Project Report

Student Name: Lakshya Pratap Singh **UID: 24MCI10203**

Branch: MCA(AIML) **Section/Group: 24MAM-1B**

Semester: 3rd **Date of Performance: 25/10/25**

Subject Name: IOT Lab **Subject Code: 24CAH-723**

Aim: IoT Weather Monitoring System using NodeMCU (ESP8266)

Objectives:

- To design an IoT based system that can continuously monitor environmental conditions in real time.
- To measure temperature and humidity using the DHT11 sensor with accurate digital readings.
- To detect rainfall levels using an analog rain sensor and represent the moisture percentage.
- To sense ambient light conditions using the LDR module and identify day or night status.
- To send all sensor readings to the Blynk IoT cloud for remote monitoring from a mobile app.
- To ensure seamless communication between NodeMCU (ESP8266) and Blynk over WiFi.
- To create a user friendly interface where the data is visualized using widgets like gauges and value displays.

- To build a low cost and energy efficient monitoring system suitable for smart home or smart farming applications.
- To store, display and analyze sensor data from anywhere using smartphone access.
- To test and validate the working of sensors by comparing real environment readings with Blynk output.

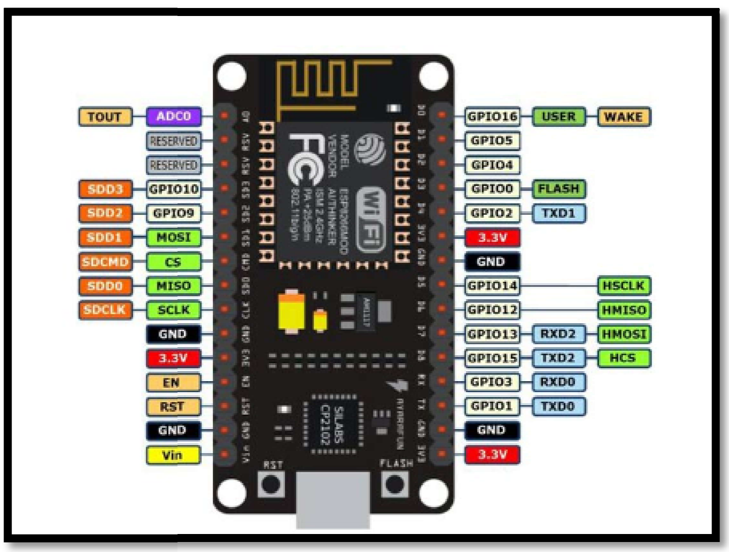
Components Required:

Sno.	Name of Component	Qty.
1	NodeMCU (ESP8266)	1
2	DHT11 Temperature Humidity Sensor	1
3	Rain Sensor Module (Analog)	1
4	LDR Module (Digital Output)	1
5	Jumper Wires	As required
6	USB Cable for NodeMCU	1
7	Breadboard	1

Details of Components:

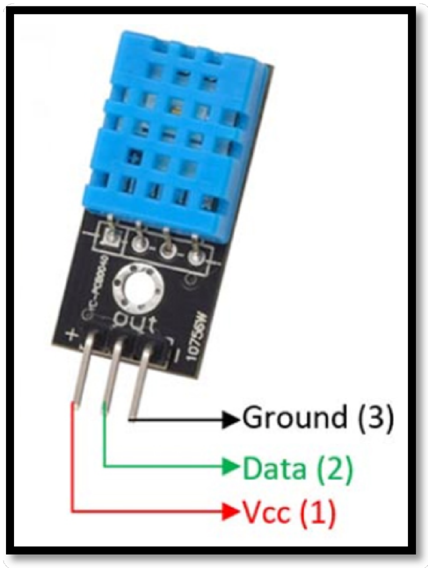
1. NodeMCU (ESP8266):

NodeMCU is a low-cost microcontroller board based on the ESP8266 WiFi module. It is widely used in IoT projects because it has built-in WiFi connectivity, making wireless communication fast and simple. The board can be programmed using Arduino IDE, supports multiple digital and analog pins, and operates on 3.3V logic. It allows sensors like DHT11, LDR, and rain sensors to collect environmental data and send it to cloud platforms such as Blynk. Its compact size, low power usage, and reliability make it ideal for smart home, monitoring, and automation projects requiring real-time data transmission.



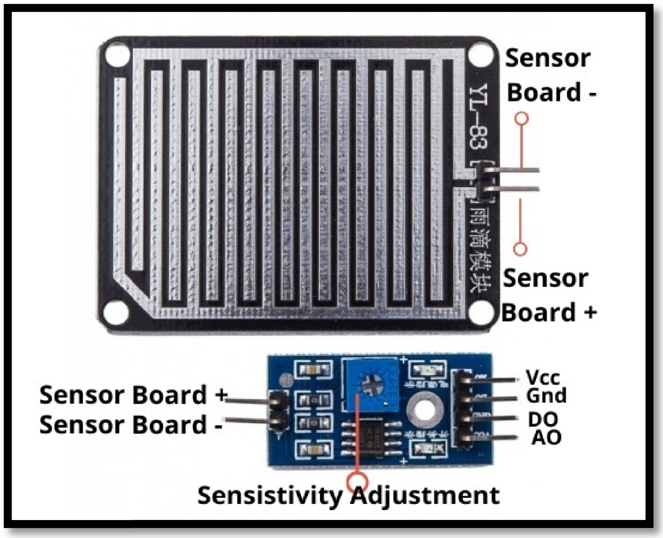
2. DHT11 Temperature and Humidity Sensor

The DHT11 is a basic, low-cost sensor used to measure temperature and humidity in real time. It contains a thermistor and a capacitive humidity sensor that provide digital output for accurate readings. The sensor operates on 3.3V to 5V, making it compatible with NodeMCU. It sends data through a single digital pin, which simplifies wiring and reduces power consumption. Although not highly precise compared to industrial sensors, DHT11 is ideal for student projects and IoT prototypes due to its simplicity and decent accuracy. It helps track environmental conditions for applications like weather stations and smart agriculture.



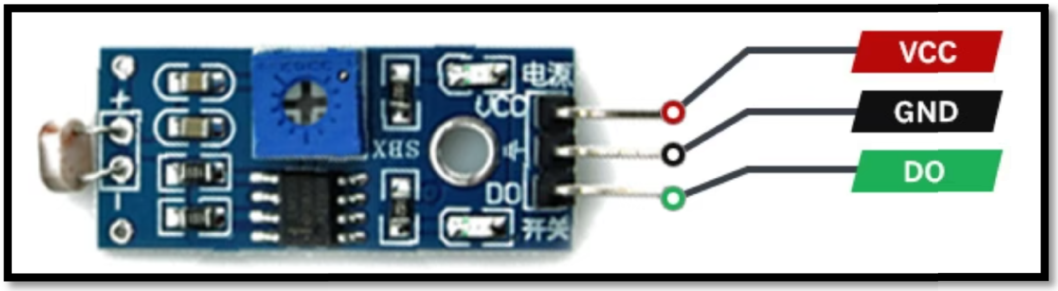
3. Rain Sensor Module

A rain sensor module detects water droplets and moisture levels on its surface. It consists of a sensing plate and an amplifier module that converts analog signals into measurable values. The more water on the plate, the lower the resistance, producing higher analog output. This helps detect rainfall intensity and wet weather conditions. The sensor works well at 3.3V, making it suitable for NodeMCU. It is commonly used in automatic wiper systems, smart irrigation, and weather monitoring systems. Its fast response and easy interfacing make it perfect for IoT applications that require real-time rainfall detection.



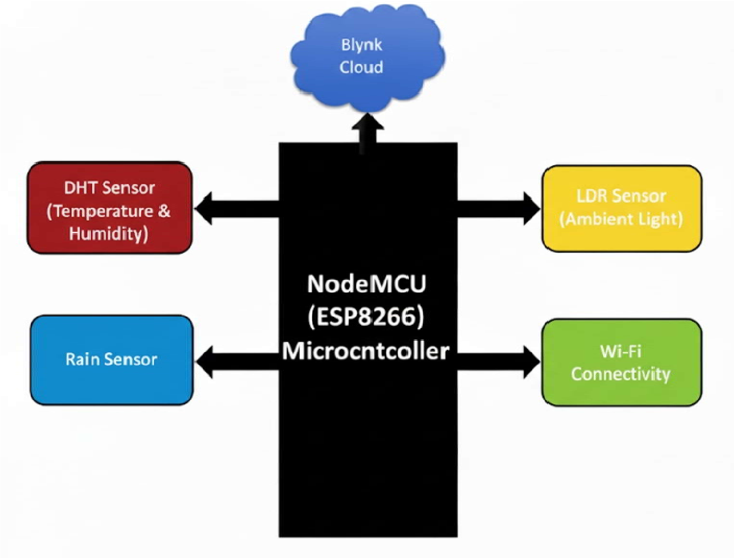
4. **LDR (Light Dependent Resistor) Module**

An LDR module is used to detect ambient light intensity by changing its resistance based on the light falling on it. Under bright light, the resistance decreases, and under darkness, it increases. The module generally contains an LDR and a comparator that provides a digital output (DO), making it simple to interface with NodeMCU. This allows the system to determine day or night conditions. LDR modules are widely used in smart street lights, automatic lamps, and IoT-based monitoring projects. They are cost-effective, durable, and require very little power while providing quick and reliable light-level detection.



Block Diagram of Designed Model:

Explanation of Block Diagram

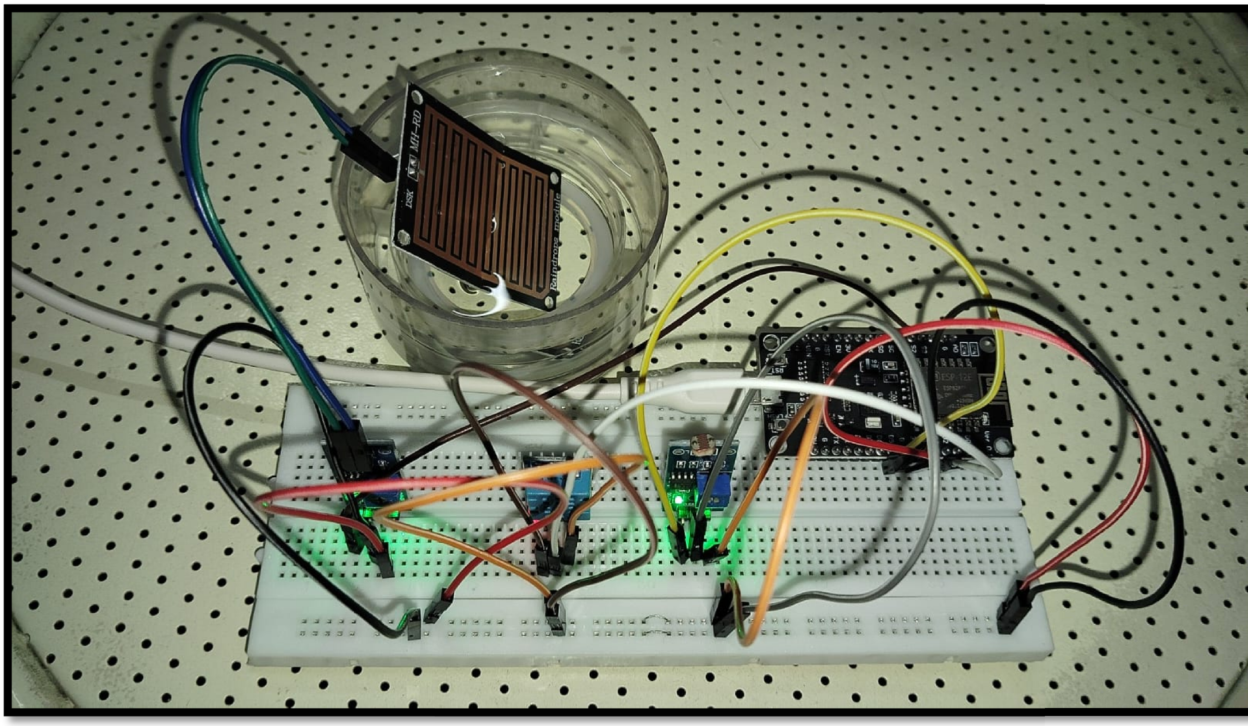


Working of Designed Model:

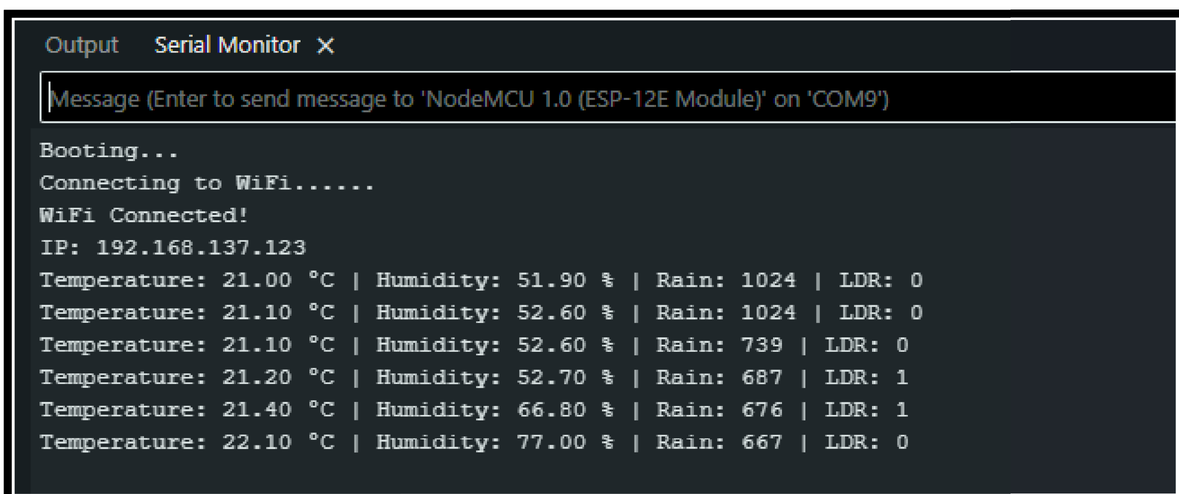
- The designed IoT Weather Monitoring System begins functioning the moment the NodeMCU (ESP8266) is powered through a USB cable connected to a laptop or adapter. The onboard voltage regulator converts the incoming 5V supply into a stable 3.3V, which then powers all connected sensors including the DHT11, rain sensor, and LDR module. Once the board boots up, it initializes the WiFi module embedded inside the NodeMCU and attempts to connect to the preconfigured WiFi network so it can communicate with the Blynk cloud server.
- After successful WiFi connectivity, the NodeMCU activates all sensor modules. The DHT11 temperature and humidity sensor starts capturing environmental data by measuring the surrounding air temperature and relative humidity. It uses a thermistor and a capacitive humidity sensor internally. The digital signal is transmitted through its data pin connected to D2 (GPIO4). The microcontroller processes this raw signal and converts it into human-readable temperature and humidity values.

- Parallel to this, the rain sensor module begins sensing moisture levels. Its analog output pin (A0) sends varying voltage levels depending on how much water is present on the sensing plate. Higher moisture results in lower resistance and therefore higher analog readings. Only the rain value is later converted into percentage for monitoring. The NodeMCU continuously monitors this reading to determine whether it is raining lightly, moderately, or heavily, allowing the system to react or issue alerts as needed.
- The LDR (Light Dependent Resistor) module simultaneously checks the surrounding light intensity. Connected through the digital output (D5/GPIO14), it produces HIGH or LOW signals depending on the threshold set on the module's onboard potentiometer. When there is sufficient light, the module outputs HIGH; during dim or dark conditions, it outputs LOW. This helps the system determine day/night conditions or sudden drops in brightness, which can be useful for automation or environmental tracking.
- Once the NodeMCU collects readings from all three sensors, it processes the signals and formats the data into values ready for transmission. Using the Blynk library, the processed data is pushed to the Blynk Cloud at regular intervals. The cloud server updates these values in real time inside the Blynk mobile application. Users can visually monitor temperature, humidity, rain percentage, and light status through widgets such as Value Displays, Gauges, LEDs, and Charts.
- If any sensor reading crosses a predefined threshold (for example, sudden rainfall or low visibility), the system can be programmed to trigger notifications through the Blynk app. This ensures the user is always informed of environmental changes no matter where they are. Because the model operates on WiFi and cloud integration.
- The entire designed model works continuously and efficiently, consuming very low power due to the nature of the ESP8266 microcontroller. The model serves as a complete, robust weather station capable of sensing, processing, and transmitting real-time environmental data with accuracy and reliability.

Pictures of Prototype:



Output of Deigned Model/Prototype


Output   Serial Monitor ×
Message (Enter to send message to 'NodeMCU 1.0 (ESP-12E Module)' on 'COM9')

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Booting...
Connecting to WiFi......
WiFi Connected!
IP: 192.168.137.123
Temperature: 21.00 °C | Humidity: 51.90 % | Rain: 1024 | LDR: 0
Temperature: 21.10 °C | Humidity: 52.60 % | Rain: 1024 | LDR: 0
Temperature: 21.10 °C | Humidity: 52.60 % | Rain: 739 | LDR: 0
Temperature: 21.20 °C | Humidity: 52.70 % | Rain: 687 | LDR: 1
Temperature: 21.40 °C | Humidity: 66.80 % | Rain: 676 | LDR: 1
Temperature: 22.10 °C | Humidity: 77.00 % | Rain: 667 | LDR: 0
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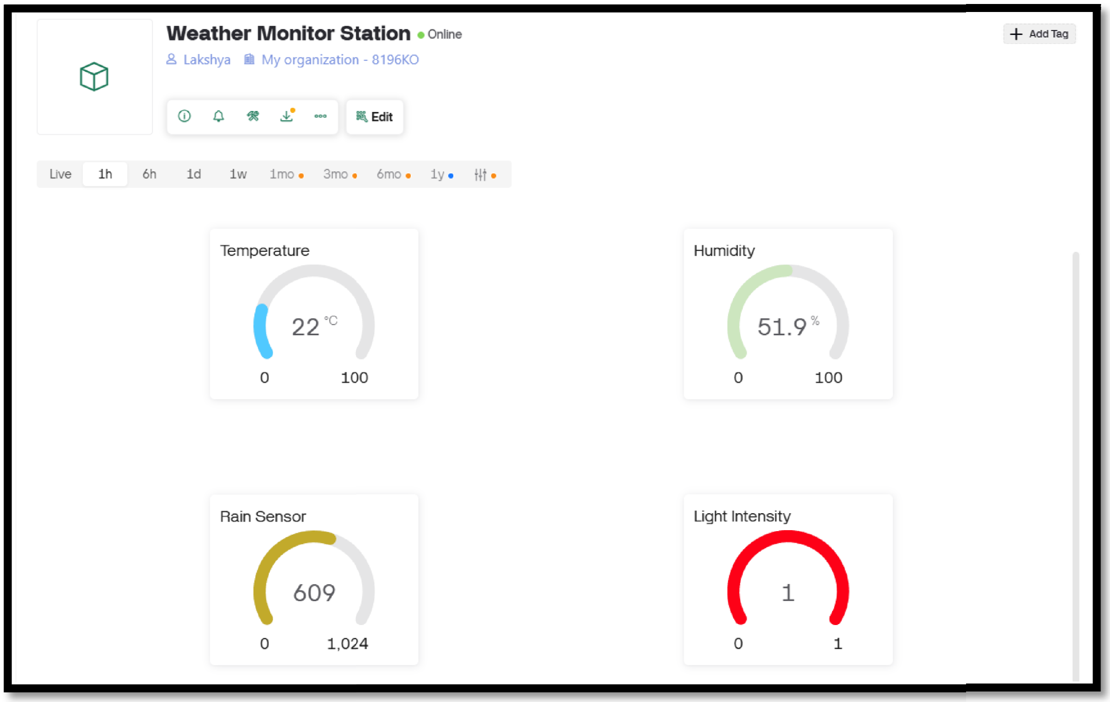

Learning outcomes (What I have learnt):

- I learnt how to interface the DHT11, Rain Sensor, and LDR with the NodeMCU (ESP8266), including proper GPIO mapping, voltage requirements, and stable sensor signal handling for accurate environmental monitoring.
- I understood how to collect, process, and interpret real-time environmental data such as temperature, humidity, rainfall intensity, and ambient light, which helped me learn how IoT-based sensing systems operate.
- I gained practical experience in using the Blynk IoT platform to visualize sensor readings on a mobile dashboard, configure virtual pins, and perform cloud-based data monitoring.
- I learnt how to establish a reliable WiFi connection between the NodeMCU and Blynk Cloud, enabling real-time remote access to sensor data from anywhere.
- I developed skills in writing and optimizing ESP8266 Arduino code, including sensor initialization, periodic data transmission, use of BlynkTimer, and debugging connectivity or reading errors.