APPLICATION OF IOT TOOLS IN FINGERPRINT VOTING SYSTEM

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Abstract: *The research paper presents the design and implementation of a fingerprint-based electronic voting system using the Arduino Uno microcontroller and DY50 fingerprint module. The primary goal is to improve the security, efficiency, and reliability of elections by leveraging biometric technology. Traditional paper-based voting systems are prone to errors, manipulation, and time-consuming processes, whereas this digital solution ensures authenticity, prevents fraudulent activities, and simplifies the voting procedure. By utilizing unique biometric data, such as fingerprints, the system effectively registers, verifies, and authorizes voters, thereby eliminating the possibility of duplicate votes. The proposed system stores and processes vote counts in EEPROM memory and delivers the results on an LCD display. While offering significant improvements in election management, the system also faces challenges related to hardware vulnerabilities, software glitches, and the need for extensive voter education.*

Key words: *Fingerprint voting system, Internet of Things, biometric authentication, Arduino Uno, DY50 fingerprint module, electronic voting, election security, digital voting, EEPROM memory, microcontroller, biometric technology.*

Introduction

Forums allow the people to vote for their delegates and share their opinion for how they want to be ruled. The validity of democracy as a whole is dependent on the authenticity of the election mechanism. The election process must be beneficial in preparing for a wide variety of fraudulent activities, as well as transparent and straightforward, so that citizens and politicians can accept election results.To achieve this, the form of governance based on the concept of majority decision making is the preferable choice since it is distinguished by a legitimate, honest, fair to everyone, and subsequently efficient election system. Numerous individuals use paper ballots to elect their legislators in conventional voting systems. For a long time, this strategy has been employed. This approach necessitates the voter's actual presence in order to select one of the candidates in confidence and then place the paper in the voting box, but it has various drawbacks. Voters, for example, must go to a polling location and stand in line to vote, and in certain situations, voters are exposed to pressure by officials. Furthermore, this system is extremely subject to fraud and changes in the number of votes cast. Additionally, collecting the voting papers and transporting them to the main center is challenging. Most notably, there is the possibility of error during the counting of votes, in addition to the high expense of the procedure and time required.

The interconnecting of physical objects—cars, buildings, and other things—embedded with electronics, software, sensors, actuators, and network connectivity that allows these things to gather and share data is known as the internet of things (IOT). The IOT makes it possible for objects to sense or be controlled remotely over current network infrastructure. This opens up possibilities for a more direct integration of the physical world into computer-based systems, which reduces the need for human intervention while also improving efficiency, accuracy, and economic benefit. The raspberry pi and Arduino may be used to help create an Internet of Things infrastructure where we can customize the hardware with software and control the devices via the internet.The internet of things ecosystem may be developed using the Raspberry Pi and Arduino platform. Numerous benefits have been brought to the voting process by the fingerprint electronic voting system. It helps make voting considerably more successful and efficient by, for example, lowering the cost of printing ballots and hiring more workers [1].

The digital voting device has evolved into a useful instrument for elections. It enables faultless voting and has therefore gained popularity. It guarantees people's right to vote. It prevents any form of fraud or illegitimate votes. Such a technique is also more cost effective because the resulting human spend is reduced. It is also handy for the voter since he just needs to touch one key, which corresponds to one of his choices. The whole mix of mechanical, electromagnetic, or electronic equipment used to specify votes, cast and count votes, record or display results of an election, and preserve and create any audit trail material is referred to as a voting machine. The early voting machines were mechanical, but electronic voting machines are becoming more popular. A election process would include the procedures and supporting documents used to identify motherboard chipsets and versions of such components; test the system during its development and maintenance; keep records of system errors or defects; determine specific changes made after initial certification; and make any materials available to the voter (such as notices, instructions, forms, or paper ballots). A voting machine has traditionally been described by the method used to cast votes and further classified by the place where the system tabulates the results.

In this project, we employed fingerprints for voter registration or identification. Because each person's thumb imprint is unique, it aids in mistake reduction. As needed, a database comprising the fingerprint pictures of all voters is established. This technique use precise coding to detect illegal votes and vote repetition. As a result of the use of this fingerprint-based EVM technology, elections might be rendered fair and free of rigging. Furthermore, elections would no longer be a time-consuming and costly task.

Technical Research

The second sort of literature study is technical research, which demonstrates in-depth technical research linked to this subject. This includes the software, programming languages, algorithms, and user interface in order to aid in the selection of the most appropriate component of this project to fulfill the desired aim of creating and implementing the fingerprint voting system.

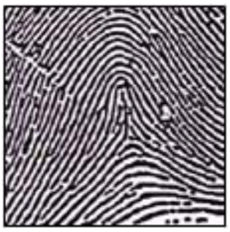
Electronic voting system equipment's

There are several biometric tapes that may be utilized for electronic voting systems, including eye recognition, voice recognition, and fingerprint recognition. Many studies have been conducted on different sorts of biometric recognition, however the fingerprint will be the most effective for the voting system. The literature listed below depicts software and languages that can aid in the construction of a fingerprint voting system.

Fingerprint classifications

Fingerprints have been divided into three distinct classifications based on their visual pattern: loops, arches, and whorls. Each fingerprint type is further classified into smaller subcategories. The arch fingerprint is the earliest type of fingerprint. Only 5% of people have his kind of fingerprint, which is classified into two types: plain arch and tented arch. The loop fingerprint is the second most common form of fingerprint, accounting for 60% of all fingerprints. It is further classified into two types: radial loops and ulnar loops. The third form of fingerprint is known as whorl, and it is found in 35% of persons. This kind is further classified into plain whorls, center pocket whorls, double loop whorls, and accidentical whorls. The images below depict many types of fingerprints [2]

Plain Arch Ridges enter on one side and exit on other side.



Tented Arches Similar to the plain arch but has a spike in the center.

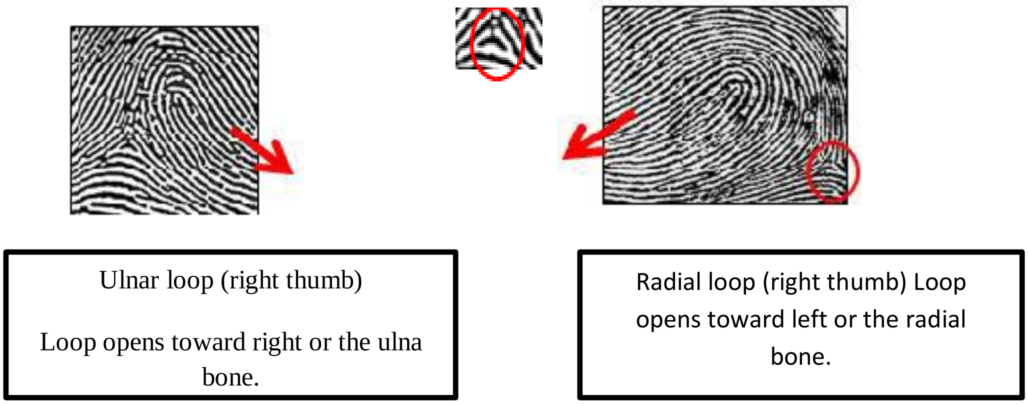


Figure 1: Types of Fingerprints

Fingerprint Module

Dactyloscopy is another term for fingerprint identification. Unique finger imprint identifiable proof is the act of comparing two examinations of grinding edge flesh imprints from human fingers, palms, or toes [3] Fingerprints are now regarded amongst the most experienced and widely used biometric technologies [4] The most important piece of equipment in this architecture is the unique finger imprint sensor, also known as the biological distinguishing proof module. This sensor generates a digital print of the edges of the fingers' skin, which may be interestingly described for verification purposes. For this concept, the fundamental task of biometric displaying is to study users' fingerprints so that each image may be individually classified and saved in its internal memory. These one-of-a-kind fingerprint pictures have been assigned distinctive number values that will be efficiently accessed

Figure 2: Fingerprint module DY50

The fingerprint data is submitted and read using an optical identifying fingerprint (DY50). It communicates with a microcontroller via TTL serial and can deliver data, detect prints, hash, and search. The unit has its own FLASH memory and can store up to 162 signatures [5]

Figure 3: Pin configuration of DY50

Microcontroller

The microcontroller is the brain and heart of today's technologically evolved world. Almost every application nowadays uses a microcontroller as its coprocessor. It functions as the system's heart and brain. There are various different types of microcontrollers available, such as Arduino, Small, MSP430, and so on. Figure 4 is a comprehensive view of the Arduino UNO microcontroller, including all of its advanced, analog, and control pins [6].

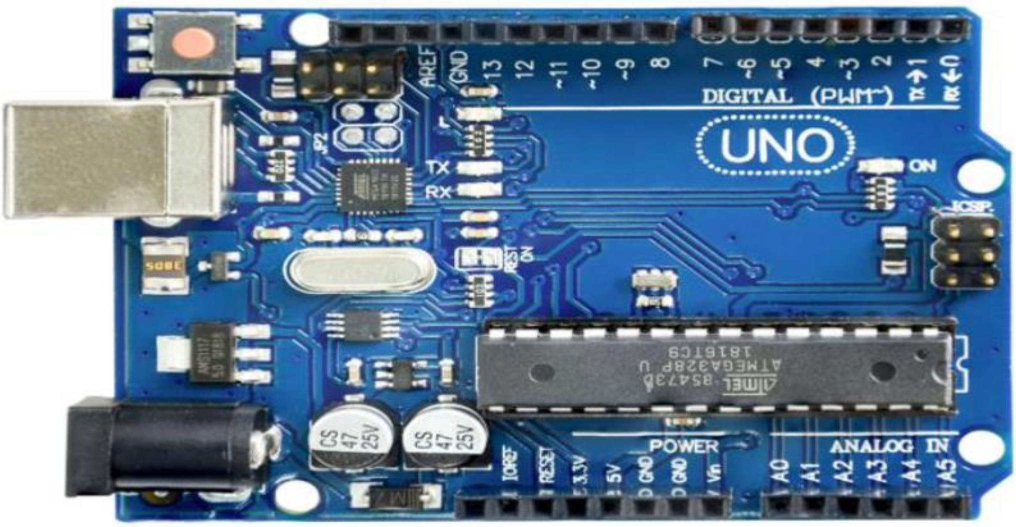


Figure 4: Top view of an Arduino UNO

An Arduino microcontroller is also used in this solution. It is an easy to use and widely freely available electronics platform. Students across the globe use Arduino as a microprocessor kit to create exciting electronic projects. Arduino offers a few microcontroller kits. Microcontroller kits include the Arduino Uno, Arduino Huge, Arduino BTl, and Arduino Leonardo. Because of its simplicity and availability, Arduino is chosen by academics, developers, professionals, and enthusiasts all around the world. The Ivrea Interaction Plan created Arduino. Designed as a soothing instrument. The open-source Arduino Software program (IDE) changes the way code is written and uploaded to the board. It works with Windows, Mac OS X, and Linux. The framework is written in Java and is based on open-source software such as Handling. This application will work with any Arduino board [7]

Arduino UNO

The Arduino Uno system was chosen for this graduation project because of its rapid pin response, simple application architecture, open source, and availability. The Arduino Uno is a microchip with an ATmega328P processor. The 14 digital input/output pins, 6 correlate inputs, a 16 MHz quartz crystal, a power connector, a USB connection, an ICP header, and a reset button are depicted in Figure 8. Arduino Uno may be powered by a battery or by connecting through A/B USB [8]

Programming

Arduino software is required to program the Arduino Uno. The Arduino IDE may be freely downloaded and installed from https://www.arduino.cc/en/Main/Software. The ATMega328 microcontroller in the Arduino Uno comes pre-burned with a bootloader, making it simple to program the board without the necessity of an additional hardware programmer.

LCD

A crystal oscillator is a combination of two different states of matter: liquid and solid. It makes use of liquid crystal technology to generate visible pictures on a small and flat display panel. It is widely used in most common electronic devices such as laptop computers, cell phones, televisions, and so on. LCD screens function by interspersing two transparent sheets with crystalline solution between them. When an electric current is sent through the liquid crystal, the crystals align, preventing light from passing through. Because LCDs do not produce light, a lighting system is required to offer a visible show [9].

Voting Procedure

After properly registering their fingerprints, users having registered finger images are entitled to vote. The microcontroller, which is configured to do so, manages the voting process. If the voter identification is acceptable, the LCD panel will provide voting instructions. In this project, two candidates are meant to gather the cast votes; hence, the user may select either candidate 1 or candidate 2 by pressing the 'CAN1' or 'CAN2' switches, which are connected to Arduino's digital I/O pins. Following the activation of the switches, a buzz sound is generated to notify the user that the vote has been cast. The total number of votes cast is increased and stored in the EEPROM memory of the microcontroller. The instructions displayed in LCD during voting process is shown in fig 5 [10].

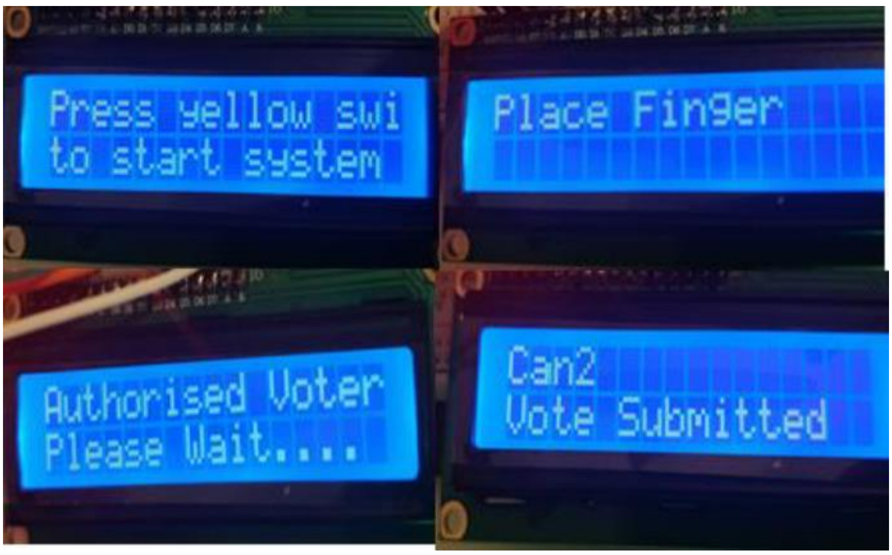


Figure 5: Messages (left to right) displayed during voting process

Authentication

The technique is designed to prevent multiple voting by preventing voters from voting for the same finger image more than once, limiting a voter's capacity to vote to only one time during a single voting session. The logic that detects whether or not a voter has previously voted is implemented within the void loop. When a vote is cast, the flag is assigned to a 0 integer; thus, if the same user attempts to vote again, the flag value is evaluated before providing vote access to vote, and if flag has value 1, the action is canceled. As a consequence, the system's authenticity is not jeopardized

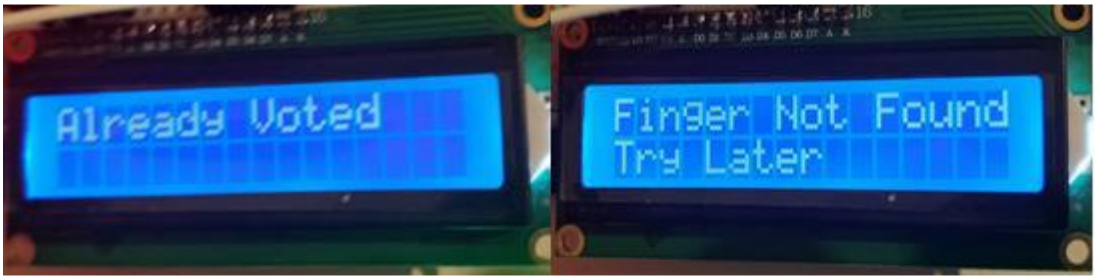


Figure 6: Message in LCD denying voting

Furthermore, if an individual whose fingerprinting is not recorded in the system attempts to vote, the notification 'Finger Not Found, Try Later' is shown on the LCD screen, as shown in fig. 6. As a result, the person is unable to vote.

Result

After the voting operation is completed, all cast votes are gathered, recorded in EEPROM memory, and analyzed. When the 'Result' switch connected to digital I/O Pin 2 is pressed, a function that determines and displays the result is triggered. The result function calculates the overall number of votes cast for each contestant by adding the number of times switches associated to each actual person were pressed; just two competitors were supplied in this project. The candidate with the greatest number of integer values is picked as the winner as a result of the numerical comparison, and the result is shown on the screen. This is also seen in Figure 7. Simultaneously, the result is recorded in the EEPROM memory of the Arduino, where it may be accessed after the voting process. If the result method is defined before the vote is finished, the message 'No Voting' is shown on the LCD as seen in figure 7

Figure 7: Two possible condition of result displayed in LCD

Possible Risks

With every physical equipment, the possibility of manipulation is unavoidable. Because the gadget is light and constructed of plastic fiber, it can readily shatter on impact. In such a case, data may be permanently lost or impossible to recover. Software and system glitches and other issues might cause the voting process to be delayed or even halted [11]. In addition, gathering fingerprint data from millions of people is a difficult and time-consuming operation. Illiterate persons who have never used electronic voting machines and are used to voting on paper may struggle to grasp the voting procedure. Adequate information or classes must be provided, which increases the cost of the election.

Conclusion

The goal of this thesis research was to design and create a prototype fingerprint voting system that assures the voting process is secure and quick. For this, an Arduino Uno-based fingerprint election process with DY50 fingerprint module, LED (162) and EE Prom memory storage technology was created. The finished system is the culmination of several successful hardware and software integrations. Review and analysis, system and algorithm design, hardwiring, software and hardware integration, testing and diagnostics, and analysis of the results are all part of the process.

To sum it up, the prototype technique was used to analyze, enroll voters' fingerprints in the DY50fingerprint module memory chips, verify voter status (registration and multiple voting), match the new fingerprint input with the stored biometric template, authorize the voter to vote, and generate the result. To summarize, the device is an excellent substitute for other time-consuming election techniques, notably the voting form voting system.

At a later stage of development, the prototypes gadget might be improved further. For example, installing a WIFI module might aid in wirelessly transmitting results to the host computer, and adding additional system memory could aid in storing many numbers of fingerprint information

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