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Design of a Parliamentary Electronic Voting Response System

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Abstract: *Voting is an important process usually employed to reveal the opinion of a group on an issue that is under consideration such as the house of assemblies where crucial issues are deliberated upon. But in Nigeria and so many other countries, voice response is usually used to determine the group of people with popular opinion, moderated by the speaker or the senate president which at times is subject to bias particularly when the minority has the louder voice as against those with the majority. This work was designed to solve the problem of voting 'for' or 'against' a motion under consideration at such parliamentary houses. The design was built around the (ATmega328P) microcontroller using software codes written in C-Language to control its functioning and activities. As a prototype, the system was designed for two respondents with a 'Yes' and 'No' keypads while the combined key based votes is displayed on a Liquid Crystal Display of the output unit. Each of this keypad communicates with this display unit wirelessly using radio frequency modules implemented in the design. The simplicity of the design is such that it can easily be replicated to cover multiple respondents with little overhead in terms of cost.*

Keywords**:** *Display, Frequency, Microcontroller, Parliament, Voting.*

I. Introduction

Voting is an important process usually employed to reveal the opinion of a group on an issue that is under consideration. It is a method used by a group of people such as in a meeting or by electorates to make a decision or express an opinion—often following discussions, debates, or election campaigns. It is often found in democracies and republics.The fact that greater efficiency, better scalability, speed, lower cost, and convenience, can be delivered by electronic devises, has made the process shift from manual process to electronics and automated process. [1]. Electronic voting means the use of some electronic means in voting in order to ensure security, reliability, and guarantee transparency. [2]

The main function of the parliament, both the Senate and House of Representatives is enact laws and/or pass bills. This usually involves decision making which always requires feedback from the other members of the house as moderated by the speaker or the senate president. The traditional way of getting the members' response or feedback is usually through a "YES" for those in support or "NO" for those against a motion passed by the speaker/senate president. This method has some shortcomings, which includes time wastage in conducting this kind of poll due to disagreement that may arise. Another is that it is highly inaccurate since the speaker/senate president is required to use his/her initiative to discern those with the majority. This judgment could be impaired if those with the minority has the loudest voice as against those with the majority. In addition to this is the rowdiness that arises in the house, which in most times results in dissatisfaction of the members who may result to physical conflict. Therefore, this work presents a design and implementation of a Microcontroller-based electronic voting system capable of reflecting the parliamentarian's response to motions.

II. Literature Review

[3] described a response system as a technology designed to facilitate sessional interaction by a group of people in which the audience members have the opportunity to respond to questions posed by the presenter. The system can be elicited in all types of group presentation sessions—including remote audiences through the use of telephone-based or online polling. He also posited that an audience response systems can also be used for co-located audiences (the parliament), which generally consist of a receiver with a digital display (through infrared or radio-frequency) and individual response devices (often referred to as "clickers") which transmits individual response to the receiver for display. Lucas also added that, the key feature of the response system is that it allows audience members to anonymously respond to questions asked in a live seminar, and to have those responses received and recorded in real time on the presenter's computer via text, tweet or World-Wide Web. The results can then be instantly displayed, allowing both the audience and presenter to know the distribution of responses.

2.1 Electronic voting response system

Electronic voting (also known as e-voting) is voting using electronic to aid casting and counting votes. [4] summarized the term "electronic voting" as the definition, collection, and dissemination of people's opinions with the help of some machinery that is more or less computer supported. It is a simple machine that can be operated easily by both the polling personnel and the voters. Being a standalone machine without any network connectivity, nobody can interfere with its programming and manipulate the result.

2.2 Requirement of E-Voting

The requirement in traditional voting process is also applicable for e-voting and some of which include

1. **Fairness:** No person can learn the voting outcomes before the tally.
2. **Eligibility**: Only eligible voters are allowed to cast their votes.
3. **Privacy:**No person can access the information about the voters vote. Neither authorities nor anyone else can link any ballot to the voter who cast it and no voter can prove that he voted in a particular way. [5]
4. **Accuracy:**All the valid votes should be counted correctly. It is not possible for a vote to be altered, it is not possible for a validated vote to be eliminated from the final tally, and it is not possible for an invalid vote to be counted in the final tally. [6]
5. **Efficiency:**The counting of votes can be performed within a minimum amount of time. [7]

2.3 Radio frequency (RF)

Ideal for large group environments, RF systems can accommodate hundreds of voters on a single base station. Using some systems, multiple base stations can be linked together in order to handle audiences that number in thousands. Other systems allow over a thousand on just one base. Because the data travels via radio frequency, the participant merely needs to be within range of the base station (300 – 500 feet). [8]

2.4The parliamentary and the voting system

A parliamentary system is a system of democratic governance of a state in which the executive derives its democratic legitimacy from, and is held accountable to, the legislature (parliament); the executive and legislature are thus interconnected. The parliamentary uses parliamentary procedures to arrive at decisions. The procedure is based on the principles of allowing the majority to make decisions effectively and efficiently (majority rule), while ensuring fairness towards the minority and giving each member or delegate the right to voice an opinion. [9]

2.5Parliamentary voting technique

According to [10], Robert's Rule of Order Newly Revised (RONR) states that a voice vote (viva voce) is the regular method of voting on any motion that does not require more than a majority vote for its adoption. [9]. A voice vote is a voting method used by deliberative assemblies in which a vote is taken on a topic or motion by responding verbally. The voice vote, or acclamation, is considered the simplest and quickest of voting methods used by deliberative assemblies. [11]. The presiding officer of the assembly will put the question to the assembly, asking first for all those in favor of the motion to indicate so verbally with a "yes", and then ask second all those opposed to the motion to indicate also verbally with a "no". The former will then make an estimate of the count on each side and state what he or she believes the result to be.

2.6Review of Related works

An Electronic Voting Machine (EVM) system was proposed by [12],whose operation is as transparent as the digital system.The Simplified Electronic Voting Machine (SEVM) responds on some flow of pulses from the switch operated by voters and produces the output of the counting values i.e. total casted votes of individual nominee and displays it.The machine is controlled both automatically and manually to operate the system for successive voters and to ensure that a voter can give only one vote to his/her chosen candidate of the same position. The manual controlling system must be operated by presiding officer who have the authorization to check and to declare a voter valid after checking some unique information e.g. NID number whereas the automatic controlling happens whenever a voter pushes a switch to vote. He uses "pulses" as the effect of a vote and counts those to make the result.

In the year 2011, Ashok and Ummal in their paper "A Novel design of Electronic Voting System Using Fingerprint" related thatthe heart of voting is trust that each vote is recorded and tallied with accuracy and impartiality, therefore suggested that the accuracy and impartiality are tallied in high rate with biometric system. Among these biometric signs, fingerprint has been researched the longest period, and shows the most promising future in real-world applications. They opined that, because of their uniqueness and consistency over time, fingerprints have been used for identification over time. However, because of the complex distortions among the

different impression of the same finger in real life, fingerprint recognition is still a challenging problem. Hence, in their study,they designed and analyzed the Electronic Voting System based on the fingerprint minutiae, which is the core in current modern approach for fingerprint analysis. The new design was analyzed by conducting pilot election among a class of students for selecting their representative. Various analysis predicted shows that the proposed electronic voting system resolves many issues of the current system with the help of biometric technology.[13] designed and developed an "Electronic Voting Machine Using Zigbee". Zigbee is a communication system for sorting out the wired e-voting problems. In the paper, fingerprint technique was also used to design a secure e-voting system. The design was based on the (ATMEGA328p) microcontroller, RS232 cable was 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 receiver, security alarm and visual basic for creating display page in computer. Simulation was done using Proteus software, coding and the .hex file was generated for microcontroller using Arduino software. [14] worked on the "Development of Electronic Voting Machine with the Inclusion of Near Field Communication ID Cards and Biometric Fingerprint Identifier". The paper focused on creating an electronic voting machine that will help to eradicate defrauding of the manual voting systems by multiple votes cast by the same user. With the inclusion of a Near Field Communication ID card reader and biometric fingerprint device, each voter will be entered into the system through a swift process only after being recognized and checked to the given database of enlisted voters.

In year 2013, Diponkar and Sobuj in a paper described the design, construction and operation of a digital voting machine using a microcontroller profoundly. The paper also portrayed counting system of votes, market survey and cost analysis. The high level digital voting machine was built with ATmega16 Micro controller.TheDesign and Construction of a Simple Microcontroller Based Conference Electronic Voting Machine with Digital Display, was carried out by [15]. The design was made around the (AT89C52) microcontroller. The concept design of this prototype is for two voters and an arbitrator. The arbitrator grants permission for voting and each voter can only vote once and protects the identity of the voter to make the process unbiased and fair.

III. Design Methodology

The design of the electronic voting machine with audience response capability was carried out using electronic components. The components includes majorly: Microcontroller logic circuitry, and sets of seven segment displays with a Power Unit, which includes a power Transformer. It also consisted of an input medium with a designed keypad, which communicates to the machine wirelessly, thereby allowing for audiences' feedback. All these units were implemented within the microcontroller's circuitry.

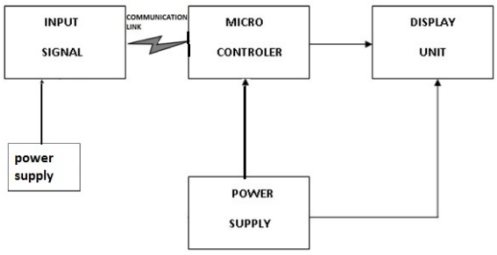

Figure 1.Block diagram of the system.

3.1 Power Regulating Circuit

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. The entire work comprised electronic materials made of semiconductors like, microcontroller IC, decade counters, seven segment displays, all of which are low power consuming devices that require a 5V D.C voltage for optimum operation.A LM7805 voltage regulator was used to achieve a 5V output voltage.

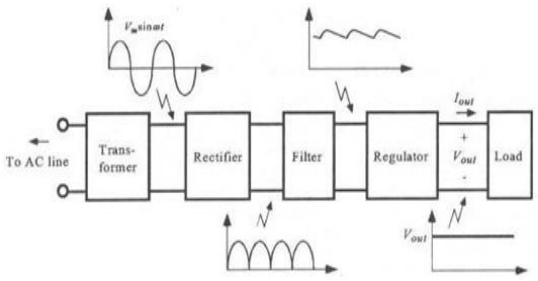

Figure 2.Complete Block diagram of power supply

3.2Design of the input unit

This unit uses a constructed keypad. The keypad which is an input device is also designed to connect with the output unit wirelessly using Radio Frequency link. The keypad has two keys: a "YES" and a "NO" key as shown in Figure 3, each key pressed transmits a corresponding value through the transmitter to be recived at the reciever end as an equivalent of the bits produced pressed.

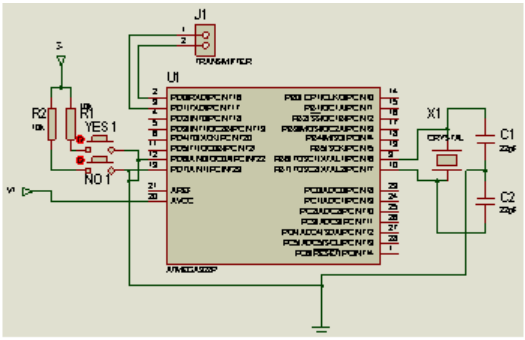

Figure 3. Circuit Diagram of the Input Unit (The keypad)

3.3Design of the Display Unit

The display unit uses the Liquid Crystal Display for its output. This Digital Display, like every other board, is controlled by a microcontroller, a microcomputer on a single chip as shown in Figure 4 with its circuit equivalent in figure 5.

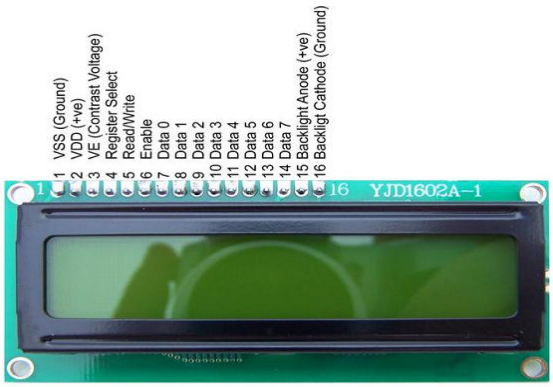

Figure 4. A Liquid Crystal Display (LCD)

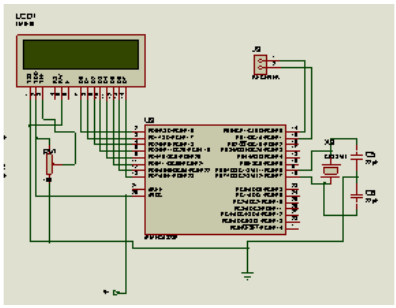

Figure 5. Circuit Diagram of the Display Unit

3.4The Communication Link

The communication link employed in this project is the wireless radio frequency (RF) link modules. It serves to link the input unit from the keypad to the microcontroller subsequently produce an output on the display unit. The transmitter works on a voltage range of 3V-12V and with 433MHZ frequency. This allows the RF to transmit up to 90m in open area. The receiver works on 5V DC and with 433M_{HZ} frequency. The use of an optional antenna, using a simple wire, will increase the effectiveness of the wireless communication.

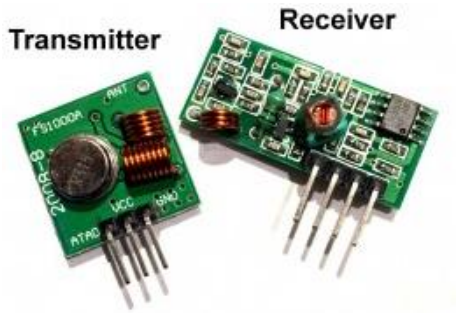

Figure 6. Radio-Frequency (RF) Link: Transmitter/Receiver modules

3.5The Microcontroller

The Atmega328p Microcontroller was used, a single chip microcontroller of 28 pins, with pin 7 as the V_{CC} connection for power and pin 8 for the Ground connection. It is an 8-bit microcontroller with 32K flash memory, 1K of EEPROM, and 2K internal SRAM. It has 14 digital I/O pins, of which 6 can be used as PWM outputs and 6 as analog input pins. These I/O pins account for 20 of the pins. The pin-out for the Atmega328 is shown in Figure 7 and the complete circuitry of the design in figure 8.

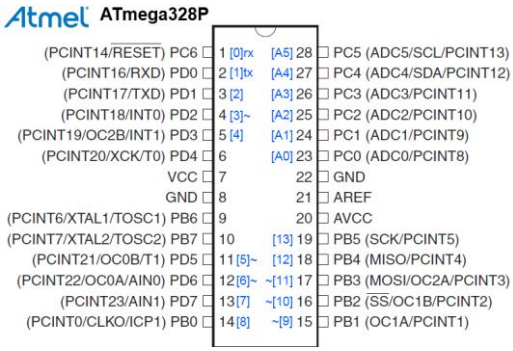

Figure 7. Pin configuration of Atmega328p microcontroller

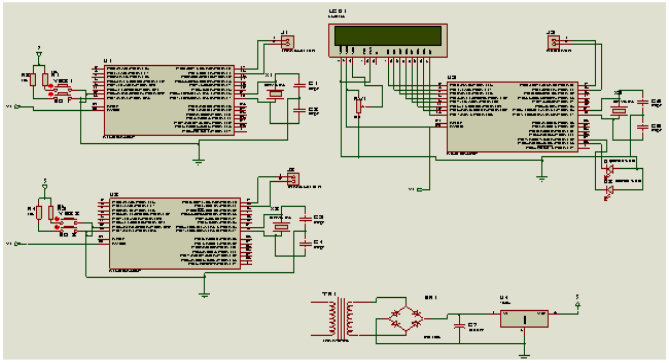

Figure 8. Complete Circuit diagram of the whole system

IV. Design Implementation

The integral system utilizes the different characteristics of each device essentially brought together by the use of the microcontroller, the ATmega328p. The design of the system as illustrated by the circuit diagram of Figure 8 was implemented on a circuit board. The implementation involves soldering of the components on the printed circuit board (Plate 1) and testing to ensure proper connection. It also involves writing of a software codes to control the functioning and activities of the microcontroller. The code was written in C language and uploaded onto the microcontroller. The process of interfacing each of the devices with the microcontrollers is described. The RF link Transmitter DATA pin is connected to the input pins 14 and 15 of the microcontroller with VCC pin connected to the power supply to power the module and the GND pin is connected to the ground. This setup makes a single keypad with a YES and NO button on it. The Transmitter module receives electric pulses generated by the YES or NO button on connected to the microcontroller, these pulses is then

sent to the RF link Receiver connected to the TX/RX pins of the microcontroller on the output unit as an electronic signal using radio frequency.

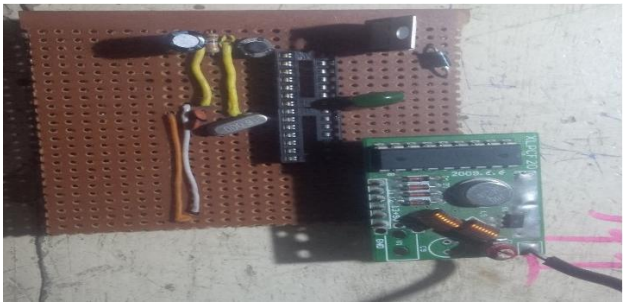

Plate 1. The circuit board implementation of the output unit

The microcontroller on the output unit processes the received electronic signal and gives the response value as was supplied by the user as a Total NO or Total YES. This response value will be displayed on the seven segment display connected to the pins of the microcontroller.

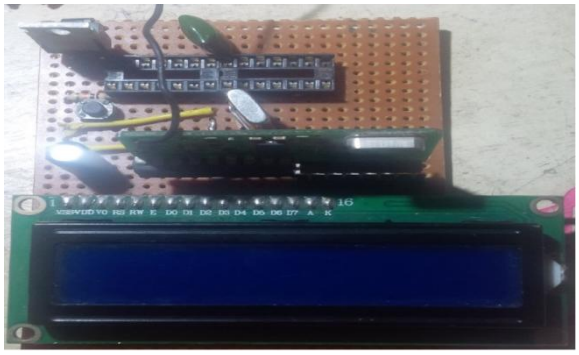

Plate 2. The circuit board implementation of the whole system.

A crystal oscillator is connected to pins 9 and 10 of the microcontroller. The 5 volt regulated output from the power supply unit was connected to pins7 and 20 and the VCC pin of the RF link transmitter and receiver to power them.

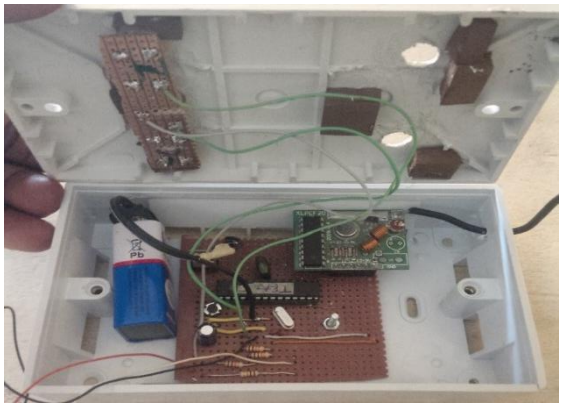

Plate 3. The output/ keypad unit design (the inside view)

4.1 The System Implementation

The parliamentary electronic voting Response system was implemented using the tmega328p Microcontroller to control both the transmission and reception of the vote signals. This was made

possible by coding the Microcontroller. For the output unit, the signals are received from the keypads and are processed by the Microcontroller for display on the Liquid Crystal Display (LCD). When no key is pressed the LCD will display 0 (zero) count for both YES and NO vote as shown in Plate 4.

Plate 4. System output when no vote is casted

However when the keypads were pressed to cast votes the result of the poll is as depicted in plates 5a and 5b.

Plate 5a. '2' yes vote casted

Plate 5b.'1' yes and '1' no vote casted

V. Conclusion

Electronic voting system is emerging as significant alternative to the conventional systems in the delivery of reliable and trusted polls. The design and implementation of the parliamentary electronic voting response machine was done successfully. It was carried out using Atmega328p microcontroller logic circuitry to control the system and powered by a 9V battery. This system affords additional convenience of wireless communication by using radio frequency modules.Hence, the design implemented in this work provides portability, flexibility and the data transmission is also done with low power consumption. The system is also fast and can be concluded that it saves enormous time and better than the traditional method of parliamentary voting response system that had been adopted and currently in use in house of assemblies.

VI. Recommendation

Considering the numerous advantages of this prototype system, which includes time safety, ease of use and flexibility, it is therefore recommended that future study on this work should include some security measures like finger print biometric security authentication to authenticate and validate a user who wishes to cast his votes using the keypads. This will go a step further to make the system more robust and gain wide acceptance in its area of applications. The focus of this project has been on the application to the parliamentary, however it is recommended for use in other institutional set up where audience response to a decision is required, for example in the classroom. The prototype system implemented in this project has only two keypads, however the system has been designed for easy expansion, it is therefore also recommended that in future study on this subject be focused on increasing the number of users or voters by increasing the number of the system's keypad.

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