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AUTOMATIC TEMPERATURE CONTROLLED FAN

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Abstract: **The "Temperature Controlled Fan" is a system where the speed of the fan changes with the change of ambient temperature. It consists of a microcontroller (Arduino Nano) which compares the preset temperature system and ambient temperature with the help of closed loop feedback system and if any difference occurs it controls the speed of the fan. It consists of microcontroller, temperature sensor, motor driver circuit and other accessory. The system is developed to run the fan with optimize speed and reduce unnecessary energy losses. The electronic components used here it's almost minimum price. The objective of the project is to keep efficient output with minimum cost and simple design. We can use this project in domestic purpose for cooling electronic equipment (i.e. Laptop, Desktop) and its modified version can be used in industry for cooling equipment machineries.**

Keywords: **microcontroller, Arduino Nano, MOSFET, temperature sensor, DC motor.**

1. INTRODUCTION

In the current scenario when people are concerned about limited energy storage of conventional energy, an automatic temperature-controlled fan plays a crucial role in energy conservation. An automatic temperature-controlled fan is used to maintain a certain temperature in the room, offices, machinery, server rooms etc. An automatic temperature-controlled fan is a semi-automatic device. It is based on a microcontroller unit. The project consists of Arduino Nano as a microcontroller or instruction house, LCD Display to display output or other messages, MOSFET as an electrical switch, Thermistor as a temperature sensor, DC motor for driving, and Blade for creating airflow.

1.1 Importance of the Project in the Present Scenario

"Automatic Temperature Controlled Fan" have become increasingly important in present days as it operate based on the actual need for cooling and it avoid unnecessarily running all time or high- speed frequency. The system also safeguards the equipment from breakdown due to overheating. As the system is automatic so the requirement of fulltime operator is not necessary. In present day the energy savings is main motive of many organizations. So, by implementing such system may help them to reach the energy saving goal and also reduces carbon footprints.

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2. CIRCUIT DIAGRAM

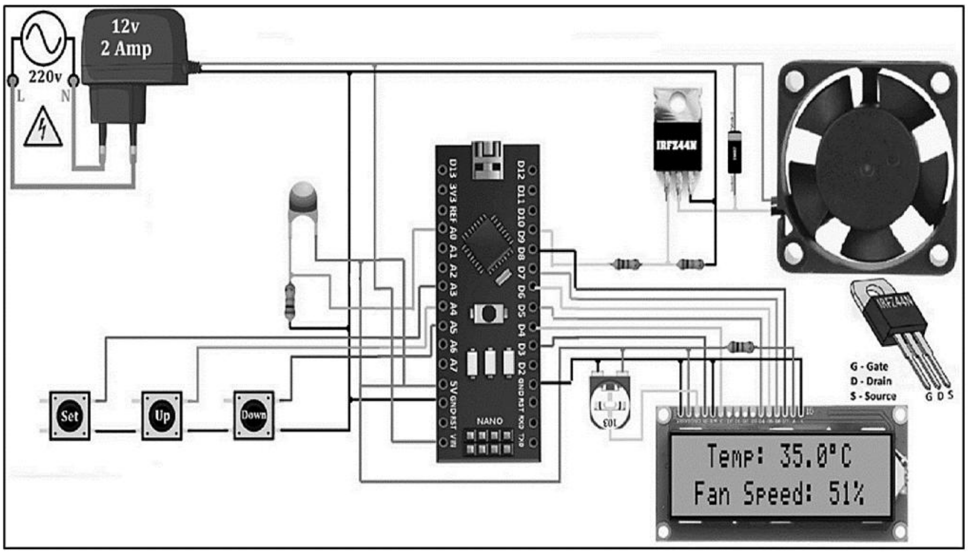

Fig 2.1 Circuit Diagram of Automatic Temperature Controlled Fan

In the first step, the sensor detects the temperature with a thermistor. The sensor output is then taken and the temperature value is converted to an appropriate number on the Celsius scale. The fan speed is controlled by PWM signals generated by the Arduino. And the last part of the system shows the temperature on the LCD screen and the fan is working. Then programming is done according to the requirements. Working with it is very easy. The PWM generated by the Arduino was used as the heel input of the transistor. The transistor then produces a voltage according to the PWM input. The LCD is connected directly to the Arduino. Connect D3, D4, D5, D6, D7, D8 pins to Arduino digital pins number 8, 7, 6, 5, 4, 3. The Thermistor1k sensor module is also connected to the Arduino A0 port. Analog input and output port A0 to A7. D2-D12 digital input output port. Two ports RXD, TXD are available for serial communication. ATmega328p microcontroller is used in this Arduino. RST, GND, 5V and 3.3V are also available. D2 and D3 are used for external interrupt control.

3. COMPONENT DETAILS

3.1. Arduino Nano

Arduino Nano is a miniature version of microcontroller board. The microcontroller board is based on ATmega328P chip. This microcontroller has total 20 digital I/O pins, 8 analog pins, and a mini-USB-B port.

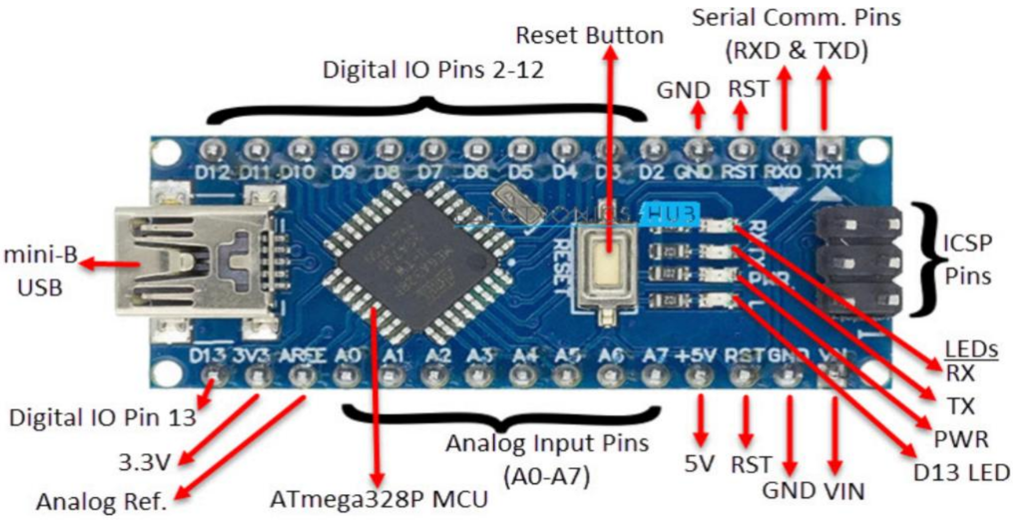

Fig 3.1.1 Arduino Nano

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Table 3.1.1 Pin Description

SL NO	PIN NUMBER	PIN DESCRIPTION
1	D0-D13	Digital Input/ Output pins
2	A0-A7	Analog Input/ Output pins
3	Pin#3,5,6,9,11	Pulse width modulation
4	Pin# 0(RX), pin# 1 (TX)	Serial communication
5	Pin# 10,11,12,13	SPI communication pins
6	Pin# A4, A5	12C communication pins
7	Pin# 13	Built-in LED for testing
8	D2 & D3	External interrupt pins1

Table 3.1.2 Basic Information of Microcontroller

Microcontroller	Atmega328p/Atmega168
Operating voltage	5v
Input voltage	7v-12v
Digital I/O pins	14
PWM	6 out of 14 digital pins
Max. current rating	40ma
USB	Mini
Analog pins	8
Flash memory	160 KB or 2 KB
SRAM	1KB or 2KB
Crystal oscillator	16 MHz
EEPORM	512bytes or 1KB

3.2. 16*2 LCD Display

The 16×2 LCD display is essential part of the project. It is used here for output device. It is compact in size and shows texted based information. In this project we use it with Arduino Nano for displaying sensor readings, messages and other relevant data.

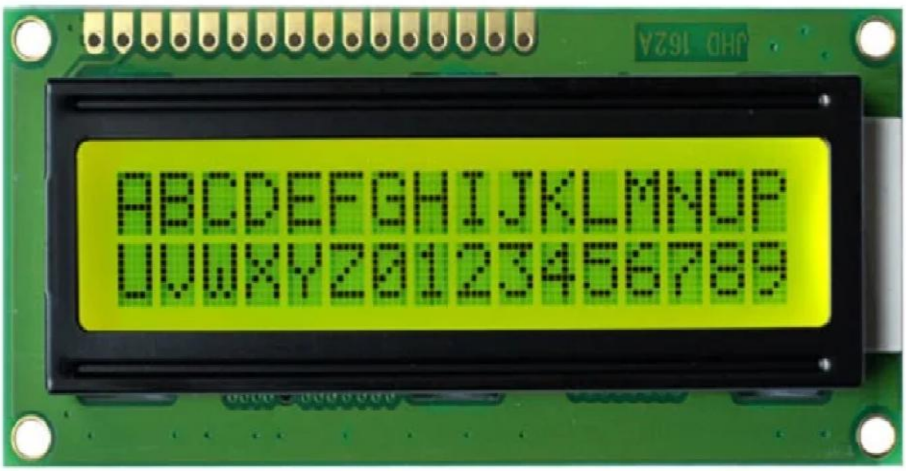

Fig 3.2.1 16*2 LCD Display

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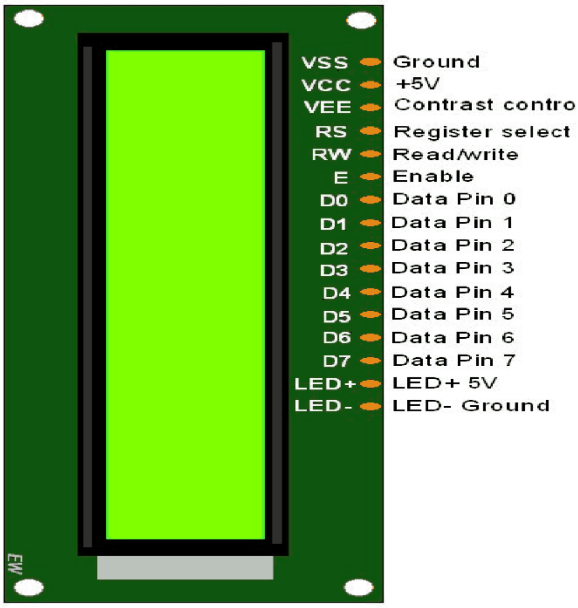

Fig 3.2.2 16*2 LCD Display Pin Configuration

Table 3.2.1 Function of 16x2 LCD Display

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	VEE
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight VCC (5V)	Led+
16	Backlight Ground (0V)	Led -

3.3. Temperature Sensor

A temperature sensor is a device used in automatic temperature-controlled fan systems to measure the ambient temperature. Common types include thermistors and temperature ICs. They provide real-time temperature readings, allowing the system to adjust the fan speed accordingly to maintain a desired temperature level. Here the temperature sensor is used to sense the room temperature or machinery temperature.

SPECIFICATIONS

- Resistance (ohm) at 25°C -> 10k±1%
- Maximum operating current (mA)-0.100
- Maximum voltage (V)-> 5
- Operating Temperature Range (°C)> -40 ~ +125

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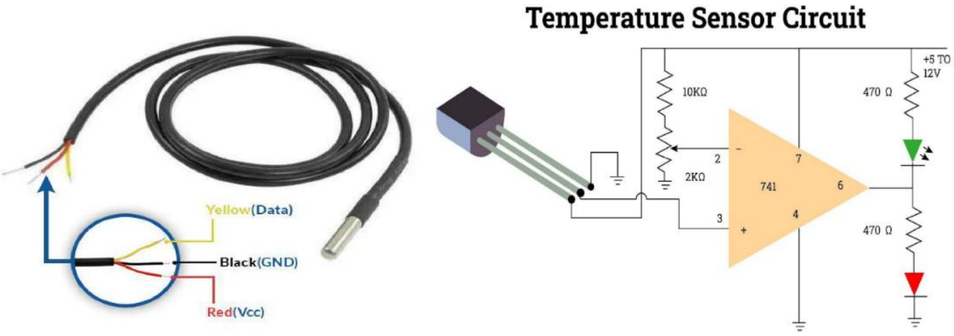

Fig 3.3.1 Temperature Sensor

Other than this, MOSFET, fan motor, fan blades, tact or tactical switch, power supply of 12 V, flexible wires, wooden board and Vero board are used.

4. WORKING PRINCIPLE

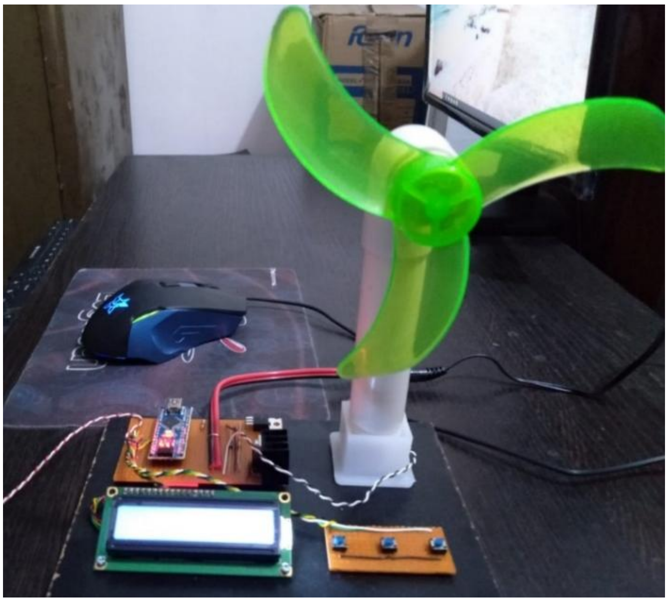

Fig 4.1 The Automatic Temperature Controlled Fan

The working principle of a temperature-controlled fan involves several key components and steps:

- **Temperature Sensing:** The system requires some temperature sensors to sense the ambient temperature and the temperature sensors act as feedback system to the microcontroller.
- **Control Algorithm:** The temperature sensors sense the room/ambient temperature and the control system (microcontroller) compare it to the pre-given temperature if the ambient temperature increases above the setpoint then fan will start or speed will increase on the other hand if the temperature decreases to predefined temperature or its below then the fan will stop or the speed will decrease.
- **Fan Speed Adjustment:** If the ambient temperature is greater than the set-point temperature then the speed will increase and vice-versa.
- **Feedback Loop:** The system continuously monitors the ambient temperature as feedback via temperature sensor.
- **User Interaction:** Some automatic temperature fan system offers the user to regulate the speed, temperature set-points manually.
- **Safety Features:** It gave extra feature compare to normal fan. If the temperature of an equipment exceeds the value that the system can handle, it shows alert in display and buzzer will on to warn the operator.

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4.1 Program Code Needed for the Project

```
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27,20,4); // if error get address from i2c scanner int tempPin = A0; // the output pin of LM35
int fan = 11; // the pin where fan is int led = 8; // led pin
int temp;
int tempMin = 30; // the temperature to start the fan 0%
int tempMax = 60; // the maximum temperature when fan is at 100% int fanSpeed;
int fanLCD;
void setup () { pinMode(fan, OUTPUT); pinMode(led, OUTPUT); pinMode(tempPin, INPUT); lcd.init();
lcd.backlight(); lcd.begin(16,2); Serial.begin(9600);
}
void loop()
{
temp = readTemp(); // get the temperature Serial.print( temp );
if(temp < tempMin) // if temp is lower than minimum temp
{
fanSpeed = 0; // fan is not spinning analogWrite(fan, fanSpeed); fanLCD=0;
digitalWrite(fan, LOW);
}
if((temp >= tempMin) && (temp <= tempMax)) // if temperature is higher than minimum temp
{
fanSpeed = temp;//map(temp, tempMin, tempMax, 0, 100); // the actual speed of fan//map(temp, tempMin, tempMax, 32, 255);
```

5. RESULT

PWM means pulse with modulation, it is the technique by which the analog signals can be got from digital devices like microcontrollers. In this project the micro controller of the Arduino is generating the PWM signal. The signals thus produced have a train of pulses, and generally they come with square wave. The time period in which the switch is on and off is from the voltage range of (0-5 V).

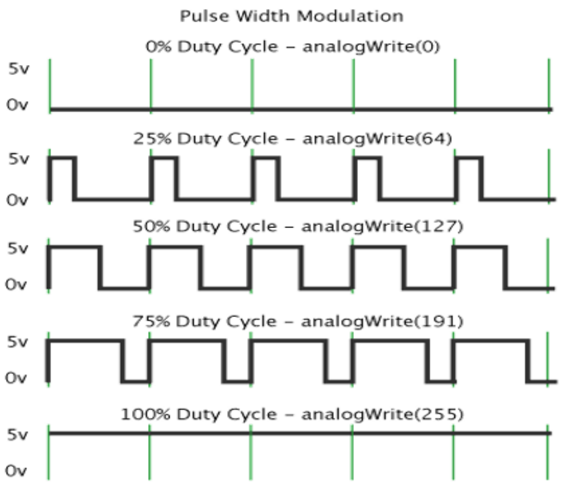

Fig 5.1 Pulse Width Modulation

5.1 Temperature vs Speed

Sl No	Temperature	Speed
1.	30	0 % RPM
2.	30.5	0 % RPM
3.	31	0 % RPM
4.	31.5	0 % RPM
5.	32	50 % RPM
6.	32.5	50 % RPM
7.	33	50 % RPM
8.	33.5	50 % RPM
9.	34	50 % RPM
10.	34.5	50 % RPM
11.	35	100 % RPM
12.	35.5	100 % RPM
13.	36	100 % RPM
14.	36.5	100 % RPM
15.	37	100 % RPM

6. ADVANTAGES

Temperature-controlled fans offer several advantages, making them valuable in various applications:

- **Energy Efficiency:** As it works on feedback system so it controls the fan speed with respect to feedback so it doesn't have to run all time or at full speed. That way energy is saved.

- **Optimized Cooling:** Automatic temperature-controlled fans are set to be operates with the specific condition of that area. As it changes its speed according to ambient temperature, they can prevent overheating or overcooling (EV batteries), ensuring that equipment and systems operate within safe temperature ranges with optimizing efficiency.

- **Extended Lifespan:** As the frequency of full speed running of the fan is low so the life span is long.

- **Improved Comfort:** The fan speed is controlled by ambient temperature so it regulates the room temperature by controlling fan speed to maintain comfort in residential usage as well as commercial usage (offices).

- **Environmental Benefits:** By reducing energy consumption carbon footprints reduced, automatic temperature-controlled fan helps to maintain the cleanness of environment that way.

- **Remote Monitoring and Control:** Many automatic speed-controlled fan offers users to use it remotely/wirelessly for speed control, changing setpoint value from computers or smart phones.

- **Enhanced Safety:** Adopting automatic speed-controlled fan will reduces the mechanical stress due to overheating and avoids fire hazardous.

7. LIMITATIONS

Thermostatic fans are widely used in various applications to control temperature through airflow. However, like all technology, there are limitations.

- **Limited Temperature Range:** Fans usually operate within a defined temperature range. If the ambient temperature is above or below this range, the fan may not work properly. Therefore, the ambient temperature must be constantly updated by encoding, which complicates the process.

- **Response Time:** Depending on the technology used, the response time may vary. Long response times prevent on-demand performance in areas with large temperature fluctuations. Therefore, an update was necessary to be able to use it in places where the temperature changes.

- **Accuracy:** The temperature sensors used in temperature controlled ventilators vary in accuracy. Small errors in temperature readings can lead to fan speed control errors, resulting in under- or over-cooling.

- **Dependence on Environmental Conditions:** The speed of the fans is adjusted according to the surrounding temperature. Things like airflow obstructions and nearby heat sources can affect the fit and require readjustment.

- **Engine Wear:** Regular use and quick changes can cause engine wear. Therefore, it must be taken care of regularly to keep it working properly.

- **Installation and Maintenance Complexity:** Deploying high-speed controllers requires additional wiring, sensors, and control systems (microcontrollers). Regular adjustments and troubleshooting are required to ensure proper operation. Therefore, you may want to hire more skilled workers.

- **Compatibility in Certain Environments:** Cool fans may not be suitable for very hot, dusty or humid environments. These conditions can reduce the performance and life of the touch system.

- **Cost:** Thermostatic fans are more expensive to purchase and install than traditional fans that do not have a thermostatic component. Due to the higher initial cost than traditional fans, some users may not like them, especially for budget applications.

8. UTILIZATION

Numerous uses for thermostatic fans exist in various fields; a few of these are covered here.

- **Living Space Cooling:** You can control the temperature inside your house with "Heat Panels.

- **"Office Environment:** The office can be kept at room temperature. It boosts worker productivity and keeps the workplace atmosphere positive.

- **Server Room Heating:** To avoid overheating and damage to the server equipment, a server room's primary goals are to keep the temperature constant and operate as efficiently as possible.

- "Thermal pads" aid in regulating the server room's temperature.

- **Manage The Greenhouse's Climate:** Maintaining a proper temperature and promoting better plant growth in the greenhouse requires careful temperature control. You can keep your plants at the ideal temperature with the aid of thermostatic fans.

- **Industrial Heat:** In settings that are industrial, machinery and other equipment, this system can be used to protect these machinery from severe heat. Sudden surge of temperature can also be controlled by this.

9. CONCLUSION

This project has presented a unique vision of the concepts which are used in this particular field. The result shows that higher efficiency is indeed achieved using the surrounded system. With a common digitalized platform, these latest instruments will enable increased flexibility in control, operation, and expansion; allow for entrenched intelligence, essentially foster the resilience of the instruments; and eventually benefit the customers with improved services, reliability and increased convenience. This project presents the major features and functions of the various concepts that could be used in this field in detail through various categories. Since this initial work cannot address everything within the proposed framework and vision, more research and development efforts are needed to fully implement the proposed framework through a joint effort of various entities.

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