International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 03 | March - 2023 Impact Factor: 7.185 ISSN: 2582-3930

IoT-BASED TEMPERATURE AND HUMIDITY MONITORING SYSTEM USING THINGSBOARD OVER MQTT PROTOCOL

A MOUNIKA, T RADHA KRISHNA

ABSTRACT:

The proposed work presents the implementation and results of an environmental monitoring system that employs sensors for the temperature and humidity of the surrounding area. The system employs an Arduino UNO board, DHT22 sensor, and ESP8266 Wi-Fi module which transmits data to open IOT API service Things Board where it is analyzed and stored. The data updated from the implemented system can be accessible on the internet from anywhere in the world. The experimental results show the usefulness of the system.

Keywords: DHT22 Sensor, ESP8266 Wi-Fi module, Arduino UNO, Thingsboard.

INTRODUCTION:

The Internet of Things (IoT) is expected to play a major role in our lives through pervasive systems of sensor networks encompassing our environment. These systems are designed to monitor vital physical phenomena generating data that can be transmitted and saved in the cloud from where this information can be accessed through applications and further actions can be taken. Through the temperature and humidity monitoring system, we can collect information about humidity and temperature and according to current and previous data we can graphically produce the results in the system.

The Internet of things refers to a type of network to connect anything with the Internet based on stipulated protocols through information sensing equipment to conduct information exchange and communications to achieve smart recognitions, positioning, tracing, monitoring, and administration.

Applications of IoT are

1. Commercial applications such as medical, healthcare, transportation, building, and home automation.
2. Industrial applications such as manufacturing, and agriculture.
3. Infrastructure applications such as metropolitan scale deployments, environmental monitoring, energy management, and military applications.

BLOCK DIAGRAM:

The Block diagram of the IOT-based temperature and humidity monitoring system using Arduino Uno and Thingsboard is shown below figure.

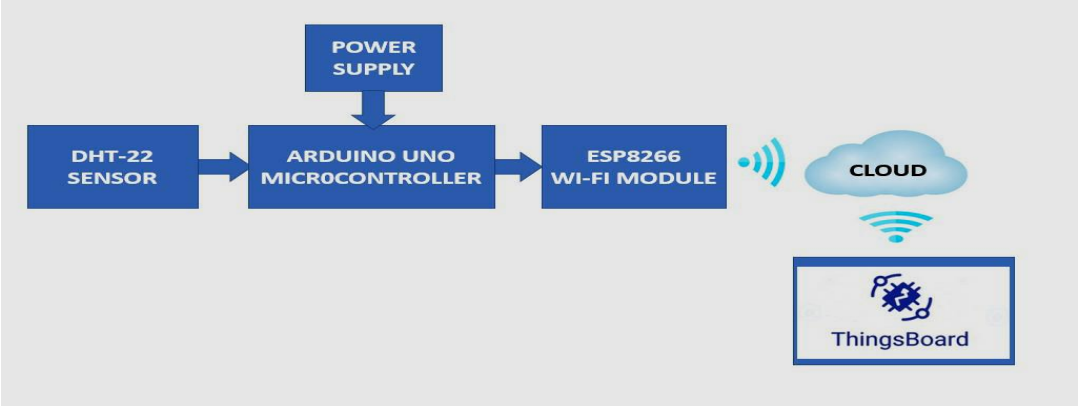

Fig 1: Block Diagram of temperature and humidity monitoring system using Arduino UNO with ESP8266.

In this paper, humidity, and temperature information from the DHT-22 sensor is analyzed graphically on the ThingsBoard platform using Arduino Uno MCU and ESP8266 Wi-Fi module.

Arduino UNO: Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards can read inputs - a light on a sensor, a finger on a button, or a Twitter message - and turn them into an output - activating a motor, turning on an LED, publishing something online

Wi-Fi Module: The ESP8266 Wi-Fi module is a self-contained system-on-chip (SOC) with integrated TCP/IP protocol stacks that can give any microcontroller access to a Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions to another application processor. Each ESP8266 module comes pre-programmed with AT Command Set firmware, meaning the module can be hooked up to an Arduino device with about the same Wi-Fi ability as a Wi-Fi shield Varying temperature and humidity information of the environment are captured by the DHT22 component.

DHT22 Sensor: It is a Temperature and Humidity Sensor that has a calibrated digital signal output. The DHT22 ensures high reliability and long-term stability by using the exclusive digital- signal-acquisition technique and temperature & humidity sensing technology.

ThingsBoard: Things Board is an open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network. Things Board enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates.

METHODOLOGY AND SYSTEM DESIGN:

CIRCUIT DIAGRAM:

The 2nd pin of the DHT22 is a data pin, it sends the temperature and humidity value to the 5th pin of the Arduino UNO. 1ST AND 4TH pins of the DHT22 are Vcc and Gnd and 3rd pin is no connection pin. The Arduino UNO processes the temperature and humidity value and sends it to the ESP8266Wi-Fi module. The transmitter and receiver pins of ESP8266 are connected to the 2nd (Rx) and 3rd (Tx) of Arduino UNO. Make sure that the input voltage of ESP8266 must be 3.3V, not 5V (otherwise it would damage a device). For that, we are using the AMS1117 Voltage regulator circuit. It can regulate a voltage from 9V to 3.3V and will give it to the Vcc pin of ESP8266. The Ch_pd is a chip enable pin of ESP8266 and should be pull-up to 3.3V through a 3.3kohm resistor. To reset the module pulls down the RST pin of ESP8266 to Gnd. ESP8266 has 2 GPIO pins GPIO 0 and GPIO 2 which have no connection.

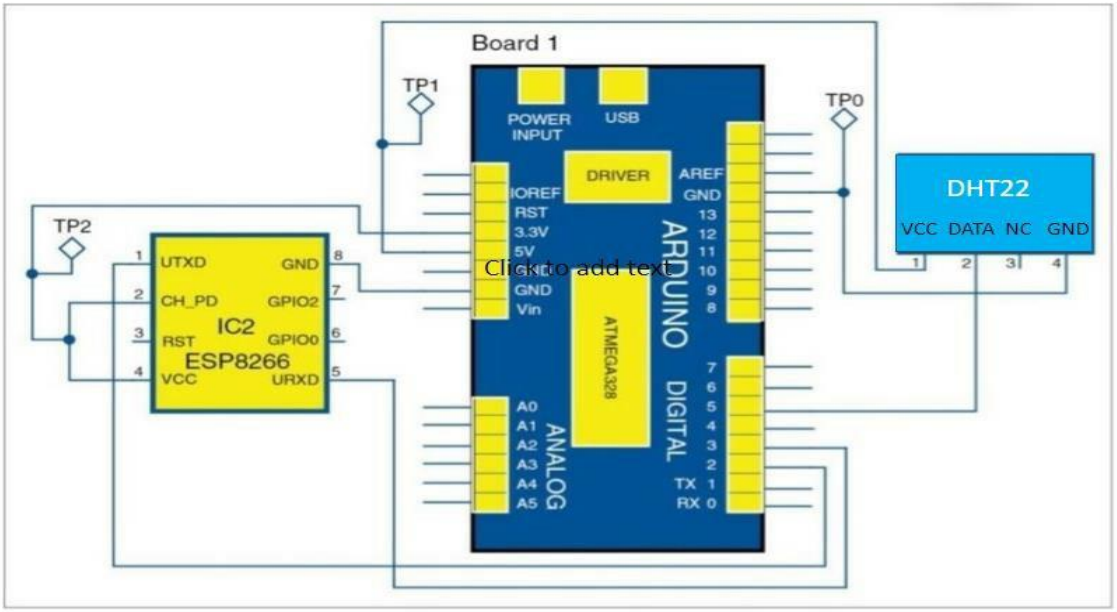

Fig 2: Circuit diagram of temperature and humidity monitoring system using Arduino Uno with ESP8266.

From Arduino MCU, humidity and temperature values are uploaded to the Cloud at regular intervals of time through the ESP8266 Wi-Fi module. From the Cloud, humidity, and temperature values can be seen graphically on the ThingsBoard platform from anywhere in the world. The circuit diagram for monitoring humidity and temperature is shown in Fig 2.

CONNECTIONS:

ARDUINO UNO PIN	**ESP8266 PIN**
Arduino UNO 3.3V	ESP8266 VCC
Arduino UNO 3.3V	ESP8266 CH_PD
Arduino UNO GND	ESP8266 GND(-)
Arduino UNO D2	ESP8266 RX
Arduino UNO D3	ESP8266 TX

Table 1: Connection between Arduino Uno and ESP8266 pin

ARDUINO UNO PIN	**DHT-22 PIN**
Arduino UNO 5V	DHT-22 VCC
Arduino UNO GND	DHT-22 GND(-)
Arduino UNO D4	DHT-22 DATA

Table 2: Connection between Arduino Uno and DHT-22 pin

THINGS BOARD SETUP: According to its developers, "Things Board is an open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network. Things Board enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates".

Things Board was originally launched by io Bridge in 2010 as a service in support of IoT applications. Things Board has integrated support from the numerical computing software MATLAB from MathWorks, allowing Things Board users to analyze and visualize uploaded data using Matlab without requiring the purchase of a Matlab license from Mathworks.Things Board has a close relationship with Mathworks, Inc. In fact, all of the Things Board documentation is incorporated into the Mathworks' Matlab documentation site and even enabling registered Mathworks user accounts as valid login credentials on the Things Board website. The terms of service

and privacy policy of Things Board.com are between the agreeing user and Mathworks, Inc.Things Board has been the subject of articles in specialized "Maker" websites like Instructables, Code project, and Channel.

MQTT Integration:

MQTT Integration allows connecting to external MQTT brokers, subscribing to data streams from those brokers, and converting any type of payload from your devices to the ThingsBoard message format. Its typical use is whenever your devices are already connected to an external MQTT broker or any other IoT platform or connectivity provider with MQTT based back-end.

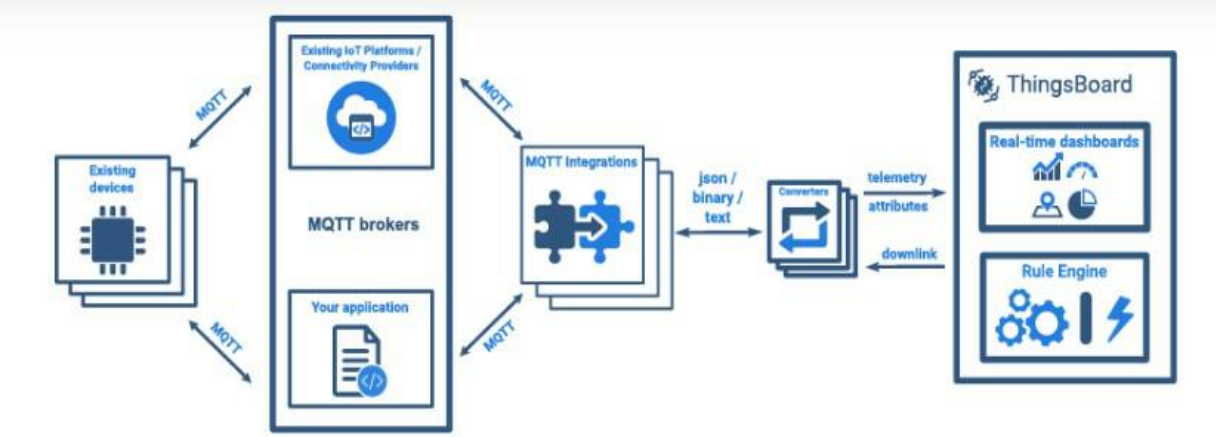

Fig 3: MQTT Protocol

ThingsBoard MQTT Integration acts as an MQTT client. It subscribes to topics and converts the data into telemetry and attribute updates. In case of a downlink message, MQTT integration converts it to the device-suitable format and pushes it to an external MQTT broker.

String apiKey= “XXXXXXXXXXXX“;

Next, substitute Host Name and Password with your Wi-Fi name and Wi-Fi password in the two lines are given below in the program (IoT.ino):

String Host _Name = “XXXXXX”; String Password = “XXXXXX”;

The program should be verified with your Wi-Fi setup. It uses the DHT library. If the DHT library is not present in your Arduino folder, download it from https://github.com/adafruit/DHT-sensor-library. To import the DHT library in Arduino IDE, select Sketch→Importlibrary→Addlibrary→Select the library that you have downloaded.

Compile the sketch/program and upload it to Arduino MCU through Arduino IDE. Ensure that the Wi-Fi modem and the Internet connection in your PC/smartphone are working properly.

After you compile the program, the temperature and humidity values can be seen in the Things Board. Once sketch uploading is done, it will upload humidity and temperature values on the Things Board platform and you will be able to see it graphically in the Private View window. If you want to change the channel or field name, you can change it from Channel Settings.

RESULTS:

IoT-based Temperature and humidity monitoring systems provide an efficient and reliable system for monitoring weather changes. The results for monitoring temperature and humidity can be seen by login into the website http://Things Board. com account and then click on the broadcast channel options. The results obtained for monitoring temperature and humidity using temperature, and humidity sensor DHT22 on Things Board are shown below:

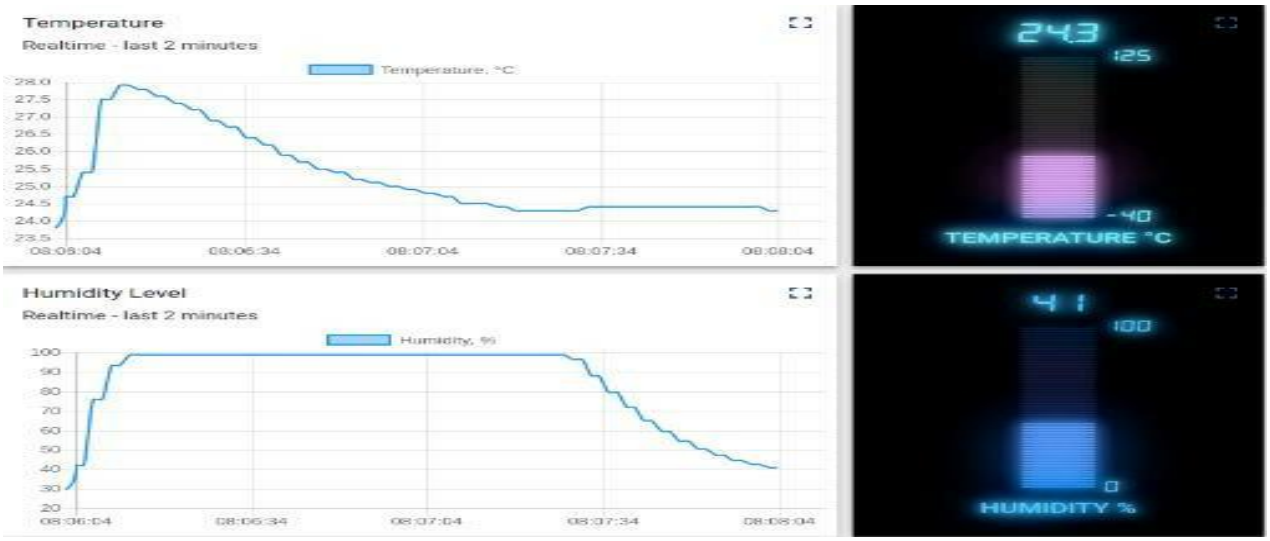

Fig 4: Graphical View Of Humidity And Temperature On Things Board Platform

Hence, we have successfully monitored Temperature and Humidity data over the Things Board using Arduino UNO and ESP8266.

CONCLUSION:

This concludes that the present work was a success and it will provide a competent method for recording real-time weather readings and help farmers whose livelihood depends on the weather in a country like India to produce better quality crops. It can be used to gather information about the requirements for each area over the years. IoT-based monitoring of the field not only permits a user to reduce human effort and time but also permits the user to analyze accurate changes in the atmosphere.

FUTURE SCOPE:

1. Adding more sensors to monitor other environmental parameters such as CO2, Pressure, and Oxygen Sensors.
2. In aircraft, navigation, and the military there is a great scope for this real-time system.
3. This IoT-based system can be extended for controlling different electronic and electrical apparatus from remote locations and the system can also be extended for soil moisture and cattle monitoring.

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