An Electronic Voting System for a Legislative Assembly

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ABSTRACT: In a variety of situations that require the administration of human beings, it is necessary that decisions be taken after some form of election has been conducted. This is particularly relevant in small and medium organizations such as boards of companies, senates of institutions of higher learning and in various arms of government. In these situations voters indicate their preferences by casting either yes or no votes. Indecisions can be handled after collating these two types of votes. The machine described here was built around a microcontroller that was appropriately programmed to accept inputs from switches which represent the voter's preferences. The collation and display of results are done automatically as soon as a voter casts his vote. The experimental machine has been designed to handle 255 voters but the hardware and the firmware are easily upgradeable to handle more voters.

KEYWORDS: Electronic Voting, Microcontroller, Electronic Display, Legislative Voting.

1   INTRODUCTION

Issues are discussed at various fora that at the end nearly always require the polling of individual preferences to enable the chief executive to know which direction his organization is headed. The indication of such preferences is done through voting which is a means of aggregating individual preferences into a collective [1]. The importance of having such elections properly conducted and having the votes accurately counted cannot be overemphasized [2]. Traditional methods of voting that involve showing of hands are inadequate as they can lead to intimidation of voters [3]. Similarly the indication of preferences by simple acclamation of "aye" and "nay" is very subjective as the resultant decision making is based solely on the loudness and intensity of sound produced. This can vary greatly from one individual to another.

The electronic system being described here eliminates the intimidation of voters since the system can be wired such that the individual voter has some measure of privacy. The system also eliminates subjectivity that may arise from the use of voice votes [4]. The conduct of elections in a typical legislative assembly differs greatly from general elections that are based on political party groupings in which the general population participates [5], [6]. In a legislative assembly the important requirements of a machine include accurate collation of the voter's preferences and ensuring that a voter can cast his vote only once. The voter should not be able to change his vote once he has indicated his preference. The requirements of the machine to be deployed in this environment are thus much more relaxed and simpler than those of machines designed for use in general elections which have to satisfy very many sets of sometimes conflicting requirements [7]. The voting system that is deployed in a legislative assembly does not need to be network-based. It also operates in a very friendly environment. The physical and software security requirements are thus not very arduous [8], [9]. This work aims at making it unnecessary for legislators or any group of people in organizations, such as a company, who make decisions through elections, to use the traditional methods of raising of hands or the use of voice vote.

2   MATERIALS AND METHOD

2.1   SYSTEM BLOCK DIAGRAM AND OPERATION

The block diagram of the voting system being proposed is depicted in figure 1. Prior to the commencement of the election the total number of accredited voters is stored in the memory of the microcontroller. A voter interacts with the machine by pressing a make-and-break switch which can represent a NO or a YES vote. The switches are processed through the diode matrix array shown in figure 2 to generate unique codes for the ports of the microcontroller. One port of the microcontroller is dedicated to processing the YES votes while the other processes the NO votes.
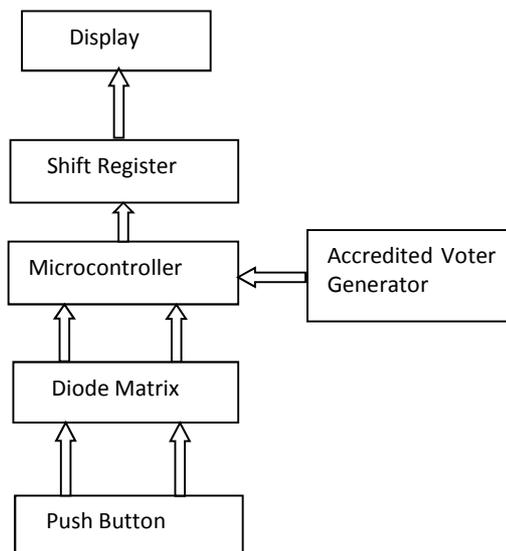
Fig. 1. Block Diagram of the Legislative Voting System

Each switch generates a code peculiar to it; for instance the code corresponding to switch S1 is 0000 0001 (01h). The microcontroller reads the port and checks for this code. If it exists the value of the YES votes is incremented by one. Simultaneously, the number of UNDECIDED votes (which at the commencement of voting equals the total number of accredited voters) is decremented by one. The microcontroller also ensures that at the ports no code with this value can be accepted again during this voting session. This fact implies that multiple voting by an individual, or the reversal of decision after an individual has cast a vote, is impossible. A similar operation occurs on the port that controls the NO votes except that in this case it is the value of the NO votes that is incremented by one. In this system, the YES and NO votes are counted as soon as the switches have been pressed. A major advantage of this system is that there is no need to have a master vote enabler who initiates the counting of the votes after the switches have been pressed by the voters.

The results of the election are available in the memory of the microcontroller and are sent to sets of 7-segment displays through shift registers. The YES votes, NO votes, and UNDECIDED votes each has three displays allocated to it. The machine can thus be used for up to 999 voters though much fewer numbers of voters have been implemented in this experimental system. The whole process is repeated at the press of any button other than those that generated the previous code. The display changes to show an increment in the YES or NO votes and a corresponding decrement in the UNDECIDED votes.

PROGRAM FLOW CHART

The flow chart used to develop the program for the microcontroller is shown in figure 3. The microcontroller monitors the switches through its ports; one port is dedicated to the YES votes while another port reads the NO votes. A pressed switch is registered in the memory of the microcontroller which also ensures that no such code is acceptable again during the current voting session. The microcontroller also decides if the pressed switch represents a YES or a NO vote and then calls the appropriate subroutine to increment the YES or the NO votes. The current value of UNDECIDED votes is then decremented. The results are converted to the appropriate format for display. In this project, seven-segment displays [10] are used to show the results. Figures 4 and 5 show the NO and YES subroutines.
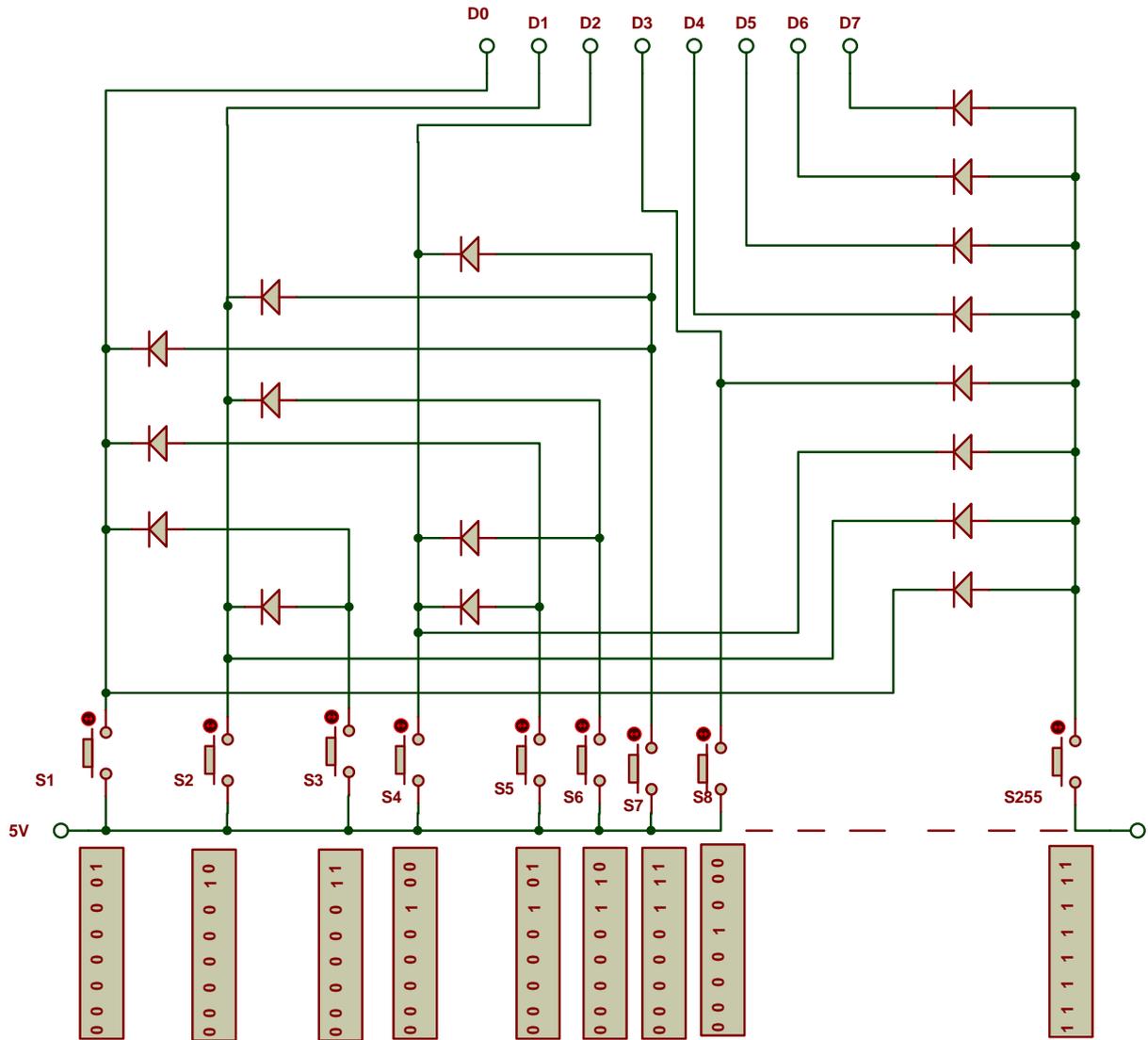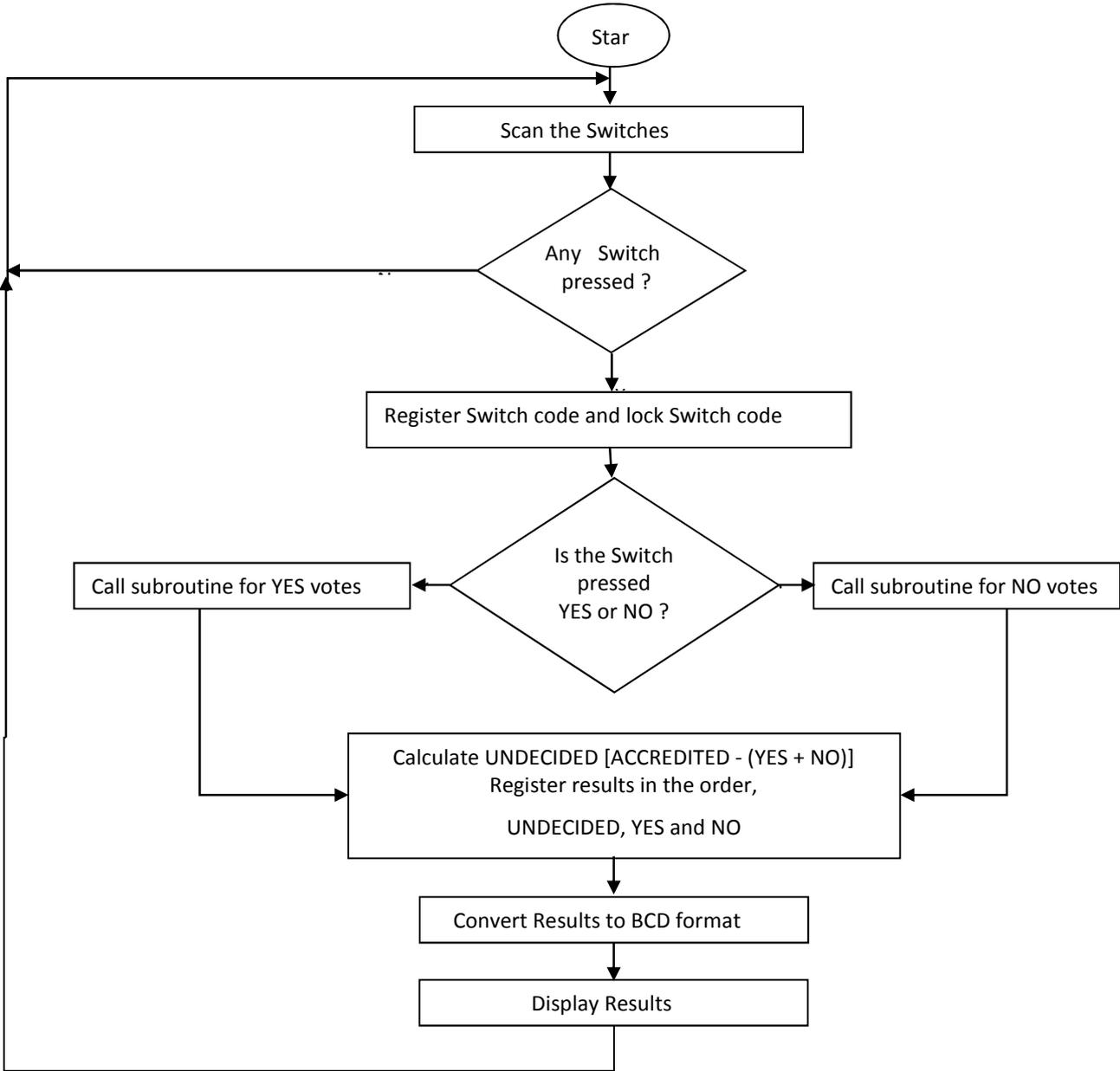
Fig. 2. Interfacing Diode Matrix to Microcontroller

Fig. 3. Flow Chart of Program for the Voting System
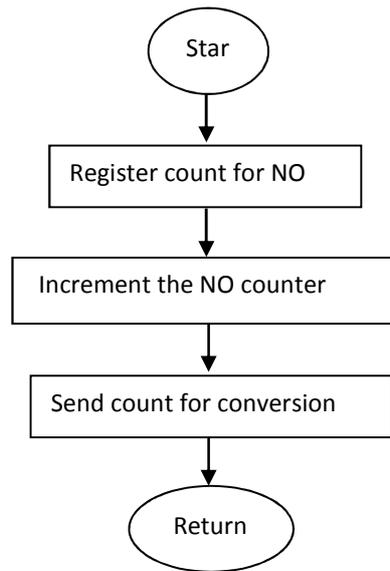
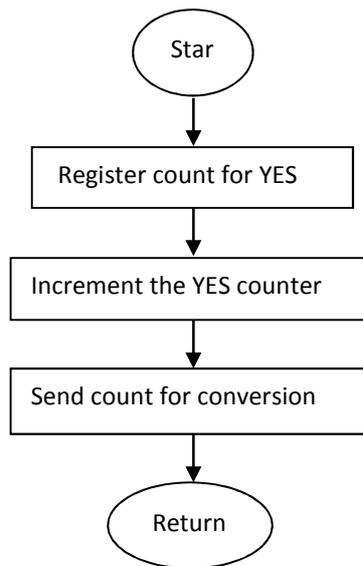*Fig. 4. Flow Chart for NO Subroutine*
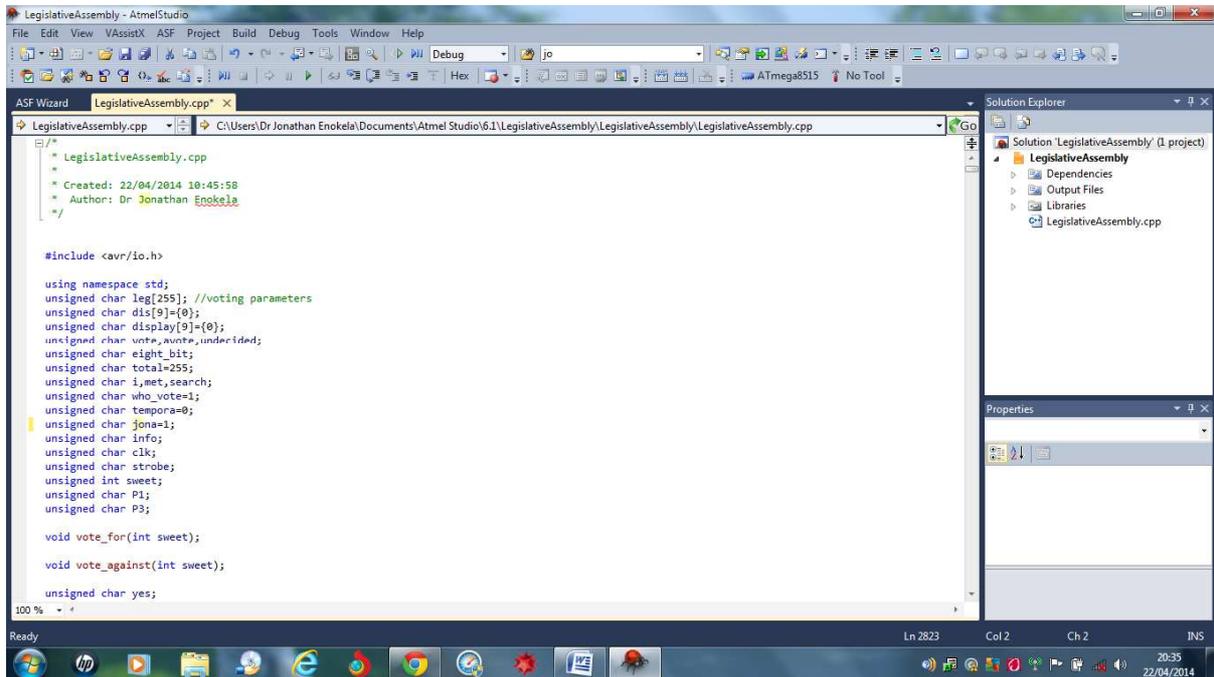

Fig. 5. Flow Chart for YES Subroutine

HARDWARE CONFIGURATION

An Atmel microcontroller AT mega 8515 [11] was used for the project. The program was written in C programming language and was tested and debugged using the Atmel studio 6 development environments [12]. The AVR Dragon [13] was used to burn the program into the memory of the microcontroller. The system described here differs significantly from others in existence in terms of the nature of instantaneous display of election results [14], [15], [16], [17].

3   RESULTS

The results of testing the program using the Atmel Studio 6 development environment are shown in the screenshots of figures 6, 7, 8. After the code had been properly debugged, the hex file generated was burnt into the flash memory of the

microcontroller. The hardware was built as a proof of concept, for a scaled-down number of voters. Photographs of the completed prototype being used in a typical voting session are shown in figures 9 and 10.

Fig. 6. Screenshot Showing Opening Section of Code for the Legislative Voting System

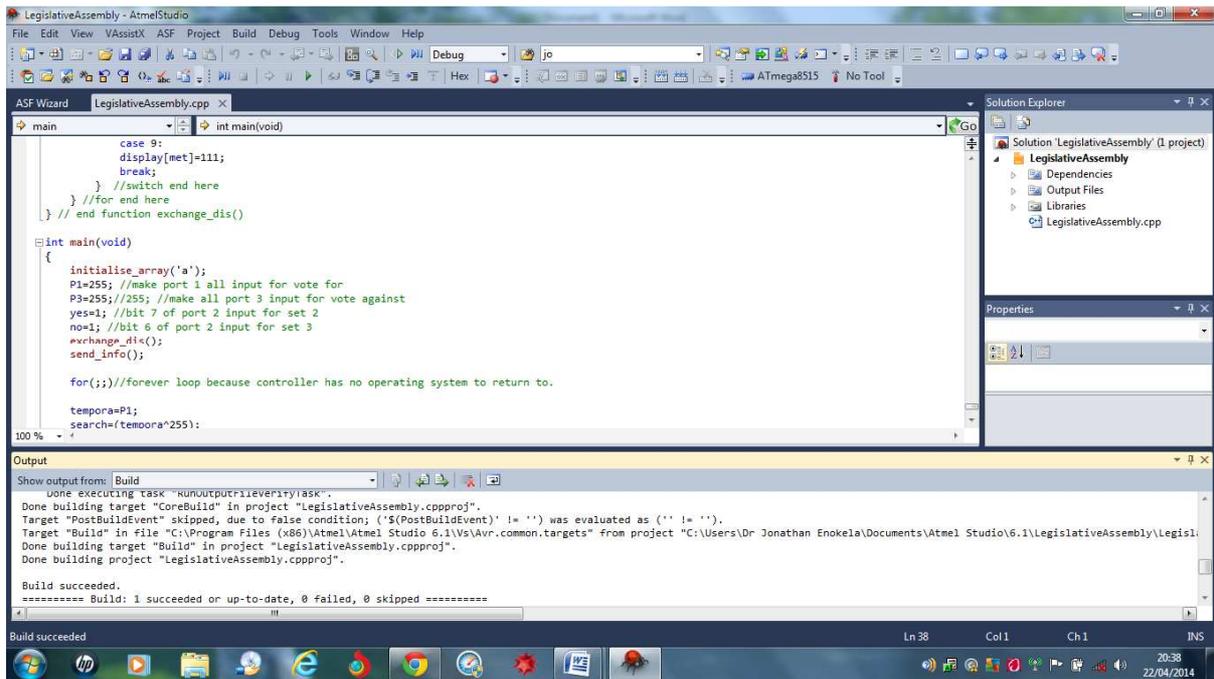*Fig. 7. Screenshot Showing Closing Section of Code for the Legislative Voting System*

Fig. 8. Screenshot Showing Successful Build Process in the Output Window

Fig. 9. The Legislative Voting System showing the Voting and Display Units

Fig. 10. A View of the Legislative Voting System Showing Only the Display Unit

4   DISCUSSION

The interfacing of a diode matrix to the microcontroller demands much less resources of the microcontroller in comparison with the use of ordinary keyboard matrix. A keyboard matrix that can handle up to 64 voters would need two 8-bit ports of the microcontroller while the diode matrix that can handle up to 255 voters, as shown in figure 2, requires only one 8-bit port of the microcontroller.

In this project a master vote enabler is not needed to initiate the counting of votes after the switches have been pressed by the voters. The system described here automates the process and the voter needs only to press a button to indicate his preference. The collation of the results of such elections is instantaneous and much simplified in comparison with the traditional method of voting.

5   CONCLUSION

A microcontroller-based electronic voting system suitable for deployment in legislative assemblies or in the board rooms of organizations has been designed and built. The system described here can be used for a maximum of 255 voters. The firmware and the hardware of the machine can be upgraded to accommodate more voters. This can be done by connecting more diode matrix array circuits such as shown in figure 2 to more ports of the microcontroller and then changing the controlling program of the microcontroller to account for the new diode matrix arrays.

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