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Fingerprint Voting System with Results in Telegram

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Abstract: As technology advances, electronic voting machines are now used to cast a vote. Voting is an important and complicated process that requires transparency. This project is based on, Fingerprint voting system that was created utilizing Nodemcu and Arduino technologies to send the results of the voting to Telegram. The Internet of Things is playing an important role in improving communication methods in all spheres of life. Everyone can now communicate, evaluate, and handle daily tasks thanks to it. It has enabled everyone to communicate, analyze, and manage daily activities more efficiently by providing seamless connectivity to the digitized world. This project combines both aspects, the voting process and the IOT world to make it easier for people to place their vote. This system is beneficial to voters because it shortens the voting process. It is a more secure method to ensure that the voting process is not rigged. The user's fingerprint is a crucial component of their identity. It is easy to transport from the polling place to the polling center and has a straightforward architecture that reacts rapidly, reduces voting center staff, and provides easy and accurate counting without any problems. The main idea of this paper is to use the internet of things to automate the voting process, which will better the accuracy, speed, and overall security of the elections.

Keywords: Internet Of Things, Nodemcu ESP8266, Telegram Application, Fingerprint Module, Voting Process.

1. Introduction

The Internet of Things (IoT) is a system of physically connected objects that can send and receive data over the internet because they have connectors, actuators, and communication medium [1]. In all spheres of life, this technology is making things simpler and easier for people[2]. Previously, when the concept of IoT was not introduced, voters in traditional ballot-based elections must cast their ballots to

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select nominated candidates. During this process, voters must deposit their ballot papers in sealed boxes located at various polling stations. In the end, all boxes were opened, and the votes were counted under the supervision of a certified officer [3]. However, the process of counting votes has to be transparent, which is not possible in paper-based elections, and that is why internet voting has become very popular in the modern era of technology.

A technique for identifying a person based on their physical traits is called biometrics. In order to identify a person, biometrics like the fingerprint, iris, face, voice, and others are frequently employed. One to one matching is the first type, while one to many matchings is the second. The biometric sample is compared to previously saved samples in one-to-many matching. The biometric approach offers quicker security and a more practical way to verify users. Because each person's fingerprint is distinct and may be used as a signature mark, verification, and authentication, biometric security is superior to password security. The fingerprint is the biometric that was used in this research. In this project, a user's fingerprints are used to authenticate him and give him the ability to cast a vote using an image of his fingerprint [4].

One characteristic of democratic administration is elections. The world had a wide variety of electoral systems. Paper ballots, punch cards, and optical mark sense ballots were all common during that time. The fingerprint voting system uses a human biometric system and is an electronic voting mechanism [5]. Under the existing approach, votes could be counted manually, which raises the risk of mistakes like double counting and missing certain votes entirely. Votes can occasionally be influenced and motivated by political parties, leading to unreliable voting and skewing election outcomes in favor of particular candidates. Because of its simplicity, durability, and precision, this gadget may be helpful. The electoral process includes the counting of votes, which is crucial. Election counting should be transparent, accurate, and dependable; only then can the public have confidence in the elections. Failure to complete the count could have an impact on people's sentiments about the existing administration [5].

Based on the project, the fingerprint voting system, fingerprints are employed for a voter’s identification and authentication. It helps to cut down on errors. A database with all of the voter's fingerprint images is created as needed. This method employs exact coding to find duplicate votes and illegitimate votes. As a result, employing this fingerprint-based EVM (Electronic Voting Machine) technology might make elections transparent and free of fraud. This project also will be able to notify all voters the results of the voting once the voting process is over. The results will be sent to their Telegram application. With the push of a button, the Nodemcu ESP8266 will send the result of the voting to the Telegram application. This feature of the project makes this project more IOT based and found that combining the fingerprint voting system and the ability to send the results to Telegram would elevate our project.

2. Literature Review

According to Piratheepan et al., the main problem with voting in the twenty-first century is that some countries are still using paper-based voting systems and are not transferring to the most recent online voting systems [6]. In their paper, Vaishakha et al. discussed how a reliable, efficient, and secure voting system is a necessary component in the proper development of this modernized society. As a result, there is a need for a system that is both cost-effective and elegant, while also being capable of maintaining fairness and impartiality over a wider range. IoT enables and creates the possibility of direct integration of the modern world with online systems, resulting in results that are different and improved in terms of efficiency and economics, as well as a reduction in human interventions [7]. Vishal Vilas Natu proposed a voting system that is totally reliant on paper and electronic machines. The voter must bring a voter ID to the ballot box for validation, and there is additional paperwork to record the voter's details. After the election official has confirmed the voter's identification, the voter can use an electronic voting machine to cast their ballot. Voters can cast their votes for a candidate by selecting one of the

buttons next to their name on the list of candidates that is displayed by the voting system. An examination of digital technology and its security is needed to replace this current electoral system [8].

Rahil Rezwan, Huzaifa Ahmed, M. R. N. Biplob, S. M. Shuvo, and Md. Abdur Rahman proposed a system that will be used in Bangladesh. They created a database where the voter's fingerprint is kept. It looks for matches with the previously constructed database when the fingerprint is put. If a voter casts multiple ballots while not registered, the system recognises this. That person may vote if the information matches the database. After some time, the system tallies the votes and displays the results. Results can now be displayed more quickly thanks to this system. This technology makes it possible to publish the results more quickly and with more accuracy [9]. Anandaraj S, Anish R, and Devakumar P.V discuss the existing voting methods. Voting machines of many kinds were introduced. The negative aspects of electronic voting machines are covered in this essay. It is stated that the voter will be able to get any acknowledgment from the electronic voting system after casting a ballot. There is a hand count of the votes. In this paper, a quick and safe biometric voting system is presented. The main objective is to shorten the time required to reveal the findings while simultaneously increasing the model's flexibility, security, dependability, and scalability. A fingerprint module is utilized while voting [10]. According to Andrew Ackerman [11], the smart e-voting system is based on human fingerprints. Two fundamentally significant objectives have been revealed as a result of the voting process. First, after around a year after birth, a person's fingerprint does not naturally change form, and second, every person's fingerprint is unique. Even identical fingerprint twins are not the same. No two people with the same fingerprint have ever been found in trials.

3. Materials and Methods

3.1 Materials

Table 1: List of Materials

No.	Materials	Description
1.	Arduino Uno	The Arduino Uno is a microcontroller board, and it is used to make a prototype of the system.
2.	NodeMCU ESP8266	An open source IoT platform. Hardware based on the ESP-12 module and firmware that utilizes Espressif Systems' ESP8266 Wi-Fi SoC are also included.
3.	Fingerprint sensor module	The Fingerprint sensor module is an input device which used for fingerprint processing and capturing a digital image of the fingerprint pattern
4.	LCD 16x2 IC2	A type of flat panel display known as an LCD (Liquid Crystal Display) operates primarily using liquid crystals.
5.	Pushbuttons	Push Buttons or switches connect two points in a circuit when you press them.

Table 1 shows the list of materials used in this project. A number of important parts work together to make the development of an IoT-based Fingerprint Voting System possible. This makes voting easy and safe. In the first place, the Arduino Uno is what this project is built on. The system's prototyping base is this microcontroller board, which connects to the fingerprint scanner module and watches over data processing to make sure the system works properly.

Another important part is the NodeMCU ESP8266, which is an open-source IoT device. It's built on the ESP-12 module and comes with firmware that works with the ESP8266 Wi-Fi SoC from Espressif Systems. It is very important for sending voting data to the cloud and making it easier to talk to people on the Telegram app. This connection to the Internet of Things (IoT) not only makes the project work better in real time, but it also lets people see the results of the votes.

An important part of this system is biometric protection, and this is where the fingerprint sensor module comes in. This module can be used as an input device and is meant to process and record digital fingerprint patterns. As a safe way to make sure people are who they say they are during the vote process, its main job is to scan and compare user IDs.

This is done so that choosing is easy to understand and doesn't involve any hidden costs. This 16x2 Liquid Crystal Display (LCD) panel shows the voter's name when a registered ID is found by the fingerprint module. This real-time display function lets voters check their choices, which increases accuracy and openness.

Finally, there are pushbuttons on the system. Making the voting process possible starts with these easy but important parts. They set up or break electrical links in the circuit when pressed. As a result, they are very important for getting the voting process going, letting people make their choices and starting the process of registering and recording votes. In this way, they make it easy for people to take part in the election process.

3.2 Methods

3.2.1 The Working of a Nodemcu

After a clear explanation and visuals of the components needed for this project, here is how each component works together to bring our project to life. A Telegram bot will be created using BotFather for our nodeMCU ESP8266 [12]. Generally, when the pushbutton is pressed, the results of the voting will be sent to the Arduino UNO. Serial communication between the Arduino UNO and the ESP8266 will allow the results of the voting to be communicated between the two components. Finally, the ESP8266 will send the result of the voting to the Telegram group which will be filled with voters.

3.2.3 To place a vote:

Now when the user wants to vote then he/she needs to place their finger on the scanner. Then, the LCD will display their name and they will be able to vote. A yellow LED will light up indicating that you can place your finger and a green LED will indicate that you are able to vote and select your choice. The LCD will show your selected choice. If the same voter tries to vote again, LCD will show ‘Already Voted’ [13]. If any non-registered user wants to vote, then the fingerprint module will not detect its ID into the system, and he/she is unable to continue to vote.

3.2.4 To obtain results of voting:

To obtain the results of the voting, press the ‘result’ key and the results will be displayed on the LCD [14]. This key will also send the results to the nodeMCU and the results will be sent to all voters Telegram applications simultaneously. **Figure 1** depicts a block diagram of our whole process:

3.2.5 Node-red for Telegram Bot

Node-red is a tool which is used to program in order to wire together hardware devices, online service providers and API in unique ways. To put in simpler words, node-red is basically a browser-based editing tool that helps to put together flows by using the variety of nodes which is provided in a palette which also can be used and deployed to its particular run time in a single click. In this project, Node-red has played a vital role in making it unique and different from the others.

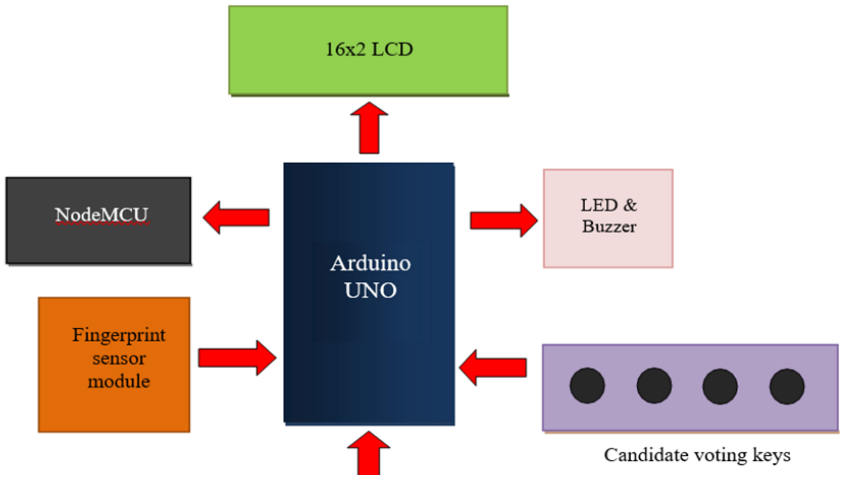


Figure 1: Block diagram

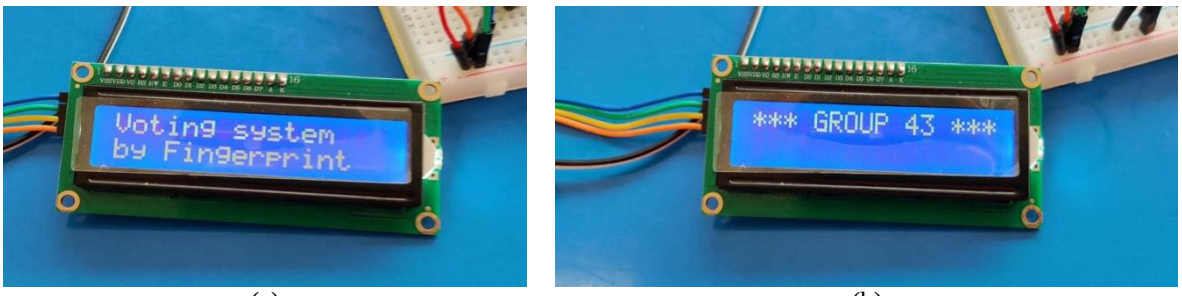
The software Node-red is used to send automated messages, results of the voting to the user that has cast their vote for the event. In our Final Year Project, we managed to connect the Telegram bot with node-red, create commands such as /start and /results. Next, when users place their finger on the fingerprint module, their vote will be stored in the fingerprint module in a format which is known as "ID". Every unique fingerprint image will be captured and converted in the module. The Arduino board in this Voting system will count the number of votes and communicate with NodeMCU to send data to the Telegram group which will be received by the voted users.

4. Results and Discussion

4.1 Results

For the results, the first result is the LCD displaying "Voting system by Fingerprint", "*** GROUP 43 ***" as shown in **Figure 2.** In this work, the results were obtained by conducting a pretend election voting between candidate 1, candidate 2 and candidate 3 for class president. There were pre enrolled 3 students' fingerprints into the fingerprint scanner database. The fingerprints are then saved into a specific id number ranging from 1-3. That made it easier to code each fingerprint to the student's name. An example of a student's name displayed upon scanning his fingerprint is as shown in **Figure 3**.

No



(a) (b)

Figure 2: LCD displaying (a) project title and (b) group number

Figure 3: LCD displaying voter's name

This is the primary process done during the registration. After that, the fingerprint template is extracted and processed. The stored template will then be compared to the scanned fingerprint. They will have access to vote for the candidates they want after being verified. The voter starts by placing his thumb on the touch-sensitive area before casting his ballot. He is eligible to cast a ballot if his fingerprint matches. Mismatched fingerprints certainly would indicate denial from the access. Below is an image of the student voting their desired candidate in **Figure 4 (a)**.

If the same person tries to vote again, the system will display “Already voted” to indicate that the person has already voted and is unable to vote again (see **Figure 4(b)**).

(a)

(b)

Figure 4: LCD displaying selected choice of voter and "Already voted"

Next is to display the results of the voting. The voting results are calculated by the system and displayed once the result button is pressed. When the results for the voting have a definite winner, the LCD will display the results of each candidate alongside the winner of the voting. If there is no definite winner, (a tie) the LCD will display “No winner”. The results for this voting are as shown in **Figure 5 (a)** and **(b)** with both situations stated above. Lastly, when the result button is pressed, the results of the voting are sent immediately to GROUP 43 Telegram group. The results will be sent with the number of votes as well. If the vote is a tie, the results will not be released to Telegram. This is because in the real world, if there was a tie, a re-election would have been conducted to find the winner. Therefore, the results will not be known to the public yet. **Figure 6** showing the results being sent to Telegram.

(a)

(b)

Figure 5: LCD displaying a (a) definite winner and (b) a tie vote

Figure 6: Results being sent to Telegram group

4.2 Discussions

The reason why the LCD is able to correctly display the students name once they place their finger on the fingerprint scanner is because of how the fingerprint scanner saves fingerprints. The enrolling process of the fingerprint is simple yet efficient in identifying fingerprints. When a finger is placed on the scanner, it takes an image of the fingerprint and saves it to a specific id number. As an example, a student's fingerprint was saved to the number "1". Therefore, in the code, we have coded that if the fingerprint matches the fingerprint saved under id 1, the student's name will appear on the LCD. Hence why, the fingerprint scanner was able to correctly display the students name after matching their fingerprint.

The voting results are tabulated and displayed through simple arithmetic calculations. In the Arduino code, by inserting that if the number of votes for a specific candidate is more than the other two candidates, it will display the name of the candidate that has the most votes by comparison as the winner of the voting. The system is also able to display a tie vote because, by comparing the number of votes for each candidate is equal to its opponents, then the results will display "No winner" to indicate a tie vote. This is how the system is able to correctly display the voting results accurately.

Next is, how is the system able to send the results of the voting to Telegram when the result button is pressed? This is because by using the NodeMCU, esp8266, we were able to connect to the Wi-Fi with this module. By coding, the results of the voting will be sent to the nodeMCU. From there, another platform is used, the node js acts as a connector for the nodeMCU and the Telegram application. Here is where the nodeMCU will send the results and it will be sent to group 43 Telegram group. Exactly when the result button is pressed, the results will be sent into the Telegram group and everyone in the group is able to see the voting results simultaneously. That is how the results can be sent to Telegram.

5. Conclusion

The Fingerprint Voting System lets users vote on their chosen candidate by using fingerprint authentication. Once the result button is pressed, the results will be automatically sent to users Telegram. The main objective as stated before is to enhance the security in order to prevent fraud and rigging of the votes. Therefore, by implementing this system, users can put their vote with a fingerprint instead of paper and users are able to access the results of the voting quickly and easily. Some suggestions to improve the project in the future is to implement an enroll button so people are able to register their fingerprint easier. Other than this, implementing a "/results" command in Telegram so that the results of the voting are sent when the user requests it. Other than that, the capacity of fingerprint templates could be increased for a larger capacity of users. Currently, the amount of fingerprint templates the scanner is able to create is 255 templates. Lastly, the voting system could also add a buzzer. The buzzer will sound when a person who already voted is trying to vote again. These are the recommendations suitable to improve the use of this voting system.

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