Clap Based Fan Switching and speed Control System

1st Shubham Ugale
Department of Electrical and Electronics Engineering
School of Engineering and Technology Sandip University, Nashik
shubhamugale2121@gmail.com

2nd Jayesh Pawar
Department of Electrical and Electronics Engineering
School of Engineering and Technology Sandip University, Nashik
Pawarj395@gmail.com

3rd Prasad Mali
Department of Electrical and Electronics Engineering
School of Engineering and Technology
Sandip University, Nashik
prasadmali137@gmail.com

4th Sham Thube
Department of Electrical and Electronics Engineering
School of Engineering and Technology
Sandip University, Nashik
shamthube9@gmail.com

5th Shankarsham Prasad Tiwari
Assistant Professor
Department of Electrical and Electronics Engineering
School of Engineering and Technology
Sandip University, Nashik
shankarsham.tiwari20@gmail.com

Abstract

This paper presents the design of a clap activated switch device that will serve well in different phono-controlled applications, providing inexpensive key and at the same time flee from false triggering. This involves the design of various sages consisting of the pickup transducer, low frequency, audio low power and low noise amplifier, timer, biostable and switches. It also consists of special network components to prevent false triggering and ensure desired performance objectives. A decade counter IC serves the biostable function instead of flip-flop, special transistor and edge triggering network for low audio frequency. We present an approach to control the household electrical devices like room light or fan in a room environment using whistle and clap. There are many alternative techniques to remotely control electrical devices in room environment such as using a TV remote control or speech recognition techniques etc. But our approach is the most cost effective. Though this product is aimed at physically challenged user, it has universal appeal as a comfortable way to control the room environment. We have designed microcontroller-based circuits to detect clap and whistle against other sounds and are controlling the intensity of the load using a microcontroller-basedtrial drive and a specific code. This paper presents the design of a clap activated switch device that will serve well in different phono-controlled applications, providing inexpensive key and at the same time flee from false triggering. This involves the design of various sages consisting of the pickup transducer, low frequency, audio low power and low noise amplifier, timer, biostable and switches. It also consists of special network components to prevent false triggering and ensure desired performance objectives. A decade counter IC serves the biostable function instead of flip-flop, special transistor and edge triggering network for low audio frequency.

Keywords: Sound, multi vibrator, microphone, relay, triggering.

---

1. Introduction

The primary purpose of switch is to provide means for connecting two or more terminals in order to permit the flow of current across them, so as to allow for interaction between electrical components, and to easily isolate circuits so as to terminate this communication flow when need be. The motivating force behind this design is based on the desire to alleviate the problem faced by the aged and physically challenged persons in trying to control some household appliances. It also takes into considerations the illiterates that may have problems operating some “complex” hand-held Remote-Control Units (RCUs) Therefore this paper provides an introductory study on the basic principles involved in utilizing acoustic energy to control switching process. This is achieved by converting the energy generated by the “handclap” into electrical pulse, which is in turn used to drive an electronic circuitry that includes a relay, which in turn switches ON/OFF any appliance connected through it to the main. The device is activated by clapping twice within a set time period that is determined by a time constant (RC) component value in the circuit. The primary purpose of switch is to provide means for connecting two or more terminals in order to permit the flow of current across them, so as to allow for interaction between electrical components, and to easily isolate circuits so as to terminate this communication flow when need be. The motivating force behind this design is based on the desire to alleviate the problem faced by the aged and physically challenged persons in trying to control some household appliances. It also takes into considerations the illiterates that may have problems operating some “complex” hand-held Remote-Control Units (RCUs) Therefore this paper provides an introductory study on the basic principles involved in utilizing acoustic energy to control switching process. This is achieved by converting the energy generated by the “handclap” into electrical pulse, which is in turn used to drive an electronic circuitry that includes a relay, which in turn switches ON/OFF any appliance connected through it to the main. The device is activated by clapping twice within a set time period that is determined by a time constant (RC) component value in the circuit.

2. Literature Survey

- **Original Clap-Based Control System**
  The original concept of clap-based control systems can be traced back to the 1980s when researchers experimented with sound-activated switches. The pioneering work by Joseph H. Stockert presented a simple design that used a microphone to detect clapping sounds, triggering the fan's switching mechanism. While this system offered basic on-off control, subsequent studies focused on enhancing its functionality and expanding its applications.

  - **Sound Recognition Technique**
    Improving the accuracy and reliability of clap detection led to the exploration of various sound recognition techniques. Researchers employed algorithms such as Fourier Transform, Hidden Markov Models (HMMs), Neural Networks (NNs), and Support Vector Machines (SVMs) to analyze and classify audio signals generated by clapping. These techniques enabled more precise clap detection, reducing false triggers and enhancing the overall performance of the system.

  - **Sensor Technologies**
    To detect clapping sounds, different sensor technologies have been employed. Electromagnetic sensors, microphones, and piezoelectric sensors are commonly used to capture audio signals. Some studies focused on integrating multiple sensors to improve the system's robustness and eliminate environmental noise interference. Researchers also explored non-acoustic sensors like motion sensors, which can detect specific hand movements associated with clapping, enhancing the system's versatility.

  - **Signal Processing and Feature Extraction**
    Once the audio signals are captured, signal processing techniques are employed to extract relevant features. Time-domain and frequency-domain analysis methods, such as Fast Fourier Transform (FFT), Mel-frequency Cepstral Coefficients (MFCC), and Wavelet Transform, have been widely used. These features provide valuable information for accurate clap detection and discrimination from background noise.

  - **Machine Learning and Pattern Recognition**
    Machine learning techniques have been employed to develop more intelligent and adaptive clap-based control systems. Researchers have explored the use of supervised learning algorithms, including decision trees, k-nearest neighbors, and artificial neural networks, to train models capable of recognizing different clap patterns and distinguishing them from non-clap sounds. These systems have shown promising results in terms of accuracy and real-time response.

- **Wireless Communication and Integration**
  Several studies have focused on enhancing the clap-based fan control system by integrating wireless communication protocols such as Bluetooth, Wi-Fi, or Zigbee. This integration enables remote control, smartphone app integration, and smart home integration, making the system more convenient and versatile for users.

- **Energy Efficiency and Power Management**
  Efforts have been made to optimize the energy consumption of clap-based fan control systems. Researchers have proposed techniques for fan speed control based on user clapping intensity, allowing for a more efficient use of electrical energy.

3. Problem Statement

The problem addressed by the clap-based fan switching and speed control system is the need for a convenient and user-friendly method to control fans in households. Traditional fan control methods, such as wall-mounted switches or remote controls, may not always be easily accessible or convenient for users. Additionally, these methods often require manual interaction, which can be cumbersome or impractical in certain situations. Therefore, the problem statement revolves around finding an alternative control mechanism that offers simplicity, ease of use, and hands-free operation for fan switching and speed control.

4. Development of Clap Based Fan Switching and speed Control System

4.1 Datasheet

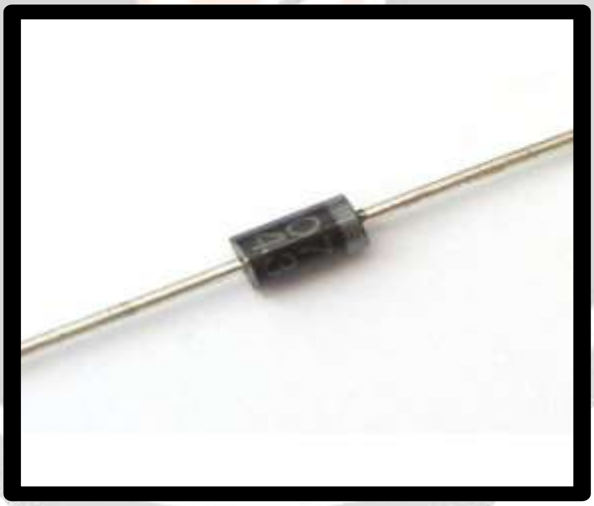

Fig. 1 Junction Diode

4.1.1 Features

• Low forward voltage drop

• Low leakage current

• High forward surge capability

• Solder dip 275 °C max. 10 s, per JESD 22-B106

• Compliant to RoHS Directive 2002/95/EC and in accordance to WEEE 2002/96/EC

4.1.2 Typical Applications

- For use in general purpose rectification of power supplies, inverters, converters and freewheeling diodes application.
- These devices are not AEC-Q101 qualified.

4.1.3 Mechanical Data

Case : DO-204AL, moulded epoxy body Moulding compound meets UL 94 V-0 flammability rating Base P/N-E3 - RoHS compliant, commercial grade .

Terminals: Matte tin plated leads, solderable per J-STD-002 and JESD 22-B102 E3 suffix meets JESD 201 class 1A whisker test Polarity: Colour band denotes cathode endvv.

Primary Characteristic	**Rating**
IF(AV)	1.0 A
VRRM	50 V to 1000 V
IFSM (8.3 ms sine-wave)	30 A
IFSM (square wave tp = 1 ms)	45 A
VF	1.1 V
IR	5.0 μA
TJ max.	150

4.2 2Pin cord

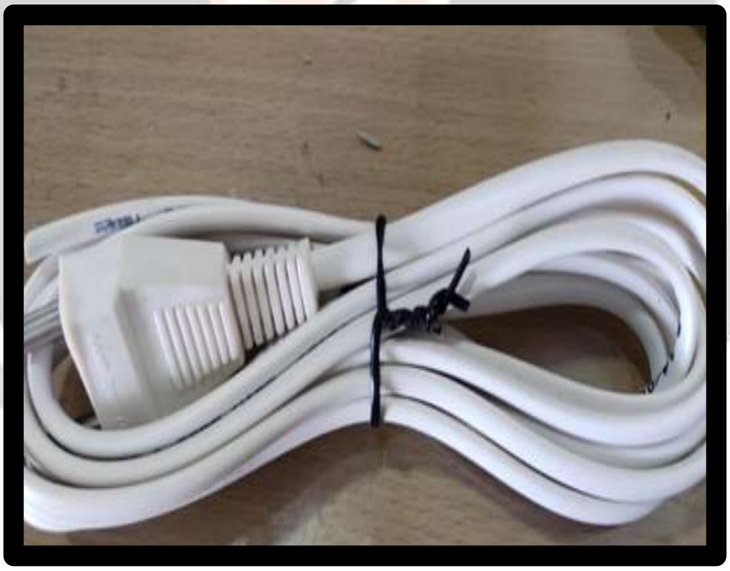

Fig. 2 Power Cord

4.2.1 Specifications

Size-1.5 sq mm

Lenght-1.5meter

Insulation classEclasPVC insulation

Pins -2pins Current capacity-3.6Amp

4.3 Relay Module

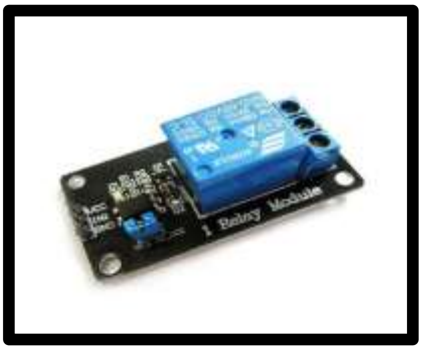

Fig. 3 Relay Module

4.3.1 Description

The new KEYES 5V Relay Module is perfectly made for Arduino application. It has three pins, the VCC, GND and Signal. It can act as switch if the circuit and the load circuit have different supply voltage. It is commonly use if the load circuit is AC. It is a switch used to connect isolated connection from the circuit using a circuit signal. It has red LED that turns on every time the coil is energized or the signal pin has a high input.

4.3.2 Specifications

- Maximum AC current and voltage : 10A 250VAC
- Maximum DC current and voltage : 10A 30VDC
- The control signal DC or AC, 220V AC load can be controlled
- There is a normally open and one normally closed contact
- To make the coil of relay energized you must need to have an input of 1 in
- The signal pin. Pin Configuration + : 5V power supply
- Ground
- S : Signal from the Arduino
- NC : normally closed
- NO : normally open
- COMMON : common

Pin Configuration

- VCC: 5V DC
- COM: 5V DC
- IN1: high/low output
- IN2: high/low output
- GND: ground

4.4 7805 Datasheet

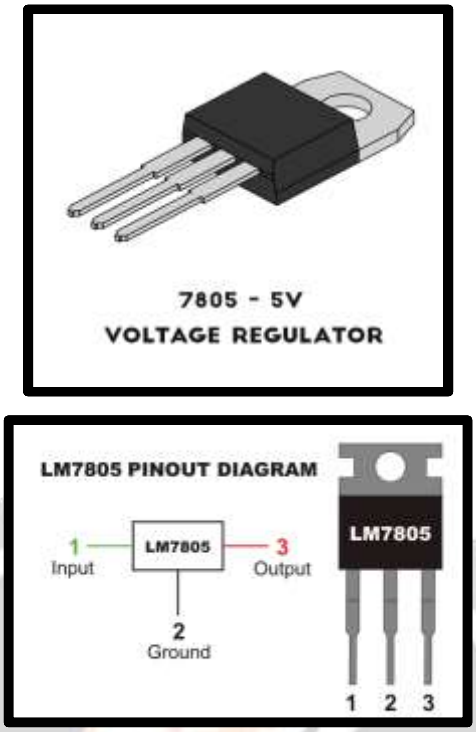

Fig. 4 Database

4.4.1 Specifications

S.N	Specification	Range
1	DC output voltage	5V DC
2	DC input voltage	Up to 35V DC
3	Output current capacity	1.5 Amp
4	Operating junction temperature	-55 to 150 Celsius
5	Storage temperature	-65 to 160 Celsius
6	Package used in our project	TO-220A Package(through hole package)
7	Short circuit current	2.5 amp for 1 milli seconds

4.4.2 Special features of 7812 voltage regulators

THERMAL OVERLOAD PROTECTION

SHORT CIRCUIT PROTECTION

PACKAGES AVAILABLE – TO220AB (Through hole package) , surface mount packages are also available.

4.4.3 General Information and purpose of use

In our project we have used 7812 voltage regulator for the voltage regulation purpose for controller. The L7800 series of three-terminal positive regulators is available in TO-220 ISOWATT220 TO-3 and D2PAK packages and several fixed output voltages, making it useful in a wide range of applications. These regulators can provide local on-card regulation, eliminating the distribution problems associated with single point regulation. Each type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

4.5 Arduino Nano Datasheet

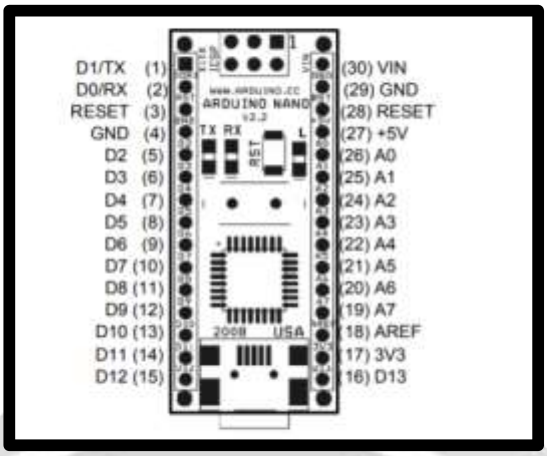

Fig .5 Arduino Nano Pin

4.5.1 Programming

The Arduino Nano can be programmed with the Arduino software (download). Select "Arduino Duemilanove or Nano w/ ATmega328" from the Tools > Board menu (according to the microcontroller on your board). The ATmega328 on the Arduino Nano comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer.

5. Methodology

5.1 System Design and Hardware Setup:

The methodology begins with the design and hardware setup of the clap-based fan switching and speed control system. This involves selecting the appropriate microcontroller or development board, microphone or sensor, and any additional components required for signal processing and fan control. The hardware setup should be capable of capturing audio signals, processing them, and generating control signals to switch the fan on/off and adjust its speed.

5.2 Clap Detection Algorithm Development

The next step is to develop a clap detection algorithm that can accurately identify clap sounds from background noise. Various signal processing techniques, such as Fast Fourier Transform (FFT) or wavelet transform, can be employed to analyse the audio signals captured by the microphone. The algorithm should be able to distinguish clap sounds based on their unique frequency content, temporal characteristics, or other distinguishing features. Machine learning algorithms, such as neural networks or support vector machines, can also be utilized to improve the accuracy of clap detection.

5.3 Feature Extraction

Once the clap sounds are detected, relevant features need to be extracted from the captured audio signals. Feature extraction methods such as Mel-frequency Cepstral Coefficients (MFCC), spectral centroid, or energy envelope can be used to represent the clap sounds in a more compact and informative manner. These features serve as inputs to the subsequent processing stages for determining the desired action (e.g., switching the fan on/off or adjusting the fan speed).

5.4 Gesture Recognition and Action Determination

After feature extraction, a gesture recognition module or classifier is employed to determine the appropriate action based on the detected clap sounds. The classifier can be trained using supervised learning techniques, utilizing labelled clap sound samples to differentiate between various gestures (e.g., single clap for switching on/off, multiple claps for speed control). Decision trees, k-nearest neighbours, or other classification algorithms can be utilized for this purpose.

5.5 Fan Control Mechanism

The determined action, such as switching on/off or adjusting the fan speed, is translated into control signals for the fan. The microcontroller or development board should be programmed to generate the required signals to interface with the fan's control circuitry. This may involve utilizing digital outputs, PWM (Pulse Width Modulation) signals, or communication protocols such as infrared or RF (Radio Frequency) to control the fan's operation.

5.6 Integration and Testing

The clap-based fan switching and speed control system should be integrated with the fan, ensuring proper communication and compatibility. Extensive testing is necessary to validate the system's performance, accuracy, and robustness. This includes evaluating the system's clap detection accuracy, responsiveness to different clap patterns, noise robustness, and overall reliability of fan control operations. User feedback and iterative improvements may be incorporated during this phase.

5.7 Energy Efficiency and Power Management

To optimize energy consumption and power management, techniques such as fan speed control based on clap intensity or incorporating energy harvesting mechanisms can be explored. Energy-efficient algorithms and hardware optimizations should be considered to ensure the system operates efficiently while minimizing power consumption.

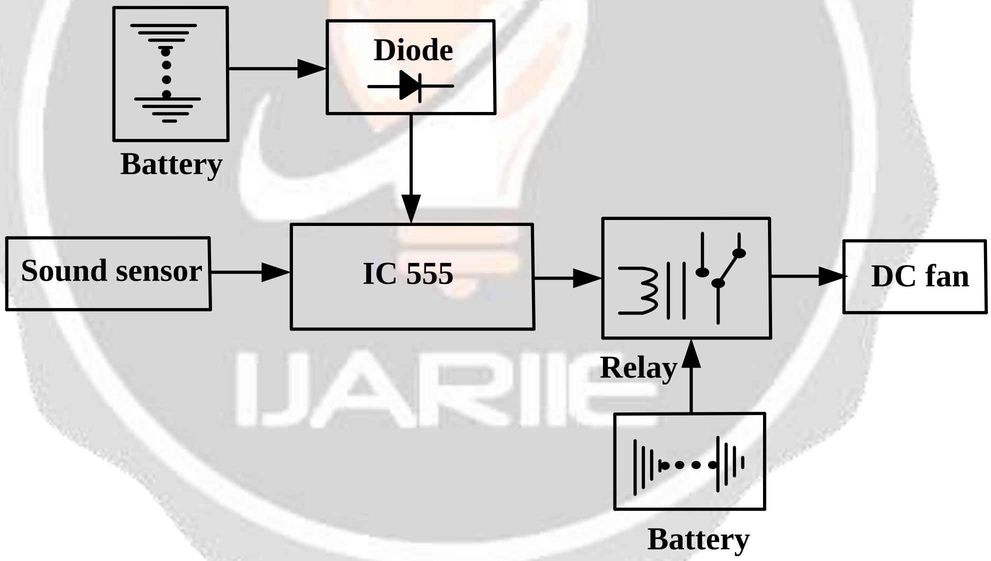

Fig. 6 Block Diagram

6. Discussion

The development of a clap-based fan switching and speed control system offers an innovative and user-friendly approach to controlling fans in households. This system utilizes sound recognition techniques, sensor technologies, signal processing algorithms, and intelligent control mechanisms to enable users to switch their fans on/off and adjust the speed through simple clapping gestures. One of the key advantages of the clap-based control system is its convenience and ease of use. Users no longer need to locate wall switches or remote controls; they can simply clap their hands to control the fan. This hands-free operation is particularly useful in situations where users have their hands full, such as when carrying objects or when cooking in the kitchen. Additionally, the system provides an intuitive interface that requires minimal effort to understand and operate, making it accessible to users of different age groups and technical backgrounds. The accuracy and reliability of clap detection are crucial for the successful implementation of the system. Researchers have explored various sound recognition techniques, including Fourier Transform, Hidden Markov Models, Neural Networks, and Support Vector Machines, to accurately detect clap sounds and distinguish them from background noise.

7. Conclusion

The clap activated switching device function properly by responding to both hand claps at about three to four meters away and finger tap sound at very close range, since both are low frequency sounds and produce the same pulse wave features. The resulting device is realizable, has good reliability and it's relatively inexpensive.

Acknowledgements

The author wish to acknowledge the kind cooperation of the laboratory technologies of the Department of Electrical & Electronic Engineering, of the Olabisi Onabanjo University, Iboga, Ogun State, Nigeria.

References

[1] Edward Hughes, Hughes Electrical technology, Addition Wesley Longman (Singapore) plc Ltd, India, Seventh Edition, (pp 395-399). (2001)

[2] Paul Horonitz and Weinbeild Hill, the Art of Electronics, second Edition, Cambridge University Ulc.(1995)

[3] Ray Marston, "Relay Output Circuits", Electronics Now Magazine, July 1994

[4] http://www.kpsec.com: Country circuits, the Electronics club

[5] http://www/starmicromics .com/components/mics.html: Microphone series

[6] The Audio Forum "How Microphones Work", www.mediccollege.com

[7] Tony Van Roon (VA3AVR) "Relays and Relay Drivers" www.starcounter.com December 6, 2006.

[8] The Electronics Clubs, "Transistor Circuit", www.kspec.com www.mccsemi.com. NPN Silicon Amplifier Transistor

[9] Edward Hughes, Hughes Electrical technology, Addition Wesley Longman (Singapore) plc Ltd, India, Seventh Edition, (pp 395- 399). (2001)

[10] Paul Horonitz and Weinbeild Hill, the Art of Electronics, second Edition, Cambridge University Ulc(1995)

[11] Ray Marston, "Relay Output Circuits", Electronics Now Magazine, July 1994