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Electronic voting machine using Raspberry Pi with Face and Biometric Authentication

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Abstract*— The Smart Voting System outlined in this project leverages IoT-enabled embedded devices and Python programming to enhance the efficiency and security of traditional voting procedures. By integrating microcontrollers, biometric or smart card readers, push buttons or touchscreens, and IoT communication modules, the system creates a connected infrastructure for seamless interactions between voters and a central server. Python, in conjunction with Flask or Django, is employed for server-side development, managing voter authentication, real-time monitoring, and the secure storage of voting data in databases. The provided code snippet offers a foundational structure, ensuring one vote per eligible voter and emphasizing the importance of compliance with local regulations and security standards to establish a reliable and trustworthy Smart Voting System.

Introduction

In this project, fingerprint biometric provide secure authentication because fingerprint is unique to each individual.it also check the age of a person. The Person is eligible to vote or not, India is spending lots of money to improve our whole voting system to provide a better government to citizens. In India, voting system should be honest, without corruption and fully secure for the better democracy. The current system is used to less transparency because there could be chances of fake voting at the voting time. Authentication (uniqueness)of Voters, Security of the voting process, protecting voted data these are the main challenges of current Election voting. To recover the challenges, we develop our Online Voting System. This system Provide a more security than the previous system.

LITERATURE SURVEY

1] "Secured Electronic Voting Machine Using Biometric Technique with Unique Identity Number and IOT, 2020" Races assume a significant part in our majority rule nation as individuals can choose an individual as a pioneer for the public authority. This paper is about implementation of voting system through biometric verification along with it aadhar id verification. When the verification is valid, it will send this data to IOT. This proposed system has automatic counting of votes: highly data secured system, sending of data immediately and safe voting.

[2] "A literature survey on micro-controller based smart electronic voting machine system S.V. Prasath, R. Mekala M.E. (Ph.D.), 2014"

A democratic framework gives rules and guidelines to guarantee substantial choice of pioneer by individuals. This review depicts another plan called Smart Electronic Voting Machine dependent on PIC Micro regulator. The working cycle of this machine is straightforward and simple to work and it should be reliable and blunder free when contrasted

with manual democratic framework where the manual plan is slower, presents entire day sluggishness on individuals and odds of mistakes are more noteworthy. In microcontroller framework elector surveys a vote effectively by squeezing a survey catch and end-product are shown in zero time by squeezing an outcome button.

[3] "J.Ramprabu, G.Sindhuja "Performance Analysis of Open-Source Real Time Operating Systems" International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 4 Issue"

The target of the paper is to dissect the General-Purpose Operation System (GPOS) execution with Real Time Operating System (RTOS) utilizing a portable robot as an ongoing application. The versatile robot module is actualized on a solitary board PC having ARM11 as its center. Strategies/Statistical Analysis: The method used to learn response is real feel technique which uses dedicated clock and block to figure the response. Revelations: The response of the adaptable robot is controlled by encroaching upon the convenient robot with specific hindrances. Findings: In development to this, various limits, for instance, speed, insurgencies opportunity and precision came to fruition by the sensor are in like manner decided. RTOS have a typical of 20µs whereas GPOS have an ordinary of 102µs of response time dynamically climate.

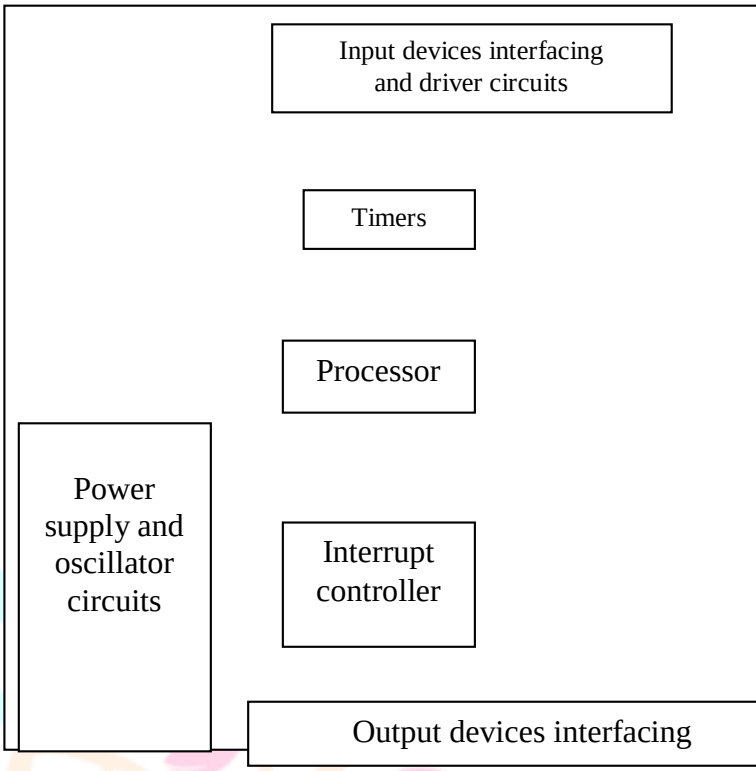


Figure: Block diagram of embedded system

Embedded System Hardware:

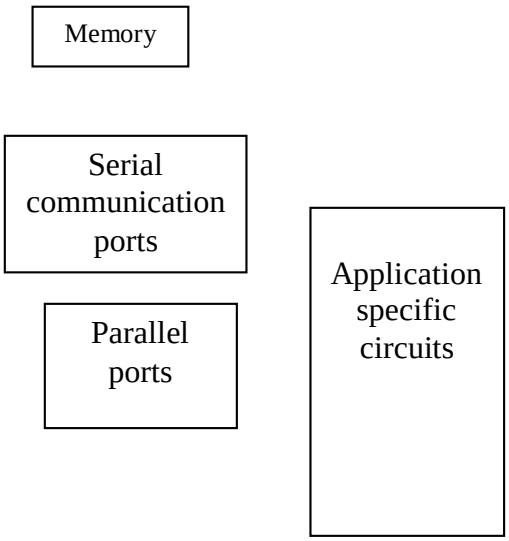
As with any electronic system, an embedded system requires a hardware platform on which it performs the operation. Embedded system hardware is built with a microprocessor or microcontroller. The embedded system hardware has elements like input output (I/O) interfaces, user interface, memory and the display. Usually, an embedded system consists of:

- Power Supply
- Processor
- Memory
- Timers
- Serial communication ports
- Output/Output circuits
- System application specific circuits

Embedded System Software:

The embedded system software is written to perform a specific function. It is typically written in a high-level format and then compiled down to provide code that can be lodged within a non-volatile memory within the hardware. An embedded system software is designed to keep in view of the three limits:

- Availability of system memory
- Availability of processor's speed
- When the system runs continuously, there is a need to limit power dissipation for events like stop, run and wake up.



EXISTING SYSTEM

Electronic Voting Machines ("EVM"), Idea mooted by the Chief Election Commissioner in 1977. The EVMs were devised and designed by Election Commission of India in collaboration with Bharat Electronics Limited (BEL), Bangalore and Electronics Corporation of India Limited (ECIL), Hyderabad.

The EVMs are now manufactured by the above two undertakings. An EVM consists of two units,
i) Control Unit
ii) Balloting Unit

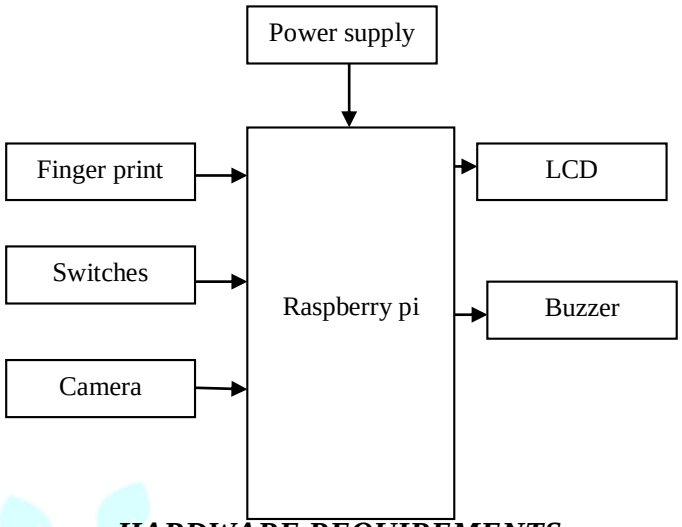
The two units are joined by a five-meter cable. The Control Unit is with the Presiding Officer or a Polling Officer and the Balloting Unit is placed inside the voting compartment.

Drawbacks:

- Accuracy
- Security Problems
- Illegal Voting (Rigging)
- Privacy
- Verifiability

PROPOSED SYSTEM

In the proposed design a new model of voting through electronic voting machine is introduced which is based on biometric system using finger print detection and face detection. If the person tries to vote multiple times, then the Microcontroller will automatically display the message on the LCD. If again person went for voting to cast false vote, then buzzer alert will be given. Then check to finer or image by camera then the matched anyone voter will be go on voting by switches and complete the vote.



HARDWARE REQUIREMENTS

Raspberry Pi:

Raspberry Pi is a credit-card sized computer manufactured and designed in the United Kingdom by the Raspberry Pi foundation with the intention of teaching basic computer science to school students and every other person interested in computer hardware, programming and DIY-Do-it Yourself projects.

The Raspberry Pi is manufactured in three board configurations through licensed manufacturing deals with Newark element 14(Premier Farnell), RS Components and Egoman. These companies sell the Raspberry Pi online. Egoman produces a version for distribution solely in China and Taiwan, which can be distinguished from other Pi's by their red coloring and lack of FCC/CE marks. The hardware is the same across all manufacturers.

DESCRIPTION OF THE COMPONENTS ON THE RASPBERRY PI:

1) Processor/SoC (System on Chip):

The Raspberry Pi has a Broadcom BCM2835 System on Chip module. It has a ARM1176JZF-S processor. The Broadcom SoC used in the Raspberry Pi is equivalent to a chip used in an old smartphone. While operating at 700 MHz by default, the Raspberry Pi provides a real-world performance roughly equivalent to the 0.041GFLOPS. The Raspberry Pi chip operating at 700 MHz by default, will not become hot enough to need a heatsink or special cooling.

2) Power source:

The Pi is a device which consumes 700mA or 3W or power. It is powered by a Micro USB charger or the GPIO header. Any good smartphone charger will do the work of powering the Pi.

3) SD Card:

The Raspberry Pi does not have any onboard storage available. The operating system is loaded on a SD card which is inserted on the SD card slot on the Raspberry Pi. The operating system can be loaded on the card using a card reader on any computer.

4) GPIO:

General-purpose input/output (GPIO) is a generic pin on an integrated circuit whose behavior, including whether it is an input or output pin, can be controlled by the user at run time. GPIO pins have no special purpose defined, and go unused by default. The idea is that sometimes the system designer building a full system that uses the chip might find it useful to have a handful of additional digital control lines, and having these available from the chip can save the hassle of having to arrange additional circuitry.

The production Raspberry Pi board has a 26-pin 2.54 mm expansion header, marked as P1, arranged in a 2x13 strip. They provide 8 GPIO pins plus access to I²C, SPI, UART), as well as +3.3 V, +5 V and GND supply lines. Pin one is the pin in the first column and on the bottom row.

5) DSI connector:

The Display Serial Interface (DSI) is a specification by the Mobile Industry Processor Interface (MIPI) Alliance aimed at reducing the cost of display controllers in a mobile device. It is commonly targeted at LCD and similar display technologies. It defines a serial bus and a communication protocol between the host and the device. A DSI compatible LCD screen can be connected through the DSI connector, although it may require additional drivers to drive the display.

6) RCA Video:

RCA Video outputs (PAL and NTSC) are available on all models of Raspberry Pi. Any television or screen with a RCA jack can be connected with the RPi.

Figure 6: RCA Video Connector

7) Audio Jack:

A standard 3.5 mm TRS connector is available on the RPi for stereo audio output. Any headphone or 3.5mm audio cable can be connected directly. Although this jack cannot be used for taking audio input, USB mics or USB sound cards can be used.

8) Status LEDs:

There are 5 status LEDs on the RPi that show the status of various activities. They are “OK” ,"ACT" ,,“POWER” (PWR), Full Duplex ("FDX"),“LNK” (Link/Activity), “10M/100” which are shown in figure below.

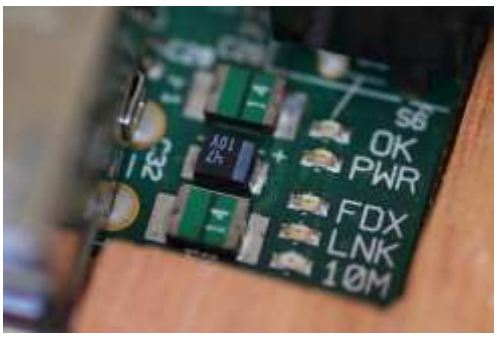


Figure 7: LED Status Indicator

9) USB 2.0 Port:

USB 2.0 ports are the means to connect accessories such as mouse or keyboard to the Raspberry Pi. There is 1 port on Model A, 2 on Model B and 4 on Mo del B+. The number of ports can be increased by using an external powered USB hub which is available as a standard Pi accessory.

10) Ethernet:

Ethernet port is available on Model B and B+. It can be connected to a network or internet using a standard LAN cable on the Ethernet port. The Ethernet ports are controlled by Microchip LAN9512 LAN controller chip.

11) CSI connector:

CSI – Camera Serial Interface is a serial interface designed by MIPI (Mobile Industry Processor Interface) alliance aimed at interfacing digital cameras with a mobile processor. The RPi foundation provides a camera specially made for the Pi which can be connected with the Pi using the CSI connector.

12) JTAG headers:

JTAG is an acronym for ‘Joint Test Action Group', an organization that started back in the mid 1980's to address test point access issues on PCB with surface mount devices. The organization devised a method of access to device pins via a serial port that became known as the TAP (Test Access Port). In 1990 the method became a recognized international standard (IEEE Std 1149.1). Many thousands of devices now include this standardized port as a feature to allow test and design engineers to access pins.

13) HDMI:

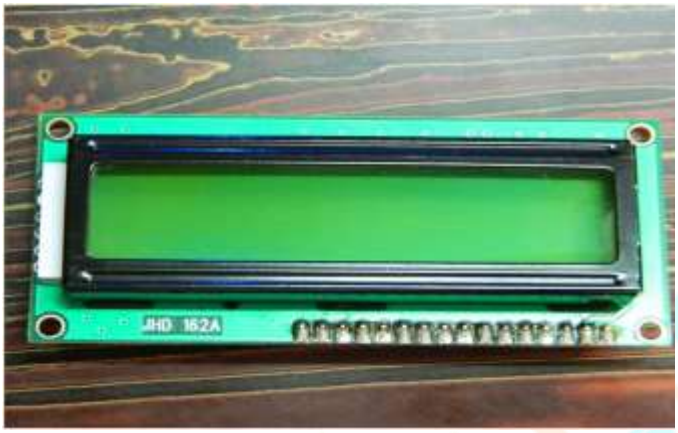
HDMI –High-Definition Multimedia Interface

HDMI 1.3 a type A port is provided on the RPi to connect with HDMI screens.

LCD (Liquid crystal display) 16x2:

LCD (Liquid Crystal Display) is the innovation utilized in scratch pad shows and other littler PCs. Like innovation for light-producing diode (LED) and gas-plasma, LCDs permit presentations to be a lot more slender than innovation for cathode beam tube (CRT). LCDs expend considerably less power than LED shows and gas shows since they work as opposed to emanating it on the guideline of blocking light.

Images of LCD Display: -



LCD – Front View

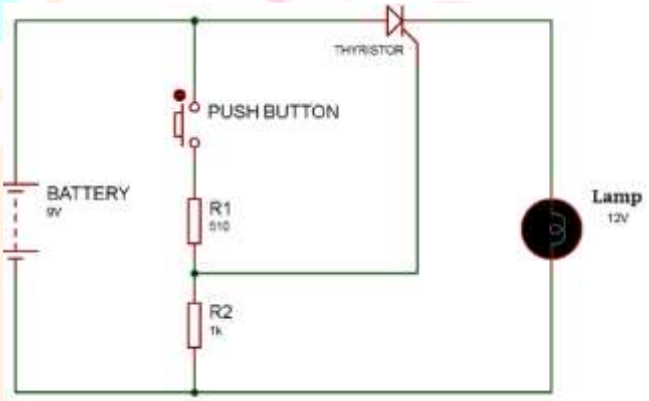
LCD – Back View

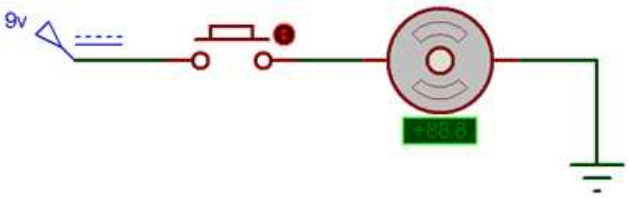
Fingerprint Sensor:

This is a finger print sensor module with TTL UART interface. The user can store the finger print data in the module and can configure it in 1:1 or 1: N mode for identifying the person. The FP module can directly interface with 3v3 or 5v Microcontroller. A level converter (like MAX232) is required for interfacing with PC.
is required for interfacing with PC.
Fingerprint processing includes two parts: fingerprint enrollment and fingerprint matching (the matching can be 1:1 or 1:N). When enrolling, user needs to enter the finger two times. The system will process the two-time finger images, generate a template of the finger based on processing results and store the template. When matching, user enters the finger through optical sensor and system will generate a template of the finger and compare it with templates of the finger library. For 1:1 matching, system will compare the live finger with specific template designated in the Module; for 1:N matching, or searching, system will search the whole finger library for the matching finger. In both circumstances, system will return the matching result, success or failure.

Switch:

A Push Button switch is a type of switch which consists of a simple electric mechanism or air switch mechanism to turn something on or off.





Buzzer:

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. Buzzer is an integrated structure of electronic transducers, DC power supply, widely used in computers, printers, copiers, alarms, electronic toys, automotive electronic equipment, telephones, timers and other electronic products for sound devices. Active buzzer 5V Rated power can be directly connected to a continuous sound, this section dedicated sensor expansion module and the board in combination, can complete a simple circuit design, to "plug and play.

WEB CAMERA

A **webcam** is a video camera that feeds or streams an image or video in real time to or through a computer network, such as the Internet. Webcams are typically small cameras that sit on a desk, attach to a user's monitor, or are built into the hardware. Webcams can be used during a video chat session involving two or more people, with conversations that include live audio and video.

Webcam software enables users to record a video or stream the video on the Internet. As video streaming over the Internet requires much bandwidth, such streams usually use compressed formats. The maximum resolution of a webcam is also lower than most handheld video cameras, as higher resolutions would be reduced during transmission. The lower resolution enables webcams to be relatively inexpensive compared to most video cameras, but the effect is adequate for video chat sessions

SOFTWARE REQUIREMENTS

PYTHON:

Python is a general purpose, dynamic, high level and interpreted programming language. It supports Object Oriented programming approach to develop applications. It is simple and easy to learn and provides lots of high-level data structures. It is easy to learn yet powerful and versatile scripting language which makes it attractive for Application Development. It's syntax and dynamic typing with its interpreted nature, makes it an ideal language for scripting and rapid application development. It supports multiple programming patterns, including object oriented, imperative and functional or procedural programming styles. It is not intended to work on special area such as web programming. That is why it is known as multipurpose because it can be used with web, enterprise, 3D CAD etc. We don't need to use data types to declare variable because it is dynamically typed so we can write a=10 to assign an integer value in an integer variable. It makes the development and debugging fast because there is no compilation step included in python development and edit-test-debug cycle is very fast.

Python Features

Python provides lots of features that are listed below.

1) Easy to Learn and Use

Python is easy to learn and use. It is developer-friendly and high-level programming language.

2) Expressive Language

Python language is more expressive means that it is more understandable and readable.

3) Interpreted Language

Python is an interpreted language i.e. interpreter executes the code line by line at a time. This makes debugging easy and thus suitable for beginners.

4) Cross-platform Language

Python can run equally on different platforms such as Windows, Linux, Unix and Macintosh etc. So, we can say that Python is a portable language.

5) Free and Open Source

Python language is freely available at address. The source-code is also available. Therefore, it is open source.

6) Object-Oriented Language

Python supports object-oriented language and concepts of classes and objects come into existence. It implies that other languages such as C/C++ can be used to compile the code and thus it can be used further in our python code.

Result

Enrollment Process:

For Enrollment, voter must carry their identity card or any such approved Id cards and needs to go to the authorized polling Enrollment centre and at the polling booth he has to register his biometric details such as face and finger with his constituency details, once his Enrollment is done , then he can cast his vote at any authorized centre.

Figure : Displaying message, when turned ON the voting machine

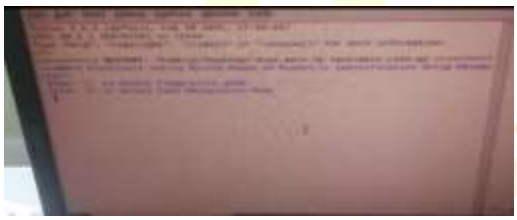
Figure : Enrolling Finger

Figure: Storing Finger details

Vote casting process:

To cast a vote to a particular candidate, The system displays two options "1" for Finger authentication and "2" for Facial authentication. For Finger authentication, First LCD displays "Place your finger", then voter has to place his finger over the finger sensor. Once if voter's finger matches the finger that stored in database (Stored during Enrollment Process), then it displays ID number in the LCD display and shows up candidates name to cast his vote. For Facial authentication, face is matched through the web camera. Once voter pressed the pushbutton respective to a particular candidate it stores the vote and displays vote saved successfully. In case if the same voter tries to cast his vote again, Buzzer will get alert preventing fraudulent votes.

Figure: Displaying to select mode (Finger or Face)



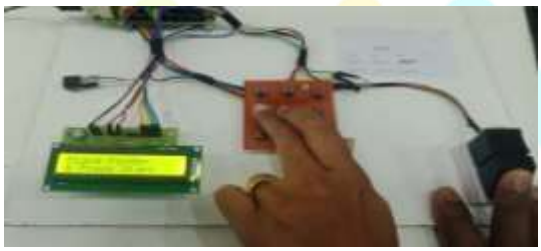


Figure: Displaying to Place finger and Start

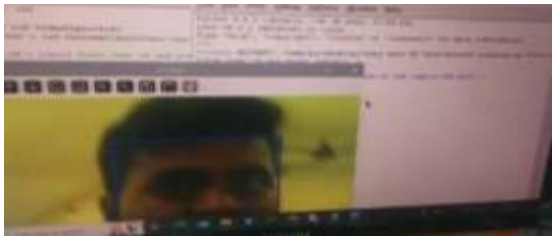


Figure: Face Authentication

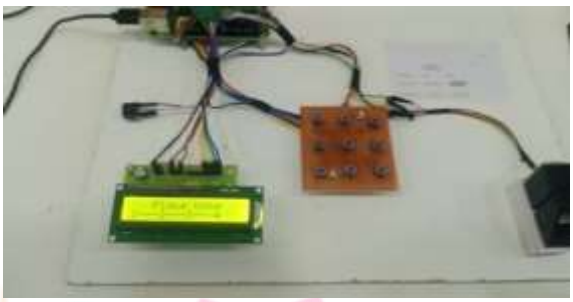


Figure: Displaying Candidates number

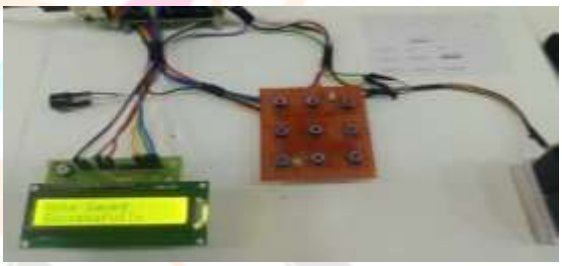


Figure: Displaying Vote saved sucessfully

Figure: Displaying Already voted

Figure: Number of votes casted for different candidates

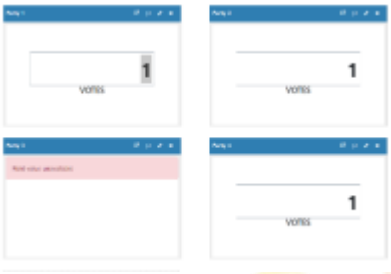


Figure: Final Result (Displaying number of Votes)

CONCLUSION

The proposed secured Online voting system uses for authentication. Database consisting of the details like fingerprint should be updated every time before election. This system affords additional security by allowing voter to vote only once by comparing unique identification. Our main proposal is to enable the user to cast his vote using OVS without going to booth. User can cast his vote from his home or any way and to reduce the proxy vote and in booth capturing situation this system help us.

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