bitcoin itself is a cash whose exchanges utilize the Internet to organize and depend on cryptography for information secrecy issues and, obviously, security at the hour of the exchange. Blockchain itself has a decentralized framework by appropriating all information to numerous substances with the goal that members in the organization can take part without the requirement for endorsement from the focal substance. Decentralization on the blockchain permits every worker to associate and has a similar part as shaping a sort of friend to peer network. For this situation, information following is simpler, and when one worker, there is a reinforcement impedance that is without any problem performed by another worker, and the hazardous worker is briefly eliminated from the blockchain network. Methods presented in this report were very different and innovative in comparison to the review done for the paper. New implementations for the UI/UX were done; separate flow charts were designed after considering the New South Wales Voting system which was identified with a very poor kind of user interface. The SHA 256 box was used in the encryption for securing the system so that no adversary can access the votes without the authorization. New Concusses blocks were designed because of the need for improving the decentralized ledger based blockchain system. The methodology proposed is an onchain peer voting protocol keeping some assumptions in mind and protocol contains different stages which are voting ,validation on chain by smart contract and then verification on client by peers and final stage is revoting of ballots encrypted by the dishonest peers public key.This protocol also uses distributed tally method so that the count remains same for all the peers. The method used in this paper is to achieve the success in data security management it is implemented using different protocols like e-verification using electoral Id then verification of the tokens given to the voters.This token works to make a selection in the selection box.The third stage of the selector inserts the token into the machine, and then the screen will display the candidate to be selected. To vote, just simply press the candidate's picture. The fourth stage of each election result will be encrypted using blockchain technology to produce valid results. In the last stage, after data encryption, the monitor will immediately display the temporary gain of each candidate.In this paper proposes to use a Homomorphic signcryption system which is suitable for secret transmission between multiple senders(voters) to one receiver(authority) and messages encrypted by same encryption key and different signature keys are allowed to carry out homomorphic computation .HSE voting only allows registered voters to vote, and ensures that each voter can vote only once, which can be guaranteed by Authentication Centre according to Voter’s ID number and time stamp of each ballot and it can also be displayed on bulletin board which displays the voter id and timestamp of each ballot , hence ensuring transparency since bulletin board is accessible by everyone.

Blockchain as a service for e-voting

In this paper, we studied existing electronic voting systems, blockchain-based and evaluated their respective needs and considerations for implementing a national e-voting system. Based on this, we devised a blockchain-based electronic voting system. In the following subsection, we start by identifying the roles and components for implementing an e-voting smart contract.

Election as a Smart Contract

Defining a smart contract includes identifying the roles that are involved in the agreement and the different components and transactions in the agreement process. We start by explaining the election roles followed by the election process

1) Election Process: In our work,each election is corresponded by a smart contract which holds the details of the party and their representative which are running for the elections in a particular constituency.A smart contract is deployed for each constituency ,so multiple smart contract are deployed .There are three main activities in election process:

- Election creation

  Election commission of India creates the election ballots using smart contracts and Dapp(decentralised application) .The app interacts with the smart contract when the vote is casted by the voter.The local corresponding district officer is given access to the smart contract to count the vote casted

Voter registration

In India each eligible voter is assigned a voter ID card which is used by voter to cast the vote.In our work ,we proposed the usage of aadhar card for the voter verification because it is widely accepted and has unique identification factors like fingerprint,face and mobile number as well.

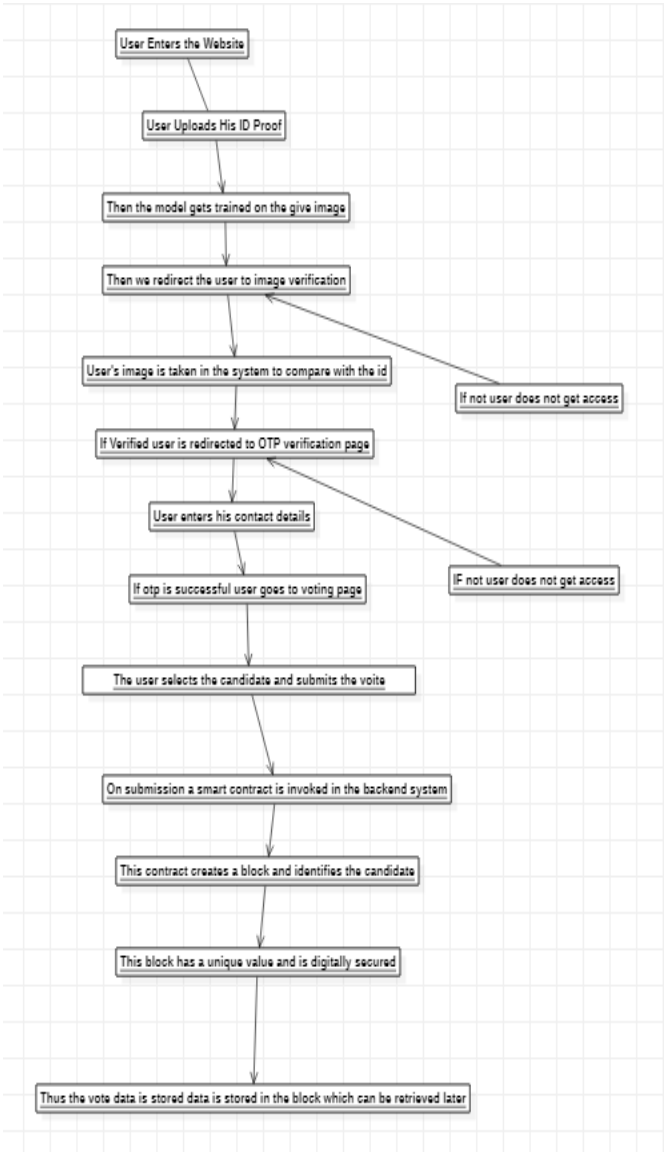
- Vote transaction

  When an individual votes at a voting district, the voter interacts with a ballot smart contract with the same voting district as is defined for any individual voter. This smart contract interacts with the blockchain via the corresponding district node, which appends the vote to the blockchain.Each transaction on the blockchain holds information about who was voted for, and the location of aforementioned vote.

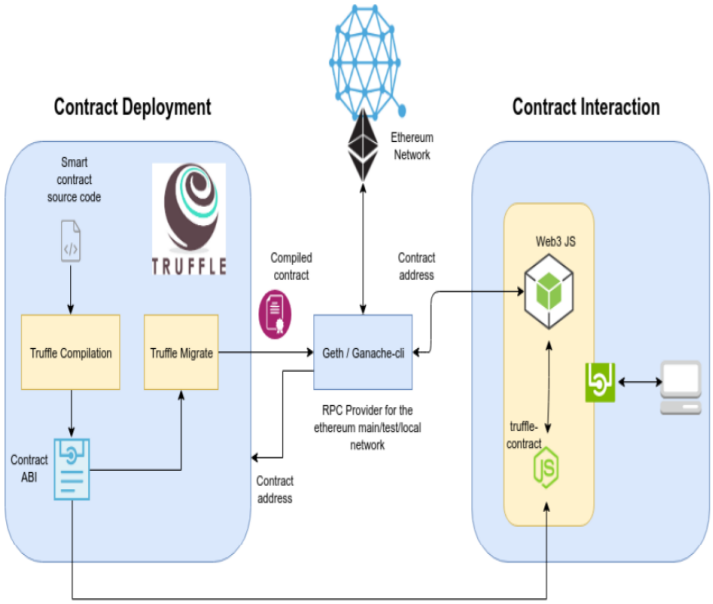
- Tallying results

  The Election commissioned appointed officer interacts with the blockchain and using a pre-defined function calculates the final tally of the votes.

4. SYSTEM ARCHITECTURE AND MODULE WISE DESCRIPTION



To present a strategy for secure validation, our proposed framework is intended to utilize electronic ID validation using multi factor authentication , which begins with facial recognition of the voter ,followed by an OTP verification , following this process makes sure that the voter is thoroughly vetted before the voter is let to vote. Then the user selects the candidate and submits the vote , this action triggers into a smart contract being invoked in the backend of the proposed system.This contract creates a block and identifies the candidate and this block has a unique value and is digitally secured and thus the vote data is secured in this block which can later on be retrieved.



Here in this system architect complete work-flow is expressed. The complicated integration of all technologies is shown in a detailed manner. Web3js, Truffle suite, Ethereum based blockchain.

7. MODULE DESCRIPTION

To introduce a method of secure authentication in our work we will be using deep learning model to capture the face of the voter in real time and compare it with the aadhar card photo of the voter. To add an extra layer of security the system will also perform otp/email verification of the voter.

1) A kiosk machine at the voting booth performs the required verification procedures.If the verification is successful the smart contract corresponding to the district of the voter is prompted.

2)After the voter has casted his/her vote that vote along with the time stamp and other necessary parameters is added to the blockchain corresponding to that election.

3)After the election process is completed the votes can be counted using the smart contract method and also can be counted in real time by the administrator.

Authentication

We followed multi-factor authentication to ensure that the user who is trying to exercise his right to vote is who he claims to be and has a valid identity.First step of multi-factor authentication is facial authentication. Here the Voter is required to upload the required identity card and proceed on , then this part of the system verifies whether the image on the ID is matching with the image that is visible on the camera.Then the user is redirected to the login page which is on a different server , we use the concept of microservices here.If the identity fails to match the user , is not redirected to the server which hosts the voting application.If the voter's authentication is verified, the user is redirected to the server which holds the voting application, there the voter has to enter an email id after which the user will get an OTP to the given email , which will be verified. If the user is authenticated , the user is given the option to exercise the right to vote.

Face Recognition

Facial Recognition is a very upcoming phenomenon due to the rise in AI technology. Recent advances in automated face analysis, pattern recognition, and machine learning have made it possible to develop automated face recognition systems. The rapid development of facial recognition is due to a combination of features: the effective development of algorithms, the

availability of large-scale facial data, and the way to test the performance of face recognition algorithms.

There are various different algorithms for facial recognition, some which we have discussed ahead.

Eigenfaces

Eigenface is one of the most investigated methods of facial recognition. It is also known as the expansion of Karhunen- Loève, eigenpicture, eigenvector, and the principal component. According to mathematical terms, eigenfaces are the main components of the surface distribution or eigenvectors of the covariance matrix of a set of facial images. Eigenvectors are instructed to represent different values of variation, respectively, between the faces. Each face can be represented by a direct value combination of the line of the eigenfaces.

Neural Networks

CNNs have shown superior performance in fields such as image recognition and are not part of neural network segregation. CNN is a type of transmitted neural feed network that contains many layers. CNNs contain neurons or filters with weight or limitations and untrained bias. CNN's structure includes Convolutional flexibility, integration, and full integration. CNN has two components: the first part of the outlet feature, which means that the input from each neuron is associated with the local field reception field; another part CNN mapping involves extraction and division into one section compared with standard visual algorithms and complex extraction processes. The convolutional layer is the central part of a Convolution network and it thus always is responsible for the heaviest computational elevation. The objective of the convolution layer is to extract important features from image input-data. Convolution preserves the spatial relationship between pixels by the use of tiny input squares to learn image properties. a spread of learning neurons are often wont to transform the image into the input.This leads to an activation map or map on the output image then the function maps are fed into the subsequent convolution layer as input file. The pooling layer reduces each activation map's dimensionality but still has the foremost significant details. The photo's inputs are divided into a collection of rectangles that don't overlap. A nonlinear activity, like limit or average, will sample each area. This layer achieves a more generalization, quicker integration, more resilient to translation and distortion.

Graph Matching

Graph matching is another approach to face recognition. It uses Dynamic Link Architecture. Dynamic-link architecture is an extension of classical artificial neural networks. Memorized objects are represented by sparse graphs, whose vertices are labeled with a multiresolution description in terms of an area power spectrum and whose edges are labeled with geometrical distance vectors. visual perception is often formulated as elastic graph matching which is performed by stochastic optimization of an identical cost function.

Blockchain

It is the technology of decentralized systems which enables to expand the System to large networks of computers known as nodes connected to each other and every computer have a ledger to keep track of the activities in the Blockchain network. It is also a very secure option for implementing a voting application, every activity is stored linearly, chronological order. After a block has been included at the end of blockchain, it’s extremely problematic to trace back and change the voting content of the block unless more than half reached a final state to do so. That’s because each block contains its own hash, along with the hash of the block before it, as well as the previously mentioned time stamp. Hash codes are created by a math function that turns digital information into a string of numbers and letters. If that information is edited in any way, the hash code changes

as well. This prevents any authority to alter the system in any way and allows common man to provide their votes successfully. The evolution of voting is imperative. Such technological moves forward are inevitable and welcome, at least for a country like India that has nearly a billion voters. Blockchain has the potential to bring transparency in voting while maintaining security and anonymity. Also, results can be gathered and processed quickly and straight after the voting is finished. The common electorate, however, might struggle to understand such a technology. In reality, common people rely much on the institutions and also on their political leaders. We know that the EVM debate got momentum repeatedly in the country.

Smart Contract

The smart contracts are examples of agreements conveyed on the Ethereum blockchain (Buterin, 2015) albeit the term was initially authored before (Szabo, 1997) with regards to electronic trade conventions between outsiders on the Internet. This stores the guidelines which:

1. Arrange the provisions of the agreement,
2. Consequently check the agreement, and
3. Execute the concurred terms.

Blockchain, combined with smart contract innovation eliminates the dependence on the focal framework between the exchange parties. Since the brilliant agreements are put away on the Blockchain, every one of the associated parties in the organization have a duplicate of them. It can execute the concurred put away cycle when set off by an approved or concurred occasion.[10] All agreement exchanges are put away in sequential requests for future access alongside the total review trail of occasions. In the event that any gathering attempts to change an agreement or exchange on the Blockchain, any remaining gatherings can identify and forestall it. On the off chance that any gathering comes up short, the framework keeps on working with no deficiency of information or respectability. It, thusly, makes a solitary enormous secure PC framework without the dangers, expenses and trust issues of an incorporated model.

We utilized Solidity programming language to compose savvy contracts since it just permits performing fundamental procedures on its essential sorts bringing about lightweight code. The EVM (Ethereum Virtual Machine) code is utilized in the agreements, and that comprises bytes, each addressing an activity. The code can get to the measure of Wei sent in the exchange and information of the approaching message, block header information, and return a byte cluster of information as a yield. For arrangement and testing of keen agreements on Ethereum blockchain, a truffle framework can be utilized since it has underlying smart contract aggregation, connecting, organization and twofold administration. As of now, our shrewd agreement runs on EVM. Notwithstanding, with the execution of the Ethereum Web Assembly (EWASM) later on, keen agreement advancement should be possible in some other programming dialects other than Solidity, and that will likewise accelerate the capacity call between Web Assembly and JavaScript (JS).

Index of functionalities

Below we elaborate the functions of the election smart contract for e-voting system

```
pragma solidity ^0.6.4;




contract Voting {



```

```
  mapping (bytes32 => uint256) public votesReceived;


  bytes32[] public candidateList;

constructor(bytes32[]memory candidateNames)
 public {
    candidateList = candidateNames;
  }
```

- VotingConstructor takes the input as the name of the candidates that are going to elect in the elections in the particular district and store them in a global candidateList array of type bytes32 and also initialize the array votesRecieved with a mapping with the candidate's name.

```
function totalVotesFor(bytes32 candidate) view public returns (uint256) {
    require(validCandidate(candidate));
    return votesReceived[candidate];
  }
```

- The function totalVotesfor takes as input the name of the candidate whose total votes we have to calculate and checks whether the candidate is valid and returns votes Received by the candidate.

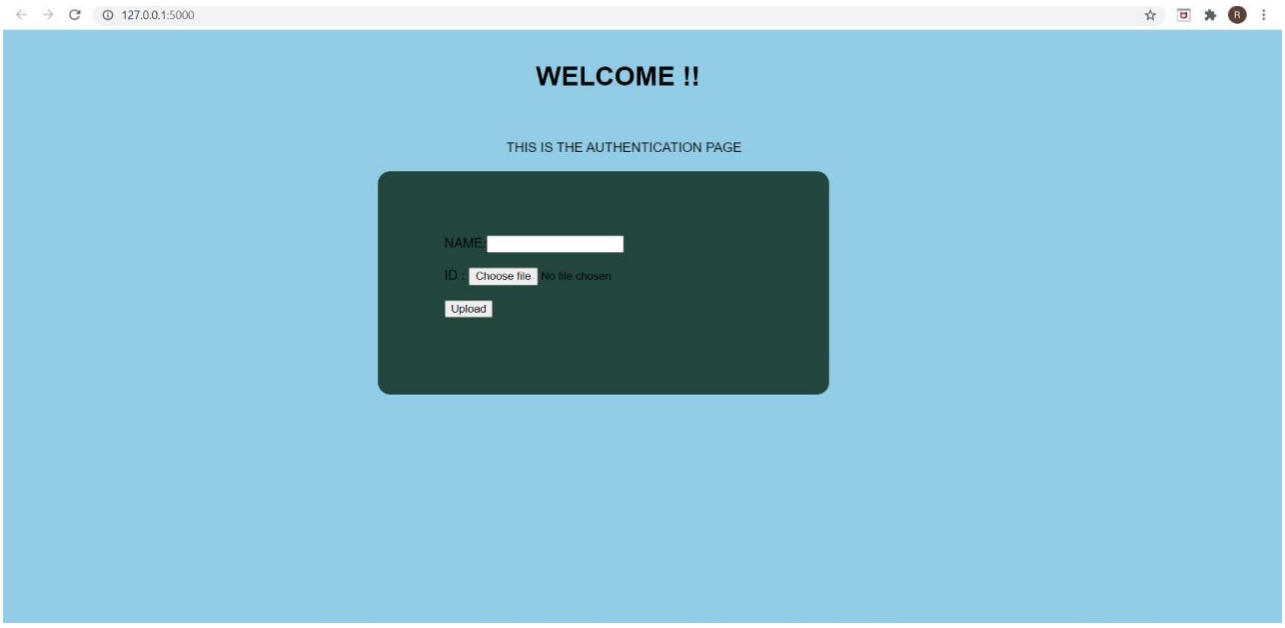
```
 function voteForCandidate(bytes32 candidate) public {
    require(validCandidate(candidate));
    votesReceived[candidate] += 1;
  }
```

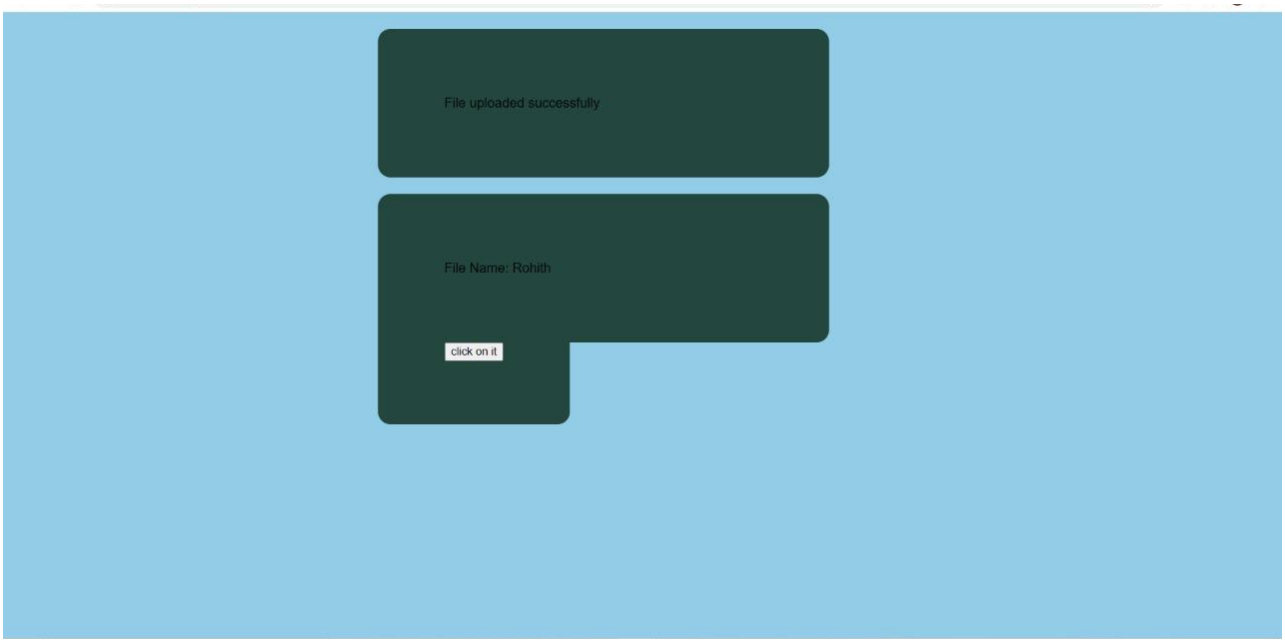
- The function takes as input the name of the candidate for whom the voter has casted vote and checks the validity of the candidate and increases the vote count of the candidate by one.

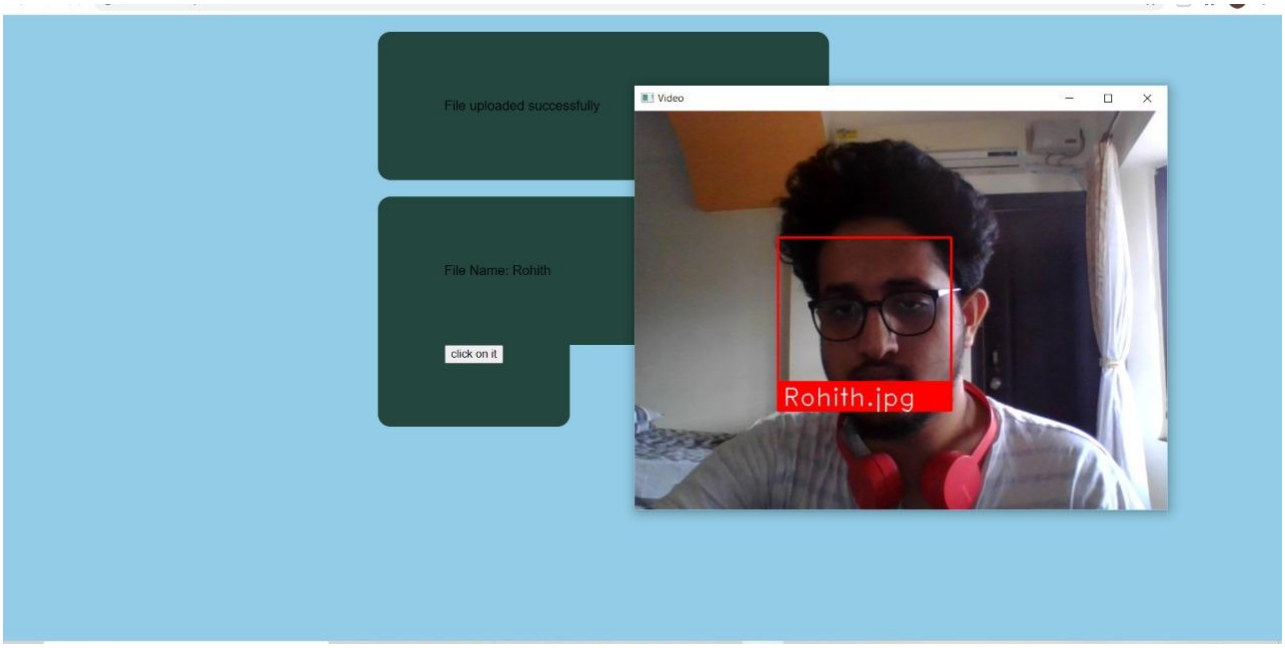
```
function validCandidate(bytes32 candidate) view public returns (bool) {
    for(uint i = 0; i < candidateList.length; i++) {
      if (candidateList[i] == candidate) {
        return true;
      }
    }
    return false;
  }
```

- This function checks whether the given candidate is present in the list of candidates or not if present it returns true,otherwise false is returned.

IMPLEMENTATION SCREENSHOTS



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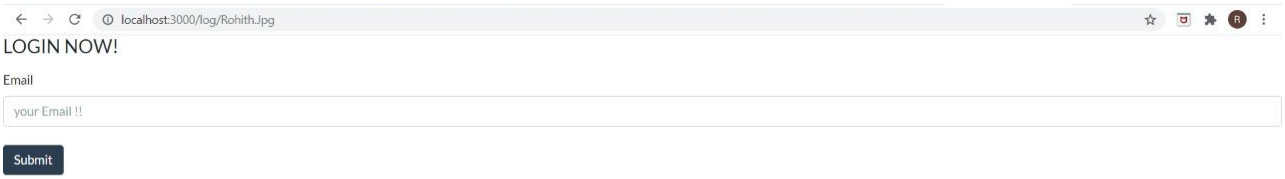
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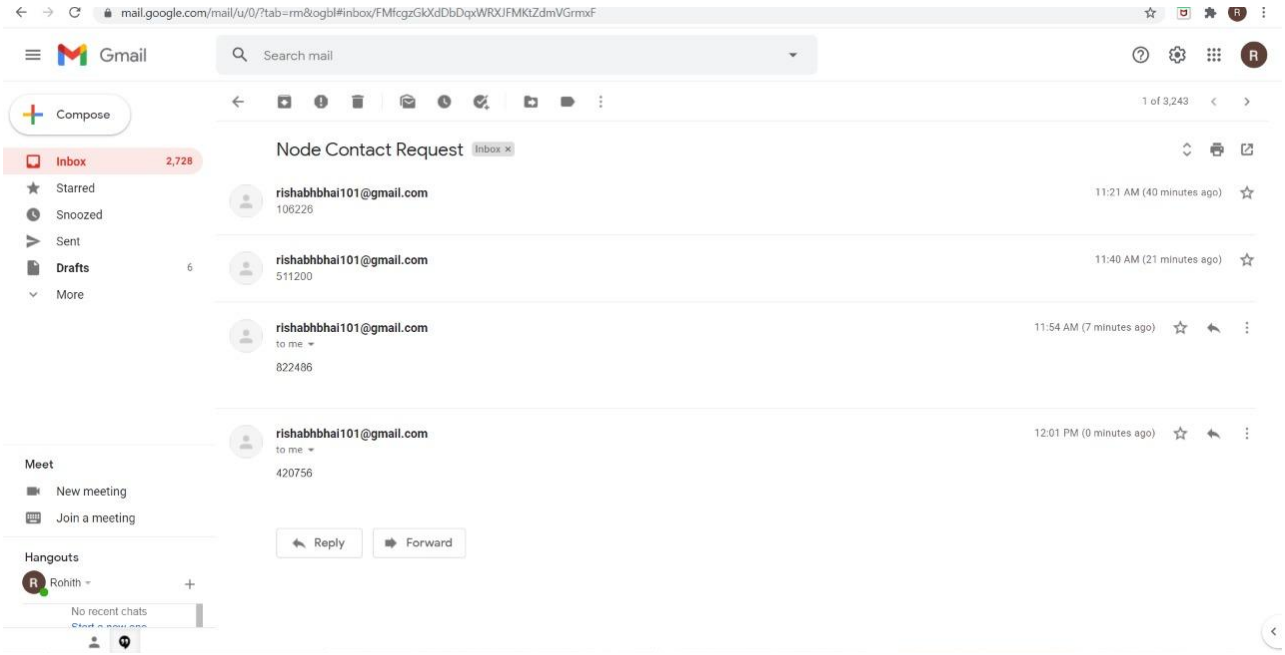
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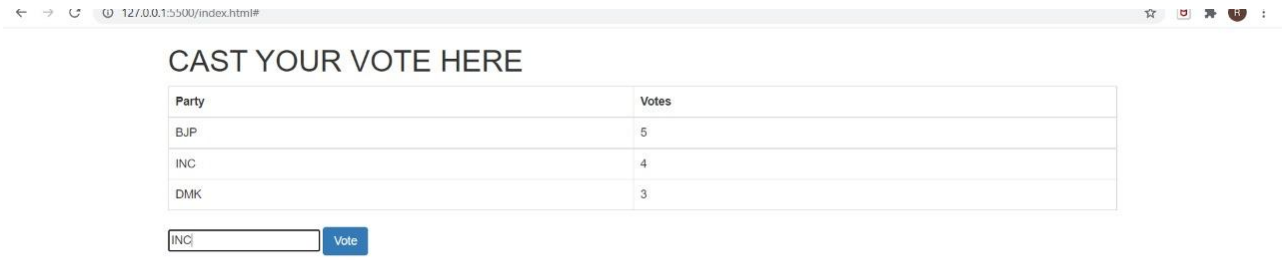

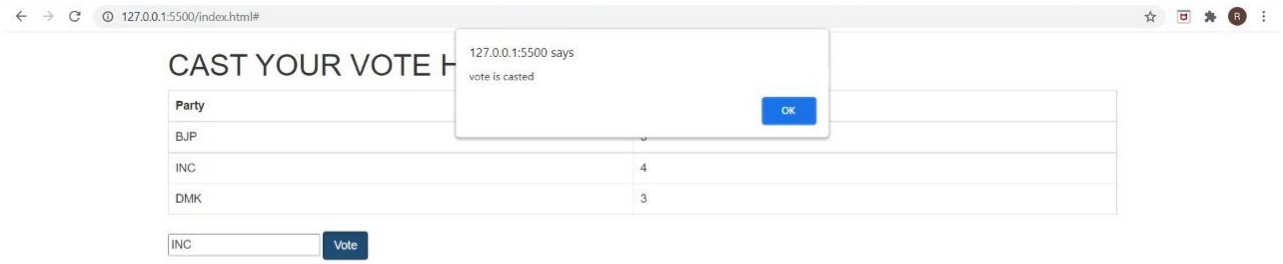

8. CONCLUSION

Adjusting computerized casting a ballot frameworks to make the public electing measure less expensive, quicker and simpler, is a convincing one in present day culture

In this paper we proposed a secure voting mechanism which is a unique, blockchain-based electronic voting system that utilizes smart contracts to empower secure and cost effective political races while guaranteeing the voters their privacy. The proposed system uses Multi factor Authentication to ensure that there are no fraudulent votes. The proposed system is easy to use for any user irrespective of backgrounds and thus helps in getting more voters to vote, hence increasing the voter turnout and with added advantage of no fraudulent voters among them.

As mentioned in the paper the goal of our project is to create a fully functional dapp which is based on blockchain and smart contracts. The primary goal was not only to create a secure system but was to create both a secure, reliable and scalable system. In order to enhance the security of our project we have used user id and face matching verification, and also we have an otp verification system to check the identity of the user. The main function of blockchain is to create an immutable system so that once a vote is casted it cannot be tampered by any adversary. Now to tackle the issue of scalability and reliability which is very important in a country like India with a huge population which in turn will lead to huge server loads. We have focused on creating a microservices based architecture which in turn helps us to scale our server more efficiently and which can be used in real time scenarios.

We also plan to containerize the application using docker and docker-compose and use container orchestration tools like Kubernetes and OpenShift.To make sure that not a single vote is lost due to server crash or any other calamity we can use Kafka or RabbitMQ to manage the real time data which can be added to the blockchain when the server is able to.

9. ACKNOWLEDGMENT

Words are in my most humble opinion, a token of gratitude and for this, I would like to say some. I would like to thank our faculty, Dr. Padma Priya R., for providing such a fruitful topic, and always guiding us. This project helped me gain insight into the subject of Blockchain. We got to know a lot about Blockchain and its benefits. Apart from that, we would also like to thank our peers, who provided us constant support and kept us motivated throughout the project.

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