DESIGN AND CONSTRUCTION OF ELECTRONIC VOTING MACHINE WITH DIGITAL DISPLAY

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DEDICATION

This work is dedicated to the Almighty God for protecting me and helping me throughout my stay in this school and to my first love, my mother, Mrs. Saka Erdoo.

DECLARATION

I, Saka Bemdoo, declare that this work was done by me and has never been presented elsewhere for the award of degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna.

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ABSTRACT

The essence of this project is to solve the problem of voting 'for' or 'against' a motion under consideration for a typical or national assembly.

The design and construction of an electronic voting machine with digital display will solve the problem of time being wasted during voting process in the house, eliminate errors due to counting of votes since votes wil be displaayed digitally and reduce electoral vices that takes place within the house.

As a prototype, the project was designed for two senators and the senate president. The senate president votes only if there is a tie in the number of votes cast. Each senator will have a button pad that contains a YES and a NO switch. The senate president too has a button pad that contains a YES and NO switch, Permission/ Result button and Reset button. The two senators can only vote if given permission by the senate president and they can vote only once. This is possible because of the microcontroller (AT89C52) that was used in the project.

Logically since the project worked for two senators, it can be concluded that it will work for as many senators as possible. The aim of the project is has been achieved; using an electronic voting system to introduce automation into the voting process in the national assembly.

TABLE OF CONTENTS

CHAPTER FIVE

LIST OF FIGURES

LIST OF TABLE

CHAPTER ONE

1.0 INTRODUCTION

Democracy is a form of government in which the people have a say in who should hold power. That is, the essence of democracy is that everyone is treated fairly and equally and everyone has a right to take part in decision making.

At the national assembly where crucial issues are deliberated upon often, they end up in deadlock which results in disagreement. Voting is the usual way of sampling the Reps opinion on the motion under consideration. The manner in which voting "for" or "against" is being done especially in this country is not encouraging. To decide who carries the day, those "for" will move to one end of the building and those "against" to the other end conversely, those "for" will raise up their hands to be counted, then those "against" will also put up their hands to be counted. The group with the highest number of people carries the day. However, going through these processes, I observed two things:

(i) The voting in most cases is not a fair one because people voted dependently (godfather) i.e. to please others

(ii) Time wasting

To avoid these, this project is aimed to design and construct a voting machine or system. With this system, distinguished Senators and members of the House of Representatives can vote electronically and independently within the shortest possible time.

1.1 Voting

According to the south edition of the oxford advanced learners dictionary, voting is defined as the action of choosing somebody or something in an election or at a meeting.

In most nations, political party leaders select candidates for office in a general election. Few nations hold primary elections prior to the general election campaign. In these elections, voters select the party's candidates for office. Progressive Era reformers introduced the primary at the beginning of the 20th century as another way to weaken the influence of political party machines in general elections. The primary is followed by the general election, which normally is the decisive electoral contest.

1.2 Electronic Voting System

The electronic voting system is a system that can be used to simultaneously provide the number of "yes" and the number of "no" votes. For example, this type of system can be used where a group of people are assembled and there is a need for immediately determining opinions (for or against) making decisions, or voting on certain issues or on other matters.

In its simplest form, the system includes a switch for "yes" or "no" election at each position in the assembly and a digital display for the number of "yes" votes and "no" votes.

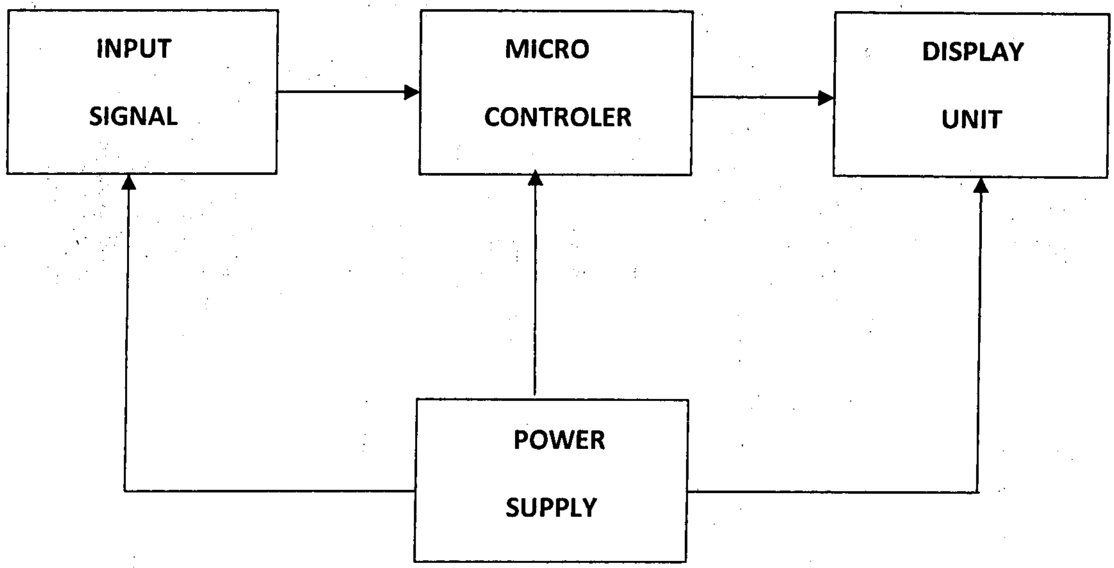

Fig. 1.1 Block diagram of an electronic voting system.

1.3 Aims and Objectives

The design and construction of electronic voting system with digital display is aimed at:

(i) Introduction of automation into the voting process to meet the challenges of the National assembly.

(ii) Reducing fraudulent acts such as rigging and other electoral vices that take place in the house.

(iii) Eliminating errors due to counting since the votes will be displayed digitally.

(iv) It will help to ensure prompt and timely release of election results.

(v) Save time being wasted when manually counting votes since it will be counted digitally.

1.4 Methodology

The construction was carried out in three stages. The first module was the construction of the power unit on the breadboard and then tested; the second module was the construction of the logic unit using the microcontroller on the breadboard and tested while the third module was the construction of the display unit.

1.5 Scope of Work

The design and construction of electronic voting system for national assembly covered some areas.The system as a prototype can only be used by two senators and the senate president. Also, the button pad is wired, it is supposed to be wireless to ensure more convinience. The implementation of the system did not include a password for the senators. The security would have been improved with passwords.

1.6 Sources of Material

All the materials (components) used for the construction of this project were sourced locally from electronic vendors at the correct specifications and rating of the components.

1.7 Constraints

Several difficulties were encountered in the course of this project work. Sourcing of materials on and before the commencement of this project work was an uphill task because a lot of finance was spent on transportation to get the materials ready for construction. Also, a lot of money was spent sourcing for materials used in the write-up of this project work.

Other problems encountered during the construction pocess; some of the components used got damaged, it took time to get them replaced, the work slowed down at this period. Also, the erratic power supply in the town was a serious problem faced during the construction and typing of this project work.

CHAPTER TWO

2.0 LITERATURE REVIEW/THEORETICAL BACKGROUND

For years, voters have taken the ballot for granted. The ballot has been through a lot of changes for many centuries. The word ballot comes from Italian word ballota (meaning "little colored ball"), because voters were originally using cast balls. In ancient Athens, each voter was given a small clay ball and the voter would drop the clay ball into their candidate's clay pot or ballot box. The practice of using balls to cast votes continued until the late 19th century, well after more advanced voting machine were invented. To vote for someone's membership, the voter would drop the white ball into a box. To vote against a candidate, the voter would deposit the black ball. The term is still used today to mean exclude someone.

At the very beginning of ancient democratic government, we find Athens coming out to their open market square to cast votes by counting the number of people that raised up their hands in favor of a particular candidate. The ancient Greece citizens also adopted another method by using pieces of broken pottery to scratch in the name of the candidate in the procedures of ostracism; this was done because while parliament was expensive and had to be imported from Egypt, broken pottery was abundant and virtually free [1].

These processes continued until the population of people grew and became so large to handle. The open market practice and broken pottery practice became insufficient due to lack of space to accommodate or gather together all the people at a time and the task of counting which was bulky and tedious, leading to errors and some other fraudulent acts.

As a result of these practices, the ancient democracy paved way to the contemporary institutions of democracy through open and secret balloting by the use of ballot box and papers. The first use of paper ballots to conduct an election was in Rome in 139 BCE [1] and the first use of paper ballots in North America was in 1629 within the Massachusetts Bay colony to select a pastor for the Salem Church. Also, the secret ballot was first introduced in Australia in the 1850s [1].

The secret ballot system is one of the most used in this part of the world. Although, it is a highly adopted system, it has limitations in the area of sorting out and counting of total votes cast which is manually done, time wasting and late release of results.

The limitations of these balloting systems coupled with technological advancement led to the use of electronic devices as voting system/machine.

In advanced countries like America, some parts of Europe e.t.c. different system/machine has been in use. The system/machine ranges from punch card, direct recording electronics (DRE) system, mechanical lever machines, and mark sense (optical scanner) voting system [2] e.t.c.

The electronic voting systems have been in use since the 1960s when punched card systems debuted. The newer optical scan voting systems allow a computer to count a voter's mark on the ballot. DRE voting machines which collect and tabulate votes in a single machine are used by all voters in all elections in Brazil and also on a large scale in India, the Netherlands, Venezuela and the United States. Internet voting systems have gained popularity and have been used for government elections and referendums in the

United Kingdom, Estonia and Switzerland as well as municipal elections in Canada and party primary elections in the United States and France [3].

This technological advancement has helped in automating and computerizing of voting process. So many people have taken advantage of this development to come up with their own ideas and worked upon this topic: Different people with the combination of different circuitry have produced different voting systems/machines. For example, the electronic ballot counter box, the unanimous vote counter machines [4].

2.1 Paper Ballot

The paper ballot employs uniform official ballots of various stocks weights on which the names of all candidates and issued are printed. Voters record their choices, in private, by marking the boxes next to the candidates or issue choice they select and drop the ballot in a sealed ballot box.

This ballot paper system was first adopted in Australian state of Victoria in 1856 and in the remaining Australian states over the next several years. The paper ballot system thereafter became known as "Australian ballot". New York became the first American state to adopt the paper ballot for state wide elections in 1889 [5].

2.2 Mechanical Lever Machines

On lever voting machines, the name of each candidate or ballot issue choice is assigned a particular lever in a rectangular array of levers on the front of the machine. A set of printed strips visible to the voters identifies the lever assignment for each candidate and issue choice. The levers are horizontal in their unvoted positions. The voter enables the machine with a lever that also closes a privacy curtain. The voter pulls down selected levers to indicate choices. When the voter exits the booth by opening the privacy curtain with handle, the voted levers are automatically returned to their original horizontal position. As each lever returns, it causes a connected lever counter wheel within the machine to turn one-tenth of a full rotation. The counter wheel serving as the "ones" position of the numerical count for the associated lever, drives a "tens" counter one tenth of a rotation for each of its full rotation. The "tens" counter similarly, drives a "hundreds". If all mechanical connections are fully operational during the voting period, and the counters are initially set at zero, the position of each counter at the close of the polls indicates the number of votes cast on the leer that drives it. Interlocks in the machine prevent the voter from voting for more choices than permitted.

The first official use of this lever type voting machine known as "Meyer Automatic Boot" occurred in Lockport, New York, in 1892. Four years later, they were employed on a large scale in the city of Rochester, New York and soon were adopted statewide. By 1930, lever machines had been installed in virtually every city in the United States, and by the 1960s well over half the nation's votes were been cast on these machines. Mechanical lever machines were used by 20.7% of registered voters in the United States as of the 1996 presidential election. Because these machines are no longer made, the trend is to replace them with computer-based mark sense or direct recording electronics systems [5].

2.3 Punch Cards

Punch cards are cards on which, in the past, information was recorded as lines of holes and used for giving instructions to computers and other machines. Punch card system employs a card (or cards) and a small clipboard-sized device for recording votes. Voters punch holes in the cards (with a supplied punch device) opposite their candidate or ballot issue choice. After voting, the voter may place the ballot in the ballot box or the ballot may be fed into a computer vote-tabulating device at the precinct. Two common types of punch cards are the "votamatic" card and the "datavote" card. With the votamatic, the locations at which holes may be punched to indicate votes are each assigned numbers. The number of the hole is the only information printed on the card. The list of candidates or ballot issue choices and directions for punching the corresponding holes are printed in a separate booklet. Votamatic cards are direct descendents of the original punch cards developed from a concept introduced by political scientist and former government administrator Dr. Joseph P. Harris.

With datavote, the name of the candidate or description of issue choice is printed on the ballot next to the location of the hole to be punched.

Fulton and De Kalb countries in Georgia were the first jurisdictions to use punch cards and computer tally machines when they adopted the system for the 1964 primary election. In November 1964 primary election, these two jurisdictions were joined by the lane country, Oregon and San Joaquin and Monterey countries in California, who also adopted the punch card system. Although many jurisdictions are now switching from punch card systems to more advanced mark sense or DRE systems. In the 1996 presidential election, some variation of the punch card system used by 37.3% of registered voters in the United States [5].

2.4 Mark Sense (Optical Scanner)

Mark systems employ a ballot card on which candidates and issue choices are preprinted next to an empty rectangle, circle, oval or an incomplete arrow. Voters record their choices by filling in the rectangle, circle, oval, or by completing the arrow. After voting, the voters either place the ballot in a sealed box or fed into a computer-tabulating device at the precinct. The tabulating device reads the votes using "dark mark logic" whereby the computer selects the darkest mark within a given set as the correct choice or vote. Various mark-sense voting systems have used a variety of different approaches to determining what marks are counted as votes. Early systems, such as the Votronic, introduced in 1965, had a single photo sensor per column of marks on the ballot. Most such tabulators used analog comparators that counted all marks darker than a fixed threshold as being votes. Although mark sense systems are often referred to as optical scan systems, mark sense technology is only one of several methods for recognizing marks on paper through optical reading techniques. An advantage of these systems is that the voters don't have to learn to use a voting machine. Physically able voters can simply use pen and paper to mark their intent.

Some disabled voters could use a machine to print a voted ballot, which can then be fed into the optical scanner along with all the other ballots, thus preserving the secrecy of their ballot. Optical scan voting systems can allow for manual recounting of ballots. Statistically relevant recounting can serve as a tool to detect or deter malfunction or fraud. Once an error in the counting process is suspected a full recount can determine the proper results. An advantage compared to DRE voting machines is that even if the optical scanner fails, voters can still fill out their paper ballot, and leave it to be scanned when the machine is fixed or replaced with a spare [5].

2.5 Direct Recording Electronics (DRE)

The most recent configuration in the evolution of voting systems is known as direct recording electronics or DRE. The raw materials for the direct recording electronic voting machine are light metals and plastics. It uses printed computer circuit boards; control panels, printers, lights, and memory cartridges made of the materials most often used for these components in other electronics such as computers or video games.They are electronic implementation of the old mechanical lever systems. As with the lever machines, there is no ballot; the possible choices are visible to the voter on the front of the machine. The voter directly enters choices into electronic storage with the use of a touch screen, push buttons, or similar device. An alphabetic keyboard is often provided with the entry device to allow for the possibility of write-in votes. The votes are stored in these machines via a memory cartridge, diskette or smart card and added to the choices of all other voters. In 1996, 7.7% of the registered voters in United States used some type of direct recording electronic voting system [5].

Two years ago, an electronic voting system was designed and constructed by Omijie Ben[6]. The system was not very secured. Also the Blinking of the LED when indicating a tie was not implemented in that project. The blinking of the LED tells all the members that there is a tie, this makes the voting process free and fair. Therefore, it is on these bases that I opted to harmonize the use of microcontroller and seven segment display units to synthesize an electronic system known as electronic voting system with digital display as an introduction to the automation of the voting process.

CHAPTER THREE

3.0 DESIGN AND IMPLEMENTATION

3.1 Power Supply Unit

Most electronic devices and circuits require a dc source for its operation. The power supply unit comprises the following:

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(i) Power transformer unit

(ii) Rectifier unit

(iii)Filtering unit

(iv)Power regulating unit

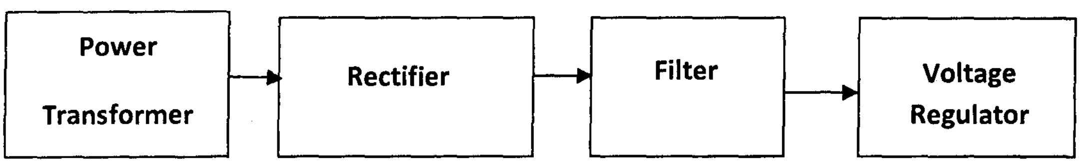

Fig 3.1 Block Diagram of Power Supply Unit

Therefore, the complete circuit diagram of the Power supply is as shown below.

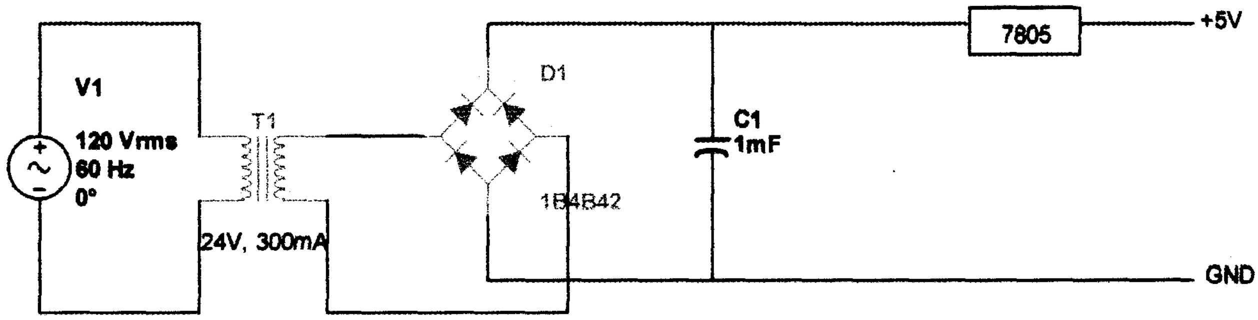

Fig. 3.2 Circuit diagram of power supply unit

3.1.1 Power Transformer Unit

The first block consists of the transformer. A transformer is an electronic device that steps up or steps down voltage. A 220V/24V was used. A voltage of 220V AC from the public power supply is passed through the transformer. The transformer then steps it down to 24V AC.

3.1.1.1 Calculation

Therefore, $V_p = \sqrt{2} \times V_{rms}$ (i)

Where $V_{rms} = 24V$ since the transformer of 220V/24V was used.

$V_p = \sqrt{2} \times 24 = 33.94V$

For safe operation, the peak inverse rating of the rectifiers must be greater than V_{peak}, therefore a 220V/24V transformer was chosen.

3.1.2 Rectifier Circuit

Rectification is a process of changing AC to DC. Diodes are commonly used as rectifiers in power supplies. The 24V AC stepped down from the transformer passes through the full wave bridge rectifier circuit. The aim is to convert it from AC to DC. After the full wave rectification, the signal still contains some AC components.

3.1.2.1 Calculation

After rectification, the 24 AC reduces by 1.4V. This is so because for full wave rectification two diodes conduct and two diodes block and since the forward breakdown voltage for a diode is 0.7V, the two voltages add up to give 1.4V. Thus the voltage after full wave rectification is

Voltage after rectification = 24V- (0.7 × 2) = 24- 1.4

= 22.6V DC

It is 22.6V that goes to the filtering circuit.

The frequency of the full wave signal is double the input frequency. A full wave input has twice as many cycles as the sine wave input has. The full wave rectifier inverts each negative half cycle so that we can get double the number of positive half cycles. The effect is to double the frequency.

Therefore the output frequency of the full wave rectifier is:

$f_{out} = 2f_{in}$ (i.e twice the input frequency) (ii)

This implies that,

$$dt = 1/2f_{in} = 1/(2\times 50) = 0.01 \text{ sec}$$

This is on the safer side as the capacitor begins charging up in less than half a cycle. The maximum current that can be drawn by the main circuit is determined by the voltage regulator following the filtering capacitor, the 7805.

3.1.3 Filtering Circuit

A filter is used to reduce the amount of AC ripple, thus providing a relatively pure form of DC. The main function of the filter is to minimize the ripple content in the rectifier output. An electrolytic capacitor connected in parallel with the output of the rectifier circuit is used as a filter.

3.1.3.1 Calculation

The main volatge of 220V is stepped down by a 220V/24V transformer. It is then rectified by full wave bridge diode rectifier. The waveform at this stage has no negative component but a lot of ripples. Smoothing capacitors are needed to reduce the ripples to an acceptable level. The resulting ripple voltage (dv) can be calculated as follows:

If the load current stays constant, as it will for small ripples, then

$$I = Cdv/dt \qquad \text{(iii)}$$

The standard 7800 series can produce output current in excess of 1A when used with adequate heat sink. Therefore, it can supply a maximum of 1A. This current will be drawn from the supply. Thus, I_{load} = 1A (maximum). The value of C can then be calculated from:

$$C = Idt/dv \qquad (iv)$$

But generally dv which is the ripple voltage is chosen to be 30% of V_P , where V_P is the peak voltage.

For bridge rectifier, $V_{p(out)} = V_{p(in)} - 1.4V$, since 0.7V dropped across a diode whenever it conducts. Only two diodes will conduct at a time.

Therefore, $V_{p(out)} = 24\sqrt{2} - 1.4 = 32.54V$

$$dv = (30/100) * 32.54 = 9.76V$$

Therefore, $C = \frac{(1 * 0.01)}{9.76} = 1.034 \times 10^{-3}$ F

$$C = 1034\mu F$$

So the commercial value of 1000μF, 35V was used in order to reduce the ripple to the nearest minimum.

3.1.4 Power Regulating Circuit

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. The entire work will comprise mainly a single microcontroller IC, two 4026 decade counters, two seven segment displays, three light emitting diodes (LEDs), all of which are low power consuming devices that require a 5V d.c voltage for optimum operation. A LM7805 voltage regulator was used to achieve a 5V output voltage. For proper operation of the LM7805 regulator, the input voltage must be at least 2V above the output voltage. Hence, a 9V transistor radio battery was utilized. The connection is as shown in fig 3.3 below.

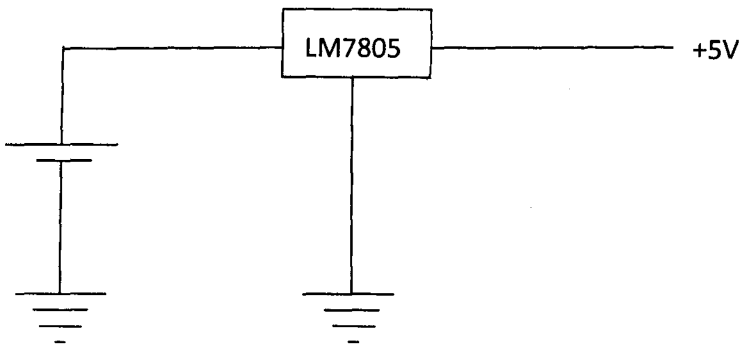

Fig 3.3 Design of power supply unit

3.1.4.1 Calcualation

Then the expected ripple voltage using this value of 1000μF capacitor is calculated as follows

$$dv = \frac{(1 * 0.01)}{1000 \times 10^{-6}} = 10.00V \qquad (v)$$

This means that the output waveform goes from a peak value of 32.54V to (32.54-10.00)V = 22.54V. It may be noted that the input voltage to the IC regulator must be at least 2V above the output voltage. This is required in order to maintain regulation.

Therefore, peak value of 32.54V to 22.54V is acceptable since the output voltage is 5V. The ripple is neglected by the 7805 regulator.

The average voltage going to the 7805 is calculated by:

$V_p - 0.5dv = 32.54 - (0.5 \times 10.00)$

$= 27.54V$

The output from the 7805 is 5V at maximum current output of 1A. The output remains constant in spite of input voltage variation.

3.2 AT89C52 Microcontroller

Initially all the pins of the microcontroller are high i.e. they are internally pulled to VCC through a high value resistor (the resistor is internally fixed inside the microcontroller by the manufacturer). Switches S_1, S_2, S_3, S_4, S_5, S_6 and S_7 are all connecting their pins to the ground so that if any of the switches is closed, the pin's logic level is changed from high to low. The AT89C52 sends a high or low signal to these pins.

Pin 1: S_1 which is connected to P1.0 of the microcontroller is the permission/result switch on the senate president's button pad. The microcontroller was programmed so that if this switch is closed, it will give access to the other senators to vote and it will also be used as the result button.

Pin 2: S_2 which is connected to P1.1 of the microcontroller is the NO switch on the senate President's button pad. The microcontroller was programmed so that if this switch is closed, a signal is sent to the 4026 to increament the NO register and display the result.

Pin 3: S_3 which is connected to P1.2 of the microcontroller is the YES switch on the senate President's button pad. The microcontroller was programmed so that if this switch is closed, a signal is sent to the 4026 to increament the YES register and displays the result.

Pin 4: A BC639 transistor (npn) is connected to P1.3 of the microcontroller. The npn transistor requires its base to be connected to Vcc for proper saturation and conduction of the collector- emitter path. Thus the LED comes on when the base is high. It does not conduct on when the base is low. The microcontroller was programmed to send a high and low signal when required. When LED is ON, permission has not been given so no senator can vote. Senator can only vote if it goes OFF.

Pin 5: S_4 which is connected to P1.4 of the microcontroller is the NO switch on the first senator's button pad. The microcontroller was programmed so that if this switch is closed, a signal is sent to the 4026 to increament the NO register and display the result.

Pin 6: S_5 which is connected to P1.5 of the microcontroller is the YES switch on the second senator's button pad. The microcontroller was programmed so that if this switch is closed, a signal is sent to the 4026 to increament the YES register and displays the result.

Pin 7: A BC638 transistor (pnp) is connected to P1.6 of the microcontroller. The pnp transistor requires its base to be cleared for proper conduction of the collector-emitter path. Thus the LED comes on when the base is low. It does not conduct on when the base is high. The microcontroller was programmed to send a high and low signal when required. When LED is ON, the first senator has successfully cast his vote.

Pin 9: This is the RESET pin the reset of the microcontroller is activated by pulling the RESET pin to Vcc for at least 2ms and pull it afterwards to the ground. The capacitor-resistor configuration cconnected to this pin takes care of this effect. On power up of the circuit, the capacitor charges on the time, $t = 1.1RC$ which is greater than 2ms. When it is fully charged, it stops conduction and then the pin is pulled to the ground through the 10kΩ resistor.

Pin 10: S_6 which is connected to P3.0 of the microcontroller is the NO switch on the second senator's button pad. The microcontroller was programmed so that if this switch is closed, a signal is sent to the 4026 to increament the NO register and display the result.

Pin 11: S_7 which is connected to P3.1 of the microcontroller is the YES switch on the second senator's button pad. The microcontroller was programmed so that if this switch is closed, a signal is sent to the 4026 to increament the YES register and displays the result.

Pin 18 and Pin 19: The crystal oscillator is connected to this pin. It synchronises the operation of the microcontroller.

Pin 20: Connected to ground.

Pin 21: Pin 3 of the 4026 IC (display enable) is connected to P2.0 of the microcontroller. The pin shows and hides the count result of the 4026 IC. When the pin is cleared, the display result is hidden but comes on when the pin is set. This is why the pin's logic level is controlled by the microcontroller.

Pin 22: Pin 1 of the first 4026 IC (count) is connected to P2.1 of the microcontroller. A count is successfully caried out by changing the logic level of the pin from high to low for at least 5ms and then taking it to high again. This pin counts the number of NO votes.

Pin 23: Pin 15 of the 4026 IC (RESET) is connected to P2.2 of the microcontroller. The reset pin of the 4026 IC is controlled through a transistor by the microcontroller. The reset pin is connected throough 1kΩ to the ground and remains in the state as long as the microcontoller is not conducting. Anytime it is required to reset the 4026, the base of the pnp transistor is cleared to allow conduction for at least 5ms thereby pulling the pin to Vcc for thT time interval and then setting it back to allow normal operation.

Pin 27: Pin 1 (count) of the second 4026 IC is connected to P2.6 of the microcontroller to count the number of NO votes.

Pin 40: it is connected to Vcc

Note: Pin 3 (Display Enable) of the two 4026 counters are looped together. Also, pin 15 (RESET) of the two counters are looped together.

3.3 Design of Output Indicator

There are three output indicators (LEDs), one for the senatate President and the other two for each of the other senator's. the first LED is powered by a npn transistor. The figure below shows the configuration of the npn transistor.

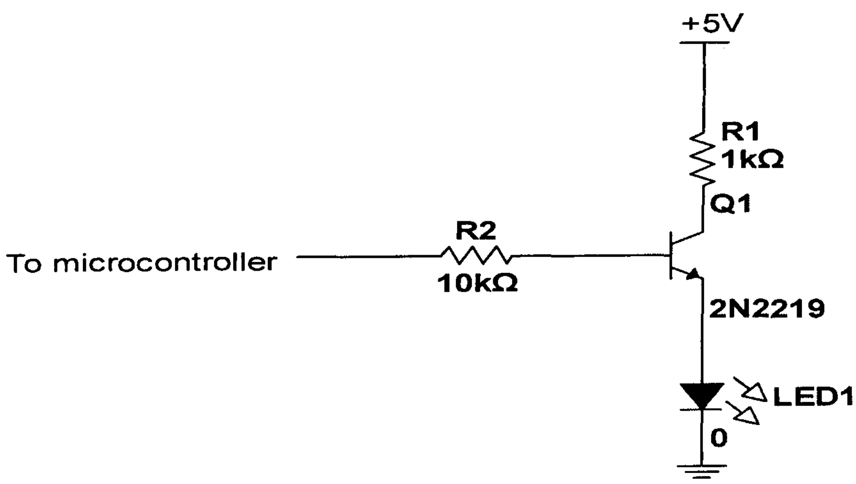

Fig 3.4 npn transistor configuration

For proper brightness of LED, it must sink a minimum current of 4mA, but maximum current should not exceed 10mA.

This maximum collector current, $I_{c(max)} = 10mA$

The minimum value of base current, $I_B = \frac{I_{c(max)}}{h_{FE}}$ (vi)

$$= \frac{10mA}{89} = 0.112mA$$

The maximum value of base resistance, R_B is

$$R_B = \frac{V_{CC} - V_{BE}}{I_B} = \frac{5 - 0.7}{0.112} = 38.39K\Omega \quad \text{(vii)}$$

A value of 10 KΩ was used to ensure saturation.

$$R_{lim(min)} = \frac{V_{CC} - V_{BE}}{I_{c(max)}} = \frac{5 - 0.7}{10mA} = 0.43\ K\Omega \quad \text{(viii)}$$

$$R_{lim(max)} = \frac{V_{CC} - V_{BE}}{I_{c(max)}} = \frac{5 - 0.7}{4mA} = 1.08\ K\Omega \quad \text{(ix)}$$

Thus, a value of 1 KΩ was used i.e. $R_{lim} = 1\ K\Omega$

The other two senators used a BC638 (pnp) transistor. Both configurations are described using the figure below.

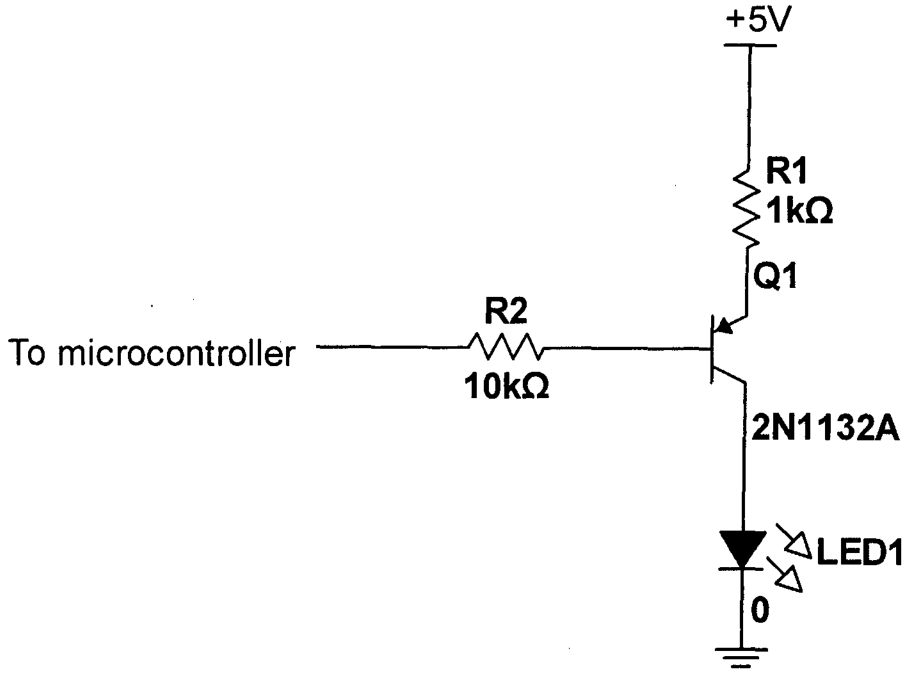

Fig 3.5 pnp transistor configuration

3.4 The 7- Segment Display

A seven segment display, as its name indicates, is composed of seven elements. Individually on or off, they can be combined to produce simplified representations of the Arabic numerals. The figure below shows a common display format composed of seven elements or segments. Energizing certain combinations of these segments can cause each of the ten decimal digits to be displayed. To produce a 1, segments b and c are energized; to produce a 2, segments a, b, g, e and d are energized; to produce a 3, segments a, b, g, c and d is energized; to produce a 4, segments f, g, b and c is energized; to produce a 5, segments a, f, g, c and d is energized; to produce a 6, segments a, f, g, e, c and d is energized; to produce a 7, segments a, b and c is energized; to produce an 8, segments a, b, c, d, e, f and g is energized; to produce a 9, segments a, b, f, g, c and d is energized.

LED displays: one type of seven segment display consists of light emitting diodes (LED) arranged in the figure as shown below. Each LED emits light when there is current through it. Because of the external source of current attached to the common anode, the common anode will be used for this project [15].The figure below shows a seven segment display.

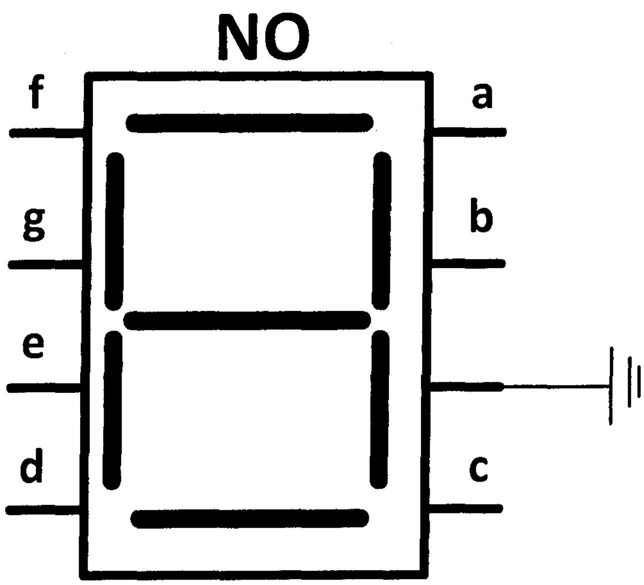

Fig 3.6 Seven Segment display

3.5 4026 Counter (Decade Counter)

The 4026 IC is a 16-pin CMOS seven-segment counter from the 4000 series. It counts clock pulses and returns the output in a form which can be displayed on a seven-segment display. This avoids using a binary-coded decimal to seven-segment decoder, but it can only be used to display the (decimal) digits 0-9.

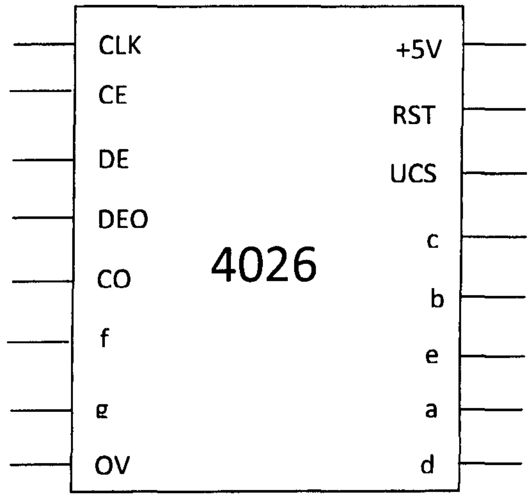

Fig 3.7 Decade counter

3.6 Complete Circuit Diagram

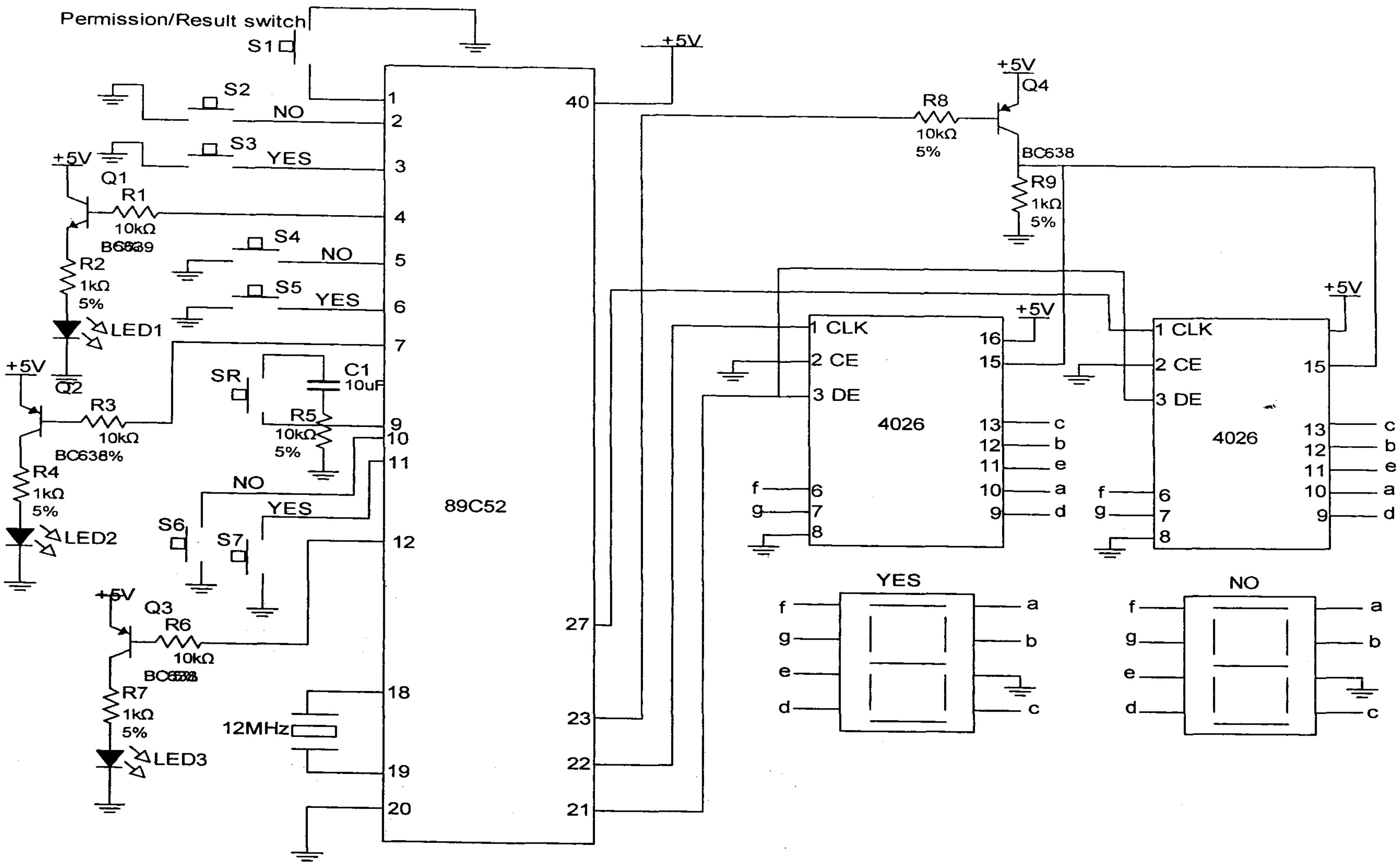

Fig 3.8 Circuit diagram showing the design and construction of an electronic voting machine with digital display

CHAPTER FOUR

4.0 TESTS, RESULTS AND DISCUSSION

4.1 Tests

Each of the units of the device being constructed was simulated one after the other before being tested on bread board and then finally soldered to the Vero board.

The microcontroller based voting system was tested to make sure that each pulse generated is being incremented and displayed by the 7-segment display unit.

Finally, the preset button was tested to ensure that is starts up the program and display zero in both 7-segment displays.

4.2 Results

Table 4.1 The results obtained after the voting process

Senator 1		Senator 2		7- Segment display	
Yes	No	Yes	No	Yes Votes	No Votes
0	0	0	0	0	0
1	0	1	0	2	0
0	1	0	1	0	2
1	0	0	1	1	1
0	1	1	0	1	1

4.3 Discussion of Result

The electronic voting system was designed in such a way that no senator can vote except with permission from the senate president. The senate president has a permission button on his button pad which on pressing gives permission to the other senators to vote. The senate president cannot vote except when there is a tie in the number of votes. The system was designed so because at the national assembly the senate president does not vote until there is a tie.

When the system is put on, it automatically resets. The LED on the senate president's button pad is ON indicating no senator can vote. When permission is given to the senators and they cast their votes by pressing yes or no on their button pads respectively, the LED lights on the senator's button pad and the LED on the senate president's button pad goes OFF indicating permission has been given. Immediately the senators cast their vote, the LED on the senator's button pad lights indicating a vote has been cast successfully. When there is a tie in the number of yes and no votes, the LED on the senate president's button pad blinks four times indicating that the senate president can cast his vote.

The system was designed in such a way that all the senators can vote at the same time thereby saving their time and no senator can vote more than one time thereby ensuring a free and fair election.

The project as a prototype was designed for only three senators. It implies that when the number of "yes votes" is more than the number of "no votes", the issue under deliberation is implemented and if the number of "no votes" is more than the number of "yes votes", the issue under deliberation is not implemented.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The target of this project which is design and construction of an Electronic Voting System with digital display was achieved as demonstrated by the results obtained from the tests carried out as explained in chapter four.

The aim which was to use an electronic voting system rather than normal raising up of hands "for" or "against" the motion in our national and state assemble was achieved. This is an improvement in the electoral process of Nigeria and other parts of the world.

Though a number of difficulties were encountered at the design and construction stage of this project, consultation and constant research helped to get through.

5.2 Recommendation

i. The system can be made to voice- out "yes" and "no" votes.

ii. The system can be made wireless.

iii. The system could be implemented biometrically.

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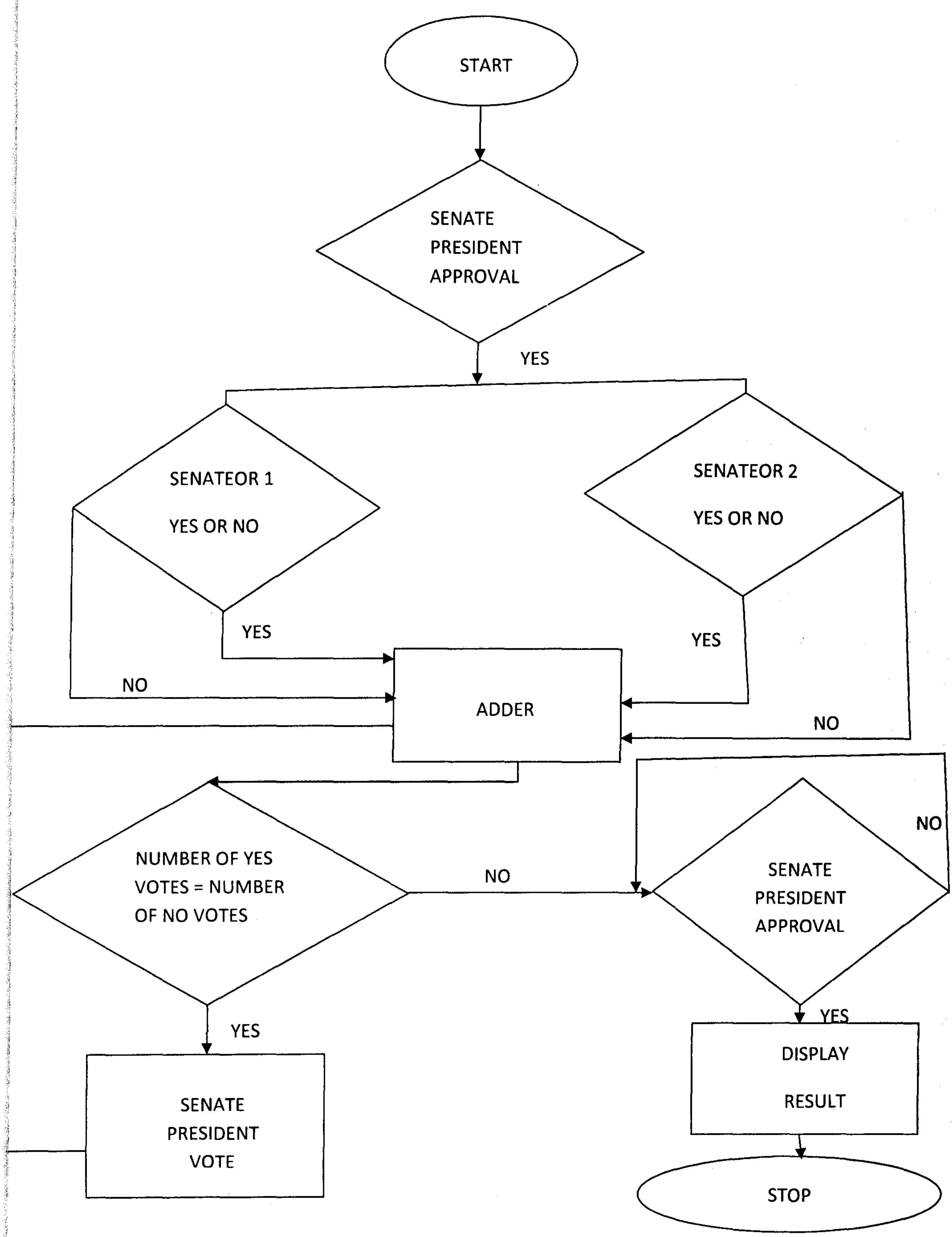
APPENDIX I



Flow chart of the program

APPENDIX II

```
ORG 0000H
    CLR A
      MOV R0,#00H
    MOV R2,#00H
      MOV R1,#00H
      MOV R3,#00H
    MOV R4,#00H
    MOV R5,#00H
    MOV R6,#00H
    MOV R7,#00H
LJMP SAKAM
OJAY:LCALL OJ
     INC R0
     CJNE R0,#14H, OJAY
     MOV R0,#00H
     RET
OJ:MOV TMOD,#01
   MOV TL0,#0H
   MOV TH0,#3CH
   SETB TR0
   JNB TF0,$
   CLR TF0
   CLR TR0
   RET
RESSET:CLR P2.2
       LCALL OJAY
       SETB P2.2
       RET
ZUBAIR:CJNE A,#0,ONE
       LCALL OJAY
       RET
ONE:CJNE A,#1,TWO
    CLR P2.1
    LCALL OJAY
    SETB P2.1
    LCALL OJAY
    RET
TWO:CLR P2.1
    LCALL OJAY
    SETB P2.1
    LCALL OJAY
    CLR P2.1
    LCALL OJAY
    SETB P2.1
    LCALL OJAY
    RET
ZUBAIRU:CJNE A,#0,ONEE
        LCALL OJAY
      RET
ONEE:CJNE A,#1,TWOE
    CLR P2.6
    LCALL OJAY
    SETB P2.6
    LCALL OJAY
    RET
TWOE:CLR P2.6
```

```
     LCALL OJAY
     SETB P2.6
     LCALL OJAY
     CLR P2.6
     LCALL OJAY
     SETB P2.6
     LCALL OJAY
     RET
SAKAM:LCALL RESSET
      CLR P2.0
SAKA:JB P1.2,$;PRESIDENTS PERMISSION
     CLR P1.3; OFF ACK LCD
SEN:JNB P1.4,YESE;YES BUTTON OF SEN1
     JNB P1.5,NOE;NO BUTTON OF SEN1
     JNB P3.0,YESE2;YES BUTTON OF SEN2
     JNB P3.1,NOE2;NO BUTTON OF SEN2
     SJMP SEN
YESE:INC R1
     CLR P1.6
     SJMP SEN2
NOE:INC R2
    CLR P1.6
    SJMP SEN2
YESE2:INC R1
    CLR P3.2
     SJMP SEN1
NOE2:INC R2
     CLR P3.2
     SJMP SEN1
SEN1:JNB P1.4,YAES
     JNB P1.5,NOES
     SJMP SEN1
SEN2:JNB P3.0,YAES2
     JNB P3.1,NOES2
     SJMP SEN2
YAES:INC R1
     CLR P1.6
     SJMP READY
NOES:INC R2
     CLR P1.6
     SJMP READY
YAES2:INC R1
    CLR P3.2
     SJMP READY
NOES2:INC R2
     CLR P3.2
     SJMP READY
READY:MOV A,R1
      MOV DPH,R2
      CJNE A,DPH,CONTOUS
BLINK:SETB P1.3
      LCALL OJAY
      CLR P1.3
      LCALL OJAY
      INC R3
      CJNE R3,#4,BLINK
```

```
      MOV R3,#00
      SETB P1.3
MAS:JNB P1.0,YESSE
    JNB P1.1,NEO
    SJMP MAS
YESSE:INC R1
      CLR P1.3
      SJMP RESULT
NEO:INC R2
    CLR P1.3
    SJMP RESULT
CONTOUS:SETB P1.3
        JB P1.2,$
RESULT:MOV A,R1
       LCALL ZUBAIR
       MOV A,R2
       LCALL ZUBAIRU
       SETB P2.0
JB P2.0,$
```

APPENDIX III