

# An Algorithm for the Display of Results of Multiple Elections involving Multiple Candidates using a Microcontroller and Character LCD Display Modules.

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## ABSTRACT

Electoral laws in many countries require that results of elections be made available at the polling places before they are transmitted for tabulation. In this work, the results of seven simultaneous elections in which 36 political parties contested, are fetched from the memory of a microcontroller and displayed on two 40x4 character LCD display modules. Each result was displayed for a specified period of time; long enough for the polling agents and voters at the polling station to view and annotate for future reference. This process enhances transparency of the elections. The result display is initiated by pressing a button on the electronic voting machine.

(Keywords: election, electronic voting, microcontroller, algorithm)

## INTRODUCTION

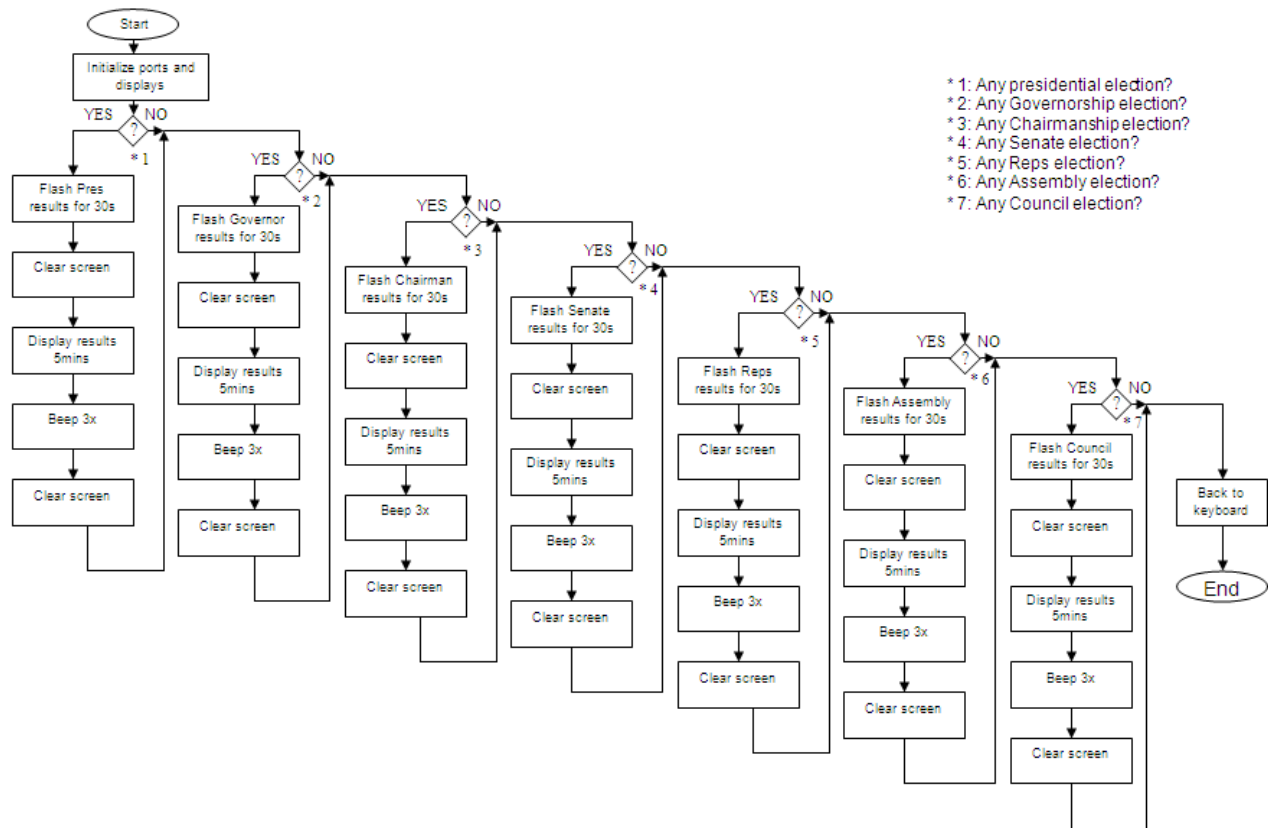
The polling station is the smallest unit in which voting usually takes place during an election. In many countries electoral and local laws require that the results of elections be immediately made available to the voters and polling agents of political parties at the end of voting for the particular polling station [1], [2], [3]. In the traditional method of organizing elections using the ballot box and paper ballots, the process of counting votes at the polling stations and assigning the votes to the candidates correctly is not only tedious and prone to counting errors it is also time consuming [11], [12]. This process accounts for the delay in the release of results to the candidates and the public at large. The process is also subject to manipulations by poll workers and creates the feeling of behind-the-scene falsifications in the minds of the voters especially given the fact that the poll workers

themselves may not be non-partisan [13], [14]. Making results available to the candidates and the voters speedily and accurately is therefore an important objective in any Electronic Voting system [15].

In the Direct Recording Electronic (DRE) voting machine being considered the results for each candidate and for each election are stored in particular locations of the EEPROM memory of a microcontroller. These results are stored as the voters interact with the machine by pressing the buttons corresponding to candidates or parties of their choice. A voter is permitted to press buttons as many times as the number of simultaneous elections being held, after which the machine disallows the voter from further interactions with the buttons. The machine thus guarantees the principle of one-man one-vote [16]. At the end of the election for the day, the results are immediately available and are displayed on LCD modules which form an integral part of the electronic voting machine.

## MATERIALS AND METHODS

Seven elections are considered to be held simultaneously. These include Presidency, Governorship, Chairmanship, Senate, House of Representatives, House of Assembly, and Council elections. These represent the elected positions in Nigeria [4]. The types of elections could easily be altered to suit local laws. These various elections are represented as ASCII values P, G, C, S, R, A, and K, respectively, and have already been written to specific locations of the EEPROM memory of the microcontroller during machine setup in the office of the Electoral Commission prior to the deployment of the machine to the polling stations. The flow chart depicted in Figure 1 gives the general format of the method used for the display of the results.



**Figure 1:** Flow Chart of Results Display Algorithm.

After the initialization of the microcontroller ports and the LCD, the EEPROM memory locations for the various types of election are read to find out if the type of election was held. If a particular type of election took place, a message is flashed on the LCD for 30 seconds to inform the voters and all concerned to expect the results of that type of election. Thus if the presidential election was among those conducted the message "Presidential Results" would be flashed for 30 seconds.

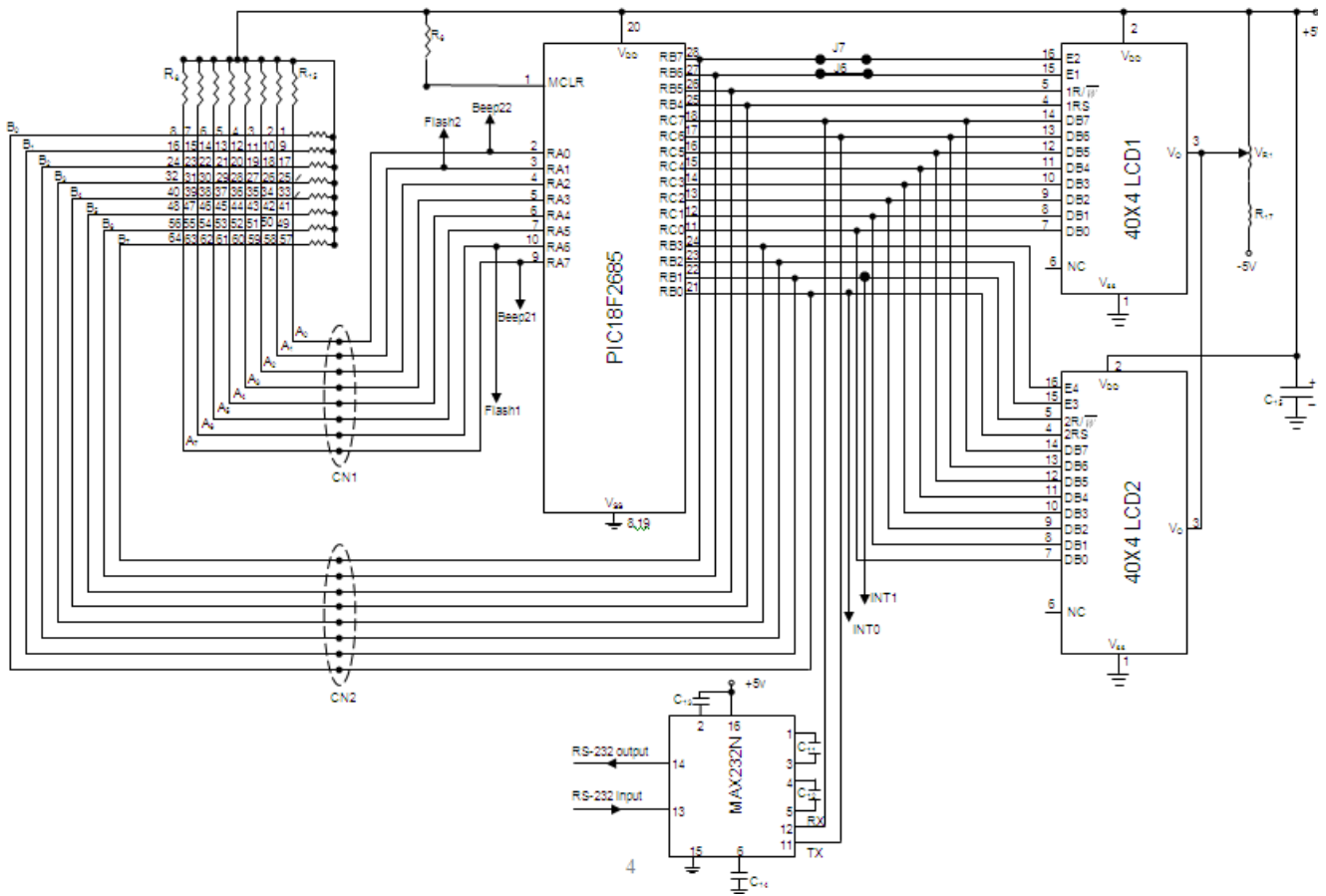
The LCD screen is cleared afterwards and the presidential results for each party are fetched from the EEPROM locations and displayed under the name of the party for five minutes. This time is considered to be long enough to allow poll agents to note the results of the elections. The results of the next type of election are displayed in a similar manner, and so on. However, if any type of election was not held, the results for that type of election will not be displayed.

## CODING, RESULTS AND DISCUSSIONS

The flow chart of Figure 1 was translated into an assembly language code using the instruction set of the PIC18F2685 microcontroller [5]. The code was developed in the Integrated Development Environment MPLAB IDE version 7.50 [6]. It was then assembled [7] and simulated using the IDE's embedded assembler and simulator MPLAB SIM.

The code which forms part of a larger firmware of the electronic voting machine was burned into the program memory of the microcontroller and was further debugged in hardware with the aid of the MPLAB ICD 2 debugger [8]. The microcontroller was inserted into the application circuit shown in Figure 2. Two 40x4 LCD modules [9], [10] were used for the display of the results.

Figure 3 gives the layout of the two LCD modules and the acronyms of the 36 political parties involved in the elections. A view of the physically constructed electronic voting machine showing party and function buttons as well as the LCD modules is given in Figure 4.



**Figure 2:** Schematic Diagram of the Voting Circuit.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
A	A			A	C	D		A	D			A	D	C		A	N	P	P		A	P	G	A		A	P	L	P		A	R	P		B	N	P	P	
C	P	N		D	A			D	P	P		F	D	P		G	P	N		J	P			L	D	P	N		M	D	J		M	M	N				
M	R	D	D		N	A	C		N	A	P		N	C	P		N	D			N	D	P		N	M	M	N		N	N	P	P		N	P	C		
N	R	P		P	A	C		P	D	P		P	M	P		P	R	P		P	S	D		P	S	P		U	D	P		U	N	P	P				

**Figure 3:** Layout of two 40x4 LCD Display Modules.

Various mock elections were conducted and the results were displayed on the screens of the LCD modules to verify the accuracy of the algorithm.

### CONCLUSIONS

An algorithm was developed to display the results of seven elections held simultaneously in which 36 political parties contested on two LCD

modules. The LCD module has been chosen as the medium for the display of results because of its low power consumption since the electronic voting machine under considerations is powered by a 6V rechargeable battery.

The Electronic Voting Machine shown in Figure 4 is based essentially on a single microcontroller. As a result of the few components count as shown in Figure 2, the 6V battery can support the

machine for up to 25 hours which is longer than the 14 hours mentioned in [15]. The algorithm described here can also be used to display results of multiple but separate events



**Figure 4:** Picture of EVM Unit Showing Party/Function Buttons and LCD Display Modules.

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