MESSAGE ALERTS WITH MQTT

INTERNET OF THINGS

Time: 60 mins

Introduction

In this class, the student/s will learn how to send and receive the temperature and humidity values as messages using the MQTT protocol.

New Commands Introduced

● #include <PubSubClient.h>	Installs library to connect the devices and applications to publish or subscribe
● PubSubClient client(espClient);	Enables the client passed to publish or subscribe through wifi
● const char* mqttServer = "broker.emqx.io";	Stores the MQTT broker address in a const variable
● client.setServer(mqttServer, 1883);	Connects the client to the server using specified server address and it port
● client.connect(clientId.c_str())	Converts a string to C style and connects the client to wifi
● String tempStr = String(temperature, 2);	Converts temperature to string with a 2 decimal value and stores it
● String humStr = String(humidity, 1);	Converts humidity to string with a 1 decimal value and stores it
● client.publish()	Publishes the data to subscribers

Vocabulary

- **Message Queuing Telemetry Transport(MQTT)** is a messaging protocol which allows users to subscribe and publish data for limited devices and networks.
- A **Publisher** is an IoT device which can send or publish information on a specific topic to a server that acts as an MQTT message broker.
- The **MQTT-Broker** is responsible for receiving all messages, filtering the messages, determining who subscribed to each message and sending the message to those subscribed clients.

- **PubSubClient** is a client library for MQTT messaging which can connect the devices and applications through wifi.

Learning Objectives

Student/s should be able to:

- ***Recall*** how different devices like ESP32, sensor and LCD's can be connected to a wifi as a circuit.
- ***Explain*** how to download and install MQTT and connect clients to it.
- ***Demonstrate*** how to send and receive the live message alerts updating temperature and humidity values of the cargo.

Activities

Class Narrative: *(3 mins)*

- Brief the student/s that James and Eva urgently need quick updates on cargo conditions during transit. Explain that they aim to set up an efficient messaging system like MQTTX.

Concept Introduction Activity: *(4 mins)*

- Let the student/s observe that the temperature and humidity values are updated as message alerts on the MQTT.
- Explain about Message Queuing Telemetry Transport(MQTT) as a messaging protocol which allows to subscribe and publish data for limited devices and networks.
- Explain the role of publisher, MQTT broker and the client(subscriber) in MQTT client connections.
- Using the slides, explain that the student/s will learn:
    - to download and install MQTT
    - to create MQTT connections
    - to send temperature and humidity data

Activity 1: Download and Install MQTT *(10 mins)*

Teacher Activity: *(5 mins)*

- Explain how MQTT is used for data transmission and mention a few applications.
- Explain how MQTT topics need to be subscribed by the clients to receive updates on it.
- Demonstrate downloading and installing the MQTT protocol files.

Student Activity: *(5 mins)*

- Guide the student/s to download, install and explore the MQTT protocol.

Activity 2: Create MQTT Connections *(18 mins)*

Teacher Activity: *(7 mins)*

- Explain how we will connect the client by creating a wifi client connection that can connect to a specified internet IP address and port using the client.connect() method.
- Explain how we will create the MQTT connections between server and clients.

Student Activity: *(11 mins)*

- Guide the student/s to create MQTT connections between devices and the applications by creating a new connection with client ID and displaying the connection status.

Activity 3: Send Temperature and Humidity Data *(12 mins)*

Teacher Activity: *(6 mins)*

- Explain that the clients are connected but aren't updated with the temperature and humidity values.
- Explain how the topics can be subscribed to receive the updates as messages to the connected clients on the wifi.

Student Activity: *(6 mins)*

- Guide the student/s to send and receive the temperature and humidity values as messages by subscribing to the topics and publishing the values to the connections.

Introduce the Post class project: *(2 min)*

- Turn the AC on when temperature is high and turn it off if temperature is less.

Test and Summarize the class learnings: *(5 mins)*

- Check for understanding through quizzes and summarize learning after respective activities.
- Summarize the overall class learning towards the end of the class.

Additional activities:

- Encourage the student/s to check if the values will be received at MQTT Client when topic names are changed.

- Encourage the student/s to debug the piece of code to check if the MQTT connection is working well.

State the Next Class Objective: *(1 min)*

- In the next class, student/s will learn to create a dashboard to display the published data.

U.S. Standards:

CSTA: 2-AP-11, 2-AP-12, 2-AP-13, 2-AP-14, 2-AP-19

Links Table		
Activity	Activity Name	Link
Class Presentation	MESSAGE ALERTS WITH MQTT	https://s3-whjr-curriculum-uploads.whjr.online/3d6bc9de-6643-4874-bebb-eded484d32dc.html
Explore Activity	MESSAGE ALERTS WITH MQTT	https://s3.amazonaws.com/media-p.slid.es/uploads/1525749/images/11076037/C139_final.gif
Student Activity 1	Download and Install MQTT	https://mqttx.app/docs/downloading-and-installation
Teacher Reference: Student Activity 1 Solution	Download and Install MQTT	https://mqttx.app/docs/downloading-and-installation
Teacher Activity 2	Create MQTT Connections	https://wokwi.com/projects/388403228702369793
Teacher Reference: Teacher Activity 2 Solution	Create MQTT Connections	https://wokwi.com/projects/388403237963395073
Student Activity 2	Create MQTT Connections	https://wokwi.com/projects/386713120274931713
Teacher Reference: Student Activity 2 Solution	Create MQTT Connections	https://wokwi.com/projects/386707800606182401
Teacher Activity 3	Send Temperature and Humidity Values	https://wokwi.com/projects/388403274137180161
Teacher Reference: Teacher Activity 3 Solution	Send Temperature and Humidity Values	https://wokwi.com/projects/388403282398911489
Student Activity 3	Send Temperature and Humidity Values	https://wokwi.com/projects/386713408633360385
Teacher Reference: Student Activity 3 Solution	Send Temperature and Humidity Values	https://wokwi.com/projects/386709320222575617

Student's Additional Activity 1	Change the Topic Name	https://wokwi.com/projects/386712988184745985
Teacher Reference: Student's Additional Activity 1 Solution	Change the Topic Name	https://wokwi.com/projects/386709481677084673
Student's Additional Activity 2	Debug the MQTT Connection	https://wokwi.com/projects/386713091629930497
Teacher Reference: Student's Additional Activity 2 Solution	Debug the MQTT Connection	https://wokwi.com/projects/386713046517039105
Post Class Project	Automate the Air Conditioner	https://wokwi.com/projects/386713562772990977
Teacher Reference: Post Class Project Solution	Automate the Air Conditioner	https://wokwi.com/projects/386512659779721217