CO326 Project - Group 5

Smart Cooling System for a Machinery Room

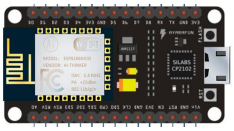
INTRODUCTION

The aim of this project is to design a cooling system which is automatically controlled according to the temperature of a particular room. This system is useful, especially in the cooling of machinery which generates a lot of heat during operation. This heat can be caused to damage the machinery and reduce its lifetime.

The system uses temperature sensors to measure the temperature of the machinery, and the microcontroller could control the speed of the cooling fans based on the temperature data received. It also includes an alert system to notify if the temperature exceeds safe limits.

MICROCONTROLLER, SENSORS & ACTUATORS

Microcontroller - NodeMCU ESP8266 - CP2102



- Built-in WiFi connectivity
- One-wire protocol support
- Low current consumption: 15 µA and 400 mA
- Open-source hardware and software
- Safe operating voltage: 3.3 V

Sensors

DS18B20 Temperature sensor

- DS18B20 has an accuracy of ±0.5°C
- It uses the OneWire protocol
- It can measure temperatures ranging from -55°C to +125°C
- The digital sensor is easy to use and can be interfaced with most microcontrollers, including the ESP8266 NodeMCU
- Waterproof
- Conversion time: 750ms at 12-bit
- A 4.7k pull-up resistor should be added
- Safe operating voltage : 3 V - 5 V

Actuators

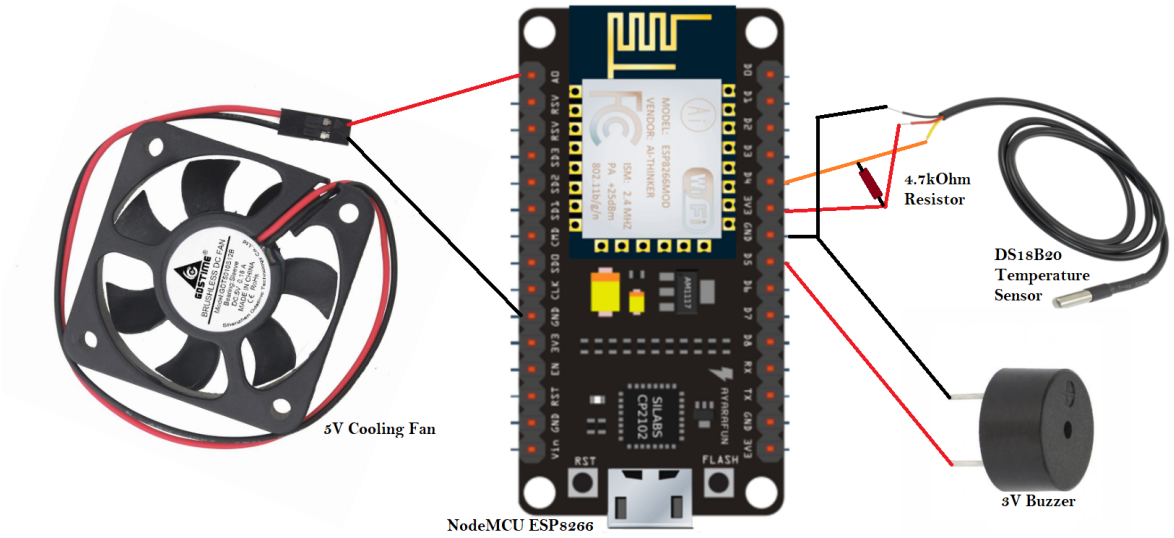
5V cooling fan

- Safe operating voltage: below 5 V

Buzzer

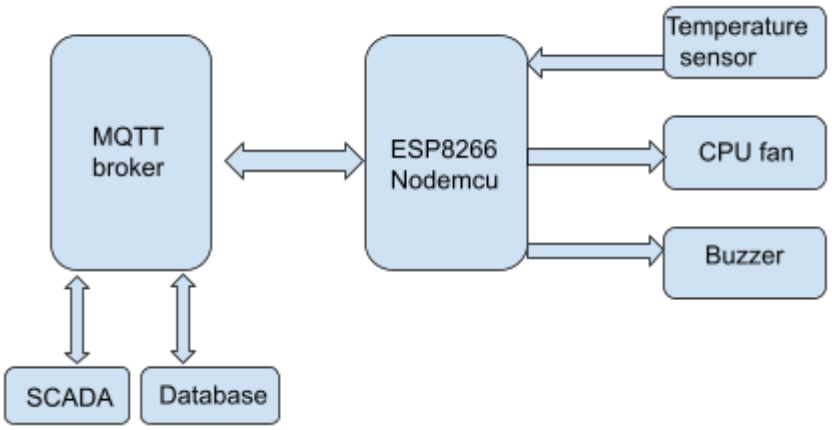
- Safe operating voltage: below 5 V

CIRCUIT DIAGRAM



The operating voltage of DS18B20 is 3-5V. The Buzzer and Cooling fan can manage a maximum 5V input voltage. NodeMCU supplies 5V through its VCC. So, it doesn't harm any of the components. So, it is safe to connect these components with NodeMCU in terms of voltage.
The current rating of the CPU fan is 0.2A~.
The current rating of the buzzer is ≤30mA.
The current rating of the DS18B20 is 1-2mA.
The current rating of the NodeMCU is 15 μA and 400 mA
So, the total current draw is <350mA.
Here, a USB cable is used to power up the NodeMCU and it usually supplies a maximum current of 500mA. Usually, the current consumption of the microcontroller is no more than 400mA. So, ideal conditions are satisfied to operate the components safely in terms of current too.

PROCESS



- The temperature of the machinery area is measured using DS18B20 temperature and those data are sent to the microcontroller(ESP8266 Nodemcu) using the Onewire protocol. It uses a single control signal to implement bus communication.
- After collecting the temperature data, the microcontroller time stamps them accurately to 1 ms before sending it to the MQTT broker.(mosquitto broker)
- The temperature data is sent under a specific topic (UoP/CO/326_E18/GrNo/Sensor or Actuator/Data or Parameter/Name). The MQTT Broker time stamps the data at the time of receiving.
- The same microcontroller, SCADA and database servers can listen to the topic and receive the temperature data in real-time.
- The same microcontroller also controls the speed of the cooling fan based on the temperature data received. This is achieved by writing corresponding values to the analog pin that the CPU fan is connected to.
- If the temperature has exceeded the safe limit, the buzzer will produce an alert sound to notify the user. The buzzer should be connected to a GPIO pin on Nodemcu
- The SCADA system (NodeRed), aka Supervisory Control and Data Acquisition, uses its interface to show the temperature data graphically.
- The database server (MySQL) stores all the received temperature data, along with timestamps and source information.

APPROXIMATED COST

Item	Qty	Unit Price (LKR)	Total
ESP8266 Nodemcu CP2102	1	1890.00	1890.00
DS18B20	1	350.00	350.00
CPU fan 5V	1	300.00	300.00
Buzzer	1	60.00	60.00
Total			2600.00

REFERENCES

Nodemcu:

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DS18B20:

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5. https://www.analog.com/media/en/technical-documentation/data-sheets/ds18b20.pdf

CPU fan

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2. https://www.farnell.com/datasheets/2171929.pdf

One wire protocol

1. https://docs.arduino.cc/learn/communication/one-wire

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