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Smart Electronic Voting Machine

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Abstract

The advancement of technology has significantly transformed various sectors, including the electoral process. This paper presents the design and implementation of a Smart Electronic Voting Machine utilizing Arduino microcontroller technology and RFID (Radio Frequency Identification) card systems. The proposed system aims to enhance the security, efficiency, and accessibility of the voting process while minimizing the potential for fraud and errors associated with traditional voting methods. This machine integrates an Arduino board with RFID readers to authenticate voters through unique RFID cards, ensuring that only eligible individuals can cast their votes. The system features a user-friendly interface that guides voters through the voting process, allowing them to select their preferred candidates with ease. Additionally, the machine records votes in real-time and stores them securely, facilitating quick and accurate tallying after the voting period concludes. This innovative approach not only streamlines the voting process but also addresses common challenges such as voter impersonation and ballot tampering. By leveraging RFID technology, the Smart electronic voting machine enhances the overall integrity of elections while providing a modern solution that can be adapted to various electoral contexts.

INTRODUCTION

In Voting systems have long been regarded as essential components of any democracy, in which elections are used to choose the government. Another significant obstacle is preventing election-related fraud, rigging, and unethical behavior. India's general elections have recently concluded. To guarantee a fair voting process, numerous technologies were used. It was noted that the unbiased voting resulted from the severe security measures failing to prevent the fraudulent voting. It may become difficult for the authorities to verify the voter's identity and halt proxy voting as a result. The percentage of frauds and election-riggings will decrease if a sophisticated voting machine is created that can quickly identify voters. This increases the electoral process's dependability, security, and safety while guarding against malpractice, fraud, and election tampering. The machine communicates with the voter and authenticates using RFID technology. The voter ID of that specific polling place and their registered mobile phones are entered into the controller. Voters must scan their identification when they arrive at the polling station to cast their ballots since their

voter ID card is embedded with an RFID tag. The RFID reader is connected to a microcontroller, which reads the RFID tag and transmits the data to the Arduino. The voter ID is then compared to the ID that is already recorded in the microcontroller. The voter ID card and RFID reader scan the data and transmit it to the microcontroller, which then verifies the database. By doing this, the election process can be made safer and more secure while also being shielded against malpractice, fraud, and election rigging. Compared to the current technologies, this intelligent EVM offers superior security and is more dependable.

LITERATURE REVIEW

Anis A. M. and Rahman H. (2014) introduced a dual authentication method that integrates voter biometrics, such as fingerprints, with unique voting pins assigned during the registration process. Sneha Vilasrao Pujari (2024) developed a voting device that employs an Arduino board and a liquid crystal display, aiming to completely eradicate fraud within the voting system.

Abdulkadir H. Alkali et al. (2019) designed an Electronic Voting Machine (EVM) that incorporates RFID technology and a fingerprint sensor. This system stores voter information, including fingerprint, name, address, gender, and age, in a database. The primary unit is an Arduino Mega, which interfaces with various subunits, including a keypad, fingerprint sensor, computer, LCD, real-time clock, and GSM module.

Shelly Bansal et al. (2024) proposed a system that utilizes the ESP8266 Wi-Fi module to facilitate an Ethernet connection for Arduino. This module is capable of managing all Wi-Fi networking functions from other processors or hosting applications. Consequently, the ESP8266 Wi-Fi module enables the transmission and reception of data over Wi-Fi.

Marwa Adeeb Al Jawaherry (2018) developed an electronic voting system that allows voters to participate in the voting process using mobile devices through a specialized application.

Syed Mehmood Hasan and Arafa Mohd. et al. (2014) developed an electronic voting machine that integrates biometric fingerprint identification with near-field communication (NFC) ID cards. The proposed system verifies the voter's fingerprint against a pre-existing database, ensuring that the information on the voter's NFC ID card corresponds with their fingerprint. Once both pieces of information are validated and matched, the voter is authorized to cast their ballot. This method employs dual layers of identification and automates the process, thereby mitigating the risk of fraudulent entries.

Ada (2017) created a web-based Electronic Voting Machine (FPEVM) utilizing Ethernet networking technologies for local area networks.

PROPOSED SYSTEM

The proposed system for a smart electronic voting machine (EVM) utilizes Arduino and RFID technology to enhance the voting process's security, efficiency, and accessibility. In this system, each voter is issued a unique RFID card that contains their identification details, which are securely stored in a database. Upon arrival at the polling station, voters present their RFID cards to a reader connected to an Arduino microcontroller. The Arduino verifies the voter's identity by cross-referencing the RFID data with the database, ensuring that each voter is eligible and has not voted previously. Once verified, the voter is allowed to cast their vote using a user-friendly interface, such as a touchscreen or keypad, which records their choice electronically. The system also incorporates real-time data transmission to a central server for monitoring and results tallying, ensuring transparency and reducing the risk of tampering. Additionally, the use of Arduino allows for easy customization and scalability, making it a cost-effective solution for modernizing the electoral process while maintaining the integrity and confidentiality of each vote.

METHODOLOGY

Datasets:

Voter registration data is the core dataset. It needs to include voter ID, name, and any other relevant information for authentication. Candidate data containing information about each candidate, such as name. Voting records dataset would store the results of each election, including the number of votes for each candidate.

Tools and Technologies:

Arduino Uno: The microcontroller brain of the system. It'll handle RFID communication, data processing, and potentially even display results.

RFID Reader: An RFID reader module is essential for reading and writing data to RFID cards.

RFID Cards: Each voter would have a unique RFID card. The card stores their voter ID and potentially other information.

RFID Keychain: An RFID keychain acts as a voter's unique identifier, allowing them to authenticate with the voting machine.

I2C module: The I2C interface connects the Arduino to the RFID reader and buzzer.

Buzzer: The buzzer provides feedback, confirming voter authentication or indicating an error.

Software: You'll need software to program the Arduino Uno and manage the datasets. You can

use the Arduino IDE and potentially other libraries for RFID communication.

WORKING MODEL

Initialization: When the electronic voting machine is powered on using the battery the Arduino board initializes and starts running the voting software.

Voter Authentication: When a voter arrives, they present their RFID card to the reader.

Data Verification: The Arduino reads the voter ID from the RFID card and checks it against the voter registration dataset.

Voting: The voter selects their candidate using a simple interface (buttons). The Arduino records the vote.

Data Storage: The vote is stored in the voting records dataset.

Results: After voting is complete, the RFID keychain will be scan through RFID reader and then it calculates and display the results

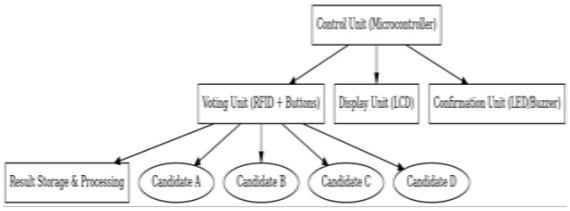


Fig.1 Block Diagram

Control unit acts as the brain of the system. It processes RFID authentication and voting operations and sends data to the display and confirmation units. Then voters authenticate themselves using RFID cards. After authentication, they select their preferred candidate using buttons. And then system registers and stores the vote. Then it displays system messages (e.g., "Scan your card", "Vote recorded", etc.). Buzzer sounds when a vote is successfully cast. The voting unit allows users to choose from multiple candidates. Then votes are recorded for each candidate accordingly.

HADWARE DISCRIPTION

Requirements:

1. Arduino Uno - It can be used to create wearable devices.
2. 16*2LCD - can be used to create simple user interfaces for devices like electronic gadgets.
3. RFID reader – RFID reader is used to scan RFID cards.
4. Connecting wires - for connection
5. RFID card - Enabling secure authentication
6. RFID keychain – It is used to act as voters' unique identifier.
7. I2C module – It enables the Arduino to control the RFID reader and buzzer.
8. Buzzer – It provides audible feedback.
9. Buttons – It used to cast the votes.

Arduino UNO: It is a microcontroller board based on the ATMEGA328. There are 14 digital I/O pins and 6 analog inputs. Arduino features a 16 MHz crystal oscillator, a USB interface, a power slot, and a reset button. It includes everything necessary to support the microcontroller; simply connect it to a computer via USB cable or power it with an AC-to-DC adapter or battery to get started.

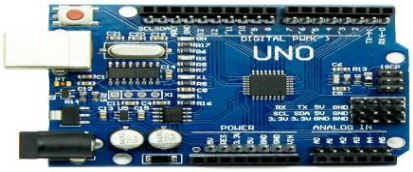


Fig.2. Arduino UNO

RFID Reader: The RFID-RC522 module is an RFID reader and writer that operates at a frequency of 13.56 MHz.. It communicates with microcontrollers Arduino. It can read data from and write data to RFID cards or keychains. Powered by 3.3V and has various pins for connection to an Arduino. The reader continuously emits radio waves at 13.56 MHz. When an RFID card or tag comes within range, it gets powered by these waves. The tag then transmits its UID (Unique ID) back to the reader. The reader sends this UID to the microcontroller for verification and processing

RFID Card: The RFID card contains a small microchip and an antenna embedded inside it. It does not have an internal power source (passive RFID card) but gets wireless power from the RFID reader when it is near. The chip inside the card holds a unique identification number (UID) or data. When brought close to an RFID reader, it transmits this data wirelessly.

RFID Keychain: Works the same way as an RFID card but is smaller and portable. It also contains a microchip and antenna. It has a unique ID number stored inside. Typically used in security systems, access control, and vehicle immobilizers.

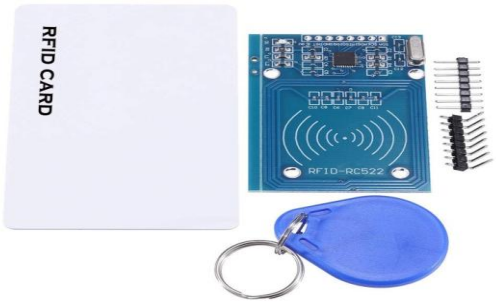


Fig.3. RFID reader, RFID card, RFID keychain

DESIGN AND IMPLEMENTATION

1. Voter Authentication:

Each voter is assigned an RFID card or keychain with a unique ID. When a voter taps their card/tag on the RFID reader, the system identifies the voter.

2. Verification Process:

The system checks the ID against a database of registered voters. If valid, it allows the voter to proceed; if not, it denies access.

3**. Voting Process:**

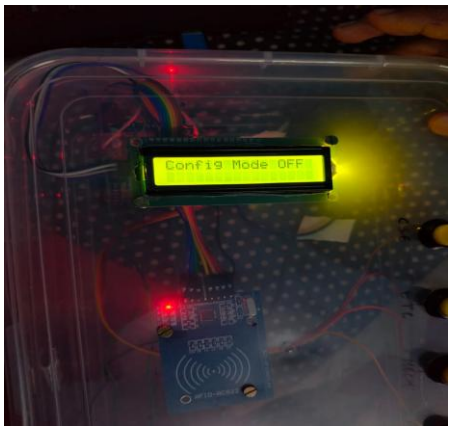
Once authenticated, the system enables the voter to cast their vote (using buttons). The vote is recorded securely in the microcontroller or sent to a database.

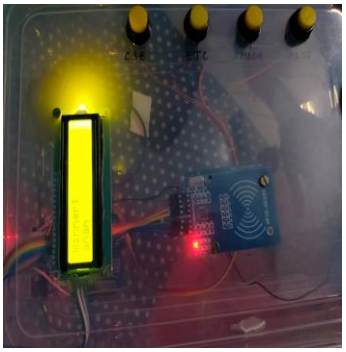
- Card Scanning

The voter places their RFID card near the RFID reader (RC522).

- Vote Registration

If the card matches, the system allows the voter to cast their vote using buttons or a touch interface.





RESULTS & DISCUSSIONS

The system reads an RFID card using the RC522 module. Each RFID card has a unique ID (UID), which is compared against pre-registered UIDs in the Arduino's memory. If the scanned RFID card matches a valid voter's ID in the system, the LCD screen displays a message, confirming that the vote has been successfully registered. The message in the document includes "Winner" and "Congrats!", suggesting that the voting process was completed successfully. The voting system recognizes the user's identity based on the RFID card. Upon validation, the system registers the vote, ensuring that only authorized individuals can participate in the election process. This prevents unauthorized voting and

helps maintain election integrity. The document further explains that the RC522 module reads the RFID tag and checks if the UID corresponds to a registered voter. If the UID matches, access is granted, and the "Congrats!" message is displayed, confirming a valid vote.

Discussion:
The RFID module (RC522) reads the card/tag. If the card's UID matches a registered voter, the system grants access. The "Congrats!" message indicates a valid vote. It provides a secure, fast, and automated method for conducting elections. While the system offers advantages in accuracy, security, and ease of use, it can be further improved by integrating biometrics, blockchain technology, and cloud storage for enhanced reliability and transparency

Fig.4. Smart Electronic Voting Machine

CONCLUSION
In conclusion, the research paper on the electronic voting machine utilizing Arduino and RFID showcases a promising advancement in the field of voting technology. The **Smart Electronic Voting Machine** using **Arduino UNO and RFID technology** is an efficient and secure way to conduct elections. By integrating an **RFID reader (RC522)** with **RFID cards or keychains**, the system ensures **unique voter authentication**, preventing unauthorized access and electoral fraud. The integration of Arduino technology offers a reliable and efficient voting system that enhances the accuracy and security of the voting process. Overall, this research highlights the potential for electronic voting machines with Arduino and RFID components to revolutionize the electoral process by providing a convenient, secure, and accessible voting solution for future elections.

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