

Electronic Voting Mechanism using Microcontroller ATmega328P with Face Recognition

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Abstract—An electronic voting system based upon face recognition algorithm, camera and ATmega328P is reported in this paper. Election is the main concern of any country when to elect someone. Also, it is very important to conduct the reliable, secure, fast and fair election so that the people can have faith in the system and they can elect the person to whom they want along with the low cost of paper work and manpower. In the present work, an electronic voting system is developed that includes the more secure version of existing system and the use of modern technology such as face recognition and IoT. The current work proposes an electronic system inclusive of multiplied verification layers such that process reliability is ensured. In this process, each voter is registered into the system database well before the time of election. Now at the voting time, In the first step voter must verify his/her government identity such as Aadhar card or voting card with his/her proper picture, once it is verified, he/she moves to the second step. In second step voter has to go under the face reorganization process. Once the corresponding matching or verification is done, the voter will move to next step to cast vote to the candidate from the electronic voter machine. The cast vote is shown on display for the satisfaction of voters. Then the voting data is continuously uploaded on ThingSpeak server (can use dedicated server of Election department). The central office of election department can monitor the data in more reliable way so that no discrepancy/modification can take place later.

Keywords— Arduino UNO, Atmega328P microcontroller, Face Recognition, LCD Display

I. INTRODUCTION

Elections form a major part of any democratic society to elect its new government. In earlier times, paper-based elections were conducted. In that, voters cast their votes on the ballot paper and then drop that paper in sealed boxes provided by the election department. When the elections end, the secret ballots are opened and manually counted to proclaim results. But in this process sometime there can be manually error or cheating to declare the results. Also, there is lot of wastage of paper and manpower.

To overcome this problem, the Indian government installed direct record electronics - DRE voting system which are popularly known as E-voting machines - EVMs [1]. The ideation in this work is to redesign electronics voting system using Arduino and face recognition algorithm to make the system more efficient and reliable. The proposed idea will help in creating a transparent environment free from data manipulation as it can freeze the vote instantly. The system

here relates to n number of the switches where n represents the number of political parties.

The user or voter will choose the intended desired contesters from the list of options. The result is then played on an LCD display and the result is automatically calculated by pressing the result button. The live votes are displayed using ThingSpeak server to prevent any data manipulation which might occur when storing on an external drive.

II. MOTIVATION FOR THE CURRENT WORK

The unreliable nature of the voting system and delays in results of the existing system is the prime motivation to design the proposed voting machine.

III. CONTEXT OF THE CURRENT WORK

To strengthen the project, a literature review on the researches of state of art voting systems were conducted. Most have shown interest in ballot paper-based voting system, while others have designed the Electronics voting machine using different features and sensors such as fingerprint, retina scanning etc. But the earlier systems were not efficient to stop the fraud voting in the system. So, this work addresses the problem. This paper reports a system using face recognition algorithm is presented and IoT server. Also, the ATmega328P Microcontroller, ESP 8266 Wi-Fi module and LCD are used for the development of final product.

IV. LITERATURE REVIEW

Agarwal, et al. [2] have designed a password-based system to increase the efficiency of system by proclaiming results in very short span.

Anandaraj, et al. have improvised the security in the existing system. They presented scaling up the number of voters as they increase. Here matching is done the server level Also the GSM and IoT is used to generate the results very fast to increase the system efficiency [3].

Rezwan et al. proposed a Biometrically Secured Electronic Voting Machine using Arduino and Fingerprint Scanner that help in identifying each user uniquely and avoid fake voters. The reported system is a secured digital one that is utilized in countries like Bangladesh, etc. [4].

Srikrishnaswetha et al. presented a study on smart e-votes with facial recognition and aadhar verifying along with

IoT. They proposed a technology that is highly secure for voting as it uses unique Aadhar card number for identification of users, face recognition along with IoT. It is intended for different users for long usage and to ensure data security [5].

Khasawneh et al. demonstrated a secured Biometric Voting System. The system uses simple biometrics. The system uses flag system which ensures that no voter can press buttons multiple times as once the buttons is pressed all the flags get automatically locked and will get unlocked only when another voter arrives as the controller unlocks the flag. Thus, the proposed design guarantees transparency in voting system [6].

Kanwardeep et al. also demonstrated a fingerprint based biometric voting system so increase the security, reliability and accessibility of the entire voting process [7].

Jagtap et al. also proposed a system for vote from anywhere. Here the voters are verified based upon his/her unique id and then using raspberry pi, more numbers of used can be managed efficiently [8].

In B. R., et al. system age criteria of the country are followed for voter verification using his/her Id. Also, the details of the voter are locked once after his voting, and no other can use his details for casting the vote [9].

Priya, et al. used different layers of security in their design to avoid the duplicity or cheating [10].

Ramprasad et al. designed a system in which RFID is used to improvise the process [11].

In the system proposed by Bhattacharya et al. biometric fingerprint recognizing and retina scans are employed to enhance the overall voting system [12].

Several researchers are working to develop electronic voting using block chain to make it more secure as the data is encrypted. Researchers are also trying to develop Voice Authentication system for electoral to help people with disabilities. Earlier the optical scanning voting method was developed to read marked paper ballots and tally the results.

V. PROPOSED SYSTEM

In this project, an advanced voting machine is designed, in which two step security is added and after that voters may cast their vote to desired candidate. The first step of security is Aadhar card verification and 2nd step security is face recognition. When the voter is verified in both the steps then after he/she can cast their vote. Also, the information of voting is continuously sent to the central server of the election department, so that the discrepancy can be reduced, and proper fair process can be implemented. Also, the LCD is used to show the voting casted to the voter at the same time.

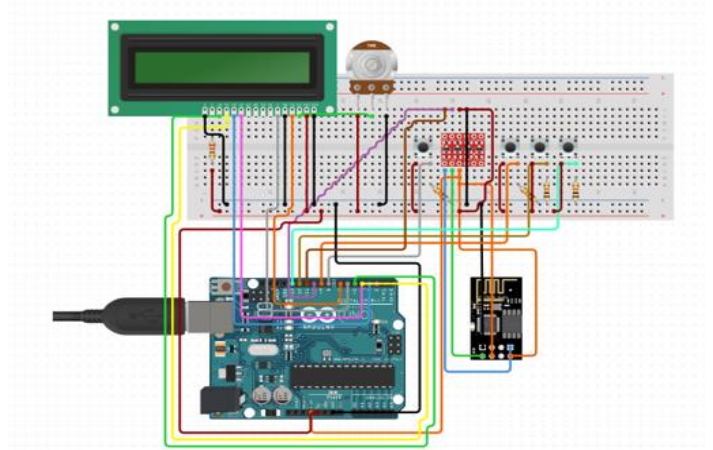


Fig. 1 Circuit System of the Proposed Project

Advantages of proposed project system

- It makes the system more reliable and secure
- Decreases the time and expenses of the overall voting process
- It generates the results in efficient way using IoT

VI. TOOLS AND TECHNOLOGY USED

- PyCharm - PyCharm is half breed stage created by JetBrains IDE using Python. It is regularly utilized for Python application advancement. Several social media platforms use PyCharm as their IDE [13].
- ThingSpeak is open sourced with IoT application and API to store/retrieve data using the HTTP and MQTT protocol over the Internet or LAN. ThingSpeak empowers creating of sensor logs and track applications, and social networking of things. ThingSpeak is also supported by unlicensed MATLAB [14].
- Python - Python is progressively composed and trash gathered. It underpins various programming standards, including organized, object-arranged, and practical programs. Python is frequently portrayed as a battery inclusive language due to its standard library [15].
- Open Source Computer Vision Library OpenCV is a set of libraries programmed functions intended for real-time computer vision. Libraries are cross platformed for use under the open sourced Apache Licensing. From 2011, OpenCV feature GPU accelerated for real time operation [16].

VII. COMPONENTS USED

- Arduino Board



Fig. 2 Arduino

- Push Buttons
- Power Supply
- Liquid Crystal Display



Fig. 3 LCD Display

- Connecting wires
- ESP8266 WiFi Module

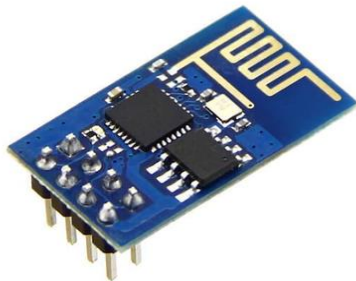


Fig. 4 ESP8266 WiFi Module

- Potentiometer



Fig. 5 Potentiometer

VIII. WORKFLOW OF THE PROPOSED SYSTEM

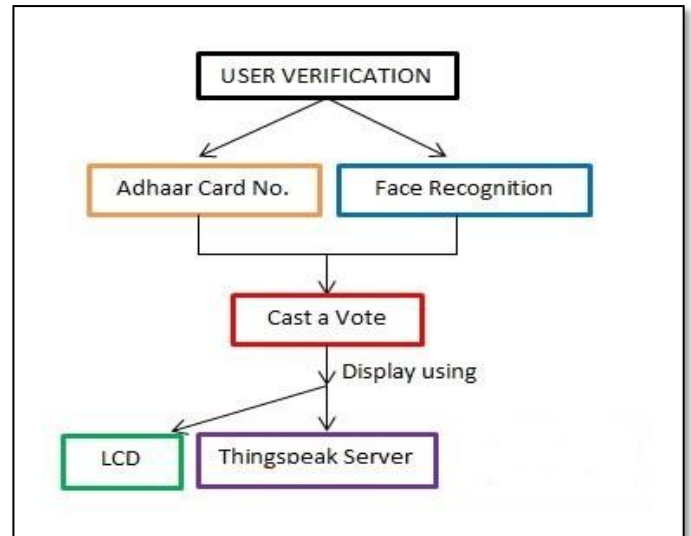


Fig. 6 Workflow of the Project

IX. WORKING OF THE PROPOSED SYSTEM

It involves a 4-step process as follows:

Step 1: Aadhar card Verification

In this step Aadhar card is verified. It is a 12-digit number and all the Aadhar number of registered voters has storage in the database of excel files in the system of election department. First voter will enter his/her the 12-digit number. If the entered number shows matching with the number stored in the database, it implies user is verified and step 2 verification will start. If not, Aadhar card verification will start again until the Aadhar card number is not verified, further processes will not execute.

Step 2: Face Recognition Process

First, all the images of registered voters are stored in the database of election department. When the user comes (after passing step 1) the image is clicked, and then recognition starts. When the user is recognized the name is displayed. The Step 1 and Step 2 verification is interconnected. If the Aadhar card verification is done successfully than only the face recognition will start and once both the verification is done successfully user will be allowed to move to step 3.

Step 3: Vote Casting and Display the casted vote on LCD

Here the hardware system is designed using Arduino Microcontroller. Four buttons are used for different candidates who are standing in the election. When voter (passed from step 2) press any of four buttons then vote casted is shown to the voter, at the LCD. Also, the voting value will be increment by one to the corresponding candidate whose button is pressed each time in the database

of Election department. When voting process ends, results are displayed on LCD using result button. Here Arduino is the heart and brain of this system.

Face Recognition Explanation: To distinguish the face or article, the "Haar Course classifier" is utilized. In this technique AI is utilized where a course work is prepared from several positive and negative images. It is then used to recognize an object in different images [16].

- Face Detector and Data Gather
- Train the Recognition system
- Face Recognizer

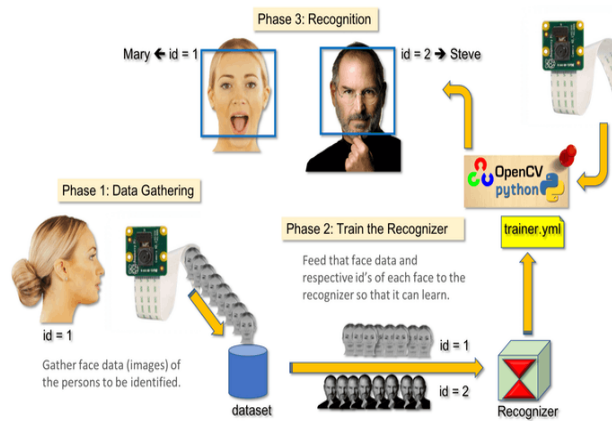


Fig. 7 Different phases of Face Recognition

Step 4: Upload data on server

Here, the casted vote details will be sent continuously to the central database of the election department using ThingSpeak server to prevent any data manipulation. This will also help in live count of the votes. We can also use Blynk App to send the data on server.

	A	B	C	D
7	774222197262			
8	899615863274			
9	715018172003			
10	896280334666			
11	912953632901			
12	780106068250			
13	736659350944			
14	815672833649			
15	879065853659			
16	765321553224			
17	840706078405			
18	745019941486			
19	817434831806			
20	824312682275			
21	938992473594			
22	970762591837			
23	981452816423			
24	816305359050			
25	821498642012			
26	795357019828			
27	789942721659			
28	707721208868			
29	722138426219			
30	980100095539			
31	797206834755			
32	771626492316			
33	780507132238			
34	701918720107			

Fig. 8 Excel Datasheet



Fig. 9 Dataset of Images

X. RESULTS AND DISCUSSION

Fig. 10 showcase the hardware connections of the proposed Electronic Voting System.

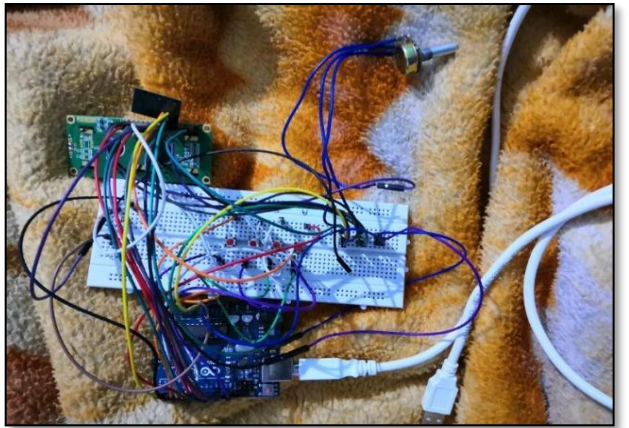


Fig. 10 Connection of proposed system

Fig. 11 shows if Aadhar number is not verified it will again ask for the Aadhar number and this process will continue until correct details are entered.

```
C:\Users\phenom\AppData\Local\Programs\Python\Python38\python.exe
Enter the 12 digit Aadhar Number :
983643299977
verifying Aadhar...
Invalid Aadhar Number!
Please enter your valid 12 digit Aadhar number.
|
```

Fig. 11 Aadhar Card Verification Check 1

Fig. 12 shows if Aadhar number is verified it will start the process of face recognition.

```
C:\Users\phenom\AppData\Local\Programs\Python\Python38\python.exe
Enter the 12 digit Aadhar Number :
983643299977
verifying Aadhar...
Invalid Aadhar Number!
Please enter your valid 12 digit Aadhar number.
780106068250
Recognising face...
|
```

Fig. 12 Aadhar Card Verification Check 2

Fig. 13 shows the face recognition process where the user is identified only after the Aadhar verification is done.

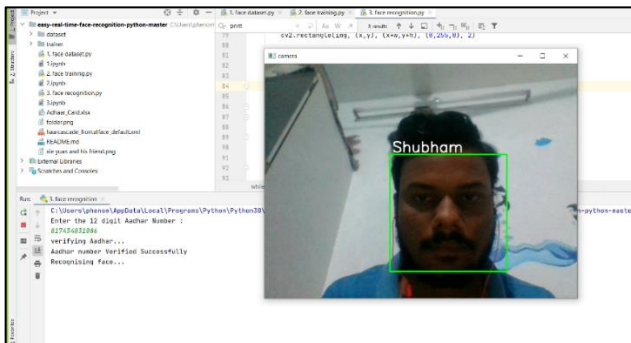


Fig. 13 Face Recognition

Fig. 14 display the LCD result for the initial phase where the vote has not been casted. Hence, $A=B=C=0$



Fig. 14 Initial Phase of LCD

Fig. 15 shows the result after the vote has been casted. Here, 'A' candidate is leading over the others because 'A' got 2 votes. While 'B' and 'C' got 1 vote each.



Fig. 15 Final Phase of LCD

Fig.16 showcase the final results after the voting is completed. In the above figure A candidate is the winner.



Fig. 16 Results Displayed on the LCD

Fig. 17 shows the serial monitor during WIFI connection setup and values being sent to the server during casting of the votes.

```
COM4
AT Command ==> AT+RST
AT Command ==> AT+CWMODE=1
AT Command ==> AT+CWJAP="Hi","justdoit"
AT Command ==> AT+CWMUX=1
AT Command ==> AT+CIPSTART=0,"TCP","api.thingspeak.com",80
AT Command ==> AT+CIPSEND=0,49
Value to be sent: 1
AT Command ==> AT+CIPMUX=1
AT Command ==> AT+CIPSTART=0,"TCP","api.thingspeak.com",80
AT Command ==> AT+CIPSEND=0,49
Value to be sent: 1
AT Command ==> AT+CIPMUX=1
AT Command ==> AT+CIPSTART=0,"TCP","api.thingspeak.com",80
AT Command ==> AT+CIPSEND=0,49
Value to be sent: 2
```

Fig. 17 WiFi Connection Setup through Serial Monitor

Fig. 18 showcase that finally the data for each candidate is uploaded to the server.

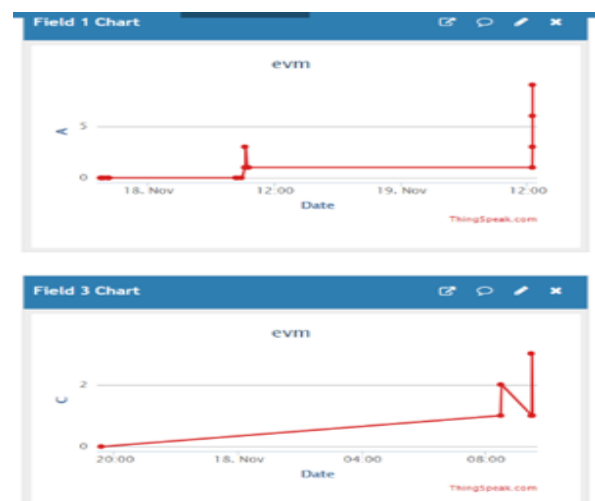




Fig. 18 ThingSpeak Server Results

XI. BUSINESS MODEL

This project is mainly made for the voting purpose of any country/democracy, so the security and speed of the process is main concern. However, the project is costing not more than 700 INR along with a requirement of PC or laptop where the face recognition algorithm can run, and verification of voter can be done. Also, since the proposed system is electronic, so less requirement of paper and manpower is required. So, the overall system can be beneficial for the system where fast and reliable voting process is required at less cost.

XII. CONCLUSIONS

The aim of the currently reported work is to develop a system that is more advantageous and reliable compared to the earlier ones. Also, we have used the two-step verification process before casting the vote. IoT is employed to improvise upon the overall efficacy of the system by sending the cast vote information regularly to the central server of the Election Department of the Government of India.

XIII. FUTURE WORK

In future advancement, we can add more security in the verification process such as biometric retina or fingerprint scanning along with more advancement in the IoT and AI. Due to increase in a greater number of household devices and mobile, the future of IoT is unlimited. A Networking and connectivity protocol have made it possible to connect people and machines on all platforms. This can be extended by adding additional verification process such as fingerprint scanner etc. Also, we can extend it by adding additional server and sharing the details to the authorized person. Also, there is so much data travelling from device to device. Security is another key concern will need to be addressed to keep up with demands. Lastly, to increase the security we can utilize some of the blockchain technology features as well to make the system more transparent and secure.

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