Electronic Voting Machine (EVM) Using Infrared Detection Technique on Arduino Platform

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Abstract. The voting system is a set of rules that determine how people's intentions may be manifest and how decisions can be achieved. Normally, vote papers are placed in the voting box and then will be sorted and calculated manually. But the problem is the use of manpower in calculating the vote manually may lead to error in the counting of votes and it takes a long time to complete the calculation process. For this purpose, an electronic voting machine (EVM) was introduced, where in this work it replace the conventional voting method in which the vote card will be calculated automatically. This paper focusing on implementation of embedded system which will help in the election process, where the Arduino UNO uses as a controller. This system uses a simple counting system based on the detection of black mark on the vote card using infrared (IR) sensor. Then, LCD 16x2 will display the number of votes for the respective candidate and the servo motor will activate to sort the valid and invalid vote card into 2 compartments in the voting box.

1. Introduction

There has been widespread concern about the trust issues on counting the amount of vote card during on the election because it is counted manually. Although the discussion of this problems have taken place in Malaysia, the deployment can go a long way in solving the problems of electoral process while others think only by reducing the level of corruption in the electoral systems can reduce the rigging and other serious problems.

Traditional voting process can be divided into three different phases. The first phase is authentication phase. In this phase, voter authenticates himself or herself by showing his or her voting card, this step is public and verified by the presiding officer. At the end of authentication process, presiding officer give a vote paper to voter to cast his or her vote. Second phase is voting phase. Voters do their candidate selection in a protected booth by writing it with pen on the vote paper. Then the vote paper will be folded and inserted into the voting box. All valid and invalid votes are mixed up in the box. The final phase is vote counting phase. At the end of voting time, the presiding officer collect the voting box containing all vote papers and submit it to the counting center. The voting boxes are opened and votes are counted and the results are then announced.

There have been several studies on methods used to improve elections. There are many ways to track the votes cast by voters. One of it used a set of switches to represent the candidates. The voters select the candidate by pressing the keypad 3x4 provided by the election committee [1]-[3]. Thumb impression
for each person has different pattern. A few researches have been done about the fingerprint detection in election process. To maximize the effectiveness and accuracy, the fingerprint is used for voter’s identification to avoid fake and repeated voting [4-8].

Although many voting prototypes have been developed, however no prototype has been established for the purpose of separating the invalid votes. This paper presents the development of electronic voting machine which used Arduino UNO as the controller. The IR sensors were used to detect the candidate that has been selected by the voters. The counted votes were displayed by using 16x2 LCD display. This EVM also provide sorting features between valid and invalid votes.

2. Research Method
The development of an Electronic Voting Machine (EVM) consists of two parts which is hardware and software implementation. Figure 1 shows the EVM block diagram for this project. There are 3 infrared (IR) sensors used in vote card’s detection. An additional pushbutton is used to send the signal to LCD to display the name of the candidate who received the most votes at the end of the election process, thus becoming the winner in the election. Every time the IR activated, the counter accumulates value for the respective candidate will be increased. The value will display using 16x2 LCD display. Servo motor is used for sorting the vote card into two compartments provided which is valid and invalid vote card storage. All input and output devices controlled by Arduino UNO controller. The 3 IR sensors have been used to represent the three election candidates. Counting the number of votes for each candidate and sorting the votes paper are the two main scopes in designing the project algorithm. The invalid votes stored in box 1, while the valid votes stored in box 2.

2.1. Process Flowchart
Figure 2 and figure 3 shows process flowchart for 2 situations that can occur in the voting process. Condition A activated when more than 1 sensor is active at the same time and Condition B activated when only one sensor is active. If voters make an invalid vote which mean they tick more than 1 candidate, condition A will be triggered. The invalid cards will goes to box 1 when the motor rotates 45 degrees angle in clockwise direction. Meanwhile, for valid vote, condition B is triggered. The counting increases on that particular candidate selected and LCD will display the current votes. The vote card then will be stored into box 2 when the motor triggered and rotates in the other direction with 45° angle. The sorting process is depends on the servo motor rotation. The motor will rotate 45° clockwise for invalid vote storage and 45° anticlockwise for valid votes storage.

Figure 1. EVM block diagram.
Figure 2. Condition A - Activates more than one IR sensor.

Figure 3. Condition B - Activates only one IR sensor.
2.2. IR Detection Technique

The working principle for IR sensors by using a specific light sensor to detect a selected light wavelength in the Infra-Red (IR) spectrum. When an object is close to the sensor, the light from the LED will be reflected back into the light sensor. This type of sensor can then be used to measure how "bright" the object is. Figure 4 shows the white surface will reflect more IR light rather than a darker surface. During the election process, all voters will be provided with a black marker or black sticker to choose their candidates by putting a mark on their selected candidate on the vote card. For this project, the IR will activate when it detects the low intensity which coming from a darker surface, and deactivates at high intensity. The vote card then will be inserted in EVM slot card for detection process. Figure 5 shows the vote card is marked by the voters where candidate A has been selected.

3. Result and discussion

Input circuit consist of three IR sensors. The signal coming from IR sensor will transfer to the Arduino UNO for execution process. The IR sensor which in analog signal will then convert to digital signal by comparator IC LM324 and then connected to the digital pin at Arduino UNO.

3.1. Simulation

Figure 6 shows the sensor was activated and increased counter value by 1 for the first candidate. Servo motor will rotate 45° anticlockwise for vote card sorting process. LCD display the count votes for candidate no 1 (ZAM) and the other two candidate, PISS and NIK shows 0 votes respectively. Figure 7 shows the simulation when it uses two IR circuits to represent the two candidates. When 2 dark surfaces were detected on the vote card, the servo motor rotates 45° angle in clockwise direction. It means that there was invalid vote was detected. The output LCD does not display the invalid vote and only valid votes will be counted and display on the LCD.
3.2. Prototype Setup
The prototype as in figure 8 shows two boxes were placed to sort the vote card. Box 1 is for the vote card that has more than one mark (invalid vote). Box 2 is for vote card that have only one mark (valid vote). The result button and LCD display were mounted on the side of the prototype. The servo motor is located precisely under the slot card which acts as the card holder. IR sensors were positioned side by side toward the slot card. Each time a vote card inserted into the slot card, the metal pedal holds the card from falling into the box. After the IR activated, the servo motor rotates accordingly. Then, the card falls into the storage boxes.

4. Conclusion
In conclusion, this developed method can facilitate the election process in which the system can separate valid and invalid votes and also can calculate the number of votes at the same time. This prototype is functioning according to the scope of the design. It is suggested that for future development, the machine can be embedded with an identification process for each voter before the voting process starts. It can track the number of voters who have voted in the respective locations. This developed system would minimize the electoral staff and saves the time.

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