PREFACE

The introduction of digital voting machines or electronic voting machines (EVMs) to conduct elections is a major step for any country. Benefits can include the inhibition of polling-station fraud, as well as improved accuracy and speed of counting and results transmission.

EVMs are often perceived as a modern tool of governance. At the same time, they are expensive and have multiple associated risks. These relate to limited transparency and therefore confidence in the process and outcome of an election.

EVMs also create opportunities for manipulation and are accompanied by the risk of malfunction; e.g., as a result of faulty storage or use. Switching to EVMs is by no means a purely technical measure. Rather, it is an important public policy choice. As such, there must be full disclosure of information about EVMs, along with broad and informed public debate before they are introduced. Public confidence is a key requirement for successful elections because without widespread trust results may be rejected. Lack of trust in an electoral process can be exacerbated by the use of new technology, which many voters can find difficult to understand.

The EVM is designed here as an embedded system which involves the use of microcontroller as one of the major electronics component being used in its making.

The voter can chose the candidate who he/she prefers as the most appropriate, by pressing the vote switch/button after being administered by the authority.
EVM is being made here considering the fact of illegal voting or any other security flaws.
Loss of any vote count is not possible due to the availability of its FLASH memory or EEPROM memory which can be programmed only by the programmer.

LIST OF FIGURES

Fig. 2.4.1: Pin layout of PIC16F887 …… *Page 12*

Fig.2.4.2: A 16x2 LCD Device…….. *Page 13*

Fig 2.4.3: Block Diagram of DDRAM in LCD……..... *Page 13*

Fig 2.4.4: LEDs with different colors…… *Page 14*

Fig 2.4.5: Control Switch……... *Page 15*

Fig 2.4.6: Crystal Oscillator……... *Page 15*

Fig 2.5.1: Block Diagram of EVM……. *Page 16*

Fig 3.2.1: Circuit Diagram for EVM…….. *Page 18*

Fig 3.2.2: Block Diagram of LCD LM016L…….. *Page 19*

Fig 3.3.1: Flowchart for EVM…… *Page 20*

Fig 3.6.1: PCB design of EVM…….. *Page 23*

Fig 3.7.1: Final EVM hardware model……... *Page 24*

TABLE OF CONTENTS

Chapter 1: Introduction…… *7*

1.1 About Organization…… *7*

Chapter 2: Project Description…… 8

2.1 Introduction to voting……... *8*

2.2 A brief history of EVM in India……... *9*

2.3 Tools and software used……... *10*

2.4 Components used with description……... *12*

2.5 Block Diagram of EVM…… *16*

Chapter 3: Technical features and details ……... *17*

3.1 Features of EVM……*17*

3.2 Circuit Diagram of EVM……... *18*

3.3 Working process of EVM…….. 20

3.4 Steps involved in making of EVM…… *21*

3.5 List of components used……..... *22*

3.6 PCB Layout……... *23*

3.7 Final working EVM model…… *24*

3.8 Application and advantage of EVM…….. *26*

3.9 Future Development…….. *27*

CONCLUSION……. *28*

BIBLIOGRAPHY……. *30*

CHAPTER-2

PROJECT DESCRIPTION

2.1 Introduction to voting

Voting is a crucial device to reveal the opinion of a group on an issue that is under consideration. Based on the promise of greater efficiency, better scalability, faster speed, lower cost, and more convenience, voting is currently shifting from manual paper-based processing to automate electronic-based processing.

The term electronic voting" characteristically depicts to the use of some electronic means in voting and ensure the security, reliability, guarantee and transparency. Now a day the wide range of application of voting include its use in reality student body elections, shareholder meetings, and the passing of legislation in parliament. Perhaps the most important, influential, publicized, and widespread use of voting is its use in national elections.

Compared to its traditional paper-based counterpart, electronic voting is considered to have many greater potential benefits. These benefits include better accuracy by eliminating the negative factor of human error, better coverage for remote locations, increased speed for tally computation, lower operational cost through automated means, and the convenience of voting from any location, whether or not electronic voting is a necessary replacement for the traditional paper-based method, it is irrefutable that the conduct of voting has been shifting to the use of electronic medium.

To date, electronic databases are used to record voter information, computers are used to count the votes and produce voting results, mobile devices are used for voting in interactive television shows, and electronic voting machines have been used in some national elections. Generally, the term "**electronic voting**" refers to the definition, collection, and dissemination of people's opinions with the help of some machinery that is more or less computer supported.

2.2 A Brief History of EVM in India

In 1980, Mr. M. B. Haneefa invented the first Indian voting machine, gazette "Electronically operated vote counting machine" (Gazette: 191/Mas/80, 15 October 1980). His original design (using Integrated Circuits) was exhibited to the public in Government Exhibitions held in six cities across Tamil Nadu. It was designed and revised by Election Commission of India in collaboration with two public sector undertakings Bharat Heavy Electronics Limited(Bangalore) and Electronics Corporation of India Ltd. (Hyderabad). The Industrial design of the EVMs were faculty members at the Industrial Design Centre, IIT Bombay. The EVMs were first used in 1998 in the by-election to North Paravur Assembly Constituency in Kerala for a limited number of polling stations.

EVM was manufactured in 1989-90, which was used on experimental basis for the first time in 16 Assembly Constituencies in the States of Madhya Pradesh, Rajasthan and NCT of Delhi at the General Elections to the respective Legislative Assemblies held in November, 1998.

Since then EVMs have been one of the most important aspect of an Election in India and other democratic countries as well.
The use of EVMs has not been limited to only elections, it has been considered in other ways also such as in Quiz competition, Audience Polling in some workshop or seminars and many others.
Thus the history of EVMs are as important as its working and application which it provides in many ways.

2.3 Tools and Software Used

- **MPLAB® IDE v8.92**

  MPLAB® X IDE is a software program that runs on a PC (Windows®, Mac OS®, Linux®) to develop applications for Microchip microcontrollers and digital signal controllers. It is called an Integrated Development Environment (IDE), because it provides a single integrated "environment" to develop code for embedded microcontrollers.
  MPLAB® X Integrated Development Environment brings many changes to the PIC® microcontroller development tool chain. Unlike previous versions of the MPLAB® IDE which were developed completely in-house, MPLAB® X IDE is based on the open source NetBeans IDE from Oracle. Taking this path has allowed us to add many frequently requested features very quickly and easily, while also providing us with a much more extensible architecture to bring you even more new features in the future.

- **Proteus® Professional 7.0- ISIS**

  Proteus is a Virtual System Modelling (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. One of the main components of Proteus 7.0 is the Circuit Simulation -- a product that uses a SPICE3f5 analogue simulator kernel combined with an event-driven digital simulator that allow users to utilize any SPICE model by any manufacturer.
  Proteus VSM comes with extensive debugging features, including breakpoints, single stepping and variable display for a neat design prior to hardware prototyping.

In short Proteus 7.0 is the program to use when you want to simulate the interaction between software running on a microcontroller and any analog or digital electronic device connected to it.

- **Proteus ® ARES**

Proteus is a single integrated application with ISIS, ARES and 3D Viewer modules appearing as tabbed modules. The program enables changes on the schematic to be reflected across PCB, BOM and Design Explorer in real time. Proteus stores the design (DSN), layout (LYT) and common database in a single project file (PDSPRJ).

- **PICkit-2 Debug Express**

PICkit 2 Debug Express allows in-circuit debugging on selected PIC microcontroller units (MCUs). In-circuit debugging allows the designer to run, examine, and modify the program while the PIC MCU is embedded in the hardware, thereby assisting the designer in debugging the firmware and hardware together. Debug Express interacts with MPLAB IDE software. Programs can be run, stopped, and single-stepped. One breakpoint can be set and the processor can be reset. Register contents can be examined and modified when the processor is stopped. Debug Express requires MPLAB IDE version 7.40 or later.

- **Soldron 25 Watt Soldering Kit**

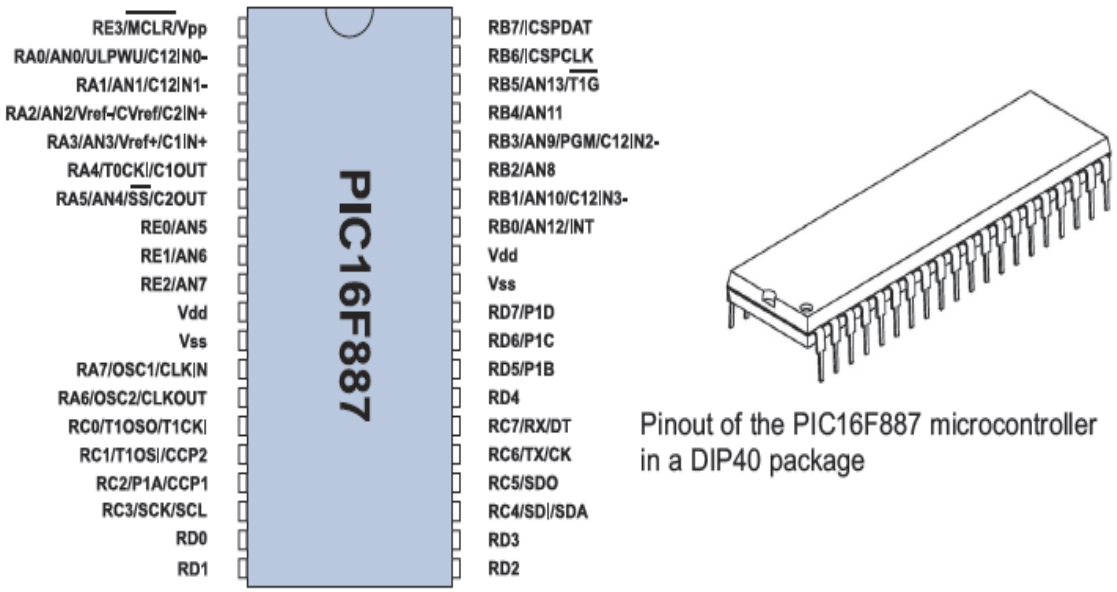
SOLDRON Soldering kit - The workhorse of electronic appliances. The most popular product General purpose for all electronic applications Continuous rated (24 hours).Attains full operating temperature within seconds Maintains full constant tip temperature .Low current leakage. Maximum heat transfer efficiency. Slide on replaceable tips. Light weight and easy to use. Durable elements designed for long life.

It is used in the soldering of electronics component used in the Electronic Voting Machine such as Microcontroller, Resistors, IC base, switches, LEDs etc.

2.4 Components used with Description

➢ Microcontroller – PIC16F887

This powerful yet easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs **Microchip**'s powerful PIC® architecture into a 40- or 44-pin package. The PIC16F887 features 256 bytes of EEPROM data memory, self-programming, an ICD, 2 Comparators, 14 channels of 10-bit Analog-to-Digital (A/D) converter, 1 capture/compare/PWM and 1 Enhanced capture/compare/PWM functions, a synchronous serial port that can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus and an Enhanced Universal Asynchronous Receiver Transmitter (EUSART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances or consumer applications.



Pinout of the PIC16F887 microcontroller in a DIP40 package

FIG 2.4.1 PIN LAYOUT OF PIC16F887

The above figure shows the 40 pin configuration of the PIC16F887 microcontroller. It has a 368Byte RAM size and Flash memory as 14Kb.

➢ 16 x 2 LCD Device

Liquid Crystal Display which is commonly known as LCD is an Alphanumeric Display it means that it can display Alphabets, Numbers as well as special symbols thus LCD is a user friendly Display device which can be used for displaying various messages unlike seven segment display which can display only numbers and some of the alphabets. The only disadvantage of LCD over seven segment is that seven segment is robust display and be visualized from a longer distance as compared to LCD. Here I have used 16 x 2 Alphanumeric Display which means on this display I can display two lines with maximum of 16 characters in one line.

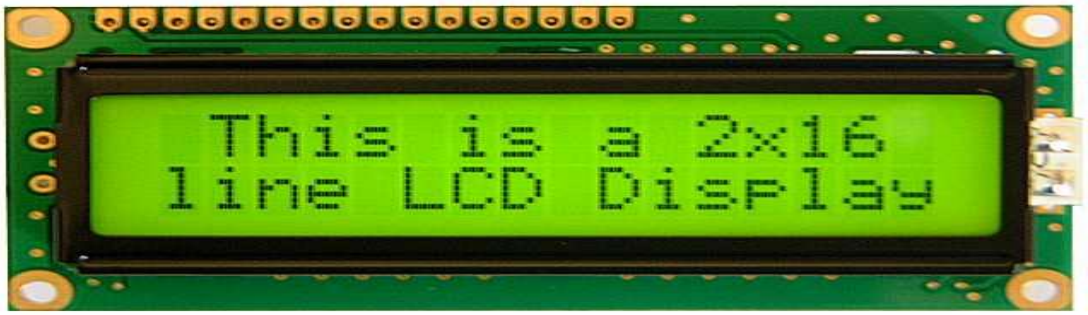


Fig. 2.4.2 A 16x2 LCD Device

Each display position can be uniquely defined by its DDRAM address, which is nothing but the coordinates of cursor. It is shown as a block diagram below:

Address locations in Hexadecimal→

0x80	0x81	0x82	0x83	0x84	0x85	0x86	0x87	0x88	0x89	0x8A	0x8B	0x8C	0x8D	0x8E	0x8F
0xC0	0xC1	0xC2	0xC3	0xC4	0xC5	0xC6	0xC7	0xC8	0xC9	0xCA	0xCB	0xCC	0xCD	0xCE	0xCF

Fig. 2.4.3 Block Diagram of DDRAM in LCD

- **LED**: A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices and are increasingly used for other lighting. Light-emitting diodes are used in applications as diverse as replacements for aviation lighting, automotive lighting (particularly brake lamps, turn signals and indicators) as well as in traffic signals.
  Here, we are using it as an indicator to view enable/disable option by the control authority. As the authority presses the control switch LED-Enable gets light up otherwise the disable LED is being turned ON giving a clear idea of when to vote and not to.

Fig.2.4.4 LEDs with different colors

- **Control switches**: There are four control switches:

  I. Clear Votes.
  II. Candidate Vote switch.
  III. Authority switch.
  IV. Result Switch

Control Switch is a push to activate button. As the voter presses the switch, the circuit gets completed and performs the necessary task required.

Figure 2.4.5 Control Switch/Push-to-activate button

- **OSCILLATOR:** An electronic oscillator is an electronic circuit that produces a periodic, oscillating electronic signal, often a sine wave or a square wave.

  PIC microcontroller has an internal oscillator as well as we can use an external oscillator also to generate a clock pulse of required amplitude and frequency, we are using crystal oscillator externally, producing a frequency of 20 MHz

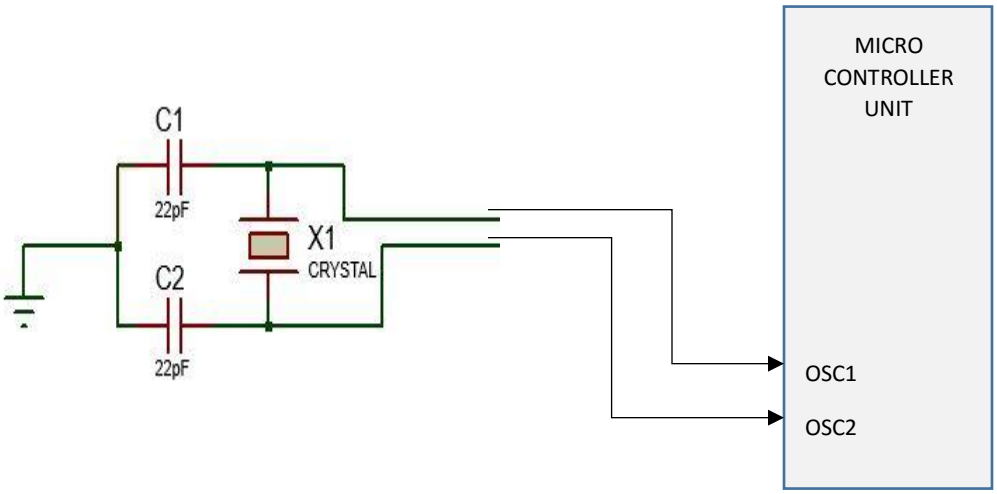


Fig. 2.4.6 Crystal Oscillator connected to Microcontroller (PIC16F887)

2.5 Block Diagram of Electronic Voting Machine

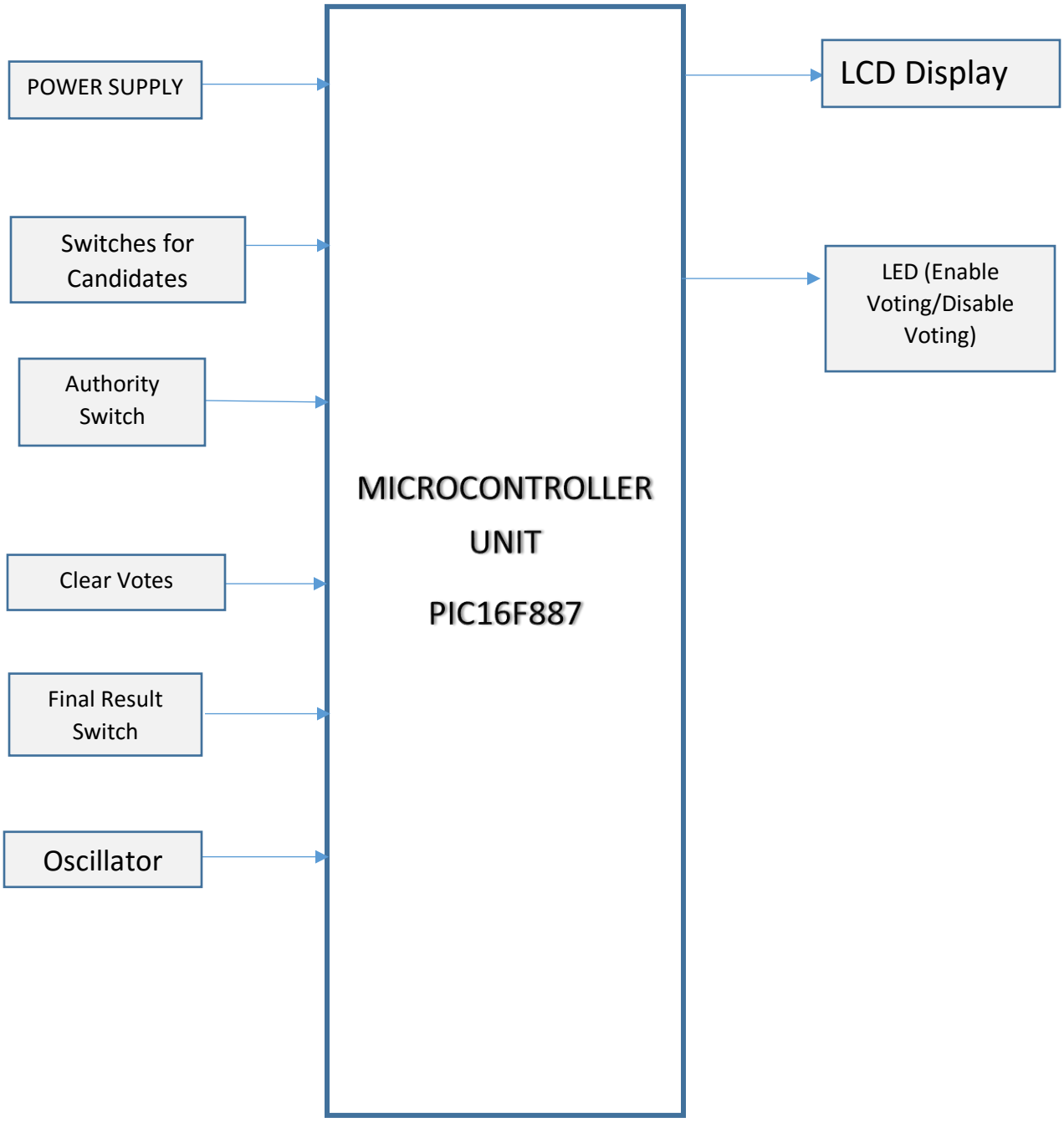


Fig. 2.5.1 Block Diagram for EVM

CHAPTER 3

Technical Features and Details

Earlier in previous chapter, we discussed about the components used, block diagram and various software and tools used in making of the Electronic Voting Machine. This chapter details with its features and technical specifications.

3.1 Features of EVM

- ✓ PIC 16F887 Microcontroller from Microchip Company.
- ✓ 8 bit Microcontroller.
- ✓ 12V D.C Supply.
- ✓ Operating Temperature is less than 150 degree Celsius.
- ✓ 256 bytes EEPROM as an internal memory of PIC 16F887.
- ✓ Eliminates the possibility of invalid votes, makes the counting process faster and reduces the cost of printing.
- ✓ Easy to use.
- ✓ 20 MHz Crystal Oscillator.
- ✓ A 16x2 line LCD device for providing a user interface (UI).
- ✓ The control unit can store the result for 10 years and even more.
- ✓ It is portable i.e. it can be carried at any place with ease.

3.2 Circuit Diagram of EVM

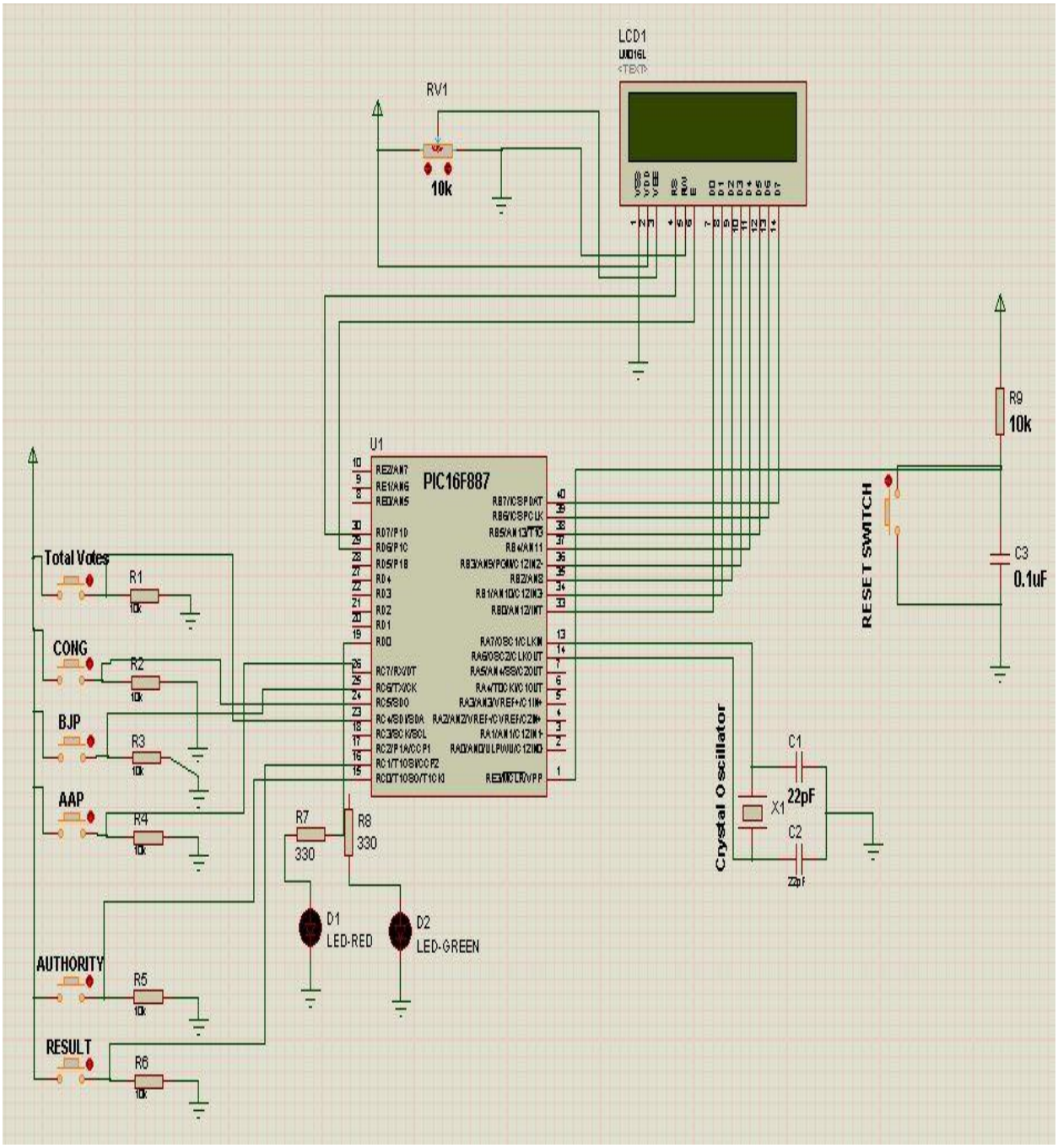


Fig. 3.2.1 Circuit Diagram of EVM

Figure 3.2.1 shows the circuit diagram of the Electronic Voting machine which consists of PIC 16F887 interfaced to LCD device (LM016L) with the **PORT B** of microcontroller. Note here that Data lines of LCD i.e. PIN No- D0 to D7 are connected to PORT B whereas PIN No 1 to 6 are connected to ground (**Vss**), power (**Vdd**), potentiometer, ground, **RD7**(PORT D), **RD6**(PORT D) respectively.

Here is a block diagram of LM016L LCD device:

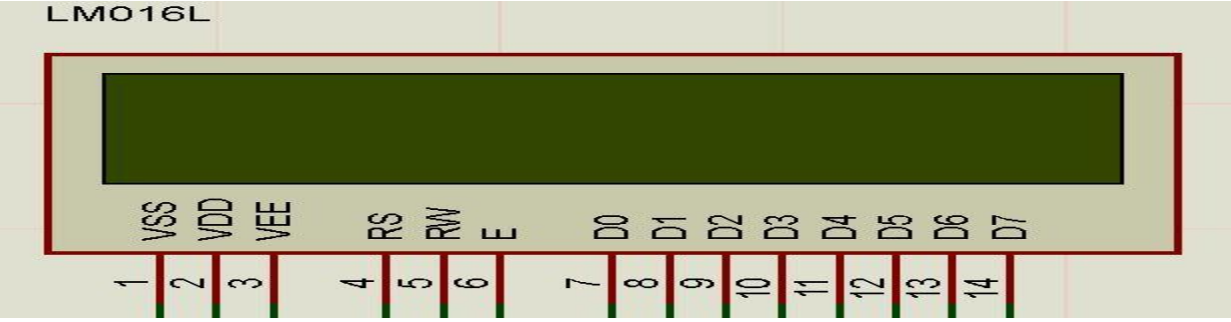


Fig. 3.2.2 Block Diagram of LCD LM016L

It is a 16 pin device with 2 pins internally connected to power and ground. Here '**RS'** stands for Read Status i.e. it checks whether to send data or command to the microcontroller unit and '**E**' stands for enable i.e. enabling/disabling when goes high to low.

Now a crystal oscillator is connected to **OSC 1** and **OSC 2** pin of PIC16F887 with two 22pF capacitors in parallel connection as shown in the fig. 3.2.1 which produces an oscillation frequency of 20 MHz

There are 6 switches connected in the circuit diagram out of which 3 are candidate's switch and one is for Authority or Booth Level Officer and the other one is used to check out the result of the voting process and the last one clears the vote count. There is also one more switch i.e. used to reset the circuit at the beginning process.

3.3 Working Process of Electronic Voting Machine

Working of the EVM can be explained with the help of a Flowchart as shown in the given below figure.

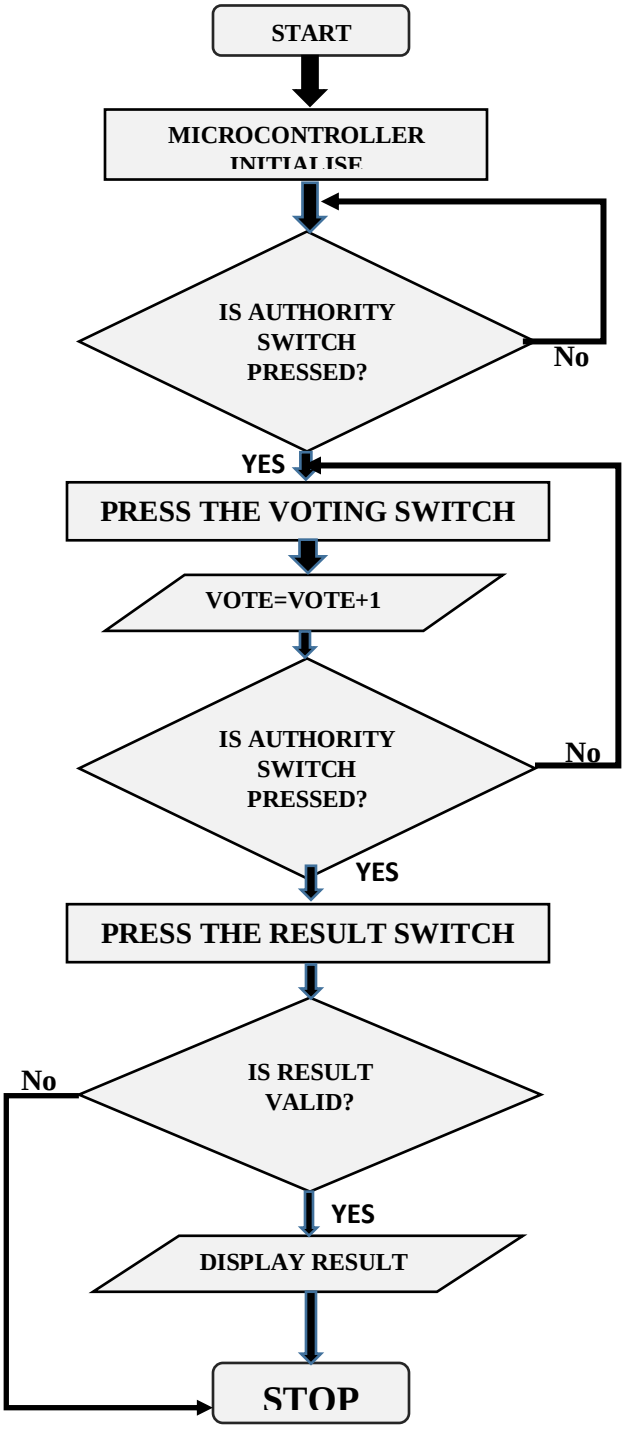


Figure 3.3.1 Flowchart for working of EVM

3.4 Steps involved in making of the EVM

- ✓ Write the Embedded C program of the EVM using **MPLAB® IDE v8.92**
- ✓ Compile the program which automatically compiles and assembles the language to an assembly language which can be loaded into the microcontroller.
- ✓ Make the circuit diagram using **PROTEUS PROFESSIONAL-ISIS** software and netlist it to **ARES** to generate the PCB design of the circuit model.
- ✓ Now take the print of the PCB design and make the PCB using ceramic board of 4x4 sheet.
- ✓ Solder the electronic components used in the design.
- ✓ Now we need to test our PCB for proper connections and make sure that all ports which require power are able to receive i.e. check for power and ground line for any missing trace.
- ✓ Now burn or load the program in the microcontroller using PICkit-2 Debugger Device, which can be connected to your computer or laptop.
- ✓ Check the configuration Bits of the program to make sure the program runs bug free and without any lag.
- ✓ This completes the making of EVM prototype and can be checked for any discrepancies.

3.5 List of Components used

- ✓ PIC16F887 IC
- ✓ 20 MHz CRYSTAL OSCILLATOR
- ✓ LCD device (16 x 2 display)
- ✓ SWITCHES/BUTTON(SMALL)
- ✓ 40 PIN BASE
- ✓ Female Bug Stripe
- ✓ 5 pin male connector
- ✓ 3 pin connector
- ✓ LEDs
- ✓ 12V adapter
- ✓ Power connector
- ✓ Capacitors (22uF, 0.1uF,220uF)
- ✓ Resistors (330ohm,1k,10k)
- ✓ IC- 7805 Voltage Regulator
- ✓ BC547 NPN transistors
- ✓ PCB
- ✓ PICkit – 2

3.6 PCB layout

Here's a look at the PCB design of the EVM using **ARES** software.

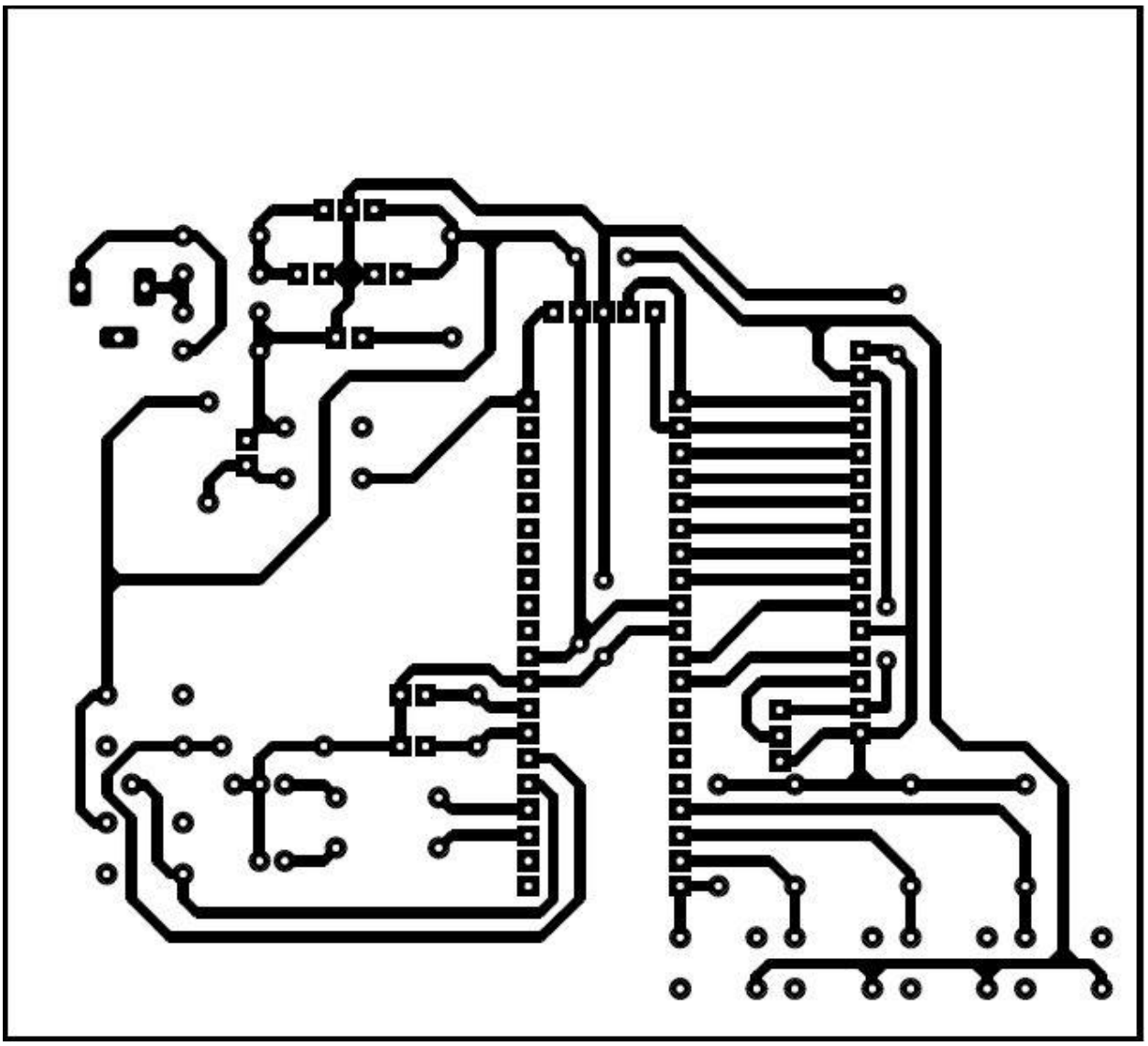


Fig. 3.6.1 PCB Design of EVM

3.7 Final Working EVM Model

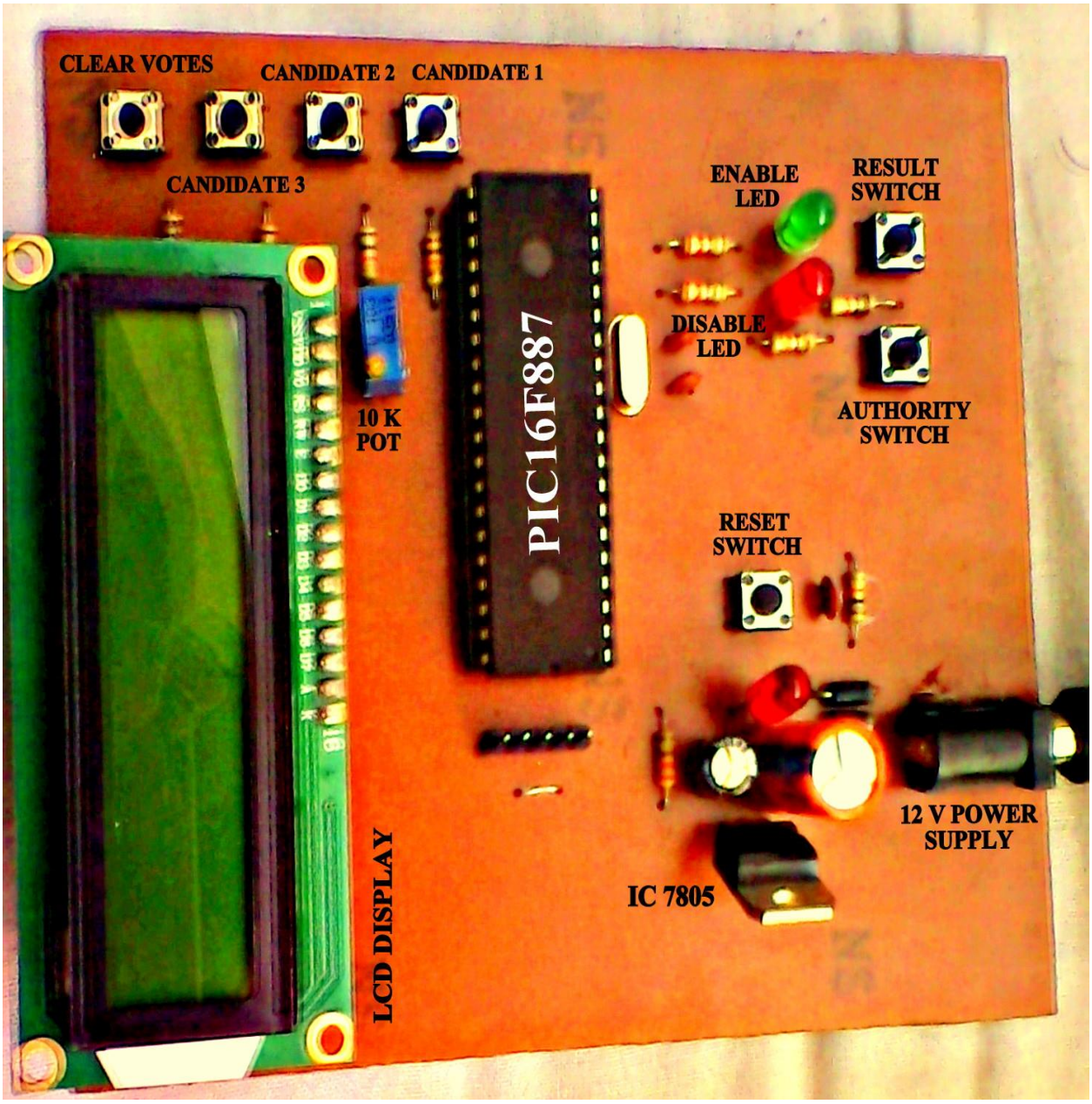


Fig. 3.7.1 EVM hardware model

Initially, the power supply is provided to circuit via 12V adapter, which starts the EVM and initialize the Microcontroller and its memory (EEPROM). Now to enable voting authority presses the authority switch which can be seen by the green color LED indicating enable voting.

Now the voter cast its vote whom he/she may have chosen. This EVM is used to vote for only 3 candidate parties (AAP, BJP, INC). It can be programmed for more parties also.

As soon the voter presses the candidate switch , vote count is being stored in the memory and can be cleared or checked only by the Booth Level Officer (BLO) or Authority and the voting process gets disabled which is indicated by the RED LED. Now this process is repeated until all the voters have been voted successfully.

In case of equal vote count for all three parties, the voting process needs to be done again and it is shown by displaying a message "**Something went wrong**". The EVM has been programmed as such that as soon the result is displayed on LCD, the vote count gets cleared after sometime.

Now the EVM has a special feature of retaining the vote count on power loss also. It consists of 256 bytes of RAM size which has been programmed to receive the vote count which can retain the vote count for at least 10 years or even more.

Now due to small size of EEPROM it can receive a maximum count of 256.

On successful completion of voting process, results can be seen easily on the permission of Authority which has the EVM rights.

3.8 Application and Advantages of Electronic Voting Machine

- ❖ It is mostly used in elections held in almost every democratic country replacing the former poling method or ballot paper method.
- ❖ It can also be used in various quizzing competition and college elections also to get the winner without any ambiguity.
- ❖ It is economically feasible.
- ❖ Less Manpower required.
- ❖ Time conscious, as less time required for voting.
- ❖ Avoids invalid voting in any case.
- ❖ Saves transportation cost due to its compact size.
- ❖ Convenient on the part of voter.

3.9 Future Development

- We can implement GSM (Global System for Mobile) technology for this project which can be used as a tracing for the EVM to continuously monitor the device.
- We can also use the RFID (Radio frequency identification) technology to provide digitalize the voting process which provides the voter digital voter card (RFID Tag) instead of ordinary voter card. It can solve the problem of ink used in the voting process as an indication to that, the person has already been voted.
- EVM can also be provided with a lock system with a proper encryption technology to avoid any fraud with the EVM. Although it is safe but to be on more safe side we can implement this easily by providing a keypad for locking the machine when not in use.
- Enhanced User Interface (UI) with finger print scanner.
- An automatic confirmation to the voter by sending them a confirmation message of successful voting.
- Providing the logo of the party instead of only name for those who can’t read.
- If we make more than EVM, each to be used at the different locations and the final result is the addition of all the results at different locations, we could think of connecting them to communicate with each other and final result can be shown on one of the LCD.

CONCLUSION

In this report, we have described the specification and architecture of an "ELECTRONIC VOTING MACHINE". Various fault-tolerance and security issues are delegated to the platform itself, therefore relieving the application designer from accommodating these features in the application design itself. This approach allows for the easy development and deployment of applications.

For quite some time, voting equipment vendors have maintained that their systems are secure, and that the closed-source nature makes them even more secure. Our glimpse into the code of such a system reveals that there is little difference in the way code is developed for voting machines relative to other commercial endeavors. In fact, we believe that an open process would result in more careful development, as more scientists, software engineers, political activists, and others who value their democracy would be paying attention to the quality of the software that is used for their elections. (Of course, open source would not solve all of the problems with electronic elections. It is still important to verify somehow that the binary program images running in the machine correspond to the source code and that the compilers used on the source code are non-malicious. However, open source is a good start.) Such open design processes have proven successful in projects ranging from much focused efforts, such as specifying the Advanced Encryption Standard (AES) [23], through very large and complex systems such as maintaining the Linux operating System. Australia is currently using an open source voting system10Alternatively, security models such as the voter-verified audit trail allow for electronic voting systems that produce a paper trail that can be seen and verified by a voter. In such a system, the correctness burden on the voting terminal's code is significantly less as voters can see and verify a physical object that describes their vote. Even if, for whatever reason, the machines cannot name the winner of an election, then the paper ballots can be recounted, either mechanically or manually, to gain progressively more accurate election results. Voter-verifiable audit trails are required in some U.S. states, and major DRE vendors have made

public statements that they would support such features if their customers required it. The EVM project an ambitious attempt to create an open-source voting system with a voter-verifiable audit trail — a laudable goal. The model where individual vendors write proprietary code to run our elections appears to be unreliable, and if we do not change the process of designing our voting systems, we will have no confidence that our election results will reflect the will of the electorate. We owe it to ourselves and to our future to have robust, well-designed election systems to preserve the bedrock of our democracy.

This EVM model was successfully tested without any glitches or faulty connections. The model can used to find the result of the election for three candidates only and can be implemented for more candidates also without any complexity.

BIBLIOGRAPHY

Various packages & tools such as PIC16F887, MPLAB® IDE v8.92, Proteus® Professional 7.0- (ISIS), Proteus® ARES and other tools & software have been referred from the following websites:

http//www.wikipedia.com/
http://www.microchip.com/
http:// www.microchip.com/mplabx/
http://www.labcenter.com/

Various information about the process of voting in India & other major democratic countries were obtained from the following websites:

http://democracy-reporting.org
http://eci.nic.in/eci_main1/evm.aspx
http//www.wikipedia.com/

Best efforts were made on the writer's side to prevent any copyright infringements.