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Please answer the following questions with their respective video records and screenshots.

1. **ESP32 as Web Server (LED on/off):** Connect LED to ESP32 (GPIO4) (please revise previous activities for circuit diagram) and upload `"/esp32_webserver/LED_Web/LED_Web.ino"` to your ESP32. At serial monitor, check the IP address of ESP32. Then connect your ESP32 web server as <http://<ESP32 IP address>> to control your LED on/off. Take a video record where you control your LED on/off via ESP32 web browser.

Remark: Fill in your WiFi credentials (SSID and Password) at "config.h".

Link your video record:

<https://drive.google.com/file/d/1iQJ5PqFEGYIGmNS-NUPhWW3E8GYdrgke/view?usp=sharing>

2. **ESP32 as Web Server (Servo Motor):** Connect a servo motor to GPIO23 (please revise previous activities for circuit diagram) and upload `"/esp32_webserver/LED_Web/Servo_Web.ino"` to your ESP32. At serial monitor, check the IP address of ESP32. Then connect your ESP32 web server as <http://<ESP 32 IP address>> to control the rotation of servo motor. Take a video record how do you control the rotation of servo motor via ESP32 web browser.

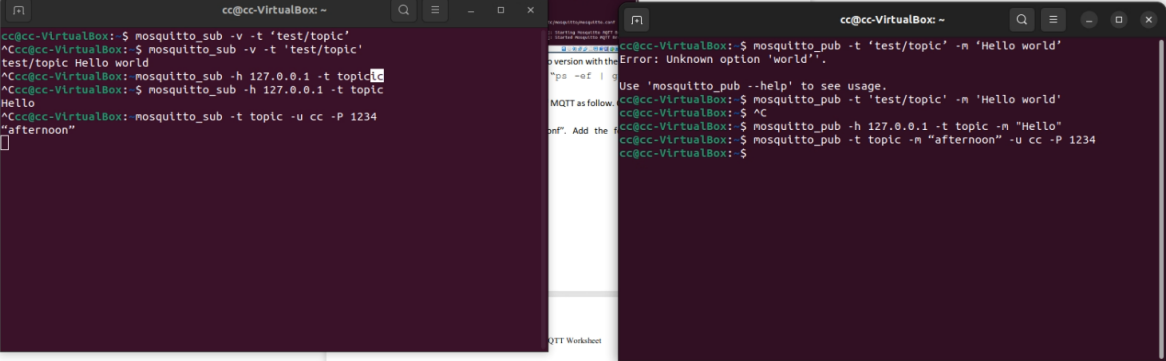
Remark: Fill in your WiFi credentials (SSID and Password) at "config.h".

Link your video record:

https://drive.google.com/file/d/1TRb71VZxnn0Q_gtUjO2Bamqz0mAF3UNj/view?usp=sharing

3. **MQTT (MQTT broker and client):** Testing mosquitto on the local system (show your results on two terminals). See the example commands at “MQTT Worksheet Page 2”.

Ans:



The screenshot shows two terminal windows in a VirtualBox environment. The left terminal window shows the following commands and output:

```
cc@cc-VirtualBox: ~$ mosquitto_sub -v -t 'test/topic'
^Ccc@cc-VirtualBox: ~$ mosquitto_sub -v -t 'test/topic'
test/topic Hello world
^Ccc@cc-VirtualBox: ~$ mosquitto_sub -h 127.0.0.1 -t topic
^Ccc@cc-VirtualBox: ~$ mosquitto_sub -h 127.0.0.1 -t topic
Hello
^Ccc@cc-VirtualBox: ~$ mosquitto_sub -t topic -u cc -P 1234
"afternoon"
```

The right terminal window shows the following commands and output:

```
cc@cc-VirtualBox: ~$ mosquitto_pub -t 'test/topic' -m 'Hello world'
Error: Unknown option 'world'.
Use 'mosquitto_pub --help' to see usage.
cc@cc-VirtualBox: ~$ mosquitto_pub -t 'test/topic' -m 'Hello world'
^C
cc@cc-VirtualBox: ~$ mosquitto_pub -h 127.0.0.1 -t topic -m "Hello"
cc@cc-VirtualBox: ~$ mosquitto_pub -t topic -n "afternoon" -u cc -P 1234
cc@cc-VirtualBox: ~$
```

Below the terminal windows, there is a section titled "Testing mosquitto on the local system (VM)" with a hint and example commands:

```
Hint: open two terminals:
one: mosquitto_sub and another one: mosquitto_pub
mosquitto_sub -v -t 'test/topic'
mosquitto_pub -t 'test/topic' -m 'Hello world'

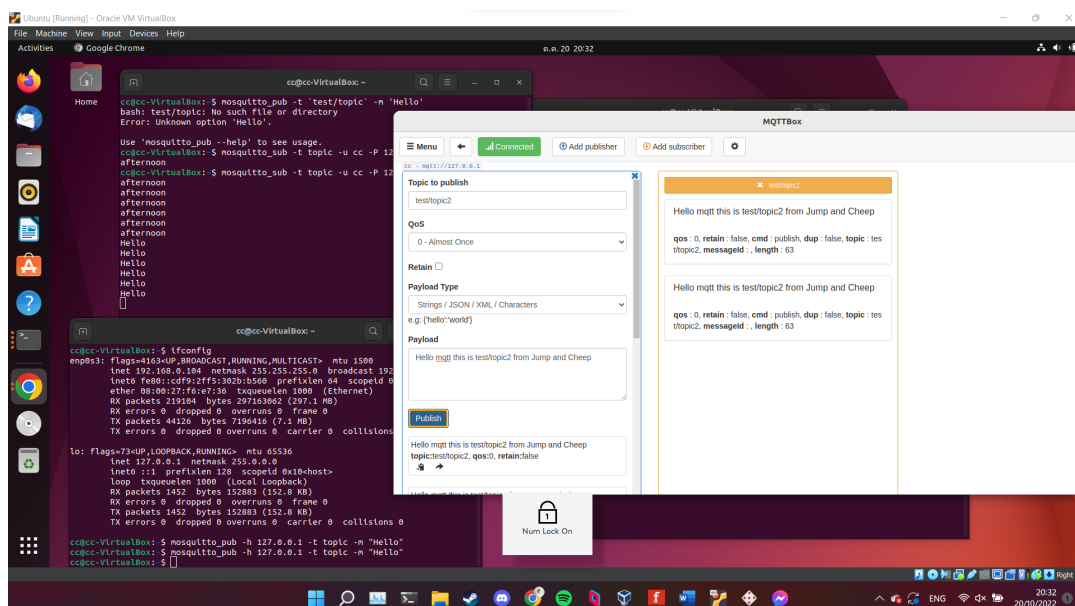
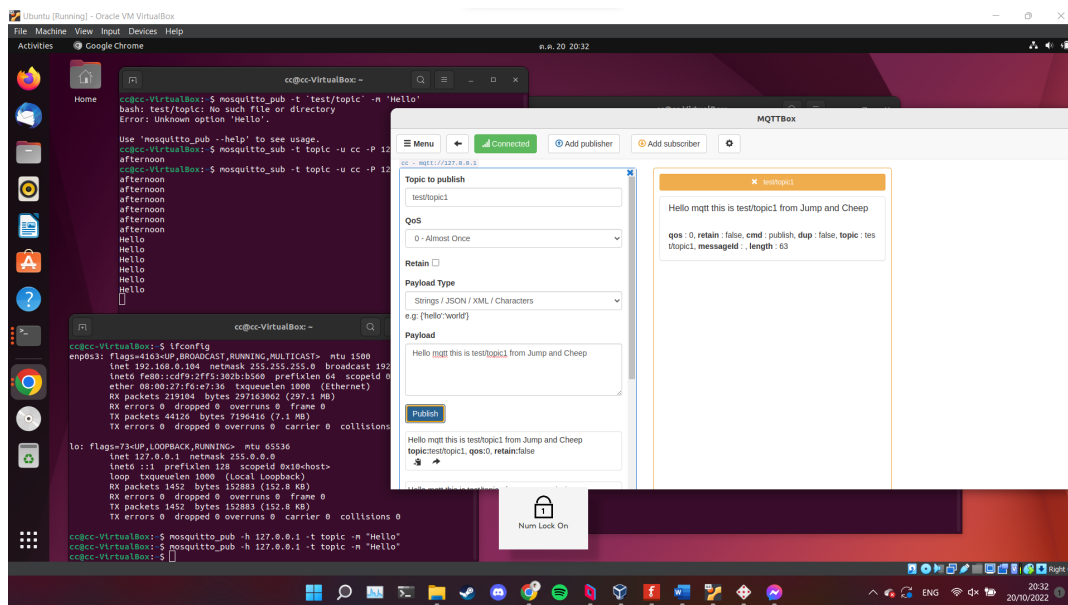
mosquitto_sub -h 127.0.0.1 -t topic
mosquitto_pub -h 127.0.0.1 -t topic -m "Hello"

mosquitto_sub -t topic -u <user> -P <pwd>
mosquitto_pub -t topic -n "afternoon" -u <user> -P <pwd>
```

4. **MQTTBox (MQTT Client):** At MQTT Box, use two different topics (e.g., test/topic1 and test/topic2) to publish messages. And then use two subscribers to subscribe your messages. Show your screenshot results. See the example result at “MQTT Worksheet Page 5”.

Remark: Fill in your MQTT Broker Credentials (IP address, username, password, and topic) at MQTTBox configuration.

Ans:



5. **ESP32 (MQTT Client):** Use ESP32 to publish MQTT messages to MQTT Broker (Mosquitto). Show your screenshot results. See the example result at “MQTT Worksheet Page 7”.

Remark: Fill in your WiFi credentials (SSID, password) and MQTT Broker credentials (IP address, username, and password) at “config.h”.

The screenshot shows two windows. The left window is a terminal titled 'cc@cc-VirtualBox: ~' with the following output:

```

8.8.8.8 ping statistics ---
Packets transmitted, 41 received, 0% packet loss, time 40262ms
min/avg/max/mdev = 21.826/24.847/77.305/8.709 ms
cc-VirtualBox: $ mosquitto_sub -t topic -u cc -P 1234
cc-VirtualBox: $
cc-VirtualBox: $ mosquitto_sub -t topic1 -u cc -P 1234
cc-VirtualBox: $ mosquitto_sub -t test -u cc -P 1234
world #81
world #82
world #83
world #84
world #85
world #86
world #87
world #88
world #89
world #90
world #91
world #92
world #93
world #94
world #95
world #96

```

The right window is a serial monitor titled 'COM4' showing the following output:

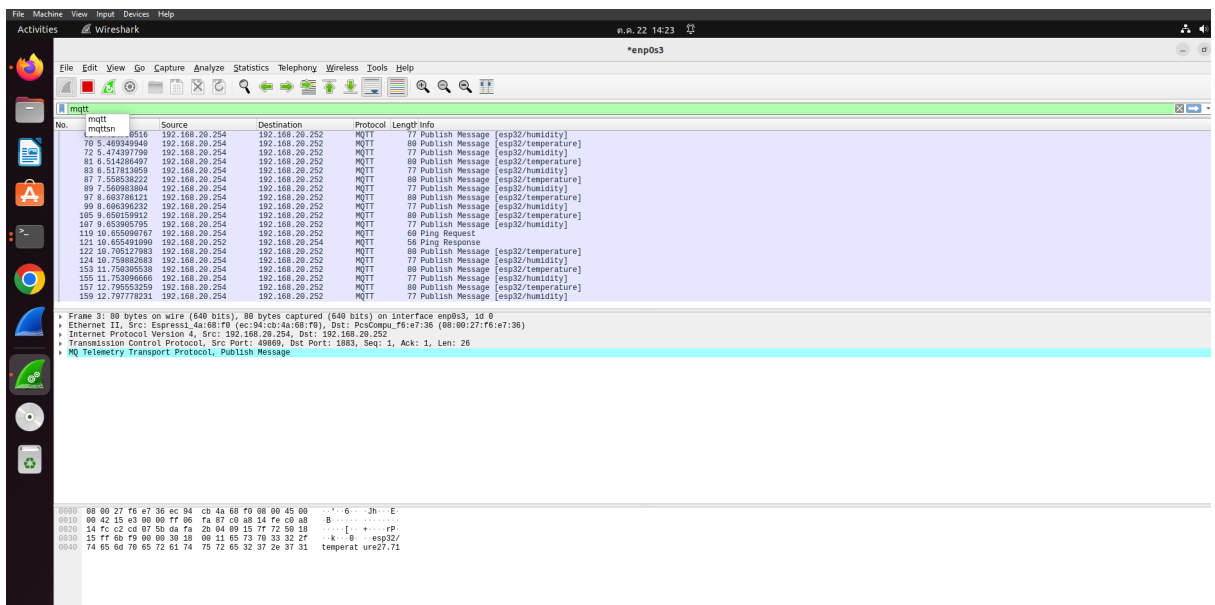
```

11:41:15.135 -> Publish message: hello world #77
11:41:17.150 -> Publish message: hello world #78
11:41:19.139 -> Publish message: hello world #79
11:41:21.169 -> Publish message: hello world #80
11:41:23.156 -> Publish message: hello world #81
11:41:25.141 -> Publish message: hello world #82
11:41:27.159 -> Publish message: hello world #83
11:41:29.147 -> Publish message: hello world #84
11:41:31.166 -> Publish message: hello world #85
11:41:33.150 -> Publish message: hello world #86
11:41:35.170 -> Publish message: hello world #87
11:41:37.155 -> Publish message: hello world #88
11:41:39.175 -> Publish message: hello world #89
11:41:41.161 -> Publish message: hello world #90
11:41:43.177 -> Publish message: hello world #91
11:41:45.158 -> Publish message: hello world #92
11:41:47.176 -> Publish message: hello world #93
11:41:49.158 -> Publish message: hello world #94
11:41:51.174 -> Publish message: hello world #95
11:41:53.157 -> Publish message: hello world #96

```

6. **ESP32 MQTT AHT20 & LED on/off:** In this exercise, we are going to study how to subscribe the AHT20 temp&humid values and how to control LED on/off via MQTT protocol (pub/sub/broker). Connect AHT20 and LED to ESP32 (please revise previous activities for circuit diagram) and upload “esp32-mqtt-aht20-led/esp32-mqtt-aht20-led.ino” to your ESP32.
- Ans:

Remark: Fill in your WiFi credentials (SSID, password) and MQTT Broker credentials (IP address, username, and password) at “config.h”.



0000	08 00 27 f6 e7 36 ec 94	cb 4a 68 f0 08 00 45 00	..6..Jh..E..	14:25:28.024 -> 27.71
0010	00 42 15 e3 00 00 ff 06	fa 87 c0 a8 14 fe c0 a8	B.....	14:25:28.024 -> 75.54
0020	14 fc c2 cd 07 5b da fa	2b 04 09 15 7f 72 50 18	...[...+...P...	14:25:29.066 -> 27.71
0030	15 ff 6b f9 00 00 30 18	00 11 65 73 70 33 32 2f	...k...0...esp32/	14:25:29.066 -> 75.57
0040	74 65 6d 70 65 72 61 74	75 72 65 32 37 2e 37 31	temperat ure27.71	14:25:30.111 -> 27.70
				14:25:30.111 -> 75.57
				14:25:31.152 -> 27.73
				14:25:31.152 -> 75.56
				14:25:32.227 -> 27.72
				14:25:32.227 -> 75.61
				14:25:33.268 -> 27.72
				14:25:33.268 -> 75.59
				14:25:34.312 -> 27.72
				14:25:34.312 -> 75.57
				14:25:35.358 -> 27.71

7. **ESP32 MQTT AHT20 & LED on/off:** Modify the code from Exercise 6 to show temperature and humidity values at Web Browser. Take a video record to explain your code and result together.

Reference :

<https://randomnerdtutorials.com/esp32-web-server-with-bme280-mini-weather-station/>

Link your video record:

<https://drive.google.com/file/d/19OipdykrM4Y1GZ-ggLkp9iKdA1-3FuDW/view?usp=sharing>