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Project Report

Smart Sound Activated Switch with Sound Intensity Sensitivity

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1 Introduction

1.1 Overview

Sound plays a vital role in humans' everyday life. Sound is a way to interact with the environment. Sound can be utilized for a convenient lifestyle. The safe range for hearing is typically between 0 dB (threshold of hearing) and approximately 120-130 dB. Sounds above this level can cause damage to the ear. [6]

1.2 Motivation

Very often, the sounds produced by us are over the safe range of hearing, causing health issues to humans and damage to nature. Also, in home automation systems, turning devices on and off is not convenient enough. Regulating the power is more admirable and demanding.

- An electronic circuit known as a clap switch is designed to control electrical appliances by the sound of clapping. On February 20, 1996, R. Carlile, Stevens, and E. Dale Reamer invented it [1]. This technology's primary benefit is that it is especially useful for people with limited mobility.
- The clap switch circuit uses a condenser microphone in place of a sound sensor to turn sound energy into electrical pulses [2].
- Nowadays, human always do their job with the help of technology. From securing the house with alarm or even using an RFID card as a train ticket. All of those are build with the intention to make the human life become safer and easier. [3] in the study by Jiwandono, Fiedel Tegar.
- Another such is the WellPCB project. The WellPCB project is an additional illustration, whereby a transistor functions as a switch, and a single 555 timer is employed as an astable multivibrator [4].
- A clap-activated switch's design and construction are detailed in Rohit Kumar's mini-project report, which was turned in to meet a requirement for a Bachelor of Technology degree. By utilizing a tiny condenser microphone to detect the sound of a clap, the switch converts the sound wave into electrical signals. A transistor set up as a common emitter amplifies these impulses even further. The switch is activated by the amplified output, which sets off a bistable multivibrator circuit. From 0.99706 in the first year of operation to 0.94299 approximately in the twentieth year of operation, that is the projected dependability of the locally built clap-activated switch five [5].

1.3 Problem Definition

Often people don't comprehend the level of sound that they produce. If only it could be visualized. Also, in home automation systems, zero-touch switches have limited capacity in controlling the power of devices.

1.4 Objectives

Our goal is to:

- Design and construct a sound-activated switch.
- Give output based on the sound intensity.
- Visually represent the output.
- Control the output intensity based on the input sound intensity.

1.5 Application

Our project is applicable in various fields such as:

- Traffic sound monitoring
- Industrial sound monitoring
- Sound regulation centers
- Home automation systems
- Entertainment systems

2 Literature Review

The "Smart Sound Activated Switch with Sound Intensity Sensitivity" is a device that allows users to control electrical appliances using sound (specifically, clapping). In recent years, research and development in this area have led to several interesting findings:

2.1 Sound-Based Control Systems

2.1.1 Various Mechanisms

Researchers have explored various sound-based control mechanisms, including voice recognition, hand claps, and finger snaps. These systems aim to enhance convenience and accessibility.

2.1.2 Sound Patterns

Studies have investigated the effectiveness of different sound patterns (e.g., single clap, double clap) for triggering switches.

2.2 Microcontroller-Based Approaches

2.2.1 Utilizing Microcontrollers

Many smart clap switches utilize microcontrollers (such as Arduino or Raspberry Pi) to process sound input and activate relays.

2.2.2 Factors Influenced by Choice of Microcontroller

The choice of microcontroller affects factors like response time, power consumption, and scalability.

2.3 Energy Efficiency and Sensitivity

2.3.1 Energy-Efficient Designs

Energy-efficient designs are crucial for battery-powered smart clap switches.

2.3.2 Improving Sensitivity

Researchers have explored ways to improve sensitivity while minimizing false triggers (e.g., due to ambient noise).

2.4 Applications and User Experience

2.4.1 Applications

Smart clap switches find applications in home automation, lighting control, and entertainment systems.

2.4.2 User Experience

User experience studies have examined user preferences, reliability, and ease of setup.

2.5 Challenges and Future Directions

2.5.1 Challenges

Challenges include robustness in noisy environments, adaptability to different sound patterns, and avoiding false positives.

2.5.2 Future Research

Future research could focus on integrating machine learning for better sound recognition and exploring novel interaction methods.

3 Material and Methodology

3.1 Introduction

As stated in the objectives, to implement our project, we require:

- A sound sensor to input the sound.

- Analogue output devices to not only switch on or off but also control the output power.
- A circuit to convert the sound into an electrical signal and provide output voltage based on the sound intensity.
- An algorithm to integrate the input system with the output system.

3.2 Project Details

Used utilities:

- An analogue sound sensor module[?].
- A microcontroller, Arduino UNO[?].
- Five LEDs.
- 100 Ohm resistors.
- Jumper wires.
- Breadboard.
- Powering device.

The sound sensor is built on the following circuit design:

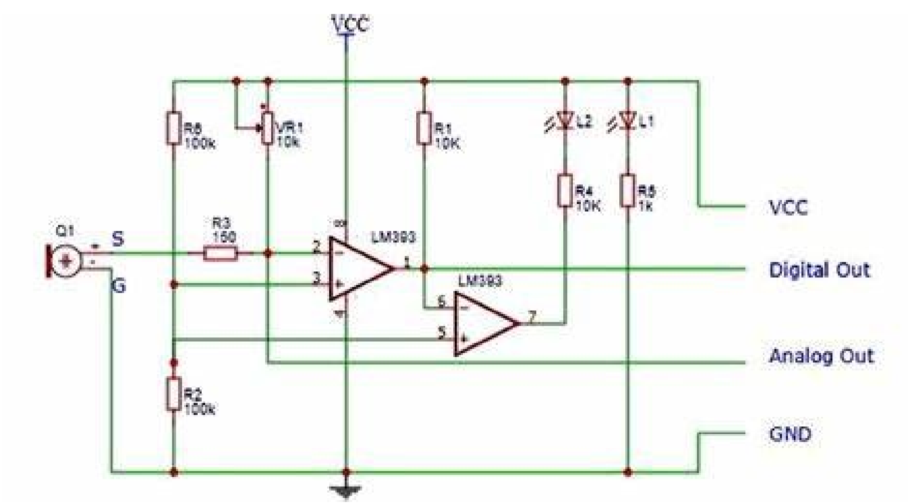


Figure 1: Sound sensor module circuit diagram

The Arduino UNO micro-controller is built on the following circuit design,

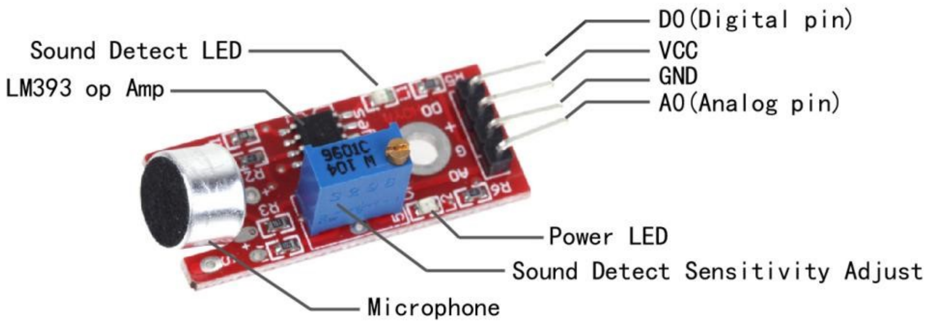


Figure 2: Sound sensor module

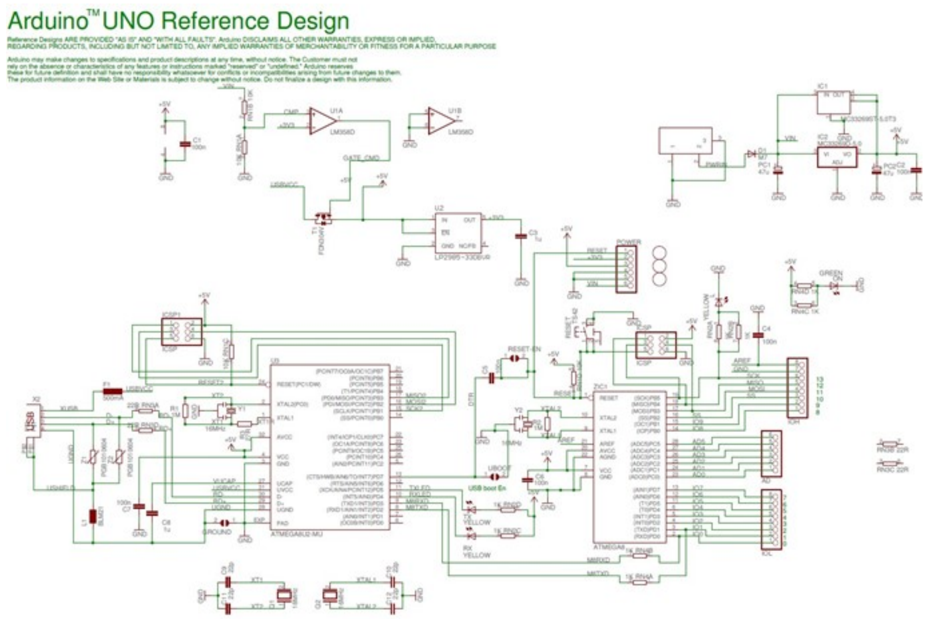


Figure 3: Arduino UNO micro-controller circuit diagram

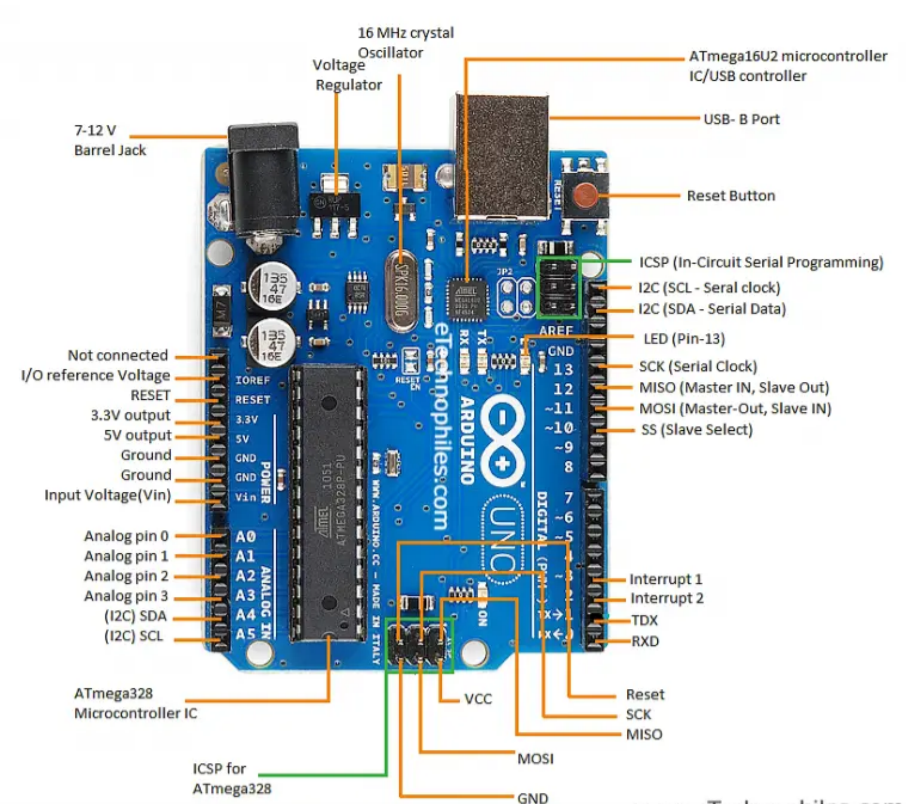


Figure 4: Arduino UNO micro-controller

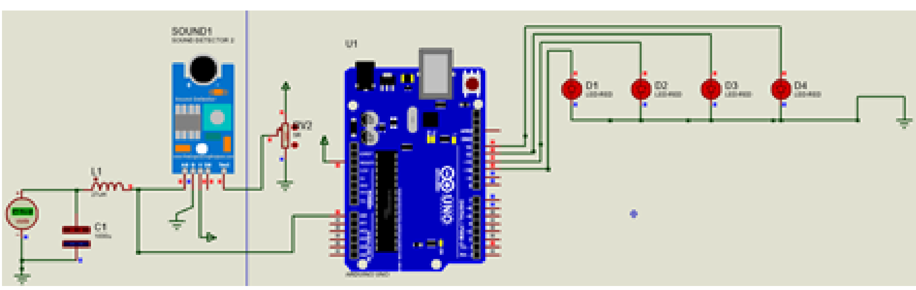
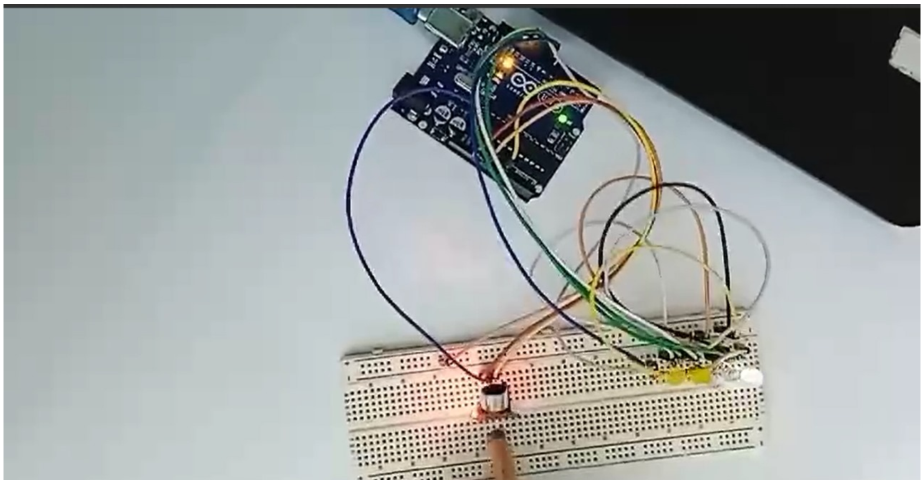
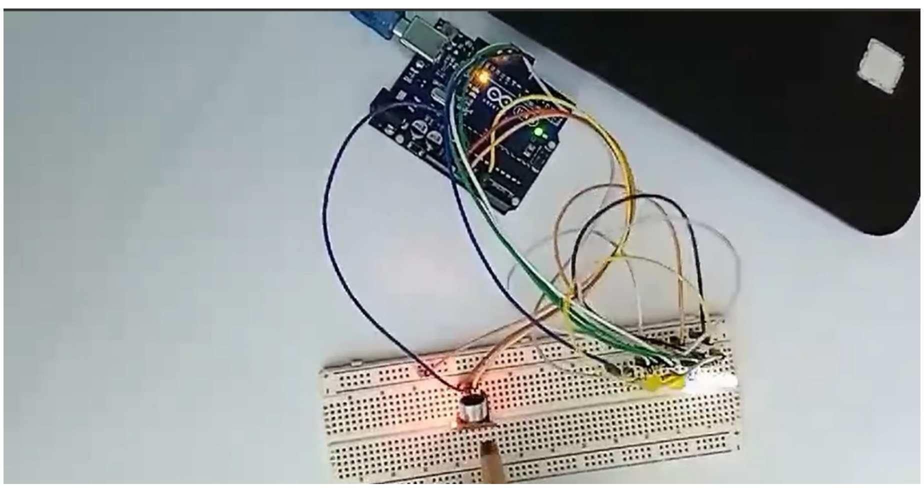


Figure 5: Simulation in Proteus 8

3.3 Implementation





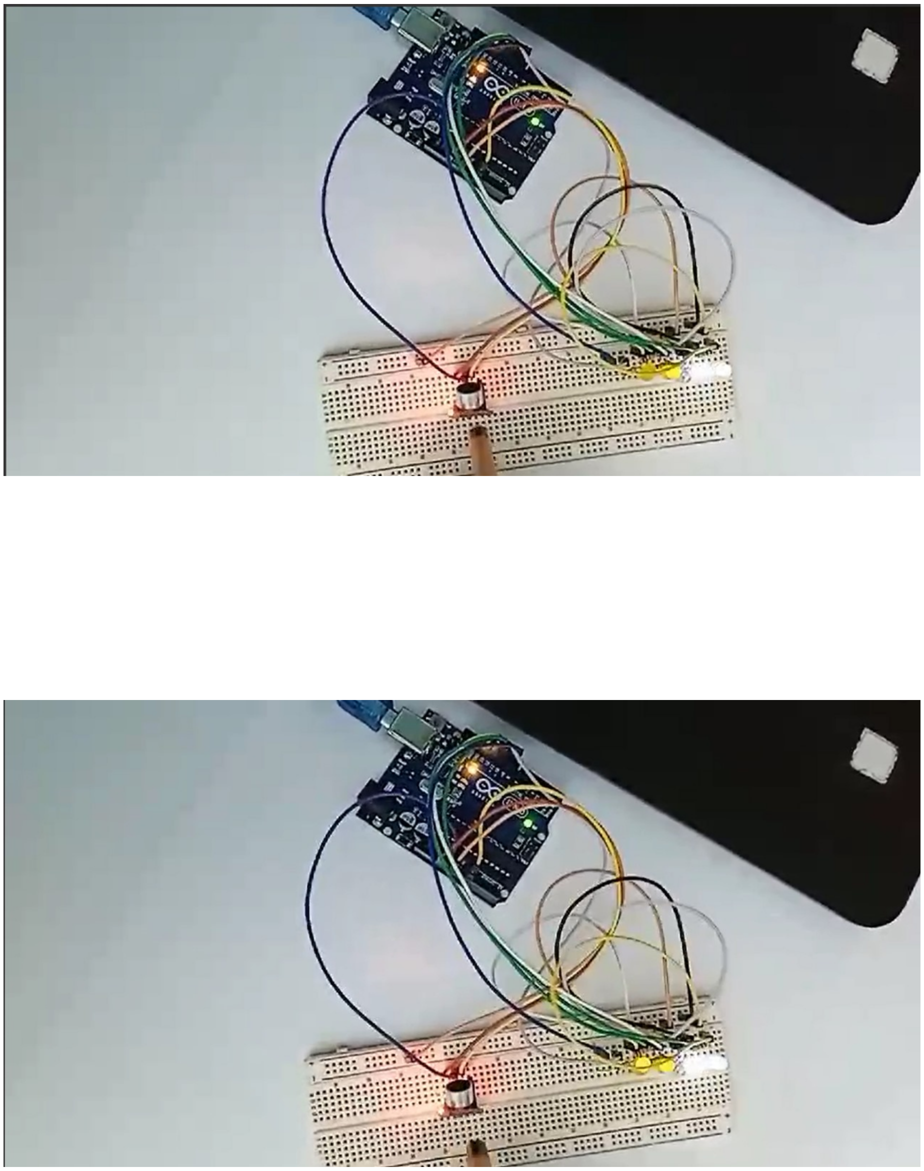


Figure 6: Smart Clap Switch with Sound Intensity Sensitivity, hardware integrated

3.4 Algorithms

The project runs on the following algorithm,

Input voltage	LED1 status	LED2 status	LED3 status	LED4 status	LED5 status
>555 & <558	ON	OFF	OFF	OFF	OFF
>558 & <560	ON	ON	OFF	OFF	OFF
>560 & <562	ON	ON	ON	OFF	OFF
>562 & <564	ON	ON	ON	ON	OFF
>564	ON	ON	ON	ON	ON

Table 1: LED Status Based on Input Voltage

Arduino code:

```
/* Arduino pins where the LED is attached */
#define LED_1 13
#define LED_2 12
#define LED_3 11
#define LED_4 10
#define LED_5 9

#define sensorPin A0 // Analog input pin that the Sensor is attached to

/* boolean variables to hold the status of the pins*/
boolean ledPin1Status;
boolean ledPin2Status;
boolean ledPin3Status;
boolean ledPin4Status;
boolean ledPin5Status;


void setup () {
// TODO: put your setup code here, to run once:
pinMode(LED_1, OUTPUT);
  pinMode(LED_2, OUTPUT);
  pinMode(LED_3, OUTPUT);
  pinMode(LED_4, OUTPUT);
  pinMode(LED_5, OUTPUT);

  pinMode(sensorPin, INPUT);

  pinMode(Sensor, INPUT);

  //digitalWrite(LED_5 HIGH);

  Serial.begin(9600);// initialize serial communications at 9600 bps:
```

```
}

void loop() {
// TODO: put your main code here, to run repeatedly:

  int sensorValue = analogRead(sensorPin);
  Serial.println(sensorValue);
  if (sensorValue > 555  )
    ledPin1Status = 1;
  if (sensorValue > 558  )
    ledPin2Status = 1;
  if (sensorValue > 560  )
    ledPin3Status = 1;
  if (sensorValue > 562  )
    ledPin4Status = 1;
if (sensorValue > 564  )
    ledPin5Status = 1;

    if (ledPin1Status == 1 || ledPin2Status == 1 || ledPin3Status == 1 || ledPin4Status == 1
    if (sensorValue > 555 || sensorValue < 537  )
      digitalWrite(LED_1, HIGH);
    if (sensorValue > 558 || sensorValue < 534  )
      digitalWrite(LED_2, HIGH);
    if (sensorValue > 560 || sensorValue < 534  )
      digitalWrite(LED_3, HIGH);
    if (sensorValue > 562 || sensorValue < 531 )
      digitalWrite(LED_4, HIGH);
    if (sensorValue > 564 || sensorValue < 528)
      digitalWrite(LED_5, HIGH);

    delay(200);
    ledPin5Status = 0;
    ledPin4Status = 0;
    ledPin3Status = 0;
    ledPin2Status = 0;
    ledPin1Status = 0;

  }
  digitalWrite (LED_1, LOW);
  digitalWrite (LED_2, LOW);
  digitalWrite (LED_3, LOW);
  digitalWrite (LED_4, LOW);
  digitalWrite (LED_5, LOW);
}
```

4 Results

Achievements:

- The project can detect sound
- The project gives output based on sound intensity level
- The project follows the algorithm

Bugs:

- Cannot eradicate noise

5 Discussion

5.1 Performance and Achievements

- **Sound Detection Capability:** Discuss how effectively your project can detect sound. Mention the range of sound intensities it can accurately detect and respond to.
- **Output Accuracy:** Evaluate how accurately the project translates sound intensity into the corresponding LED outputs. Discuss any tests you conducted to verify this accuracy.
- **Responsiveness:** Comment on the system's response time. How quickly does it react to changes in sound intensity?

5.2 Challenges and Issues

- **Noise Sensitivity:** Discuss the issue of noise interference. Detail any specific situations where ambient noise caused false triggers or affected the system's performance.
- **Calibration:** Mention any challenges you faced in calibrating the sensor to ensure it accurately reflects the sound intensity levels.
- **Hardware Limitations:** Talk about any limitations of the hardware components used (e.g., sensitivity of the sound sensor, limitations of the Arduino Uno in handling rapid changes in input).

5.3 Limitations

- **Environmental Factors:** Explain how different environmental conditions (e.g., background noise, acoustics of the room) might affect the system's performance.

- **Range of Detection:** Discuss the limitations regarding the range of sound levels the system can detect. Are there sounds that are too low or too high for the system to pick up accurately?
- **Power Supply:** Mention any limitations related to the power supply. Does the system require a constant power source, or can it operate efficiently on batteries?

5.4 Potential Improvements

- **Noise Filtering:** Suggest methods to reduce noise interference, such as implementing software-based noise filters or using more sophisticated sound sensors.
- **Algorithm Optimization:** Discuss potential improvements in the algorithm to enhance the system's accuracy and responsiveness. For example, integrating machine learning techniques to better distinguish between different sound sources.
- **Scalability:** Consider how the system could be scaled up to handle multiple sensors or control more complex devices.

5.5 Implications and Applications

- **Practical Applications:** Reiterate the potential applications of your project in real-world scenarios, such as home automation, industrial noise monitoring, and traffic sound regulation.
- **User Experience:** Discuss feedback from any users or testers. How intuitive and user-friendly is the system?
- **Health and Safety:** Reflect on the implications for health and safety, particularly in environments where sound levels need to be monitored and controlled for safety reasons.

5.6 Future Research

- **Advanced Features:** Propose additional features that could be integrated in future versions, such as voice recognition or integration with other smart home devices.
- **Expanded Testing:** Suggest conducting more extensive testing in different environments to gather more data on system performance and reliability.
- **Collaboration:** Consider collaborating with experts in acoustics or signal processing to further refine the system's accuracy and efficiency.

6 Conclusion

The project "Smart Sound Activated Switch with Sound Intensity Sensitivity" promises to make human lifestyle even more convenient.Moreover, The "Smart Sound Activated Switch with Sound Intensity Sensitivity" project aimed to create a system that could detect sound and control output devices based on the intensity of the detected sound. Throughout the development and testing phases, the project demonstrated several key achievements and provided valuable insights into the practical implementation of sound-activated control systems.

6.1 Key Achievements

- **Sound Detection and Response:** The project successfully implemented a sound sensor to detect varying levels of sound intensity and translated these levels into corresponding outputs using LEDs. This capability was verified through multiple tests, which showed consistent and accurate responses to different sound intensity levels.
- **Algorithm Efficiency:** The algorithm developed for the project was effective in processing the input from the sound sensor and activating the LEDs based on predefined thresholds. The system followed the specified logic, ensuring that the output was proportional to the sound intensity.
- **User Interaction and Control:** By providing a visual representation of sound intensity through LEDs, the project offered an intuitive way for users to understand and interact with the sound environment. This feature is particularly beneficial for applications in home automation and industrial sound monitoring.

7 References

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