



# **CAPSTONE PROJECT**

*AGRI-TECH-FARM WATER MANAGEMENT*

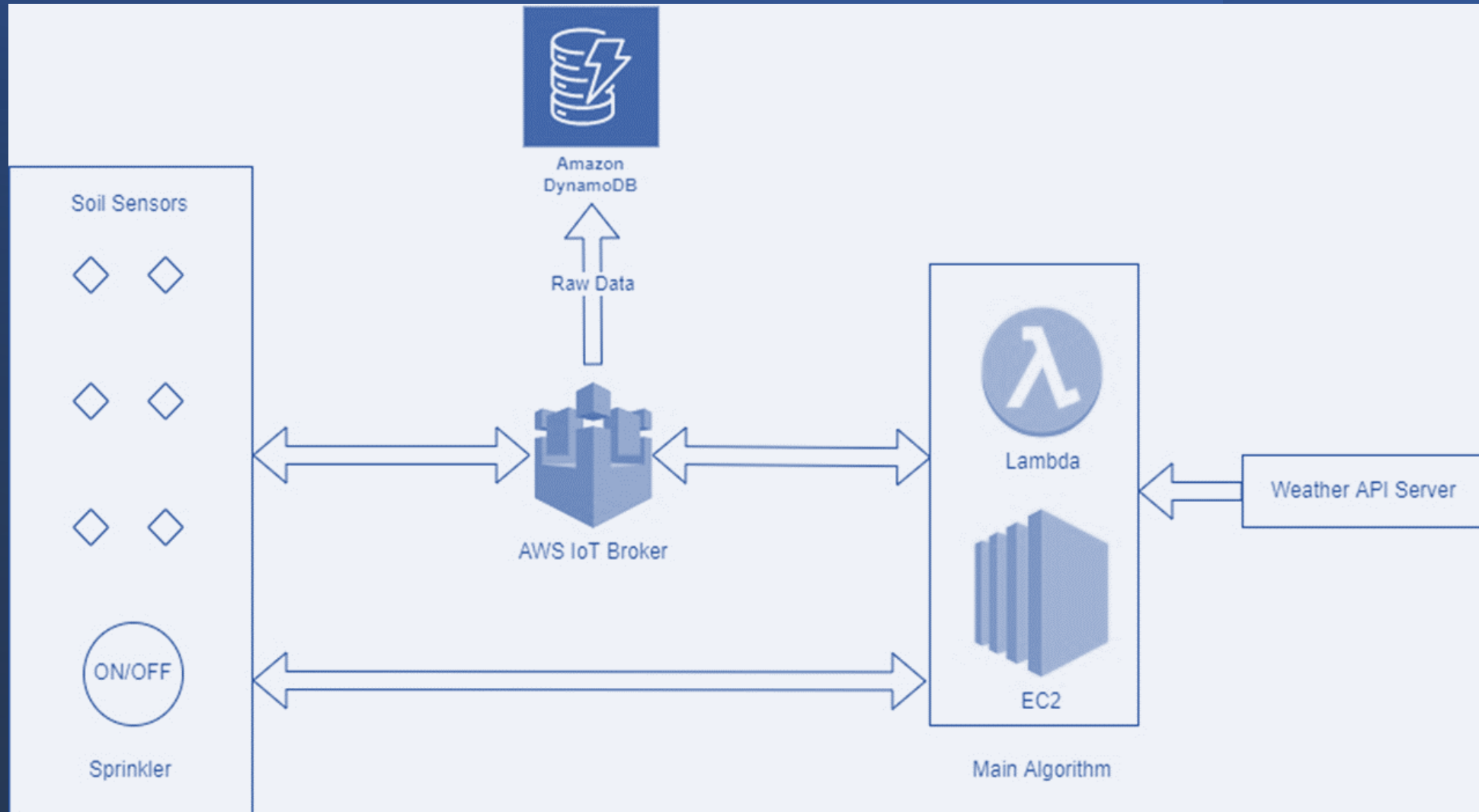
**IIT Madras ACSE – August'21 Batch**



# IOT Capstone Micro Group - 4

- Priyesh Rathore (Group Lead)
- Arup Ray
- Sudhakar Deekollu
- Abdullah Sholapur

# High Level Architecture



IoT  
Gateways  
and Devices



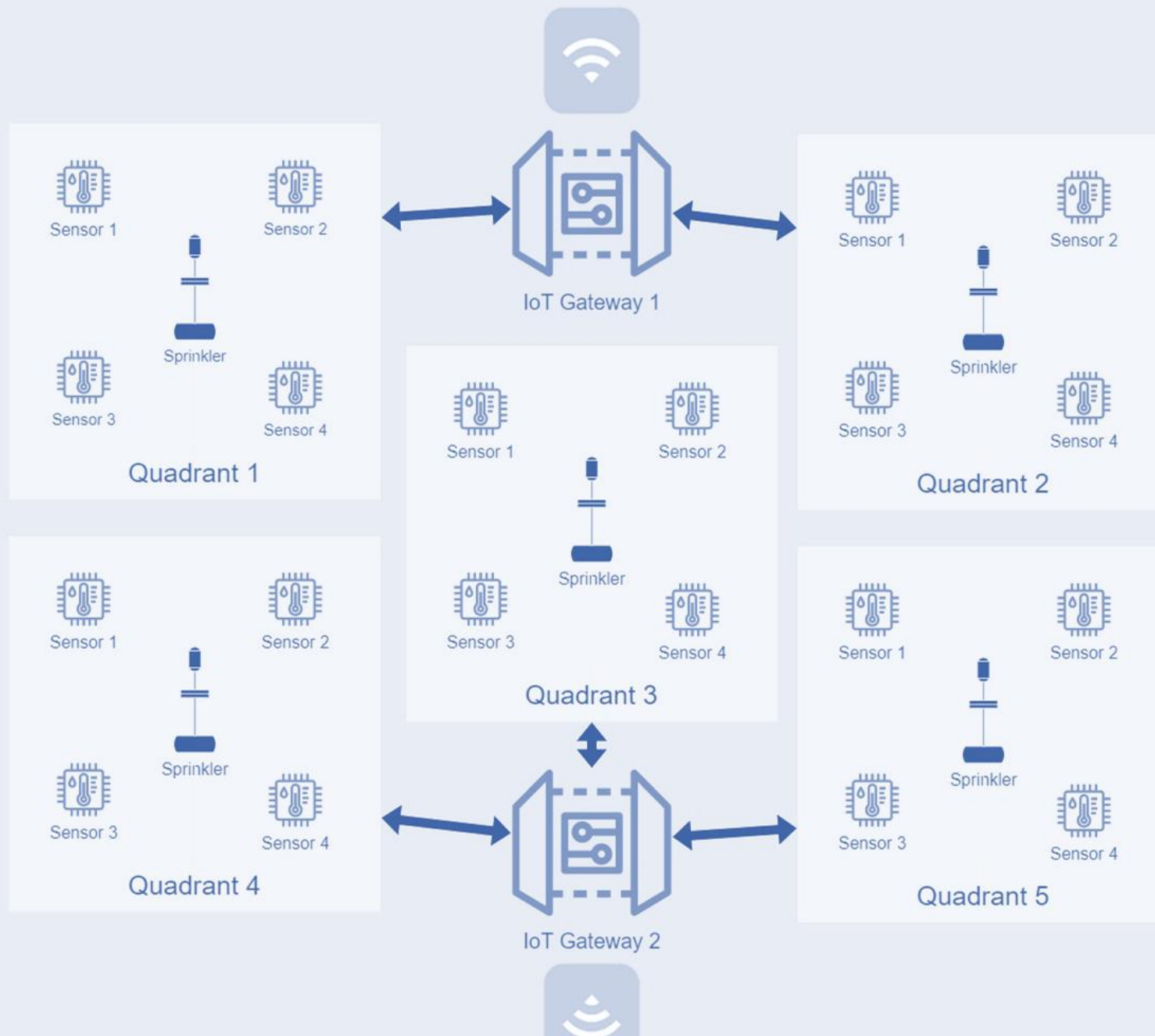
Data  
Endpoints



Backend and  
Frontend Servers



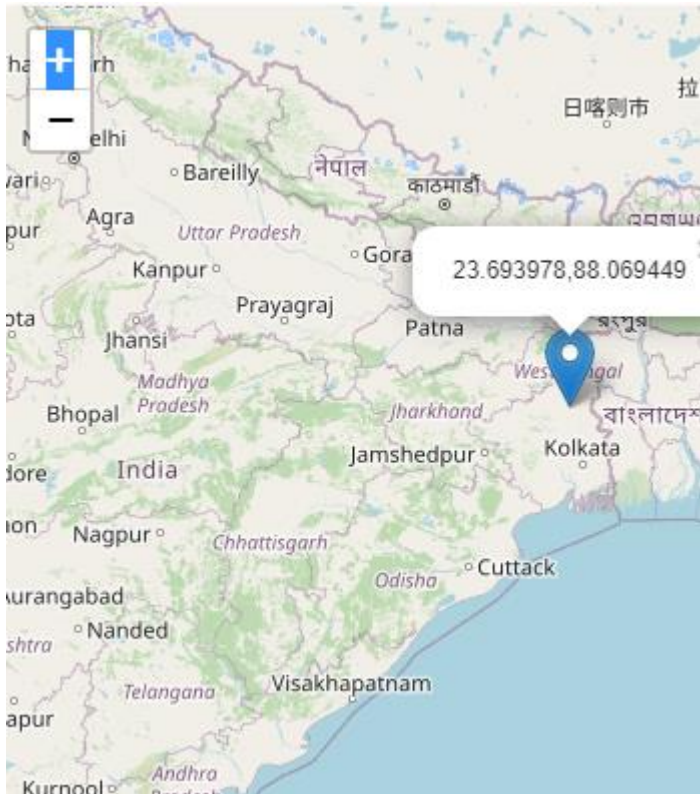
IoT Pipeline



- Farm is divided into 5 Quadrants.
- Each Quadrant has 4 soil moisture sensors and one sprinkler.
- When at least 2 moisture sensors go below/above the threshold of pre-set values for soil moisture, sprinkler will turn ON/OFF.
- If it is raining in the quadrant (via openweatherAPI), sprinklers won't turn ON.
- All messaging achieved through AWS IoT Core and the decision making logic working on EC2.



# Location of Agricultural Land



Sprinkler to Sprinkler Distance ~ 350 Mt  
Sprinkler to Sensor Distance ~ 55 Mt



Location  
of Sprinklers

# Latitude & Longitude of Sprinklers & Sensors

			Sensor5C										Sensor2C				
			23.696863	88.067579									23.696863	88.072179			
Sensor5B			Sprinkler 5		Sensor5D				Sensor2B				Sprinkler 2			Sensor2D	
23.696363	88.067079		23.696363	88.067579	23.696363	88.068079			23.696363	88.071679			23.696363	88.072179		23.696363	88.07268
			Sensor5A										Sensor2A				
			23.695863	88.067579									23.695863	88.072179			
								Sensor1C									
								23.694563	88.069879								
					Sensor1B			Sprinkler 1			Sensor1D						
					23.694063	88.069379		23.694063	88.069879		23.694063	88.070379					
								Sensor1A									
								23.693563	88.069879								
			Sensor4C										Sensor3C				
			23.692263	88.067579									23.692263	88.072179			
Sensor4B			Sprinkler 4		Sensor4D					Sensor3B			Sprinkler 3			Sensor3D	
23.691763	88.067079		23.691763	88.067579	23.691763	88.068079				23.691763	88.071679		23.691763	88.072179		23.691763	88.07268
			Sensor4A										Sensor3A				
			23.691263	88.067579									23.691263	88.072179			

# Major Components

- **Simulators:**

- Soil sensors and Sprinkler (actuator) simulators.
- Soil sensors simulators send simulated moisture values which depend on rain, sprinkler state and quadrant temperature.
- Group of 4 soil sensors and 1 sprinkler for each quadrant is registered as an IoT thing in AWS IoT Core.
- Usage of OpenweatherAPI for rain and temperature parameters.
- Connected to AWS IoT Core MQTT for pub/sub. Publishes soil sensors data and sprinkler telemetry periodically.
- Subscribed to sprinkler topics for ON/OFF actuation.

- **Backend & Frontend Components:**

- DynamoDB for storing all the static device information (name, type, id, coordinates)
- AWS IoT Core for receiving and sending MQTT data.
- EC2 as main decision-making and data ingestion component.
- EC2 is registered as a thing in IoT Core for Pub/Sub. Subscribes to all topics for sensor and sprinkler telemetry and publishes sprinkler ON/OFF commands to appropriate topics.
- InfluxDB for application data (hosted at the EC2) as well as visualization Dashboards.
- Open Weather API integrated in backend (EC2) for weather monitoring purposes.
- Web GUI based device provisioning application.



# MQTT TOPIC(S) STRUCTURE

TOPIC NAME	TOPIC STRUCTURE	TOPIC EXAMPLE
SOIL SENSOR TOPIC	<company name>/<quadrant>/soil_sensors	"petrichor_agritech/quadrant_1/soil_sensors"
SPRINKLER_TELEMETRY_TOPIC	<company name>/<quadrant>/sprinkler_telemetry	"petrichor_agritech/quadrant_1/sprinkler_telemetry"
SPRINKLER_COMMAND_TOPIC	<company name>/<quadrant>/sprinkler_command	"petrichor_agritech/quadrant_1/sprinkler_command"

# SIMULATOR RUNNING

main.py - quadrant\_1 - Visual Studio Code

File Edit Selection View Go Run Terminal Help

EXPLORER

- QUADRANT\_1
  - \_\_pycache\_\_
  - config
    - AmazonRootCA1.pem
    - AmazonRootCA3.pem
    - certificate.pem.crt
    - private.pem.key
    - public.pem.key
  - aws\_iot\_core\_mqtt.py
  - device\_config.py
  - Features.txt
  - main.py
  - OpenWeatherAPI.py

main.py

```
1 import random
2 import time
3 import threading
4 import json
5 import datetime as dt
6
7 from device_config import *
8 from OpenWeatherAPI import *
9 from aws_iot_core_mqtt import *
10
11 def set_weather_info():
12     global weather_info
13     # Calling the OpenWeather API and get the temperature value at the sprinkler's coordinates.
14     lat, long = sprinkler_info["coordinates"][0], sprinkler_info["coordinates"][1]
15     try:
16         openweatherAPI_response = get_weather_info(lat, long)
17         if(openweatherAPI_response["weather"][0]['main'] == 'Rain'):
18             # Yes, it is raining
19             weather_info['is_raining'] = 1
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL JUPYTER

Python + - [ ] [X] [^] [X]

```
{'name': 'sprinkler_q1', 'id': 'c9f73e82-0866-11ed-a5d2-fcde56ff0106', 'quadrant': 'quadrant_1', 'coordinates': [23.694063, 88.069879], 'state': 1, 'timestamp': '2022-07-30 21:25:40.952797'}
```

```
Weather in Quadrant 1 : {'temperature': 31.84, 'is_raining': 0}
{'name': 'sprinkler_q1', 'id': 'c9f73e82-0866-11ed-a5d2-fcde56ff0106', 'quadrant': 'quadrant_1', 'coordinates': [23.694063, 88.069879], 'state': 1, 'timestamp': '2022-07-30 21:25:50.971664'}
```

```
Weather in Quadrant 1 : {'temperature': 31.84, 'is_raining': 0}
{'name': 'sprinkler_q1', 'id': 'c9f73e82-0866-11ed-a5d2-fcde56ff0106', 'quadrant': 'quadrant_1', 'coordinates': [23.694063, 88.069879], 'state': 1, 'timestamp': '2022-07-30 21:26:00.975663'}
```

```
Weather in Quadrant 1 : {'temperature': 31.84, 'is_raining': 0}
{'name': 'sprinkler_q1', 'id': 'c9f73e82-0866-11ed-a5d2-fcde56ff0106', 'quadrant': 'quadrant_1', 'coordinates': [23.694063, 88.069879], 'state': 1, 'timestamp': '2022-07-30 21:26:10.979589'}
```

```
Weather in Quadrant 1 : {'temperature': 31.84, 'is_raining': 0}
{'name': 'sprinkler_q1', 'id': 'c9f73e82-0866-11ed-a5d2-fcde56ff0106', 'quadrant': 'quadrant_1', 'coordinates': [23.694063, 88.069879], 'state': 1, 'timestamp': '2022-07-30 21:26:20.999887'}
```

# AWS IOT CORE RECEIVING MQTT DATA

The screenshot shows the AWS IoT console interface. The left sidebar contains navigation options: Monitor, Connect, Test, and Manage. The 'Test' section is active, showing the 'MQTT test client'. The main content area displays a list of subscriptions under the heading 'Subscriptions'. Two subscriptions are listed: 'petrichor\_agritech/+/soil\_sensors' and 'petrichor\_agritech/+/sprinkler\_telemetry'. The first subscription is selected, and its details are shown on the right. The details include a 'petrichor\_agritech/+/soil\_sensors' subscription with a 'Pause', 'Clear', 'Export', and 'Edit' button. Below this, a message is shown with a timestamp of 'July 30, 2022, 21:27:51 (UTC+0530)'. The message payload is a JSON object: { "device\_name": "soil\_sensor\_q1\_3", "device\_id": "9b43c2ce-0866-11ed-b767-fcde56ff0106", "quadrant": "quadrant\_1", "coordinates": [ 23.693563, 88.069879 ], "moisture": 58.4, "temperature": 30.63, "timestamp": "2022-07-30 21:27:51.110978" }. Below this, another message is shown with the same timestamp, but with a different device\_id: "8e0d96a6-0866-11ed-9568-fcde56ff0106".

us-east-1.console.aws.amazon.com/iot/home?region=us-east-1#/test

aws Services Search for services, features, blogs, docs, and more [Alt+S]

N. Virginia greatlearningco1659192307385 @ 9464-6899-8920

### AWS IoT

- Monitor
- Connect
  - Connect one device
  - ▶ Connect many devices
- Test
  - ▶ Device Advisor
  - MQTT test client**
- Manage
  - ▶ All devices
  - ▶ Greengrass devices
  - ▶ LPWAN devices
  - ▶ Remote actions
  - ▶ Message Routing
    - Retained messages
  - ▶ Security

### Subscriptions

- petrichor\_agritech/+/soil\_sensors
- petrichor\_agritech/+/sprinkler\_telemetry

### petrichor\_agritech/+/soil\_sensors

Pause Clear Export Edit

▼ petrichor\_agritech/quadrant\_1/soil\_sensors July 30, 2022, 21:27:51 (UTC+0530)

```
{  "device_name": "soil_sensor_q1_3",  "device_id": "9b43c2ce-0866-11ed-b767-fcde56ff0106",  "quadrant": "quadrant_1",  "coordinates": [    23.693563,    88.069879  ],  "moisture": 58.4,  "temperature": 30.63,  "timestamp": "2022-07-30 21:27:51.110978"}
```

▼ petrichor\_agritech/quadrant\_1/soil\_sensors July 30, 2022, 21:27:51 (UTC+0530)

```
{  "device_name": "soil_sensor_q1_2",  "device_id": "8e0d96a6-0866-11ed-9568-fcde56ff0106",  "quadrant": "quadrant_1",
```

Feedback Looking for language selection? Find it in the new Unified Settings

© 2022, Amazon Internet Services Private Ltd. or its affiliates. Privacy Terms Cookie preferences

# AWS IOT CORE RECEIVING MQTT DATA

← → ↺

us-east-1.console.aws.amazon.com/iot/home?region=us-east-1#/test

🔖 ☆ ⚙️ 🗖️ 👤

📧 Gmail

📺 YouTube

📍 Maps

🔍 Google

📊 Dashboard - Great...

🌐 LinkedIn

aws

Services

🔍 Search for services, features, blogs, docs, and more [Alt+S]

📄 🔔 ⓘ

N. Virginia ▾

greatlearningco1659192307385 @ 9464-6899-8920 ▾

AWS IoT

×

Monitor

Connect

Test

Manage

Connect one device

▶ Connect many devices

▶ Device Advisor

MQTT test client

▶ All devices

▶ Greengrass devices

▶ LPWAN devices

▶ Remote actions

▶ Message Routing

Retained messages

▶ Security

Subscriptions

petrichor\_agritech/+/soil\_sensors

petrichor\_agritech/+/sprinkler\_telemetry

petrichor\_agritech/+/sprinkler\_telemetry

Pause Clear Export Edit

▼ petrichor\_agritech/quadrant\_1/sprinkler\_telemetry

July 30, 2022, 21:28:01 (UTC+0530)

{  
 "name": "sprinkler\_q1",  
 "id": "c9f73e82-0866-11ed-a5d2-fcde56ff0106",  
 "quadrant": "quadrant\_1",  
 "coordinates": [  
 23.694063,  
 88.069879  
 ],  
 "state": 1,  
 "timestamp": "2022-07-30 21:28:01.121986"  
}

▼ petrichor\_agritech/quadrant\_1/sprinkler\_telemetry

July 30, 2022, 21:27:51 (UTC+0530)

{  
 "name": "sprinkler\_q1",  
 "id": "c9f73e82-0866-11ed-a5d2-fcde56ff0106",  
 "quadrant": "quadrant\_1",  
 "coordinates": [  
 23.694063,  
 88.069879  
 ],  
 "state": 1,  
 "timestamp": "2022-07-30 21:27:51.121986"  
}

Feedback

Looking for language selection? Find it in the new Unified Settings

© 2022, Amazon Internet Services Private Ltd. or its affiliates.

Privacy

Terms

Cookie preferences



# AWS IOT CORE RECEIVING MQTT DATA

us-east-1.console.aws.amazon.com/iot/home?region=us-east-1#/test

Gmail YouTube Maps Google Dashboard - Great... LinkedIn

aws Services Search for services, features, blogs, docs, and more [Alt+S]

N. Virginia greatlearningco1659769774376 @ 9464-6899-8920

August 06, 2022, 21:07:38 (UTC+0530)

petrichor\_agritech/+/soil\_sensors

petrichor\_agritech/+/sprinkler\_command

```
{
  "name": "sprinkler_q3",
  "id": "f2d7f8eb-1282-11ed-a75b-a8b13bacd0d2",
  "coordinates": [
    23.691763,
    88.067579
  ],
  "quadrant": "quadrant_3",
  "state": 0
}
```

petrichor\_agritech/quadrant\_3/sprinkler\_command

August 06, 2022, 21:04:58 (UTC+0530)

```
{
  "name": "sprinkler_q5",
  "id": "325dedf1-1283-11ed-af81-a8b13bacd0d2",
  "coordinates": [
    23.696363,
    88.072179
  ],
  "quadrant": "quadrant_5",
  "state": 1
}
```

Feedback Looking for language selection? Find it in the new Unified Settings

© 2022, Amazon Internet Services Private Ltd. or its affiliates. Privacy Terms Cookie preferences

# AWS DYNAMODB : STATIC DEVICE INFORMATION

Items | Amazon DynamoDB Man

+

←

→

↺

us-east-1.console.aws.amazon.com/dynamodbv2/home?region=us-east-1#item-explorer?initialTagKey=&maximize=true&table=GL\_IoT\_Group\_4\_Device\_Data

🔍

🔗

☆

⚙️

☰

🖨️

🌐

⋮

📧 Gmail

📺 YouTube

📍 Maps

🔍 Google

🏠 Dashboard - Great...

🌐 LinkedIn

aws

Services

🔍 Search for services, features, blogs, docs, and more

[Alt+S]

🖨️

🔔

🔍

N. Virginia

greatlearningco1659640469051 @ 9464-6899-8920

⬆️

DynamoDB

×

Dashboard

Tables

Update settings

Explore items

PartiQL editor New

Backups

Exports to S3

Reserved capacity

Settings New

▼ DAX

Clusters

Subnet groups

Parameter groups

Events

DynamoDB > Items > GL\_IoT\_Group\_4\_Device\_Data

>

GL\_IoT\_Group\_4\_Device\_Data

Autopreview

View table details

▶ Scan/Query items

Expand to query or scan items.

🟢 Completed

Read capacity units consumed: 0.5

Items returned (25)

🔄

Actions ▼

Create item

<

1

>

⚙️

🔍

<input type="checkbox"/>	device_id ▼	device_name ▼	lat ▼	long ▼	quadrant_name ▼
<input type="checkbox"/>	325dedf1-1283-11ed...	sprinkler_q5	23.696363	88.072179	quadrant_5
<input type="checkbox"/>	de111f20-1282-11ed...	soil_sensor_q...	23.692263	88.067579	quadrant_3
<input type="checkbox"/>	f2d7f8eb-1282-11ed-...	sprinkler_q3	23.691763	88.067579	quadrant_3
<input type="checkbox"/>	2579b236-1283-11e...	soil_sensor_q...	23.695863	88.072179	quadrant_5
<input type="checkbox"/>	d754c869-1282-11ed...	sprinkler_q2	23.696363	88.067579	quadrant_2
<input type="checkbox"/>	2c22ed24-1283-11ed...	soil_sensor_q...	23.696363	88.072679	quadrant_5
<input type="checkbox"/>	8e0d96a6-0866-11ed...	soil_sensor_q...	23.694063	88.069379	quadrant_1
<input type="checkbox"/>	d1228c4a-1282-11ed...	soil_sensor_q...	23.695863	88.067579	quadrant_2
<input type="checkbox"/>	e8993f04-1282-11ed...	soil_sensor_q...	23.691263	88.067579	quadrant_3

Feedback

Looking for language selection? Find it in the new [Unified Settings](#)

© 2022, Amazon Internet Services Private Ltd. or its affiliates.

Privacy

Terms

Cookie preferences

# BACKEND (EC2) RUNNING

```
ubuntu@ip-172-31-28-78: ~  
{'device_id': 'e8993f04-1282-11ed-a85b-a8b13bacd0d2', 'coordinates': [23.691263, 88.067579], 'quadrant': 'quadrant_3', 'temperature': 27.84, 'moisture': 35.76, 'needs_water': 1}  
{'device_id': '0994ca05-1283-11ed-92b9-a8b13bacd0d2', 'coordinates': [23.691763, 88.072679], 'quadrant': 'quadrant_4', 'temperature': 28.09, 'moisture': 34.46, 'needs_water': 1}  
{'device_id': '04538d48-1283-11ed-92d6-a8b13bacd0d2', 'coordinates': [23.691263, 88.072179], 'quadrant': 'quadrant_4', 'temperature': 28.41, 'moisture': 38.39, 'needs_water': 0}  
{'device_id': 'f8f6ca96-1282-11ed-bd7d-a8b13bacd0d2', 'coordinates': [23.692263, 88.072179], 'quadrant': 'quadrant_4', 'temperature': 26.08, 'moisture': 36.92, 'needs_water': 0}  
{'device_id': 'fd102720-1282-11ed-9c73-a8b13bacd0d2', 'coordinates': [23.691763, 88.071679], 'quadrant': 'quadrant_4', 'temperature': 29.95, 'moisture': 38.05, 'needs_water': 0}  
{'device_id': '2579b236-1283-11ed-9f1d-a8b13bacd0d2', 'coordinates': [23.695863, 88.072179], 'quadrant': 'quadrant_5', 'temperature': 28.29, 'moisture': 61.15, 'needs_water': 0}  
{'device_id': '2c22ed24-1283-11ed-87cf-a8b13bacd0d2', 'coordinates': [23.696363, 88.072679], 'quadrant': 'quadrant_5', 'temperature': 28.15, 'moisture': 66.27, 'needs_water': 0}  
{'device_id': '203f0df9-1283-11ed-ae27-a8b13bacd0d2', 'coordinates': [23.696363, 88.071679], 'quadrant': 'quadrant_5', 'temperature': 27.57, 'moisture': 59.87, 'needs_water': 0}  
{'device_id': '1bbf1d32-1283-11ed-9523-a8b13bacd0d2', 'coordinates': [23.696863, 88.072179], 'quadrant': 'quadrant_5', 'temperature': 27.97, 'moisture': 62.31, 'needs_water': 0}  
  
{'name': 'sprinkler_q1', 'id': 'c9f73e82-0866-11ed-a5d2-fcde56ff0106', 'coordinates': [23.694063, 88.069879], 'quadrant': 'quadrant_1', 'state': 0}  
{'name': 'sprinkler_q2', 'id': 'd754c869-1282-11ed-8b4d-a8b13bacd0d2', 'coordinates': [23.696363, 88.067579], 'quadrant': 'quadrant_2', 'state': 0}  
{'name': 'sprinkler_q3', 'id': 'f2d7f8eb-1282-11ed-a75b-a8b13bacd0d2', 'coordinates': [23.691763, 88.067579], 'quadrant': 'quadrant_3', 'state': 1}  
{'name': 'sprinkler_q4', 'id': '0f10bf24-1283-11ed-a30d-a8b13bacd0d2', 'coordinates': [23.691763, 88.072179], 'quadrant': 'quadrant_4', 'state': 0}  
{'name': 'sprinkler_q5', 'id': '325dedf1-1283-11ed-af81-a8b13bacd0d2', 'coordinates': [23.696363, 88.072179], 'quadrant': 'quadrant_5', 'state': 0}  
  
{'quadrant_1': 0, 'quadrant_2': 0, 'quadrant_3': 3, 'quadrant_4': 1, 'quadrant_5': 0}  
  
{'device_id': '839d184c-0866-11ed-a098-fcde56ff0106', 'coordinates': [23.694563, 88.069879], 'quadrant': 'quadrant_1', 'temperature': 28.07, 'moisture': 35.18, 'needs_water': 0}  
{'device_id': '9b43c2ce-0866-11ed-b767-fcde56ff0106', 'coordinates': [23.693563, 88.069879], 'quadrant': 'quadrant_1', 'temperature': 30.57, 'moisture': 31.0, 'needs_water': 0}  
{'device_id': '8e0d96a6-0866-11ed-9568-fcde56ff0106', 'coordinates': [23.694063, 88.069379], 'quadrant': 'quadrant_1', 'temperature': 28.94, 'moisture': 23.22, 'needs_water': 0}  
{'device_id': 'a59e0e7e-0866-11ed-9b48-fcde56ff0106', 'coordinates': [23.694063, 88.070379], 'quadrant': 'quadrant_1', 'temperature': 29.78, 'moisture': 23.43, 'needs_water': 0}  
{'device_id': 'cbb5e74f-1282-11ed-ad09-a8b13bacd0d2', 'coordinates': [23.696363, 88.068079], 'quadrant': 'quadrant_2', 'temperature': 31.6, 'moisture': 22.37, 'needs_water': 0}  
{'device_id': 'bc76da1d-1282-11ed-b290-a8b13bacd0d2', 'coordinates': [23.696863, 88.067579], 'quadrant': 'quadrant_2', 'temperature': 27.93, 'moisture': 22.86, 'needs_water': 0}  
{'device_id': 'd1228c4a-1282-11ed-b522-a8b13bacd0d2', 'coordinates': [23.695863, 88.067579], 'quadrant': 'quadrant_2', 'temperature': 29.32, 'moisture': 23.06, 'needs_water': 0}  
{'device_id': 'c568db46-1282-11ed-aab6-a8b13bacd0d2', 'coordinates': [23.696363, 88.067079], 'quadrant': 'quadrant_2', 'temperature': 30.95, 'moisture': 22.38, 'needs_water': 0}  
{'device_id': 'edd5a890-1282-11ed-b142-a8b13bacd0d2', 'coordinates': [23.691763, 88.068079], 'quadrant': 'quadrant_3', 'temperature': 26.62, 'moisture': 36.47, 'needs_water': 1}  
{'device_id': 'e344f61c-1282-11ed-ab6e-a8b13bacd0d2', 'coordinates': [23.691763, 88.067079], 'quadrant': 'quadrant_3', 'temperature': 28.85, 'moisture': 33.02, 'needs_water': 1}  
{'device_id': 'de111f20-1282-11ed-8761-a8b13bacd0d2', 'coordinates': [23.692263, 88.067579], 'quadrant': 'quadrant_3', 'temperature': 29.47, 'moisture': 39.35, 'needs_water': 0}  
{'device_id': 'e8993f04-1282-11ed-a85b-a8b13bacd0d2', 'coordinates': [23.691263, 88.067579], 'quadrant': 'quadrant_3', 'temperature': 29.76, 'moisture': 37.35, 'needs_water': 1}  
{'device_id': '0994ca05-1283-11ed-92b9-a8b13bacd0d2', 'coordinates': [23.691763, 88.072679], 'quadrant': 'quadrant_4', 'temperature': 28.85, 'moisture': 34.09, 'needs_water': 1}  
{'device_id': '04538d48-1283-11ed-92d6-a8b13bacd0d2', 'coordinates': [23.691263, 88.072179], 'quadrant': 'quadrant_4', 'temperature': 27.56, 'moisture': 38.03, 'needs_water': 0}  
{'device_id': 'f8f6ca96-1282-11ed-bd7d-a8b13bacd0d2', 'coordinates': [23.692263, 88.072179], 'quadrant': 'quadrant_4', 'temperature': 30.34, 'moisture': 36.55, 'needs_water': 0}  
{'device_id': 'fd102720-1282-11ed-9c73-a8b13bacd0d2', 'coordinates': [23.691763, 88.071679], 'quadrant': 'quadrant_4', 'temperature': 29.57, 'moisture': 37.68, 'needs_water': 0}  
{'device_id': '2579b236-1283-11ed-9f1d-a8b13bacd0d2', 'coordinates': [23.695863, 88.072179], 'quadrant': 'quadrant_5', 'temperature': 28.75, 'moisture': 60.04, 'needs_water': 0}  
{'device_id': '2c22ed24-1283-11ed-87cf-a8b13bacd0d2', 'coordinates': [23.696363, 88.072679], 'quadrant': 'quadrant_5', 'temperature': 31.78, 'moisture': 65.16, 'needs_water': 0}  
{'device_id': '203f0df9-1283-11ed-ae27-a8b13bacd0d2', 'coordinates': [23.696363, 88.071679], 'quadrant': 'quadrant_5', 'temperature': 28.24, 'moisture': 58.75, 'needs_water': 0}  
{'device_id': '1bbf1d32-1283-11ed-9523-a8b13bacd0d2', 'coordinates': [23.696863, 88.072179], 'quadrant': 'quadrant_5', 'temperature': 27.05, 'moisture': 61.19, 'needs_water': 0}  
  
{'name': 'sprinkler_q1', 'id': 'c9f73e82-0866-11ed-a5d2-fcde56ff0106', 'coordinates': [23.694063, 88.069879], 'quadrant': 'quadrant_1', 'state': 0}  
{'name': 'sprinkler_q2', 'id': 'd754c869-1282-11ed-8b4d-a8b13bacd0d2', 'coordinates': [23.696363, 88.067579], 'quadrant': 'quadrant_2', 'state': 0}  
{'name': 'sprinkler_q3', 'id': 'f2d7f8eb-1282-11ed-a75b-a8b13bacd0d2', 'coordinates': [23.691763, 88.067579], 'quadrant': 'quadrant_3', 'state': 1}  
{'name': 'sprinkler_q4', 'id': '0f10bf24-1283-11ed-a30d-a8b13bacd0d2', 'coordinates': [23.691763, 88.072179], 'quadrant': 'quadrant_4', 'state': 0}  
{'name': 'sprinkler_q5', 'id': '325dedf1-1283-11ed-af81-a8b13bacd0d2', 'coordinates': [23.696363, 88.072179], 'quadrant': 'quadrant_5', 'state': 0}  
  
{'quadrant_1': 0, 'quadrant_2': 0, 'quadrant_3': 3, 'quadrant_4': 1, 'quadrant_5': 0}
```

# INFLUXDB HOME PAGE

← → ↻ Not secure | 54.196.189.22:8086/orgs/a2fc136bc3162ec2

Gmail YouTube Maps Google Dashboard - Great... LinkedIn

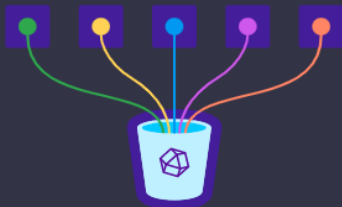


9



## Getting Started

1



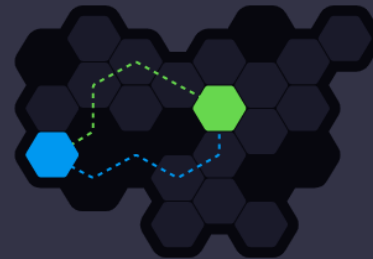
LOAD YOUR DATA

2



BUILD A DASHBOARD

3



SET UP ALERTING

Some Handy Guides and Tutorials

[Get Started with Flux](#)

[Explore Metrics](#)

[Build a Dashboard](#)

Account

LOGOUT

Recent Dashboards

Filter dashboards...

[Quadrant - 1: Weather](#)

[Quadrant 1: Graphs](#)

[Quadrant - 1: Real Time](#)

[Name this Dashboard](#)

InfluxDB v2.3.0+SNAPSHOT.090f681737

Server: 090f681

Frontend: a2bd1f3



# INFLUXDB DATA EXPLORER

← → ↻ Not secure | 54.196.189.22:8086/orgs/a2fc136bc3162ec2/data-explorer

📧 Gmail 📺 YouTube 🗺️ Maps 🌐 Google 🏠 Dashboard - Great... 🔗 LinkedIn



## Data Explorer

9

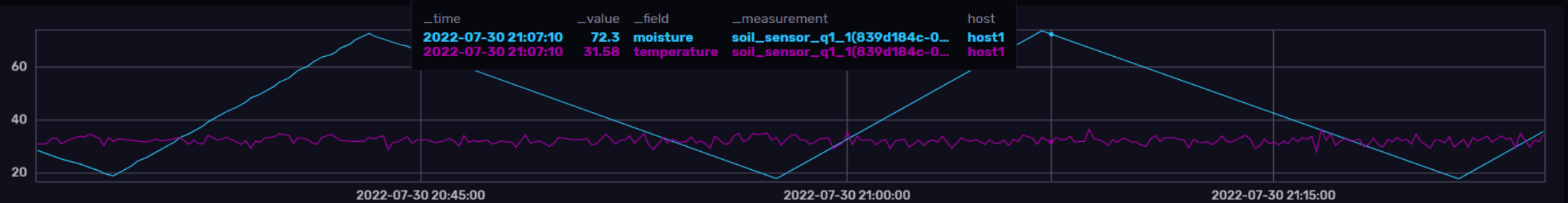


Graph

CUSTOMIZE

Local

SAVE AS



Query 1 (0.33s)

+

View Raw Data

CSV



Past 1h

SCRIPT EDITOR

SUBMIT

FROM

Search for a bucket

quadrant\_1

quadrant\_2

quadrant\_3

quadrant\_4

quadrant\_5

\_monitoring

tasks

Filter

\_measurement

1

Search \_measurement tag

soil\_sensor\_q1\_1(83...

soil\_sensor\_q1\_2(8e...

soil\_sensor\_q1\_3(9b...

soil\_sensor\_q1\_4(a5...

Filter

\_field

Search \_field tag values

moisture

temperature

WINDOW PERIOD

CUSTOM

AUTO

auto (10s)

Fill missing values



AGGREGATE FUNCTION

CUSTOM

AUTO

# DASHBOARDS

## Dashboards

Q Filter dashboards...

Sort by Name (A → Z)

+ CREATE DASHBOARD

### Quadrant - 1 : Real Time

No description

Last modified 9 hours ago

+ q1 real\_time

### Quadrant - 2 : Real Time

No description

Last modified 9 hours ago

+ real\_time q2

### Quadrant - 3 : Real Time

No description

Last modified 4 hours ago

+ real\_time q3

### Quadrant - 4 : Real Time

No description

Last modified 9 hours ago

+ real\_time q4

### Quadrant - 5 : Real Time

No description

Last modified 9 hours ago

+ real\_time q5

### Quadrant 1 : Graphs

No description

Last modified 43 minutes ago

+ q1 graphs

### Quadrant 1 : Weather

No description

Last modified 7 minutes ago

+ q1 weather

### Quadrant 2 : Graphs

No description

Last modified 9 hours ago

+ q2 graphs

### Quadrant 2 : Weather

No description

Last modified 6 minutes ago

+ q2 weather

### Quadrant 3 : Graphs

No description

Last modified 9 hours ago

+ q3 graphs

### Quadrant 3 : Weather

No description

Last modified 6 minutes ago

+ q3 weather

### Quadrant 4 : Graphs

No description

Last modified 7 minutes ago

+ q4 graphs

### Quadrant 4 : Weather

No description

Last modified 5 minutes ago

+ q4 weather

### Quadrant 5 : Graphs

No description

Last modified 6 minutes ago

+ q5 graphs

### Quadrant 5 : Weather

No description

Last modified 5 minutes ago

+ q5 weather

# DASHBOARDS

## Quadrant - 1 : Real Time

ADD CELL

ADD NOTE

Show Variables

Enable Annotations

...

REFRESHING EVERY 10S

Local

Past 1h

This dashboard doesn't have any cells with defined variables. [Learn How](#)

Soil Sensor 1 : Moisture



Soil Sensor 2 : Moisture



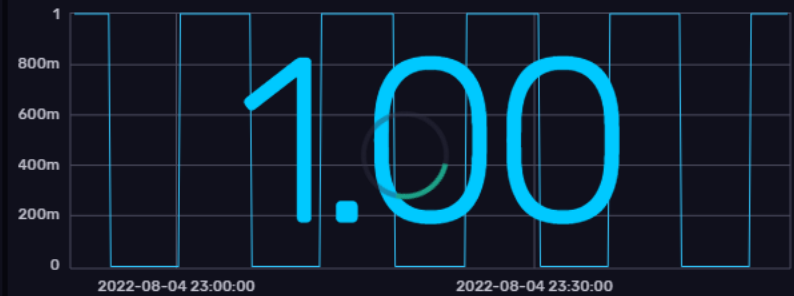
Soil Sensor 3 : Moisture



Soil Sensor 4 : Moisture



Sprinkler State



Soil Sensor 1 : Temperature



Soil Sensor 2 : Temperature



Soil Sensor 3 : Temperature



Soil Sensor 4 : Temperature



Rain State



# DASHBOARDS

## Quadrant - 2 : Real Time

ADD CELL

ADD NOTE

Show Variables

Enable Annotations

...

🔄

ENABLE AUTO REFRESH

Local

Past 1h

This dashboard doesn't have any cells with defined variables. [Learn How](#)

Soil Sensor 1 : Moisture



Soil Sensor 2 : Moisture



Soil Sensor 3 : Moisture



Soil Sensor 4 : Moisture



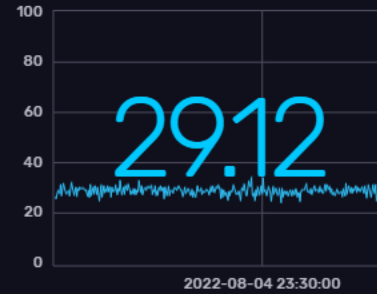
Sprinkler State



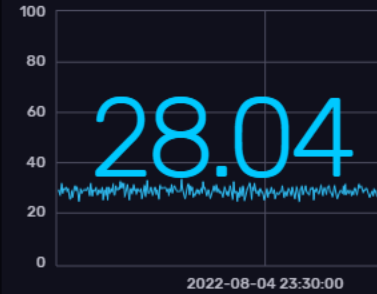
Soil Sensor 1 : Temperature



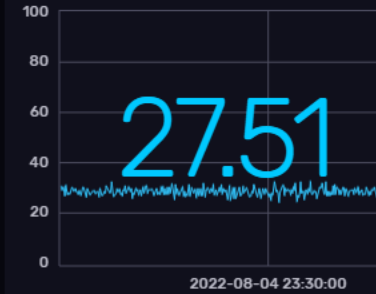
Soil Sensor 2 : Temperature



Soil Sensor 3 : Temperature



Soil Sensor 4 : Temperature



Rain State





# DASHBOARDS

This dashboard doesn't have any cells with defined variables. [Learn How](#)

☰

Sensor 2

⚙



☰

Sensor 3

⚙



_time	_value	_field	_measurement	host
2022-08-04 23:17:30	70.22	moisture	soil_sensor_q1_3(9b43c2ce-0...	host1
2022-08-04 23:17:30	29.45	temperature	soil_sensor_q1_3(9b43c2ce-0...	host1

☰

Sensor 4

⚙



☰

Sprinkler

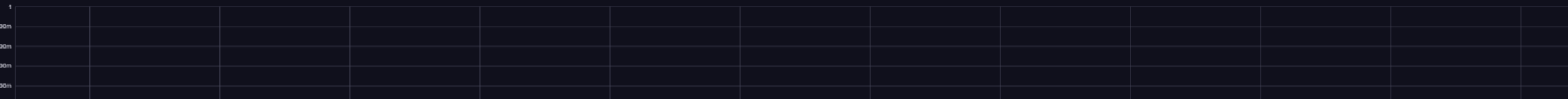
⚙



☰

Rain State

⚙



# DASHBOARDS

## Quadrant 2 : Graphs

ADD CELL

ADD NOTE

Show Variables

Enable Annotations

...

?

○

ENABLE AUTO REFRESH

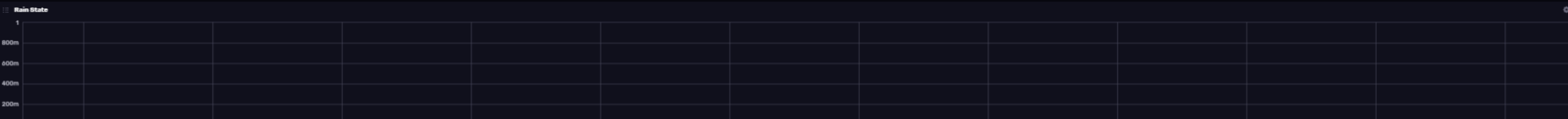
Local

Past 3h

This dashboard doesn't have any cells with defined variables. [Learn How](#)



_time	_value	_field	_measurement	host
2022-08-04 22:15:00	70.49	moisture	soil_sensor_ag_4(d1228e4s-1_	host1
2022-08-04 22:15:00	29.04	temperature	soil_sensor_ag_4(d1228e4s-1_	host1



# DASHBOARDS

## Quadrant 1 : Weather

ADD CELL

ADD NOTE

Show Variables

Enable Annotations

...



REFRESHING EVERY 10S

Local

Past 6h

This dashboard doesn't have any cells with defined variables. [Learn How](#)



# SCALABILITY

- The backend application is completely dynamic i.e. it doesn't require any hard-coding in terms of device information.
- When the backend application starts running it subscribes the MQTT topics using wildcards. So even if there is data on new topics it will still receive the data.
- Then as soon as it gets the device packets, it starts keeping and updating a real-time buffer for all the devices (soil sensors and sprinklers), maintaining real-time information for those devices.
- If it receives a MQTT message for a device that is not present in its buffer then it adds the device to the buffer, creates appropriate measurements (storage) in the InfluxDB and according to its quadrant it will start acting on its readings.
- So adding devices will be a task for the field only and the backend will automatically adjust the data ingestion and control logic as long as the MQTT topics are appropriate.
- The control logic periodically iterates over each quadrant checking all the soil sensors measurements and actuates the sprinklers if needed.



# DEVICE PROVISIONING APPLICATION

- This App is a web based GUI which takes parameters : Device Name, Device Type, Quadrant, Latitude, Longitude.
- It then generates a uuid (Unique ID) for that device.
- Then it registers it on AWS IoT Core as a thing and generates its certificates.
- It saves the certificates in a folder in the same directory.
- It also creates a DynamoDB entry for that created device.

# DEVICE PROVISIONING APPLICATION

localhost:61632

Gmail YouTube Maps Google Dashboard - Great... LinkedIn

Agritech : New Device Registration

Enter Device(AWS-Thing) Name

new\_device\_1

Submit Reset

localhost:61632

Gmail YouTube Maps Google Dashboard - Great... LinkedIn

Agritech : New Device Registration

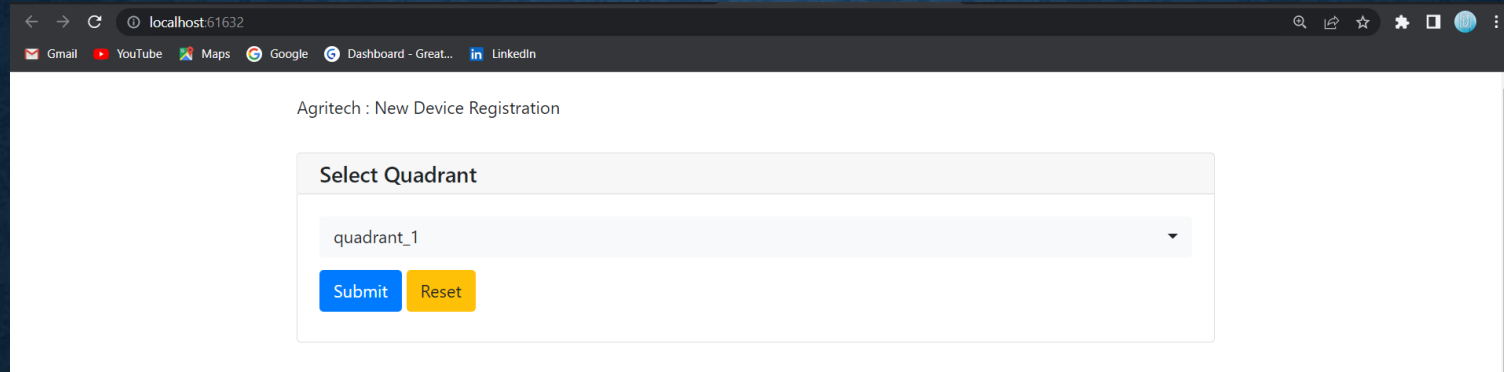
Select Device Type

soil\_sensor

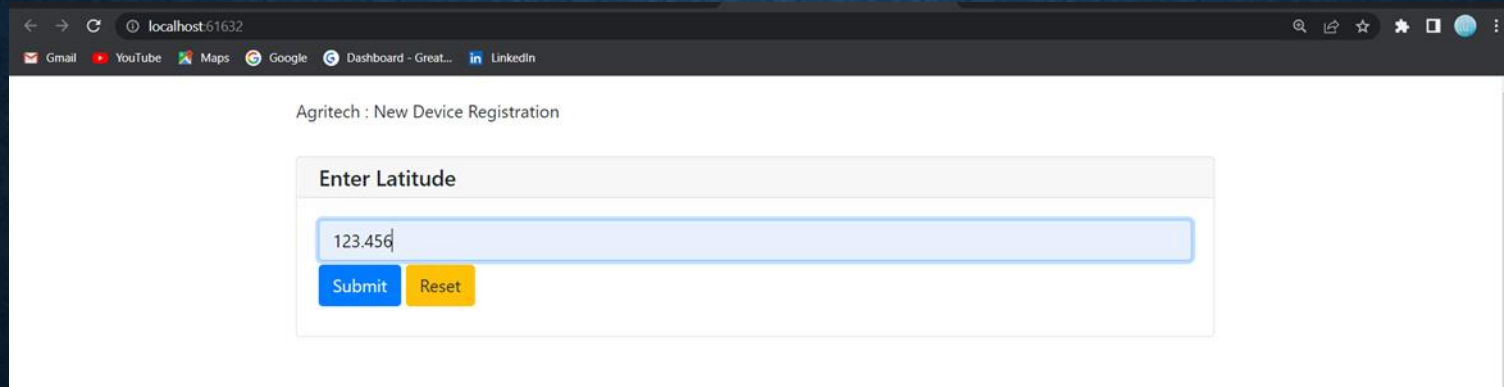
soil\_sensor

sprinkler

# DEVICE PROVISIONING APPLICATION



A screenshot of a web browser displaying the 'Agritech : New Device Registration' page. The browser's address bar shows 'localhost:61632'. The page features a form titled 'Select Quadrant' with a dropdown menu currently showing 'quadrant\_1'. Below the dropdown are two buttons: a blue 'Submit' button and a yellow 'Reset' button.



A screenshot of the same web browser displaying the 'Agritech : New Device Registration' page. The browser's address bar shows 'localhost:61632'. The page features a form titled 'Enter Latitude' with a text input field containing the value '123.456'. Below the input field are two buttons: a blue 'Submit' button and a yellow 'Reset' button.



# DEVICE PROVISIONING APPLICATION

localhost:61632

Gmail YouTube Maps Google Dashboard - Great... LinkedIn

Agritech : New Device Registration

Enter Longitude

180.123

Submit Reset

localhost:61632

Gmail YouTube Maps Google Dashboard - Great... LinkedIn

Agritech : New Device Registration

Device Registered on AWS IoT Core!

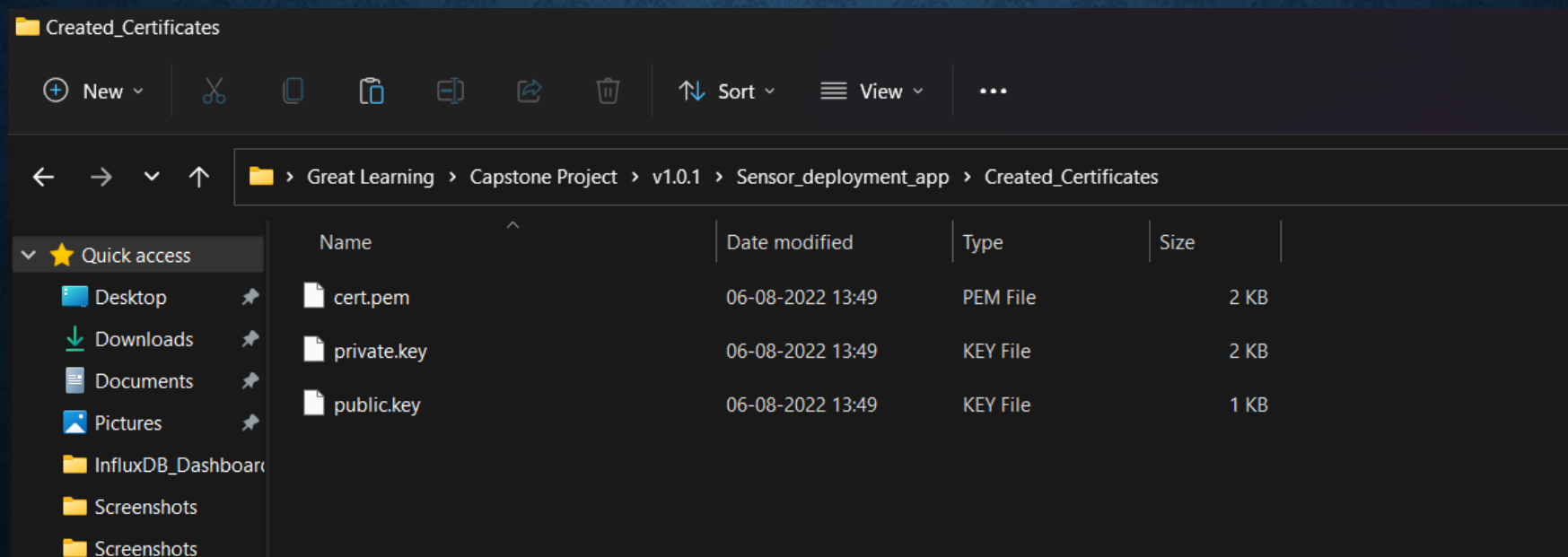
Device Name : new\_device\_1  
Device Type : sprinkler  
Device ID : 4e3cf832-1560-11ed-95e2-a8b13bacd0d2  
Quadrant : quadrant\_1  
Coordinates = [123.456,180.123]

Register another device?

YES NO

# DEVICE PROVISIONING APPLICATION

- After this a new device is created on AWS IoT Core as a Thing with proper policy attached. Certificates are saved as shown below.
- A new item is inserted into the DynamoDB table.  
(See code for more details.)



# AREAS OF FUTURE IMPROVEMENT

- We are currently storing “cold” data into DynamoDB. This design can be improved because we can store it in S3 buckets which are better for cold-storage since we are using InfluxDB to store our real-time data.
- Process metrics can be studied and fed as inputs to improve the software architecture which is a continuous process.





**THANK YOU**