Micro Project Proposal

Weather Monitoring System using ESP8266 NodeMCU

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Semester & Branch: S3 ER
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Introduction

The proposed project aims to design and implement a compact IoT node for **Weather Monitoring**. The ESP8266 NodeMCU microcontroller board will be used to sense environmental parameters such as **temperature, humidity, pressure**, and **light** using digital and analog sensors. The sensed data will be processed by the NodeMCU and transmitted via WiFi to a local web dashboard. Such a system is cost-effective, portable, and demonstrates feasibility for smart city and environmental IoT applications.

Functional Block Diagram

Explanation: The functional block diagram illustrates the flow of data and power within the Weather Monitoring System. The key components are described below:

- **DHT22 (Temperature & Humidity Sensor):** Senses ambient temperature and humidity. Connected digitally to the NodeMCU via a single data pin. Requires a 10k pull-up resistor.
- **BMP280 (Pressure Sensor):** Measures atmospheric pressure. Communicates with the NodeMCU using the I2C protocol (SDA and SCL lines).
- **LDR (Light Dependent Resistor):** Detects light intensity. Connected to the analog input (A0) of the NodeMCU through a voltage divider circuit.
- **ESP8266 NodeMCU:** Central microcontroller that collects sensor data, processes it, and sends it wirelessly to a web dashboard via WiFi.
- **WiFi Dashboard / Browser:** Displays real-time sensor readings. Data is hosted by the NodeMCU on a local web server accessible through its IP address.
- **Power Supply (USB / 3.3V):** Provides power to the NodeMCU. The onboard voltage regulator ensures that connected sensors receive a stable 3.3V supply.

Functional Block Diagram

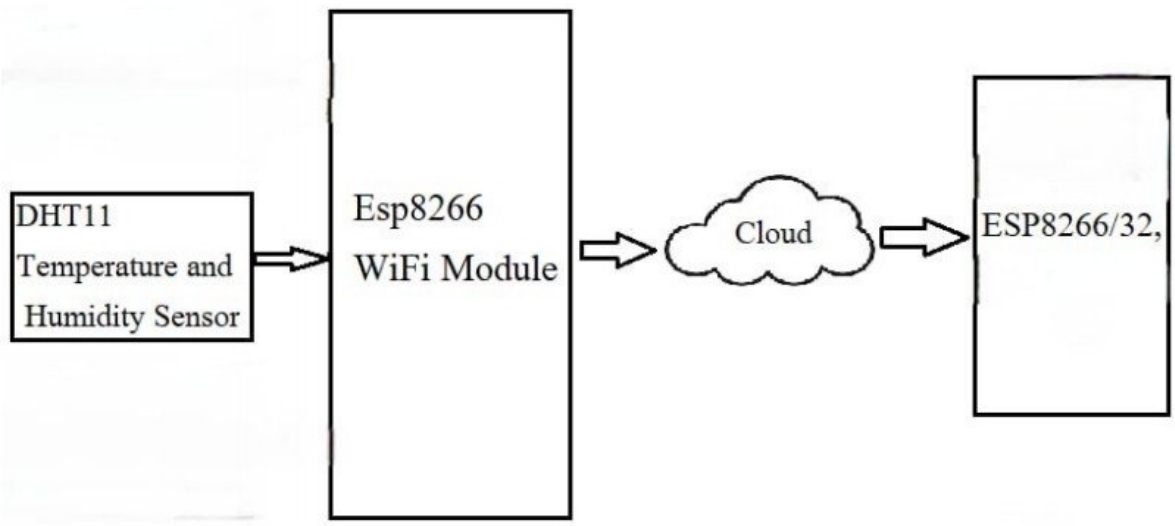

Figure 1: Functional Block Diagram of the Weather Monitoring System

Explanation: The above image shows the interconnection between the components of the Weather Monitoring System:

- **ESP8266 NodeMCU:** Acts as the central controller. It reads data from sensors and transmits it via WiFi.
- **DHT22 Sensor:** Measures temperature and humidity and sends digital data to the NodeMCU.
- **BMP280 Sensor:** Measures atmospheric pressure and communicates with NodeMCU via I2C protocol.
- **LDR (Light Dependent Resistor):** Detects light intensity and gives analog data to the NodeMCU through the A0 pin.
- **Power Supply:** The NodeMCU is powered via USB (5V), which internally regulates to 3.3V for sensors.
- **WiFi Dashboard:** Displays the real-time sensor data on a local web page hosted by the NodeMCU.

Explanation: Each sensor module is connected to the ESP8266 NodeMCU, which processes and transmits data via WiFi. Images help visually represent components. Power is provided via USB or regulated 3.3V.

Circuit Diagram

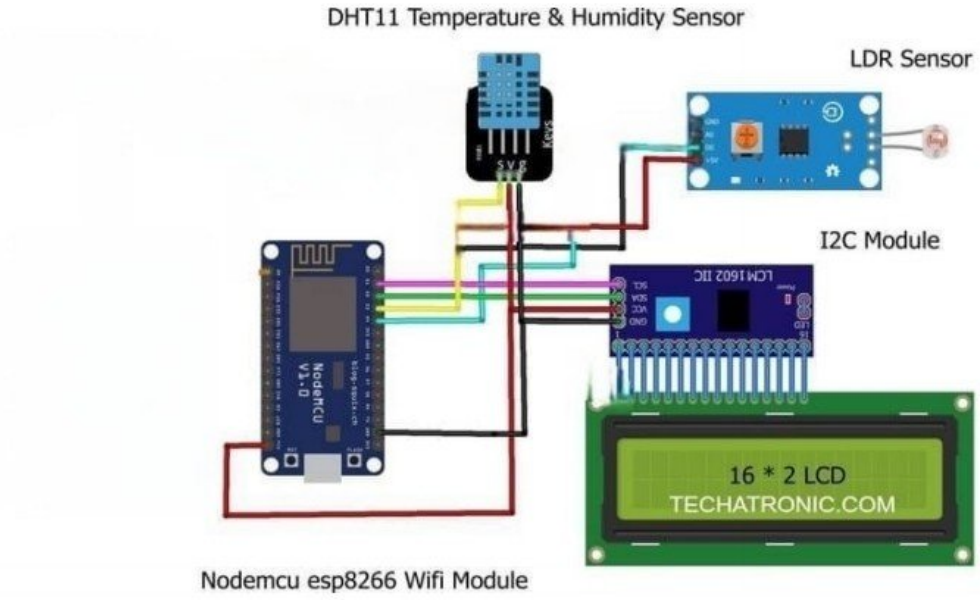

Figure 2: Circuit Diagram of Weather Monitoring System

Connections Summary:

- **DHT22:** DATA → D5 (GPIO14), VCC → 3.3V, GND; 10 kΩ pull-up resistor on DATA.
- **BMP280:** I2C Bus — SDA → D2 (GPIO4), SCL → D1 (GPIO5), VCC → 3.3V, GND.
- **LDR:** Connected as a voltage divider to A0 (analog input).
- **NodeMCU:** Powered via USB (5V); uses onboard regulator to provide 3.3V to sensors.

Components Required

1. **LDR Sensor (Light Dependent Resistor)**
   Function: Detects ambient light intensity. Operation: Resistance decreases as light increases. Applications: Light-level monitoring, automatic lighting systems.
2. **DHT22 Sensor**
   Function: Measures temperature and humidity. Advantage: Better accuracy than DHT11. Output: Digital signal readable by microcontroller.
3. **LCD Display (16×2)**
   Function: Optional display for local sensor readings without relying on the web dashboard.
4. **NodeMCU (ESP8266)**
   Function: WiFi-enabled microcontroller. Reads sensor data and hosts web server or pushes data to online platforms.

5. **Breadboard and Jumper Wires**
   Purpose: For prototyping and creating easy sensor connections.
6. **USB Cable / Power Supply**
   Function: Provides power and programming interface for the NodeMCU.

Expected Outcomes

- Real-time monitoring and local display of temperature, humidity, pressure, and light intensity.
- Wireless data access via NodeMCU's IP using a web dashboard.
- Expandability for multiple nodes in smart agriculture or environmental monitoring.
- Demonstrates the capability of ESP8266 in low-cost IoT systems.

Working Principle

The Weather Monitoring System collects environmental data using sensors, processes the readings using the NodeMCU, and displays the results on an optional LCD or web interface over WiFi.

Step-by-Step Operation

1. **Sensing:** DHT22 measures temperature and humidity; BMP280 measures pressure; LDR detects light level (analog signal).
2. **Signal Conditioning:** LDR output is connected as a voltage divider to A0 (analog input). DHT22 and BMP280 provide digital output (DHT - single-wire, BMP280 - I2C).
3. **Processing:** NodeMCU collects, formats, and optionally averages sensor data.
4. **Display and Transmission:** Readings are displayed on the 16×2 LCD (if used) and served via a local WiFi web page.
5. **Power Supply:** NodeMCU is powered via USB (5V) and supplies 3.3V regulated output to the sensors.

Prepared for: MBSD Microproject Assignment
Submission Format: PDF (maximum 3 pages) via Linways