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SMART ELECTRONIC VOTING MACHINE WITH FACE RECOGNITION USING RASPBERRY PI

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Abstract
Smart Electronic Voting Machine SEVM promises to revolutionize the electoral experience. By harnessing the capabilities of Raspberry Pi, a compact and affordable single-board computer, in conjunction with sophisticated facial recognition algorithms, the SEVM ensures secure and accurate authentication of voters while 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 reliable and trustworthy Smart Voting System.
Keywords: Raspberry pi, Face recognition, fingerprint sensor, GSM module

I.Introduction

The primary intent of implementing face recognition in a smart electronic voting machine using Raspberry Pi is to enhance voter authentication, ensuring secure and accurate identification during the electoral process, thereby reducing the potential for fraud and ensuring the integrity of the voting system. In the contemporary landscape of electoral systems, the integration of advanced technologies is reshaping the traditional methods of voting. The Smart Electronic Voting Machine (SEVM) employing Raspberry Pi with Face Recognition stands at the forefront of this technological evolution, offering a pioneering solution to enhance the security, efficiency, and accessibility of the voting process. Leveraging the computational power and versatility of Raspberry Pi, coupled with the precision and reliability of face recognition technology, this innovative streamlining the voting process. This introduction outlines the transformative potential of the SEVM, heralding a new era of democratic participation in the digital age.

II.Literature Review

The integration of Raspberry Pi and face recognition technology into electronic voting machines represents a significant advancement in the realm of electoral systems. Through a comprehensive literature review, it becomes evident that such a system offers numerous benefits including enhanced security, increased efficiency, and improved accessibility. Studies have highlighted the Raspberry Pi's versatility and affordability, making it a suitable platform for developing smart voting machines. Additionally, the utilization of face recognition adds an extra layer of authentication, mitigating concerns related to identity verification and voter fraud. Researchers have emphasized the importance of user-friendly interfaces and robust encryption protocols to ensure the integrity and privacy of the electoral process. While challenges such as technological reliability and regulatory compliance remain, the collective findings underscore the potential of smart electronic voting machines to revolutionize democratic practices by promoting transparency, inclusivity, and trust in electoral outcomes.

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Certainly, here's a comparison table outlining the differences between types of voting machines used in previous years and modern smart electronic voting machines, along with their hardware results:

Sr.no	Type of voting	Hardware	Result
1	Ballot paper voting	Paper and ballot box is used for this type of voting	It can enhance transparency and trust in the electoral process.
2	Vvpat voting (voter verified paper audit trail)	Ballot unit	Its ability to provide a physical paper trail for voters to verify their choices
3	Electronic voting machine	Control unit and ballot unit	It reduces ballot errors and enabling faster tabulation of results.
4	Remote Internet voting	Internet connection, Website, Software	It allows eligible voters to cast their ballots from any location with internet access, potentially increasing voter turnout.
5	Biometric voting machine by using Fingerprint module	Arduino and Finger print module	It is the enhanced security and accuracy in voter authentication, reducing the risk of identity fraud
6	Smart Electronic Voting Machine by using Raspberry pi with face Recognition and Fingerprint sensor	Raspberry pi, Buzzer, Webcam, GSM Module and Fingerprint module	It is the advanced biometric authentication, which enhances security and reduces the potential for voter impersonation

Table: Comparison between Voting system

These comparisons highlight how smart electronic voting machines leverage modern technologies and advanced components to address the limitations of traditional EVMs, offering enhanced security, flexibility, reliability, and usability in electoral processes and various voting scenarios.

III.Methodology

1. **Hardware Setup:** Assemble Raspberry Pi with necessary peripherals (screen, keyboard, etc.) and connect a camera module for face recognition**.**
2. **Software Installation:** Install an operating system (e.g., Raspbian) on the Raspberry Pi and necessary libraries for face recognition (e.g., OpenCV).
3. **Face Database Creation:** Collect images of eligible voters and create a database for face recognition.
4. **Voter Authentication:** Implement a face recognition algorithm to authenticate voters before they can cast their vote.
5. **Voting Interface:** Develop a user-friendly interface on the Raspberry Pi for voters to select their candidates securely.
6. **Vote Storage and Security:** Store votes securely in a database or file system on the Raspberry Pi, ensuring encryption and integrity.
7. **Result Generation:** Implement algorithms to count votes and generate results accurately.
8. **Testing and Validation:** Thoroughly test the system for accuracy, reliability, and security, ensuring it meets all requirements and regulations.

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9. **Deployment:** Deploy the smart electronic voting machine in the desired voting locations, providing necessary training and support to election officials.

10. **Monitoring and Maintenance:** Regularly monitor the system during elections and perform maintenance as needed to ensure smooth operation

IV.Working

The working of Smart Electronic Voting Machine (SEVM) typically refers to the envisioned improvements or enhancements that stakeholders propose to implement in the existing electronic voting system. These enhancements may include integrating new technologies, refining existing features, or addressing shortcomings identified in the current system. For example, a proposed SEVM system might introduce biometric authentication methods such as fingerprint or facial recognition to enhance voter verification and prevent fraud. Additionally, proposed SEVM systems might incorporate advanced communication modules such as GSM or Wi-Fi for real-time data transmission and monitoring. Other proposed features could include improved user interfaces, accessibility options, and security measures to ensure the integrity and transparency of the electoral process. Overall, the working in an SEVM represents a vision for leveraging technology to optimize the efficiency, accuracy, and accessibility of electronic voting systems.

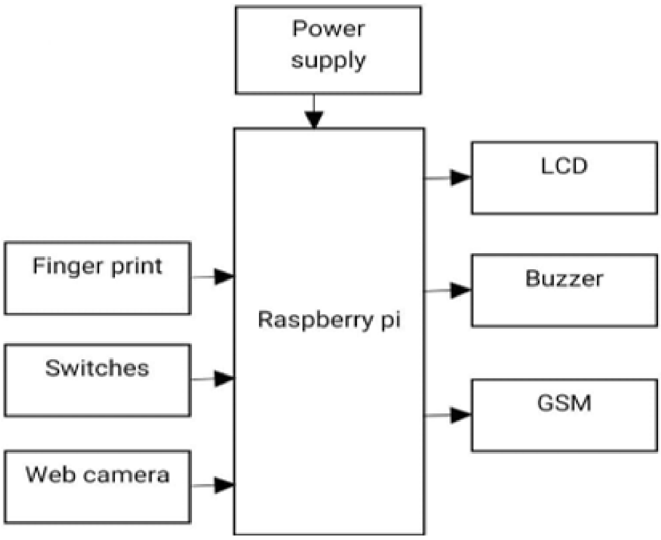

Figure 1. Block diagram of smart electronic voting machine

In the block diagram of a smart electronic voting machine incorporating a Raspberry Pi with face recognition, fingerprint sensor, GSM module, LCD display, switches, and power supply, the input-output connections are intricately linked to ensure seamless functionality. The face recognition and fingerprint sensor modules serve as input devices, capturing and processing biometric data to authenticate voters. These modules interface with the Raspberry Pi, which acts as the central processing unit, managing the authentication process and handling voting data.

The GSM module facilitates communication by transmitting real-time voting data securely over cellular networks, establishing a vital connection for data transmission. The LCD display acts as the primary output device, providing a clear interface for voters to interact with, displaying instructions and feedback throughout the voting process. Switches are integrated into the system to enable user inputs, controlling various functions such as initiating the voting process or navigating the interface.

The power supply unit ensures the continuous operation of the system by providing stable power to all components. Input connections from external power sources are directed to the power supply unit, which distributes power to the Raspberry Pi and other components. Output connections from the power supply unit are distributed to the various modules, ensuring they receive the necessary power to function reliably. Overall, these interconnected input-output connections form a robust electronic voting machine capable of accurately authenticating voters, securely transmitting data, and providing a user-friendly interface for efficient electoral processes.

V.Components

5.1 Raspberry pi:

Figure 2. Raspberry Pi

A Raspberry Pi is a small, affordable, single-board computer widely used in various electronic projects. In a smart electronic voting machine employing face recognition, the Raspberry Pi serves as the brain of the system, handling data processing and control functions. Its components typically include a processor, memory, input/output ports, and connectivity options like Wi-Fi or Bluetooth. The Raspberry Pi interfaces with a camera module for capturing images, and facial recognition algorithms are implemented to identify voters.

5.2 LCD Display:

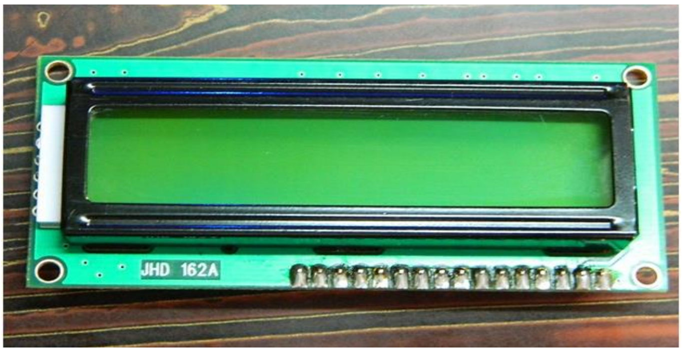

Figure 3. LCD Display

The LCD (Liquid Crystal Display) display plays a crucial role in the Smart Electronic Voting Machine (SEVM) by providing a user-friendly interface for voters and election officials. In the SEVM, the LCD display serves as the primary means of presenting information, including candidate lists, ballot instructions, and voting confirmation messages. Its high resolution and sharp clarity ensure that voters can easily navigate through the voting process and make informed choices.

5.3 Fingerprint Sensor:

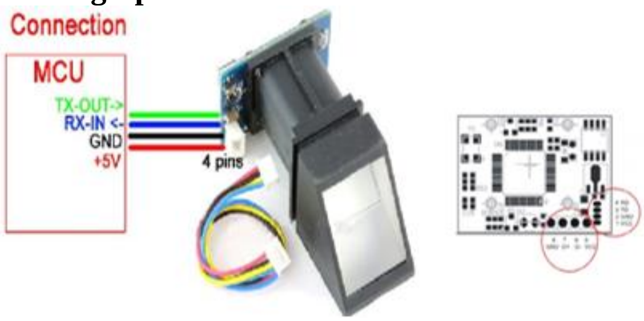

Figure 4. Fingerprint Sensor

The fingerprint sensor in the smart electronic voting machine is a hardware component that captures and reads unique fingerprint patterns to authenticate voters. It interfaces with the Raspberry Pi, which processes the fingerprint data and integrates it with the face recognition system for enhanced voter identification and authentication. Together, these technologies ensure secure and accurate voter verification in the electronic voting process.

5.4 Buzzer:

Figure 5. Buzzer

The buzzer in a smart electronic voting machine with Raspberry Pi and face recognition serves as an auditory feedback mechanism to confirm successful voting or alert users of errors. It's typically connected to the Raspberry Pi's GPIO pins and controlled through the voting application's logic. When a vote is cast or a face is recognized, the buzzer emits a sound signal to inform the voter or election staff of the action's status.

5.5 GSM Module:

Figure 6. GSM Module

The GSM module in a smart electronic voting machine with Raspberry Pi and face recognition enables remote communication for result transmission and monitoring. It facilitates sending voting data securely to a central server via SMS or GPRS. Integrated with the Raspberry Pi, it allows real-time updates and ensures transparency and efficiency in the voting process by enabling communication with election authorities and stakeholder

5.6 Web Camera:

Figure 7. Web Camera

The web camera in a smart electronic voting machine with Raspberry Pi and face recognition captures live images of voters' faces during the voting process. These images are then processed by the face recognition software running on the Raspberry Pi to verify the identity of voters and prevent fraudulent

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voting. The camera's high-resolution capabilities ensure accurate facial recognition, enhancing the security and integrity of the voting system.

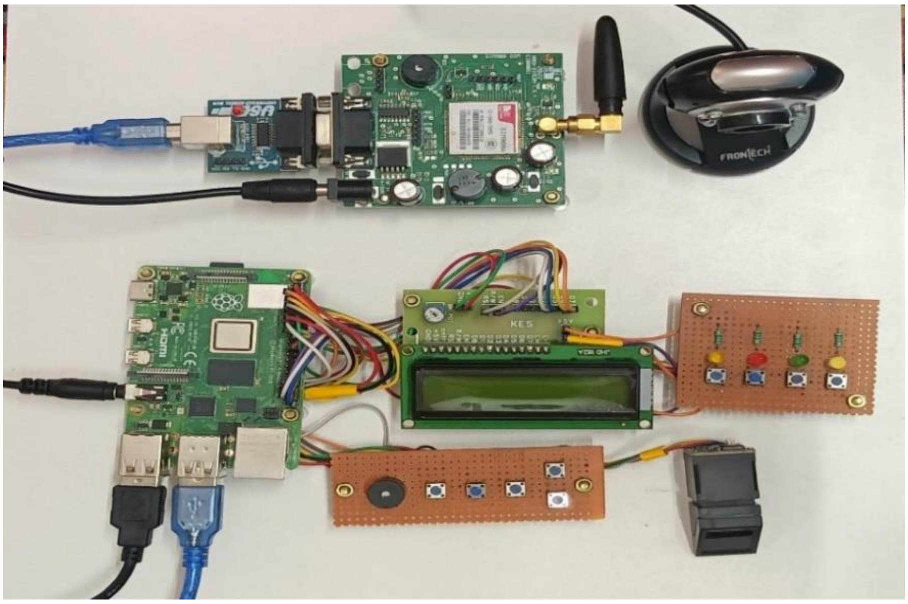

Figure 8. Hardware setup

VI.Pin Description of Raspberry Pi

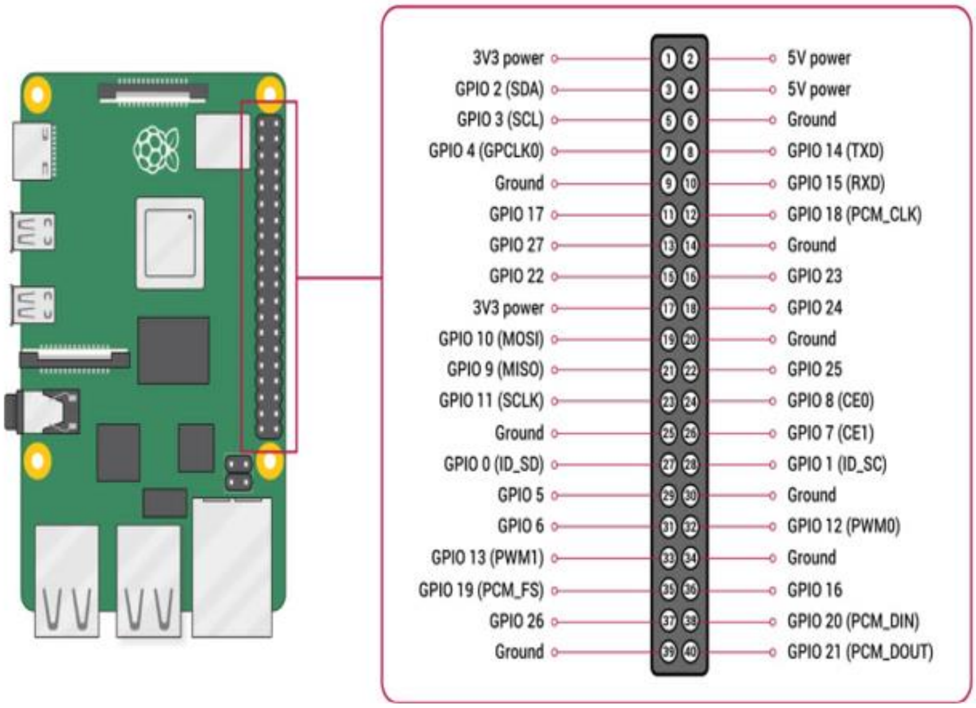

Figure 9. Pin Description of Raspberry Pi

1. **GPIO (General Purpose Input Output) Pins:** These pins allow the Raspberry Pi to interact with external devices. They can be configured as either input or output pins to read sensor data or control actuators respectively.
2. **5V Power Pins:** These pins provide a regulated 5V power supply, typically used to power external components or sensors.
3. **3.3V Power Pins:** Similar to the 5V power pins, these pins provide a regulated 3.3V power supply, suitable for powering low-voltage components or sensors.

4. **Ground Pins (GND):** These pins are connected to the ground of the Raspberry Pi and are used as reference points for electrical circuits.
5. **UART (Universal Asynchronous Receiver/Transmitter) Pins:** These pins facilitate serial communication and can be used to connect the Raspberry Pi to other serial devices like GPS modules, RFID readers, or other microcontrollers.
6. **I2C (Inter-Integrated Circuit) Pins:** These pins enable the Raspberry Pi to communicate with other devices using the I2C protocol. They are commonly used to connect sensors, LCD displays, and other peripherals.
7. **SPI (Serial Peripheral Interface) Pins:** These pins allow high-speed serial communication between the Raspberry Pi and other devices, such as LCD screens, SD cards, or other microcontrollers.
8. **PWM (Pulse Width Modulation) Pins:** These pins can generate analog-like signals by varying the duty cycle of the digital signal. PWM pins are often used to control the brightness of LEDs or the speed of motors.
9. **ID_SD and ID_SC Pins:** These pins are used for HAT (Hardware Attached on Top) identification on Raspberry Pi models with the 40-pin GPIO header.

VII.Result

Fig. a

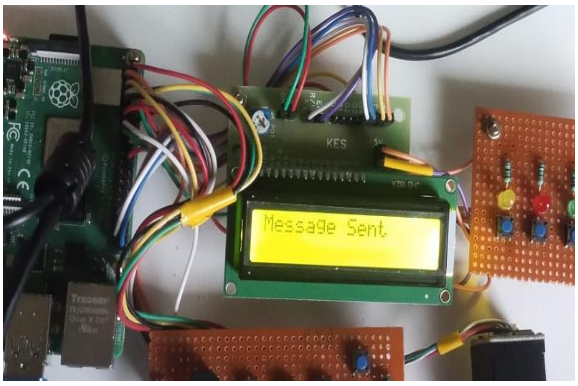

Fig. b

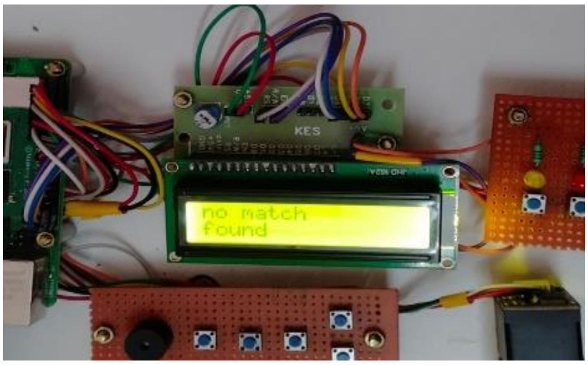

Fig. c

Fig. d

a. If a person tries to enrol a second time, the LCD will display "The fingerprint already exists."
b. After the vote is saved successfully, the voter will receive a message through the GSM module, and the LCD will display "Message sent."
c. If a person tries to vote when their data is not saved, the LCD will display "No match found."
d. When a vote is cast successfully, the LCD will display "Vote saved successfully."

VIII.Conclusion

The Smart Electronic Voting Machine (SEVM) utilizing Raspberry Pi with Face Recognition represents a significant milestone in the evolution of electoral technology. By amalgamating the computational prowess of Raspberry Pi with the precision and security of face recognition technology, the SEVM offers a robust and reliable platform for conducting transparent, efficient, and accessible elections. Through its innovative features, such as biometric authentication and real-time data processing, the SEVM ensures the integrity of the voting process while enhancing voter trust and participation. As we embrace the possibilities of digital innovation, the SEVM stands as a beacon of progress, paving the way for democratic elections that are not only technologically advanced but also inclusive and fair. With its potential to revolutionize the electoral landscape, the SEVM underscores the transformative power of technology in strengthening democratic institutions and fostering civic engagement.

The advantages of a Smart Electronic Voting Machine (SEVM) using Raspberry Pi with face recognition include enhanced security through biometric authentication, streamlined voting processes enabled by Raspberry Pi's computational efficiency, and increased accessibility for voters through intuitive user interfaces.

The applications of a Smart Electronic Voting Machine (SEVM) using Raspberry Pi with face recognition extend to secure and efficient voting in elections, enhancing the integrity of organizational decision-making processes, and facilitating secure and convenient authentication in various identity verification scenarios.

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