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Design and Construction of a 300-Member Electronic Voting System for a Legislative Assembly Using a Microcontroller: A Case Study of the 6th National Assembly of the Federal Republic of Nigeria

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Abstract
This paper presents the design and construction of a **300-member electronic voting system** developed as part of an undergraduate project in 2010, with a case study of the **6th National Assembly of the Federal Republic of Nigeria**. The system was implemented using the **AT89S52 microcontroller**, aimed at providing a **secure, efficient, and reliable voting process** for legislative settings. Manual voting procedures in assemblies are often hindered by delays, counting errors, and potential manipulation. This work responds to those challenges by designing an electronic platform where each of the members 300 can cast votes electronically, with the AT89S52 handling processing, validation, and storage. Principles of voting theory, including majority rule and proportional representation, informed the design. Testing confirmed improvements in **speed, accuracy, and transparency** compared to manual methods. While developed as a prototype, the system demonstrates the potential of microcontroller-based voting solutions to strengthen democratic governance, particularly in parliamentary and institutional contexts.

Keywords: Electronic Voting, AT89S52 Microcontroller, Legislative Assembly, Voting Theory, Democratic Governance, Nigeria.

1. Introduction

Voting is at the core of every democracy, and for legislative assemblies, it is the primary way decisions are made. In Nigeria's **6th National Assembly**, like many others around the world, votes were often cast manually, tallied by hand, and announced after lengthy delays. This process not only consumed time but also opened the door to human error and, at times, mistrust in the results.

With democracy increasingly dependent on **trustworthy and transparent systems**, the need for more modern approaches to legislative voting has become clear. Electronic voting systems offer a chance to speed up decision-making, eliminate counting errors, and protect the integrity of the process.

This project, completed in 2010 as part of an undergraduate thesis, set out to design and construct a **prototype electronic voting system for 300 members**, modeled after the **Nigerian National Assembly**. The solution uses an **AT89S52 microcontroller**, chosen for its balance of simplicity, reliability, and availability. The broader aim was to demonstrate how embedded systems could serve democratic institutions in practical and affordable ways [6].

2. Literature Review

Over the years, researchers and engineers have worked on various approaches to electronic voting. Many studies have shown how **microcontroller-based systems** can handle the task of collecting and processing votes efficiently [1],[2], [3]. Others have raised concerns about vulnerabilities in manual systems, such as counting delays and opportunities for manipulation [4].

A voting system allows voters to choose between options, often in an election where candidates are selected for public office or in decision making polls. Voting theory particularly in Nigeria has voting rules; Majority rule, proportional representation and Plurality voting rules.

The majority rule is the simplest and is mostly used to determine the winner between two choices or motions. This is the voting system used by the legislative assembly. In the case where more than two options exist; either proportional representation or plurality voting is employed, since there would not be a single option that is preferred by the majority.

In this project, we are concerned with an electronic voting machine foe a 300-member legislative assembly. This is meant for a maximum of 300 persons, who have to choose between two options, YES and NO i.e. for and against a motion, respectively. Thus, a decision-making machine.

This is a type of deliberating assembly with its members elected from various zones or state of a particular country. This assembly is invested with the powers to pass, amend and repeal laws of its country. Examples are the congress of the United States of America, parliament of Great Britain or England and the Nigerian House of Assembly. Since by the virtue of election they are a fair representation of the of the country, it is considered as the best medium to trash issues affecting the people they represent and in retrospect the entire country. The issues are usually deliberated upon in one or more seating, depending on the sensitivity of the issue, giving room for all members to at least have a say after which it is put to vote.

The ruling decision for or against the issue is always ruled in favor of the majority. A typical example is the National House of Assembly, those for the motion are requested to say aye and those against the motion say nay and the ruling is usually the aye's have it or the nay's depending on the majority.

At the same time, much of the global literature highlights the importance of **security, confidentiality, and trust** in the design of any voting system [5], [6]. Without these, the credibility of elections is easily questioned. This project builds on those earlier works by tailoring a system to the specific needs of a **large legislative body**. While similar ideas have been tested in smaller contexts, applying the design to **300 members** posed both technical and logistical challenges, which this project sought to address.

3. Methodology

3.1 Research Design

The project followed a **design–build–test cycle**, starting with defining system requirements, moving through hardware and software design, then building a working prototype and testing its performance.

3.2 System Requirements

The requirements set out were straightforward but demanding:

- Handle **300 voting units** simultaneously.
- Record and display results **in real time**.
- Provide **authentication** for voting units.
- Ensure **accuracy, reliability, and confidentiality**.

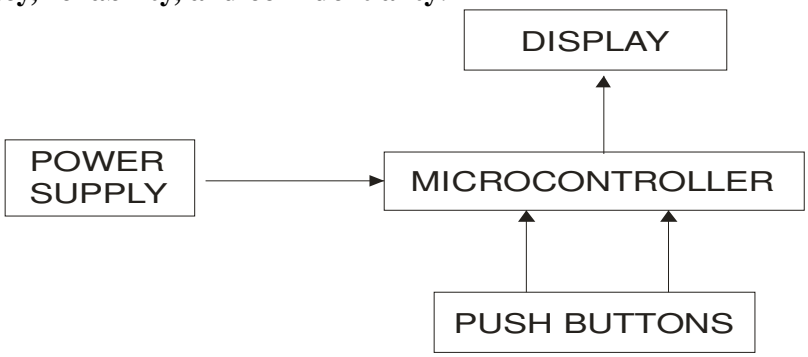

Fig.3.1 Block Diagram of the Microcontroller Based EVM

3.3 System Design

The system was broken down into two main parts:

- **Hardware:**
  - The **AT89S52 microcontroller** was selected for its processing speed and I/O capacity.
  - Each member's voting unit used push-button inputs (Yes/No).
  - A **central control unit** managed input collection and processing.
  - Results were displayed on an **LCD/LED panel** in real time.
  - Power supply input

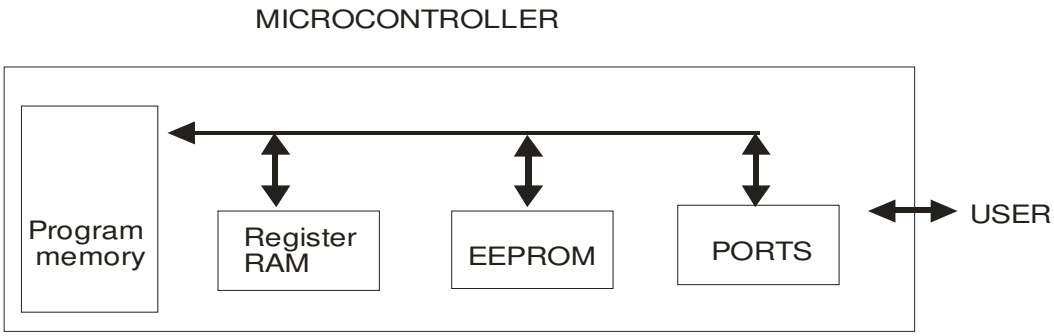

Fig.3.2 Generalized Block Diagram of a Microcontroller.

- **Software:**
  - Firmware was written in **C ++** and uploaded to the AT89S52.
  - Functions included vote recognition, validation, error handling, and result computation.
  - Confidentiality was built into the design so votes could not be traced back to individuals and no double voting.

Pins	1	2	3	4	5	6	7	8
Status	Low	Low	High	Low	High	Low	Low	High
Code	0	0	1	0	1	0	0	1

Table 3.1 An Illustration of Code Generation by Diode Matrix Array

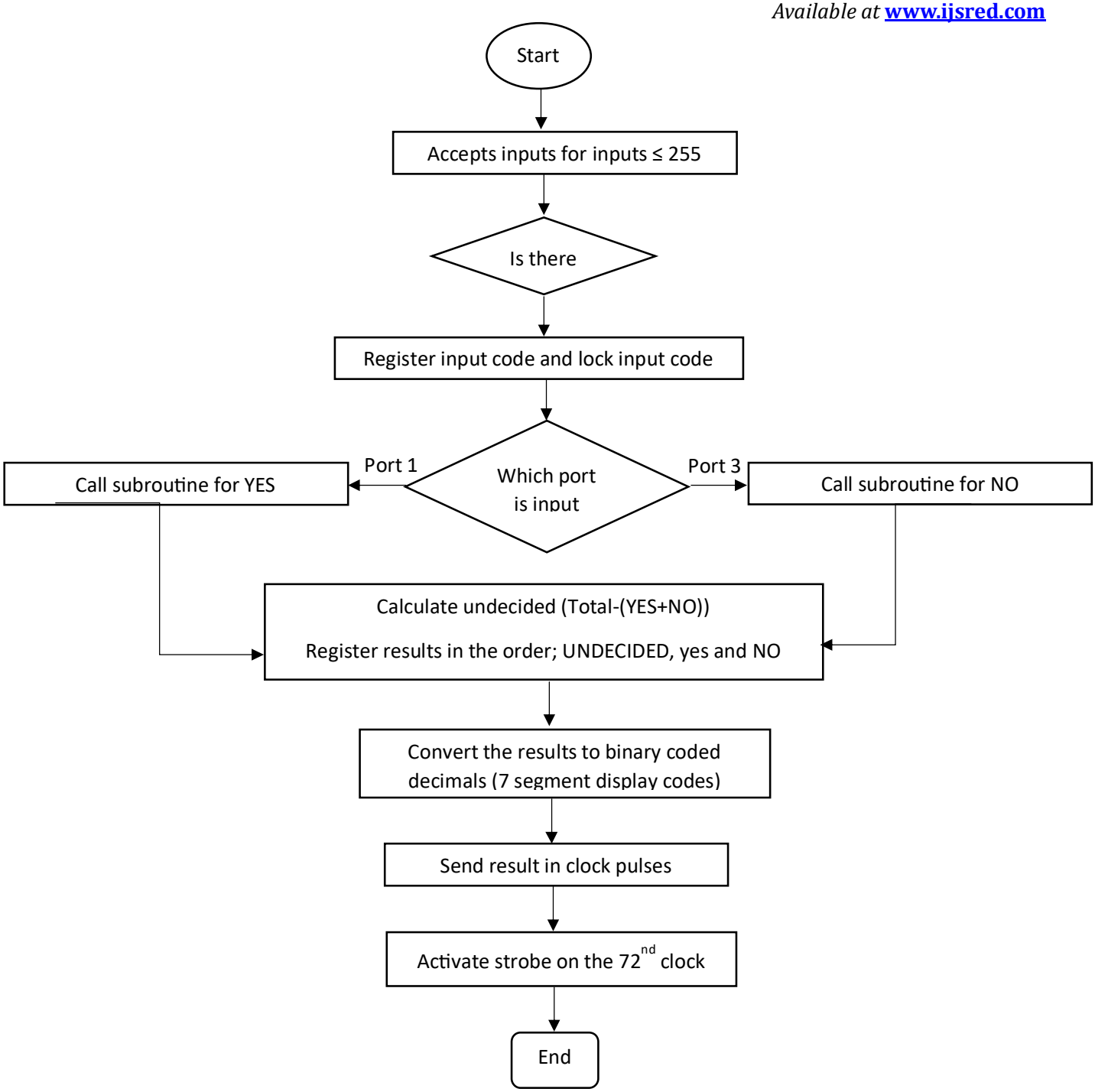

Fig. 3.3 Flow Chart of the System.

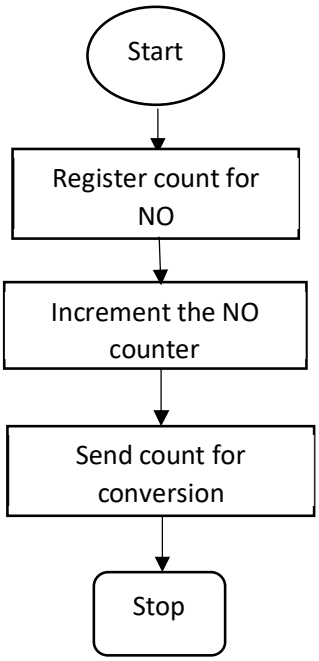

Fig. 3.4 The NO Subroutine Flow Chart

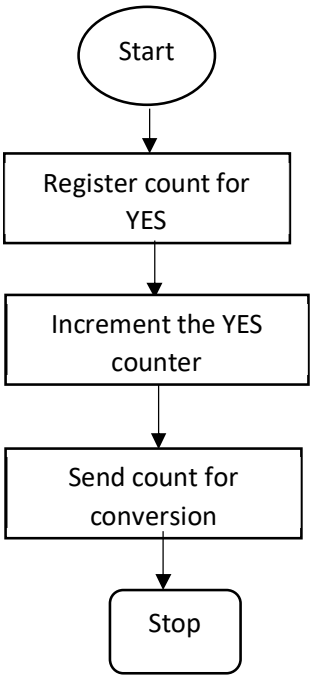

Fig. 3.5 The YES Subroutine Flow Chart

3.4 Construction

The prototype was first assembled on **breadboards**, then later soldered onto a **PCB** for durability. Programming tools allowed the firmware to be uploaded and tested iteratively until the system was stable.

Once the software is written, compiled and the code checked for errors (using BASCOM compiler). The first step in the burning process is the building of the project. (A 300 Member Electronic Voting Machine for a Legislative Assembly). The output window will print the result of each step in the building process after which the output window will show a memory usage map. A large number of files are created and stored ion the project directory, that is, on completion of the build process. The most important file created in the Hexadecimal file also called the "executable file". This is the file that will be "burned" into the microcontroller.

The Hex file is copied and then taken to the microcontroller which has a programmer connected to it. The microcontroller is placed in the ZIF socket of the programmer and the lever placed in the down position to clamp unto the I/O pins. The Rider programmer was used to burn the program (or to activate the software on the microcontroller) into the AT89S52.

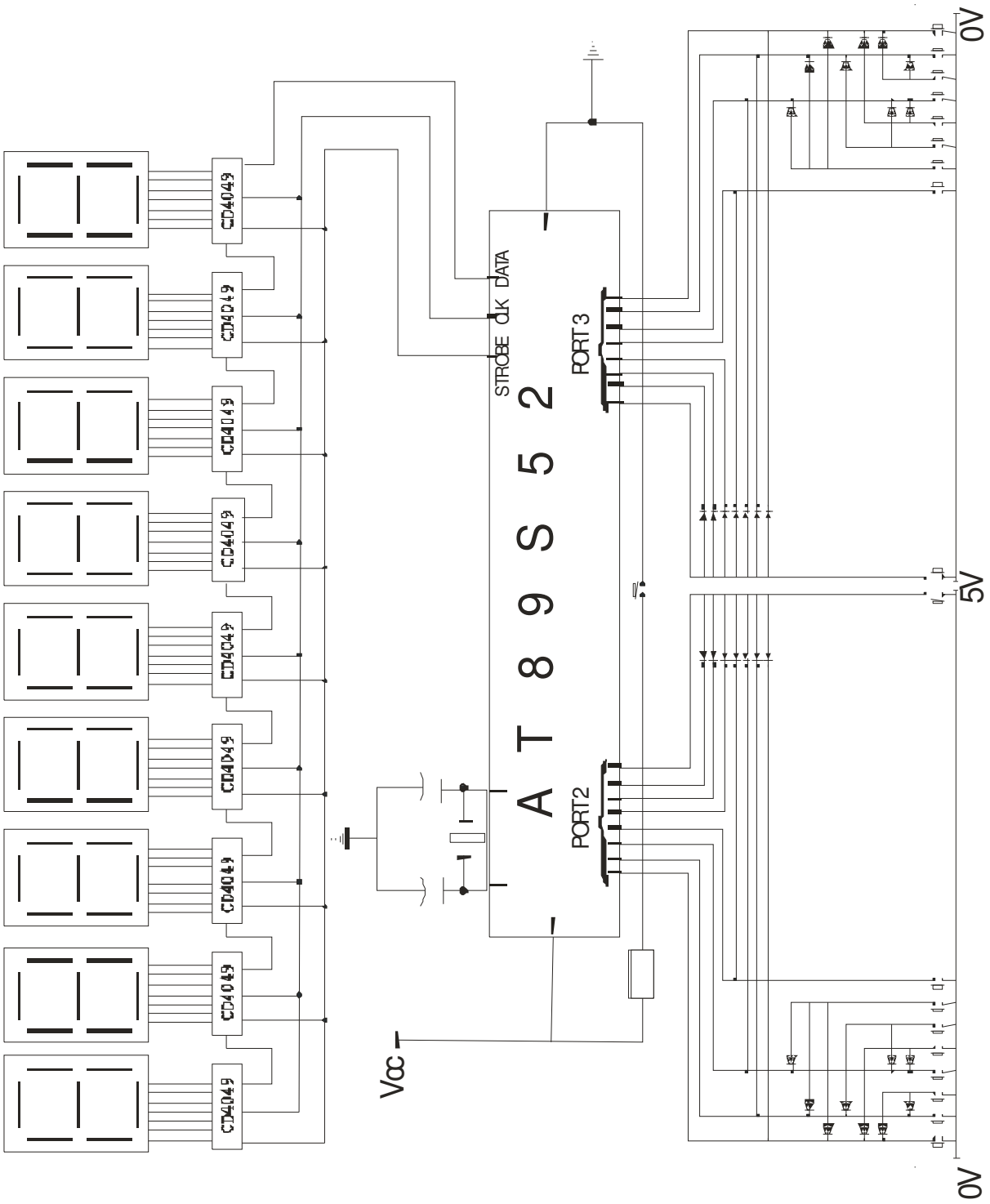

Fig. 3.6 The Circuit Diagram of the Electronic Voting Machine.

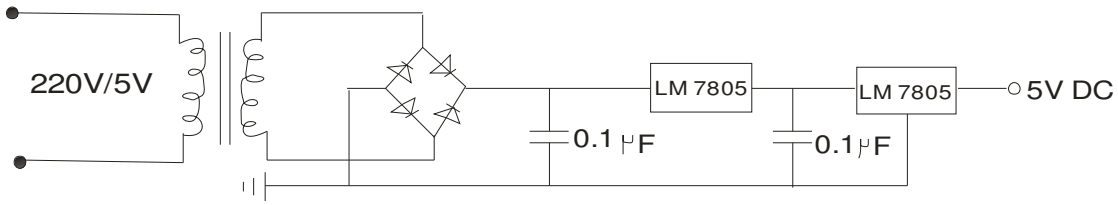

Fig. 3.7 The Circuit for the Power Supply of 5V.

3.5 Testing and Evaluation

Testing included:

- **Unit testing** for each voting device.
- **Integration testing** to ensure votes were transmitted and recorded correctly.
- **Load testing** simulating all 300 members voting at once.
- **Accuracy checks** to confirm results matched intended votes.

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4. Results and Discussion

The prototype system worked as expected, handling **300 votes in real time** with no errors in recording or counting, no double voting. Compared to manual methods, the system drastically reduced the time required to complete a vote and publish results.

The **authentication system** ensured that only valid votes were registered, and built-in confidentiality protected voter privacy. The use of the **AT89S52** proved effective, demonstrating that even a relatively simple microcontroller could support a large-scale voting system.

One limitation of the prototype was that it used wired connections, which may be less practical in a large assembly hall. However, the design could be adapted to include **wireless communication and biometric authentication** in future versions. Also, a design taking into account those neither for nor against a motion and recording those absent at the sitting.

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5. Conclusion

This project demonstrated the feasibility of using an **AT89S52 microcontroller** to design and build an electronic voting system for a legislative assembly, programmed using C++. It is composed of two keys for each member i.e. YES and NO buttons and a nine 7 segment display with a reset button to reset for another voting session.

Applied to the **6th National Assembly of Nigeria**, through simulation of votes casted, the system proved accurate, secure, and far more efficient than manual methods.

While this was only a student prototype, the implications are significant: **embedded systems can play a direct role in strengthening democratic governance** by making voting more reliable and transparent. Future upgrades could integrate wireless technology, stronger encryption, and user-friendly interfaces to bring such systems closer to real-world deployment.

6. Limitations and Challenges

The following are the limitations and challenges as regards this project;

- Poor orientation in the practical area of construction.
- Poor knowledge in programming

7. Recommendation

In this era where technology and science have the 'rule', with the microcontroller playing a vital role in this work, I recommend this design to Organizations, Communities and of course, decision making bodies to ensure smoother and fast decision-making process.

8. Acknowledgement

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