TASK-1: TEMPERATURE MONITORING SYSTEM FOR AN INDUSTRY CONSISTING OF STEAM BOILERS

LIST OF COMPONENTS & THEIR FUNCTIONS:

1. Temperature Sensors

- **Type**: Thermocouples, RTDs (Resistance Temperature Detectors), or Thermistors.
- **Functionality**: Measure the temperature of the steam boiler.
- **Working**:
  - **Thermocouples**: Generate a voltage proportional to temperature differences between two different metals.
  - **RTDs**: Change resistance with temperature, typically using platinum (Pt100).
  - **Thermistors**: Change resistance with temperature, typically more sensitive than RTDs but with a non-linear response.

2. Microcontroller or Microprocessor

- **Type**: Arduino, NodeMCU, ESP32, Raspberry Pi.
- **Functionality**: Process the signals from the temperature sensors, perform calculations, and control other components.
- **Working**: Reads analog or digital signals from sensors, processes data, and communicates with other components or a central system.

3. Analog-to-Digital Converter

- **Type**: Built-in ADC in microcontroller or external ADC (e.g., MCP3008).
- **Functionality**: Convert analog signals from sensors to digital data for processing.
- **Working**: Converts continuous analog voltage from the sensor to discrete digital values that the microcontroller can read.

4. Display Unit

- **Type**: LCD, OLED, or LED display.
- **Functionality**: Display the temperature readings.
- **Working**: Receives data from the microcontroller and visually presents the temperature.

5. Communication Module

- **Type**: Wi-Fi (ESP8266, ESP32), Bluetooth (HC-05), Zigbee, or GSM module.
- **Functionality**: Transmit temperature data to a remote server or cloud.
- **Working**: Connects to a network or device to send and receive data, enabling remote monitoring and logging.

6. Power Supply

- **Type**: Battery, mains power supply, or power adapter.
- **Functionality**: Provide necessary power to the system.
- **Working**: Supplies stable voltage and current to all components.

7. Data Logger (Optional)

- **Type**: SD card module, EEPROM.
- **Functionality**: Store temperature data locally.
- **Working**: Records data from the microcontroller to memory for future analysis.

8. Enclosure

- **Type**: Waterproof, heat-resistant casing.
- **Functionality**: Protect components from environmental factors.
- **Working**: Ensures durability and longevity of the system by shielding it from moisture, dust, and heat.

9. Alarm System (Optional)

- **Type**: Buzzer, LED indicators, or alarm siren.

- **Functionality**: Alert operators if the temperature exceeds safe limits.
- **Working**: Activates when the microcontroller detects a temperature outside the predefined range.

10. Cooling System (Optional)

- **Type**: Fans, heat sinks.
- **Functionality**: Prevents overheating of electronic components.
- **Working**: Activates when temperatures exceed safe operating limits to cool down the system.

11. Software Components

- **Microcontroller Firmware**: Code to read sensor data, process it, and control other components.
- **Cloud/Server Application**: For remote data logging, visualization, and alerts.
- **Mobile/Web Application**: User interface for monitoring and controlling the system remotely.

Workflow Overview:

1. **Sensor Measurement**: Sensors measure the temperature of the steam boiler.
2. **Signal Conversion**: ADC converts analog sensor signals to digital.
3. **Data Processing**: Microcontroller processes the digital data.
4. **Data Display**: Processed data is displayed on the local display unit.
5. **Data Transmission**: Communication module sends data to a remote server or cloud.
6. **Remote Monitoring**: Data is accessible via a mobile/web application.
7. **Alerts/Actions**: Alarm system triggers if temperature exceeds safe limits.
8. **Data Logging**: Optionally, data is logged locally or on the cloud for analysis.

APPROXIMATE PRICES:

1. Temperature Sensors

- **Thermocouple (Type K)**: ₹200 - ₹500
- **RTD (Pt100)**: ₹300 - ₹700
- **Thermistor**: ₹50 - ₹200

2. Microcontroller or Microprocessor

- **Arduino Uno**: ₹500 - ₹700
- **NodeMCU (ESP8266)**: ₹300 - ₹400
- **ESP32**: ₹500 - ₹600
- **Raspberry Pi 4**: ₹3,500 - ₹4,000

3. Analog-to-Digital Converter (ADC)

- **MCP3008 (8-channel ADC)**: ₹200 - ₹300

4. Display Unit

- **16x2 LCD**: ₹200 - ₹300
- **OLED Display (0.96 inch)**: ₹300 - ₹500
- **7-Segment LED Display**: ₹50 - ₹150

5. Communication Module

- **ESP8266 Wi-Fi Module**: ₹200 - ₹300
- **HC-05 Bluetooth Module**: ₹300 - ₹400
- **Zigbee Module**: ₹800 - ₹1,200
- **GSM Module (SIM800L)**: ₹500 - ₹700

6. Power Supply

- **Battery Pack (9V)**: ₹50 - ₹100
- **Power Adapter (5V 2A)**: ₹200 - ₹300

7. Data Logger (Optional)

- o **SD Card Module**: ₹150 - ₹250
- o **EEPROM Module**: ₹100 - ₹200

8. **Enclosure**

- o **Plastic Enclosure**: ₹200 - ₹500
- o **Metal Enclosure**: ₹500 - ₹1,000

9. **Alarm System (Optional)**

- o **Buzzer**: ₹20 - ₹50
- o **LED Indicators**: ₹10 - ₹20 each
- o **Alarm Siren**: ₹200 - ₹500

10. **Cooling System (Optional)**

- o **Fans**: ₹100 - ₹300
- o **Heat Sinks**: ₹50 - ₹150

11. **Miscellaneous**

- o **Wires, Connectors, and Breadboards**: ₹100 - ₹300
- o **Resistors, Capacitors, and other passive components**: ₹50 - ₹200

Approximate Total Cost (Basic Setup):

- Using Arduino Uno, Thermocouple, 16x2 LCD, and Wi-Fi Module: ₹2,000 - ₹3,000
- Using ESP32, RTD, OLED Display, and GSM Module: ₹3,500 - ₹5,000