ADAMA SCIENCE AND TECHNOLOGY UNIVERSITY

SCHOOL OF ELECTRICAL ENGINEERING AND COMPUTING

Design and Implementation of Alternative Power Supply Operating Electronic Voting Machine Using PIC16F877A Microcontroller

A Thesis/Project submitted in Partial Fulfillment of the requirements for the Award of the Degree of Master of Science

In Industrial Automation and Control Technology Management

By

Eyob Birhanu
Haile Kibret
Tumiso Hogego
Temesgen Samual

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINERING

June-2015Adama, Ethiopia

EXAMINATION BOARD APPROVAL

1. CHAIR PERSON

_____ _____ _____

Name Signature Date

2. ADVISOR

_____ _____ _____

Name Signature Date

3. CO-ADVISOR

_____ _____ _____

Name Signature Date

4. INTERNAL EXAMINER

_____ _____ _____

Name Signature Date

5. EXTERNAL EXAMINER

_____ _____ _____

Name Signature Date

6. SCHOOL DEAN

_____ _____ _____

Name Signature Date

CERTIFICATE

The project **Design and Implementation of alternative power supply operating voting machine using pic16f877A microcontroller by** Eyob Birhanu, Haile Kibret, Temesgen Samuel and Tumiso Hogego has been carried out under my supervision and that this work has not been submitted elsewhere for a degree. This project has been submitted for examination with my approval as a University advisor.

Advisor Name V.G. Sangam(Dr)

Signature _____

DECLARATION

We,Eyob Birhanu, Haile Kibret, Temesgen Samual and Tumiso Hogego hereby declare that this project entitled **Design and Implementation of alternative power supply operating electronic voting machine using PIC16F877A microcontroller** is entirely our own work and to our knowledge it has not been done or presented by other person. The result of our own work carried out under the supervision of

DR V.G. Sangam.

We swear that all the material used has been properly referenced.

Candidates Name	**Signature**	**Date**
1. EYob Birhanu	_____	_____
2. Haile Kibret	_____	_____
3. Temesgen Samual	_____	_____
4. Tumiso Hogego	_____	_____

ACKNOWLEDGEMENT

We would like to begin by thanking our project advisor Dr. V.G Sangam, for her advice and throughout this project.
We would also like to thank our co-advisor Mr. Hinsermu Alemayehu for his advice throughout the project.

Special thanks must go to the God. Praise GOD for his Almighty and Graciousness, we was able to complete this project report in the dateline given.

We would like to thank Mr. Shafi Dadi for providing the tools and instruments.

Last but not least, thank you so much to our beloved parent and friends that gave us encouragement and morale support from behind.

TABLE OF CONTENTS

Content **page**

LIST OF FIGURE

Figure Page

ACRONYM

Abbreviation	Description
AC	Alternating current
A/D	Analog to digital convertor
AFIS	Automated fingerprint identification
BC	British Calder
BOR	Brown out circuitry for brown –out reset
CAN	Control are net work
CASI	Computer assisted self-interviewing
CPU	Central process unit
CAD	Computer Aided Design
CASI	Computer assisted self-interviewing
CPU	Central process unit
DC	Direct current
EEPROM	Electrical Erasable Programmable Read Only Memory
ELPA	Electric labor power application
EEPCO	Ethiopian electric public cooperation organization
E.C	Ethiopia Calder
EAVG	Average value of output voltage
EMF	Electromotive force
EPRDF	Ethiopian people revolution of democratic front
IC	Integrated circuit
I²C	Intel integrated circuit
IDE	Integrated Development Environment
IO	Output current

ISIS	Intelligent Schematic input System
LED	Light emitted diode
LCD	Liquid crystal display
Li-ion	Lithium-ion
mAh	Mil ampere hour
MHZ	Megahertz
mm	mile meter
MP lab	Microchip lab
NiCad	Nickel Cadmium
Ni-lMh	Nickel- Metal –Hydride
NPN	Negative Positive Negative
PCB	Printed circuit board
PIC	Programmable interface controller
PNP	Positive Negative Positive
PSP	Parallel slave port
PSU	Power supply unit
POR	Power on reset
PWM	pulse with modulation
WRT	Power –Up Timer
RAM	Read access memory
RC	Resistance capacitance load
RL	Resistance inductance load
ROM	Read only memory
SSP	Synchronous Serial Port
SPI	Synchronous port interface

SDLC	System design life cycle
SPST	Single pole single throw switch
UART	Universal Asynchronous Receiver Transmitter
USB	Universal serial bus
USART	Universal Synchronous Asynchronous Receiver Transmitter
VSM	Virtual System Modeling
VO	Output voltage
Vp	Peak voltage/Primary induce voltage
Vs.	Secondary voltage
WRT	Write Read timer
XC	Capacitance impedance
ZO	Zener diode

ABSTRACT

Electronic voting systems have the potential to improve traditional voting procedures by providing added convenience and flexibility to the voter. Numerous electronic voting schemes have been proposed in the past, but most of them have failed to provide voter authentication in an efficient and transparent way. This Electronic voting machine designed with integrated power supply (it works on solar ,Ac mains and rechargeable battery) so that one can use it everywhere at any time regardless of being urban or rural, in absence or presence of Ac ,being day time or night . It is designed in such a way that a voter can act by reading instruction displayed on the LCD how long to wait , when to press candidate switch and weather his/her vote is registered or not. This machine enables voting process secure by allowing a voter to cast only once. This is achieved by master switch placed for the election observers and the result is also managed by the authorized body after activating count button. This paper deals with the design of microcontroller based Electronic Voting Machine. It has the provisions for casting vote among the four candidates by pressing the switches and after completing the voting process total result will be displayed in the LCD.

Keywords: PIC16F877 Microcontroller, LCD (LM016), vote switches, master switch, count switch, voltage regulator (LM7805, LM317), rechargeable battery, battery charge controller, photo voltaic cell.

CHAPTER ONE

1. BACKGROUND OF THE STUDY

1.1 Introduction

Democratic Election in Ethiopia is apolitical process which accounts around two decades since it began after EPRDF came to power. The country's constitution declares multi-party system and hence a lot of opponent political parties exist. Ethiopia engaged four general national wide elections and other local elections in different terms as election for fulfillment. However no election is done with digital technology that is reliable in the citizens/voters/. The country engaged the past elections with the oldest paper ballot method.

There is need of a voting machine technology that facilitates counting of votes and a technology that works both in urban and rural areas of the country with the alternative power sources. As there is no electric in the rural areas of the country, the technology shall use solar as a power source, which connected to rechargeable battery used to protect power interruption when electric power goes off in urban areas and when the sun sets in the rural areas. There are two types of "electronic voting" or "e-voting." The first type is voting over the Internet, using (for example) home computers. The second type is using electronic voting systems in "stand-alone" mode, unconnected to any network. [1] This note focuses on the second type. Throughout this note, the term "e-voting" means the second type of electronic voting machine.

Electronic voting machine has now replaced the traditional mechanism of voting due to several advantages like security, automatic counting etc. This project presents a way to develop an electronic voting machine which displays the count of votes on a 16x2 LCD interface. A user can get his/her vote register through a set of switches (one for each candidate). After every cast of vote, the subsequent count can be seen on LCD. The circuit uses PIC16F877A microcontroller and the code for the project has been written in C. This LCD based electronic voting machine is designed for four candidates uses PIC16F877. The input part consists of a set of six tactile switches. The switches and 16x2 LCD are interfaced to microcontroller PIC16F877A for various operations and displays. [2].

1.2. Statement of the problem

In line with the materials resource constraints as well as the backward process of voting using paper and ink it is tedious to held voting. The quantity of paper to be used and voided, unaccustomed trend for recycling used papers for further use and the ink to be consumed results in worldwide extravagance of resources. So, it is better to have a solution which substitute these resources thereby can be used repeatedly once it has been built.

In addition to this large number of people required to facilitate electoral process and it takes long time during election in traditional voting system of Ethiopia.

A technology is needed to eliminate mistakes in counting votes of paper. Of course there are other e voting technologies like through Ethernet but it is highly exposed for hacking.

The other problem is absence of power for electronic voting technology that can be applicable both in urban and rural areas of Ethiopia and our project gives solution for power interruption conditions. An alternative source of power in order not to be dependent only on ELPA/EEPCo is very important by incorporating solar power and rechargeable battery sources.

1.3. Objective of the project

1.3.1 General Objective

This project aims to design and implementation of alternative power supply operating electronic voting machine using PIC16F877A microcontroller having LCD display mechanism for human interfacing.

1.3.2 Specific Objective

This project attempts to,

- To minimize high cost of paper and ink used for voting.
- To modernize the existing voting system of Ethiopia.
- To minimize voting time by letting voters to press a switch momentarily.
- To avoid manual counting of vote (no need of counting, it displays the number of votes digitally).
- To reduce number of facilitators and transportation cost of materials in oldest method of voting.
- To develop a voting machine used for both urban and rural areas which works by

alternative power sources i.e. AC sources, solar power and rechargeable battery and

- To supply Ethiopian market for the potential uses

1.4 Significance of the project

The significance of this specific project is for those who wish to held vote/choice/ among alternatives/competitors/. The alternatives may be people, ideas, some groups or it may be political parties. Its significance can be seen in terms of conserving disposable resources, conserving time spend to put some marks over the paper using ink and counting votes, using modern digital voting machine. The beneficiaries are;

- Federal Electoral board
- Kebele administrators election
- Sport federations
- Arts association
- Religious organization leaders election
- In school college or university student representative election etc.

1.5 Scope of the project

The scope of this project covers the hardware design and programming of electronic voting machine. The design work also includes an alternative and an integrated power supply circuit design and programing using C- language. On the programming part, PIC Microcontroller is used to integrate the hardware or model with the control algorithm developed. This project prototype is used for four candidates who are competing to win and it is also possible to increase the number of candidates by adding some components such as switches, micro-controller and using of large size of LCD.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 General description of voting system

People decide that who is going to do administration of government or who gets democratic power through a process called “voting”. The voting is not a fresh idea rather it is as old as the history of mankind. All over the history different methods and techniques of voting have been adopted. The first ever vote in record took place in Rome in 139BC and used simple hand written paper ballots. [3] This system was designed like all concerned parties acting as candidates as well as voters that are polling the votes must be satisfied with the announcement of results after elections have been conducted. Atmosphere of voting and conducting elections basically depends upon the cultural values as well as political policies. Fundamental right to vote or simply voting in elections forms the basis of Ethiopian democracy. In Ethiopian all earlier elections be it state elections or center elections a voter used to cast his/her vote to his/her favorite candidate by putting the stamp against his/her name and then folding the ballot paper as per a prescribed method before putting it in the Ballot box. This is a long, time-consuming process and very much prone to error.

The major issue of traditional voting systems oscillates around the system of tallying. The main problem of this system is dependable on manual procedure and for this reason has raised many questions. [4]This situation continued until election scene was completely changed by electronic voting machine. No more ballot paper, ballot boxes, stamping, etc. all this condensed into a simple box called ballot unit of the electronic voting machine. Now the current voting system is migrating from the conventional ballot papers and boxes to the micro-controller- based methods.

2.2 Overview of electronic voting system

Electronic voting machine has now days become an effective tool for voting. It ensures flawless voting and thus has become more widespread. It ensures people about their vote being secured. It avoids any kind of malpractice and invalid votes. Also such kind of system becomes more economical as consequent expenditure incurred on manpower is saved. [5] It is also convenient on the part of voter, as he has to just press one key whichever belongs to his candidates. Electronic voting all seem to agree on two things:

- Internet voting does not meet the requirements for public elections
- Currently widely-deployed voting systems need improvement

In its essence, an electronic voting machine is a computer assisted self-interviewing device (CASI) giving the voter the opportunity to review and change his/her votes before submitting it. The different types of voting machines allow for different kinds of interaction, such as using a touch screen technology, using a dial wheel, touching a paper panel, or pressing a button on an LCD screen. [6]

voting machines are the total combination of mechanical, electromechanical, or electronic equipment (including software, firmware, and documentation required to program control, and support equipment), that is used to define ballots; to cast and count votes; to report or display election results; and to maintain and produce any audit trail information. The first voting machines were mechanical but it is increasingly more common to use electronic voting machines. A voting system includes the practices and associated documentation used to identify system components and versions of such components; to test the system during its development and maintenance; to maintain records of system errors or defects; to determine specific changes made after initial certification; and to make available any materials to the voter (such as notices, instructions, forms, or paper ballots). [7]

Voting machines have different levels of usability, security, efficiency and accuracy. Certain systems may be more or less accessible to all voters, or not accessible to those voters with certain types of disabilities. They can also have an effect on the public's ability to oversee elections.

2.3 Voting machine technologies

There are several technologies associated with electronic voting system. We are going to look at it from two perspectives: voting over the Internet, using (for example) **home computers and electronic voting systems in "standalone" mode, unconnected to any network.** [8]

2.3.1 Voting over the internet, using (for example) home computers

Internet voting is an appealing concept to most voters, primarily for reasons of convenience while appealing because of the attractiveness of technology. However, Internet voting is fundamentally different from other types of online transactions such as banking or shopping. In this Article, we describe some of Internet voting, the advantages and disadvantages from a

security and privacy perspective, and provide perspective on the history and evolution of the field. [9]

The term “Internet voting” is used to cover a wide range of technologies. “Internet voting” to refer to actions that are used by voters to obtain and potentially return marked ballots using the Internet. The term “Internet voting” is used to refer both to the distribution of blank ballots (printed) to voters via the Internet, through a website or via e-mail, and to the return of marked ballots via the Internet, through a website, e-mail, or fax. Regardless of the acquisition cost of the software and hardware, costs for Internet voting also include training staff to operate the system, constant monitoring of the voting system for security and reliability issues, updating the software to resolve problems found in operation, testing, maintaining and upgrading hardware, etc.

Online Voting System:

Online Voting System is the latest electronic voting system introduced. In which the voted ballot is transmitted over the public internet through web browser [10]. The voter can directly vote online from anywhere in the world. Security is the major issue in the Online Voting System. It is very efficient and portable.

Advantages of Online Voting System

1. Portable: It is very much portable system as the system works on internet only the internet supporting device is required.
2. Fast: It is very fast as compare to traditional paper ballet voting system. The voter doesn’t need to wait in long queue for voting. He /She can cast their vote just on a single click.
3. Flexibility: As this system is functional on the internet that makes this system more flexible to support variety of paper ballot question formats.
4. Mobility: This system gives the freedom of casting the vote from anywhere in country. This is beneficial for the voters who are regularly out of station.
5. Reusability: The extent to which the existing application can be reused in new application. The system can be reused a number of times without any technical difficulties.

Disadvantages of Online Voting System

1. Complexity: The designing phase of this system is highly complex. As the system has deal with large no of users and has to maintain huge database.
2. Security Issues: The whole system operates over the internet which makes the system more complex and exposed for hacking.
3. High Expense: This system is very much costlier than the other systems because various equipment and utilities are required to be purchased which are quite costlier.

2.3.2 Electronic voting systems in "standalone" mode, unconnected to any network

A. Electronic Voting System using Fingerprint technologies

To overcome conventional voting system problems the use of fingerprint identification using reliable biometric technologies. Use of biometrics in voting systems has been an acclaimed one as fingerprints are unique to individuals. [11]

The field of biometrics was formed and has since expanded on to many types of physical identification. Still, the human fingerprint remains a very common identifier and the biometric method of choice among law enforcement [12]. These concepts of human identification have led to the development of fingerprint scanners that serve to quickly identify individuals and assign access privileges. Finger printing recognition, the electronic methods of recording and recognizing an individual finger print, advanced substantially during the last decade of the 21th century [13]. Today, identification can be achieved in a few seconds with reasonable accuracy. As a result, the use of automated fingerprint Identification systems (AFIS) that record, store, search, match and identify finger prints is rapidly expanding. AFIS can be integrated with a microcontroller and other peripherals to form an embedded system which is a comprehensive electronic voting machine with fingerprint print identification system. [14]

Generally fingerprint electronic machine uses equipment's like fingerprint sensors, digital camera, computer, software and experts needed to operate the system these makes the system costly.

B. Electronic voting machine using ZIGBEE

Design and develop an electronic voting machine using ZIGBEE communication system for sorting out the wired e-voting problems. Fingerprint technique is also used to design a secure e-voting system. The design is based on the (ATMEGA328p) microcontroller, RS232 cable which is used for interfacing between ZIGBEE and the microcontroller, Liquid Crystal Display (16X2) for displaying the instruction, fingerprint sensor for scanning voter's fingerprint before voting, ZIGBEE transmitter, ZIGBEE receive, security alarm and visual basic for creating display page in computer. Simulation is done using Proteus software, coding and the .hex file is generated for microcontroller using Arduino software. Each voter can vote only once thus protecting the identity of the voter in making the process unbiased and fair. Database comprising details of all voters with their personal details and fingerprint are stored in microcontroller for comparing and verification during polling. [15]

The author described use of fingerprint sensor for scanning voter's fingerprint before voting, ZIGBEE transmitter, ZIGBEE receive, security alarm and visual basic for creating display page in computer makes the cost of these system very high so that it is not preferable for our country.

2.4 Conventional voting system of our country

These systems are not efficient as they are conducted manually and therefore very often are not accurate. As a consequence, it is obligatory to carry the available voting through an electronic system.

Traditional Voting System has the following defect:

1. Inaccurate due to human errors.
2. .Time consuming: This system is very much time consuming a. As only one person can vote at a time and all the voters has to wait in the queue for their turn which in turns increases the crowd at the polling stations.
3. Low Tally Speed: Once the voting schedule is over, the result of the election cannot be declared immediately. All the ballot boxes are collected at a specific location and then the counting of the votes is carried out which is very much time consuming.
4. Conventional voting systems are not efficient due too long period of preparation, bogus voting, include papers, punch cards, mechanical levers, optical-scan machines .

5. Would involve printing of huge volume of ballot paper.
6. Manual counting of votes may require large manpower, time and possibly be prone to human error.
7. Re-counting will be time consuming, particularly, when counting is done immediately after the close of polls.
8. Segregation of invalid votes will be burdensome and may lead to disputes fights.
9. Manual voting may be prone to mal-practices and not tamper-proof.
10. Storage and distribution of ballot paper may require large manpower and security.

2.5 New Trends

Voting system has advanced technologically, ranging from mail to Electronic Voting System using Fingerprint scanning and vote through internet. Now a day there are a variety of electronic voting machines but one is costly and others does not consider the current situations of our country from this two perspectives our project includes design of PIC microcontroller based voting machine with alternative power supply circuit.

In our project there are two switches one for starting EVM another for ending the voting process. A set of switches are provided through which a user can cast vote. After every cast of vote, the subsequent count can be seen on the LCD display. The LCD and switches are controlled through PIC16F877 microcontroller. In this machine we have the provision of casting votes for the candidates has been provided through four of these switches. A candidate cast votes simply by pressing a single push button makes voting system very easy.

In our project we select PIC microcontroller due to the following advantages:

- Small instruction set to learn
- Built-in oscillator with selectable speeds
- Easy entry level, in-circuit programming plus in-circuit debugging units available for less than $50
- Inexpensive microcontrollers
- Wide range of interfaces including I²C, SPI, USB, USART, A/D, programmable comparators and Ethernet[16]
- Availability of processors in DIL package makes them easy to handle for hobby use.

.

This design of Electronic Voting Machine will save considerable amount of time and manpower. Thus, the proposed EVM system is more reliable, low cost and fast as compared to existing e-voting system. At the end of the polling, just by pressing a button the results can be obtained. This paper gives the complete design details of the building blocks of the entire system.

After comparing the above mentioned voting machine design of alternative power supply operating voting machine should be implemented according to characteristic of Ethiopian electoral system. This project has the following advantages:

1. Many electronic voting systems that have been proposed before contain the use of online networking, and the risk of tampering of information through hacking posed a great threat. [17]
2. The machine presented eliminates the use of a live network altogether, thus causing the vote casted to be safe from any tampering [18].
3. All this condensed into a simple box called ballot unit of the electronic voting machine. EVM is capable of saving considerable printing stationery and transport of large volumes of electoral material.
4. It is easy to transport, store, and maintain.
5. It completely rules out the chance of invalid votes.
6. Use of EVM results in reduction of polling time, resulting in fewer problems in electoral preparations, law and order candidates' expenditure, etc. and easy and accurate counting without any mischief at the counting center.
7. It makes the process of counting of votes much faster than the conventional system.
8. It reduces to a great extent the quantity of paper used thus making the process of eco-friendly (avoidance of spoilt ballot papers).
9. Reliable, user-friendly, portable, simple to operate and can be installed in a short time.
10. Re-usable by simply erasing votes recorded in earlier poll.

2.6. Power Circuit

i) Rectifier

In many power supply circuits, the bridge rectifier is used. The bridge rectifier produces almost double the output voltage as a full wave center-tapped transformer rectifier using the same secondary voltage. The advantage of using this circuit is that no center-tapped transformer is required. [19]

During the positive half cycle both D3 and D1 are forward biased. At the same time, both D2 and D4 are reverse biased. Note the direction of current flow through the load. During the negative half cycle D2 and D4 are forward biased and D1 and D3 are reverse biased.

ii) **Filtering:**

The output of the rectifier is pulsating DC. This pulsating DC is converted into pure DC using filter. The filter used in this circuit is LC filter, but practically we won't use inductor because it is bulky. The value of capacitor depends upon the output voltage and output current.

iii) LM7805 IC Voltage Regulator

A regulated power supply is very much essential for several electronic devices due to the semiconductor material employed in them have a fixed rate of current as well as voltage. The device may get damaged if there is any deviation from the fixed rate. The AC power supply gets converted into constant DC by this circuit. By the help of a voltage regulator DC, unregulated output will be fixed to a constant voltage. The circuit is made up of linear voltage regulator 7805 along with capacitors and resistors with bridge rectifier made up from diodes. [19]

ICs regulator is mainly used in the circuit to maintain the exact voltage which is followed by the power supply. A regulator is mainly employed with the capacitor connected in parallel to the input terminal and the output terminal of the IC regulator. For the checking of alterations in the input as well as in the output filter, capacitors are used. While the bypass capacitors are used to check the small period spikes on the input and output level. Bypass capacitors are mainly of small values that are used to bypass the small period pulses straightly into the Earth.

IV) DC-DC conversion

Solar energy

In today's environmentally conscious climate there is more and more interest being taken in alternative forms of power supply. Currently there are plans underway for a new Engineering Building for the University, in which it is hoped that some of these alternative and more environmentally friendly technologies may be incorporated. The purpose of this project is investigate the feasibility of implementing a battery charging which is powered by energy generated from solar panels that may be integrated in the input side of filter circuit.[20]

This project involves designing a small scale voting machine charging system which is powered via a solar panel and that is capable of charging batteries. The project also

requires research into the different solar panels available for the small scale system being designed, as well as into larger solar panels that may be implemented.

DC/DC converters/regulators form the Backbone of different portable electronic devices like cellular phones, laptops, MP3 players which are using batteries as their power supply. Portable devices usually comprise of several sub-circuits that should be supplied with different voltage levels, which are not the same as battery's voltage level which is the main supply voltage. Employing DC/DC converters can be offered as a method to generate multiple voltage levels from a single DC supply voltage to feed the different sub-circuits in the device. This method of generating multiple voltage levels from a single battery source can reduce the device area substantially. On the other hand DC voltage provided by battery or rectifier contains high voltage ripples and it is not constant enough, thus it is not applicable for most devices. DC/DC regulators are employed to attenuate the ripples regardless of change in the load current or input voltage [20]

DC-DC Step-Down (Buck) Converter

Building a DC-DC Step-Down (Buck) Converter Circuit Using Positive Voltage Regulator Voltage regulators are commonly found in the power supplies as they play a major role to stabilize the output DC voltages. The operation of the voltage regulators basically by comparing the actual output voltage with the internal fixed reference voltage and utilize the negative feedback control loop in order to increase accuracy and reduce the error. [20]

The LM7805 is a positive voltage regulator that is made by Fairchild Semiconductor. It is a positive linear voltage regulator with three terminal pins. Unlike switching voltage regulator, positive linear voltage regulator only has the functionality of stepping-down (input voltage must be greater than the output voltage). This particular voltage regulator has limiting output current, short circuit and thermal shut down protection.

CHATER THREE

3. METHODOLOGY

System block diagram design methods are necessary for successfully designing a complex hardware. There may be specific tasks involved with system design. A system design of our project typically consists of problem analysis, program design, program coding, program debugging and testing the program with software designed circuit. Documentation taking place in each critical activity. It consists about details what the program does and how it works. In the above methods of the system design life cycle (SDLC), the system analysis a set of specification's indicating exactly what the new system should do and how it will do. These specifications include data flow diagram, system flow charts, input and output designed, and so on.

In this method of the SDLC, the specifications developed during the problem analysis step are used to define a precise description of the nature of the required program. In this project there are two main methods considered in designing the system. These are: Hardware and software design method.

In hardware designing different types of the components can be selected according to their specifications and connected to together to build the complete system. The complete system circuit can be drawn using different circuit making software. In this project proteus8 ISIS Professional is used to draw and to build the PCB of the system.

In software designing the control program can be written in micro c pro for PIC using C-Language. Then the entire program can be built and simulated on Proteus8 ISIS professional window.

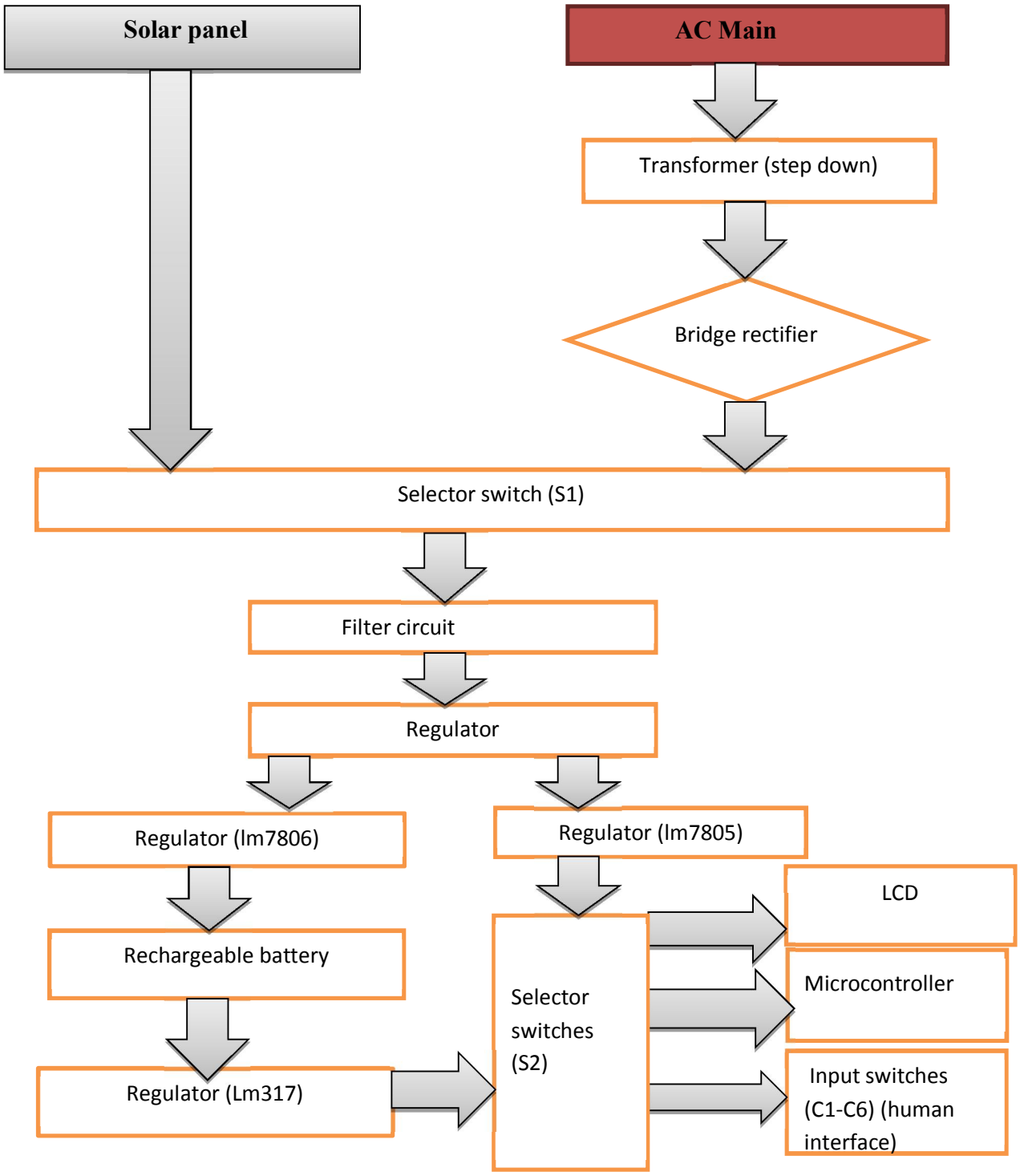


Fig 3.1 General Block diagram of the System

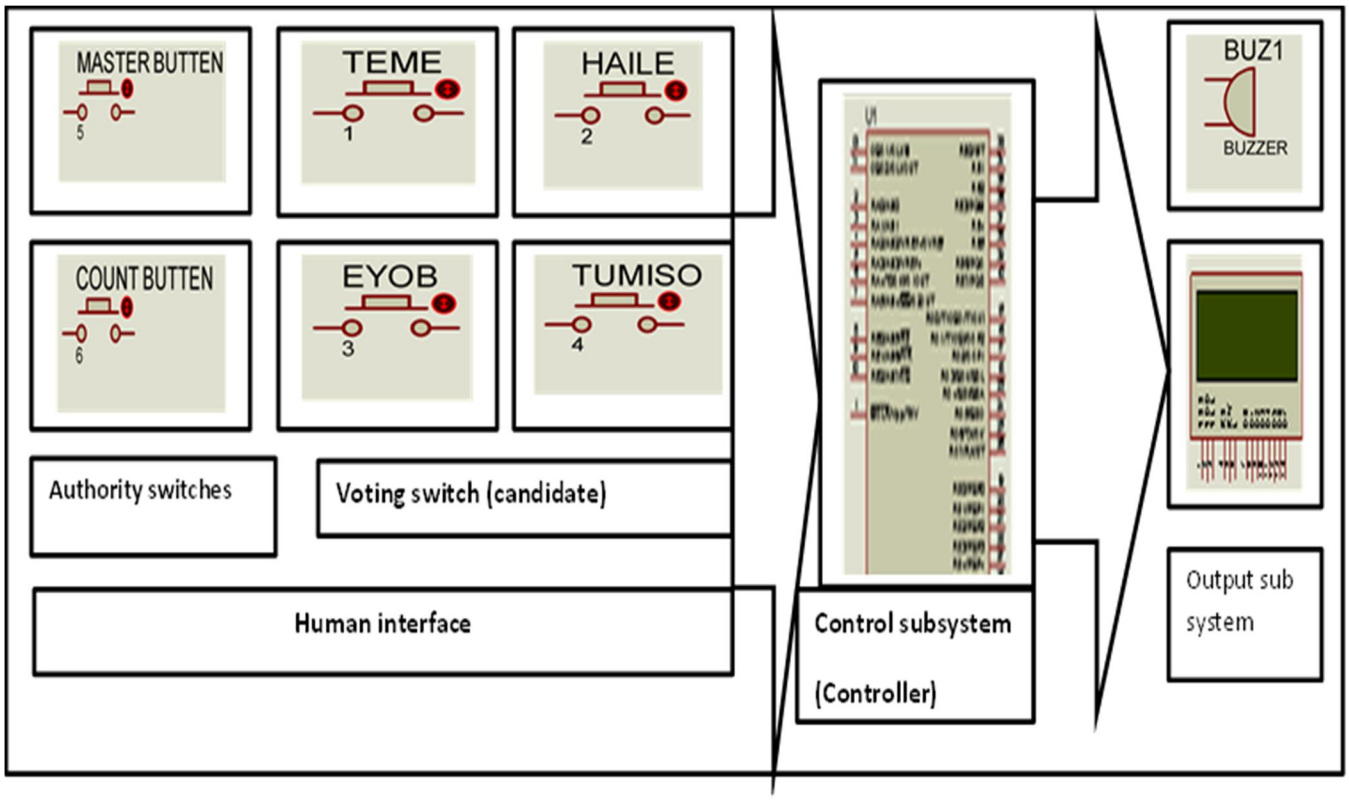


Fig 3.2 System block diagram with independent switch board

The system block diagram consists of Human interface, Switch board, PIC16F877A, Selector switch, Rechargeable battery, Filter, Regulator, Solar panel, Ac mains, Buzzer&LCD display. The input consists of six SPST switches: from these four are candidate switches are made active high and connected to pins 0-3 (P0^1 – P3^4) of the controller. . The remaining two switches (both active low) are to master and count the voting procedure. They are connected to pins 4 and 5 (P4^5and P5^6) respectively. The master switch initializes the voting system when pressed, while the count switch ends the voting and displays the poll (election) results on LCD screen.

The switches and 16x2 LCD are interfaced to microcontroller PIC16F877Afor various operations and displays. The micro controller PIC 16F877A interfaced to the LCD & the candidate switch for various operations &display the message on the LCD. The output part consists of LCD& Buzzer, the user votes for a candidate by pressing one of the switches the value of the corresponding variable is increased by one. The power supply parts consist of solar panel, AC main, Ac to Dc convertor circuit, Filter, Regulator& Rechargeable battery. Solar panels generate free power from the sun by converting sunlight to electricity. Solar power system consists of Solar Panels, a Power convertor, a Charge Controller, and Rechargeable Batteries.

Solar panel is supplies the electricity & charges the batteries. Ac power can be converted in to Dc using one of the power electronic converters called as Rectifier. There are different types of rectifiers, such as half wave rectifier, full wave rectifier and bridge rectifier. Due to the advantages of the bridge rectifier over the half and full wave rectifier, the bridge rectifier is frequently used for converting AC to DC. DC can be filtered using a capacitor filter for removing the ripples. DC voltage can be stepped down by using a DC step-down converter called as voltage regulator IC7805. The first two digits '78' of IC7805 voltage regulator represent positive series voltage regulators and the last two digits '05' represents the output voltage of the voltage regulator.

A Charge Controller is needed to prevent overcharging of the batteries. Proper charging will prevent damage and increase the life and performance of the batteries. Rechargeable batteries save money and resources and expected to continue growing with the increasing prevalence of portable electronics, Appliances and tools. A battery is composed of one or more cells, either parallel or series connected to obtain a required current/voltage capability.

CHAPTER FOUR

4. DESIGN AND ANALYSIS

4.1. Design Method

Designing methods are techniques which make a system design simple by decomposing it. A system can be design using either top-down or bottom-up design approaches for the purpose of studying how well those component parts work and interact to accomplish their purpose.

4.1.1. Top-Down Decomposition

It is easier to understand the operation of the whole by looking at its pieces and their interactions. We “divide” a system into subsystems and components in order to more easily “conquer” the problem and build the larger system. This is a good strategy for constructing any kind of complex system. The process of top-down decomposition starts with the description of a whole system and replaces it with a series of smaller steps- each step is a more primitive subsystem.

Figure 4.1 shows the possible decompositions of the electronic voting machine system. It is broken down into power supply subsystem, input subsystem, controller unit subsystem and output unit subsystem. The power supply subsystem uses three alternatives of electric power from solar, AC mains and rechargeable battery to enable the machine works both in urban and rural as well as in dark/night/ time. The input subsystem allows the voters to cast their votes, to initialize the machine and to compare and display results for. The controller is used to count and display votes by preventing repeated touching of switches to avoid cheating. The output subsystem is used to display the results, display instructions for the voters and examiners and produces sound to note both voters and examiners.

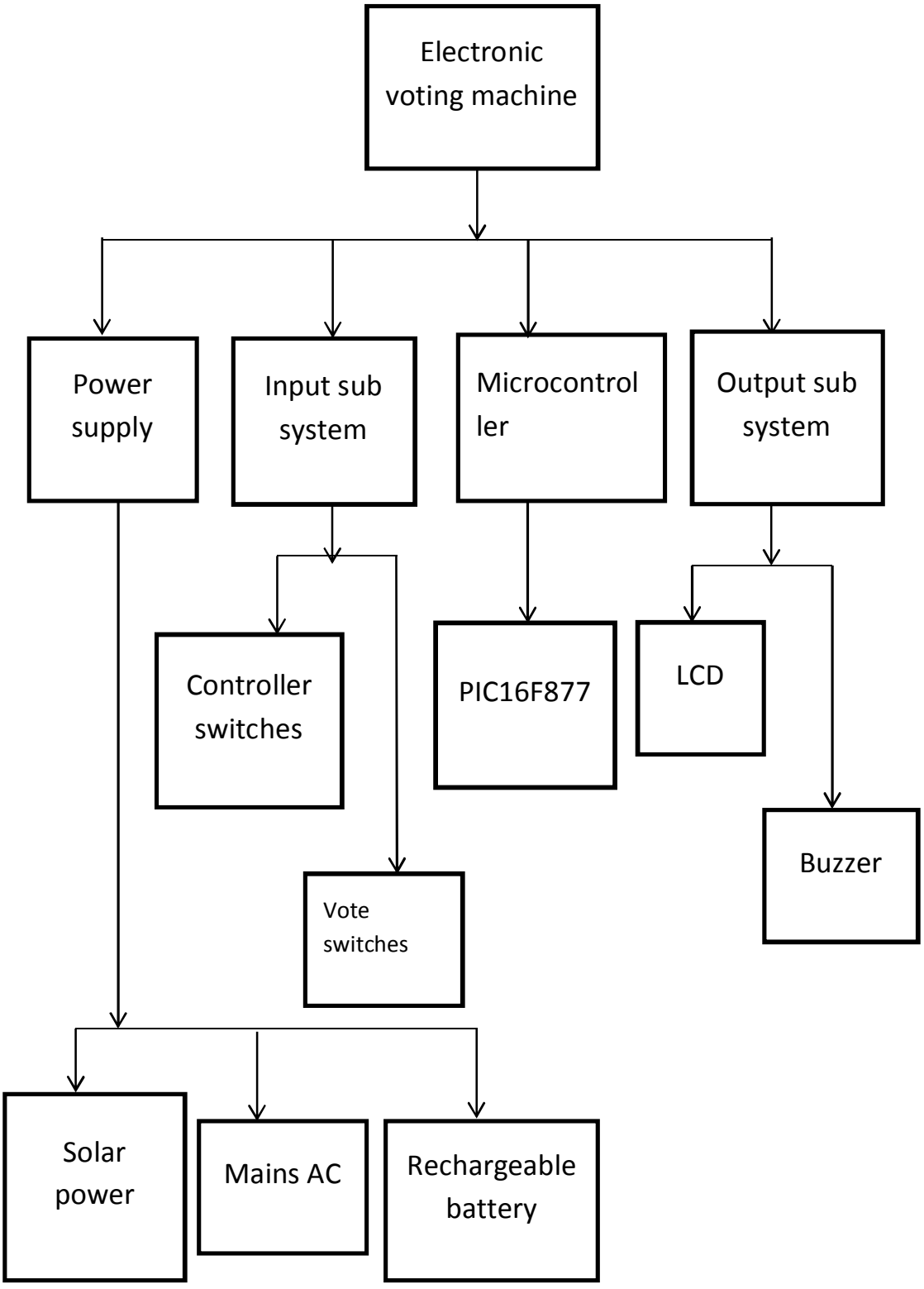


Figure 4.1 Electronic voting machine system decomposition

4.2. The design process

The design should follow known sequence of tasks to reach a successful result.

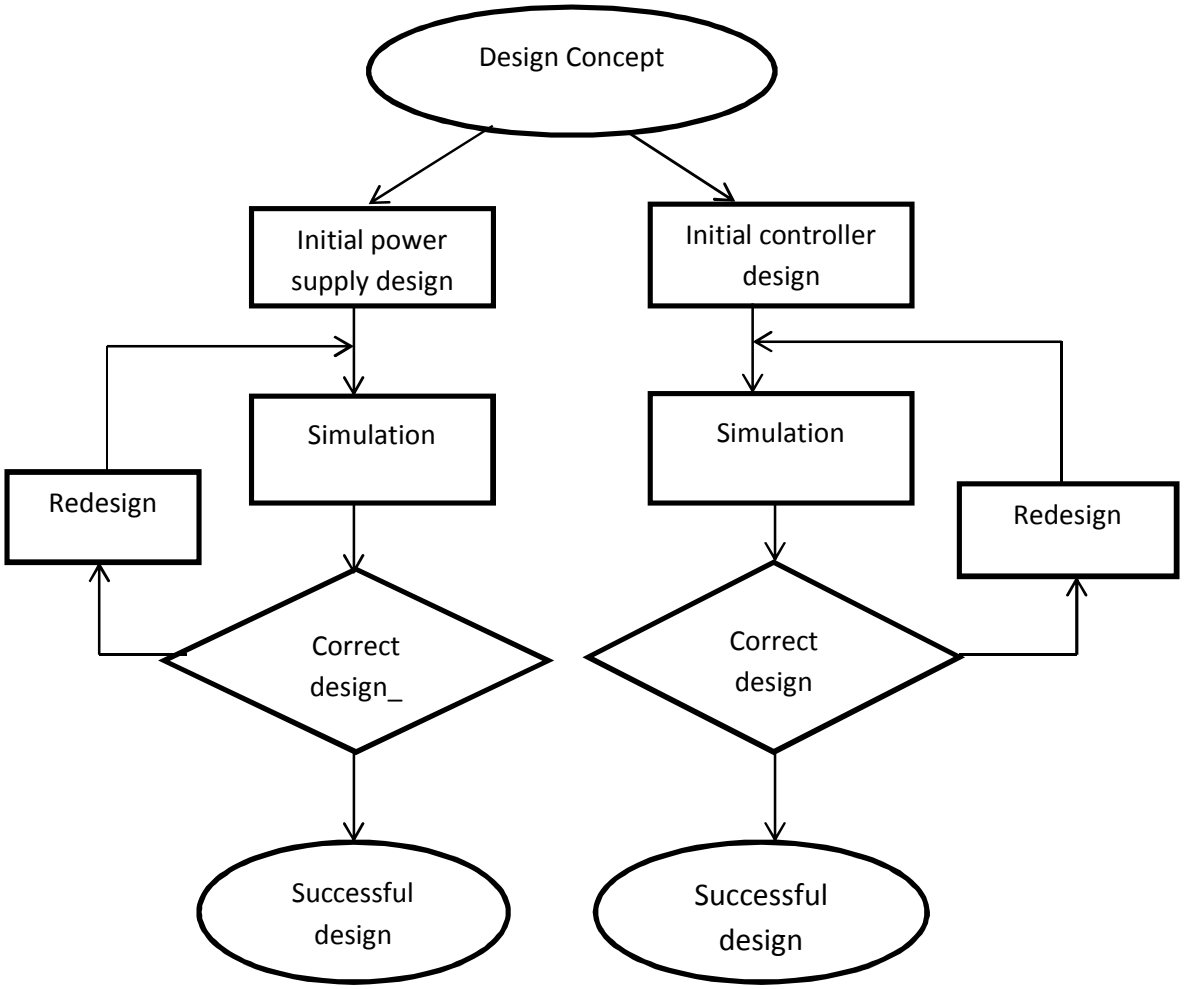


Fig 4.2 flow chart of the system design

The design comprises of power supply and vote controller system. The power supply is designed from three alternatives of solar, mains AC and rechargeable battery. The solar is designed to produce regulated 5Volts using LM7805 IC and the other supply from AC is designed to produce 5 Volts by using the same filter and regulator parts with solar after it has rectified. The rechargeable battery is to be charged from solar or mains AC depending on the availability of the power. The power supply is designed to supply the microcontroller from the available power using selector switch. The microcontroller part of our project is designed to cast vote by pressing

switch and to display results after pressing a stop switch. It starts accepting vote after pressing a master switch.

4.3. Analysis

This project consists of alternative power supply system (solar power, mains AC and rechargeable battery as power backup), input system (SPST switch for each candidate, master switch and stop switch), controller (PIC16F877A microcontroller) and display system (LM016L LCD).

- An integrated power supply is designed so that some portion of each source allowed using common devices in order to be economic wise. Mains AC has to be rectified using bridge rectifier and pulsating DC with some ripple will be produced. Now this output is nearly similar with the power from solar. Hence the filter and regulator part of the power supply is designed to serve for both sources since we use one of it at a time. The rechargeable battery is to be charged from the output of this power supply system later serves as power backup when electric goes off and the day time gets night. It is equipped with selector switch to select the source at a time to prevent simultaneous connection of the sources. The microcontroller is to be supplied from these alternative sources depending on the place and time.
- The input system consists of tactile switch for each candidate to cast vote. The switches are inputs of the controller to activate the controller to increase the value by one for each touch. The functioning of these tactile switches are governed by the master switch after it transmits signal for the controller, there by the controller allows the tactile switches. This technique is used to prevent cheating by repeated touching by a single person. Stop switch is also connected within the input pin of the controller to display numbers of votes for the respective candidates.
- The controller is responsible for receiving switches state and performing its activity by fetching instructions from its ROM. The controller uses PIC 16F877 chip and the source code is written using C language.
- For this specific project LM016L LCD is used for four candidates with two lines and each of capable of displaying sixteen characters. Hence instructions of the controller for the voters and examiners and results will be displayed on it.

4.4. Hardware subsystem design

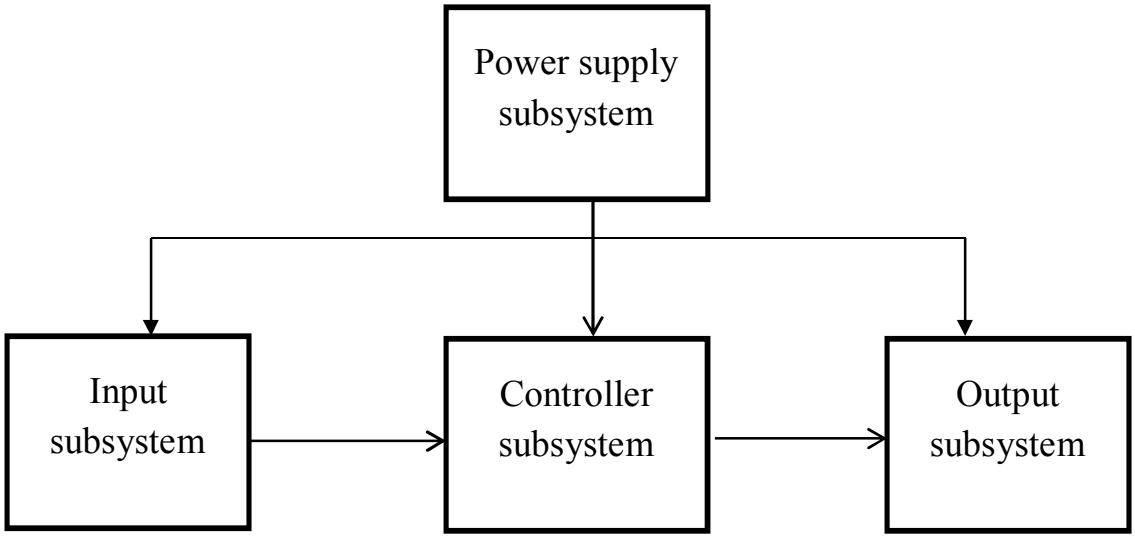


Figure 4.3.Electronicvoting machine subsystem block diagram

As shown in the above block the electronic voting machine is designed to be supplied with alternative power source. The input systems are of SPST switches connected to microcontroller directly. The control system is of control algorithm stored in the memory and control logic in the processing unit. The output subsystem consists of LM016L LCD and buzzer interfaced with PIC16F877A controller. This chapter discusses details about hardware design.

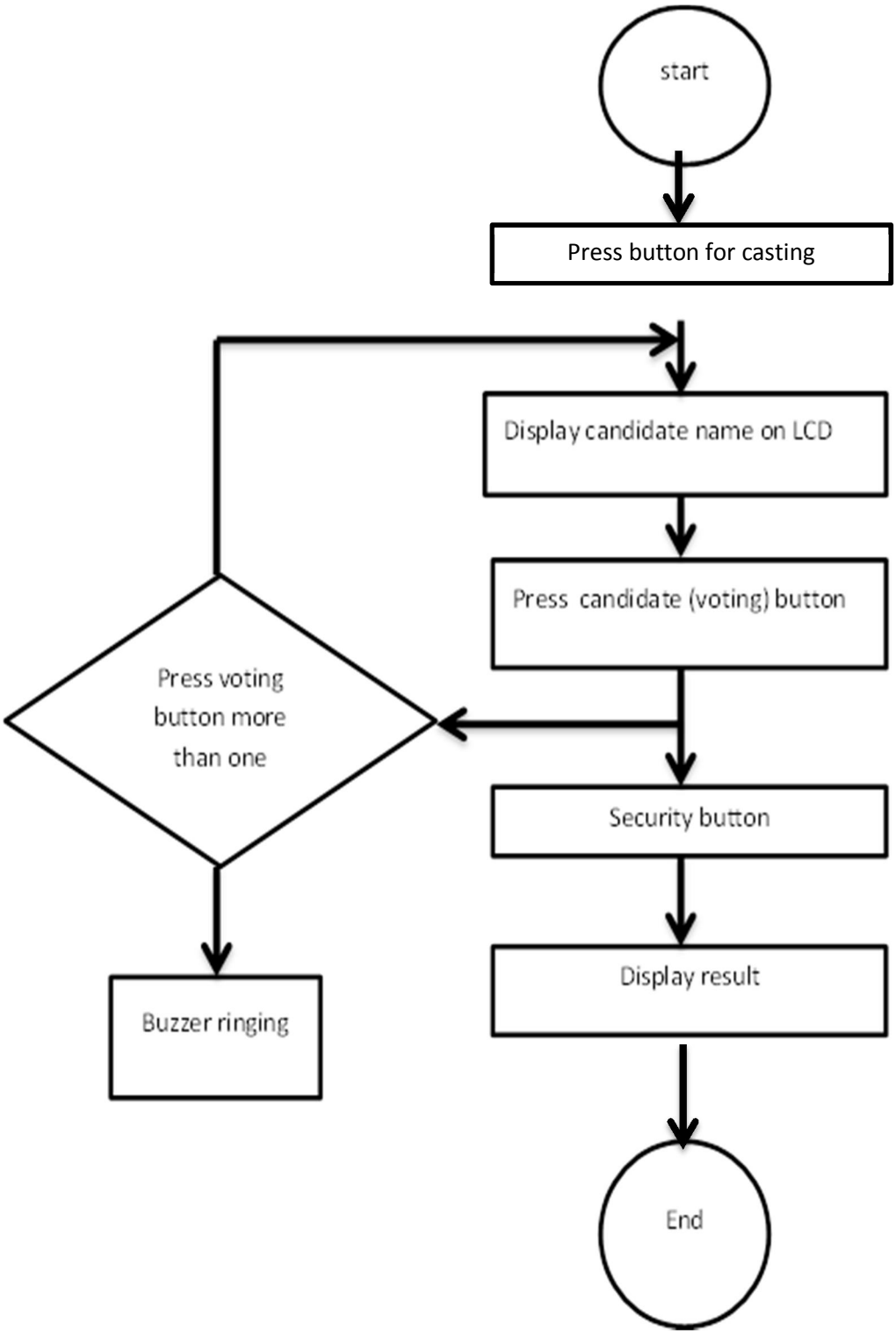


Fig.4.4 flow chart of EVM

4.4.1. Power supply subsystem

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others. Here in our application we need a 5V & 6V DC power supply for all electronics involved in our project. We use different power sources for this project these are solar, mains AC and rechargeable battery. This requires step down transformer, rectifier, voltage regulator, and filter circuit for generation of 5V & 6V DC power. Here a brief description of all the components and design aspects are given as follows:

4.4.2 Design of power supply from Mains AC source

The input power supply applied to the circuit is from the regulated power supply which supplies constant 5V to the microcontroller. The AC input of 230V from the mains supply is fed to the step down transformer to step down the voltage to 12V which is supplied as input to the rectifier. The output obtained from the rectifier is a pulsating DC voltage. Now in order to obtain pure D.C voltage, the output voltage from the rectifier is fed to a filter to remove any A.C components present even after rectification. This voltage is given to a voltage regulator (7805) to obtain a pure constant 5V dc voltage.

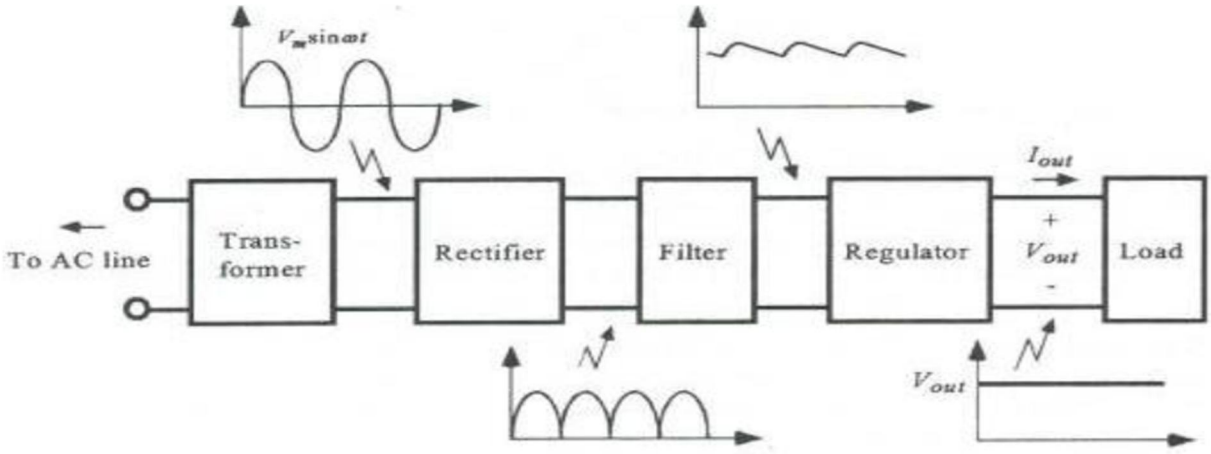


Fig 4.5. Block diagram of power supply

4.4.2.1 Step down Transformer

Transformer is a device that transfers electrical energy from one circuit to another through inductively coupled conductors -the transformer's coils or "windings". Except for air-core transformers, the conductors are commonly wound around a single iron-rich core, or around separate but magnetically coupled cores.

A varying current in the first or "primary" winding creates a varying magnetic field in the core (or cores) of the transformer. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the "secondary" winding. This effect is called mutual induction.

Fig 4.6.transformer

If a load is connected to the secondary circuit, electric charge will flow in the secondary winding of the transformer and transfer energy from the primary circuit to the load connected in the secondary circuit.

The secondary induced voltage *VS*, of an ideal transformer, is scaled from the primary *VP* by a factor equal to the ratio of the number of turns of wire in their respective windings:

$$\frac{V_S}{V_P} = \frac{N_S}{N_P}$$

By appropriate selection of the numbers of turns, a transformer thus allows an alternating voltage to be stepped up — by making *NS* more than *NP* — or stepped down, by making it.

BASIC PARTS OF A TRANSFORMER

In its most basic form a transformer consists of:

- A primary coil or winding.
- A secondary coil or winding.
- A core that supports the coils or windings.

Refer to the transformer circuit in figure as you read the following explanation: The primary winding is connected to a 60-hertz ac voltage source. The magnetic field (flux) builds up

(expands) and collapses (contracts) about the primary winding. The expanding and contracting magnetic field around the primary winding cuts the secondary winding and induces an alternating voltage into the winding. This voltage causes alternating current to flow through the load. The voltage may be stepped up or down depending on the design of the primary and secondary windings.

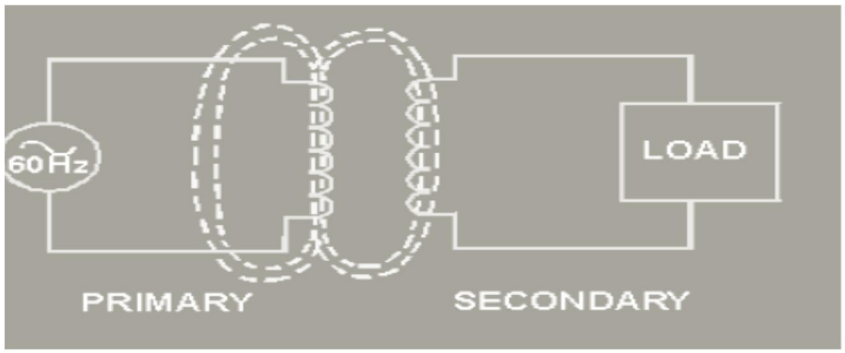


Fig.4.7 Structure of transformer /www.electricicuit.com

4.4.2.2 Bridge rectifier

We designed rectifier circuit, using rectifier diode. The diode is a p-n junction device. Diode is the component used to control the flow of the current in any one direction. The diode widely works in forward bias. When the current flows from the P to N direction, then it is in forward bias. The Zener diode is used in reverse bias function i.e. N to P direction. Visually the identification of the diode`s terminal can be done by identifying the silver/black line. The silver/black line is the negative terminal (cathode) and the other terminal is the positive terminal (cathode).

Based on their application diodes are classified in to:

- Diodes: Rectification, free-wheeling, etc
- Zener diode: Voltage control, regulator etc
- Tunnel diode: Control the current flow, snobbier circuit, etc

A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full-wave rectification. This is a widely used configuration, both with individual diodes wired as shown and with single component bridges where the diode bridge is wired internally.

Basic operation

According to the conventional model of current flow originally established by Benjamin Franklin and still followed by most engineers today, current is assumed to flow through electrical conductors from the positive to negative pole. In actuality, free electrons in a conductor nearly always flow from the negative to the positive pole. In the vast majority of applications, however, the actual direction of current flow is irrelevant. In the diagrams below, when the input connected to the left corner of the diamond is positive, and the input connected the right corner is negative, current flow from the upper supply terminal to the right along the red(positive) path to the output ,and returns to the lower supply terminal via the blue (negative) path.

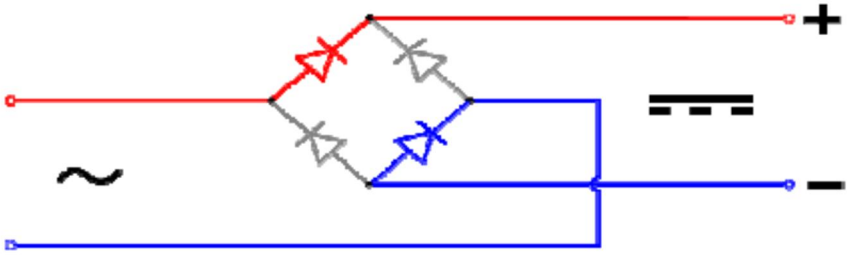


Fig 4.8 operation of bridge mode -1

When the input connected to the left corner is negative, and the input connected to the right corner is positive, current flow from the lower supply terminal to the right along the red path to the output, and returns to the upper supply terminal via the blue path.

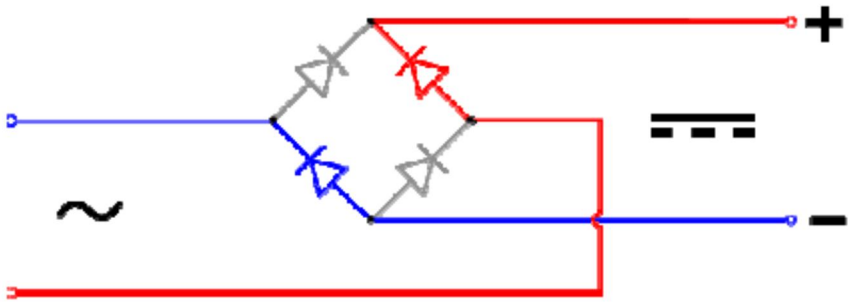


Fig 4.9 operation of bridge at mode -2

In each case, the upper right output remains positive and lower right output negative. Since this is true whether the input is AC or DC, this circuit not only produces a DC output from an AC input, it can also provide what is sometimes called "reverse polarity protection". That is, it permits normal functioning of DC-powered equipment when batteries have been installed backwards, or when the leads (wires) from a DC power source have been reversed, and protects the equipment from potential damage caused by reverse polarity.

4.4.2.3 Filter

The simple capacitor filter is the most basic type of power supply filter. The application of the simple capacitor filter is very limited. It is sometimes used on extremely high-voltage, low-current power supplies for cathode-ray and similar electron tubes, which require very little load current from the supply. The capacitor filter is also used where the power-supply ripple frequency is not critical; this frequency can be relatively high. The capacitor (C1) shown in figure 4.10 is a simple filter connected across the output of the rectifier in parallel with the load.

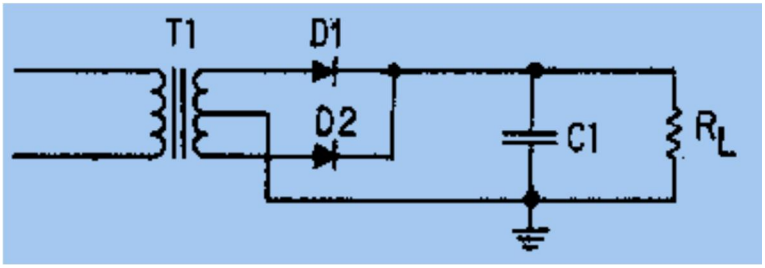


Fig.4.10 simple capacitor filter connected across the output of the rectifier in parallel with the load

Full-wave rectifier with a capacitor filter

When this filter is used, the RC charge time of the filter capacitor (C1) must be short and the RC discharge time must be long to eliminate ripple action. In other words, the capacitor must charge up fast, preferably with no discharge at all. Better filtering also results when the input frequency is high; therefore, the full-wave rectifier output is easier to filter than that of the half-wave rectifier because of its higher frequency. For you to have a better understanding of the effect that filtering has on Eavg, a comparison of a rectifier circuit with a filter and one without a filter is illustrated in views A and B of figure 4-10. The output waveforms in figure 4-10 represent the unfiltered and filtered outputs of the half-wave rectifier circuit. Current pulses flow through the load resistance (RL) each time a diode conducts. The dashed line indicates the average value of output voltage. For the half-wave rectifier, Eavg is less than half (or approximately 0.318) of the peak output voltage. This value is still much less than that of the applied voltage. With no capacitor connected across the output of the rectifier circuit, the waveform in view A has a large pulsating component (ripple) compared with the average or dc component. When a capacitor is connected across the output (view B), the average value of output voltage (Eavg) is increased due to the filtering action of capacitor C1.

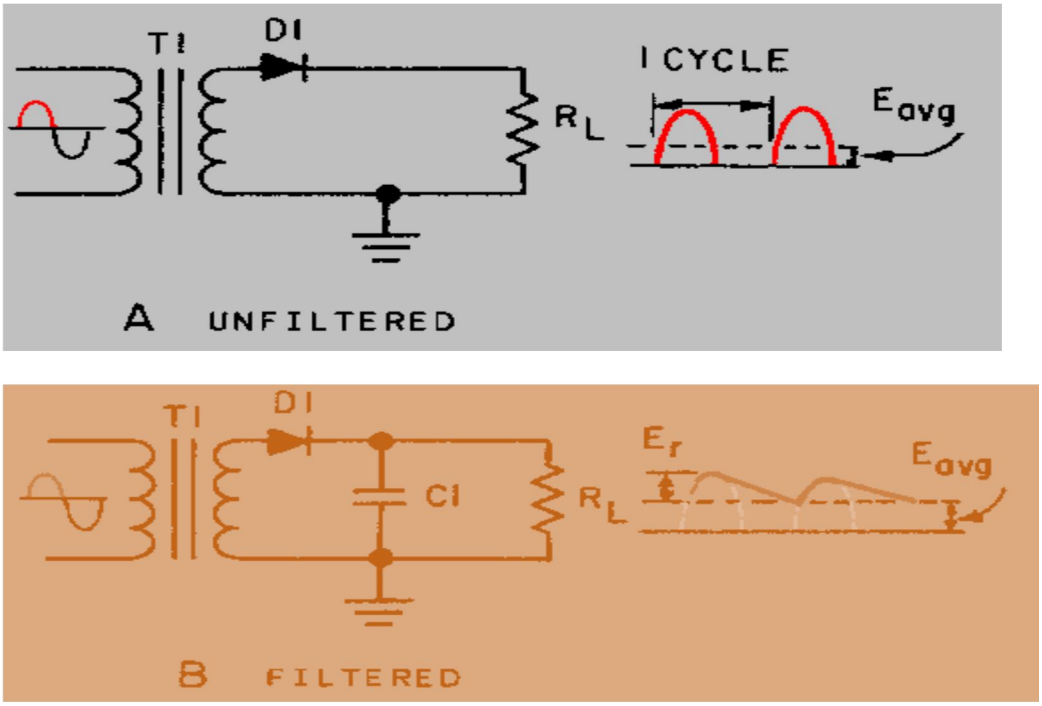


Fig 4.11 Half-wave rectifier with and without filtering

Doubling the frequency of the rectifier, you reduce the impedance of the capacitor by one-half. This allows the ac component to pass through the capacitor more easily. As a result, a full rectifier output is much easier to filter than that of a half-wave rectifier. Remember, the smaller the Xc of the filter capacitor with respect to the load resistance, the better the filtering action.

$$X_C = \frac{1}{2\pi fC}$$

Since the largest possible capacitor will provide the best filtering. Remember, also, that the load resistance is an important consideration. If load resistance is made small, the load current increases, and the average value of output voltage (Eavg) decreases. The RC discharge time constant is a direct function of the value of the load resistance; therefore, the rate of capacitor voltage discharge is a direct function of the current through the load. The greater the load current, the more rapid the discharge of the capacitor, and the lower the average value of output voltage. For this reason, the simple capacitive filter is seldom used with rectifier circuits that must supply a relatively large load current. Using the simple capacitive filter in conjunction with a full-wave or bridge rectifier provides improved filtering because the increased ripple frequency decreases the capacitive reactance of the filter capacitor. To determine filter capacitor:

$$C=\frac{5*I_O}{V_P*f}$$

Where;-
Vp=peak voltage (Vp=Vrms*√2)=10.6*1.42=15V
f=frequency
I_O=load current
Vrms=10.6v
We use microcontroller, LCD, battery as a load and the total circuit load current from the data sheet will be (I_O=650mA).

$$C=\frac{5*650*10^{-3}A}{15v*100hz}=0.22\ uF$$

Alternatively we can determine the capacitance of filter capacitor as follow.
The charge Q (coulombs) removed from the capacitor is Q=I*there I is the current and t is time.
Q=C*ΔV
So C*ΔV=Q=I*t
Rearranging the above equation, it gives C=I*t/ΔV

4.4.2.4 Bypass capacitor

We use bypass in our power supply circuit. Bypass capacitor is a capacitor that shorts AC signal to ground, so that any AC noise that maybe present on a DC signal is removed, producing a much cleaner and pure DC signal. A capacitor is a device that forces a tremendously high resistance for a signal of low frequencies. Therefore, signal at low frequency will not go through them. This is because signals (current) always takes the path of least resistance .finally a bypass capacitor block the DC from entering it by the greet resistance it offers to the signal but accepts the AC noise that may be on the DC line and shunts or bypasses it to ground .Based on the general formula we used 22uF electro-light capacitor for our power supply circuit.

4.4.2.5 Voltage regulator

A regulated power supply is very much essential for several electronic devices due to the semiconductor material employed in them have a fixed rate of current as well as voltage. The device may get damaged if there is any deviation from the fixed rate. The AC power supply gets converted into constant DC by this circuit. By the help of a voltage regulator DC, unregulated output will be fixed to a constant voltage. The circuit is made up of linear voltage regulator 7805 along with capacitors and resistors with bridge rectifier made up from diodes.

LM7805 voltage regulator

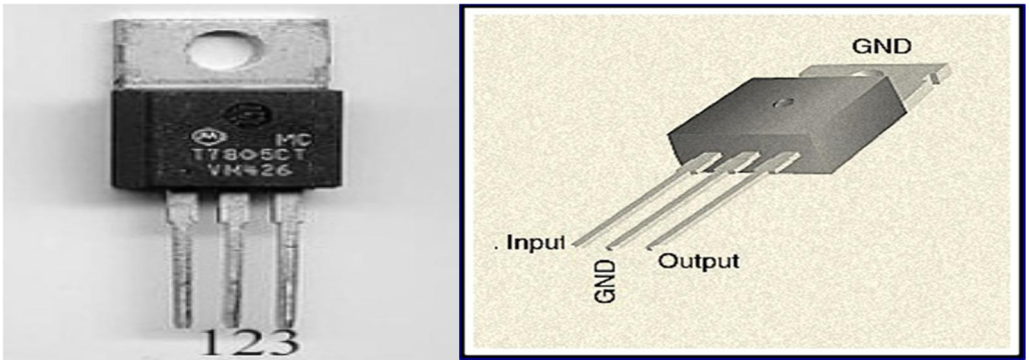


Fig 4.12 Voltage regulator

REGULATOR IC (78XX)

It is a three pin IC used as a voltage regulator. It converts unregulated DC current into regulated DC current. Normally we get fixed output by connecting the voltage regulator at the output of the filtered DC (see in above diagram).

There are two types of voltage regulators.

1. Fixed voltage regulators (78xx, 79xx)
2. Variable voltage regulators (LM317)

Fixed voltage regulators are also there is another classification:

1. +ve voltage regulators
2. -ve voltage regulators

Positive voltage regulators

This includes 78xx voltage regulators. The most commonly used ones are 7805 and 7812.7805 gives fixed 5V DC voltage if input voltage is in (7.5V, 20V).

4.4.3 Schematic circuit diagram of Ac to Dc converter

The schematic circuit below shows the design details of power supply from mains AC to the loads. Since our power supply is integrated, we talked similarly in different places; however each type of source has to be studied independently. Accordingly, our design of the filter and regulator as well as design preconditions is the same, so we applied the same rule and formula to determine such sections. All design procedures and methods applied to solar also used for mains AC except that of transforming it and rectification.

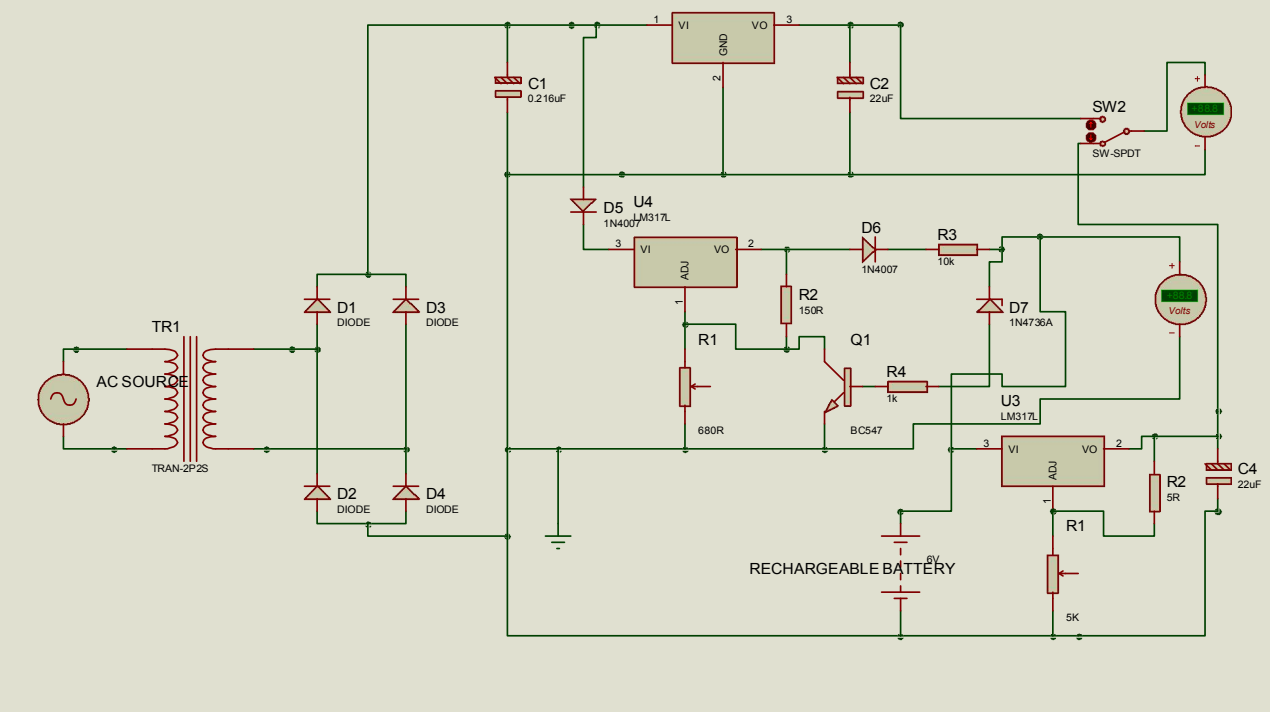


Fig 4.13 Circuit design from AC source to the loads and charging the battery

First we selected 12V step down transformer so that our need is low voltage application and our standing point is the output, i.e. our need is 5V & 6V dc. Next to produce these voltages, we selected voltage regulators of LM7805 & LM317. In this case the input voltage ranges of the regulators were important to determine the secondary output of the transformer. By this analogy, the output of the rectifier must be within the above range. Note that we used schottky diode whose drop is 0.7V. Since two diodes work simultaneously a total of 1.4V will be dropped. Therefore, the secondary output voltage of the transformer must satisfy the working range of the

regulators and the dropped voltage values in the rectifier. It is known that this source is used to feed the loads directly and to charge the battery, so it incorporates two regulators of having 5V & 6V.

4.4.4. Solar power supply design

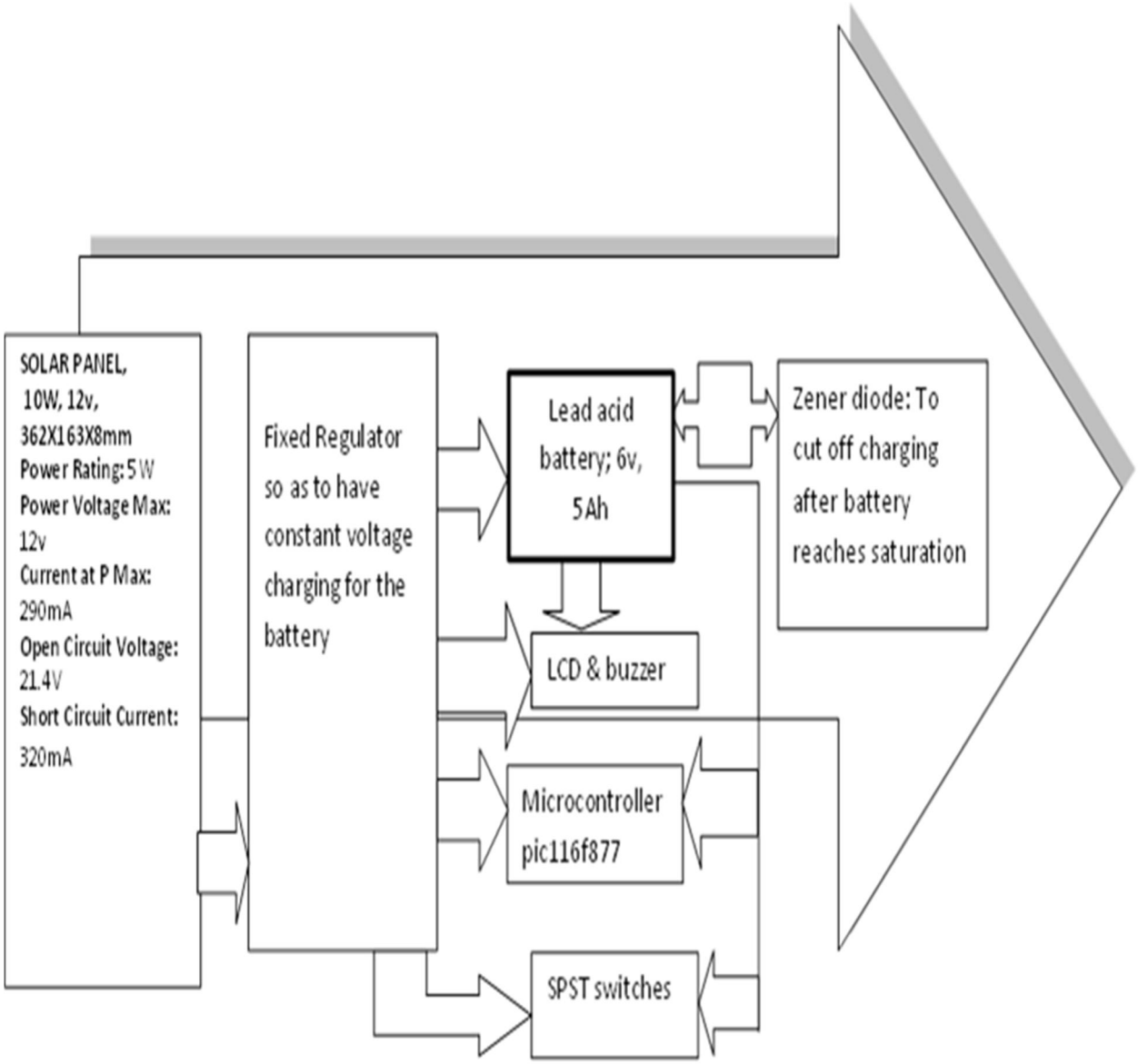


Fig 4.14 Brief description of solar power supply circuit as follows:

Photovoltaic cell

The term "photovoltaic" comes from the Greek (photo) meaning "light", and "voltaic", meaning electric, from the name of the Italian physicist “VOLTA “after whom a unit of electro-motive force, the volt is named.

The term "photo-voltaic" has been in use in English since 1849.The sun is a star made up of hydrogen and helium gas and it radiates an enormous amount of energy.

Principle of PV cell

Solar cell works on the principle of photovoltaic effect. Sunlight is composed of photons, or "packets" of energy. These photons contain various amounts of energy corresponding to the different wavelengths of light. When photons strike a solar cell, they may be reflected or absorbed, or they may pass right through. When a photon is absorbed, the energy of the photon is transferred to an electron in an atom of the cell (which is actually a semiconductor). With its new found energy, the electron is able to escape from its normal position associated with that atom to become part of the current in an electrical circuit every second and it is clean.

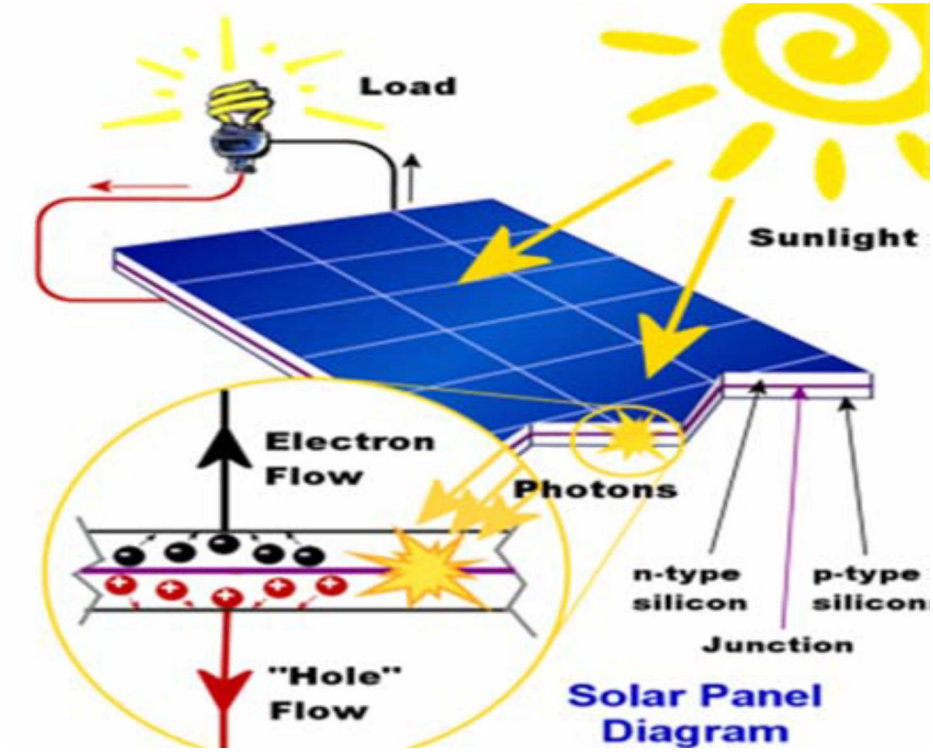


Fig 4.15.principle of PV cell

4.4.5. Final solar power supply circuit design

As shown in the circuit diagram below, the solar power is designed to supply different loads in our project. It is used to charge the battery, to supply the controller, inputs and outputs. Our selection criteria for the panel is the total circuit loads which consists of charging battery, microcontroller, output devices and input devices which is around 650mA. The other selection criterion for the panel is the regulators working range. As described earlier our regulators work on the ranges of 7V to 35V. In our design we allowed the solar through common filter and regulator with mains AC. Therefore the same design and analysis also works for the solar.

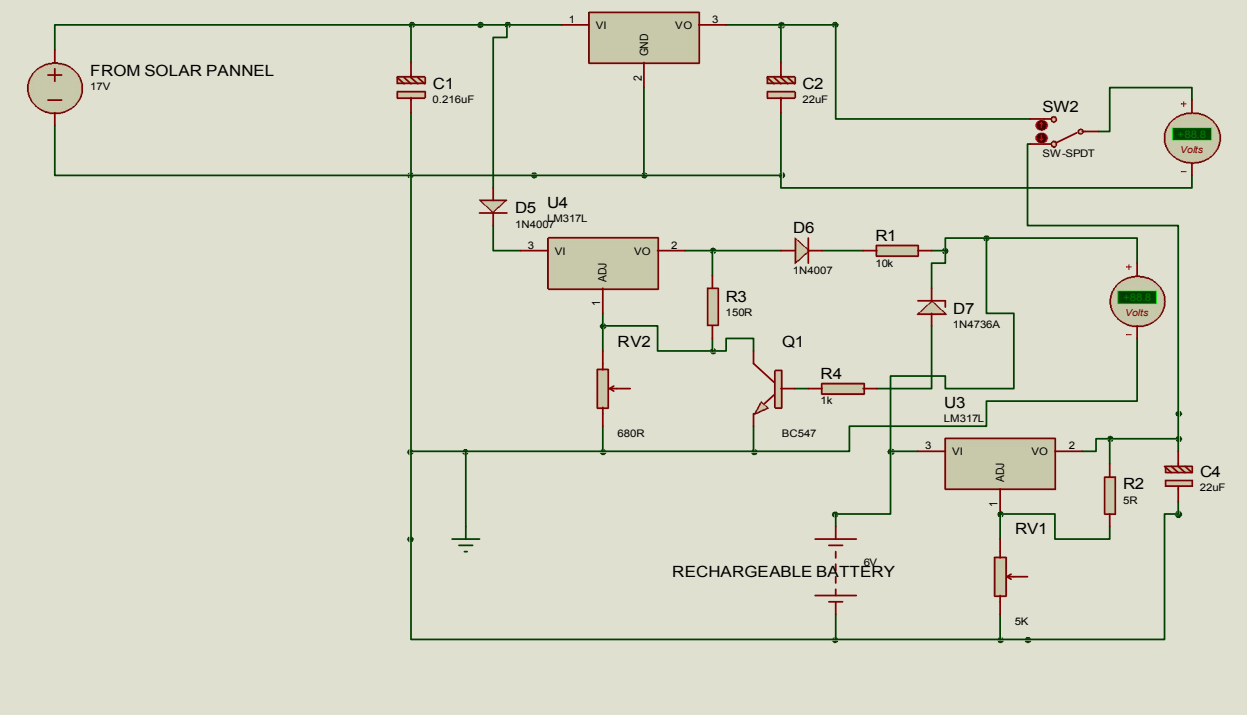


Fig 4.16. The solar panel and associated circuit to convert voltage level to suit the loads

4.4.6 Design of battery charge regulator

Here a battery charger circuit below is used to charge lead acid or Ni-Cd battery using solar and AC energy power. The circuit harvests both solar and AC energy to charge our 6 volt 4.5Ah rechargeable battery for our voting machine. The below circuit has voltage and current regulation and over voltage cut-off facilities.

The circuit uses a 12V solar, 12V after bridge rectifier from AC circuit and variable voltage regulator IC LM317.

12 volt DC is available from the panel to charge the battery. Charging current passes through D3 to the voltage regulator IC LM317.Resistor R3 restrict the charging current and D2 to prevent discharge of current from the battery.

Transistor Q1 and zener diode ZD act as a cut-off switch when the battery is full. Normally Q1 is off and battery gates charging current. When the terminal voltage of the battery rises above 6v. Zener conducts and provides base current to Q1. It then turns on grounding the output of LM317 to stop charging.

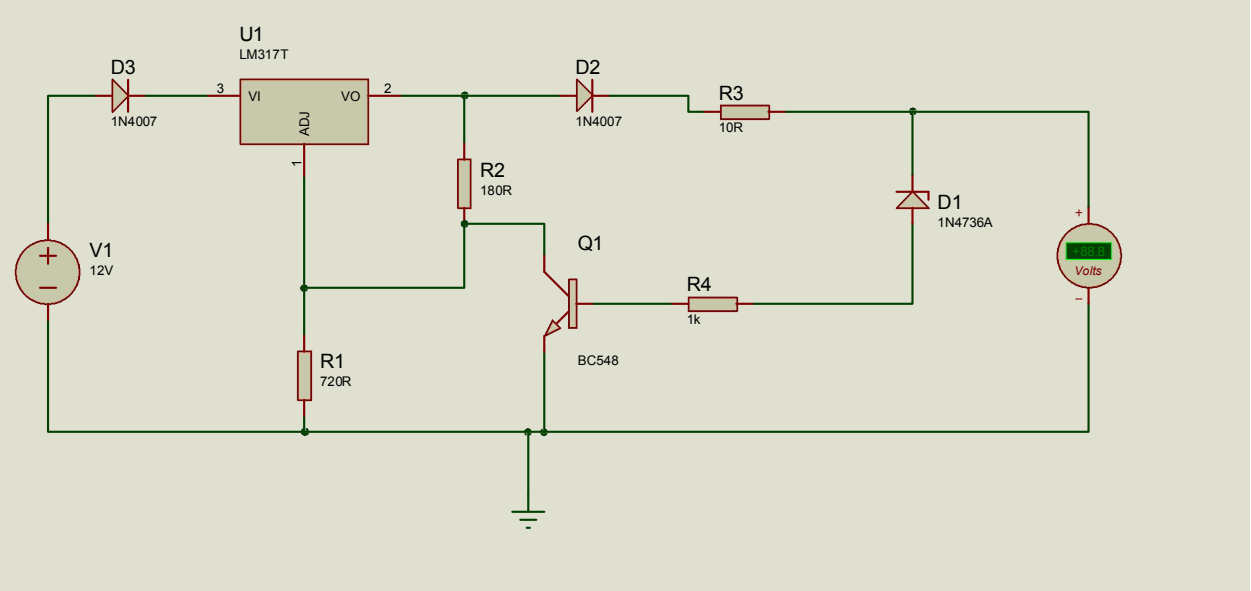


Fig 4.17 circuit design showing battery charger with cut off.

4.4.6.1 Rechargeable battery

In systems that utilize solar panels as the source of energy it is recommended to employ some sort of storage device. A storage device can prove very useful as it can store any unused energy generated by the solar panel throughout the day and, in turn, this store energy can be used to power a system when no sunlight is available to the solar panel, thus making the system more practical. The most realistic choice for this storage device is a backup battery. There are many different backup batteries available on the market today, with various different battery

chemistries. A number of battery chemistries that were researched for use in this project are discussed below, highlighting the advantages and disadvantages of each. Before that, let's see the design aspect of the battery power source in general. The following schematic circuit taken from protues8 shows the detailed circuit design of the rechargeable battery, the charge controller and the loads connection with the integrated power supply system.

4.4.6.2 Types of rechargeable battery

Lead Acid Batteries

Lead acid batteries are the oldest rechargeable batteries in existence. They are Inexpensive, reliable and widely used today. However, they are quite heavy and for a system like this storage may be a problem. Also charging times can be quite slow. Overall, lead acid batteries are more appropriate for larger power applications.

Nickel Cadmium (NiCad)

Nickel-Cadmium batteries have a long shelf life; they can be left to store energy for up to five years in some cases. They have other advantages as well, they prefer fast charging and work well under rigorous conditions, as well as having quite a high efficiency at 70%- 90%. However, they have a relatively low energy to weight ratio and can suffer from memory effect. Memory effect is a phenomenon observed in some rechargeable batteries, namely those with nickel-cadmium chemistries. It occurs when the rechargeable battery is repeatedly recharged without being fully discharged. This causes the battery to lose the capacity it originally had, and the performance of the battery is significantly lowered.

Nickel- Metal –Hydride(Ni-lMh)

Ni-Mh based battery cells have a larger capacity then the Ni-Cad batteries, so they are lighter, and are less prone to the memory effect described above. However, they can be expensive and have a relatively short storage life with a high self-discharge rate, making them less efficient.

Lithium-ion(Li-ion)

Li-ion performs the most efficiently out of all the battery chemistries discussed, with efficiencies of up to 99.9%. It also has the best weight to ratio, weighing about half that of a Ni-Cad or NI-Mh cell of the same capacity, making the batteries light and easy to to store. The average voltage of a Li-ion cell (3.6v- 3.7v) means one cell would be required for use in charging most mobile phones, compared to 3 Ni-Cad or Ni-MH batteries at1.2v each. Li-ion cells also relatively good

life cycle, as shown in ***Figure***.4.22Taking all of its advantages into account, it was decided that a Li-ion backup battery would be the most suitable for this system.

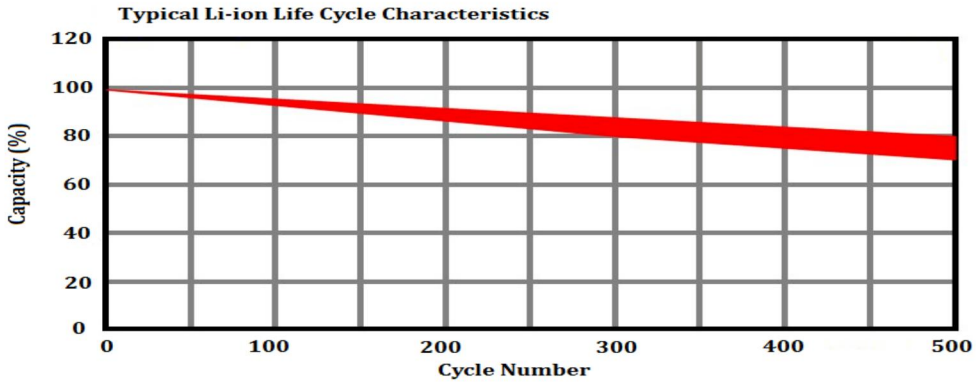


Figure 4.18 Li-ion life cycle

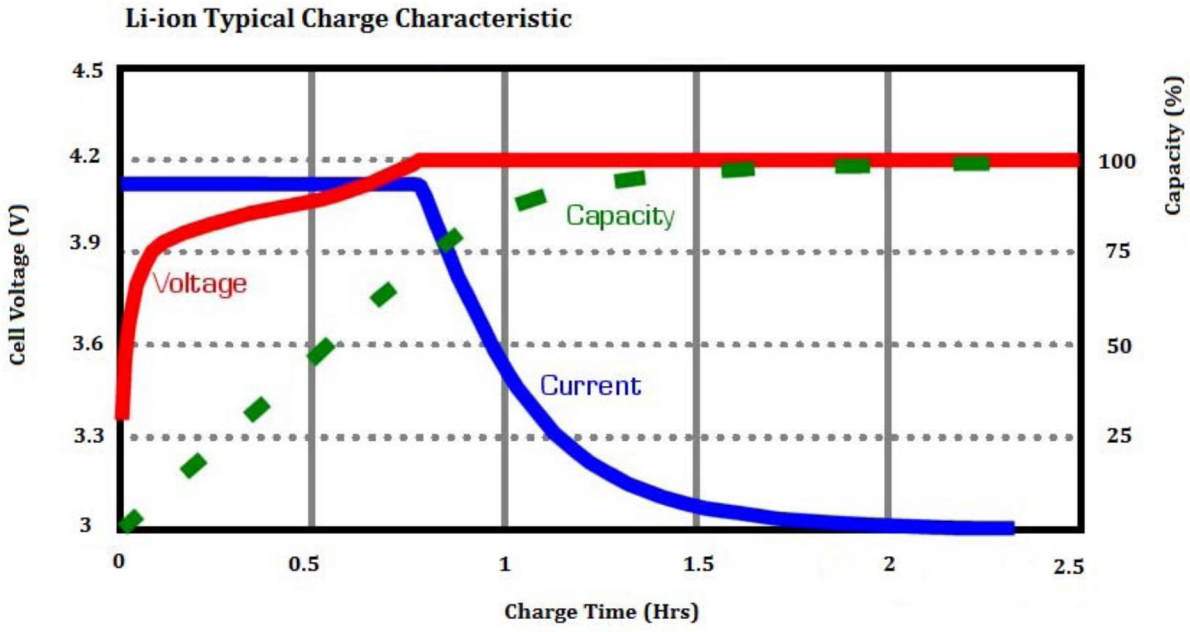


Figure 4.19 Charging profile for Li-ion

4.4.7 Final power supply schematic circuit diagram design

The schematic diagram shown in below is the integrated power supply composed of three sources. It is designed in such a way that our total circuit load is determined from all the loads i.e the input switches, microcontroller, LCD, buzzer and rechargeable battery. Hence the total load current is 650mA. This value is taken from the data sheet of the devices. In our design we used voltage regulators of LM7805, LM7806 & LM317. The mains AC after it has transferred to

lower potential level (12V) and rectified, we allowed it to use the same filter and regulator with solar power source. As a result our capacitor for filtering is determined from the total load current, peak voltage value of the rectifier and frequency. The frequency is now doubled due to rectifier, i.e. 100 Hz. C=5*Io/Vp*f.

Now both solar power and mains AC after some process they are allowed to pass through LM 7805 and the output of the regulator is used for direct supply of the loads and to charge the battery. We used 6V rechargeable battery and hence LM7806 is selected to feed the battery. The capacity of the battery is 650mAh and it is also protected from over charging by using 6v, 2A zener diode.

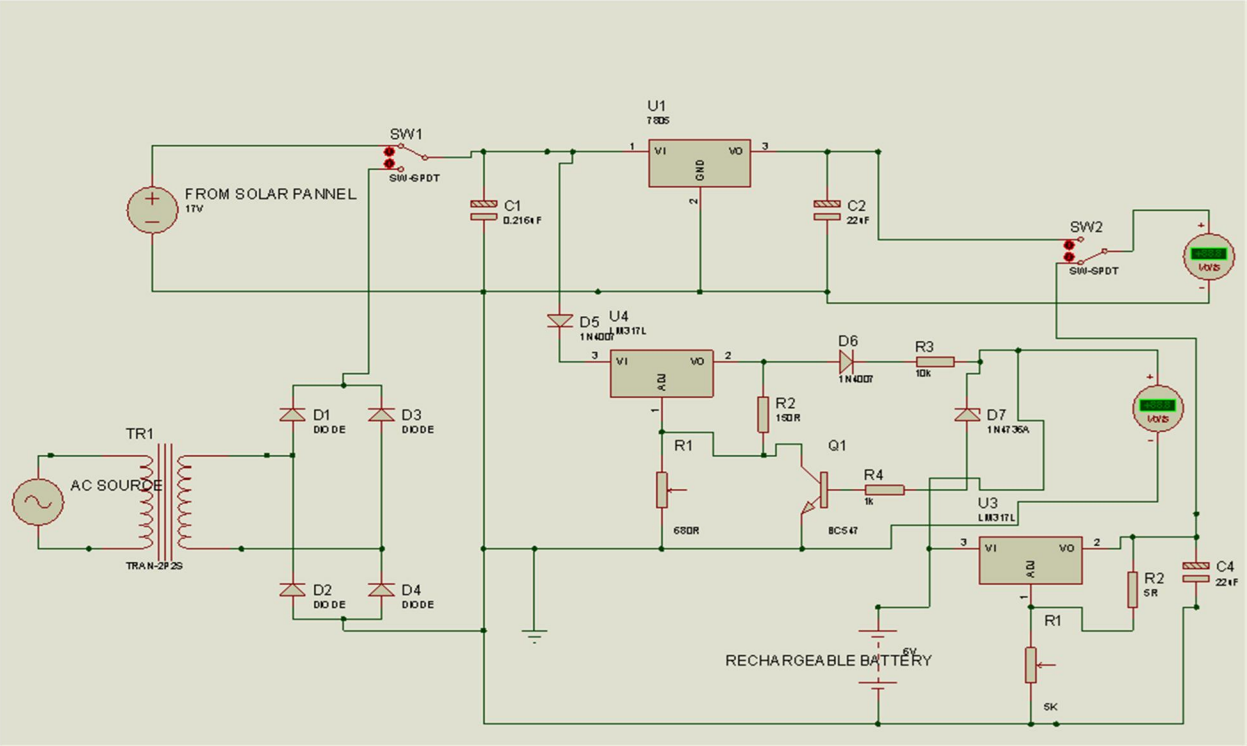


Fig 4.20 complete design of power supply circuit diagram

The output of the battery must be regulated using LM317 voltage regulator due to its feature of being adjustable. We did not use LM7805 regulator due to its limitation of working or regulating range i.e. it regulates for the input voltage range of 7V to 35V. This is because our battery output is 6V. One advantage of LM 317 is its adjustability by using voltage divider resistors. Note that we used selector switches at two points, i.e. where solar source and mains AC are selectively

connected to filter and the second one is where output of rechargeable battery and solar/mains AC are selectively used based on the availability of the sources.

As shown in the circuit above, the battery is to be charged from one of among solar and mains AC at a time on the availability of the type of source. To do this, there is a selector switch to select one of it at a time. The battery we used is to be charged with 6V and hence we used LM317 voltage regulator. As explained above the battery is equipped by charge controller using zener diode. The battery outputs 6Vdc and this voltage must be converted to 5V using LM317adjustable voltage regulator. We determine the values of resistors for voltage divider using the following formula.

VO=1.25(1+$\frac{R2}{R1}$), where VO is the output voltage; R1 & R2 are voltage divider resistors.

4.8. Input subsystem

Fig. 4.21 control switches

There are three control switches: I. Clear Votes. II. Controller switch. III. Total Votes

We used four SPST switches for candidates (these are active high) and also two active low SPST switches for control purpose i.e. master and count button. Two selector switches also used for selecting input power from solar ,mains AC and battery.

The switches are connected to the LCD and are controlled by microcontroller. Here, the switches are used to cast vote. Besides every switch the name of the candidate is printed so that the voter can choose their candidate and by pressing the switch can cast the vote to their respective candidates.

4.9. The control subsystem

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 specifically used is the area of computer design. In this work Microcontroller PIC16F877 is used as the controller unit which controls the sensed signal.

A single highly integrated chip that contains all the components comprising a controller. Typically this includes a CPU, RAM, some form of ROM, I/O ports, and timers. Unlike a general-purpose computer, which also includes all of these components, a microcontroller is designed for a very specific task -- to control a particular system. As a result, the parts can be simplified and reduced, which cuts down on production costs. Microcontrollers are sometimes called embedded microcontrollers, which just mean that they are part of an embedded system that is, one part of a larger device or system.

4.9.1 Overview of PIC 16F877

PIC 16F877 is one of the most advanced microcontroller from Microchip. This controller is widely used for experimental and modern applications because of its low price, wide range of applications, high quality, and ease of availability. It is ideal for applications such as machine control applications, measurement devices, study purpose, and so on. The PIC 16F877 features all the components which modern microcontrollers normally have. The figure of a PIC16F877 chip is shown below.

Fig 4.22 Features of PIC16F877

The PIC16FXX series has more advanced and developed features when compared to its previous series. The important features of PIC16F877 series is given below.

General Features

- High performance CPU.
- ONLY 35 simple word instructions.
- All single cycle instructions except for program branches which are two cycles.
- Operating speed: clock input (200MHz), instruction cycle (200nS).

- Up to 368×8bit of RAM (data memory), 256×8 of EEPROM (data memory), 8k×14 of flash memory.
- Pin out compatible to PIC 16C74B, PIC 16C76, PIC 16C77.
- Eight level deep hardware stack.
- Interrupt capability (up to 14 sources).
- Different types of addressing modes (direct, Indirect, relative addressing modes).
- Power on Reset (POR).
- Low power- high speed EEPROM.
- Fully static design.
- Wide operating voltage range (2.0 – 5.56)volts.
- High sink/source current (25mA).
- Commercial, industrial and extended temperature ranges.
- Low power consumption (<0.6mA typical @3v-4MHz, 20μA typical @3v-32MHz and <1 A typical standby).

Peripheral Features

- Timer 0: 8 bit timer/counter with pre-scalar.
- Timer 1:16 bit timer/counter with pre-scalar.
- Timer 2: 8 bit timer/counter with 8 bit period registers with pre-scalar and post-scalar.
- Two Capture (16bit/12.5nS), Compare (16 bit/200nS), Pulse Width Modules (10bit).
- 10bit multi-channel A/D converter
- Synchronous Serial Port (SSP) with SPI (master code) and I2C (master/slave).
- Universal Synchronous Asynchronous Receiver Transmitter (USART) with 9 bit address detection.
- Parallel Slave Port (PSP) 8 bit wide with external RD, WR and CS controls (40/46pin).
- Brown Out circuitry for Brown-Out Reset (BOR).

Key Features

- Maximum operating frequency is 20MHz.
- Flash program memory (14 bit words), 8KB.
- Data memory (bytes) is 368.
- EEPROM data memory (bytes) is 256.
- 5 input/output ports.
- 3 timers.
- 2 CCP modules.
- 2 serial communication ports .
- PSP parallel communication port
- 10bit A/D module (8 channels)

Analog Features

- 10bit, up to 8 channel A/D converter.
- Brown Out Reset function.
- Analog comparator module.

Special Features

- 100000 times erase/write cycle enhanced memory.
- 1000000 times erase/write cycle data EEPROM memory.
- Self-programmable under software control.
- In-circuit serial programming and in-circuit debugging capability.
- Single 5V,DC supply for circuit serial programming
- WDT with its own RC oscillator for reliable operation.
- Programmable code protection.
- Power saving sleep modes.
- Selectable oscillator options.

Pin Diagrams

PIC16F877 chip is available in different types of packages. According to the type of applications and usage, these packages are differentiated. The pin diagram of a PIC16F877 chip in different packages is shown in the Appendix-A

4.10 Output subsystem

4.10.1 Lm016l LCD Display

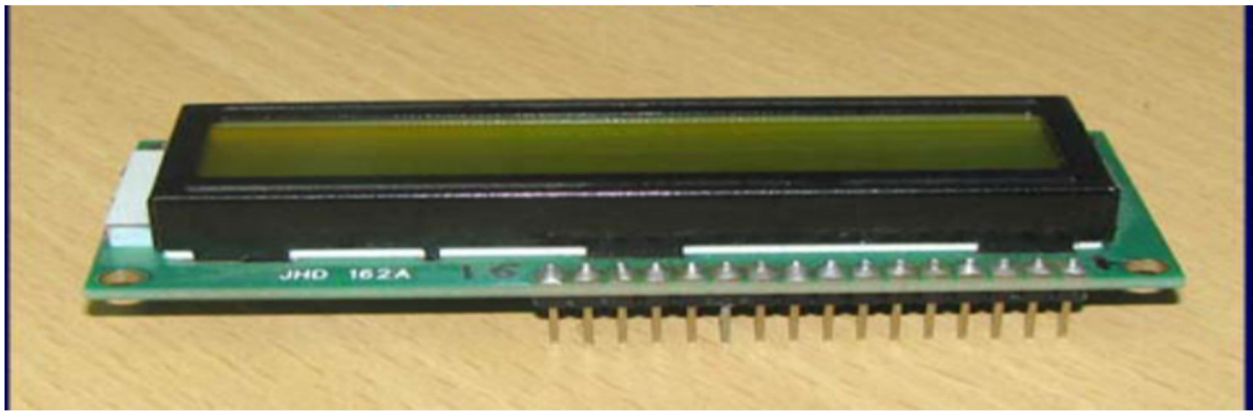


Fig 4.23 LM016L LCD DISPLAY

Display device shown the result of the measuring instrument. Liquid Crystal Display and Security Alarm LCD screen (16X2) functions as interface between the user and microcontroller. The main function of the LCD is to display the instruction “what the voter has to do after what”.

If the voter tries to vote twice then it will display “Buzzer ring”. After completion of correct voting process by the voter immediately back to initial step “Welcome press button cast your vote”.

An LCD is a small low cost display. It is easy to interface with a micro-controller because of an embedded controller (the black blob on the back of the board). This controller is standard across many displays which mean many micro-controllers have libraries that make displaying messages as easy as a single line of code.

4.10.2 Buzzer

A buzzer is provided for audio effect of switch bounce. Whenever a switch is bounced, the system acknowledges the bounce by a short beep sound. This buzzer is driven by an NPN transistor. If voter tried to multiple polling a long beep sound is generated.

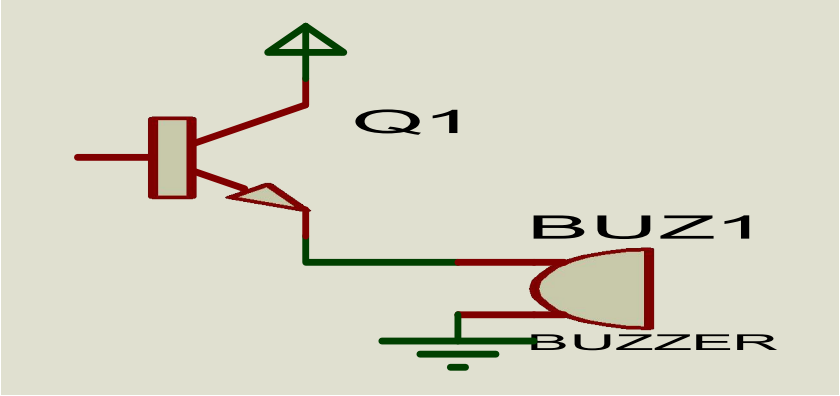
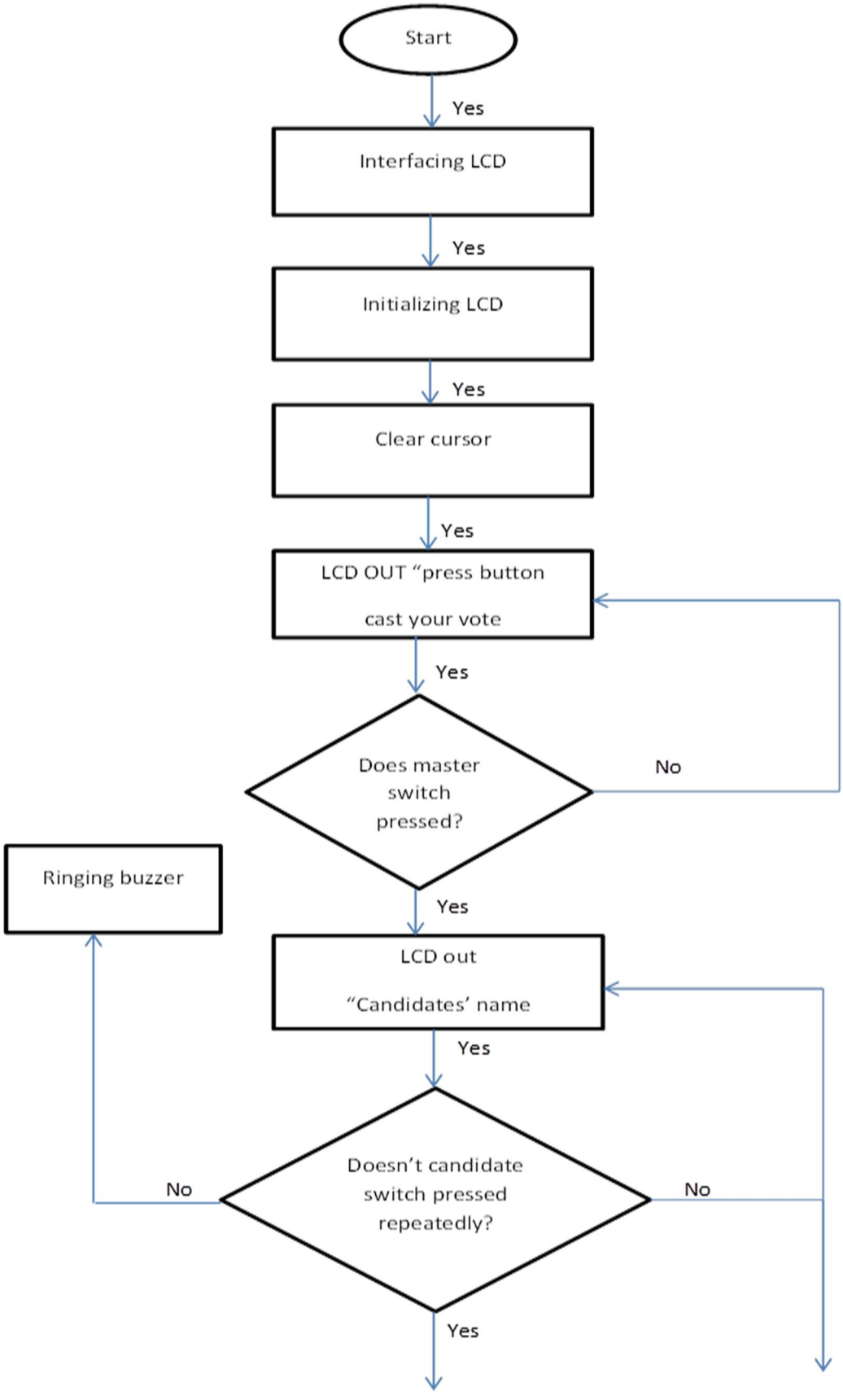


Fig 4.24 buzzer

4.11. The Software subsystem design

The control algorithm helps in writing source code by defining the sequence of operations. It also helps to select the appropriate instruction sets for the corresponding actions the controller should act. The decision and process of the action can be well defined in control algorithm.


Start
Yes
Interfacing LCD
Yes
Initializing LCD
Yes
Clear cursor
Yes
LCD OUT "press button
cast your vote
Yes
Does master
switch
pressed?
No
Ringing buzzer
Yes
LCD out
"Candidates' name
Yes
Doesn't candidate
switch pressed
repeatedly?
No
No
Yes

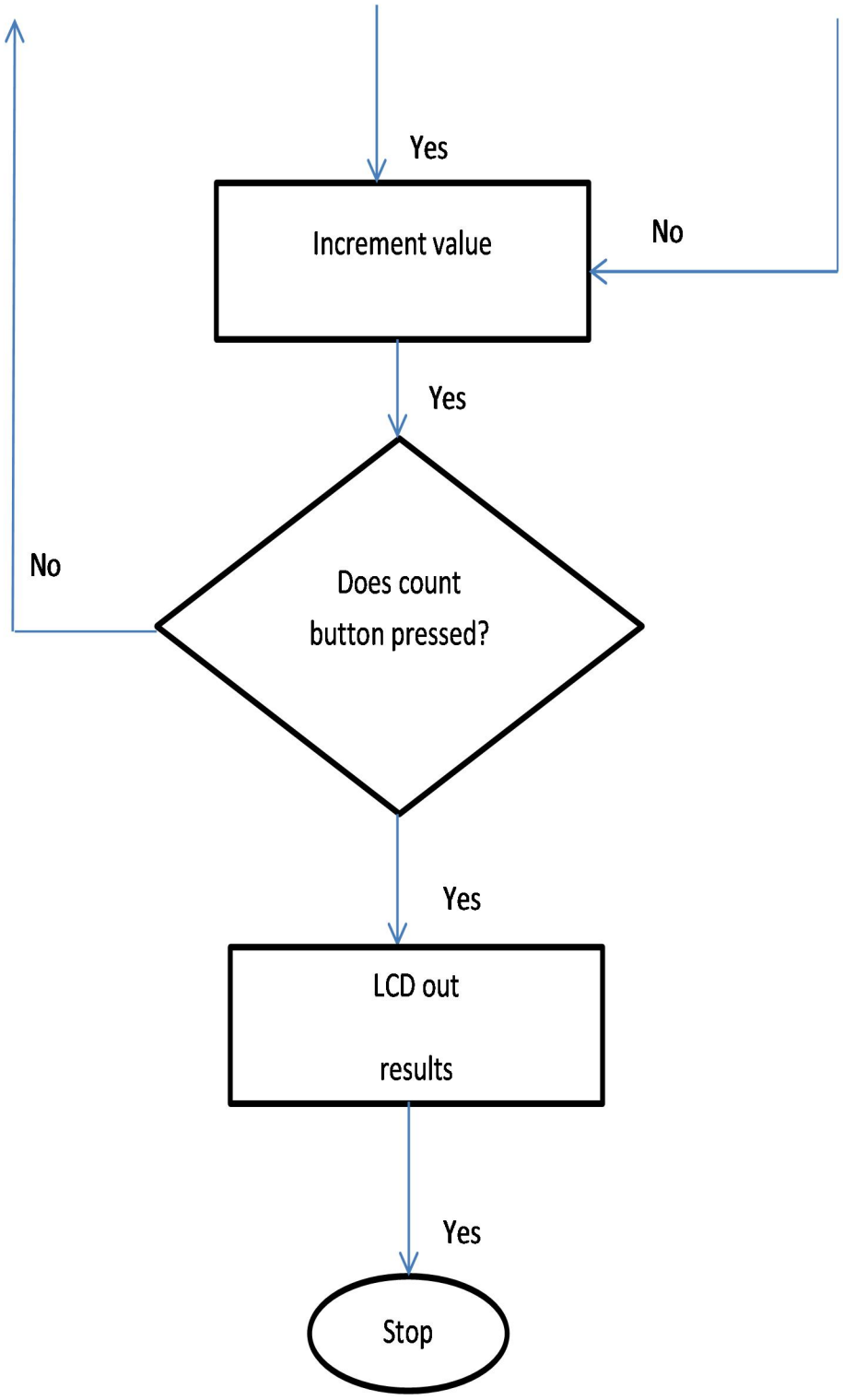


Fig4.25 Software algorithm

The source code was developed after the above algorithm has been developed. Code development starts by interfacing the PIC with the LCD. This is accomplished by defining output ports of the PIC and declaring LCD pins. The direction of each register bit of selected output port has been directed to the respective LCD pins and it enables initializing of the LCD. Then the cursor must be cleared, thereby text will be displayed later.

Instruction which lets the voters as well as the authorized body to take some action must be displayed. In this case the LCD displays “press button to cast vote”. After this the controller waits the masters switch and it makes decision. If it is not activated it branches to the LCD to display “press button to cast vote” again. It must display “candidates’ name” and their symbol. Then it waits for the candidates switches being pressed. If it is pressed repeatedly the controller lets the buzzer to ring and it must be loop to the display “press button to cast vote”, On the other hand it must increase the value by one. Again the controller waits for the count button state. If it is pressed it must display result and if not it loops back to “press button to cast vote”.

Protues8

It is very famous software in electrical, electronics, computer and telecom engineering students for simulation of electrical, electronics and microcontrollers based circuits. Proteus is simulation software for electric circuits provided by Lab center electronics. Proteus provides thee type of platforms for simulation and designing of electric circuits. Main platform of Proteus is intelligent schematic input system (ISIS). ISIS is used for simulation of electrical, electronics, embedded system and microcontrollers based circuits. Proteus VSM is complete software to learn microcontrollers. Proteus 8.0 is a Virtual System Modeling (VSM) that combines circuit simulation, animated components and microprocessor models to co-simulate the complete microcontroller based designs. This is the perfect tool for engineers to test their microcontroller designs before constructing a physical prototype in real time. This program allows users to interact with the design using on-screen indicators and/or LED and LCD displays and, if attached to the PC, switches and buttons.

Procedures to work on protues-8 window

The Home Page is a new application module in Proteus 8 which makes it easy to get started with a project and also performs some system tasks.

The Start Panel on the screen control project opening and creation while the News Panel includes general information, integrated update manager and crash dump reporting.

Opening, Creating & Importing Projects

In Proteus 8, the relationship between Schematic Design and PCB Layout involves a shared database and is far more integrated. We therefore have a single project file rather than separate design and layout files. You can create a new project or import a legacy schematic/layout via the options on the home page.

Opening Projects

Existing projects can be opened via the button on the home page or, in the case of recent projects, directly from the recent projects list.

Finally, you can browse and open our extensive sample design libraries via the Open Sample button at the right of the Start Panel.

Creating New Projects

This wizard guides you through the setup of your next Proteus 8 project. There is a start page in which you specify the project name and destination directory and then potentially three main screens for schematic, PCB and firmware.

Schematic

If you are creating a schematic check the box at the top of the screen and then select the template on which you want to base the schematic. Those provided by Labcenter basically contain different sizes of work area, although you can customize and save your own templates from within the schematic capture module.

PCB Layout

If you are creating a PCB check the box at the top of the screen and select from the available templates. PCB templates contain pre-defined board edges, mounting holes and a full set of technology data (design rules, layers in use, default units, etc.) As with schematic, you can customize and save your own templates from within the PCB layout module.

Micro c PRO for PIC

The micro C PRO for PIC is a powerful, feature-rich development tool for PIC microcontrollers. It is designed to provide the programmer with the easiest possible solution to developing

applications for embedded systems, without compromising performance or control .micro C PRO for PIC IDE.

MikroC is a C Compiler for PIC as well as some other microcontroller. It has large precompiled library to be used in accessing the peripheral that are connected the PIC microcontroller. MikroC has an independent IDE which doesn't need to be plugged in to MPLAB. In addition, MikroC IDE has numerous tools such as ASCII chart, EEPROM Editor and UART Terminal etc.

The C programing language

The C programming language is a general-purpose,at was originally developed by Dennis M. Ritchie to develop the UNIX operating system at Bell Labs. C was originally first implemented on the DEC PDP-11 computer in 1972.

In 1978, Brian Kernighan and Dennis Ritchie produced the first publicly available description of C, now known as the K&R standard.

The UNIX operating system, the C compiler, and essentially all UNIX applications programs have been written in C. The C has now become a widely used professional language for various reasons.

- Easy to learn
- Structured language
- It produces efficient programs.
- It can handle low-level activities.
- It can be compiled on a variety of computer platforms.

C was initially used for system development work, in particular the programs that make up the operating system. C was adopted as a system development language because it produces code that runs nearly as fast as code written in assembly language. Some examples of the use of C might be:

- Operating Systems
- Language Compilers
- Assemblers
- Text Editors
- Print Spoolers
- Network Drivers
- Modern Programs

 Databases

 Language Interpreters

The C Compiler

The source code written in source file is the human readable source for your program. It needs to be "compiled", to turn into machine language so that your CPU can actually execute the program as per instructions given.

This C programming language compiler will be used to compile your source code into final executable program.

4.12 System Implementation

4.12.1 Hardware Subsystem Implementation

As it is composed of from different functioning blocks of input system, controller, output system and power supply, bottom-up approach is used. Each sub system is implemented and developed and then its functioning was checked independently. The overall project functionality is the sum total functioning of each sub system.

It was checked using software (Protues8, ISIS) before we go to implement the project hardware. ISIS tool of Protues8 software is used to check the implementation before we go to implement practically. The software library is enrich with electrical and electronics components and ranges to different microcontroller families. Hence it enables us to check circuit performance and outputs. Each subsystem and the entire project are tested by simulation using this wonderful Protues8 software. In order to reduce construction errors, the final circuitry was done using another CAD software tool Proteus ARES, which guided in the production of all the tracks (signal lines) linking one pin to the other. The CAD tool makes it possible to easily layout the various components on board. Hence the components layout was properly positioned; each component before they are linked to one another by the traces.

Once the schematic of the project has developed the next procedure was developing PCB layout using ARESS tool of Protues. Of course our project is constructed on PCB.

but we used ARESS to assist the assembly of the circuit. Before we assemble the circuit we tested each component for their functionality. The final circuit was implemented after we tested using bread-board. The bread-board allowed us to assemble the circuit and test it with no need of soldering it. We can change and move each component freely so that no device is being broken. As the project constructed on bread-board was successful, we transferred to the real read-made

circuit board. It was accomplished by soldering using lead permanently. As the PIC is highly sensitive for heat, we used and soldered IC socket (holder) instead of it so that the controller can be plugged in the socket (holder). The other main advantage of using this socket is to take out the controller for repeated use i.e. to erase and reload the program.

The overall circuit diagram of the project and the circuit of the power supply system as well as the EVM are given in the following circuit diagram taken from the simulation snapshot. Refer appendix c.

The power supply subsystem is implemented so that both power from the solar panel and output of the mains AC after it is rectified are allowed to pass through or allowed to use the same circuit to be filtered and regulated. It incorporates a selector switch to allow only one source at a time to serve as source of electric power. As the project is designed so that it works everywhere and at any time it also has a buck up battery. This battery is to be charged from the output of the solar and mains AC after they are filtered and regulated. The output of the solar power supply and mains AC supply after it is converted to DC is connected to the PIC, LCD, buzzer, tactile switches and to charge the battery. Again the rechargeable battery is used to supply the all components of the project as the two power sources did.

4.12.2 Software Implementation

In this section we try to describe how the control system is implemented in software and programing microcontroller using microC. The overall control system designed by protues ISIS professional microcontroller programing. The code for the microcontroller is written in C-language. A software package called microC was used. It provides a full development environment and includes a compiler for the PIC16F877A. The development of firmware involved many stages of testing and debugging. As section of the code were written, programed into the microcontroller and tested to ensure they worked properly. A fully commented program listing of micro programing is found in appendix B.

When we write in the embedded C–code, first we interfaced LCD with PIC16F877A microcontroller. After interfacing LCD with PIC microcontroller, then we initialized theLCD. After initialization clear display and cursor off, on our LCD screen. then we want to give some initial instruction for voters, so that it displays'' welcome press button ''on the first row of our LCD screen and also write text' 'cast your vote'' on the second row of our LCD screen. These

are the initial instructions for voters, after pressing master button the candidates' name will displayed on the screen of LCD. We used active high switches for each candidate, so the voter press one button at a time for single vote, after pressing single voting switch automatically then the system ready for next voting but you must press master button.

The method of transferring our compiled .HEX (machine code) file to the memory of microcontroller using microcontroller burning software is called burning or programming of a microcontroller. Once a program is burned into the memory of the microcontroller, it then works with respect to the program logic.

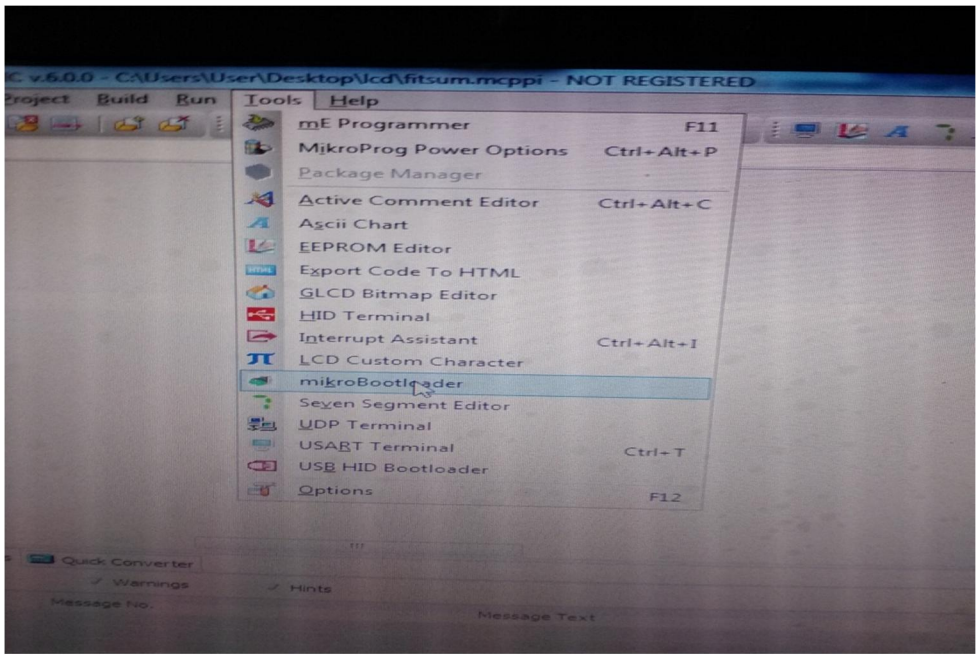
We used 'Mikro C' compiler which provides an environment to develop embedded program, test, debug and build. Hex for the microcontroller. 'Mikro C Pro' is the best microcontroller software for PIC family. The advantage of 'Mikro C' is that it has so many inbuilt functions to perform different tasks along with microcontroller programming software (Boot loader- burning tool or burning software). It is the better Integrated Development Environment (IDE) for PIC family of microcontrollers and allows C language for code development. Finally the compiler converts the embedded C codes into .HEX file

Tools we used to burn/ program a PIC Microcontroller

1. PIC programmer (burner) or development board
2. Serial port cable
3. Microcontroller burning software Boot loader in 'Mikro C'

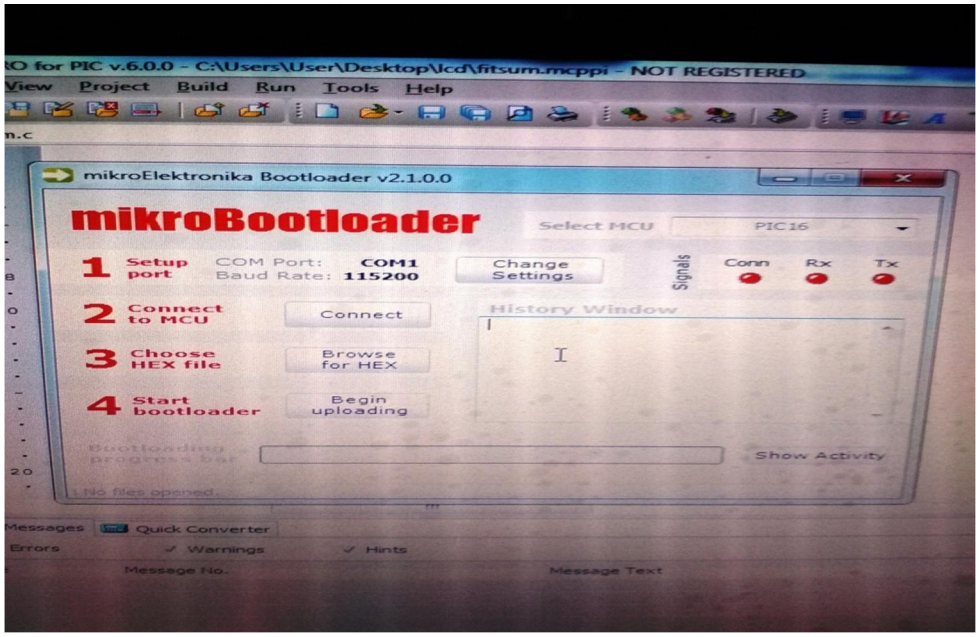
Burn PIC Microcontroller

- Our aim is to transfer our .HEX file to the memory of PIC microcontroller.
- The burner and the dedicated software perform the function of transferring .HEX file into the PIC.
- The burner is connected to the PC via a serial port cable.
- 'Mikro C' has inbuilt 'boot loader' tool to burn our PIC microcontroller.
- We Connected our PIC programmer to the PC and navigate to Tools>>mikroBootloader in Mikro C, then a Bootloader window will appear.



Step-1

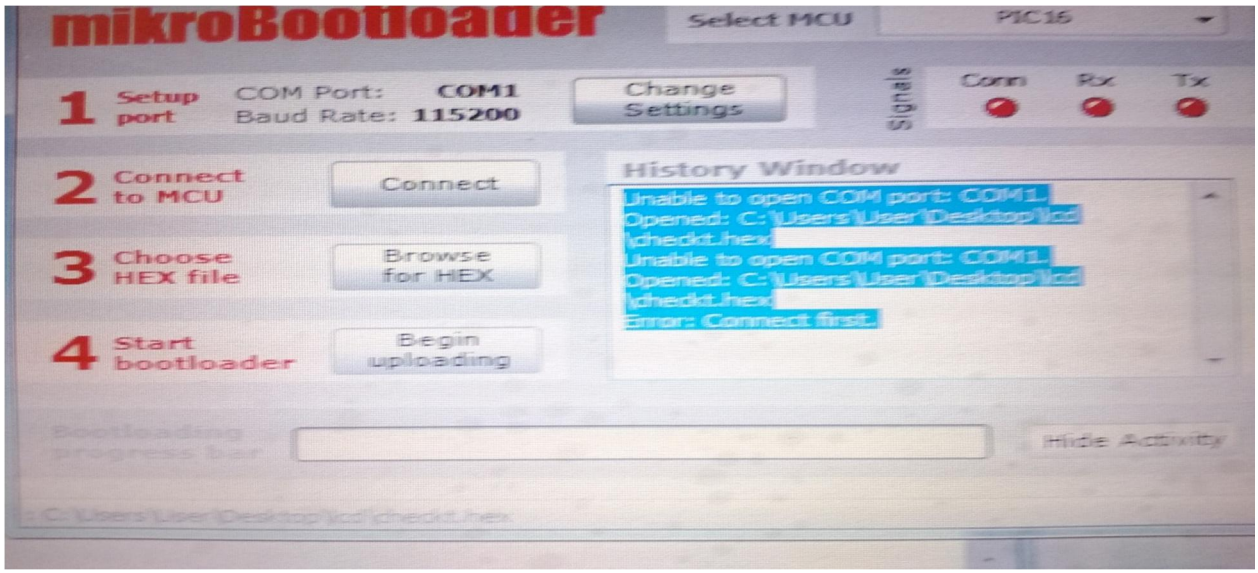
There is ‘Setup Port’ button on the left top corner. Since we used PC and serial port cable we select ‘COM1.



Step-2

Select the same port from the port setup window after setting the specific port and click the **OK** button.

Now by clicking on ‘Connect’ button, a message will appear in the ‘History window’ box with “Waiting PIC response; Disconnected”. Then ‘Reset‘to get connected.



Step-3

On development board or PIC burner press the ‘**Reset**’ button of PIC. Then rapidly click the connect button in the mikroBootloader window.

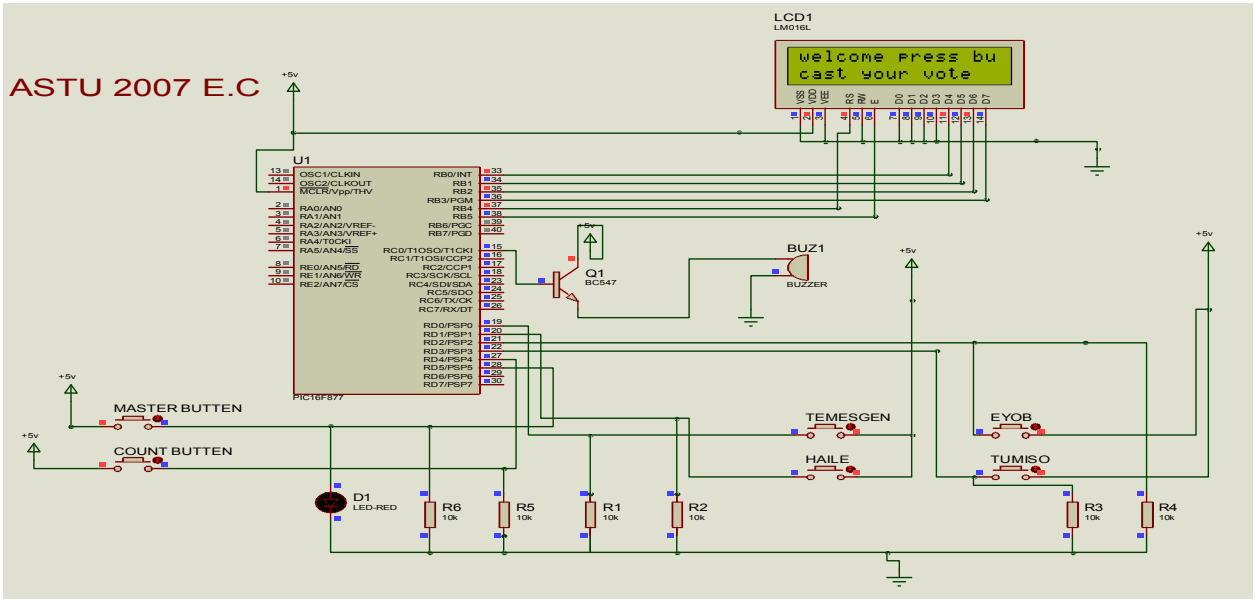
Then “Connected” in the history window is displayed.

Now click on ‘**Open HEX file**’ button and select the **.HEX** file that you had built in the folder (project directory) before.

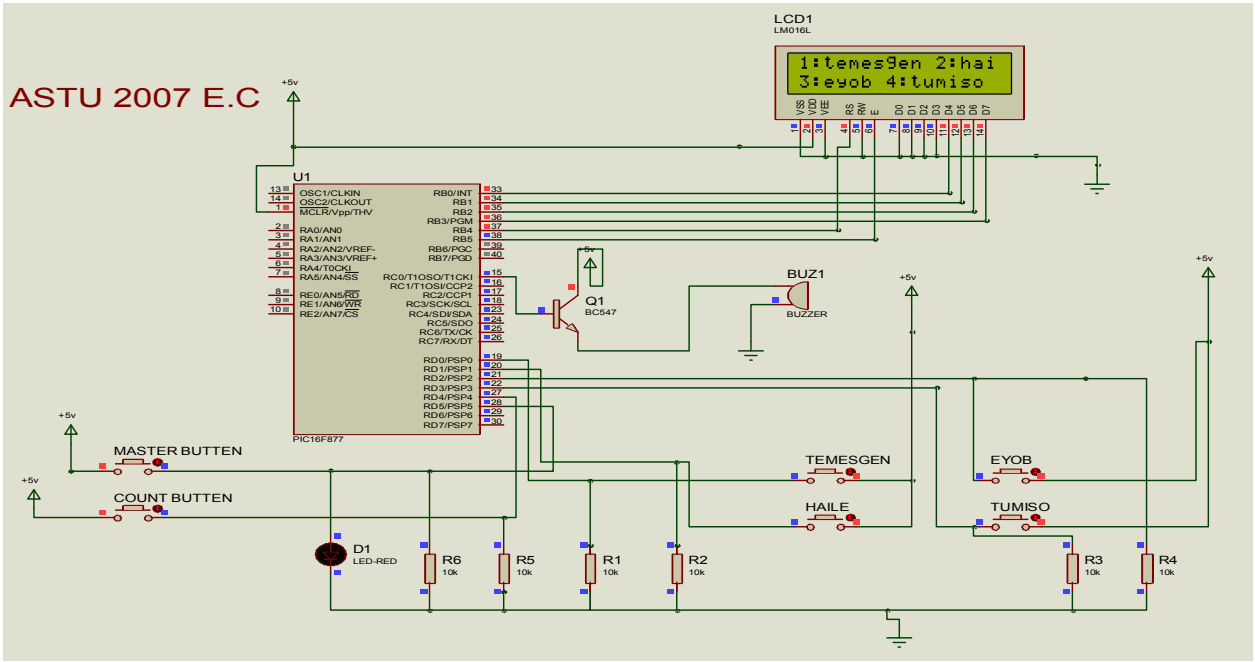
Then click on ‘**Start Bootloader**’ button to burn the PIC microcontroller.The burning process via the ‘Terminal window’ displayed.

After the burning process a message box will appear saying “**Reset PIC**”. Click **OK** and now PIC microcontroller burning is finished.

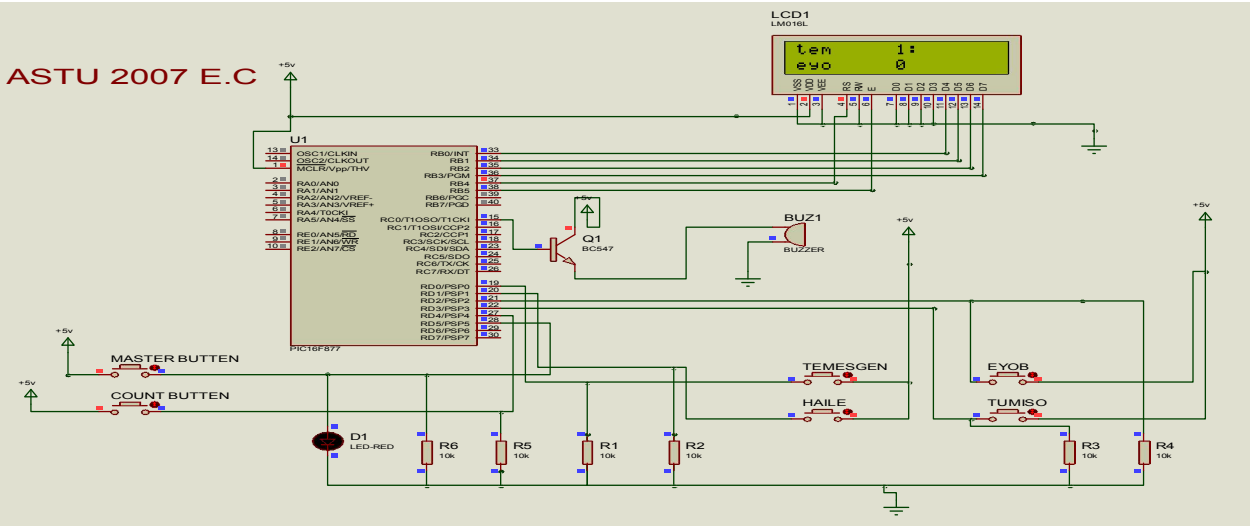
4.12.3 Working principle of electronic voting machine



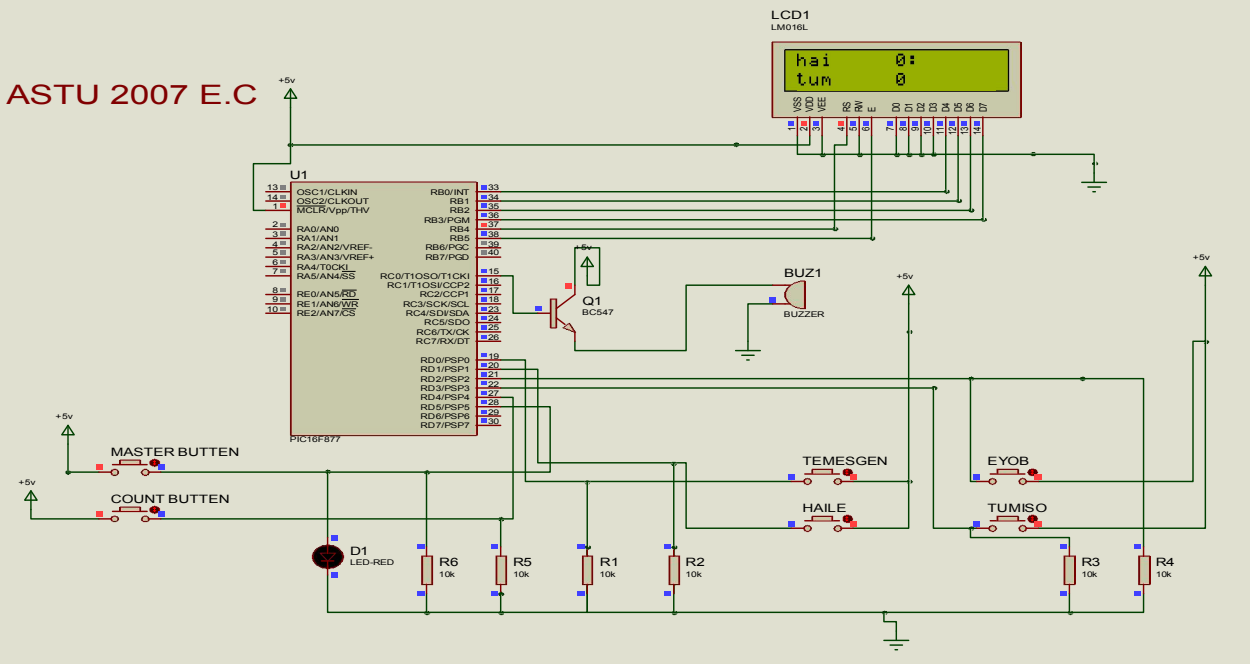
A



B



C



D

Fig.4.27 working principles of software implementation

In above circuit diagrams you see that four numbers of push button are used for voting four candidates. One master button is there which ensure that any voter can vote one candidate at a time. When a voter wants to cast his vote master Switch has to be press to active the system and when voter press any push button to vote, the system will deactivated. Then any button will not work until master button is being pressed again. There is a count button and when we press it the result will displayed.

CHAPTER FIVE

5. RESULT AND CONCLUSION

5.1 Conclusion

This project aimed to avoid the backward traditional voting system of our country using electronic voting machine. In addition to design of electronic voting machine this project basically includes design of alternative power supply to which the machine operates. The design begins from initial ideal stage to final circuit assembly in sequence. By implementing the prototype of the system from the simulation is possible to avoid problems occurred before using of traditional voting system and we have successfully gets the result as showed in CHAPTER 4.

There are a number of problems in conventional systems like requirement of large number of people to facilitate election, high cost of paper and ink, Inaccurate due to human errors, time consuming and etc. we develop and implement electronic voting machine which totally replace traditional system. Since most people of Ethiopia live in rural parts of the country to use the machine solar energy and rechargeable battery which solves interruption of power.

Using of this electronic voting machine the provision of casting votes for the candidates has been provided through switches. 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. The EVM is ready for voting only after ready to vote button is pressed and the LED is on. The led turns off after a vote is casted along with a buzzer. . Using of microcontroller based electronic voting machine reduces ambiguity occur during casting of votes by pressing a single push button switches. There are varieties of advantages of electronic machine over traditional system of voting. In days of using nonpolluting and environment friendly resources of energy it could pose a very good example.

5.2 Problems Encountered

In the course of developing this prototype, the real challenging problems encountered were after we start design of our project on AT89C51 microcontroller, due to unavailability of debugger we tried to change into PIC16F877A which takes time during starting time.

5.3 Recommendation and Future Improvement

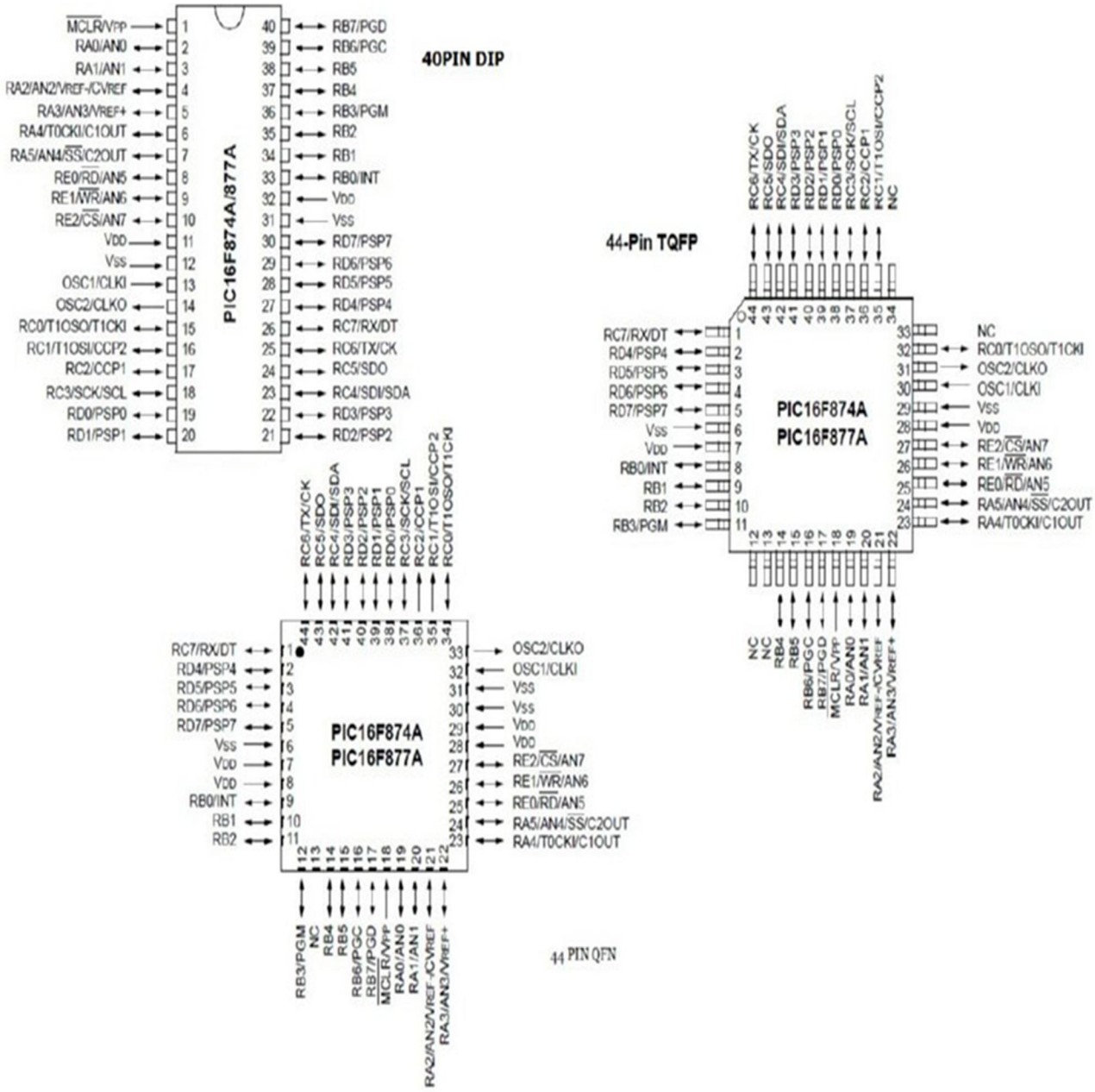
This prototype of electronic voting machine can easily be implemented in real situation. In this electronic voting machine we have option of choosing one candidate among four candidates. We can also increase the number of candidates, by adding another microcontroller, switches and large size of LCD. In the future if power Geez (Amharic language) in the program added it is better those people who cannot understand the instruction written in English language and they can understand easily.

REFERENCE

1. See Clyde W. Summers, The Privatization of Personal Freedoms and Enrichment of Democracy: Some Lessons from Labor Law, 1986 U. ILL. L. REV. 689, 712–14 (discussing some similarities between private union elections and public elections).
2. Alam, M.R. ; Univ. Kebangsaan Malaysia ; Masum, M. ; Rahman, M. ; Rahman, A.,Design and implementation of microprocessor based electronic voting system, Computer and Information Technology, 2008. ICCIT 2008. 11th International Conference, 24-27 Dec. 2008.
3. I .U Voting: What Is; What Could Be, (2001, July). Available: (http://www.vote.caltech.edu/Reports/)
4. Mercuric, R. "A better ballot box?" IEEE SPECTRUM, vol.39, no. 10, October, 2002.
5. "A Report on the Feasibility of Internet Voting", California Internet Voting Task Force,2000
6. Alam, M.R. ; Univ. Kebangsaan Malaysia ; Masum, M. ; Rahman, M. ; Rahman, A.,Design and implementation of microprocessor based electronic voting system, Computer and Information Technology, 2008. ICCIT 2008. 11th International Conference, 24-27 Dec. 2008.
7. Punch Cards, and Lever Machines," ACM International Conference on Human Factors in Computing Systems, pp. 171–180, 2007.
8. Lin Hong. "Automatic Personal Identification Using Fingerprints", Ph.D.Thesis, 1998.
9. K. Memon, D. Kumar and S. Us man, "Next Generation A secure E-Voting System Based on Biometric Fingerprint Method", International Conference on Information anIntelligent Computing (IPCSIT), pp. 26-32, 2011.
10. D.A. Kumar, T.U.S Begum, "A Novel design of Electronic Voting System Using Fingerprint," International Journal of Innovative Technology & Creative Engineering, vol.1, no.1, pp.12-19, January 2011.
11. A r men, C. and Morelli, R.,"E-Voting and Computer Science: Teaching about the Risks of Electronic Voting Technology "ACM ITiCSE, 2005.
12. D. Maltoni, D. Maio, A. K. Jain, and S. Prabhakar, Handbook of Fingerprint Recognition. New York: Springer-Verlag, 2003.
13. PIC16F87X data sheet"microchiptechinologyinc."

14. Hand Book for Returning Officer 2011, Election Commission of Bhutan International journal of S. Zubair, " Design and Construction of a Simple Microcontroller Based Conference Electronic Voting Machine with Digital Display".SussaneCaarls, " E-voting Handbook: Key Steps in the Implementation of E-enabled Elections", Council of Europe, 2010.
15. "A Report on the Feasibility of Internet Voting", California Internet Voting Task Force,2000
16. B.T. Mackintosh, "Methods and arrangements for identifying objects," U.S. Patent Application 13/946,968, July 19, 2013.
17. Source: http://www.electronicshub.org/understanding-7805-ic-voltage-regulator/
18. M. Byrne, K. Greene, and S. Everett, "Usability of Voting Systems: Baseline Data for Paper,
19. PWM DC-DC Converters Prof. W.G. Hurley, EE411 Power Electronics notes.
20. Punch Cards, and Lever Machines," ACM International Conference on Human Factors in Computing Systems, pp. 171–180, 2007.

Appendix –A Pin diagram of PIC16FXX



Pin diagram description of PIC 16Fxx

Input/output ports

PIC16F877 has 5 basic input/output ports. They are usually denoted by PORT A (R A), PORT B (RB), PORT C (RC), PORT D (RD), and PORT E (RE). These ports are used for input/ output interfacing. In this controller, “PORT A” is only 6 bits wide (RA-0 to RA-7), ”PORT B” , “PORT C”,”PORT D” are only 8 bits wide (RB-0 to RB-7,RC-0 to RC-7,RD-0 to RD-7), ”PORT E” has only 3 bit wide (RE-0 to RE-7).

PORT-A RA-0 to RA-5 6 bit wide

PORT-B RB-0 to RB-7 8 bit wide

PORT-C RC-0 to RC-7 8 bit wide

PORT-D RD-0 to RD-7 8 bit wide

PORT-E RE-0 to RE-2 3 bit wid

All these ports are bi-directional. The direction of the port is controlled by using TRIS(X) registers (TRIS A used to set the direction of PORT-A, TRIS B used to set the direction for PORT-B, etc.). Setting a TRIS(X) bit '1' will set the corresponding PORT(X) bit as input. Clearing a TRIS(X) bit '0' will set the corresponding PORT(X) bit as output.

(If we want to set PORT A as an input, just set TRIS(A) bit to logical '1' and want to set PORT B as an output, just set the PORT B bits to logical '0'.)

- Analog input port (AN0 TO AN7) : these ports are used for interfacing analog inputs.
- TX and RX: These are the USART transmission and reception ports.
- SCK: these pins are used for giving synchronous serial clock input.
- SCL: these pins act as an output for both SPI and I2C modes.
- DT: these are synchronous data terminals.
- CK: synchronous clock input.
- SD0: SPI data output (SPI Mode).
- SD1: SPI Data input (SPI mode).
- SDA: data input/output in I2C Mode.
- CCP1 and CCP2: these are capture/compare/PWM modules.
- OSC1: oscillator input/external clock.
- OSC2: oscillator output/clock out.
- MCLR: master clear pin (Active low reset).

oVpp: programming voltage input.

- THV: High voltage test mode controlling.

oVref (+/-): reference voltage.

- SS: Slave select for the synchronous serial port.
- T0CK1: clock input to TIMER 0.
- T1OSO: Timer 1 oscillator output.
- T1OS1: Timer 1 oscillator input.
- T1CK1: clock input to Timer 1.
- PGD: Serial programming data.
- PGC: serial programming clock.
- PGM: Low Voltage Programming input.
- INT: external interrupt.
- RD: Read control for parallel slave port.
- CS: Select control for parallel slave.
- PSP0 to PSP7: Parallel slave port.
- VDD: positive supply for logic and input pins.
- VSS: Ground reference for logic and input/output pins.

Take a look at the specifications of the PIC 16F87X Series

PIC microcontroller data sheet

PIC16F87X

Key Features PICmicro™ Mid-Range Reference Manual (DS33023)	PIC16F873	PIC16F874	PIC16F876	PIC16F877
Operating Frequency	DC - 20 MHz	DC - 20 MHz	DC - 20 MHz	DC - 20 MHz
RESETS (and Delays)	POR, BOR (PWRT, OST)	POR, BOR (PWRT, OST)	POR, BOR (PWRT, OST)	POR, BOR (PWRT, OST)
FLASH Program Memory (14-bit words)	4K	4K	8K	8K
Data Memory (bytes)	192	192	368	368
EEPROM Data Memory	128	128	256	256
Interrupts	13	14	13	14
I/O Ports	Ports A,B,C	Ports A,B,C,D,E	Ports A,B,C	Ports A,B,C,D,E
Timers	3	3	3	3
Capture/Compare/PWM Modules	2	2	2	2
Serial Communications	MSSP, USART	MSSP, USART	MSSP, USART	MSSP, USART
Parallel Communications	—	PSP	—	PSP
10-bit Analog-to-Digital Module	5 input channels	8 input channels	5 input channels	8 input channels
Instruction Set	35 instructions	35 instructions	35 instructions	35 instructions

Wide operating voltage range: 2.0V to 5.5V
• High Sink/Source Current: 25 mA
• Commercial, Industrial and Extended temperature ranges
• Low-power consumption:
- < 0.6 mA typical @ 3V, 4 MHz
- 20 µA typical @ 3V, 32 kHz
- < 1 µA typical standby current

SOURCE : MICROCHIP PIC 16F87X DATA SHEET

Appendix-B

```
// Name :  program to make electronic voting machine using PIC16F877A microcontroller
// Author :ASTU2007PG
// Date : 11-05-15
// LCD module connections
sbit LCD_RS at RB4_bit;
sbit LCD_EN at RB5_bit;
sbit LCD_D4 at RB0_bit;
sbit LCD_D5 at RB1_bit;
sbit LCD_D6 at RB2_bit;
sbit LCD_D7 at RB3_bit;sbit LCD_RS_Direction at TRISB4_bit;
sbit LCD_EN_Direction at TRISB5_bit;
sbit LCD_D4_Direction at TRISB0_bit;
sbit LCD_D5_Direction at TRISB1_bit;
sbit LCD_D6_Direction at TRISB2_bit;
sbit LCD_D7_Direction at TRISB3_bit;
// End LCD module connections
char txt[7],txt1[7],txt2[7],txt3[7];
void main() {
int a=0,b=0;
int c=0,d=0,e=0;
trisd=1;
portd=0;
trisc=0;
portc=0;
while(1)
```

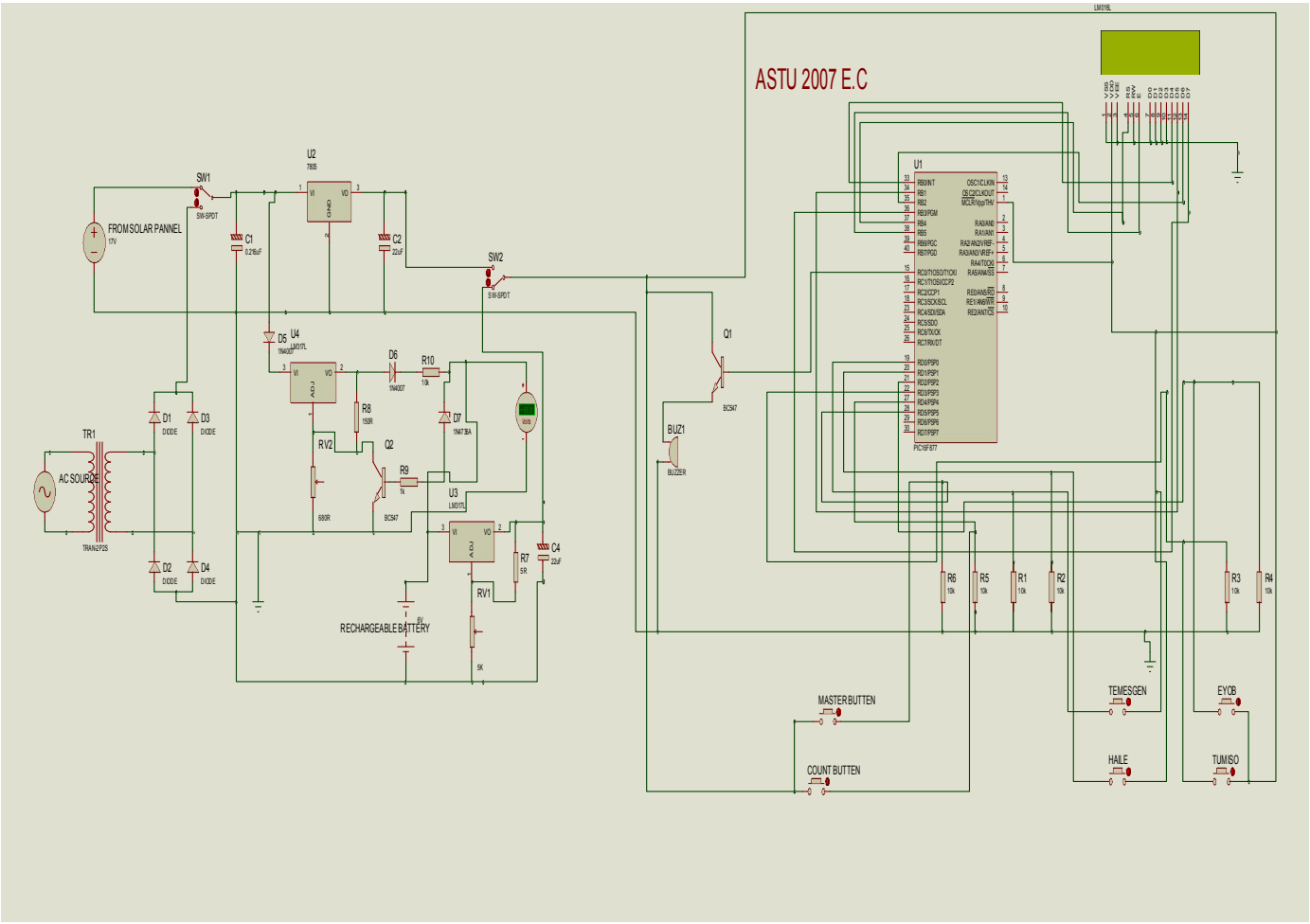
```
{
Lcd_Init(); // Initialize Lcd
Lcd_Cmd(_LCD_CLEAR); // Clear display
Lcd_Cmd(_LCD_CURSOR_OFF); // Cursor off
Lcd_Out(1,1,"welcome press button "); // Write text in first row
Lcd_Out(2,1,"cast your vote"); // Write text in second row
while(portd==0)
{ // This loop use for pusing the system
}
if (portd==0b00100000)
{
e=1;
}
while (e==1)
{
Lcd_Cmd(_LCD_CLEAR); // Clear display
Lcd_Out(1,1,"1:temesgen 2:haile"); // Write text in first row
Lcd_Out(2,1,"3:eyob 4:tumiso"); // Write text in second row
while(portd==0)
{
}
portc=0b00000001;
delay_ms(100);
portc=0b00000000;
Lcd_Out(2,1,"voting");
if (portd==0b00000001)
{
```

```
a=a+1;
e=0;
}
if (portd==0b00000010)
{
b=b+1;
e=0;
}
if (portd==0b00000100)
{
c=c+1;
e=0;
}
if (portd==0b00001000)
{
d=d+1;
e=0;
}
if (portd==0b00010000)
{
Lcd_Cmd(_LCD_CLEAR);
inttostr(a, txt);
inttostr(b, txt1);
inttostr(c, txt2);
inttostr(d, txt3);
delay_ms(500);
Lcd_out(1,1,"thank you:");
```

```
Lcd_out(1,1,"teme:"); // Write text in first row
Lcd_out(1,4,txt); // Write text in first row
Lcd_out(2,1,"eyo:"); // Write text in second row
Lcd_out(2,4,txt2); // Write text in second row
delay_ms(2000);
Lcd_out(1,1,"hai:"); // Write text in first row
Lcd_out(1,4,txt1); // Write text in first row
Lcd_out(2,1,"tum:"); // Write text in second row
Lcd_out(2,4,txt3); // Write text in second row
delay_ms(2000);
}
}
}
}
```

Appendix –C

Overall schematic circuit diagram of electronic voting machine with power circuit



Appendix-D /LCD data sheet

NO	Name	Use
1	Ground	
2	Vcc	
3	Contrast	
4	RS	0= instruction input 1=data input
5	R/W	0=write to LCD 1=read to LCD
6	Enable(EN)	From 1 to 0=data/commands are transferred to LCD
7	DB0	Data bus line
8	DB1	Data bus line
9	DB2	Data bus line
10	DB3	Data bus line
11	DB4	Data bus line
12	DB5	Data bus line
13	DB6	Data bus line
14	DB7	Data bus line
15	LEC+	Back light
16	LEC-	

EN – Enable:

This control line is used to inform the LCD that you are sending in data. To send data to the LCD, put data on the data bus, then make EN high (1) and wait a little bit and end by bringing EN to low (0) again.

RS – Register Select:

When RS is low (0), the information in the DB0 to DB7 pins are to be considered as an instruction (command- such as Clear screen, Display set, etc.). When RS is high (1), the information in the DB0 to DB7 pins are to be considered valid text data to print on the LCD screen. For example, to display the letter "i" on the screen you should set RS= high.

RW – Read/Write:

When RW is low (0), the information on the data bus is written to the LCD module.

DB0 to DB7:

Data bus lines of LCD display.

LED+, LED-:

Used for enabling back light on the screen. If you don't want the back light you can leave it unconnected.