e-ISSN:2582-7219

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

Volume 7, Issue 4, April 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.521

International Journal Of Multidisciplinary Research in Science, Engineering and Technology (IJMRSET)

| ISSN: 2582-7219 | www.ijmrset.com | Impact Factor: 7.521| Monthly Peer Reviewed & Referred Journal |

| Volume 7, Issue 4, April 2024 |

| DOI:10.15680/IJMRSET.2024.0704140 |

Temperature Based Automatic Fan Speed Control

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ABSTRACT: In present scenario, availability of electricity is found to reach crucial stage. To protect and safeguard one's future we need to save the energy. As a slogan suggest "One unit saved is one unit generated". The project is a standalone automatic fan speed controller that controls the speed of an electric fan according to our requirement. Use of embedded technology makes this closed loop feedback control system efficient and reliable. Arduino microcontroller allows dynamic and faster control. It is very compact as it is constructed by using few components and can be interfaced for several applications including air-conditioners, water-heaters, snow-melters, ovens, heat-exchangers, mixers, furnaces, incubators, thermal baths and veterinary operating tables. Arduino micro controller is the heart of the circuit as it controls all the functions. The temperature sensor DS18B20 senses the temperature and converts it into an electrical signal, which is forwarded to the microcontroller. The microcontroller drives Transistor to control the fan speed. This project uses regulated 12V, 2A power supply. This project is useful in process industries for maintenance and controlling of Boilers temperature.

KEYWORDS: Temperature, fan, DS18B20, speed, PWM

I. INTRODUCTION

With the advancement in technology, intelligent systems are introduced every day. Everything is getting more sophisticated and intelligible. There is an increase in the demand of cutting edge technology and smart electronic systems. Microcontrollers play a very important role in the development of the smart systems as brain is given to the system. Microcontrollers have become the heart of the new technologies that are being introduced daily. A IJIRT 147629 microcontroller is mainly a single chip microprocessor suited for control and automation of machines and processes. Today, microcontrollers are used in many disciplines of life for carrying out automated tasks in a more accurate manner [1]. Almost every modern day device including air conditioners, power tools, toys, office machines employ microcontrollers for their operation. Microcontroller essentially consists of Central Processing Unit (CPU), timers and counters, interrupts, memory, input/output ports, analog to digital converters (ADC) on a single chip. With this single chip integrated circuit design of the microcontroller the size of control board is reduced and power consumption is low. This project presents the design and simulation of the fan speed control system using PWM technique based on the room temperature. A temperature sensor has been used to measure the temperature of the room and the speed of the fan is varied according to the room temperature using PWM technique. The duty cycle is varied from 0 to 100 to control the fan speed depending upon the room temperature. Pulse Width Modulation, or PWM, is a technique for getting analog results with digital means. Digital control is used to create a square wave, a signal switched between on and off. This on-off pattern can simulate voltages in between full on (5 Volts) and off (0 Volts) by changing the portion of the time the signal spends on versus the time that the signal spends off. The duration of "on time" is called the pulse width.

II. PROPOSED SYSTEM ARCHITECTURE

In the proposed systems, microcontroller plays a vital role in the smart system development. Microcontrollers have become an essential part in the present technologies that are being presented daily. This article discusses temperature based fan speed control and monitoring system using an Arduino system. This system is used to control the cooling system automatically based on the room temperature [2]. The system uses an Arduino board to implement a control system. Since this system is proposed to control the cooling system and it is very important to know Arduino controlled system well.

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The architecture of proposed system as shown in Fig1. It consists of Arduino controller [6] as a main source which receives input signal from temperature sensor which is used to measure room temperature. The components described in the architecture are Arduino, sensor, triac, amplifier, Ac fan, capacitor. The triac is used twice first to step down than later to amp up the voltage.

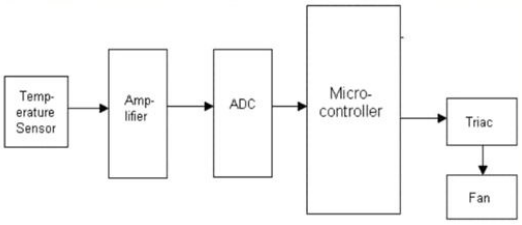

Fig1: Architecture of the Proposed System

III.HARDWARE DESCRIPTION

1. Arduino: The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started [6].

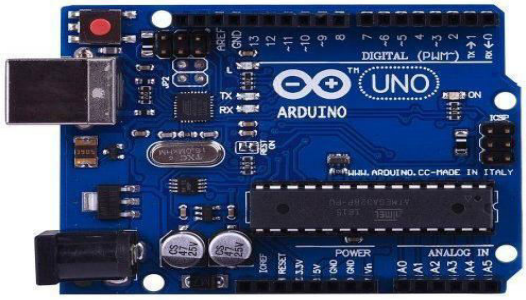

Fig 2: Arduino UNO

Sensors Interfacing to Arduino: The Arduino comprises of 28pins, where there 20 I/O pins. There are 14 digital pins and 6 analog pins. Here in this system all the respective sensors are connected to the analog pins of Arduino. The analog pins AO, A1, A2, A3, A4, A5 from Port B of Arduino are used for interfacing with the sensors. The digital pins (2, 3, 4, 5, 7,6,7,8) Port C of Arduino are used here to connect to the data lines of respective LCD display. The power supply of 5v is supplied to the Arduino through the USB cable. The output pin of Arduino i.e., 13th pin is connected to the buzzer to determine the output of the project. The main components of this project i.e. GSM and GPS are connected to Arduino. Hence in this proposed system the Arduino is completely used for implementation of the security system.

2. DS18B20 Waterproof Digital Temperature Sensor: Global If you have an MCU like an Arduino and you want to measure temperature, the DS18B20 is one of the most popular of the temperature measurement ICs to use. Being a digital device, it can avoid some of the pitfalls of analog sensors which are more sensitive electrical noise pickup, especially if the device is remote from the MCU.

Fig3: GDS18B20 Waterproof Digital Temperature Sensor

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3. 4N35 Optocoupler 6 pin: 4N35 is an optocoupler IC in which an infrared emitter diode drives a phototransistor. They are also known as opto isolators since they separate two circuits optically. These are used to couple two circuits without any ohmic contact. They allow one of the circuits to switch another one while they are completely separate. The first circuit is connected to IR diode while the other circuit with the phototransistor.

Fig 4: 4N35 Optocoupler 6 Pin

4. 0-12 Volt 1Amp Transformer, AC Step Down power supply: The transformer is a static electrical device that transfers energy by inductive coupling between its winding circuits. A varying current in the primary winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic flux through the secondary winding.

Input Voltage: 230V AC
Output Voltage: 0-12V AC
Output Current: 1 Amp
Mounting: Vertical mount type

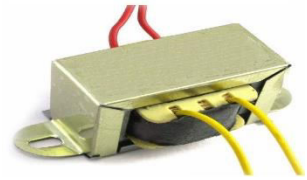

Fig 5: 0-12V 1 Amp AC Transformer

5. L7805CV Triac: The L7800 series of three-terminal positive regulators is available in TO-220, TO-220FP, 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 voltage and currents.

- Output Current to 1.5A
- Output Voltages of 5; 5.2; 6; 8; 8.5; 9; 12; 15;18; 24V
- Thermal Overload Protection
- Short Current Protection
- Output Transition Protection
-

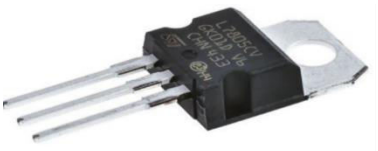

Fig 6: L7805CV Triac

6 BT134 600E Triac: Glass passivated triacs in a plastic envelope, intended for use in applications requiring high bidirectional transient and blocking voltage capability and high thermal cycling performance. Typical applications include motor control, industrial and domestic lighting, heating and static switching.

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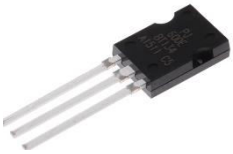

Fig 7: BT134 600E Triac

7. Variable Resistor: The variable resistor is an element that offers variable resistance to the circuit. By adjusting its internal configuration, we can obtain variable resistance at the load side. This element is frequently used in electrical and electronic circuits to

Fig 8: Variable Resistor

vary the current flowing in the circuit [9]. Apart from varying current, this element is also used to control some basic parameters like speed, temperature for commonly used electrical loads. A simple example would be, the speed control of single phase induction motor (ceiling fan) through a potentiometer (variable resistor).

8. Capacitor Electrolytic 1000uF 25V: These are high quality 1000uF, 25V radial leaded miniature aluminium electrolytic capacitors from manufactures such as Nichicon, KEMET, NIC and Panasonic. Aluminium electrolytic caps are the go-to general purpose capacitors that can be used in most applications that require larger capacitance values of $\geqslant$ 1uF and can handle a polarized capacitor [9].

Fig 9: Electrolytic Capacitor 1000Uf

These are the latest technology miniature variety with radial leads to keep the size of the component as compact as possible to take up minimum board space. Outer construction is aluminium.

9. Resistors: There are five different kind of resistors installed in the circuit of Automatic Temperature Based Fan Speed Control with different kind of values which are 1k ohm, 220ohm, 1ohm, 1k ohm, 1ohm.

Fig 10: Resistors

10. Diode: There are total nine diodes are used in the circuit and eight of them are used to make bridge rectifiers. Total two bridge rectifiers are made in the circuit.

Fig 11: Diode

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IV. WORKING

- Temperature Sensing: Sensors such as thermistors or temperature ICs are placed strategically to measure the temperature of the device or the environment.
- Control Algorithm: A control algorithm, often implemented in software, continuously reads the temperature sensor data and calculates the desired fan speed based on a predefined temperature profile or set points.
- Fan Speed Adjustment: The control algorithm then adjusts the speed of the fan using a motor controller or PWM (Pulse Width Modulation) technique. Higher temperatures trigger the fan to spin faster, while lower temperatures result in slower fan speeds or even turning the fan off completely if the temperature is within the desired range [3].
- Feedback Loop: The system constantly monitors the temperature and adjusts the fan speed accordingly, creating a closed-loop feedback system to maintain temperature stability.
- Safety Features: Sometimes, safety features are implemented to prevent the fan from malfunctioning or causing damage. These features may include temperature limits, error detection, and fail-safe mechanisms.

V. IMPLEMENTATION OF THE PROPOSED SYSTEM

The implementation of our project is shown in the following :
i) The configuration mode is initiated by pressing the configuration button, this turns ON the red LED of Arduino [8].

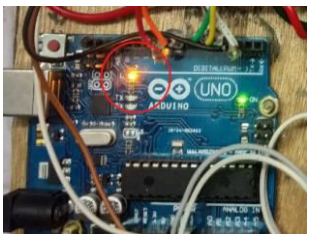

Fig 2: Device in Configuration Mode: RED LED turns ON

ii) GDS18B20 Temperature sensor now senses the temperature and the most important part is to set the variables temp Min and temp Max with your desired values. Temp Min is the temperature at which the fan starts to spin.
iii) Requirements Gathering: Understand the specific requirements for the system, such as the range of temperatures at which the fan should activate or deactivate, the type of fan to be controlled, the sensors to be used, etc. [7].
iv) Hardware Selection: Choose the necessary hardware components such as a microcontroller or single-board computer (like Arduino, Raspberry Pi), temperature sensor (like LM35, DHT11, DHT22), fan (AC or DC depending on requirements), and any additional components like transistors or relays for controlling the fan.
v) Circuit Design: Design the circuit that connects the temperature sensor, microcontroller, and the fan. Ensure proper connections and compatibility between components [2].

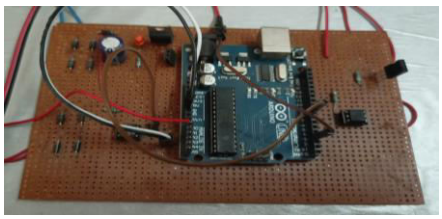

Fig 3: Assembled equipment's on PCB

vi) Programming: Write the code to read temperature values from the sensor and control the fan based on predefined thresholds. If using an Arduino or similar platform, you'd typically write code in Arduino IDE using C/C++ or Python for Raspberry Pi.
vii) Temperature Threshold Logic: Implement logic in the code to determine when the fan should turn on or off based on temperature readings. For example, if the temperature exceeds a certain threshold, turn on the fan; if it falls below another threshold, turn off the fan.
viii) Testing and Calibration: Test the system extensively to ensure it operates correctly under various temperature conditions. Calibrate the temperature thresholds if necessary to achieve desired performance [8].

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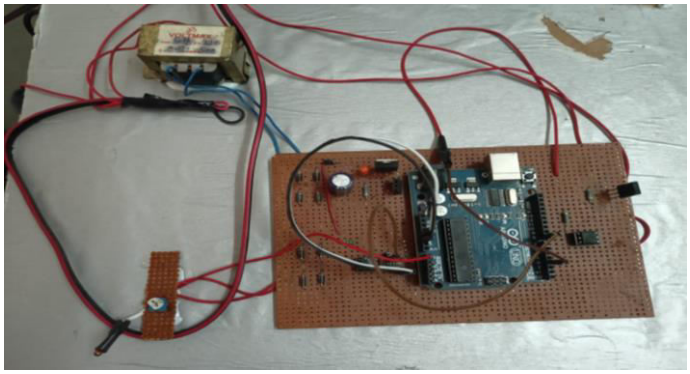

Fig 4: Testing and Calibration

ix) Integration: Integrate the hardware and software components together, ensuring proper communication between the temperature sensor, microcontroller, and fan.

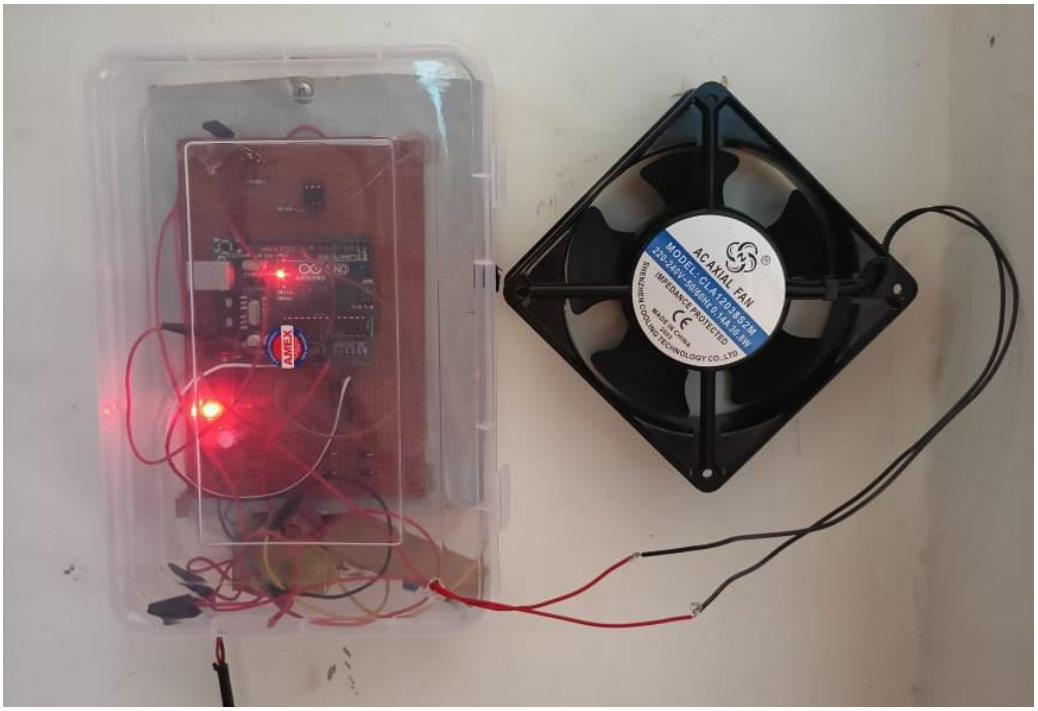

Fig 5: Snapshot of Final Project

VI. CONCLUTION

Arduino based temperature controlled fan is implemented. Thus, here fan speed has been controlled by using Pulse Width Modulation and Arduino board according to the temperature sensed by the help of Temperature Sensor (GDS18B20). The idea of the project is to change the fan temperature automatically. PWM technique is found to be the best technique for controlling the fan speed using the sensed temperature. The system is working properly. The speed of fan depends on the temperature and there is no need for regulating the fan speed manually again and again.

VII. FUTURE SCOPE

- The future scope of automatic temperature based fan speed control is promising and multifaceted. As technology advances and the demand for energy-efficient and smart solution increases, this concept is likely to see significant development and adoption in various fields. Here are some potential future directions.

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- Commercial And Industrial Application: In commercial and industrial setting, such as data centres, warehouses, and manufacturing facilities, automatic temperature-based fan speed control can play a crucial role in optimizing cooling system and reducing operation costs. Future developments may focus on scalability, reliability and integration with existing HVAC (Heating, Ventilation and Air Condition) System.
- Health and Comfort: Beyond energy efficiency, future advancement may prioritize enhancing occupant health and comfort by incorporating features such as personalized temperature settings, air circulation pattern, and adoption control algorithms. This can lead to improved productivity and well-being in various environments, including-offices, schools, hospitals and public spaces.
- Energy Efficiency Regulation and Standards : As governments and and regulation bodies continue to emphasize energy efficiency and environmental sustainability, automatic temperature-based fan speed control system may become subject to stricter regulation and standards. Future developments may focus on meeting these requirements while also providing cost-effective solutions for end-user.

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