Radio frequency identification based electronic voting machine using fingerprint module

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Abstract. Radio frequency identification (RFID) based electronic voting machine (EVM) with fingerprint module overcomes the challenges of wired electronic voting. Finger print module is to authenticate the voters. In this paper the system is constructed with microcontroller, Liquid Crystal Display (LCD), RS232 cable, RFID reader, RFID tag, fingerprint module and buzzer alarm. Dishonest voting will be avoided if the government uses the biometric based system. The details of all voters with their fingerprint will be stored in the database. Database is kept in microcontroller. Microcontroller verifies the voter by comparing the database during polling. If a person with RFID comes for second time voting, immediately the buzzer gives sound. The RFID base EVM will reduce time consumption. When compared to the existing voting system, the system in this paper is expected to be fast and reliable. The voters' details will not be revealed out. For every polling end, the button should be pressed for getting the number of votes polled.

1. Introduction

During polling the voter has to show his voter ID which was already issued, to the polling officer. Polling officer will have a list in hand and will check the voter ID of confirm. He has to permit the voter to poll. This process consumes more time. So a new voting machine is proposed to reduce time consumption.

RFID tag is compared with the database stored in microcontroller to check that the voter belongs to the same polling booth. At the same time the fingerprint module tells that the voter is original or not by comparing with the stored details. If the voter is original then the match is displayed in LCD to allow the voter to vote. If the fingerprint of the voter does not match with the stored information then LCD displays “ACCESS DENIED”. An alarm will ring so that the polling officer may remove the person from voting. Manual switches are used in the voting process. The existing systems require six volts battery only but the security is not assured.

Present voting systems are completely based on manual process. Before elections, different persons who are on election duty will come to home and they will hand over a voter id paper. During the time of elections, every individual should carry their voter ID card as shown in Figure 1 to the election booth and the duty officer will manually check individual person in their records. If both the data get matched then the person can vote otherwise he cannot vote.
In this paper the system combines biometrics technology and embedded system technology. Biometric sensor in the fingerprint module senses the fingerprint. There are several types of sensor such as optical, thermal and ultrasonic. The proposed system adopts optical technology. The voter has to keep his finger on the optical sensor before voting. The system is operating on two modes namely setting mode and normal mode. To store the fingerprint in database as well as to add the fingerprints the module is to be kept in “Settings mode or Admin mode”. In this mode the data is entered into the database of fingerprint module. For comparison of fingerprint with the database in flash memory the system is to be kept in “Normal mode or Search mode”. If the fingerprint is matched with the database then the module gives the signal with the person’s ID. If the fingerprint is not matched with the database then the module gives an error signal. Fingerprint module output is taken as an input by the microcontroller. Microcontroller activates the respective devices based on the input received. For fingerprint match, microcontroller activates a relay and motor. For fingerprint mismatch, microcontroller activates a buzzer.

Surendra Rao et al., 2019 [1] explained about a RFFID based smart voting system to reduce dishonest voting and manual switches. The system is easy to use with less cost. Voter identification is not a burden. The system included microcontroller, RFID, global system for mobile communications (GSM) technology to eliminate dishonest voting by ensuring security and transparency. Kiruthika et al., 2017 [2] developed a voting machine will eradicate defrauding of the manual voting systems. Abdulkadir et al., 2019 [3] explained their work with Arduino Mega which was interfaced with GSM and personal computer. Sudhakar et al., 2015 [4] used ARM9 microcontroller for developing their low cost and simple EVM with fingerprint module. An electronic voting machine is stored with voters’ details. The processing after voting is done digitally. Prasad et al., 2016 [5] included a liquid crystal display with Arduino board. They used internet to link the authentication to Indian citizen database. Every citizen has got an identification number. Venkateswarlu et al., 2014 [6] developed their system with fingerprint module with GSM. Kumar et al., 2016 [7] linked the authentication to Indian citizen database using zigbee. Prabha et al., 2016 [8] developed a system with microcontroller activating the fingerprint module. Database is stored in personal computer. In [9] and [10] the authors explained about GSM. In [11] the authors explained the fingerprint authentication. In [12] the sensor networks are explained by the authors. In [13] GSM technology is explained for security purpose.

In the proposed work four voters are considered for database. In practical the number of voters is high. So for data storage, database management system is adopted. An external memory is necessary to save the huge data.

EVM must be in power on mode till the end of the election process. Microcontroller uses the volatile memory. So the temporary data will be lost. The total number of votes will be taken but the details such as who voted and who has not voted will be lost if power fails.
2. Methodology

Figure 2 shows the block diagram of RFID based EVM system using fingerprint module.

![Figure 2. Block diagram](image)

Figure 3 explains the interfacing of microcontroller with each block.

![Figure 3. Schematic block diagram of RFID based EVM using fingerprint](image)

Figure 3 is the schematic diagram of RFID based EVM using fingerprint module explains the interfacing section of each component with microcontroller, RFID module and fingerprint module. Fingerprint module, LCD, buzzer and buttons are connected to digital pins from (D0-D13) and RFID module, regulated power supply are also connected to digital pins.

The design includes the microcontroller, RS232 cable, LCD, fingerprint module, RFID reader, RFID tag and buzzer alarm.

Atmega328 microcontroller is used in this work. Microcontroller is interfaced with the fingerprint module by RS232 cable. LCD (16X2) displays the voter ID. Fingerprint module scans the finger of the voter. RFID consists of a semiconductor (micro-chip) in a tag. The tag transmits the stored data when the radio waves of the correct frequency impinge on it. The radio waves are sent by the RFID reader.
The tags output is received by the RFID reader. A buzzer, electromechanical, is a sound signaling device.

ARA-EM01 is the fingerprint module. When ARA-EM01 is embedded into the system, the other functions will be controlled by MCU Controller. Interfacing of fingerprint section is given in Figure 4.

Figure 4. Interfacing of fingerprint block

3. Results and Discussion

A person needs to enroll the fingerprints. After enrolling, he needs to verify the fingerprints and RFID tag at the same time. If both the data match, “Poll Ur Vote” will be displayed on the LCD. After voting using buttons, “Ur vote for P1/P2” will be displayed. If the same person tries to vote for second time “2nd time vote No” will be displayed. If another person uses the same card then “Unmatch” is shown. The total number of votes polled can be viewed by pressing the total button at the end of process and it will be displayed on LCD. Figure 5 shows the enrolment of finger print.

Figure 5. Enrolling fingerprint
Figure 6 shows the verification of the fingerprint with RFID card.

Figure 6. Verification of the fingerprint with RFID card

Figure 7 shows the vote polling.

Figure 7. Polling vote
Figure 8 shows the display of the polling status.

![Image](image1.png)

**Figure 8.** After polling vote

Figure 9 alarms the second vote of a person.

![Image](image2.png)

**Figure 9.** If same person tries to vote for second time
Figure 10 shows the unidentified person.

![Figure 10. If another person uses same card](image)

Figure 10. If another person uses same card

Figure 11 shows the total number of votes.

![Figure 11. Total number of votes](image)

Figure 11. Total number of votes
4. Conclusion
Radio frequency identification (RFID) based electronic voting machine (EVM) with fingerprint module overcomes the challenges of wired electronic voting. Finger print module is to authenticate the voters. In this paper the system is constructed with microcontroller, Liquid Crystal Display (LCD), RS232 cable, RFID reader, RFID tag, fingerprint module and buzzer alarm. Dishonest voting will be avoided if the government uses the biometric based system. The details of all voters with their fingerprint will be stored in the database. Database is kept in microcontroller. Microcontroller verifies the voter by comparing the database during polling. If a person with RFID comes for second time voting, immediately the buzzer gives sound. The RFID base EVM will reduce time consumption. When compared to the existing voting system, the system in this paper is expected to be fast and reliable. The voters’ details will not be revealed out. For every polling end, the button should be pressed for getting the number of votes polled.

5. Future scope
The voting machine may be integrated with face recognition system also by replacing the fingerprint block. All voter details can be stored in server rather than in EVM. So the voter can poll his vote anywhere.

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