Secure E-Voting System using Blockchain technology and authentication via Face recognition and Mobile OTP

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Abstract— In the digital era where hacking and bypassing a system is easy, tampering of data is always possible leading to bad situations. Blockchain is used to store data which is near impossible to change or tamper with as it is very secure in nature. Voting as a process in any nation is an essential event and if votes get miscalculated by any external source it will be harmful. To avoid such kinds of situations and making it more comfortable blockchain technology comes in acknowledgment. This paper proposes a decentralized national e-voting system based on blockchain technology. It includes an admin panel to schedule the voting, manage candidates and declare the results. The web application will provide the users with an interface to enter their Aadhar card ID (text input) and a photo of themselves at the time of voting. The eligibility of the voter will be checked at the time they enter their Aadhar card ID. Eligible voter's phone numbers will be verified via One Time Password (OTP). After voter verification, individual voters will be considered eligible for voting. During voting, voters will be monitored through a webcam/front camera. The votes will be stored in a blockchain and any tampering would be detected easily. The address and the corresponding constituency will be checked in the backend. Voting results will be declared on a specified date and will be handled by the admin. The results will be displayed graphically with various options to choose from and will also include past results and statistics.

Keywords— E-Voting System, Online voting system, Blockchain, Machine learning, Deep learning.

I. INTRODUCTION

Blockchain technology is the new age technology that can be utilized as a distributed ledger for storing data and information. Elections and casting a vote is a fundamental piece of any democracy. With the advancement of innovation in technology, web-based voting systems have shown up and have been effectively evolved. Electronic voting systems can be extremely helpful and can be accessed by all citizens even those living in rural areas. Voting guarantees that every citizen is a part of the legislation of a nation in a roundabout way. Citizens have a say in who they need as a leader for themselves. There are three sections to a constitution: legislation, executive, and judiciary. The legislation is the solitary territory in which a citizen has a say. To guarantee that every single citizen should get an opportunity to vote, the voting system of any nation should be hearty and accessible to everybody. It must be straightforward and should avoid any alteration. Blockchain is a continuous chain of blocks which are connected to one another as a consistent chain. Blockchain is a decentralized system where the clients are associated with one another and can likewise see the entire process. There are a bunch of miners who mine on the blockchain. These miners get an incentive for mining on the blockchain. When an exchange is made on the blockchain, to include it on the chain, it should be first confirmed by every one of the nodes on the blockchain then only it is added to the chain. If maximum nodes check and say it as a legitimate exchange, then only it has to be added to the chain or it is rejected. A gathering of exchanges are incorporated into a block to add to the blockchain. Each block contains a cryptographic hash of the previous block, a timestamp and exchange information. This sort of process i.e to add transactions to the blockchain guarantees that every transaction is associated with the past transaction. When an exchange is done on the blockchain, it can't be turned around or erased. The present businesses and systems are facing significant security issues; they need highly skilled individuals to accomplish the desired security. These skilled individuals, as people, commit errors or deliberately may influence the degree of safety. A proposed answer for this is to store the voting related details on the blockchain and utilizing Face Recognition System which utilizes live monitoring of the user during voting process, which can detect a user when he/she is voting to know that they are a verified user or else will not be able to cast a vote.

II. CONTRIBUTION OF WORK

Deep learning algorithms are used to procure face id and matching it with the image as on the Aadhar card. Through the web application, the status of the voting process can be seen. Blockchain makes the process more secure making it impossible to hack or leave traces. This paper is organized as follows:

Section I describes the various basic concepts used to develop the system. Section II, summarizes the existing work related to E-voting and Machine Learning. The proposed

algorithm for this project using Machine Learning is stated in Section III.Section IV, states the experimental setup that demonstrates the performance.Section V covers the result of the entire proposed system. Section VI, concludes the work and gives highlights for future work.

SECTION I : BASIC CONCEPTS

A.   Image Processing

Image processing techniques using machine learning will be used to verify the voter's face. This would help to avoid problems like identity theft, as the voter's face will be verified during the voting session.

B.   Aadhaar card-based user verification

This voting system will use an Aadhaar card for user verification, as each citizen of India is issued with a UID. As these Ids are unique, only the registered person would be allowed to vote and only once. This would also act as frontline security as non-Indian citizens and people without valid documents would be barred from voting. Details such as phone number and date of birth linked with the Aadhaar card will be used to ensure that users do not vote more than once, as the Aadhaar number will be verified by an OTP.

C.   Implementing a voting blockchain

When a user votes for a specific candidate, the user's preferred candidate's data will be stored on the chain. This will be concurrently updated on the blocks in the same chain. The main feature of blockchain is that once the data is stored on the chain it can not be changed or tampered.

SECTION II : RELATED WORK

This section shows some existing e-voting systems that use blockchain. Going through the literature shows that blockchain-based solutions have been proposed for voting in all types of different backgrounds.

A.   *Algorithms and techniques for voter verification (Face and OTP)*

Mandavkar A.A. & Agawane R.V. propose a system that uses OTP and face verification as a part of an online voting process. Through an application, registered voters verify themselves via an OTP sent to their phone number following which is the face verification system which verifies the faces captured in real time with the one stored in the Aadhar database [1]. Chowdhary N. et   al. perform a comparative study of 3 algorithms : EigenFace , FischerFace and SURF with SURF being the most accurate on the mentioned dataset [2]. Schroff F. et al. introduce a method for facial verification that provides state of the art accuracy . It is based on learning the euclidean embedding on an image using a deep convolutional network. Problems like facial verification and recognition are hence easily solved as these tasks become straightforward to just finding the appropriate threshold between face embeddings [3].

B.   *Blockchain and overall voting*

Agarwal H.   and Pandey G. discuss an online voting system based on Aadhar verification. The system is password protected thus ensuring no malpractice [4]. Shaikh A. et al. talk about a system based on face recognition and OTP verification acting as a second layer of security. The system first detects a face from the images captured in real time and then uses face recognition techniques to confirm the identity of the voter [5]. Marella P. et al. develop a private blockchain for secure voting system using ethereum's blockchain[7]. The blockchain white paper describes an online transaction system - bitcoin based on blockchain technology with proof of work (Nakamoto 2008) .Nakamoto mentions that technically , a blockchain becomes very hard to compromise since more than 50% of the nodes in the chain must be compromised to achieve that.

C.   Improvements from past systems .

Online voting systems that have been developed in the past only verify user based on their UID. There is no system that implements UID verification, Face verification and OTP verification together. There was a need for a robust ,holistic and secure system that voters and vote organizers can rely upon. Our paper introduces a method to overcome various problems in online voting related to user authentication , user face verification , secure voting , avoiding vote tampering . We have combined the above mentioned features to develop a novel and secure system. Our system authorizes a voter using their Aadhaar card number as the first step in user authentication . It then verifies the voter's face at the time of voting which acts as a second line of defence. The votes are stored on a Blockchain which solves single point of failure problem.

SECTION III : PROPOSED APPROACH

The proposed system introduces blockchain technology instead of using the regular database. It also implements image processing using machine learning for authentic and secure voting. Blockchain will ensure that once a transaction or a vote is cast, it cannot tamper. Voters are anonymous on the blockchain. The admin has the authority to add or remove candidates from the voting system. Smart contracts written on the blockchain make sure that a voter can vote only once. It also makes sure that the candidate has met all the conditions necessary to stand in the elections. The proposed system tries to overcome the shortcomings of the system followed right now in our country.

The objective of this system is to create a secure and scalable environment for voting across the nation. It ensures that the election process of the country is as transparent as possible. The System must provide user authentication, it must provide verification and viewing of votes and it must prevent the double voting issues in current systems. The major objectives of the proposed system are:

●   Transparent and secure storage of details of all stakeholders of the system.

●   Enable secure anonymous voting and disallow double voting.

●   Transparent tallying of votes, which can be re-verified and tallied easily.

Any eligible Indian citizen can use this system to vote just by using their Aadhaar card number. The system verifies users via OTPs to ensure safety. Voters can vote at the time scheduled by the Poll Master (Admin). Face recognition will help the users to identify themselves while voting and allow them to vote in a secure manner without any influences. After the voting has ended, the results will be visible in a graphical manner for the users to see and analyze.

The system is divided into 3 major parts:

Face recognition: To get the verification of whether the person is authenticated or not to proceed with the voting, face recognition will play a huge role to check the authenticity of the user.

Voting - Blockchain: At the point when a user votes in favour of a particular applicant, the user's favoured up-and-comer's information will be put away on the chain. This will simultaneously be refreshed on the squares in a similar chain. The fundamental element of blockchain is that once the information is put away on the chain it cannot be changed or altered.

Status: The data or the votes counted can be shown in a graphical manner whereas the votes which are being tally can be shown in a live count manner.

Here in Figure 1, as shown below states the user and admin flow. Flow of users has various steps such as : login into the system, the user gets authenticated and finally gets access to the voting part of the system. The admin has the following access start and ending of the voting process along with result declaration.
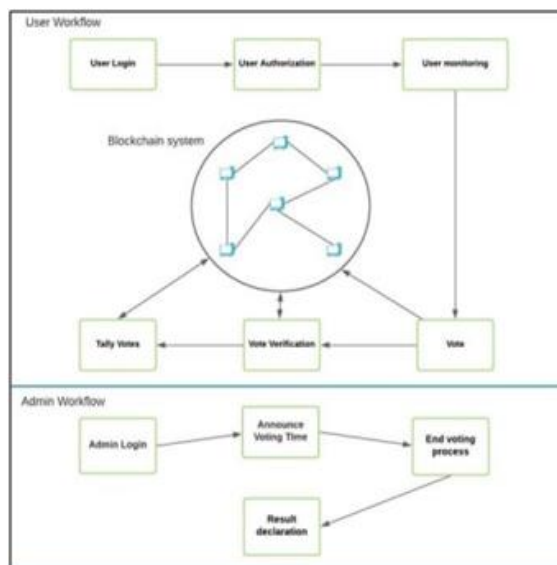

Fig. 1. Workflow diagram of the Overall system

SECTION IV : EXPERIMENTAL SETUP

To measure the effectiveness of the proposed project, we performed empirical studies with different data sets and web applications. Here we will show you the dataset used, implementation details of the project and end results of the proposed project.

A. Dataset

1) Aadhar information - phone number, age, name, photo, address.The dataset is formed to be stored in a NoSQL database which includes the Aadhaar information such as phone number, age, name, address and photo of the voter's face which will be used to identify the voter.

We are using MongoDB Atlas which is an online database to store the Aadhaar information and the Voting related information will be stored in the blockchain.

2) Candidate information – This will store the candidate' information which will include name, candidate party, and their region.

3) Data Collection – The database will consist of data collected from all the group members of this project.

4) Database size – Since the project requires a UID number, which is sensitive, only willing group members will add their data . Therefore, the database size has been kept to 4 entries only.

B. Software and Algorithms

1. Solidity: It is a high level programming language which is designed to implement smart contracts. It is a mixture of JavaScript, C++ and Python. It is the base for blockchain based applications.

2. Ui-kit : UI kits is a frontend framework which is based on CSS. It can be said that it is a steroid version of bootstrap which has many more additional functionalities when compared to bootstrap. It is very easy to use and has a similar outline as that of any other css frameworks.

3. MongoDB : MongoDB is a NoSQL based database management system, this tech stack is used to manage the data and the datasets generated for the Aadhaar verification based authentication.

4. Nodejs : Nodejs is a backend JavaScript environment which runs on v8 engine. Its main motive is to build scalable applications. It is used to route between different stages of the voting process and it is also used to build the admin dashboard.

5. Teachable machine: Teachable Machine is a web-based tool powered by google that makes creating machine learning models fast, easy, and accessible to everyone. It is very easy to set up and can work with a wide range of platforms. Here the model is hosted online on the google platform.

6. Face api.js: Face-api. js is a JavaScript API for face discovery and face acknowledgment in the program carried out on top of the TensorFlow. js center API. It carries out a progression of convolutional neural organizations (CNNs), improved for the web and for cell phones.

7. Heroku : This particular software is used for the hosting of any framework API/websites for the other scripts which is used here to host the API and used for communicating to the application.

8. FaceNet: FaceNet algorithm, developed by researchers at Google [10] has been chosen to verify the faces of the voters. This algorithm provides state of the art results on various datasets and is extremely accurate in determining face embeddings, extracting facial features, face verification (are both faces of the same person), face recognition (whose face is this), and face clustering (finding similar faces from a group of faces). FaceNet is able to touch 100% accuracy on YALE, JAFFE, AT & T datasets, Essex faces95, Essex grimace, 99.375% for Essex faces94 dataset and the worst 77.67% for the faces96 dataset[11].

SECTION V : RESULTS

In this section, we demonstrate the results observed through different algorithms.

Fig. 2. Enter Aadhar ID page

Accepts voter's UID as input from the voter.

Fig. 3. OTP verification page

Accepts OTP sent to voter's registered mobile number.

Fig. 4. Live Face Monitoring and face recognition page

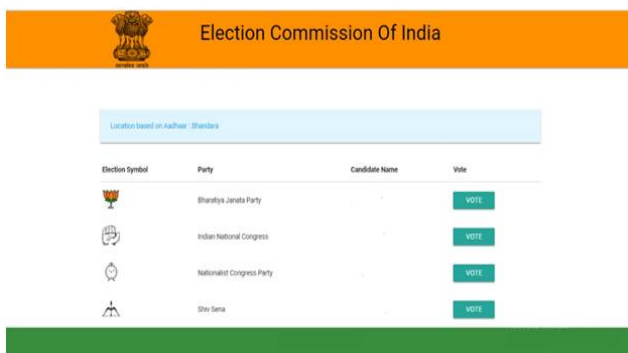Live monitoring of the voter's face. The voter can see his/her face in a webpage canvas.

Fig. 5. Political Party voting page

Voting page, The user can see a list of candidates to vote and a button to vote.

The above Figures 2, 3, 4, and 5 show the implementation of the website having different profiles such as the voting authentication, voting system, and the status of the voting (to vote a party).

SECTION VI : CONCLUSION AND FUTURE WORK

Voting is an essential part of any democracy and given the traditional process of voting, it is very easy to exploit the loopholes. Many vote frauds come to the surface after every election. With this system, we aim to eliminate the shortcomings of the traditional ballot system and provide the citizens of India an easy and secure access to voting. Our system would also help to conserve paper, indirectly saving trees which is the need of the hour as it is used in huge amounts in traditional voting. With the technology available today, we aim to strive for a brighter future for voting.

There are certain limitations to this system . If , hypothetically , all citizens of India decide to vote in the same hour, then the system might fail due to scalability issues. To prevent this , phased voting can be carried out . Lack of good internet connectivity can also prove to be a hindrance in the voting process. Although very accurate , the face verification module may provide different results for the same person based on the sharpness , brightness and quality of the images captured and if the voter's machine is compromised by any virus or malware , the process maybe jeopardized . Biometric devices could prove futile to use to authenticate a voter since they are expensive . These limitations may be overcome in the future with advent of new technologies.

The future plan of work will be executed by a spiral model technique which will help to test the modules again and again as per the changes and improvements were done in the system. Future work will also include more focus on the system availability to every eligible voter.

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