

Assignment 3

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Report on the Development of a Cloud-based IoT System Using MQTT

Introduction

This report outlines the development of a cloud-based IoT system for environmental monitoring. The system collects data from virtual sensors using MQTT protocol and ThingSpeak, a cloud-based IoT analytics platform. The system simulates environmental stations that generate and publish random data for temperature, humidity, and CO2 levels.

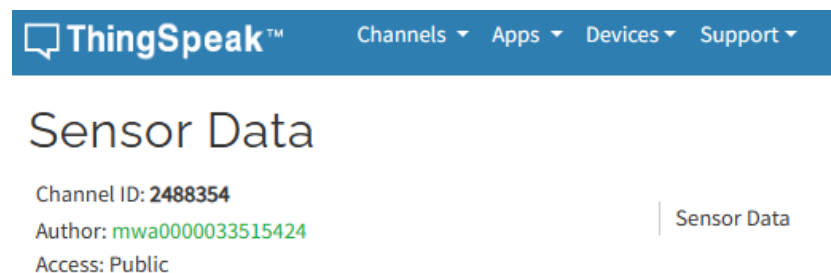
1. ThingSpeak Account and Channel Setup

Account Creation

A ThingSpeak account was created to facilitate the data handling and visualization process. ThingSpeak offers a comprehensive platform for IoT data collection, analysis, and visualization.

Channel Setup

A channel named "Sensor Data" was established within ThingSpeak. This channel was dedicated to handling the data from the virtual sensors. It was configured with three fields to store temperature, humidity, and CO2 data.



MQTT Device Configuration

An MQTT device, named "Sensor MQTT", was configured. This device was authorized to access the "Sensor Data" channel. The MQTT credentials, including username, password, and client ID, were noted. Additionally, the channel ID of the created channel was documented for future reference.

MQTT Devices

[Add a new device](#)

Device Details:
Sensor MQTT
Sensor MQTT

Authorized Channels and Permissions:
Sensor Data (2488354)
No channels authorized.
✓ publish ✓ subscribe

MQTT Client ID:
MxsePSYuKRgfHivGIMPMQ

[Edit](#)
[Delete](#)

2. Development of Python Script

Python Script for Data Simulation: Developed a Python script to simulate environmental sensor data. Key functionalities include:

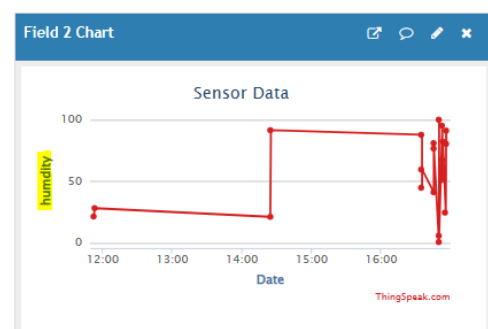
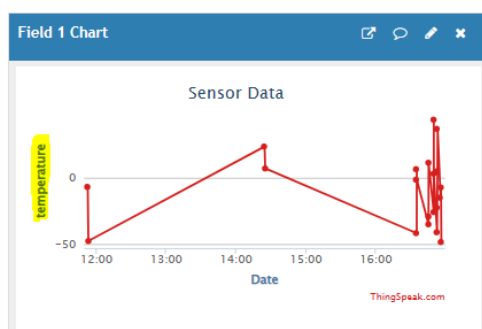
- MQTT Client Initialization: Set up with necessary credentials for ThingSpeak connectivity.
- EnvironmentalStation Class: Created for generating random sensor data.
- Data Publishing: Implemented a method within the class to publish data to the ThingSpeak channel.
- Simulation Control: Executed and terminated the data publishing process based on specified parameters.

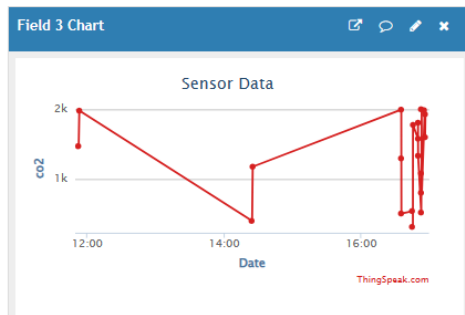
Data Publishing

Upon running the Python script, data was successfully published to the ThingSpeak channel, reflecting the real-time operation of the simulated environmental stations.

Channel Stats

Created: [about 8 hours ago](#)
Last entry: [about 2 hours ago](#)
Entries: 20





3. MATLAB Script for Data Display

Latest Sensor Data Display

A MATLAB script was written to display the latest sensor data values from all sensors of a specified environmental station. The script successfully fetched and displayed the most recent data, demonstrating the real-time data visualization capabilities of the system.

Last Five Hours Data Display

Another MATLAB script was developed to display sensor data received during the last five hours from all environmental stations for a specified sensor. This script effectively retrieved historical data, allowing for trend analysis and environmental monitoring over a specified duration.

Apps / MATLAB Analysis

Click **New** and choose a template to get started. Templates contain sample MATLAB® code for analyzing data.

New

Name	Created
Sensor Data - Last 5 hours	2024-03-27
Sensor Data Latest	2024-03-27

Conclusion

The project successfully demonstrated the development of a cloud-based IoT system using MQTT protocol for environmental monitoring. The integration of Python and MATLAB scripts

with ThingSpeak facilitated the simulation, publishing, and visualization of sensor data. This system can be further expanded or modified for various IoT applications, showcasing the versatility and efficacy of cloud-based IoT solutions.

2. Screenshot of the Output:

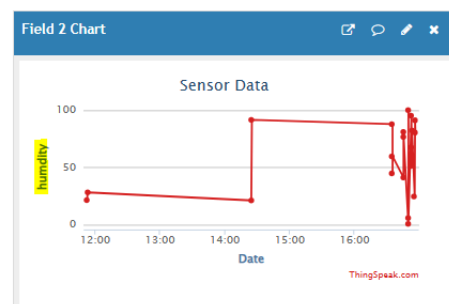
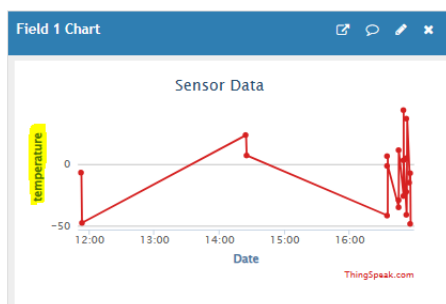
a) Channel published with sensor data:

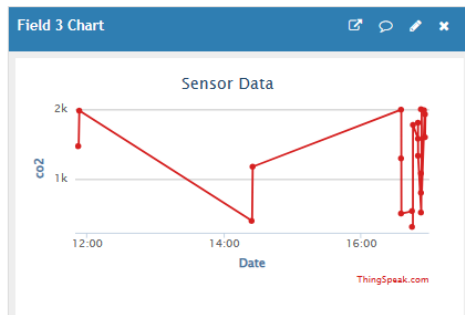
```
IoT sensor.ipynb
File Edit View Insert Runtime Tools Help All changes saved
+ Code + Text

<ipython-input-17-431a00ce59a2>:56: DeprecationWarning: Callback API version 1 is deprecated, update to latest version
mqtt_client = mqtt.Client(mqtt.CallbackAPIVersion.VERSION1,client_id=client_id)
Station 1e8980c9-d86e-4ffc-883a-9fe7f01cf426 Data: {'temperature': -42.05133170995359, 'humidity': 45.87443076545509, 'co2': 646.6845924487511}
Station 6f0fa224-fb99-4d24-a9b4-f056089d9126 Data: {'temperature': -4.497034761046336, 'humidity': 98.64196563143328, 'co2': 720.920598842492}
Station b341df34-4ded-410c-b0d6-ab9e1c1ad2e9 Data: {'temperature': 48.81518663230128, 'humidity': 77.83210940390597, 'co2': 1949.9335322339227}
Connected successfully.
Connected successfully.
Connected successfully.
Station 1e8980c9-d86e-4ffc-883a-9fe7f01cf426 Data: {'temperature': 12.169985292184528, 'humidity': 31.436452623013256, 'co2': 650.5617136507246}
Station 6f0fa224-fb99-4d24-a9b4-f056089d9126 Data: {'temperature': -6.314216174562034, 'humidity': 38.98297826545307, 'co2': 504.31951172831896}
Station b341df34-4ded-410c-b0d6-ab9e1c1ad2e9 Data: {'temperature': -14.892300656055959, 'humidity': 24.29367102480088, 'co2': 1986.017941071669}
Connected successfully.
Connected successfully.
Connected successfully.
Station 1e8980c9-d86e-4ffc-883a-9fe7f01cf426 Data: {'temperature': -40.59825989030523, 'humidity': 94.10501368157735, 'co2': 1123.496059525437}
Station 6f0fa224-fb99-4d24-a9b4-f056089d9126 Data: {'temperature': 25.329793575484743, 'humidity': 49.451414391925816, 'co2': 1338.076922434854}
Station b341df34-4ded-410c-b0d6-ab9e1c1ad2e9 Data: {'temperature': 13.427384221386639, 'humidity': 50.866804251319444, 'co2': 994.6997893682784}
Connected successfully.
Connected successfully.
Connected successfully.
Station 1e8980c9-d86e-4ffc-883a-9fe7f01cf426 Data: {'temperature': -8.612528396666775, 'humidity': 84.394203201534, 'co2': 1528.2765226977908}
Station 6f0fa224-fb99-4d24-a9b4-f056089d9126 Data: {'temperature': 8.65923006162911, 'humidity': 88.49221763127358, 'co2': 1782.3682710813027}
Station b341df34-4ded-410c-b0d6-ab9e1c1ad2e9 Data: {'temperature': -7.152802285872426, 'humidity': 91.0035466911956, 'co2': 1598.1574381986277}
Connected successfully.
Connected successfully.
Connected successfully.
Station 1e8980c9-d86e-4ffc-883a-9fe7f01cf426 Data: {'temperature': 41.755113908537695, 'humidity': 71.09354638708135, 'co2': 516.7498693393958}
Station 6f0fa224-fb99-4d24-a9b4-f056089d9126 Data: {'temperature': -18.599273852370366, 'humidity': 33.335730372257544, 'co2': 1557.1000051770038}
Station b341df34-4ded-410c-b0d6-ab9e1c1ad2e9 Data: {'temperature': -38.867262973255144, 'humidity': 40.87253528882015, 'co2': 1380.3502407160538}
Connected successfully.
Connected successfully.
Connected successfully.
Station 1e8980c9-d86e-4ffc-883a-9fe7f01cf426 Data: {'temperature': -48.47253207866225, 'humidity': 80.2232258531676, 'co2': 1927.3734495653866}
Station 6f0fa224-fb99-4d24-a9b4-f056089d9126 Data: {'temperature': 3.3735724669042213, 'humidity': 83.90976103431649, 'co2': 1592.217279618951}
Station b341df34-4ded-410c-b0d6-ab9e1c1ad2e9 Data: {'temperature': -48.969582041776135, 'humidity': 29.945241751818795, 'co2': 1866.340925304855}
Connected successfully.
Connected successfully.
Connected successfully.
```

Channel Stats

Created: [about 8 hours ago](#)
Last entry: [about 2 hours ago](#)
Entries: 20





b) Output of the Latest Sensor Data Display script:

```
Output

Latest sensor data:
-----
Timestamp: 27-Mar-2024 23:23:28
Temperature: -48.47 °C
Humidity: 80.22%
CO2: 1927.37 ppm
```

Output of the Last Five Hours Data Display script:

```
Output

Sensor data for the last 5 hours from all environmental stations:
-----
Timestamp: 27-Mar-2024 18:24:12
Temperature: 23.90 °C
Humidity: 20.87%
CO2: 398.65 ppm

Timestamp: 27-Mar-2024 18:25:12
Temperature: 7.27 °C
Humidity: 91.35%
CO2: 1176.18 ppm

Timestamp: 27-Mar-2024 18:26:12
Temperature: 11.55 °C
Humidity: 88.87%
CO2: 1176.18 ppm
```

3. Github URL:

[ji-john/lot-Assignment3 \(github.com\)](https://github.com/ji-john/lot-Assignment3)