



Design and Construction of an Electronic Voting System

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ABSTRACT

The amount of money spent on the production of ballot papers and other electoral materials has increased exponentially over the years. Large democracies such as Nigeria's require more balloting materials running into billions of dollars for a national election. These materials which are neither transferable nor re-useable are valid for just a session of election; thus, whatever is left after an election cannot be re-used. This means that after every election, a similar or higher budget than the preceding one is required for the next election. This results in a colossal waste of revenue. An electronic voting system eliminates the use of ballot papers and other electoral materials, gives an accurate result, and generally eliminates electoral fraud which has characterized elections in most Sub-Sahara African countries over the years. The system is re-useable as it can also be reset to conduct the fresh election as the needs arise. This paper, the design and construction of an electronic voting system, presents a simple electronic voting system. It is made up of both hardware, and software sections. While the hardware section consists of a microcontroller.

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INTRODUCTION

Voting is an important process usually employed to reveal the opinion of a group on an election. It is also a method for a group such as a meeting or an electorate to make a decision or express an opinion, usually following discussions, and debate or election campaigns. The fact that greater efficiency, better scalability, speed, lower cost, easy accessibility, and convenience, can be delivered by electronic devices, has made it imperative for voting to shift from manual process to electronic and automated process. For a democratic country, public opinion is the most important determinant to establish a government, thus voting is the process through which people display their opinion and help to set up a democratic government.

Currently, in Nigeria and most countries in the world especially in Africa, a paper-based voting system is still in use.

The paper-based voting system is fraught with the following drawbacks to mention but a few, unnecessary waste of time, huge financial expenses are borne by the government, sometimes people ruin their votes by thumb printing on two or more signs mistakenly thereby invalidating their vote, since votes are manually counted, results may be inaccurate because results are moved from polling unit to collation centres for collation, incidences of election rigging (electoral fraud) are rife with the paper-based voting system. All the aforementioned problems made it imperative for a new system that will reduce electoral fraud, increase accuracy and eliminate time wastage to be devised. Thus, the concept of an electronic voting system has been designed and proposed. Electronic voting means the use of some electronic means in voting to ensure

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security, reliability, guarantee and transparency (Balzarotti, et al, 2010). In (Qadah and Taha, 2007) design and implementation requirements were presented while (Kumar and Begum, 2011) presented a fingerprint-based system. (Arthur et al, 2005) presented A_PC-Based Open-Source Voting Machine with an Accessible Voter-Verifiable Paper Ballot which they called the (OVC) where the design applies Computer technology to the traditional system. However, unlike some of the other computerized voting systems that change the basic nature of the traditional system, the OVC design applies computer technology only in a limited and conservative way. (Everett et al, 2008) compared the electronic voting machine and the traditional method, relying on the result of their experiments on direct-recording electronic (DREs) systems and the traditional method, they concluded that the use of DREs does not lead to more efficient or effective voting performance but voters are very satisfied with these electronic systems. (McClure and Lohry, 2001; Everett, 2006) invented an electronic voting system to manage electoral processes. Although these designs are quite efficient, the intensity involved and complexity of the overall system is an issue which our design answers, the simplicity of our design is the main novelty we present.

MATERIALS AND METHOD

The parts or elements of any design should be made of materials that have properties that are most suitable for the condition of operation. The best materials are those that serve the desired

objectives at minimum cost. In selecting this material, the following three factors were put into consideration, (1) The cost of the material (2) the availability of the material (3) the suitability of the material for the working conditions in service. Based on the above factors, the materials/components used for the various units of this design are discrete components such as diodes, capacitors, resistors, voltage regulator, bridge rectifier, microcontroller, switches, LED and liquid crystal display (LCD).

The design and analysis of the various units that make up the digital counting system are discussed in this session. Design calculations, software development, hardware design and assembly language were all thoroughly analysed. The system consists of a hardware section and a software section (an application program for microcontroller unit developed in C program language). The hardware section comprises the input, the display interface, the microcontroller and the power supply unit.

The control action is performed by the microcontroller. It processes the signal that is inputted from the voters. The code for the person or party to be voted is stored in selected general-purpose registers in the microcontroller. The microcontroller reads the number of votes of each candidate, and compares with the number of votes received by each candidate and display the winner of the contest on the display interface. The output interface of the microcontroller is connected via an LCD. The block diagram for the design is shown in figure 1.0 below.

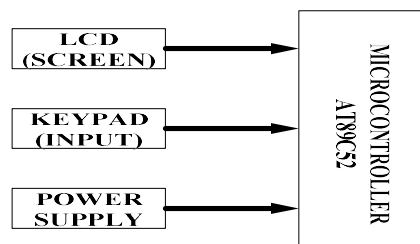


Figure 1: Block diagram of a microcontroller-based electronic voting system

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Hardware Design

The hardware section comprises the input, the display interface, the microcontroller and the power supply unit. The various units that make up the hardware section are discussed as follows:

Display

The display unit used is a 16x2 Liquid Crystal Display (LCD). It is an

electronic display module and it is used in this work to display the number of votes received by each candidate in any contest. The LCD has two registers, namely command and data; while the command register stores the command instructions given to the LCD, the data register stores the data to be displayed to the LCD.

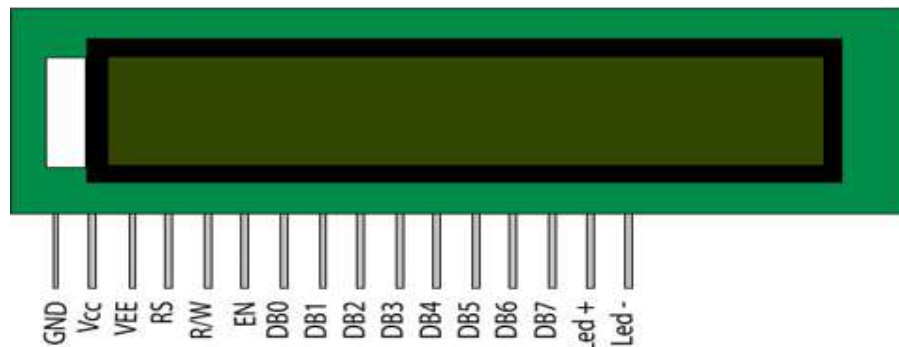


Figure 2: LCD Pin diagram. (Source: Engineer Garage)

Keypad Section

The keypad is an input device designed to issue an instruction to the microcontroller. It consists of a start button, 4 candidate vote buttons and a stop button. Each key upon being pressed transmit its instruction to the CPU of the microcontroller. The keypad is found at the output port of the microcontroller. The interface is at port 1 bit 0, 1,2,3,4 and pins 9 as the reset.

Microcontroller AT89C52

The AT89C52 is a low-power, high-performance CMOS 8-bit microcomputer with 8K bytes of Flash programmable and erasable read-only memory (PEROM). The device which was manufactured using Atmel's high-density non-volatile memory technology and is compatible with the industry-standard 80C51 and 80C52 instruction set of 255 operation codes (opcodes), 32 input/output line (that is port

1, port 2, port 3, and port 4), three user-controllable timers, an integrated and automatic serial port, and 256 bytes of chip RAM. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C52 is a powerful microcomputer that provides a highly flexible and cost-effective solution to many embedded control applications. The AT89C52 was designed such that control of the microcontroller and all input/output device is accomplished via Special Function Registers (SFR). Writing a value of 1 to a bit of these SFR will send a high signal on the corresponding input/output pin whereas a value of 0 will bring it to a low level. The AT89C52 microcontroller structure is shown in Figure 4.0 below.

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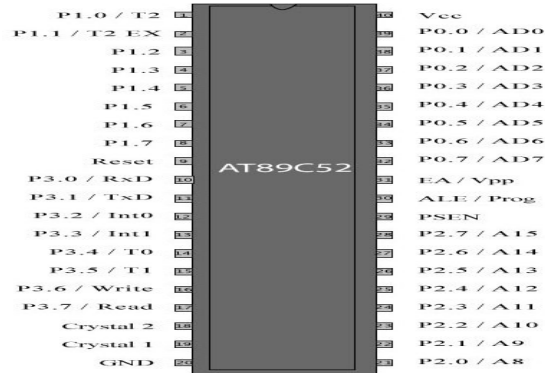


Figure 3: AT89C52 pin diagram (Source: Engineers Garage)

Selection of the pull-down resistor (R_{RESET})

This capacitor and resistors are connected such that when the button is depressed, a high comes to pin 9 of the microcontroller and when the button is released, the capacitor discharges through the resistor (R_{RESET}). According to the data sheet specification of the AT89C52 microcontroller, the capacitor value of the reset pin must be $10\mu\text{f}$, thus, the resistor value (R_{RESET}) must be determined. This can be done using the formula below:

$$V_c = V e^{-t/Rc} \quad (2)$$

But $V_c = 4.5\text{v}$

$$V = 5\text{v}$$

$$t = 10\text{ms}$$

$$C = 10\mu\text{f}$$

The above values were gotten

from data book

$$V_c = V e^{-t/R_{RESET}}$$

$$e^{-t/R_{RESET}} = V_c/v$$

$$-t/C R_{RESET} = \ln(V_c/v)$$

$$(-10 \times 0.001)/(10 \times 0.000001 \times R_{RESET})$$

$$= \ln(4.5/5)$$

$$-1000/R_{RESET} = \ln 0.9$$

$$-1000 = -0.1054 R_{RESET}$$

$$R_{RESET} = -1000/-0.1054$$

$$R_{RESET} = 948.7 = 1000$$

$$R_{RESET} = 1\text{K}$$

Therefore for this design 1K will be used since it is readily available in the local electronic market.

Power Supply Unit

The power supply unit provides the DC voltage needed by the adjoining

electronic circuits for operation. This design is powered by a 9v battery which is regulated with a 7805 voltage regulator to 5v to power the microcontroller and LCD.

Software Design

The software system is a term used to describe a program that was provided by the manufacturer to aid the development of user (application) programs. This included program that converts the assembly language into machine codes (assembly) or high-level language into machine code (compiler). It also includes programs that facilities program modification (Kelsey, 2005; Jones, 2001).

Development Process

In writing the software for this work, a modular approach was employed. The three major tools used in the development process are the A51 assembler (used to translate from the source code into the object code). The L51 (employed to link the program), and the OHS 51 (carried out the conversation from binary to hexadecimal). The choice assembly language was chosen because it makes a program small and enhances faster execution. A text editor was used to enter the source code into the microcontroller.

Software Development flowchart

The software development flowchart used to analyse, design and

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manage the process and program of this work is shown in figure 4, below.

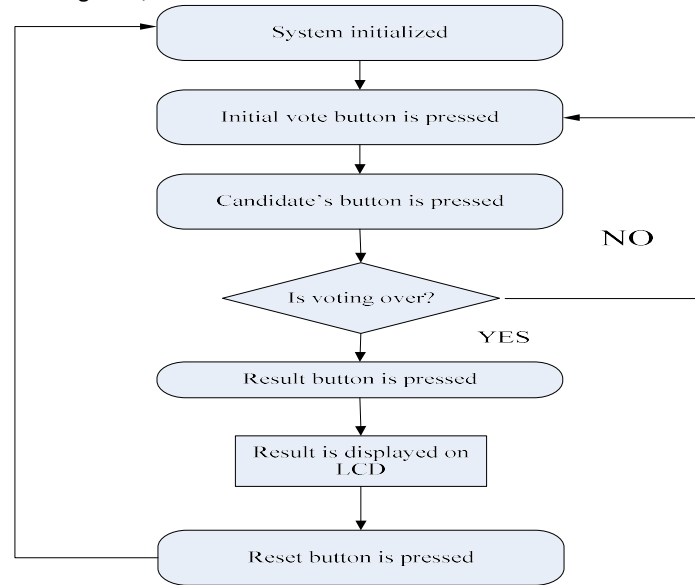


Figure 4. Flow chart

Assembly and Test

This design was done according to the block diagram shown in figure 1. Every unit was arranged on the Vero board and soldered, other connections were finished using jumper wires. After the soldering process, using a multi-meter, tests were carried out to ensure that all the components are properly connected. The tests carried out on the designed system were done to confirm the level of its performance and efficiency in conformity with design specifications.

All the test carried out confirmed that the designed system worked according to design objectives.

RESULT AND DISCUSSION

The electronic voting machine is designed for four candidates. The input part consists of a set of six switches, the switches and 16*2 LCD are interfaced to microcontroller AT89C52 for various operations and displays.

The four switches through which the candidates are voted for are made active high and connected to pins 2-5 of

the microcontroller. The remaining two switches (both active low) are to start and show the results of the voting procedure. They are connected to pins 1 and 6 respectively. The start switch initializes the voting system when pressed, the result switch ends the voting and display the poll results On the LCD screen.

The data pin of the LCD (PINS 7-14) is connected to the output port P2 of the microcontroller. The control pins (RS, R/W and EN) are connected to port P3 pins P3.0, P3.1 and P3.6 respectively.

The voting is started by pressing the INT1 switch after which the user is prompted to vote. The count of votes is stored in four different variables. As soon as the user votes for a candidate by pressing one of the switches, the value of the corresponding variable is increased by one. After this, a thank you message is displayed on LCD acknowledging the registration of the user's vote.

The message stays on the screen until the next user either presses the start button to cast another vote or the stop switch is pressed to get the poll results.

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When the stop button is pressed, the names of the candidates are displayed along with their vote counts. After some delay, the result is displayed which could be either declaration of the winner or the candidates with a tie in their number of votes.

CONCLUSION

This paper presents the design and construction of an electronic voting system that displays the count of votes on an LCD interface. This work was done to introduce a new voting system that has fewer complexities, accurate, transparent and fast. It will also eliminate the incidences of electoral frauds as only votes by persons that physically voted are accepted by the system. Furthermore, the number of votes garnered by each candidate in the election conducted by using the designed system are immediately displayed; thereafter, either a winner or a tie in case more than one candidate garnered the same number of votes based on the result is displayed. The system which is simple and very easy to implement will not only make elections faster, accurate and fraud-proof, it will also save huge revenue for the government if adopted.

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