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Electronic Voting Machine with Enhanced Security

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***Abstract*—Electronic Voting Machine (EVM) retains all the characteristics of voting by ballot papers, while making polling a lot more expedient. Considerable amount of time, man power and money is saved as it is extremely fast and reliable. Voting secrecy is also maintained without use of ballot paper. VVPAT that is currently used for voting machine is much more expensive than EVM to be created. The EVM is 100 per cent tamper proof. Results are available in the end just a click away. But these EVM can be tampered with by changing the hardware connections. Hence a printed acknowledgement is provided to the voter thus assuring him that vote has been casted to candidate voter wanted. Here, we describe the design, construction and operation of this voting machine using ATMEGA 32 microcontroller which has enhanced three layered extra security.**

***Keywords*—** voting, security, VVPAT, printed acknowledgement, confirmation

I. Introduction

Whenever we go to vote for elections we come to see electronic voting machines. [1][2] Voter Verifiable Paper Audit Trail system (VVPAT) was introduced in 2013 to provide even greater transparency to the poll process. The VVPAT is an additional unit attached to the EVM, which prints a small slip of paper that carries the symbol, name and serial number of the candidate voted by Voter, which is visible for limited time in a window. Here we are going to design and develop a simple voting machine by using ATmega32 microcontroller. To keep things simple and create a machine for 4 candidates which can be up to 32 candidates. We will have four buttons for four people and whenever a button is pressed, the buzzer and light ensures the button pressed. Then a vote goes for the corresponding person and the number of votes each person gets shown on LCD. Further the button pressed also triggers the printer to print an acknowledgement. Every button pressed has a different printed acknowledgement. The electronic voting machine plays an important role in deciding outcome of election; hence it should be upgraded with critical attention. However, a number of recent studies have shown that most of the electronic voting systems being used today are fatally defective. [3][4] An electronic voting machine has been designed by a microcontroller for which the code is written in assembly language. [5] Various code protection schemes specified by the manufacturer of the microcontroller are used to prevent inadvertent or deliberate reading and reproduction of the code contained in the microcontroller.

This paper presents some of the key development activities of the e-voting machine, which we believe to be of general interest and applicability to other contexts and domains. As voter votes for a certain candidate, he is asked for a confirmation of the vote once again as the voter should answer the confirmation of yes or no. On verifying the vote the count of the candidate's vote increases and the printed acknowledgement for the same is provided to the voter which creates extra security on the votes cast by the voter. The machine along with its security is also meant to fulfill the primary purpose to remove the manual counting of votes.

II. Hardware Development for Electronic Voting Machine with Printed Acknowledgement

System is designed [6] using basic controller as Atmega 32 as shown in Fig. Although we can create up to 32 votes using all the ports we decided to get 4 votes for simplicity. We divide the circuit into 6 major parts:

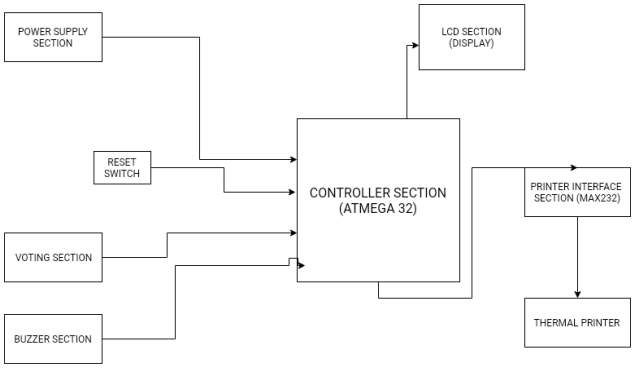

Fig. 1. Block Diagram for System

A. LCD Section:

LCD is connected to data port C of the controller. The JTAG communication in PORTC is disabled here. Total 16 ports are connected to LCD. If the backlight is not needed then 14 ports are required. [7] In 14 pins – 8 data pins, 2 pins for Vcc(+5v) ,

1 pin for Gnd(0v) and there are 3 control pins(RS, RW and E).The confirmation process for the vote will also be displayed on the LCD screen.

B. Voting Section:

Five buttons present here are to increment votes of 4 candidates and one to reset all the votes i.e. make them zero. The capacitors present here is for nullifying the bouncing effect of buttons.[8] If they are removed the controller might count more than one each time the button is pressed. The resistors limit current flowing through buttons when it is connected to some voltage. Button pressed joins the one end of button to ground, which is recognized by controller, which can decipher 1 and 0 i.e. Vcc and ground.

C. Printing Interface Section:

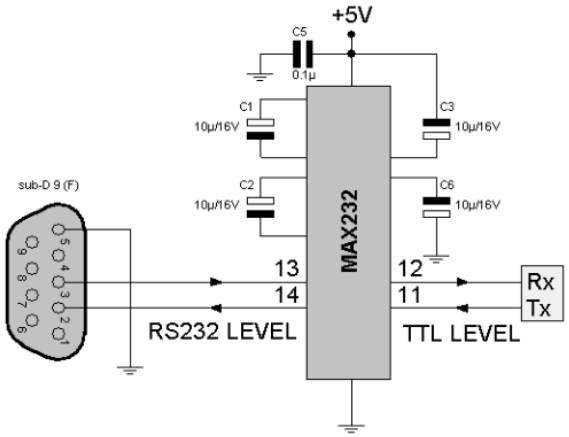

Fig. 2. MAX232 Connections

The further connection is connected using MAX232 IC. [9] The RXD (pin 14) and TXD (pin 15) of the ATMEGA 32 are connected to TX (pin 9) and RX (pin 10) of MAX232 respectively. The MAX232 is used to further connect to a DB9 switch to which the printer is connected as shown if Fig 2. Printing process which is digital and printed image is produced by heating thermo chronic paper or thermal paper selectively is known as Thermal or Direct printing. Using thermal printer will ensure no use of ink thus making an attempt towards a greener environment. During this type of printing, the paper passes over the thermal print head. Where the paper is heated, the coating turns black and everything else remains white, creating a digitally printed direct image.

D. Buzzer Section:

A buzzer or beeper is a signaling device which uses audio as its indicator. It can be mechanical, electromechanical or piezoelectric. Typical uses of buzzers and beepers include alarm devices. [8] These devices are output transducers converting electrical energy. This mechanical device will get energized as power is applied and will move from its place to interrupt power connection and comes back to get energized again. This cycle continues till power supply is removed. Sound produced is the same irrespective of magnitude of voltage applied. It consists of piezo crystals between two conductors. Potential applied across these crystals lead to a pull and push action which creates a sound as indicator. Vote casted is acknowledged by buzzer.

E. Power Supply Section:

This electronic circuit requires a fixed constant +5 V supply as an integral part of circuit, hence we use voltage regulator to provide this. Here we use 7805 Voltage regulator for which output is fixed +5v dc volt. [10] A voltage regulator generates a fixed output voltage of a preset magnitude that remains constant in spite of changes in its input voltage or load. Supply from this circuit is provided to entire circuit to provide constant 5v supply. The bridge circuit first converts the ac voltage to rectified positive voltage. This rectified voltage is further passed through 7805 to create 5v constant dc.

F. Controller Section:

A control unit in general is a central part of the machinery that controls its operation, provided that a piece of machinery is complex and organized enough to contain any such unit. One domain in which the term is used specifically is the area of computer design. [7] In this work Microcontroller ATMEGA32 is used as the controller unit which controls the sensed signal. This controller section in an integrated circuit contains all components like RAM, ROM, CPU, I/O ports and timers.

III. Software Development for Electronic Voting Machine

The program created for the process is to be converted into hex file to burn the program on IC. Software Atmel Studio 6.1 is used to edit and create hex file for the program. Software ProgISP is used to burn the IC through USB-ASP. Atmel Studio is integrated software developed by Atmel. It is considered most effective and used mostly for AVR and ARM development.

IV. Flowchart for Process of Electronic Voting Machine

As and when power supply is provided to the EVM, it asks the User to cast his vote through a message displayed on the LCD. After the vote is casted by pressing the button of his desired candidate, the internal software of the system detects which candidate the vote was casted for.

In a normal EVM this process would have terminated with the corresponding counter of the candidate being incremented after casting of the vote; which is prone to tampering of hardware, hacking of software or poll rigging as the person doesn't have any acknowledgement or proof of his/her vote being casted to the candidate he/she desired.

But unlike a normal EVM, the controller of this EVM is programmed in such a manner that the system reconfirms the vote of the voter (i.e. the party he/she voted for). If the voter finds a mismatch in the casted vote and the desired vote he /she can deny it to revote again and the undesired vote doesn't get counted. If the desired vote and the casted vote match then the controller increments the counter of the corresponding candidate and the data of vote is sent to the printer by the controller through MAX232 circuitry. This process of reconfirmation increases the efficiency and security trait of the EVM and the voter is more assured regarding his/her vote. The data in the controller is in TTL format which is incompatible with the Thermal Printer.

Thermal Printer uses serial communication standard of RS232 format. To eliminate this compatibility issue MAX232 circuitry is used which converts TTL data into RS232 form making it compatible with the printer.

A Thermal Printer is interfaced with the controller through a port of the controller and the controller has been programmed to send the detailed data of the casted vote to the printer serially.

The data of the casted vote received by the printer from the controller is then used by the printer to print the acknowledgement on a paper for the voter giving him/her a proper confirmation of his/her vote with a proof. Since this is a thermally printed acknowledgement the

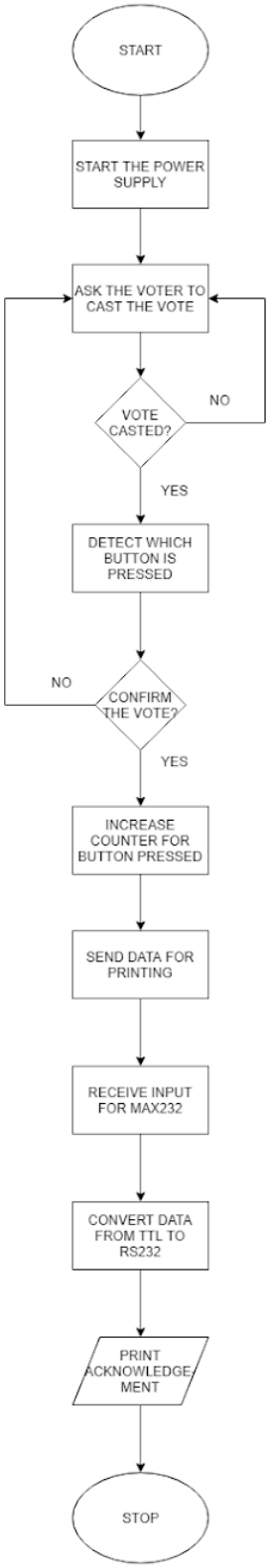

Fig. 3. Flowchart for System

voter can anytime erase the printed information or dispose the paper in case of any security threat to the voter.

Our software architecture improves upon many features of the old EVM, strengthens the security and decorum of the whole democratic voting process along with providing a sense of contentment and assurance to the voter thus managing to keep his/her faith in the democratic system intact.

V. Conclusion and Future Scope

We can conclude here that we devised a testing methodology, developed new tools that are specifically tailored to the security analysis of these systems, and learned a number of lessons, all of which should be of use to another user In the system that we analyzed and developed we found that we can overcome many of the security vulnerabilities that could compromise the availability and integrity of the voting process.

We don't effect drastic change in the system just a few improvements which can ensure that voting process goes on with all its trueness. Due to our modifications, we can notice that, the confirmation for the vote gives the voter another chance to vote in case he has gone wrong or in case of malfunctions which can be intentional or unintentional. The printed acknowledgement furthers this confirmation and we can make sure we take greater care of a voters mind and satisfaction so that he does not hesitate to vote next time due to skepticism. Further encrypting the program will get extra protection and surety that a process like voting ought to have.

If the current process becomes a success, there is a lot of scope in development of system. The best way forward has to be inclusion of Biometric identifiers which will be matched with the records available on a secure server. This will also disintegrate the possibility of fake identity and make the system immensely secure.

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