IOT TEMPERATURE BASED FAN SPEED CONTROL AND MONITORING SYSTEM

CONTENTS

INTRODUCTION

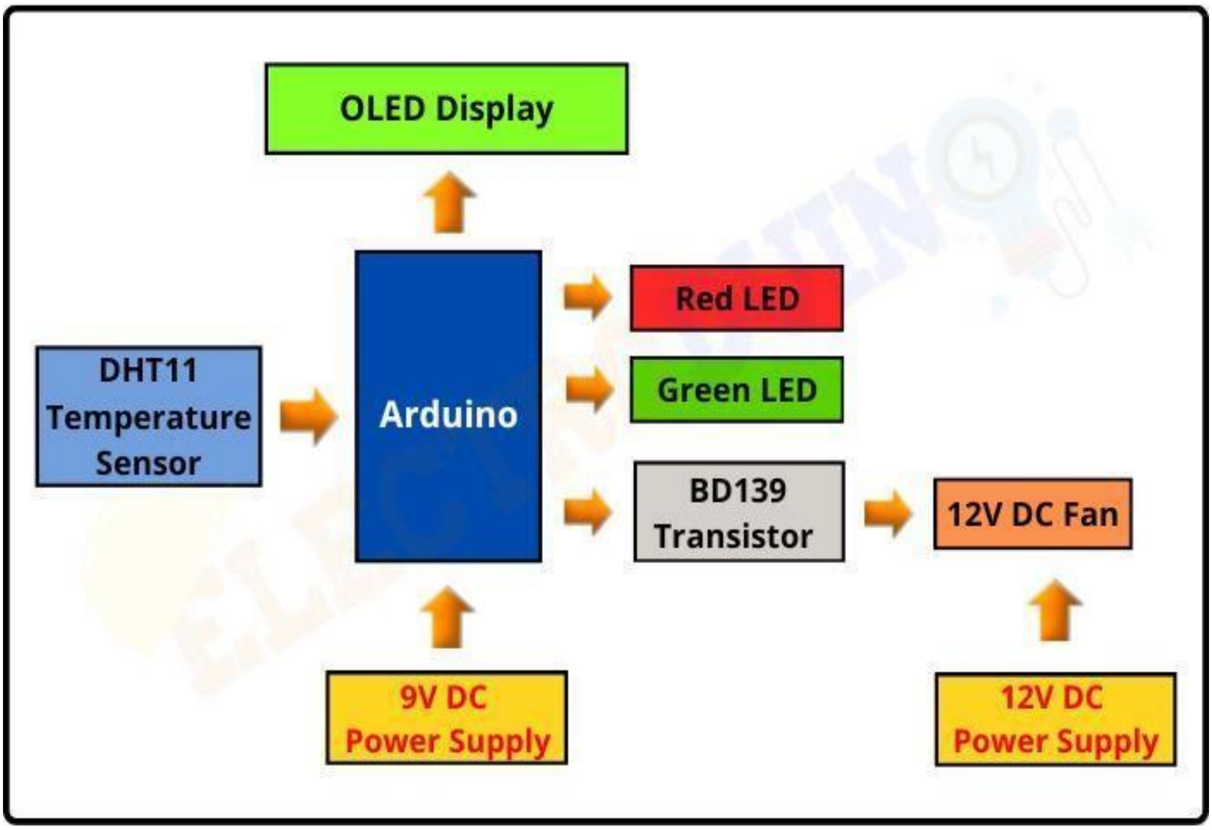
With the rapid advancement of technology, our homes have embraced full automation, leading to a significant increase in our daily electricity consumption. Among the various benefits, the regular use of fans stands out as a means of ensuring comfort, particularly during hot weather. Consequently, it becomes our responsibility to establish a reliable system that promotes efficient electricity usage. This article outlines the procedure and functionality of an ESP32-based Temperature Based Automatic Ceiling Fan system. The core components of this system include the ESP32 microcontroller and a dimmer. The ESP32 microcontroller offers built-in Wi-Fi capabilities, allowing seamless data transmission to the cloud. By leveraging these features, we can create a standalone automatic fan controller that adjusts the fan's speed based on the prevailing room temperature. The proposed system operates by measuring the room temperature using a sensor, such as the DHT11, and transmitting the collected data to the microcontroller. The microcontroller then regulates the fan's speed according to the temperature reading. This project serves as a demonstration of how to implement temperature-based fan speed control and monitoring using the DHT11 sensor, ESP32 microcontroller, and dimmer.

By incorporating these components, the microcontroller facilitates efficient operation by dynamically adjusting the fan's speed to meet specific requirements. The dimmer module comprises various components such as capacitors, TRIACs, diodes, and registers. These elements work together to control the power supplied to the fan, thus regulating its speed. Additionally, the inclusion of an OLED screen enhances the user-friendliness of the project by providing real-time displays of the fan speed and temperature at regular intervals.

ABSTRACT

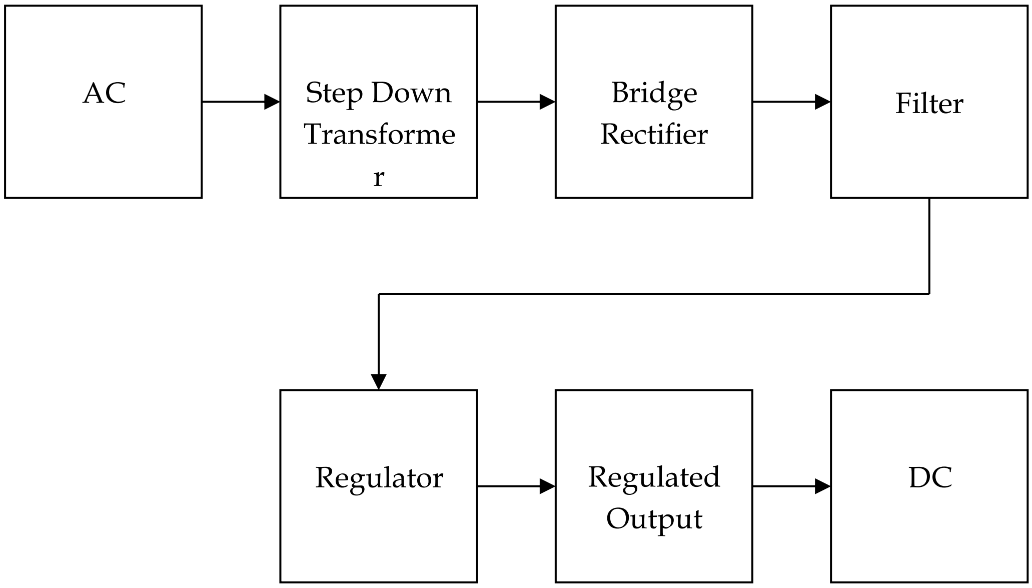
In this project, we will make Temperature Based Fan Speed Control & Monitoring System using ESP32 WiFi Module & observe the data on IoT THINK SPEAK.The fan speed increases based on the increase in temperature. The THINK SPEAK.App will show the current temperature & Fan speed in percentage. Using the THINK SPEAK.we can also set the threshold value at what temperature the fan should turn ON.To sense the room temperature, we will use a DHT11 Temperature Sensor. For the fan part, a 12V fan is perfect for this application as it is easy to control the speed with the PWM signal.The16×2OLED Display will display the instantaneous temperature and fan speed as well.

BLOCK DIAGRAM



POWER SUPPLY

Block Diagram for Power Supply:



A **power supply** is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that they power. Examples of the latter include power supplies found in desktop computers and consumer electronics devices. Other functions that power supplies may perform include limiting the current drawn by the load to safe levels, shutting off the current in the event of an electrical fault, power conditioning to prevent electronic noise or voltage surges on the input from reaching the load, power-factor correction, and storing energy so it can continue to power the load in the event of a temporary interruption in the source power (uninterruptible power supply).

All power supplies have a power input connection, which receives energy in the form of electric current from a source, and one or more power output connections that deliver current to the load. The source power may come from the electric power grid, such as an electrical outlet, energy storage devices such as batteries or fuel cells, generators or alternators, solar power converters, or another power supply. The input and output are usually hardwired circuit connections, though some power supplies employ wireless energy transfer to power their loads without wired connections. Some power supplies have other types of inputs and outputs as well, for functions such as external monitoring and control.

Block Diagram Description for Power Supply:

Definitions:

It is an electronics unit which is used to give regulated power to any electronics system.

Block Diagram Description:

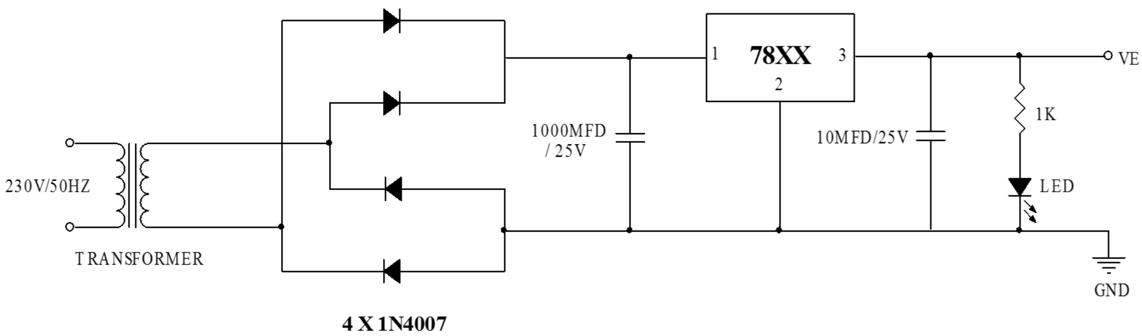
1. Transformer **:** This block consists of step – down transformer for our required ratings.

2. Rectifier **:** This block consists of diode – based rectifier circuit.

3. Filter Circuit **:** This block consists of capacitor – based filter circuit.

4. Regulator **:** This block consists of +Ve (and) –Ve three terminal regulators.

POWER SUPPLY CIRCUIT



Power Supply:

The signal end regulator power supplies have the following section.

1. Transformer
2. Rectifier
3. Filter
4. Regulator
5. Indicator

The ordinary low power E & I core transformer is used to get required voltage. It is basically step down transformer, which reduce the voltage from mains supply depending upon the output voltage. The rectifier sections convert AC into DC. The rectifier is designed using four 1N 4007 diode. It is a bridge type rectifier, which give full cycle conduction output. The capacitor based filter section smooth the rip OLED DC and makes it as pure DC. The smoothing level is increased by increasing filter capacitor value. The regulator block is designed using 78 XX series.

The regulator is selected to get constant voltage at output side. We can give input voltage up to 30V. The OLED indicates circuit is on live. This circuit arrangement gives constant voltage output.

Power Supply Design Concept:

Transformer Selection:

Voltage Rating = DC output voltage +5V

Current Rating = required current +1/2 required current.

Type:

Ordinary Transformer = Half wave & Bridge rectifier

Control Tape Transformer = Full wave rectifier.

Example:

For +5v @ 1A RPS

Transformer Voltage Rating

Voltage = 5V + 5V = 10V

Transformer Current Rating

Current = 1A + 0.5A = 1.5A

Type:

Ordinary Transformer = 0-10v @ 1.5A

Center Tapped Transformer = 10 – 0 – 10V@ 1.5A

Practical Selection of Transformer:

0 -9V @ 2A

(Or)

9V-0-9V @ 2A

Diode Selection for Rectifier (Based on Load Current):

1N 4007 - 1A

1N 5408 - 2A

6A 4 Mic - 3A

Capacitor Selection for Filter:

Voltage Rating = Transformer secondary voltage X 2.

Capacitance = Load Current / Ripple Frequency x Ripple Voltage.

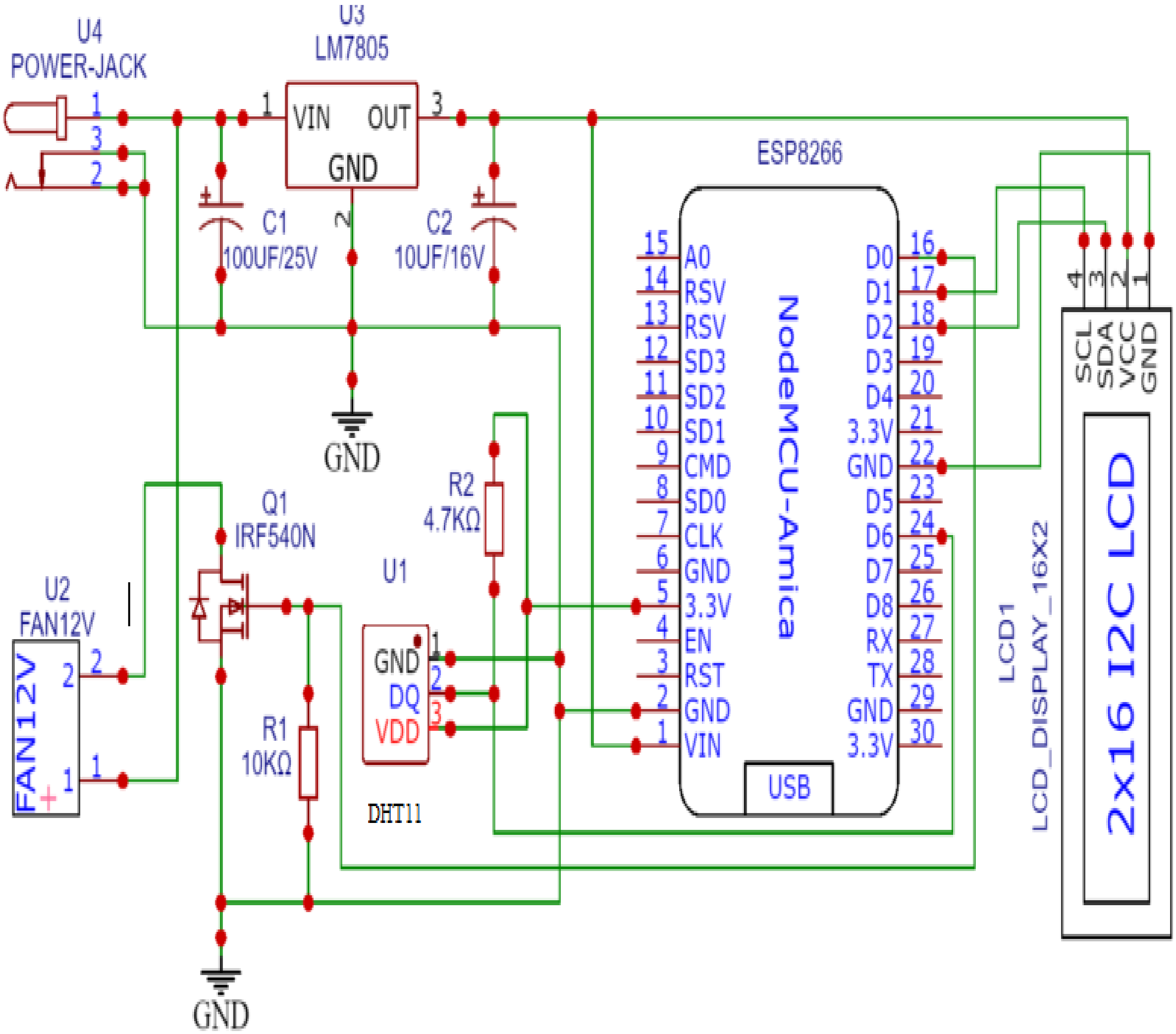
Regulator Selection:

Positive three terminal voltage regulator 78XX series for Positive voltage output. The XX to indicate voltage level the 79XX series for negative voltage output.

OLED Circuit for Indication:

Series resistor for OLED circuit = Source Voltage - OLED Voltage / OLED Current.

Schematic diagram:



WORKING PRINCIPLE

The entire circuit can be powered by a 12V DC power supply. Actually, the DC Fan only requires 12V for operations. The rest of the components takes 5V as input from the 7805 Voltage regulator IC. The DS18B20 Waterproof temperature sensor is connected to the D6 pin of Nodemcu ESP32. The DS18B20 VCC & GND is connected to 3.3V & GND of NodeMCU. The output pin of DS18B20 is pulOLED high with a 4.7K resistor.

For displaying temperature and Fan Speed, we are using a 16×2 I2C OLED Display. Connect the VCC, GND, SDA & SCL pins of the OLED Display to 5V, GND, D2 & D1 of NodeMCU ESP32.

The digital pin of NodeMCU is not capable of controlling the 12V fan alone. Therefore we are using an IRF540 Mosfet to control a fan. This output of the NodeMCU pin D0 goes to the Gate terminal of the IRF540 Mosfet. This Mosfet work as an Amplifier, which can control a large amount of voltage by applying a small amount of voltage at the Gate Terminal.

COMPONENT DETAILS:

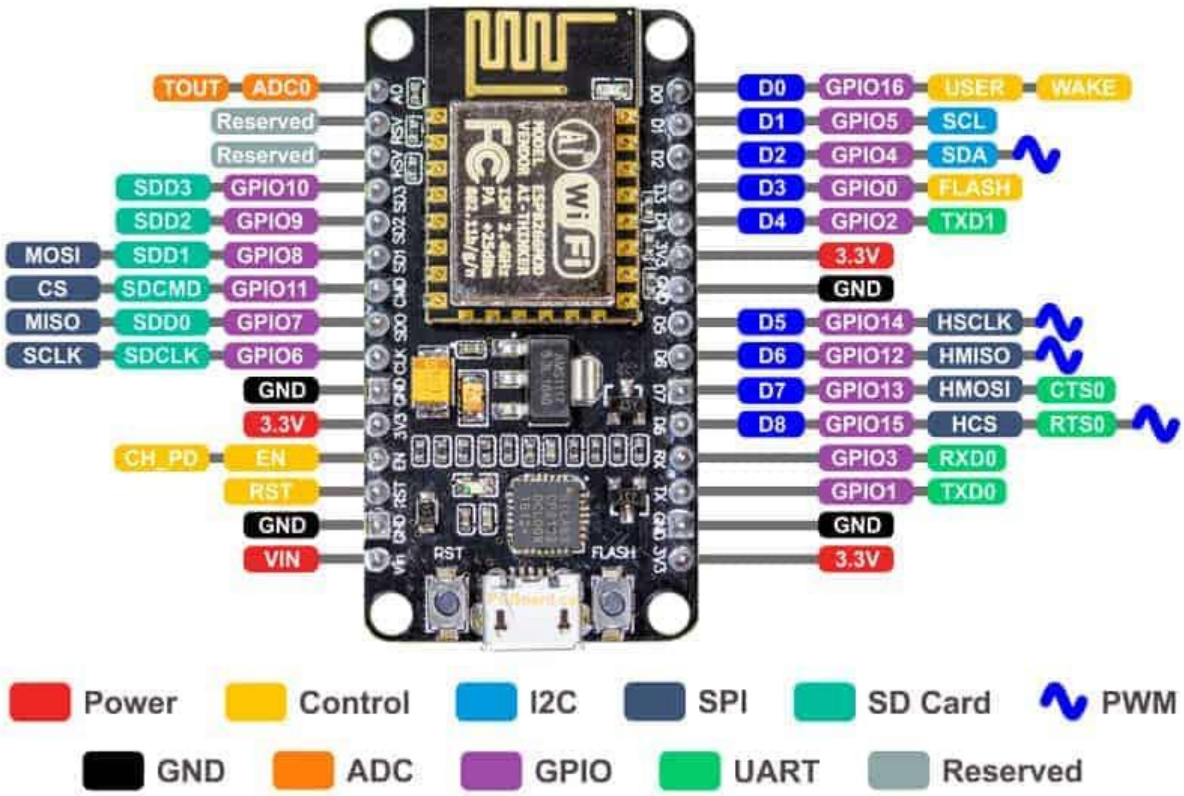
NodeMCU:

The NodeMCU (***N***ode ***M***icro***C***ontroller ***U***nit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) calOLED the ESP32. The ESP32, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.

However, as a chip, the ESP32 is also hard to access and use. You must solder wires, with the appropriate analog voltage, to its pins for the simplest tasks such as powering it on or sending a keystroke to the "computer" on the chip. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP32 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

But, what about Arduino? The Arduino project created an open-source hardware design and software SDK for their versatile IoT controller. Similar to NodeMCU, the Arduino hardware is a microcontroller board with a USB connector, OLED lights, and standard data pins. It also defines standard interfaces to interact with sensors or other boards. But unlike NodeMCU, the Arduino board can have different types of CPU chips (typically an ARM or Intel x86 chip) with memory chips, and a variety of programming environments. There is an Arduino reference design for the ESP32 chip as well. However, the flexibility of Arduino also means significant variations across different vendors. For example, most Arduino boards do not have WiFi capabilities, and some even have a serial data port instead of a USB port.

NodeMCU Pinout and Functions Explained



- Power Pins There are four power pins. **VIN** pin and three **3.3V** pins.
- **VIN** can be used to directly supply the NodeMCU/ESP32 and its peripherals. Power delivered on **VIN** is regulated through the onboard regulator on the NodeMCU module – you can also supply 5V regulated to the **VIN** pin
- **3.3V** pins are the output of the onboard voltage regulator and can be used to supply power to external components.

- GND are the ground pins of NodeMCU/ESP32

- I2C Pins are used to connect I2C sensors and peripherals. Both I2C Master and I2C Slave are supported. I2C interface functionality can be realized programmatically, and the clock frequency is 100 kHz at a maximum. It should be noted that I2C clock frequency should be higher than the slowest clock frequency of the slave device.

- GPIO Pins NodeMCU/ESP32 has 17 GPIO pins which can be assigned to functions such as I2C, I2S, UART, PWM, IR Remote Control, OLED Light and Button programmatically. Each digital enabOLED GPIO can be configured to internal pull-up or pull-down, or set to high impedance. When configured as an input, it can also be set to edge-trigger or level-trigger to generate CPU interrupts.

- ADC Channel The NodeMCU is embedded with a 10-bit precision SAR ADC. The two functions can be implemented using ADC. Testing power supply voltage of VDD3P3 pin and testing input voltage of TOUT pin. However, they cannot be implemented at the same time.

- UART Pins NodeMCU/ESP32 has 2 UART interfaces (UART0 and UART1) which provide asynchronous communication (RS232 and RS485), and can communicate at up to 4.5 Mbps. UART0 (TXD0, RXD0, RST0 & CTS0 pins) can be used for communication. However, UART1 (TXD1 pin) features only data transmit signal so, it is usually used for printing log.

- SPI Pins NodeMCU/ESP32 features two SPIs (SPI and HSPI) in slave and master modes. These SPIs also support the following general-purpose SPI features:
- 4 timing modes of the SPI format transfer
- Up to 80 MHz and the divided clocks of 80 MHz
- Up to 64-Byte FIFO

- SDIO Pins NodeMCU/ESP32 features Secure Digital Input/Output Interface (SDIO) which is used to directly interface SD cards. 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are supported.

- PWM Pins The board has 4 channels of Pulse Width Modulation (PWM). The PWM output can be implemented programmatically and used for driving digital motors and OLEDs. PWM frequency range is adjustable from 1000 μs to 10000 μs (100 Hz and 1 kHz).

- Control Pins are used to control the NodeMCU/ESP32. These pins include Chip Enable pin (EN), Reset pin (RST) and WAKE pin.
- **EN:** The ESP32 chip is enabOLED when EN pin is pulOLED HIGH. When pulOLED LOW the chip works at minimum power.
- **RST:** RST pin is used to reset the ESP32 chip.
- **WAKE:** Wake pin is used to wake the chip from deep-sleep.

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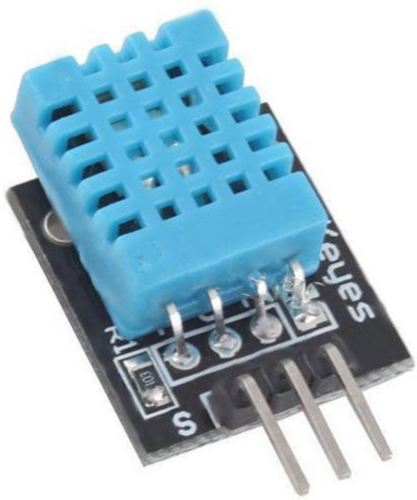
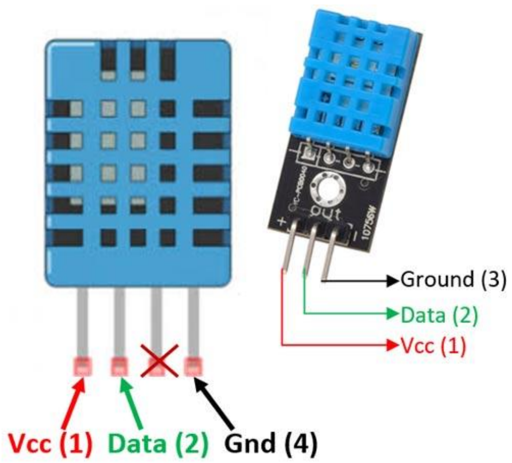
DHT11–Temperature and Humidity Sensor:





DHT11–Temperature and Humidity Sensor

DHT11 Sensor Pinout

The **DHT11** is a commonly used **Temperature and humidity sensor that** comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data.

DHT11 Pinout Configuration

No:	**Pin Name**	**Description**
For DHT11 Sensor		
1	Vcc	Power supply 3.5V to 5.5V
2	Data	Outputs both Temperature and Humidity through serial Data
3	NC	No Connection and hence not used
4	Ground	Connected to the ground of the circuit
For DHT11 Sensor module		
1	Vcc	Power supply 3.5V to 5.5V
2	Data	Outputs both Temperature and Humidity through serial Data
3	Ground	Connected to the ground of the circuit

You can buy DHT11 sensor module from here.

DHT11 Specifications

- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: 0°C to 50°C
- Humidity Range: 20% to 90%
- Resolution: Temperature and Humidity both are 16-bit
- Accuracy: ±1°C and ±1%

BILL OF MATERIAL

POWER SUPPLY CIRCUIT

S.No	Materials	Qty	Rate
1	Transformer (0-9V)	1	75.00
2	Diode 1N 4007	4	8.00
3	Capacitor 1000Mfd/25v	1	10.00
4	Polyester Capacitor 0.1Mfd	1	5.00
5	Capacitor 10Mfd/25v	1	5.00
6	OLED	1	2.00
7	PCB	1	150.00
Total			**255.00**

MAIN CIRCUIT

S.No	Materials	Qty	Rate
1	Node mcu ESP32	1	2000.00
2	Dht11 temperature sensor	1	1000.00
3	Fan driver board	1	500.00
4	Micro switch	1	200.00
5	fan	2	100.00
6	model	1	50.00
7	OLED	1	300.00
8.	Key board	1	100.00
9	Mains card	1	100.00
TOTAL			**4250.00**

S.No	Materials	Qty	Rate
1	Power supply		255.00
2	Main circuit		4250.00
3	Miscellaneous		1300.00
4	Net total		5805.00

ADVANTAGES

- To watch the environments that is not comfortable, or possible, for humans to monitor, especially for extended periods of time.
- Prevents waste of energy when it’s not hot enough for a fan to be needed.
- To assist people who are disabOLED to adjust the fan speed automatically.
- In future case we can monitor more parameters like humidity, light and at the same time control them and also can send this data to a remote location using mobile or internet.
- Using this technology we can able to draw graphs of variations in these parameters using computer. And the temperature exceeds the limit; a call will be diaOLED to the respective given number by an automatic Dialer system.

DISADVANTAGES

1) Unreliable performance due to sensor quality.

2) Higher technical complexity, more maintenance is required.

APPLICATIONS

- Normally we use the regulator to change the speed of the fan. Here the room temperature changes the speed varies so that according to the temperature the fan rotates.
- The fan designed in this project, has the more scope to use in the Middle East countries. This product is more suitable for the hot regions.

CONCLUSIONS

Traditionally the manual switching is a way long method to control the fan speed. So we proposed this to overcome the drawbacks. With this project you can control the speed of the fan from automatically and displays the speed to the user. This paper is effectively experimented & implemented for automation Smachine is cost effective, reliable, versatile and easy to use.

BIOGRAPHY

[1] Automatic Room Temperature ControlOLED Fan Speed Controller Using PT-100 [August 2015].

[2] Fan Speed Control with Temperature Change Using ArduinoRani, M Jamuna; Vadivu, M Senthil; Surya, K; Krishna,

[3] Shivshankar Adsule1 , Shivani Mohite2 , Rahul Patil3 , Prof. Namrata R. Dhawas4 :

[4] Siddharth Remane1, Radhika Sutar2, Pranav Joshi3, Digambar Patil4, Yogesh Naik5: AUTOMATIC LIGHT SWITCHING AND TEMPERATURE BASED FAN SPEED CONTROL USING MICROWAVE, TEMPERATURE AND LDR SENSOR; International Research Journal of Engineering and Technology (IRJET) Volume: 08 Issue: 05 | May 2021, e-ISSN: 2395-0056, p-ISSN: 2395-0072.

[5] Benjamin Kommey 1, John Kwame Dunyo1, Bright Yeboah Akowuah1, Elvis Tamakloe2 : Automatic Ceiling Fan Control Using Temperature and Room Occupancy; JITCE (Journal of Information Technology and Computer Engineering) JITCE - VOL. 06 NO. 01 (2022) 1-7 . ISSN (Online) 2599-1663

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