King Fahd University of Petroleum and Minerals

Computer Engineering Department

Homework Assignment #2

Due date: Wednesday April 9, 2025 @11:59 PM (before midnight)

Instructions:

1. Solution should be uploaded through Blackboard as a compressed zip file named HW2_NAME_ID.zip where NAME is your name and ID is your student ID. Name the packet tracer file as HW2.pka.
2. Students are encouraged to discuss the homework in groups, but each student must write and submit his/her own program.
3. If cheating or copying is detected, both parties will get zero in the assignment.
4. No late submissions will be accepted.

Outcomes: After finishing this assignment, you should be able to:

1. Configure and implement an MQTT Broker for home automation in PT.
2. Subscribe and publish to topics by MQTT Clients.
3. Build a functioning IoT application using MQTT protocol in PT.

Requirements: Cisco Packet Tracer version 8.1.1 (or above).

Preparations:

See the "A Guide for using MQTT in PT" lecture notes on BB.

Homework Problems:

Problem 1: (100 points) Home Automation using MQTT

You are required to implement a "Digital Home" using PT with the following specifications:

1. The system includes:
    a. A server (hosting an MQTT Broker)
    b. A Wireless Router
    c. A Rocker Switch (ON/OFF)
    d. An LED (ON/OFF)
    e. A Potentiometer (Variable range)
    f. A Dimmable LED (Variable Range)
    g. An LCD Display

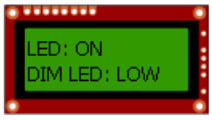
The system works as follows:

1. Each device is connected to a separate SBC that is running an MQTT client.
2. If the Rocker switch is ON, the LED turns ON.

3. Based on the Potentiometer value, the dimmable LED must be set to the same value (between 0 and 1023).
4. The LCD Display shows the status of the LED and Dimmable LED. For the Dimmable LED, choose the following descriptions.

Value of LED	LCD Display message
0-350	LOW
351-700	MED
701-1023	HIGH

Here is an example of the LCD Display information:



Hint:

1. Use the included program as a starting point. The program (main.py) uses the implementation in (mqttclient.py). The program connects to the broker, and subscribes to a topic. You need to extend the functionality according to the role of the device (subscriber/publisher).
2. Use the "**Help**" menu under "**Programming**" Tab to check the different available Python APIs.
3. Here is a brief description of some useful APIs from mqttclient.py

API	Use	Argument		
		arg	type	content
MQTT CLIENT				
init()	Initializes a TCP client	None		
`connect(broker_add,usr,pwd)`	Connects to the Broker	broker_add:	String	IP address of Broker
		usr	String	Username
		pwd	String	Password
`subscribe(topic)`	Subscribe to a topic	topic	String	Topic to subscribe to
`unsubscribe(topic)`	Unsubscribe to a topic	topic	String	Topic to unsubscribe from
`publish(topic, payload, qos):`	Publish a topic	topic	String	Topic to publish
		payload	String	Message
		qos	String	QoS level

`pingreq():`	A ping request	None		
MQTT Broker				
`add_user(username, password)`	Add an authorized user to the broker	username	String	Username
		password	String	Password

Testing: The system must respond as described above. All functionalities will be tested.