SMART LIGHTING

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INTRODUCTION

- Internet of Things(IoT) is being used widely these days to take care of the home automation applications such as smart lighting, smart heaters, smart air conditioners, smart Televisions etc.
- IoT services are affordable
- It is much easier to interact with these applications/appliances
- Remote access is also possible

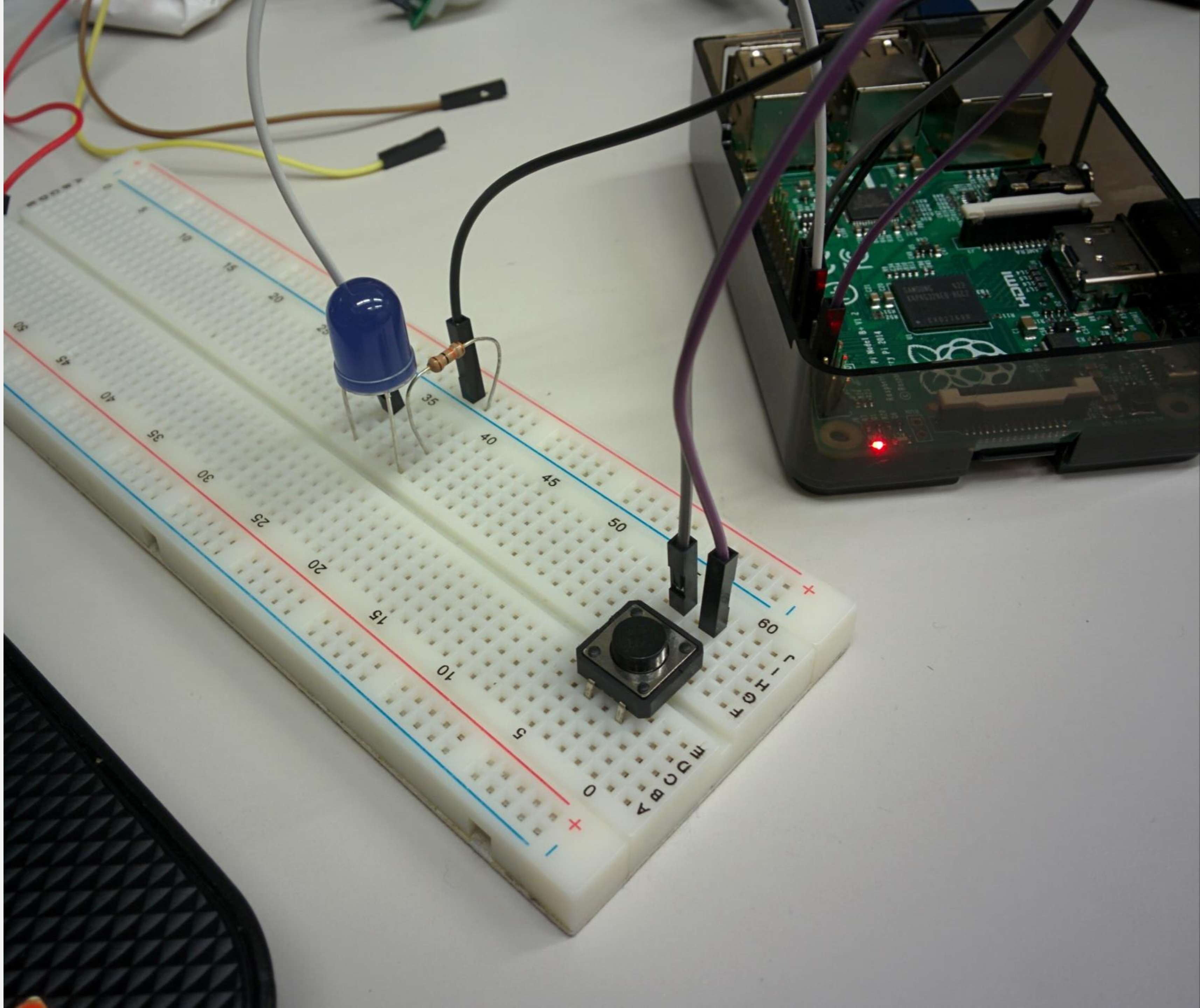
PROJECT OVERVIEW

- Smart Lighting application using AWS IoT and Raspberry-Pi
- Control LED light using button as well as remotely through commands on a PC
- Button presses as well as PC commands are synchronized through AWS IoT

PROCEDURE OVERVIEW

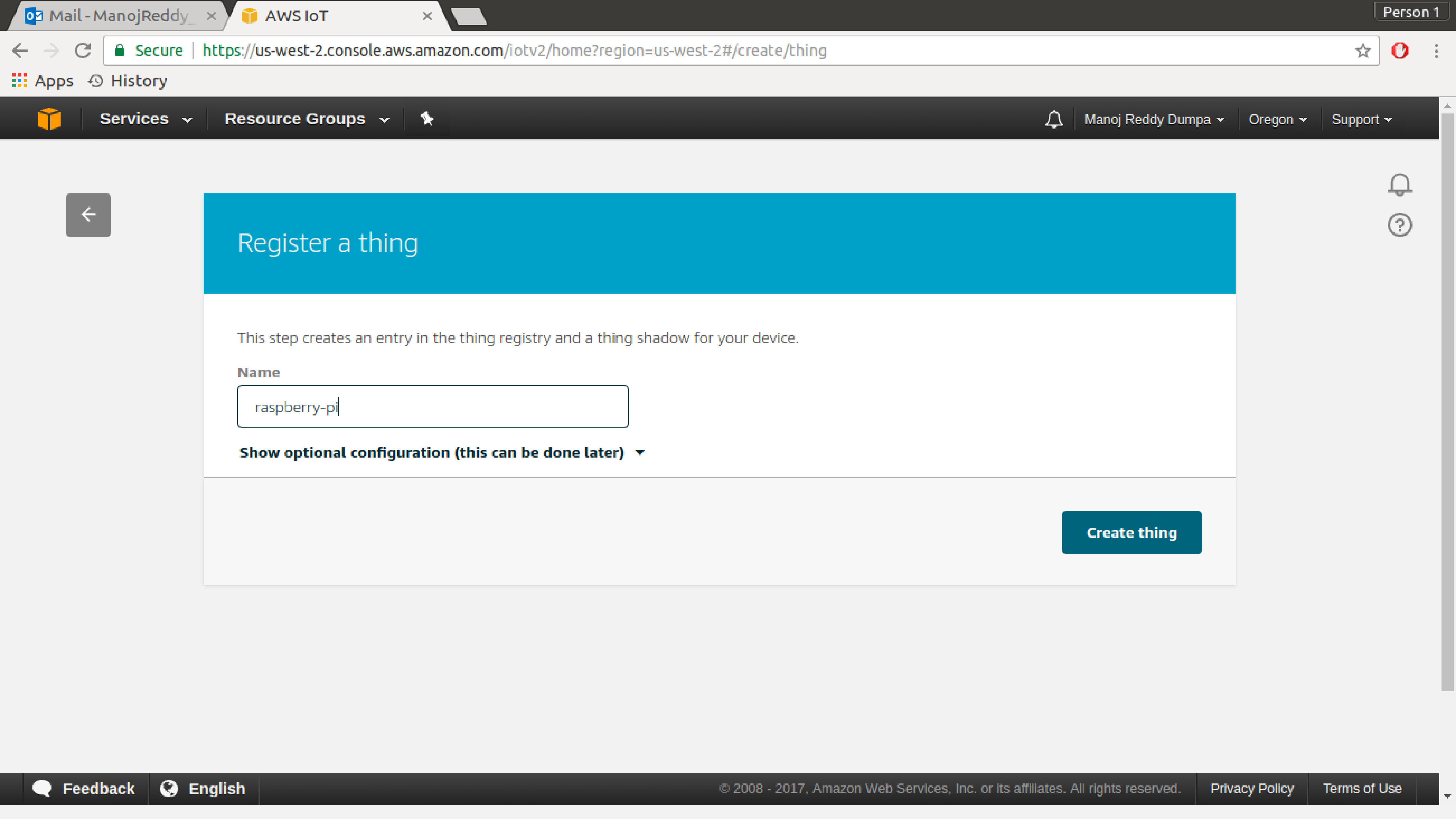
- Registered to AWS IoT
- Connected the circuit
- Wrote code in Python for the logic to be implemented on PC as well as Raspberry-Pi
- Started the process

CIRCUIT CONNECTIONS



PROCEDURE

- Created an AWS account
- Registered the thing



Mail - ManojReddy_
AWS IoT
Person 1
Secure
https://us-west-2.console.aws.amazon.com/iotv2/home?region=us-west-2#/create/thing
Apps
History
Services
Resource Groups
Manoj Reddy Dumpa
Oregon
Support

Register a thing

This step creates an entry in the thing registry and a thing shadow for your device.

Name

raspberry-pi

Show optional configuration (this can be done later) ▼

Create thing

Feedback
English
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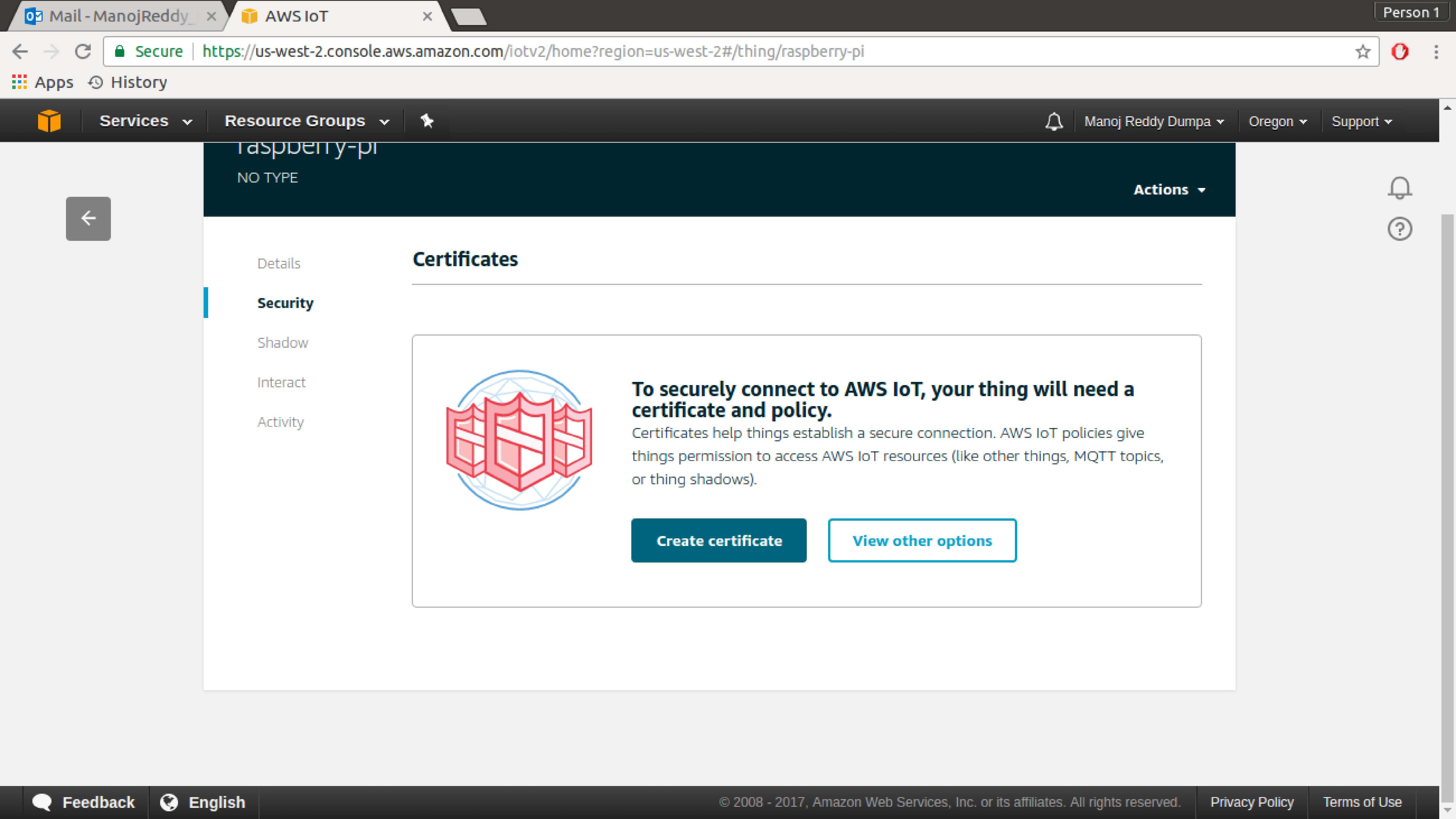
PROCEDURE (CONTD.)

- Created a certificate which automatically generates a certificate, public key and private key
- Activated the certificate, public and private keys



Certificates

To securely connect to AWS IoT, your thing will need a certificate and policy.

Certificates help things establish a secure connection. AWS IoT policies give things permission to access AWS IoT resources (like other things, MQTT topics, or thing shadows).

Create certificate
View other options
Feedback
English
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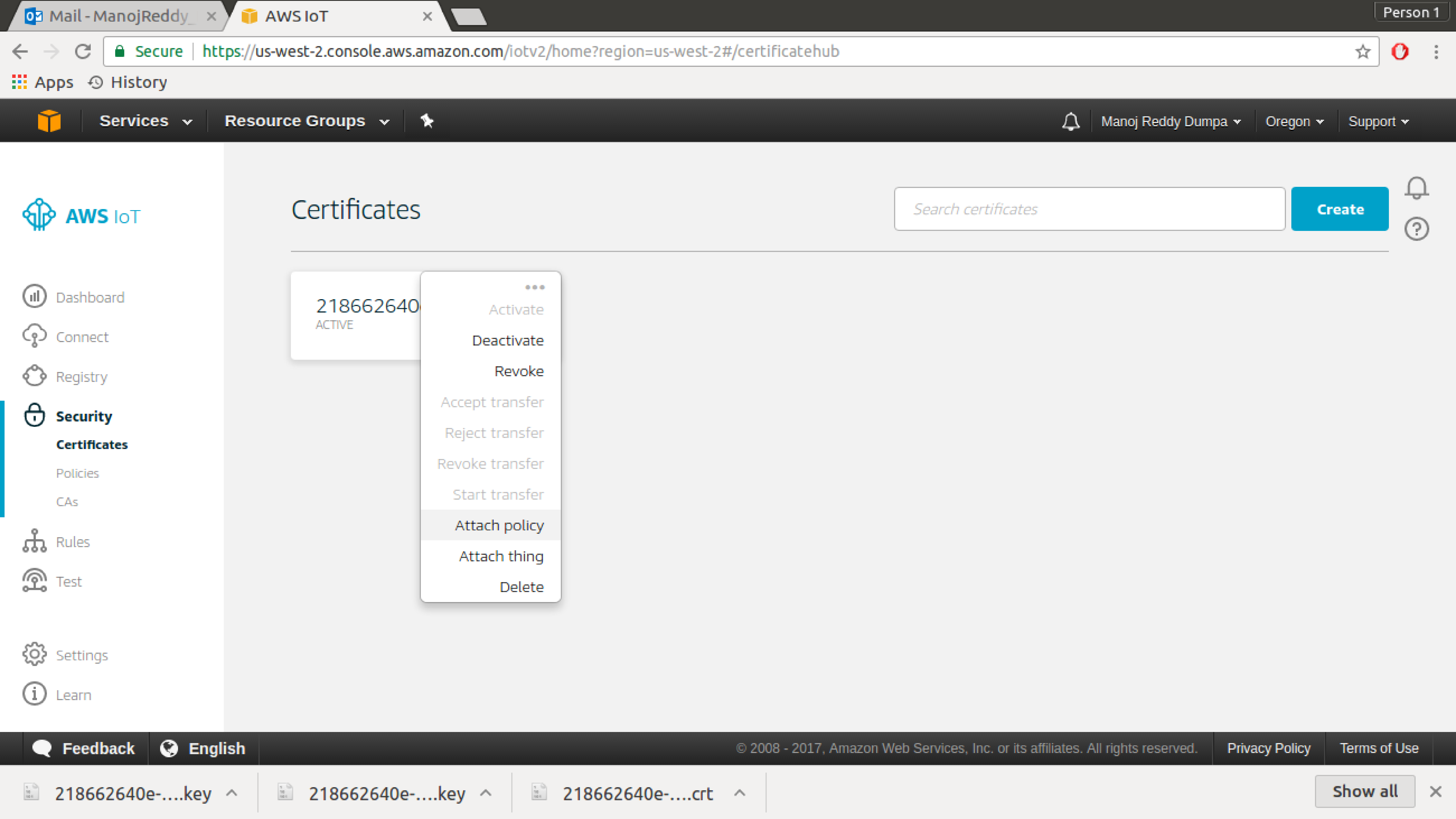
PROCEDURE (CONTD.)

- Created a policy
- Attached the policy to the certificate
- Attached the thing to the certificate


Mail - ManojReddy_
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Person 1
Secure
https://us-west-2.console.aws.amazon.com/iotv2/home?region=us-west-2#/certificatehub
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Rules
Test
Settings
Learn
Certificates
Search certificates
Create
218662640
ACTIVE
Activate
Deactivate
Revoke
Accept transfer
Reject transfer
Revoke transfer
Start transfer
Attach policy
Attach thing
Delete
Feedback
English
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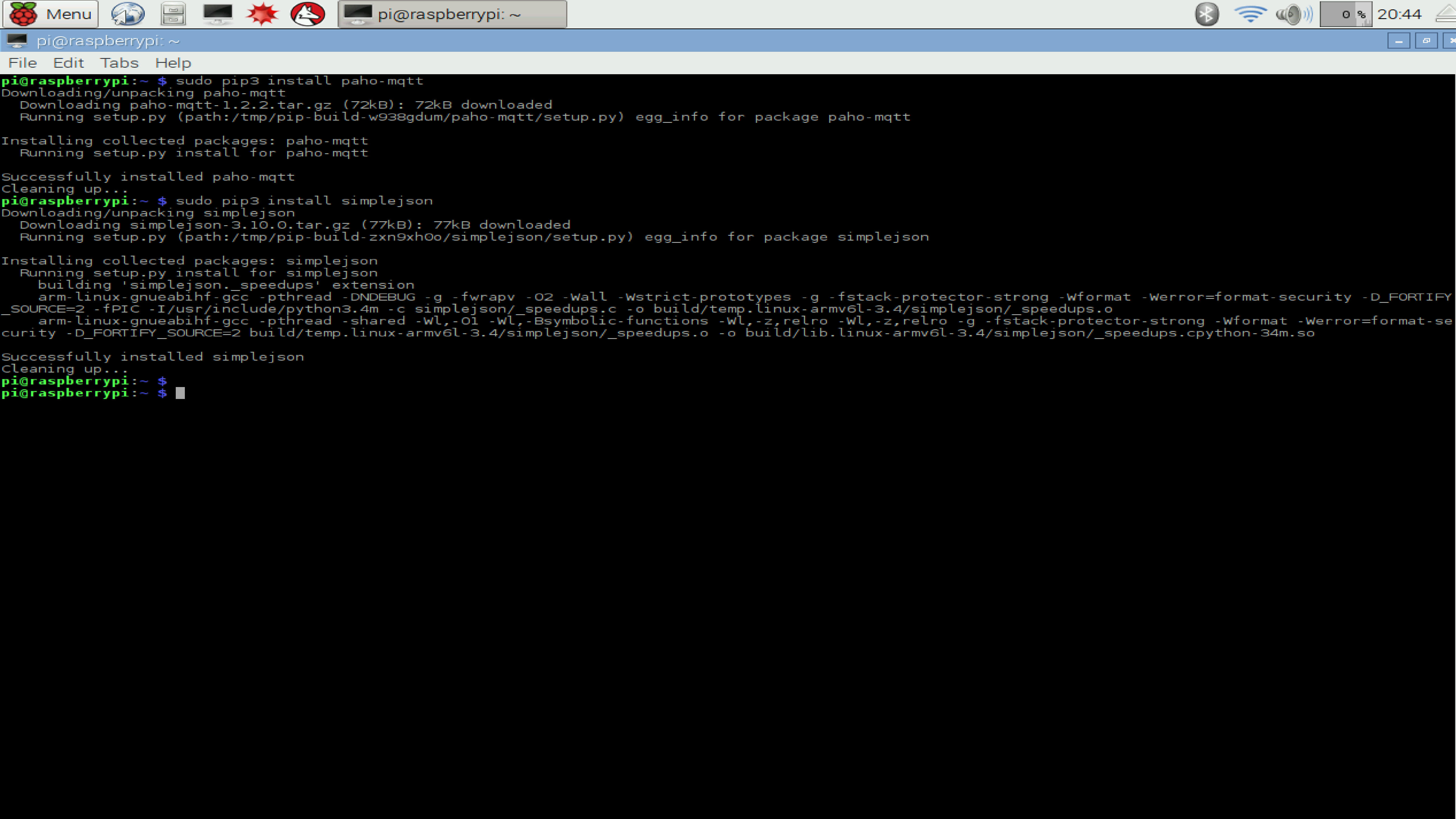
218662640e-....key
218662640e-....key
218662640e-....crt
Show all

PROCEDURE (CONTD.)

- paho-mqtt was installed on the Raspberry-Pi as well as on PC

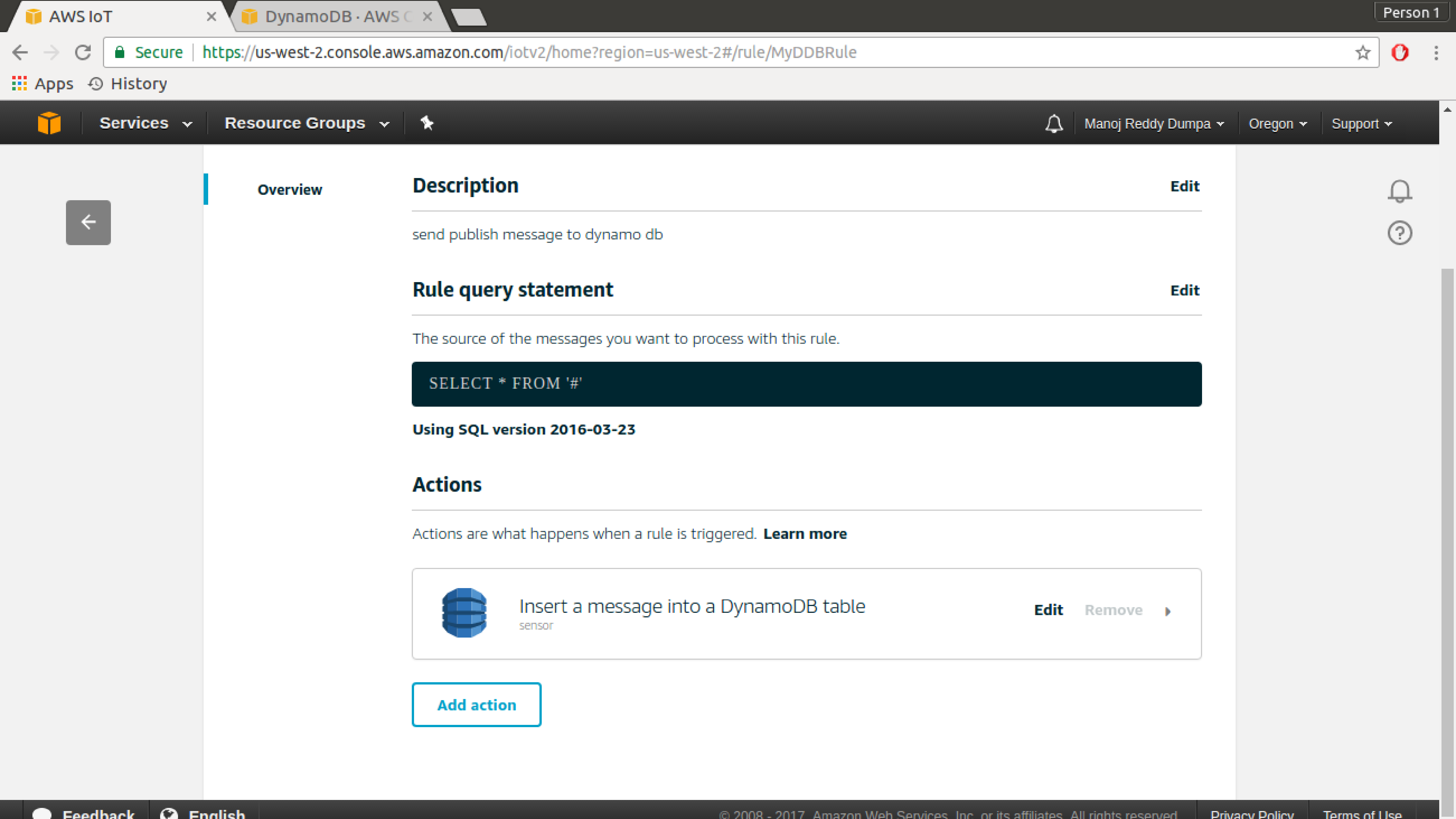
- simplejson was also installed



```
pi@raspberrypi:~ $ sudo pip3 install paho-mqtt
Downloading/unpacking paho-mqtt
  Downloading paho-mqtt-1.2.2.tar.gz (72kB): 72kB downloaded
  Running setup.py (path:/tmp/pip-build-w938gdum/paho-mqtt/setup.py) egg_info for package paho-mqtt

Installing collected packages: paho-mqtt
  Running setup.py install for paho-mqtt

Successfully installed paho-mqtt
Cleaning up...
pi@raspberrypi:~ $ sudo pip3 install simplejson
Downloading/unpacking simplejson
  Downloading simplejson-3.10.0.tar.gz (77kB): 77kB downloaded
  Running setup.py (path:/tmp/pip-build-zxn9xh0o/simplejson/setup.py) egg_info for package simplejson

Installing collected packages: simplejson
  Running setup.py install for simplejson
    building 'simplejson._speedups' extension
    arm-linux-gnueabihf-gcc -pthread -DNDEBUG -g -fwrapv -O2 -Wall -Wstrict-prototypes -g -fstack-protector-strong -Wformat -Werror=format-security -D_FORTIFY
_SOURCE=2 -fPIC -I/usr/include/python3.4m -c simplejson/_speedups.c -o build/temp.linux-armv6l-3.4/simplejson/_speedups.o
    arm-linux-gnueabihf-gcc -pthread -shared -Wl,-O1 -Wl,-Bsymbolic-functions -Wl,-z,relro -Wl,-z,relro -g -fstack-protector-strong -Wformat -Werror=format-se
curity -D_FORTIFY_SOURCE=2 build/temp.linux-armv6l-3.4/simplejson/_speedups.o -o build/lib.linux-armv6l-3.4/simplejson/_speedups.cpython-34m.so

Successfully installed simplejson
Cleaning up...
pi@raspberrypi:~ $
pi@raspberrypi:~ $
```

PROCEDURE (CONTD.)

- Created a rule in AWS IoT to extract led state from a particular topic and store it in dynamoDB



Description

Edit

send publish message to dynamo db

Rule query statement

Edit

The source of the messages you want to process with this rule.

```
SELECT * FROM '#'
```

Using SQL version 2016-03-23

Actions

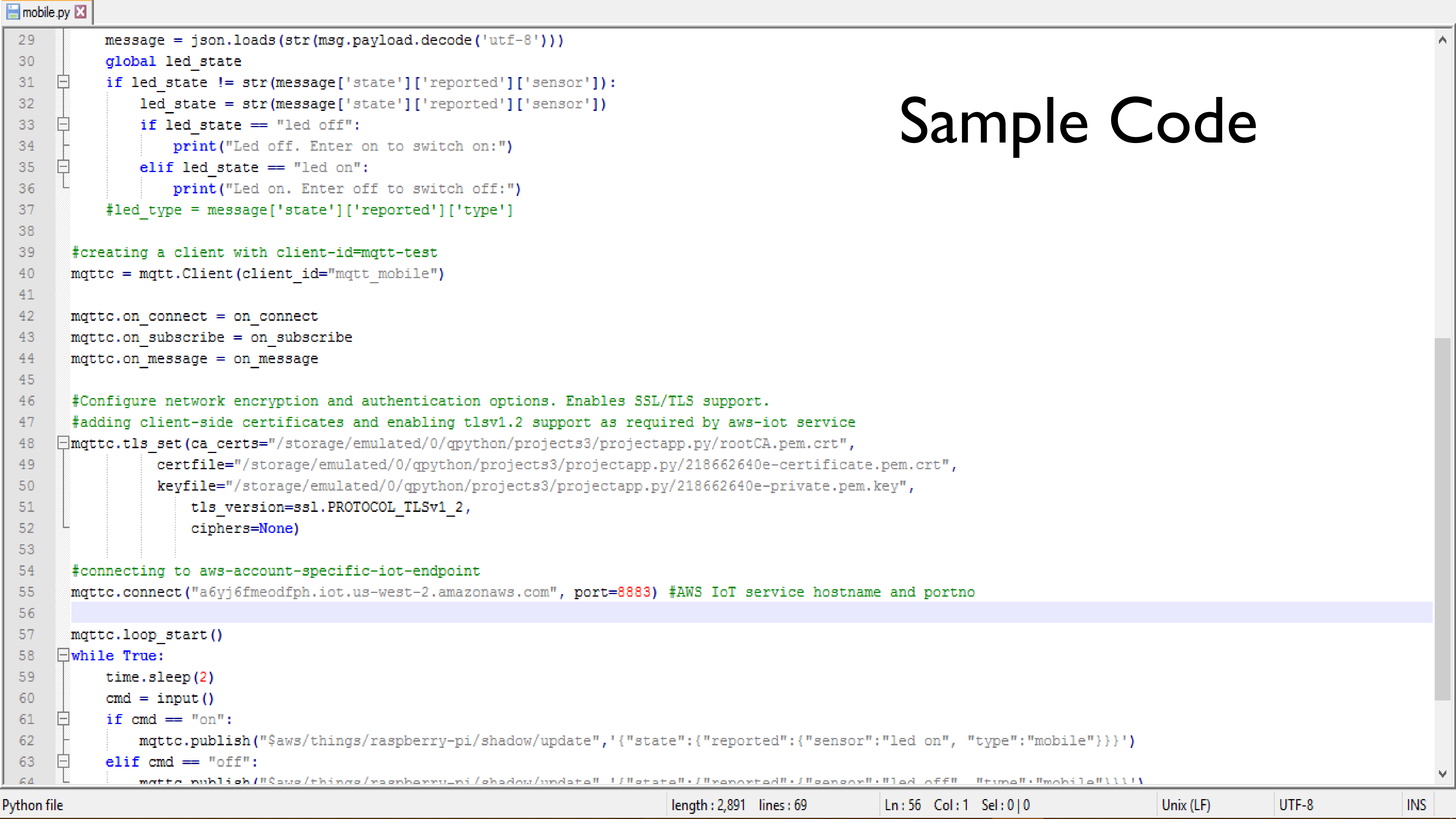
Actions are what happens when a rule is triggered. **Learn more**

Insert a message into a DynamoDB table
sensor

PROCEDURE (CONTD.)

- Python code was written for the button LED combination for PC as well as for Raspberry-Pi

Sample Code

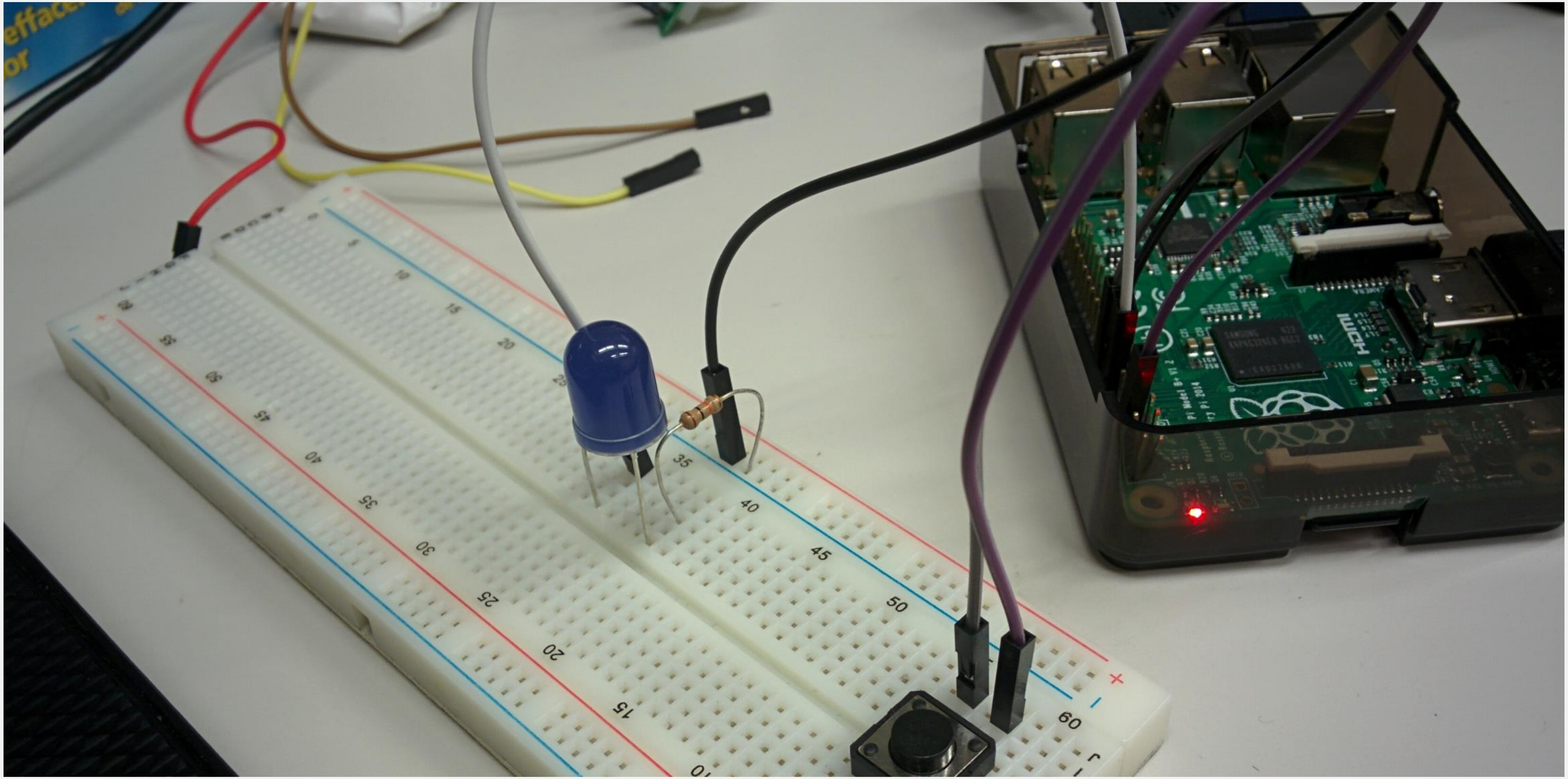


```python
    message = json.loads(str(msg.payload.decode('utf-8')))
    global led_state
    if led_state != str(message['state']['reported']['sensor']):
        led_state = str(message['state']['reported']['sensor'])
        if led_state == "led off":
            print("Led off. Enter on to switch on:")
        elif led_state == "led on":
            print("Led on. Enter off to switch off:")
    #led_type = message['state']['reported']['type']

#creating a client with client-id=mqtt-test
mqttc = mqtt.Client(client_id="mqtt_mobile")

mqttc.on_connect = on_connect
mqttc.on_subscribe = on_subscribe
mqttc.on_message = on_message

#Configure network encryption and authentication options. Enables SSL/TLS support.
#adding client-side certificates and enabling tlsv1.2 support as required by aws-iot service
mqttc.tls_set(ca_certs="/storage/emulated/0/qpython/projects3/projectapp.py/rootCA.pem.crt",
          certfile="/storage/emulated/0/qpython/projects3/projectapp.py/218662640e-certificate.pem.crt",
          keyfile="/storage/emulated/0/qpython/projects3/projectapp.py/218662640e-private.pem.key",
              tls_version=ssl.PROTOCOL_TLSv1_2,
              ciphers=None)

#connecting to aws-account-specific-iot-endpoint
mqttc.connect("a6yj6fmeodfph.iot.us-west-2.amazonaws.com", port=8883) #AWS IoT service hostname and portno


mqttc.loop_start()
while True:
    time.sleep(2)
    cmd = input()
    if cmd == "on":
        mqttc.publish("$aws/things/raspberry-pi/shadow/update",'{"state":{"reported":{"sensor":"led on", "type":"mobile"}}}')
    elif cmd == "off":
        mqttc.publish("$aws/things/raspberry-pi/shadow/update",'{"state":{"reported":{"sensor":"led off", "type":"mobile"}}}')
```

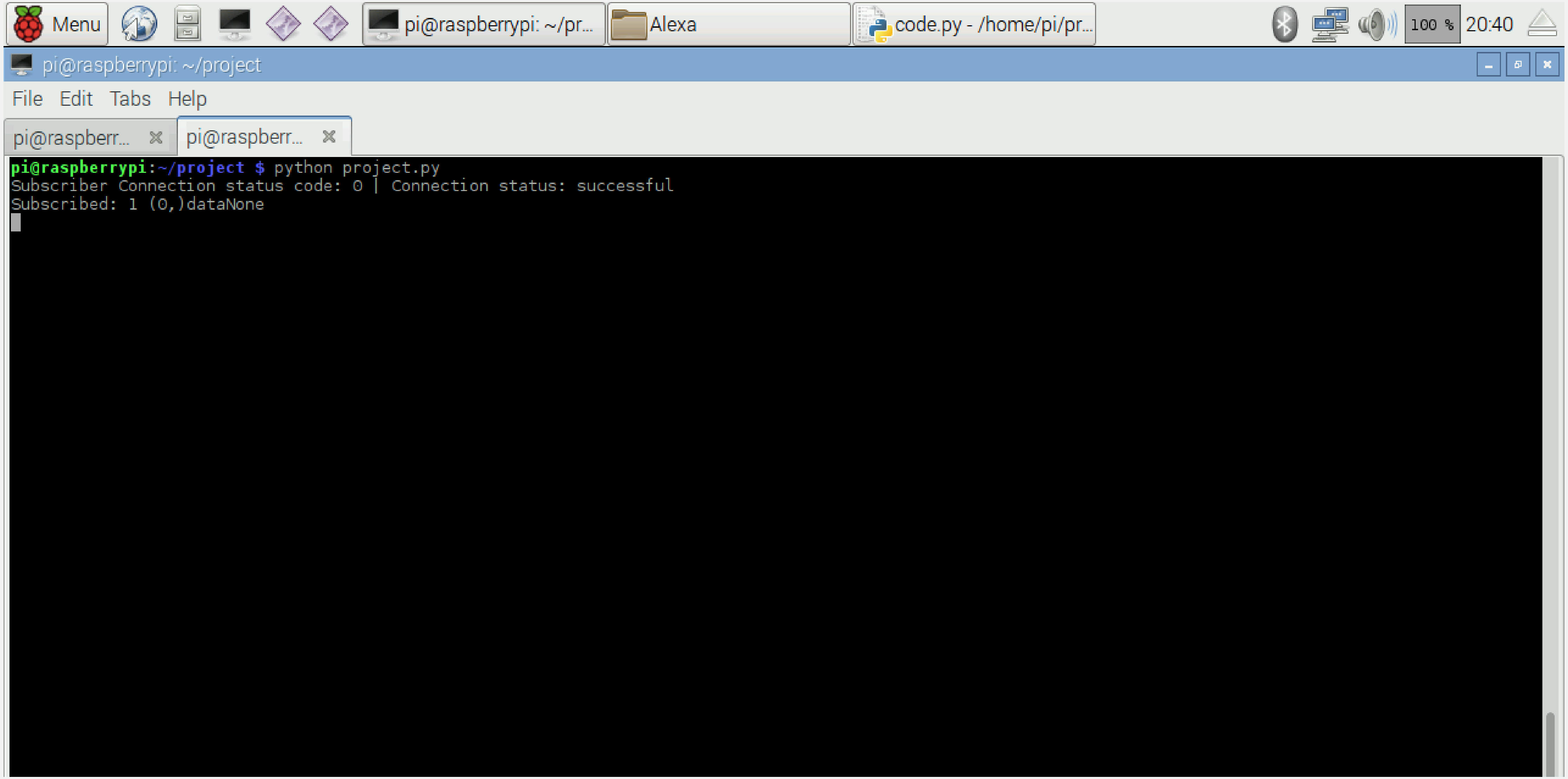
PROCEDURE (CONTD.)

- The python code was run on PC and Raspberry-Pi
- It was made sure that both were subscribed to the same topic

Initial State of LED

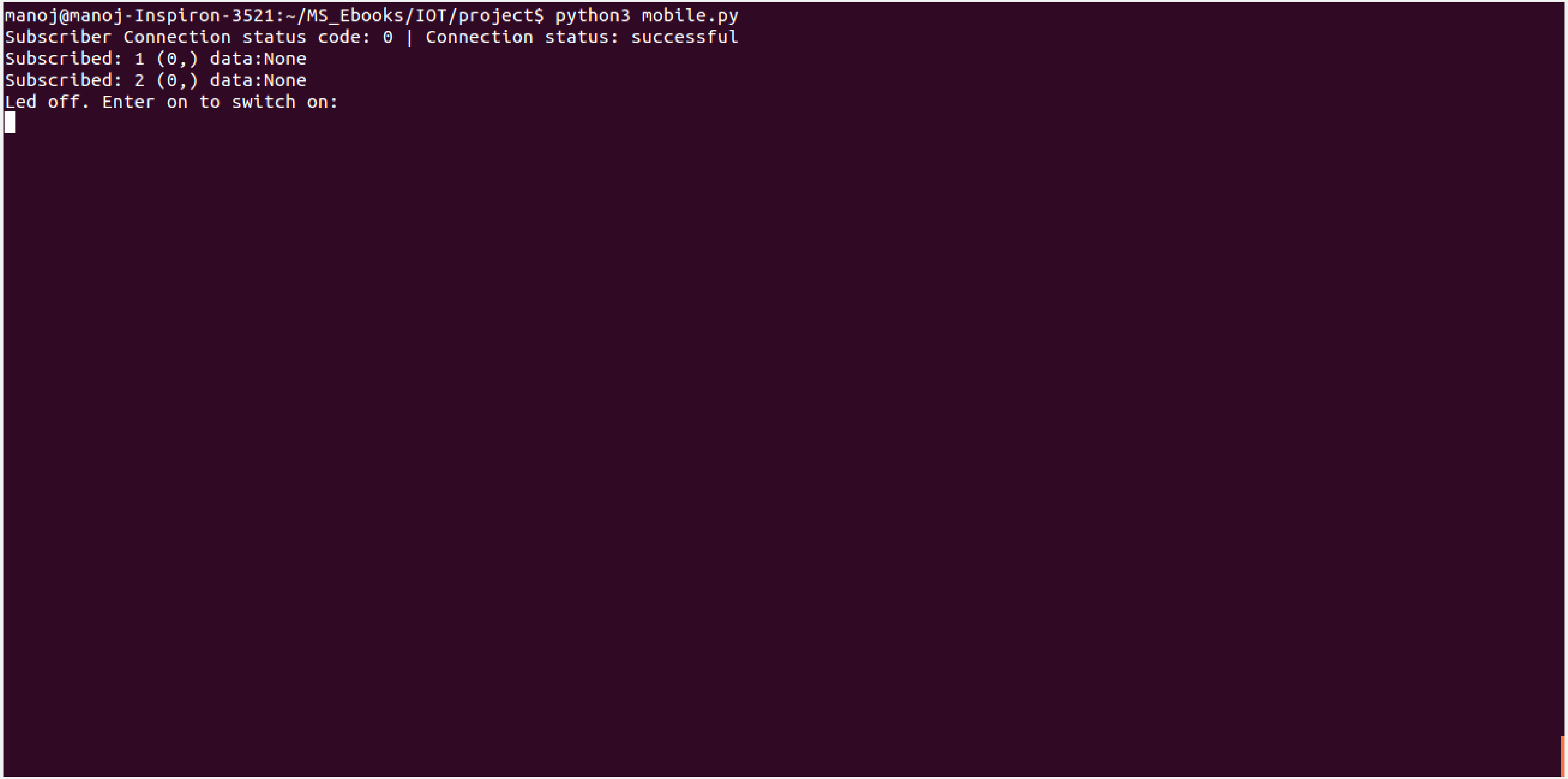


Raspberry-Pi Console



```
pi@raspberrypi:~/project $ python project.py
Subscriber Connection status code: 0 | Connection status: successful
Subscribed: 1 (0,)dataNone
```

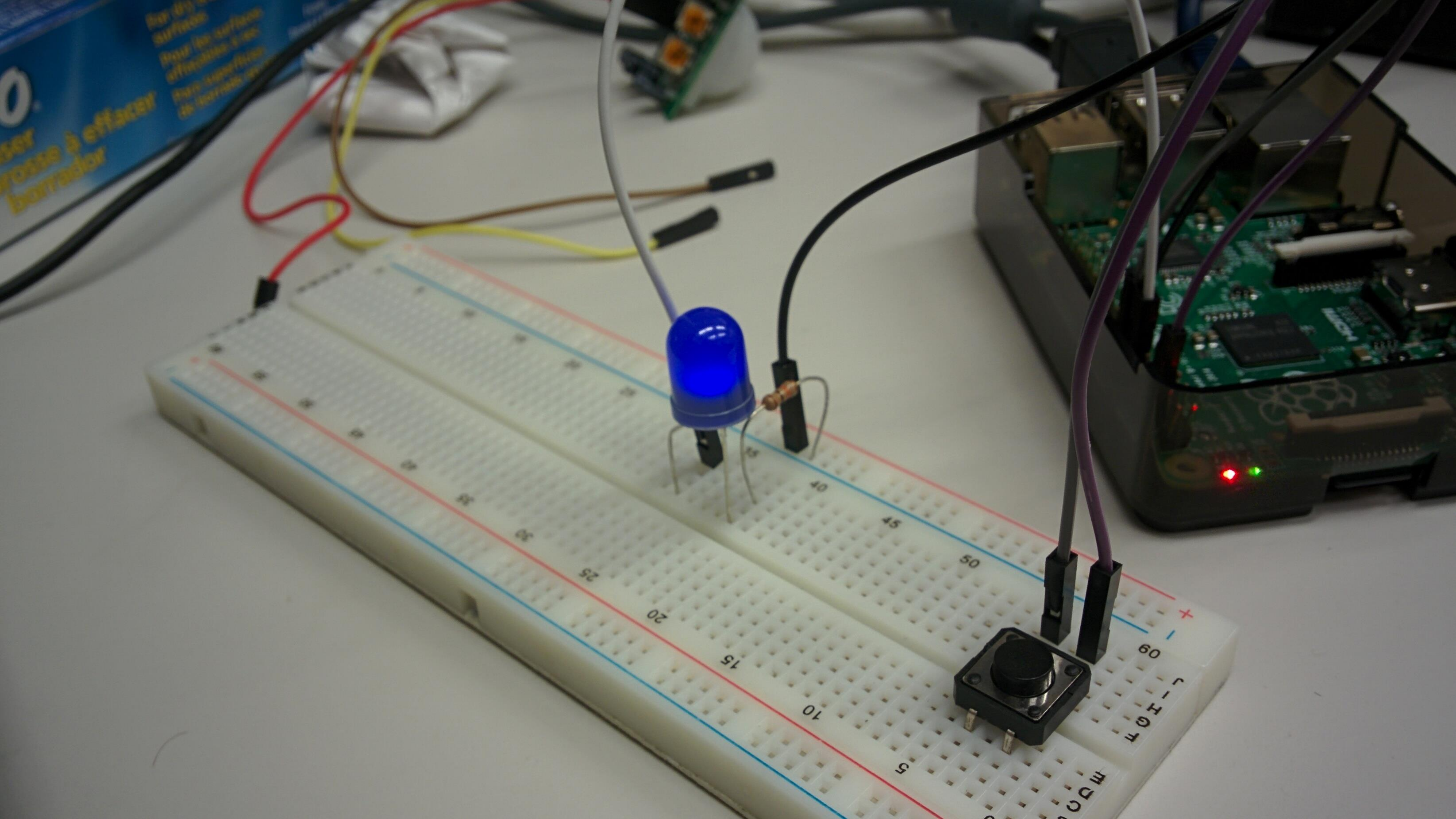
Remote PC Console



```
manoj@manoj-Inspiron-3521:~/MS_Ebooks/IOT/project$ python3 mobile.py
Subscriber Connection status code: 0 | Connection status: successful
Subscribed: 1 (0,) data:None
Subscribed: 2 (0,) data:None
Led off. Enter on to switch on:
```

PROCEDURE (CONTD.)

- When Button was pressed, the LED lit up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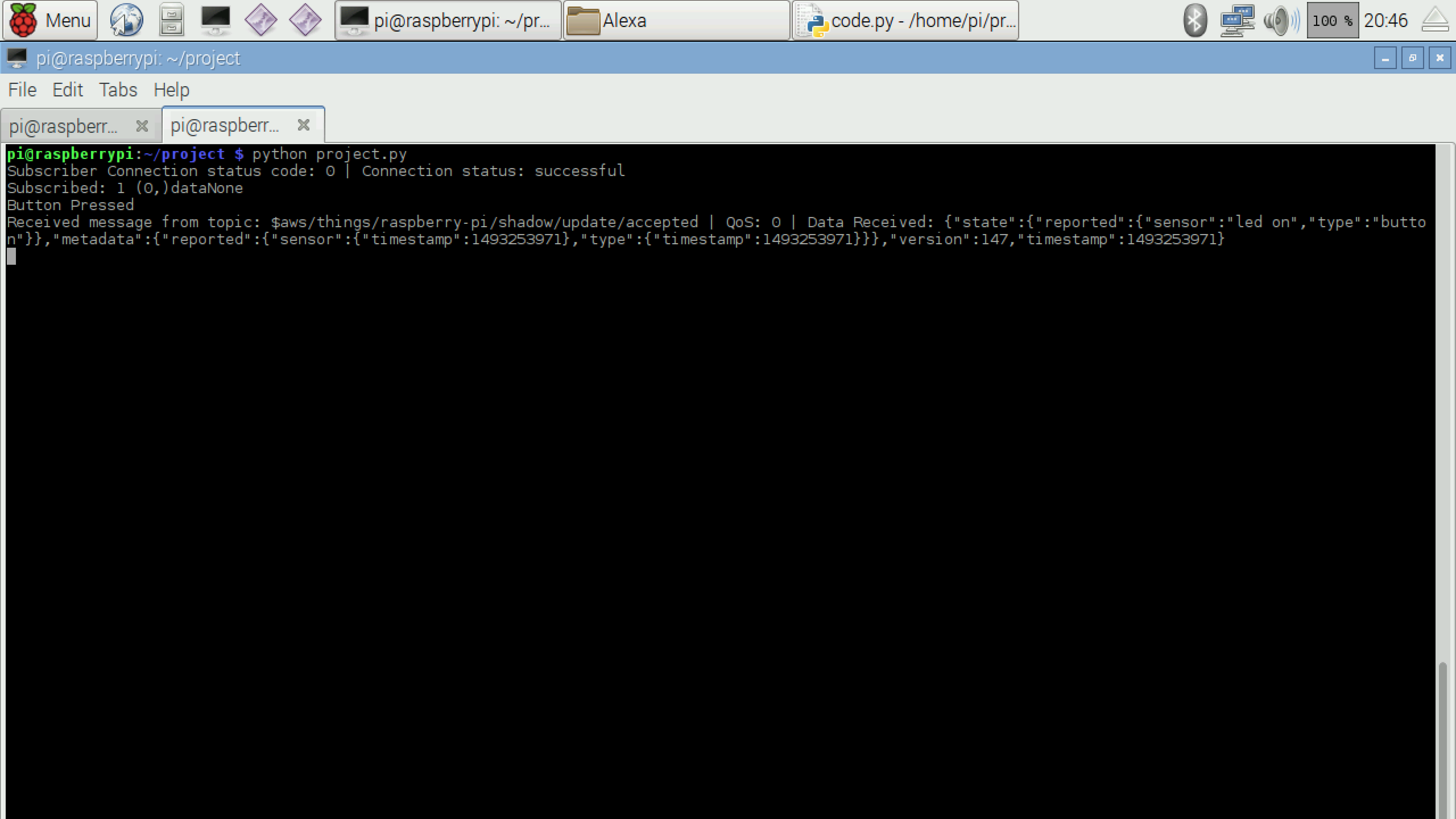
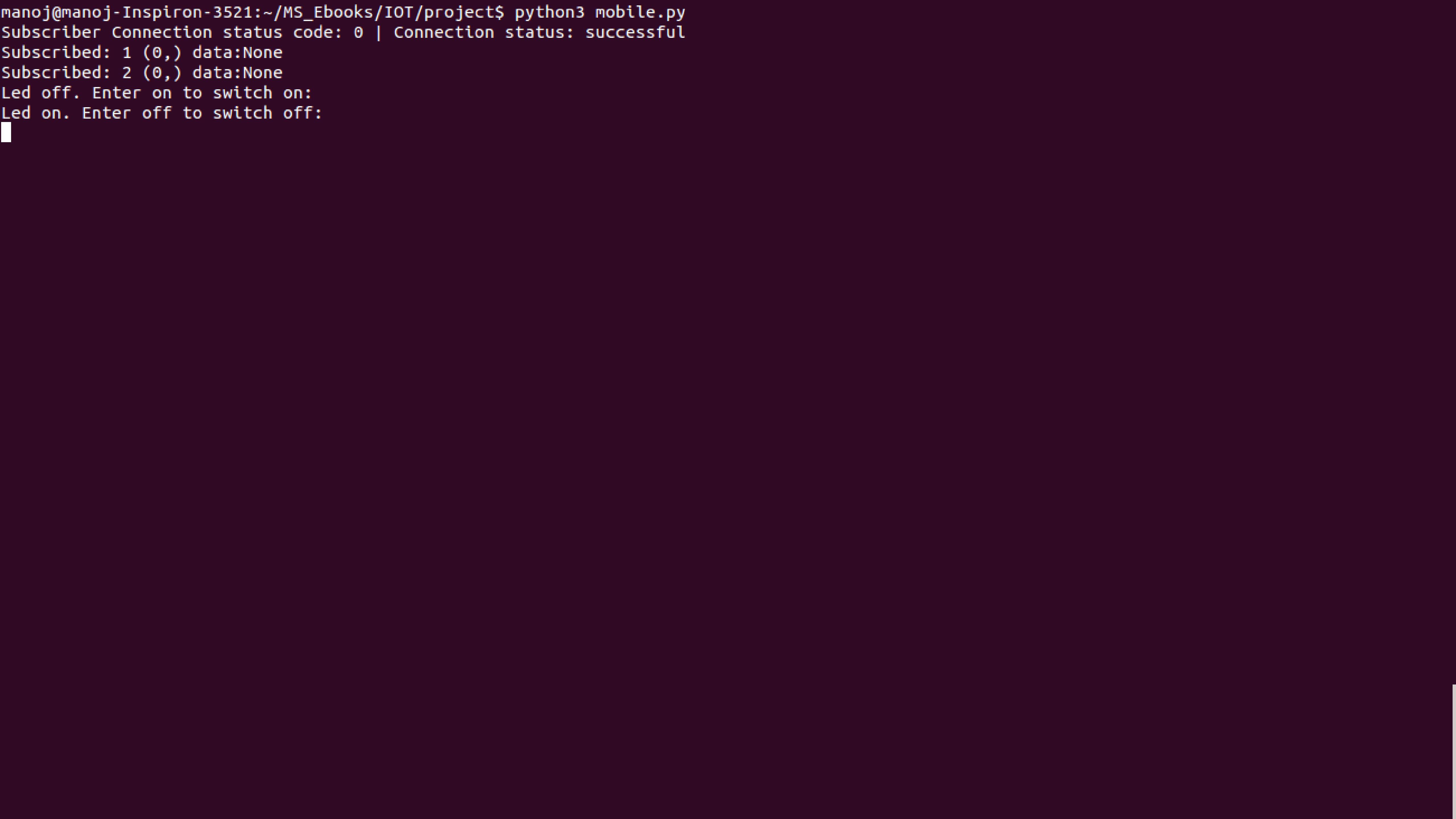
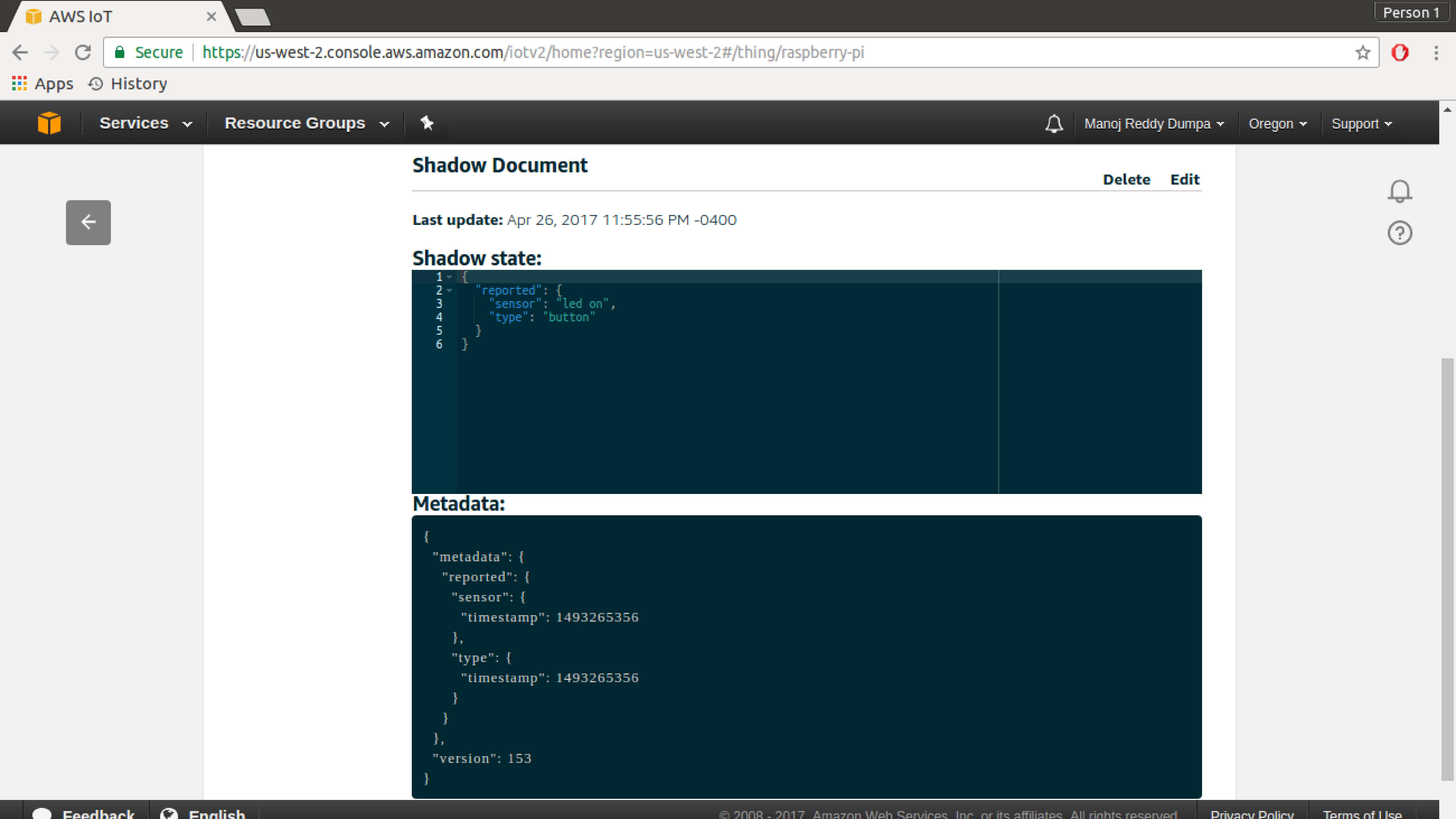


```
pi@raspberrypi:~/project $ python project.py
Subscriber Connection status code: 0 | Connection status: successful
Subscribed: 1 (0,)dataNone
Button Pressed
Received message from topic: $aws/things/raspberry-pi/shadow/update/accepted | QoS: 0 | Data Received: {"state":{"reported":{"sensor":"led on","type":"butto
n"}},"metadata":{"reported":{"sensor":{"timestamp":1493253971},"type":{"timestamp":1493253971}}},"version":147,"timestamp":1493253971}
```



```
manoj@manoj-Inspiron-3521:~/MS_Ebooks/IOT/project$ python3 mobile.py
Subscriber Connection status code: 0 | Connection status: successful
Subscribed: 1 (0,) data:None
Subscribed: 2 (0,) data:None
Led off. Enter on to switch on:
Led on. Enter off to switch off:
```



Shadow Document

Last update: Apr 26, 2017 11:55:56 PM -0400

Shadow state:

```
{
  "reported": {
    "sensor": "led on",
    "type": "button"
  }
}
```

Metadata:

```
{
 "metadata": {
  "reported": {
   "sensor": {
    "timestamp": 1493265356
   },
   "type": {
    "timestamp": 1493265356
   }
  }
 },
 "version": 153
}
```

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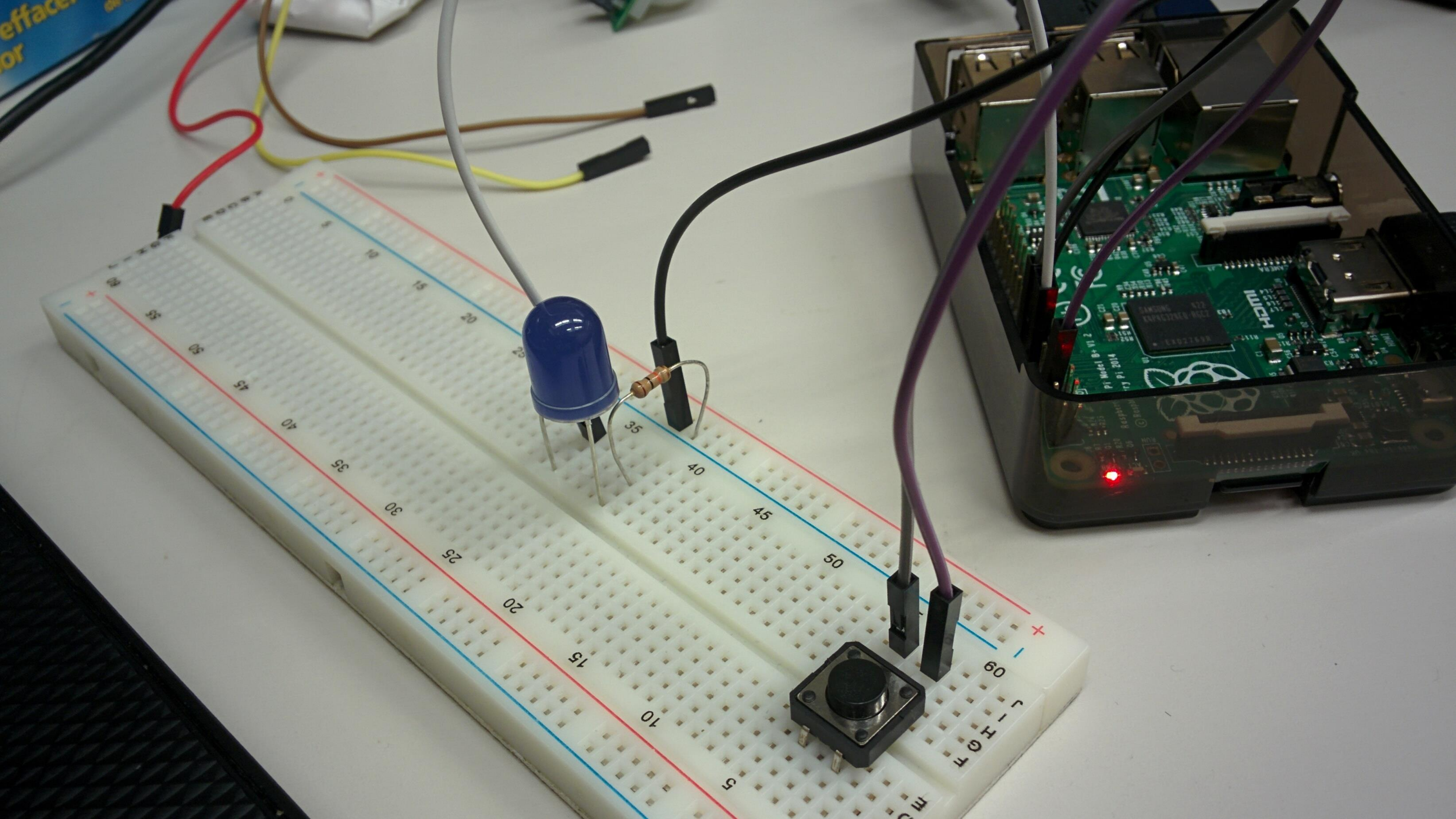
PROCEDURE (CONTD.)

- When the button was pressed again as the LED was on, it got switched off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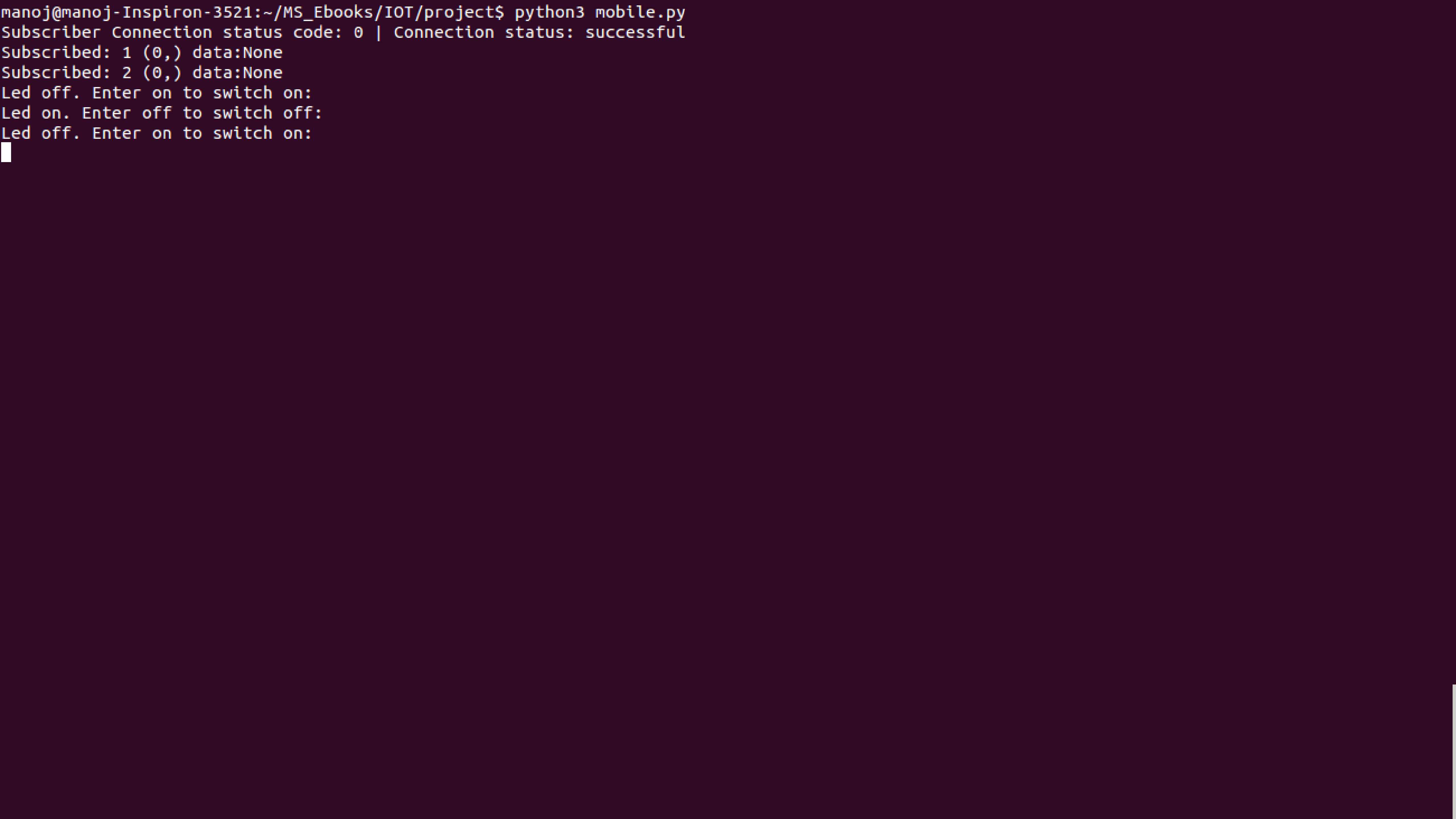
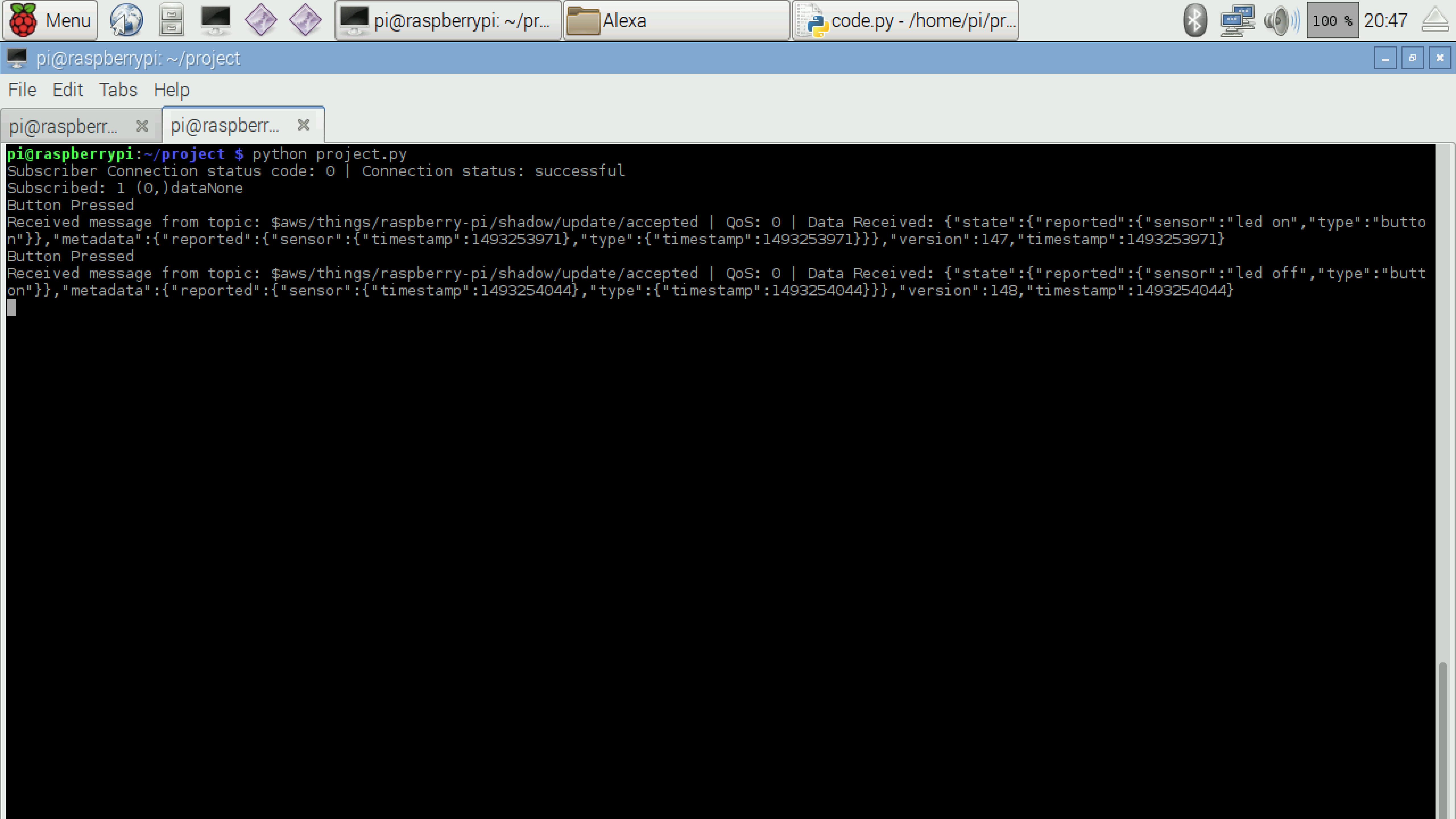
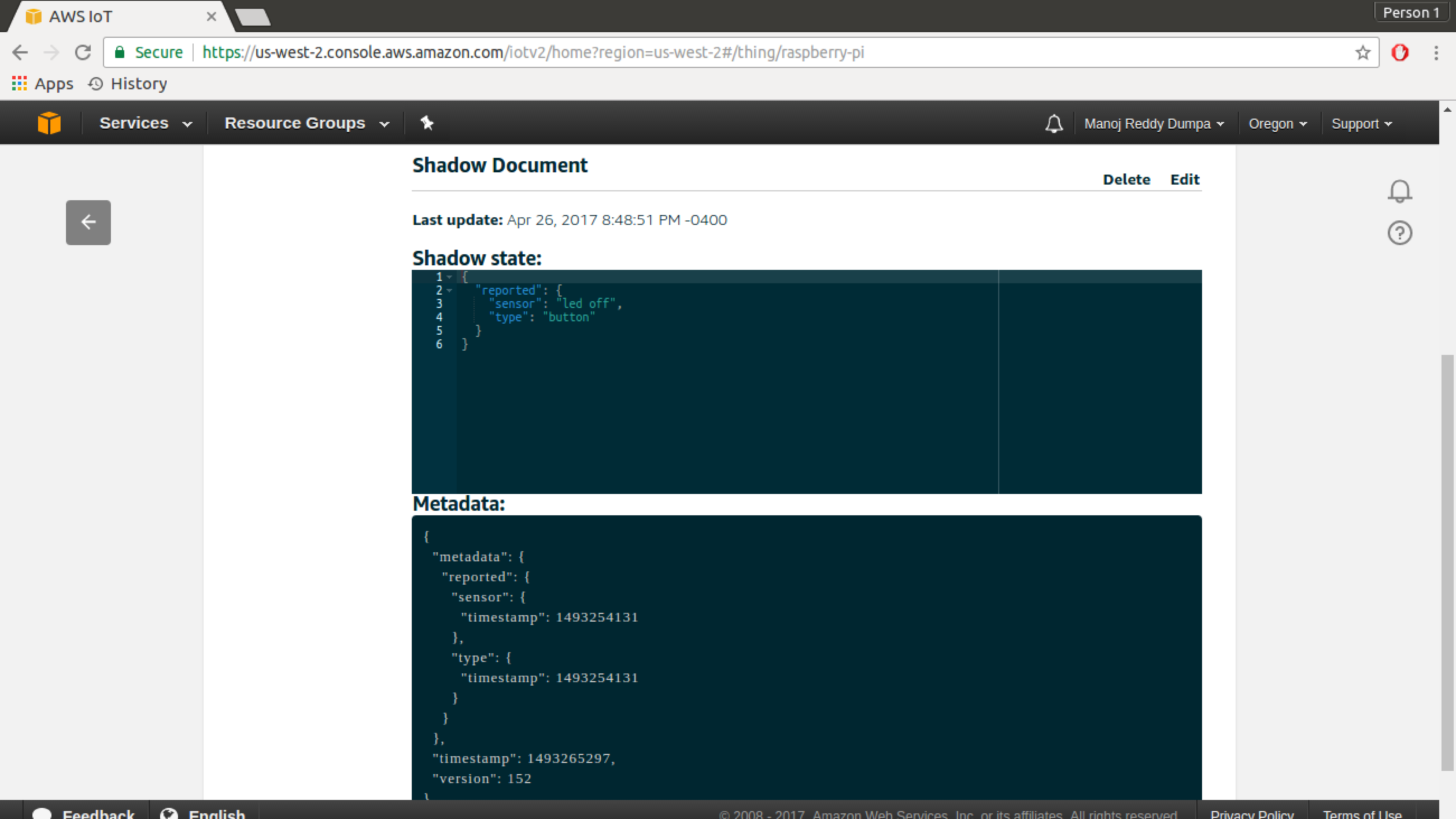
HDMI
Raspberry Pi Model B+ V1.2
SAMSUNG



```
manoj@manoj-Inspiron-3521:~/MS_Ebooks/IOT/project$ python3 mobile.py
Subscriber Connection status code: 0 | Connection status: successful
Subscribed: 1 (0,) data:None
Subscribed: 2 (0,) data:None
Led off. Enter on to switch on:
Led on. Enter off to switch off:
Led off. Enter on to switch on:
```



```
pi@raspberrypi:~/project $ python project.py
Subscriber Connection status code: 0 | Connection status: successful
Subscribed: 1 (0,)dataNone
Button Pressed
Received message from topic: $aws/things/raspberry-pi/shadow/update/accepted | QoS: 0 | Data Received: {"state":{"reported":{"sensor":"led on","type":"butto
n"}},"metadata":{"reported":{"sensor":{"timestamp":1493253971},"type":{"timestamp":1493253971}}},"version":147,"timestamp":1493253971}
Button Pressed
Received message from topic: $aws/things/raspberry-pi/shadow/update/accepted | QoS: 0 | Data Received: {"state":{"reported":{"sensor":"led off","type":"butt
on"}},"metadata":{"reported":{"sensor":{"timestamp":1493254044},"type":{"timestamp":1493254044}}},"version":148,"timestamp":1493254044}
```


AWS IoT
Person 1
Secure
https://us-west-2.console.aws.amazon.com/iotv2/home?region=us-west-2#/thing/raspberry-pi
Apps
History
Services
Resource Groups
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Oregon
Support

Shadow Document

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Shadow state:

```
{
  "reported": {
    "sensor": "led off",
    "type": "button"
  }
}
```

Metadata:

```
{
 "metadata": {
  "reported": {
   "sensor": {
    "timestamp": 1493254131
   },
   "type": {
    "timestamp": 1493254131
   }
  }
 },
 "timestamp": 1493265297,
 "version": 152
}
```

Feedback
English
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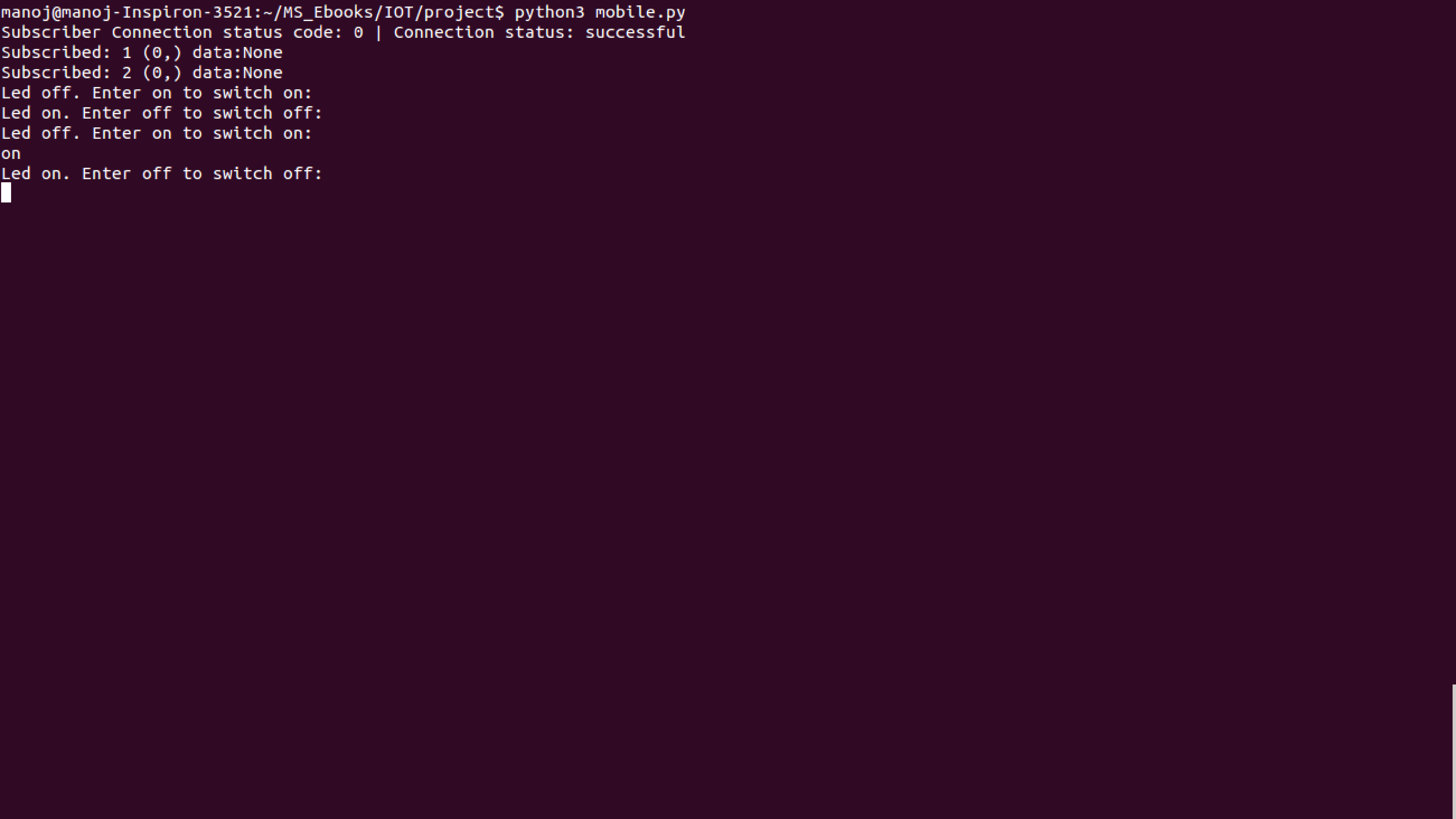
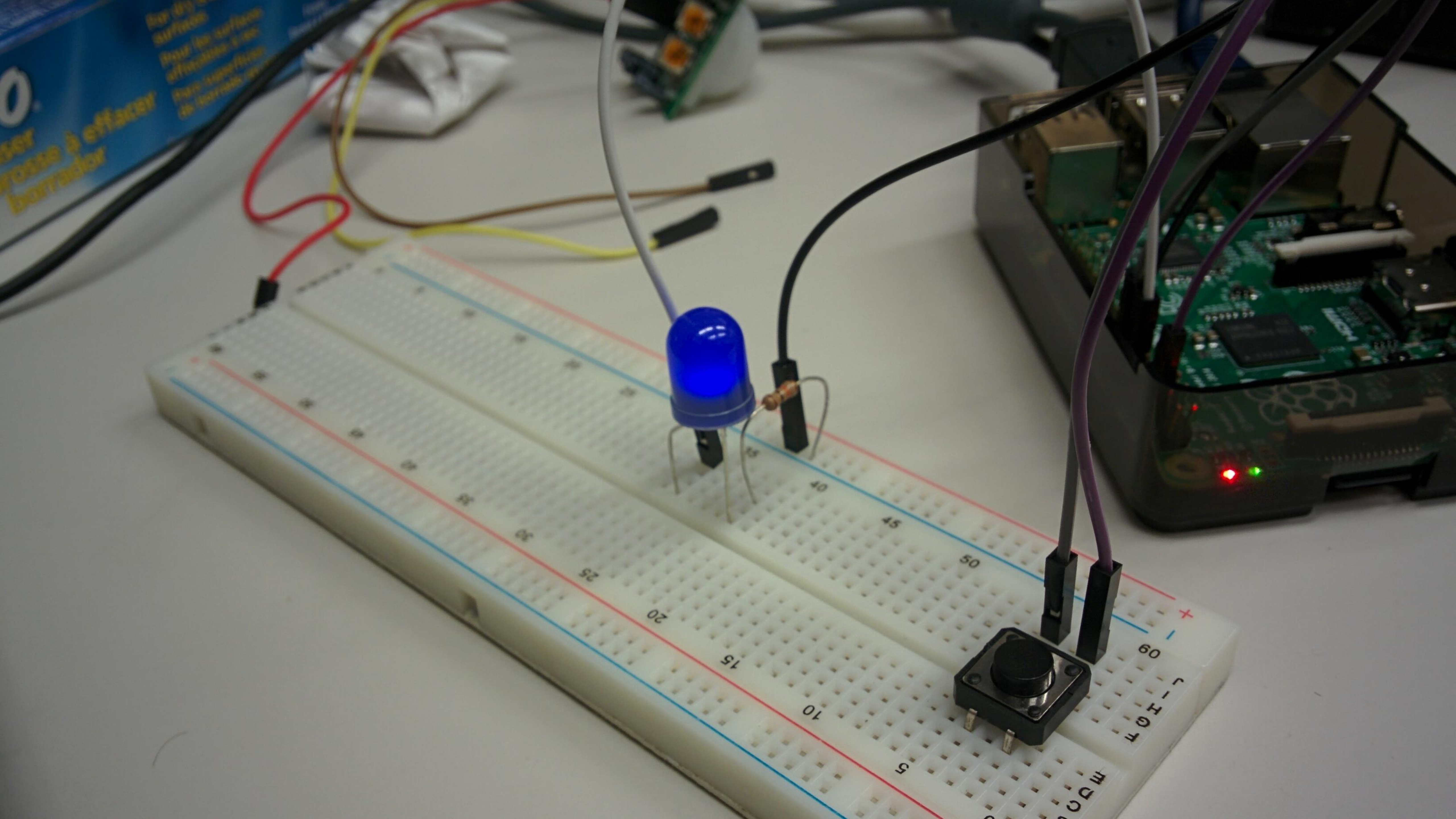
PROCEDURE (CONTD.)

- Now, according to the code, if the LED was off, keyword "on" was entered on the PC to switch on the LED



```
manoj@manoj-Inspiron-3521:~/MS_Ebooks/IOT/project$ python3 mobile.py
Subscriber Connection status code: 0 | Connection status: successful
Subscribed: 1 (0,) data:None
Subscribed: 2 (0,) data:None
Led off. Enter on to switch on:
Led on. Enter off to switch off:
Led off. Enter on to switch on:
on
Led on. Enter off to switch off:
```



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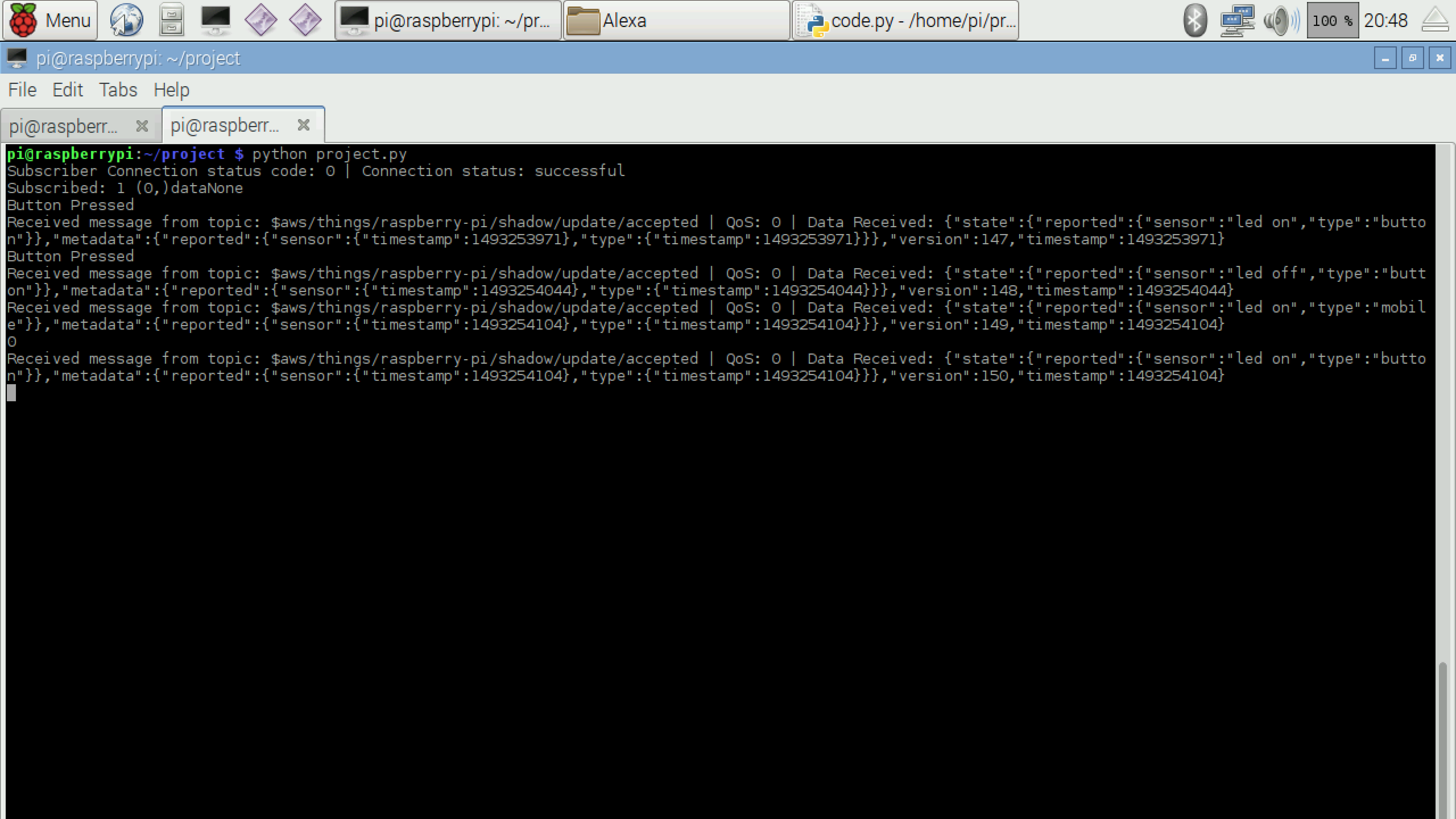
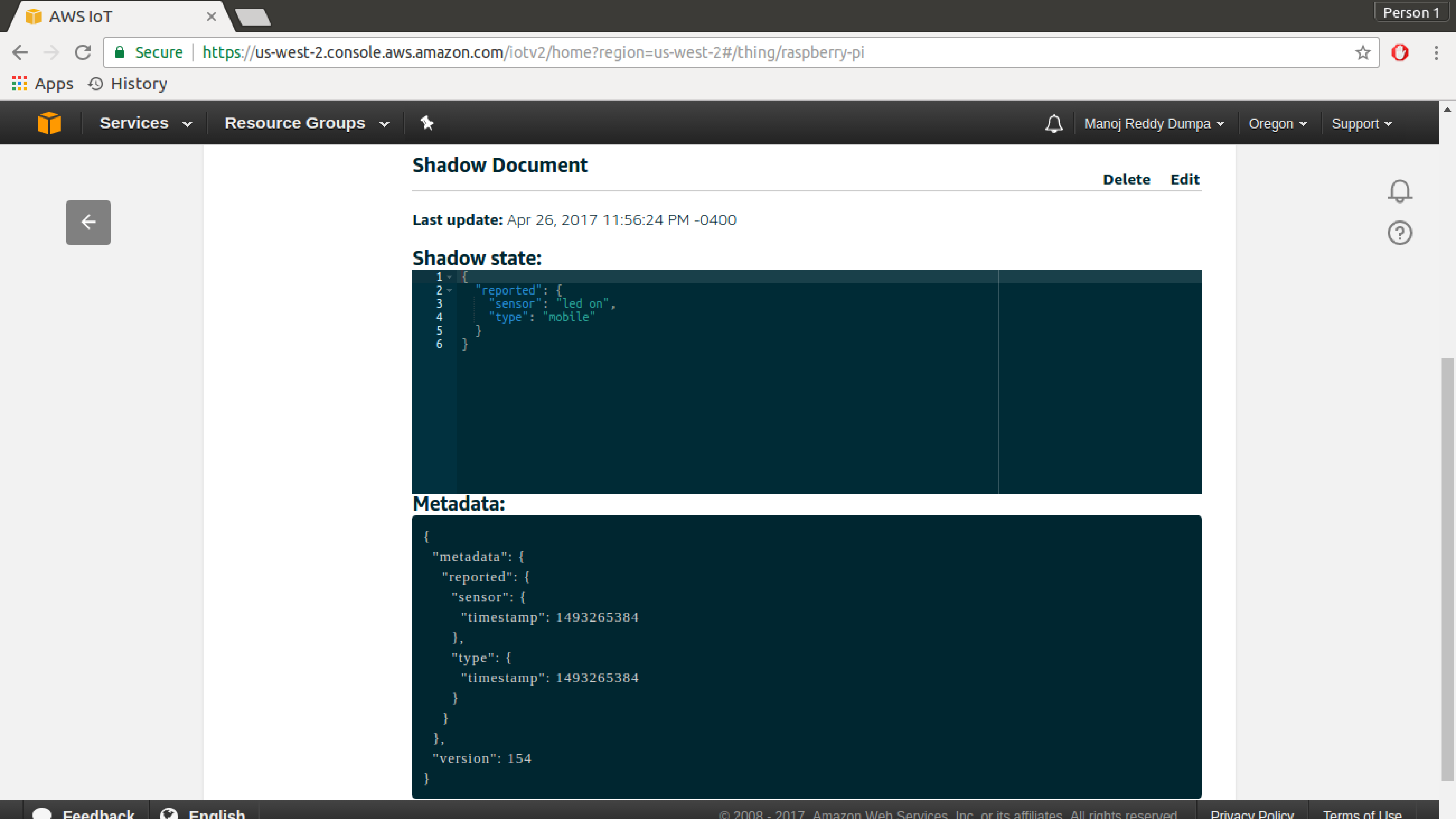


```
pi@raspberrypi:~/project $ python project.py
Subscriber Connection status code: 0 | Connection status: successful
Subscribed: 1 (0,)dataNone
Button Pressed
Received message from topic: $aws/things/raspberry-pi/shadow/update/accepted | QoS: 0 | Data Received: {"state":{"reported":{"sensor":"led on","type":"butto
n"}},"metadata":{"reported":{"sensor":{"timestamp":1493253971},"type":{"timestamp":1493253971}}},"version":147,"timestamp":1493253971}
Button Pressed
Received message from topic: $aws/things/raspberry-pi/shadow/update/accepted | QoS: 0 | Data Received: {"state":{"reported":{"sensor":"led off","type":"butt
on"}},"metadata":{"reported":{"sensor":{"timestamp":1493254044},"type":{"timestamp":1493254044}}},"version":148,"timestamp":1493254044}
Received message from topic: $aws/things/raspberry-pi/shadow/update/accepted | QoS: 0 | Data Received: {"state":{"reported":{"sensor":"led on","type":"mobil
e"}},"metadata":{"reported":{"sensor":{"timestamp":1493254104},"type":{"timestamp":1493254104}}},"version":149,"timestamp":1493254104}
0
Received message from topic: $aws/things/raspberry-pi/shadow/update/accepted | QoS: 0 | Data Received: {"state":{"reported":{"sensor":"led on","type":"butto
n"}},"metadata":{"reported":{"sensor":{"timestamp":1493254104},"type":{"timestamp":1493254104}}},"version":150,"timestamp":1493254104}
```


AWS IoT
Person 1
Secure
https://us-west-2.console.aws.amazon.com/iotv2/home?region=us-west-2#/thing/raspberry-pi
Apps
History
Services
Resource Groups
Manoj Reddy Dumpa
Oregon
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Delete
Edit
Feedback
English
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Shadow Document

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Shadow state:

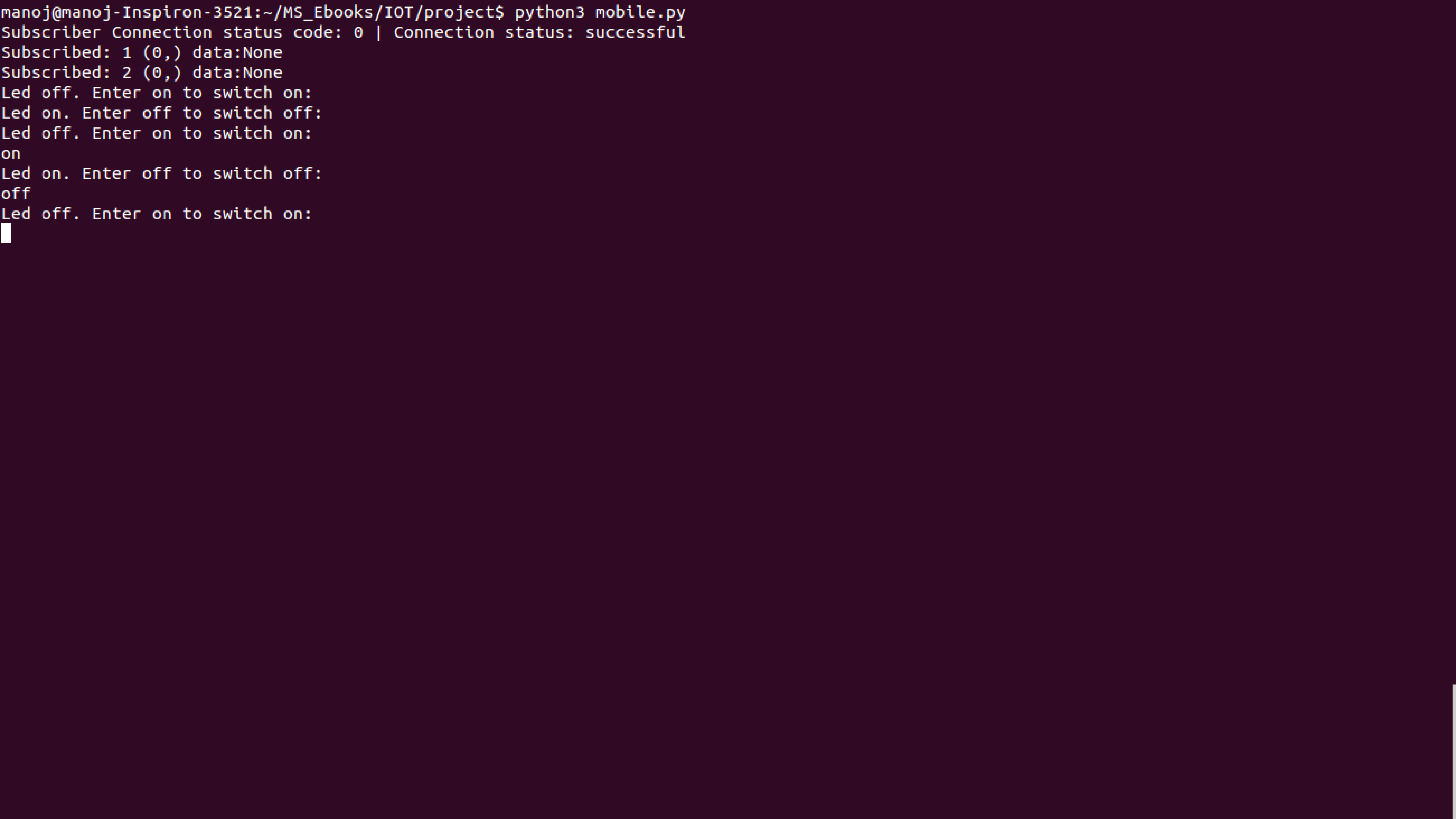
```
{
  "reported": {
    "sensor": "led on",
    "type": "mobile"
  }
}
```

Metadata:

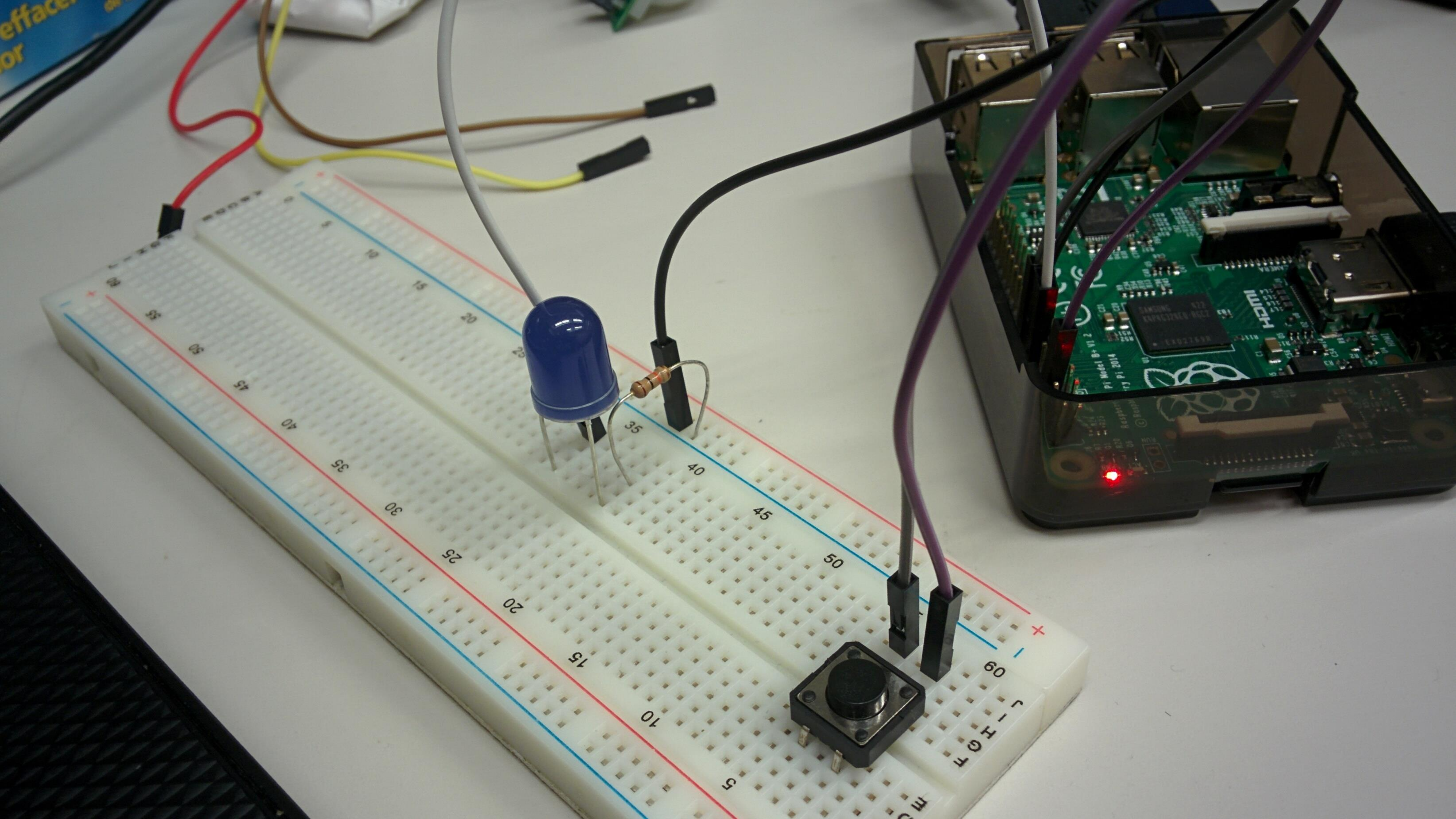
```
{
 "metadata": {
  "reported": {
   "sensor": {
    "timestamp": 1493265384
   },
   "type": {
    "timestamp": 1493265384
   }
  }
 },
 "version": 154
}
```

PROCEDURE (CONTD.)

- Now, according to the code, if the LED was on, keyword "off" was entered on the PC to switch on the LED



```
manoj@manoj-Inspiron-3521:~/MS_Ebooks/IOT/project$ python3 mobile.py
Subscriber Connection status code: 0 | Connection status: successful
Subscribed: 1 (0,) data:None
Subscribed: 2 (0,) data:None
Led off. Enter on to switch on:
Led on. Enter off to switch off:
Led off. Enter on to switch on:
on
Led on. Enter off to switch off:
off
Led off. Enter on to switch on:
```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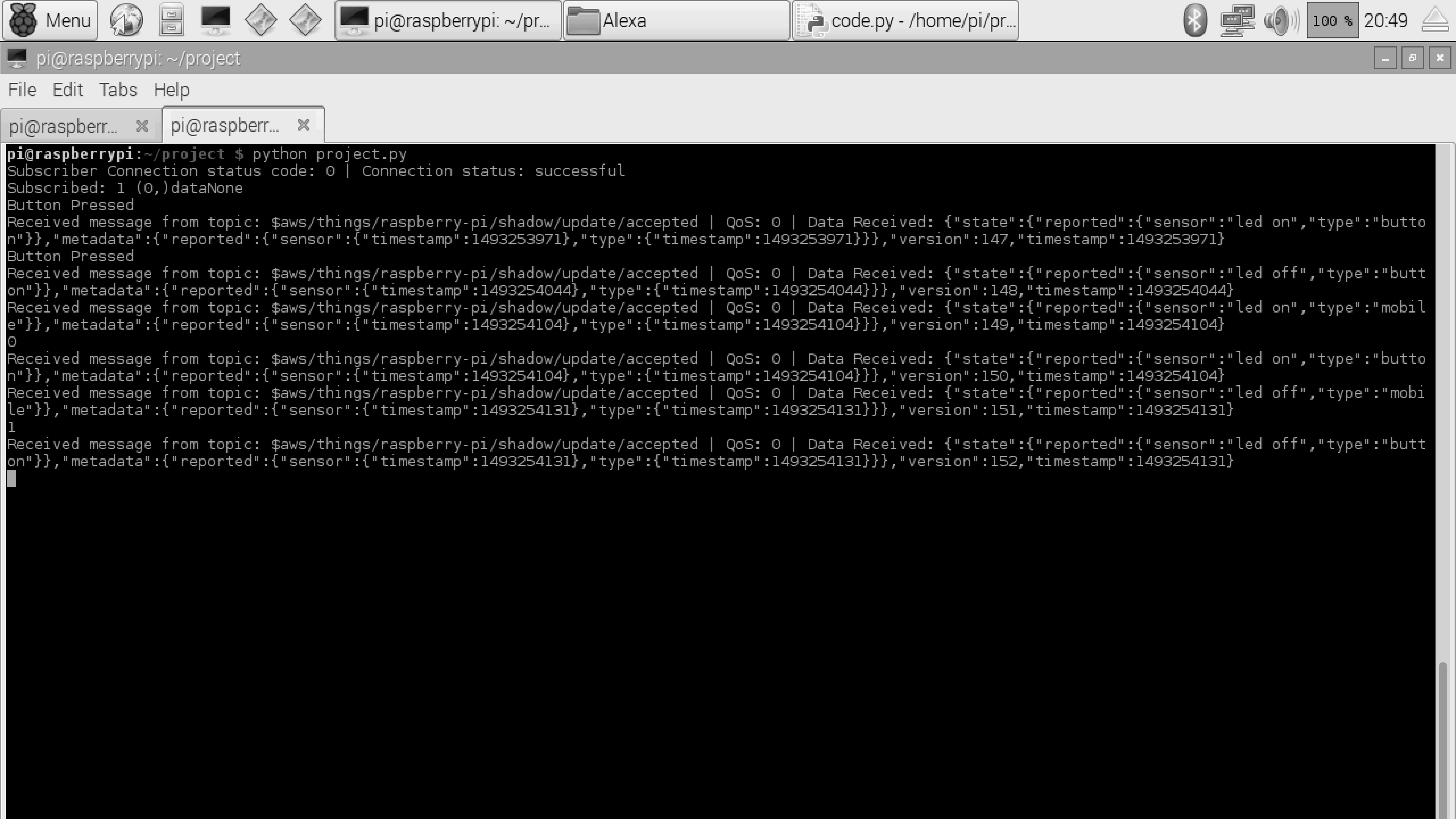
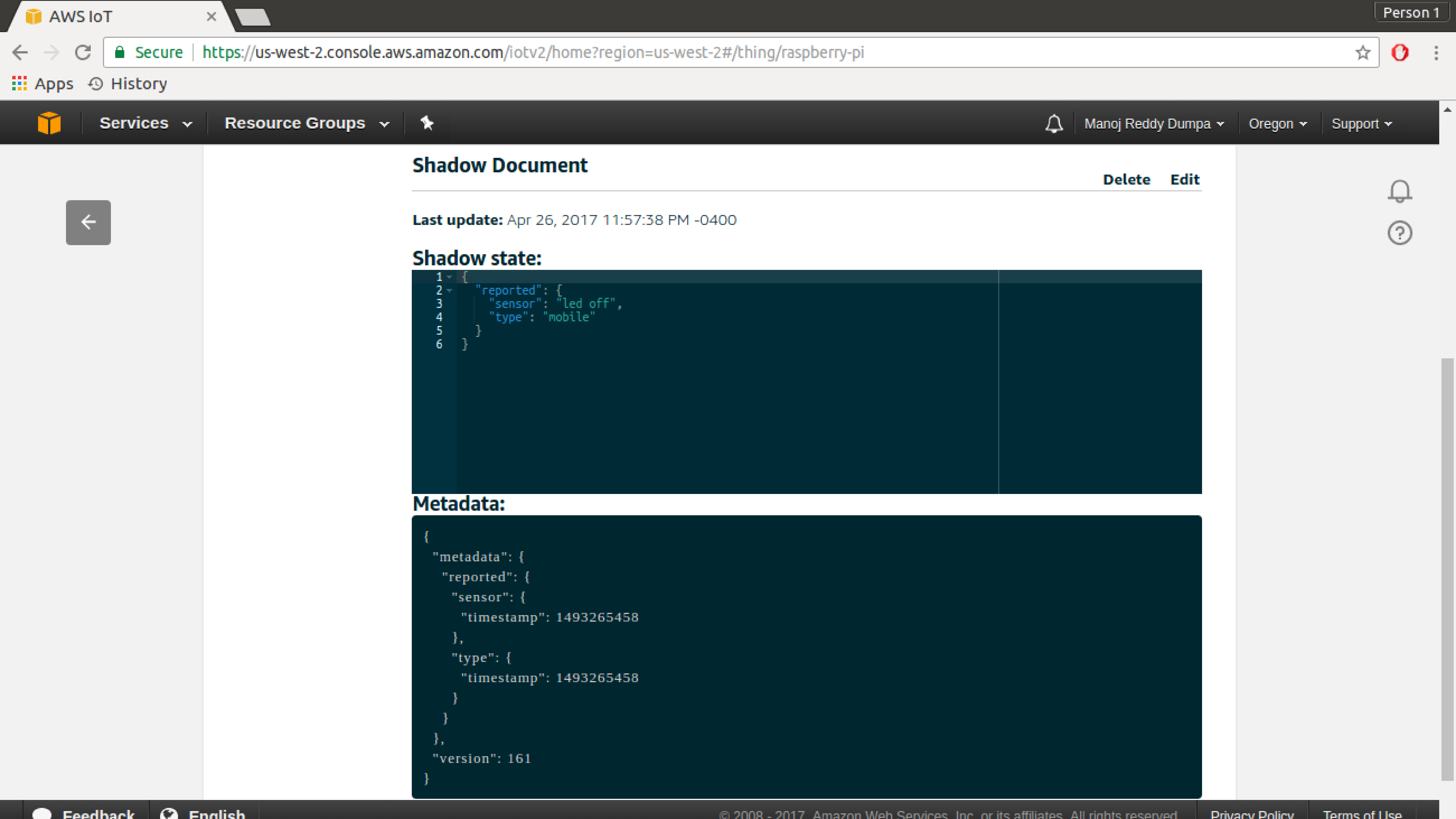
HDMI



```
pi@raspberrypi:~/project $ python project.py
Subscriber Connection status code: 0 | Connection status: successful
Subscribed: 1 (0,)dataNone
Button Pressed
Received message from topic: $aws/things/raspberry-pi/shadow/update/accepted | QoS: 0 | Data Received: {"state":{"reported":{"sensor":"led on","type":"butto
n"}},"metadata":{"reported":{"sensor":{"timestamp":1493253971},"type":{"timestamp":1493253971}}},"version":147,"timestamp":1493253971}
Button Pressed
Received message from topic: $aws/things/raspberry-pi/shadow/update/accepted | QoS: 0 | Data Received: {"state":{"reported":{"sensor":"led off","type":"butt
on"}},"metadata":{"reported":{"sensor":{"timestamp":1493254044},"type":{"timestamp":1493254044}}},"version":148,"timestamp":1493254044}
Received message from topic: $aws/things/raspberry-pi/shadow/update/accepted | QoS: 0 | Data Received: {"state":{"reported":{"sensor":"led on","type":"mobil
e"}},"metadata":{"reported":{"sensor":{"timestamp":1493254104},"type":{"timestamp":1493254104}}},"version":149,"timestamp":1493254104}
0
Received message from topic: $aws/things/raspberry-pi/shadow/update/accepted | QoS: 0 | Data Received: {"state":{"reported":{"sensor":"led on","type":"butto
n"}},"metadata":{"reported":{"sensor":{"timestamp":1493254104},"type":{"timestamp":1493254104}}},"version":150,"timestamp":1493254104}
Received message from topic: $aws/things/raspberry-pi/shadow/update/accepted | QoS: 0 | Data Received: {"state":{"reported":{"sensor":"led off","type":"mobi
le"}},"metadata":{"reported":{"sensor":{"timestamp":1493254131},"type":{"timestamp":1493254131}}},"version":151,"timestamp":1493254131}
1
Received message from topic: $aws/things/raspberry-pi/shadow/update/accepted | QoS: 0 | Data Received: {"state":{"reported":{"sensor":"led off","type":"butt
on"}},"metadata":{"reported":{"sensor":{"timestamp":1493254131},"type":{"timestamp":1493254131}}},"version":152,"timestamp":1493254131}
```



Shadow Document

Last update: Apr 26, 2017 11:57:38 PM -0400

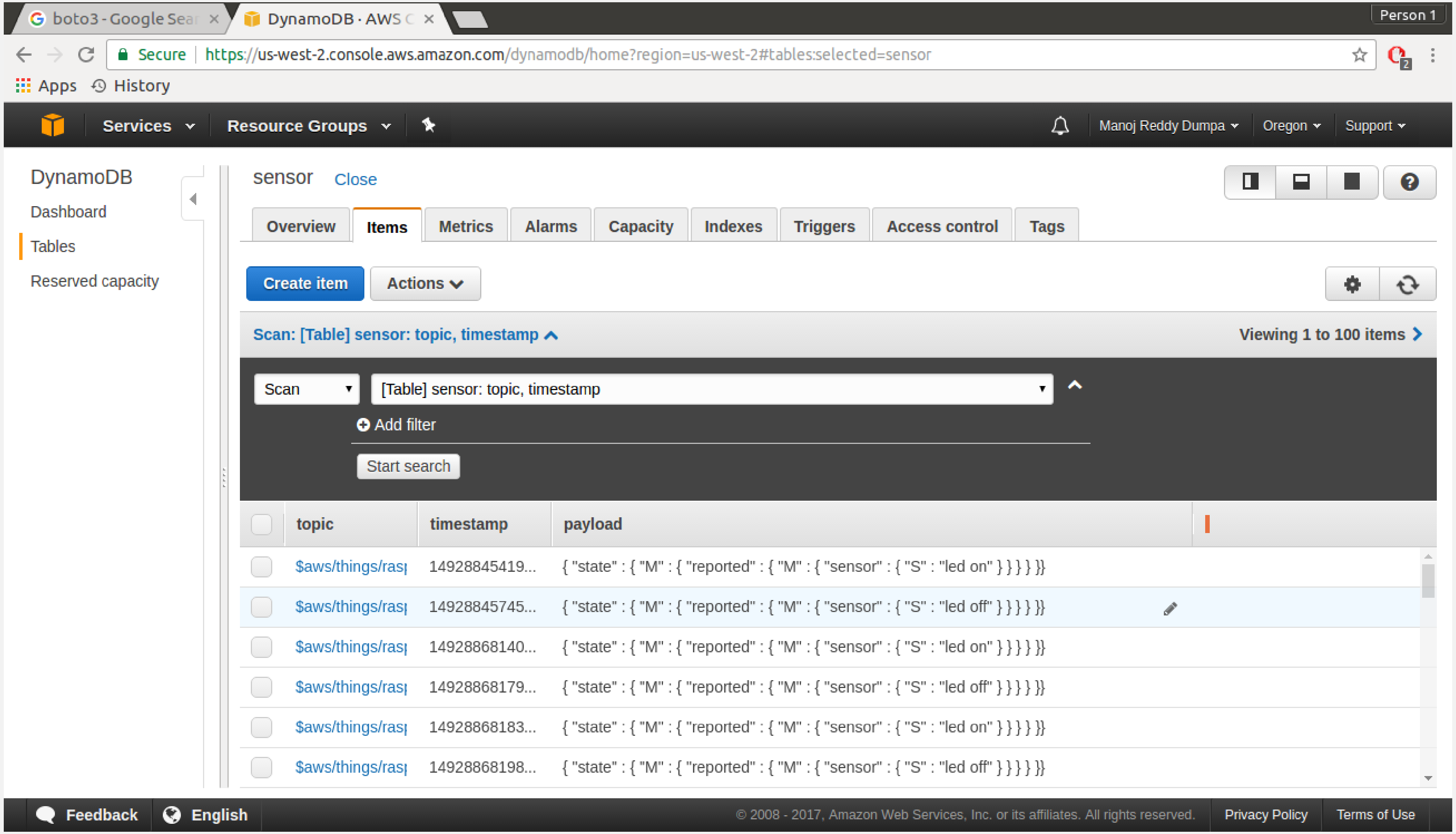
Shadow state:

```
{
  "reported": {
    "sensor": "led off",
    "type": "mobile"
  }
}
```

Metadata:

```
{
 "metadata": {
  "reported": {
   "sensor": {
    "timestamp": 1493265458
   },
   "type": {
    "timestamp": 1493265458
   }
  }
 },
 "version": 161
}
```

LED State data stored in DynamoDB



https://us-west-2.console.aws.amazon.com/dynamodb/home?region=us-west-2#tables:selected=sensor

sensor

Scan: [Table] sensor: topic, timestamp

Viewing 1 to 100 items

Scan | [Table] sensor: topic, timestamp

	topic	timestamp	payload
□	$aws/things/ras|	14928845419...	{ "state" : { "M" : { "reported" : { "M" : { "sensor" : { "S" : "led on" } } } } }}
□	$aws/things/ras|	14928845745...	{ "state" : { "M" : { "reported" : { "M" : { "sensor" : { "S" : "led off" } } } } }}
□	$aws/things/ras|	14928868140...	{ "state" : { "M" : { "reported" : { "M" : { "sensor" : { "S" : "led on" } } } } }}
□	$aws/things/ras|	14928868179...	{ "state" : { "M" : { "reported" : { "M" : { "sensor" : { "S" : "led off" } } } } }}
□	$aws/things/ras|	14928868183...	{ "state" : { "M" : { "reported" : { "M" : { "sensor" : { "S" : "led on" } } } } }}
□	$aws/things/ras|	14928868198...	{ "state" : { "M" : { "reported" : { "M" : { "sensor" : { "S" : "led off" } } } } }}

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CONCLUSION

- We were able to create a synchronized system where the LED could be controlled remotely through a device i.e. PC as well as through physical means i.e. a button

QUESTIONS?