Architecture of Electronic Voting Machine for Preferential Voting used in University Election

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Abstract

Allowin Toffel in his book 'Third Wave' had described the third revolutions that have witnessed namely the agrarian revolution, industrial revolution and the computer revolution. But now we are in the age of convergence which emphasizes communication at a faster speed. Electronics and electronic gadgets have assumed a greater significance in this era of speed and accuracy. One such electronic device is the EVM[1] (electronic voting machine). It is a simple electronic device which records votes in place of ballot papers and boxes which were used earlier. In India it was first used in 1982 at Parur assemble constituency at Kerala on 50 polling stations. It can be used without electricity as it runs on alkaline battery. This machine is microprocessor based, such an EVM can record maximum 3,480 votes.

However there are situations where preferential voting is used. Traditional EVM cannot be directly used for this purpose. In this paper we present the design and construction of an EVM intended for use in preferential voting. The EPVM (Electronic Preferential Voting Machine) is designed keeping in view the preferential voting system of Dr. BAMU. The firmware of the EPVM can be modified to suit other preferential Voting Systems that are different from this.

1. Introduction

Preferential voting is flexible voting mechanism that allows voters to cast their vote against multiple candidates in the race, according to the order of the voter's choice. It is a type of ballot structure used in several electoral system in which voters rank candidates in order of relative preference. For example, the voter may select their first choice as '1' for first candidate, second preference as '2' for next candidate and so on. The complete task of conducting election and scrutiny as well as counting the votes is still done *[manually using paper ballot]* by man power.(BAMU)

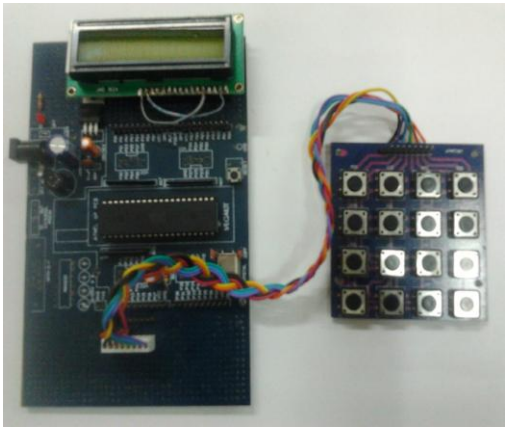
As this is an era of speed and accuracy, why not to use an electronic machine for this kind of voting. However, the EVMs that are already available will not serve the purpose of preferential voting.

A different type of hardware and software is required. So, keeping in view the process of preferential voting according to the University Statute of 1974 and University Act 1994, we tried to design EPVM. The advantage of EVM and EPVM is that the election process right from the polling to the counting and declaration of result can be made transparent and error free. There are few branded EPVM but those are intended for altogether different environment and conditions and thus are not cost effective and viable solution for this type preferential voting system.

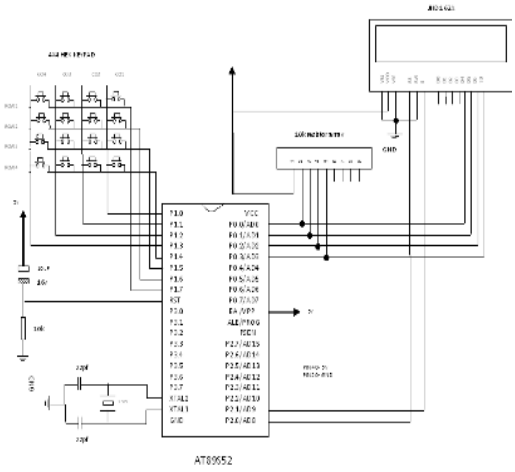
2. Methodology

The design consideration of EPVM used for preferential voting is dictated by the rules governing the conduct of voting process, additionally constraints like cost effectiveness and magnitude of its usage and flexibility and versatility are also to be handled carefully to cope with the requirements. The EPVM is designed using a microcontroller from Atmel corporation based on 8051 architecture namely the AT89S52. Advantage of using this MCU is that it has 8k bytes of In-system programmable (ISP) flash memory – endurance: 1000 write/erase cycle, 4.0v to 5.5v operating range, fully static operation: 0Hz to 33MHz, 3 level program memory lock, 256 x 8 – bit internal RAM, 32 programmable I/O lines, three 16- bit timer / counters, eight interrupt sources, full duplex UART serial channel, lower – power Idle and power down Modes, interrupt recovery from power down mode that make it ideal for such field applications where power can not be guaranteed round the clock, etc.

The microcontroller is interfaced with LCD display with two lines of 16 characters each. The LCD uses the HD44780 series LCD driver from Hitachi, or equivalent controller. The LCD display shows the relevant information to the user during the course of operation of the voting machine. As the voter proceeds in the voting process giving preferences to the candidates one by one, the display shows the name of the candidate and the preference assigned. For exercising the preferential voting a 4x4 matrix keypad is provided which contains necessary keys for the use of voters. The LCD display makes use of four pins (p0.0-p0.3) from port P0 and two pins (p2.0and p2.1) from port P2. The key pad is connected to port P1. Both the rows and columns are interfaced to the same port using upper and lower nibbles respectively.



Photograph of the Circuit



Circuit Diagram

The circuit is assembled on a standard general purpose PCB supporting 8051 family microcontrollers. The main circuit board contains all the components including power supply, except the LCD display and the keypad. The implementation of the preferential voting required modifying and debugging of the circuit and the controlling program from time to time, to this effect, utilizing the ISP capability of the MCU an ISP port was also provided on the circuit board. For the purpose of programming of microcontroller, we used a simple home made ISP programmer utilizing the parallel port of the computer.

3. Design and Construction

As this EPVM is meant for preferential voting system of Dr. BAMU, it is not going to be used on a large scale like assembly elections. The system is to be so designed that it is user friendly and initial and maintenance cost should be reasonable. The EPVM is expected to be simple in use so that training of the man power is easier and at the same time efforts and resources are saved. Data security and reliability of operation is also to be kept at priority. For the successful implementation of the preferential voting process, the university rules for conducting election were thoroughly studied. From the summary of the rules an algorithm was evolved to make provision for the implementation of the voting process. Programs were written in assembly language to keep the code compact and efficient and make judicious utilization of the resources. Most of the programming was done using 8051 IDE and the programs were tested both using dry run and simulation. After successful compilation of the assembly code the .Hex file was generated and finally transferred to the microcontroller 89S52 using ISP programmer. As soon as the programming is over, the system is in operation and can be tested. Series of testing operations under various conditions were conducted and the results recorded. During the course of testing many practical issues popped up and those were not noticed till the stage of testing, one such example is the time for which the display should stay after a preference is exercised.

4. Features

At the power on, the EPVM performs necessary initializations and is ready for the voting process. There is a master switch that can be pressed one to issue permission for casting the vote, this switch is available with the authority granting permission for voting after the completion of rest of the formalities by the voter. As the voter reaches the booth for voting the name of the first candidate is displayed on the LCD screen and the voter is expected to cast his vote by assigning the desired preference to this candidate. As soon as a preference as assigned, a LED flashes for a while and the LCD display displays the selected preference. If the preference is invalid because it has already been used for some other candidate or the preference (number) falls beyond the

permissible range, it makes a beep and prompts for entering the preference again. If no preference is to be assigned to a candidate, pressing the next button on the key pad will skip this candidate and go to next candidate whose name will be displayed on the LCD screen and the voter will exercise his preference for each candidate in this manner. After all the candidates are exhausted, i.e. last candidate has been assigned a preference or skipped, the voting system will give a beep and the key pad will be deactivated till the next voter is permitted by the controlling authority.

The preferences assigned by the voters to different candidates are stored in the memory of the microcontroller, for larger amount of data; there is provision of using external memory. The circuit is provided by battery back up that can retain the data for more than 72 hours before which the data has to be transferred to computer for further processing and declaring the result of the preferential voting. An interface is provided to download data from the voting machine into a computer under program control. If voting is conducted at more than one place, the data from all the booths is brought at one place for further processing. Computer programs are written in C++ and VB for analyzing the data implementing the procedures laid down for the declaration of a candidate as elected. It includes all the details of elimination of candidates if required quota is not reached and the transfer of the votes till the final result is reached.

5. Results and Discussion

The entire EPVM system is designed and constructed to implement the preferential voting process prevailing at the Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. Step by step testing done and debugging implemented. The EPVM was tested at different occasions using different parameters like candidates and voters and the results were analyzed. The outcome of voting and result analysis was cross checked using manual counting of ballets by physically implementing the same voting process using paper ballets and counting of the votes. In all the tests conducted the results were found to be in perfect agreement establishing the proper functioning of the EPVM.

6. Further / future scope

It is planned to incorporate non volatile memory for data storage and security, latest data transfer schemes will be implemented for reliable functioning. Four line LCD display will also be included to improve the performance and interactive usage. High end MCUs like AVR etc will also be attempted and performance evaluated for large system applications.

7. References

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