DSI5168

A Smart Bed Exit Alarm

- Tutorial Resourses:
  https://github.com/Lys-0929/DSI5168_MQTT-SSL
  Or you can scan the QR code

•Designed by David Lee
•Directive Agency: Industrial Development Bureau, Ministry of Economic Affairs
•Executive Institute：Digital Service Innovation Institute, Institute for Information Industry

Content

Chapter 1 Abstract

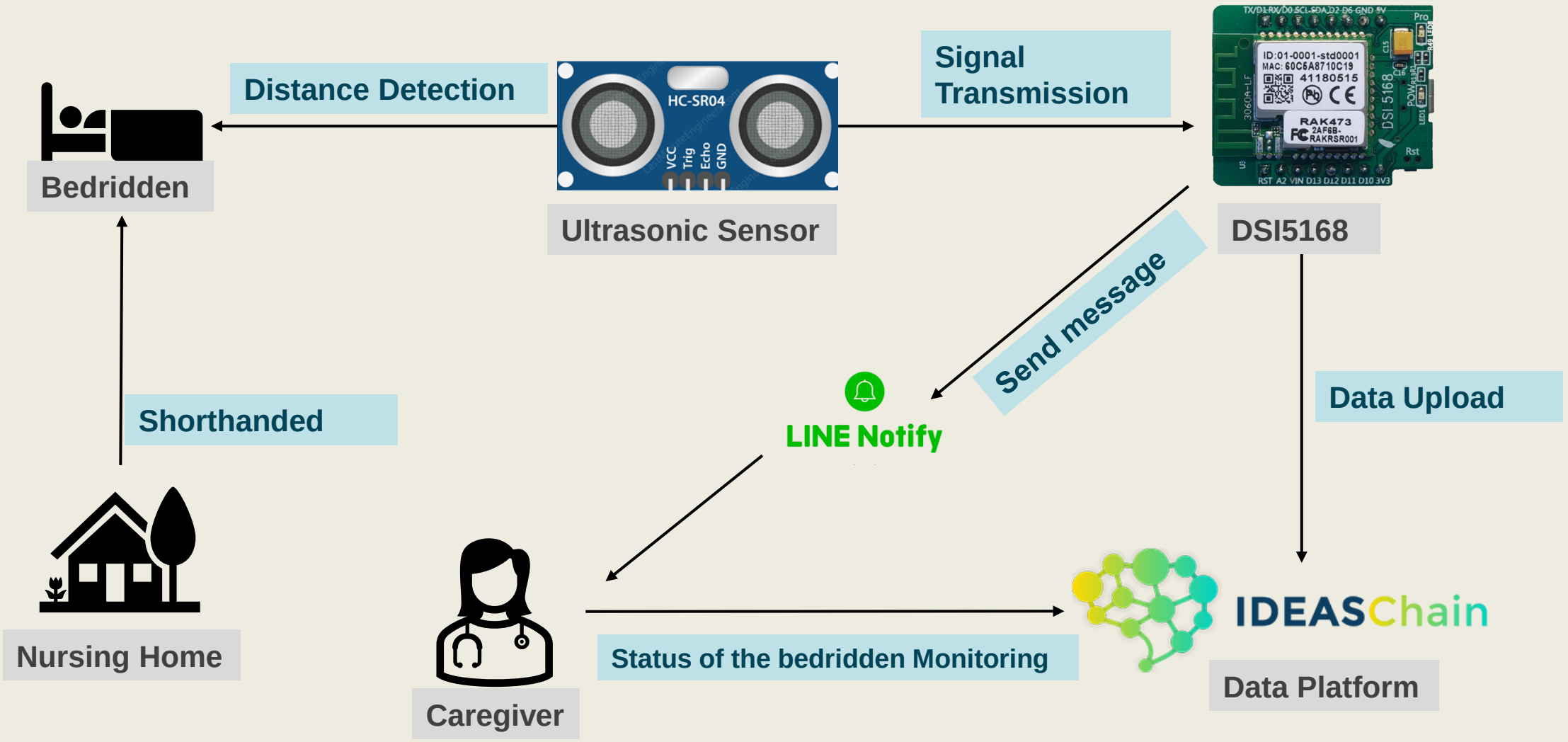
Design Purpose:

As the proportion of elders continues to rise in Taiwan, the dependency ratio has also been rising. In the case of insufficient support manpower, the demand for remote monitoring of elderly people has gradually emerged. To monitor the situation on the bed of elders is the purpose of this design. So that, even if the caregivers are not on-site, they can get the latest information of bedridden elderly people.

Design Methods:

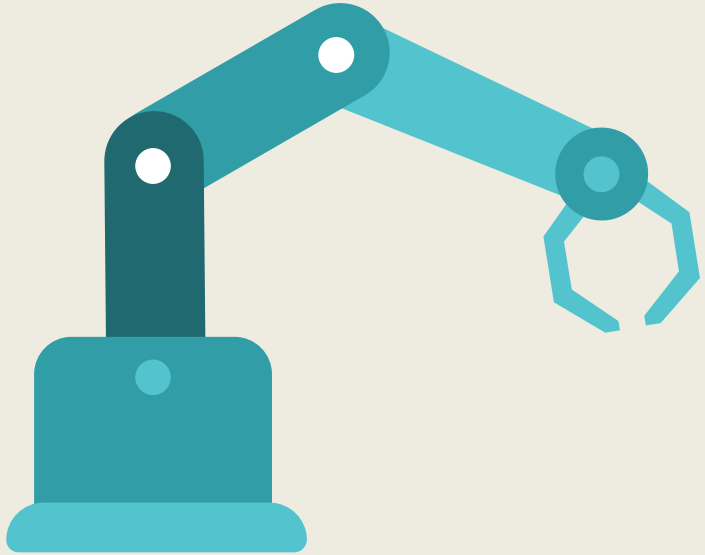
The application installs the ultrasound sensor on the head of the bed. Measure the change of the distance from the patient to the head of the bed. The distance decreasing as the patient gets up. If the sensor detects the distance decreasing, LINE will publish an alarm message to the caregiver.

1-1 Schematic diagram of the Project



(Image Source：IDEAS Chain)

Chapter 2 Hardware Overview



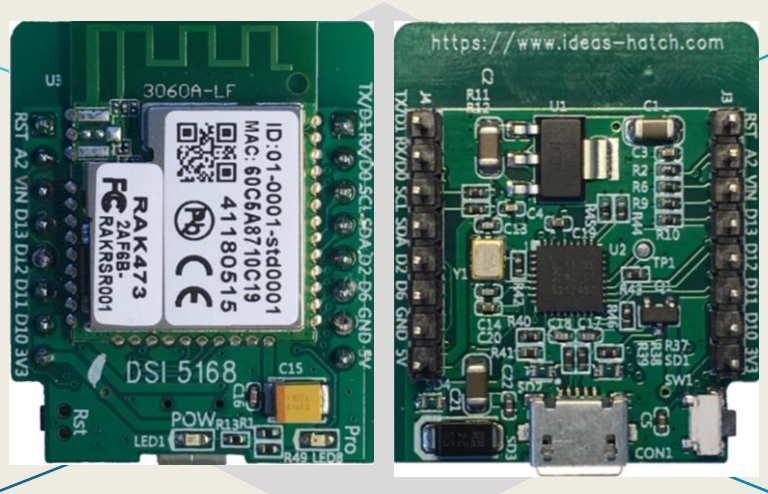
2-1 DSI5168 Evaluation Board

Micro Control Unit

The module offers a flexible interface includes SPI, I2C, UART, PWM and ADC ports.

Development Enviroment

Can be compiled and burned through Arduino IDE, also compatible the development environment of Arduino



Institute for Information Industry takes Ameba-RTL8711AM as the core of DSI5168. The Evaluation Board made in Taiwan is designed for IoT. It is compatible with Arduino IDE development environment that makes it more convenient to use.

Wi-Fi connect

Support For LAN 802.11b/g/n
Operating frequency 2.4GHz

IOT

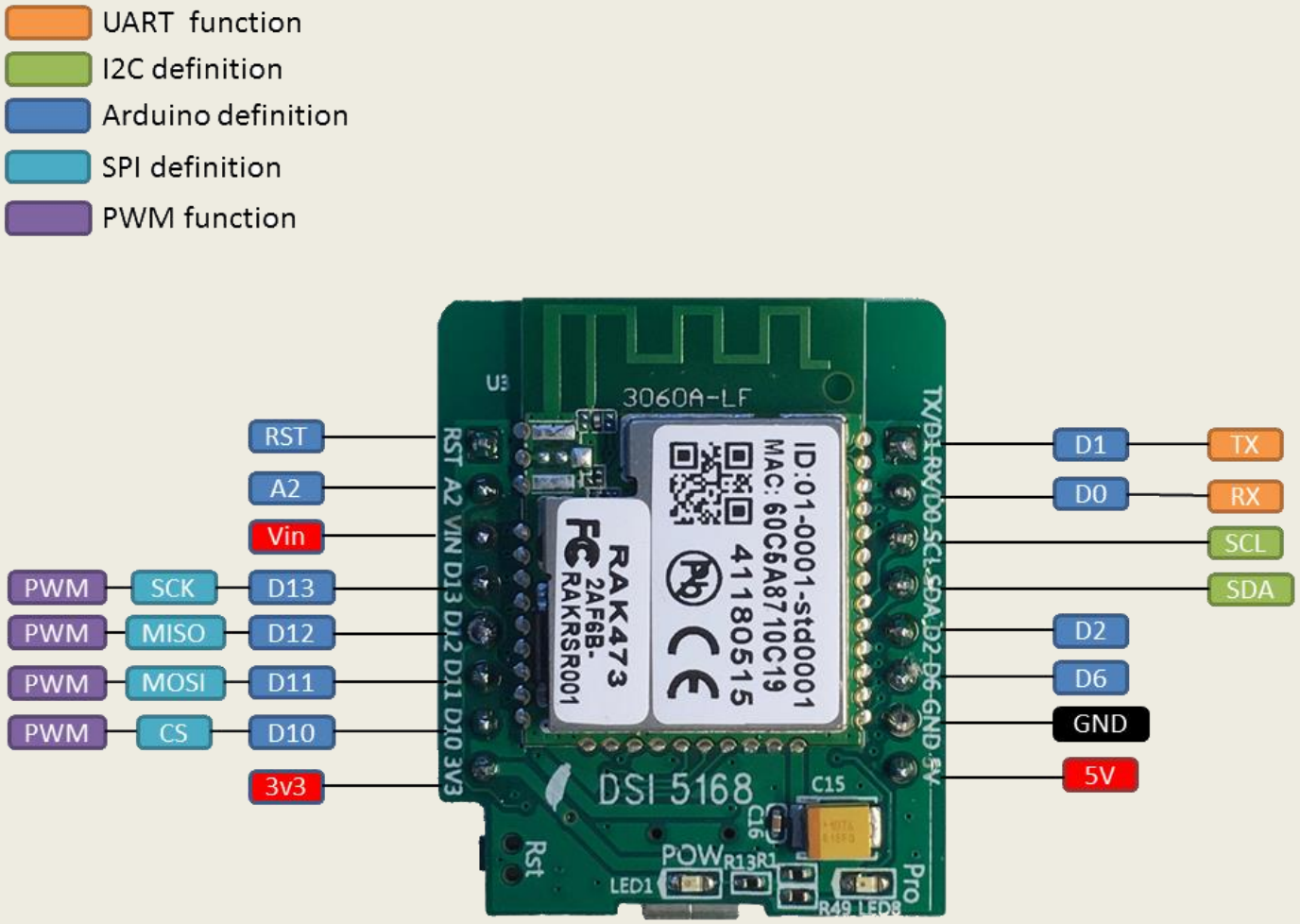
Support For MQTT and http network protocol, can be used to monitor the updated data.

(Reference：Institute for Information Industry)

2-2 Pinout & Features of DSI5168

Board Features

硬體功能	規格
Chipset	RTL8711AM
MCU	ARM M3/166MHz
I/O	12
ROM	1MB
SRAM	512KB
Internal Flash	N/A
External Flash	2MB
ADC	1
SPI	1
UART	1
I2C	1
I2S	N/A
PWM	4
SSL	Support

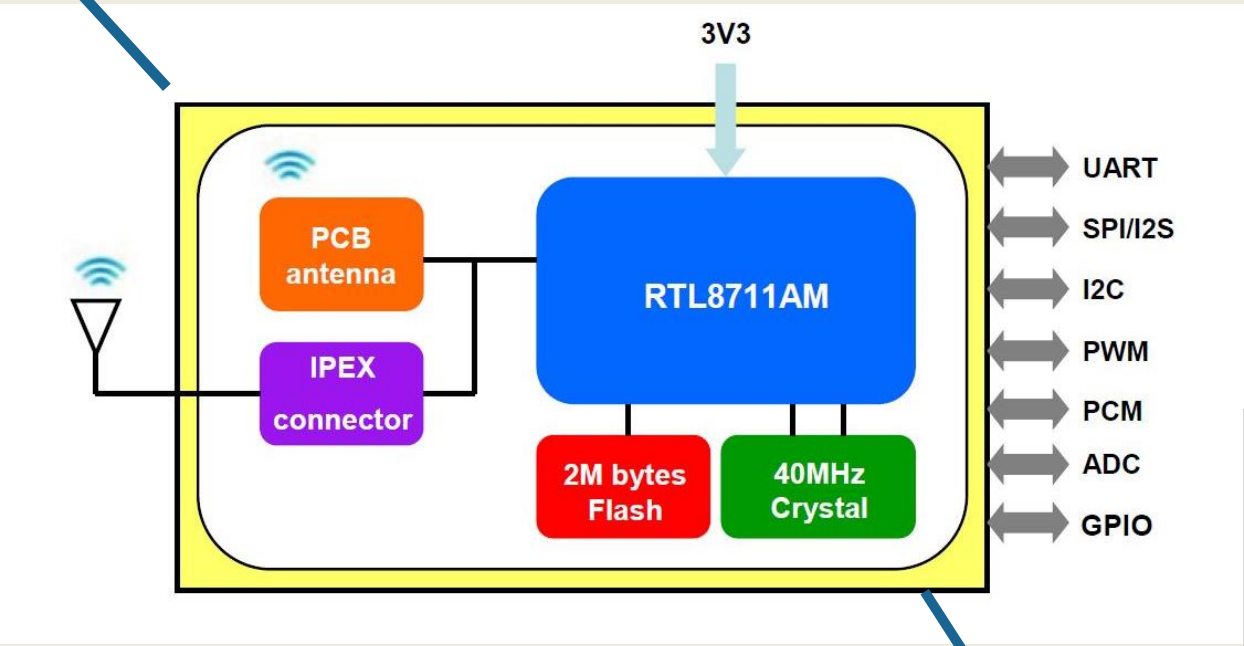


Reference: https://makerpro.cc/2019/11/iot-development-board-dsi5168/

2-3 REALTEK Ameba RTL8711AM

IC Data Sheet

RTL8711AM WiFi Module is a small form factor, single stream, 801.11 b/g/n WiFi module with embedded low power application processor.



General Features

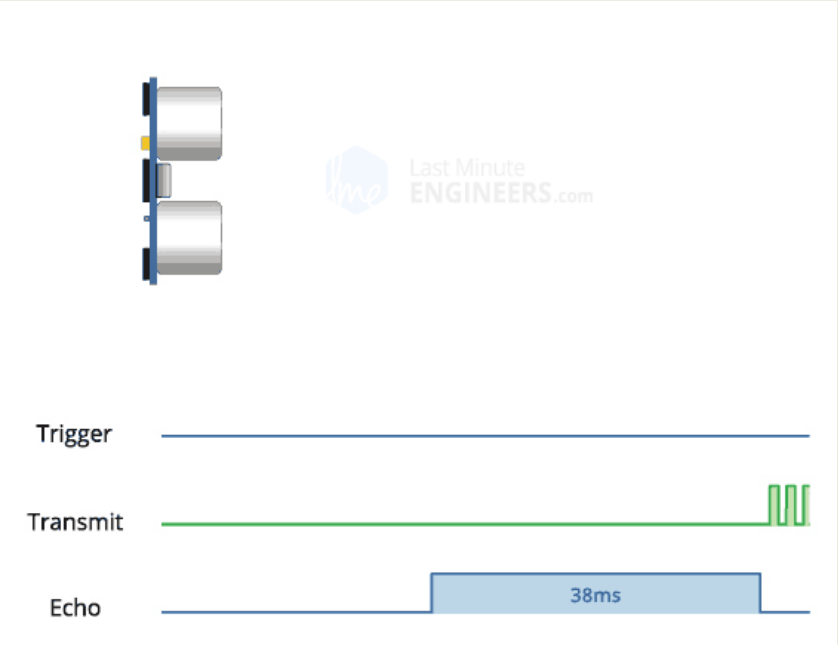
- Connector ports including GPIO ports, UART, I2C, SPI, I2S, PCM, PWM,ADC.
- Integrated 2MB flash
- Small footprint: 19×22.25×2.3 mm
- IEEE 802.11b/g/n compliant

(Image Source : Realtek)

2-4 Sensor Overview

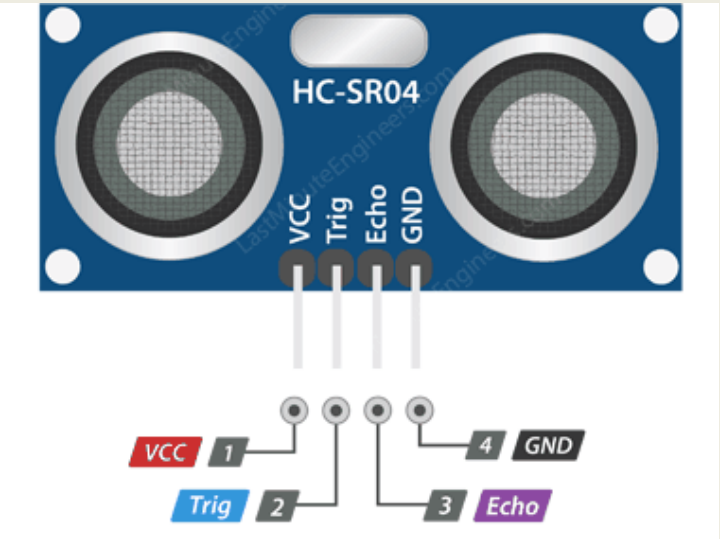
“HC-SR04” Ultrasonic sensor

The HC-SR04 Ultrasonic distance sensor consists of two ultrasonic transducers. The one acts as a transmitter which converts electrical signal into 40 KHz ultrasonic sound pulses. The receiver listens for the transmitted pulses. If it receives them it produces an output pulse whose width can be used to determine the distance the pulse travelled.



Specifications

Operating Voltage	DC 5V
Max Range	4m
Min Range	2cm
Ranging Accuracy	3mm
Trigger Input Signal	10µS TTL pulse
Dimension	45 x 20 x 15mm



(Image Source : lastminuteengineers.com)

2-5 Wiring HC-SR04 with DSI5168

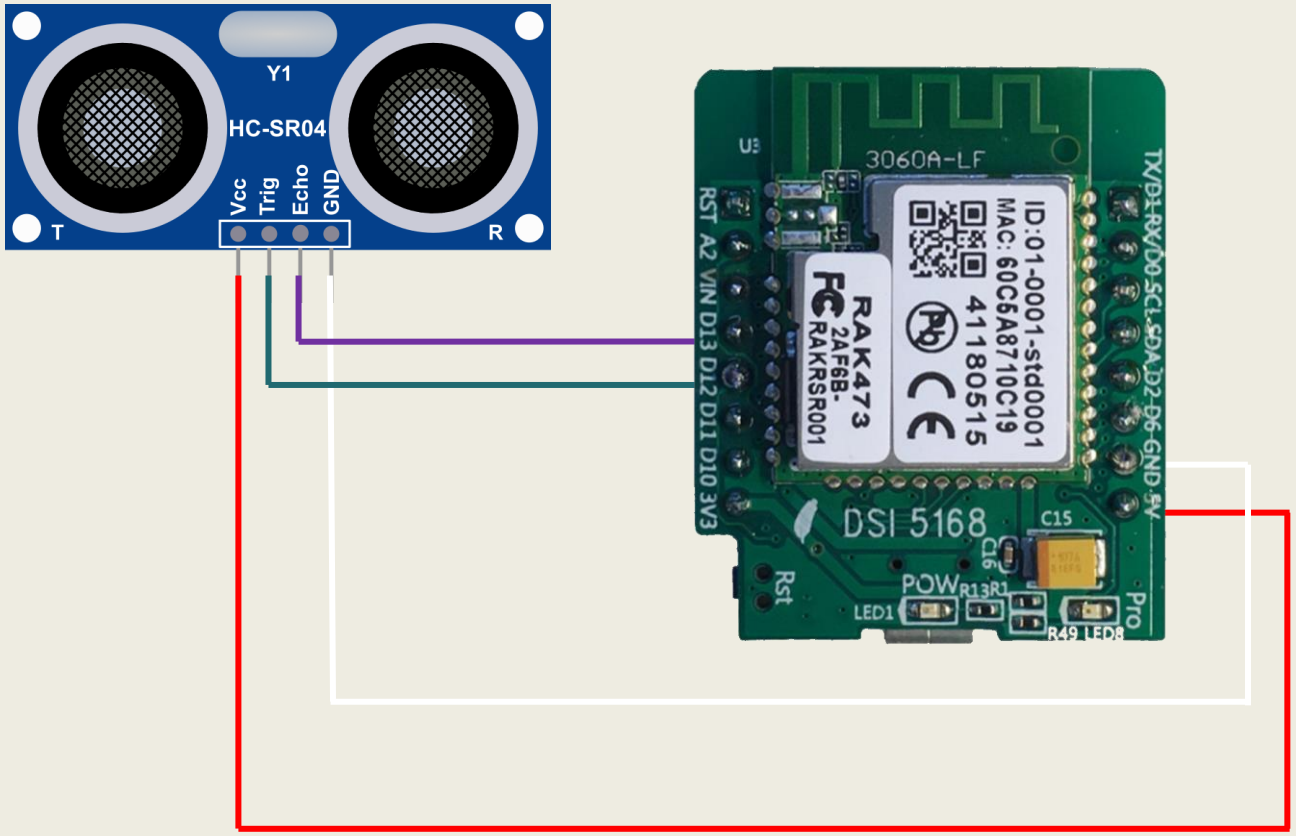
Components

1.DSI5168 Evaluation Board
2.Ultrasonic sensor HC-SR04
3.Jumper wires

Pin connection

· Connect DSI5168 to power with micro usb.
· Wiring:

Vcc →5V
trig →D12
echo →D13
GND →GND



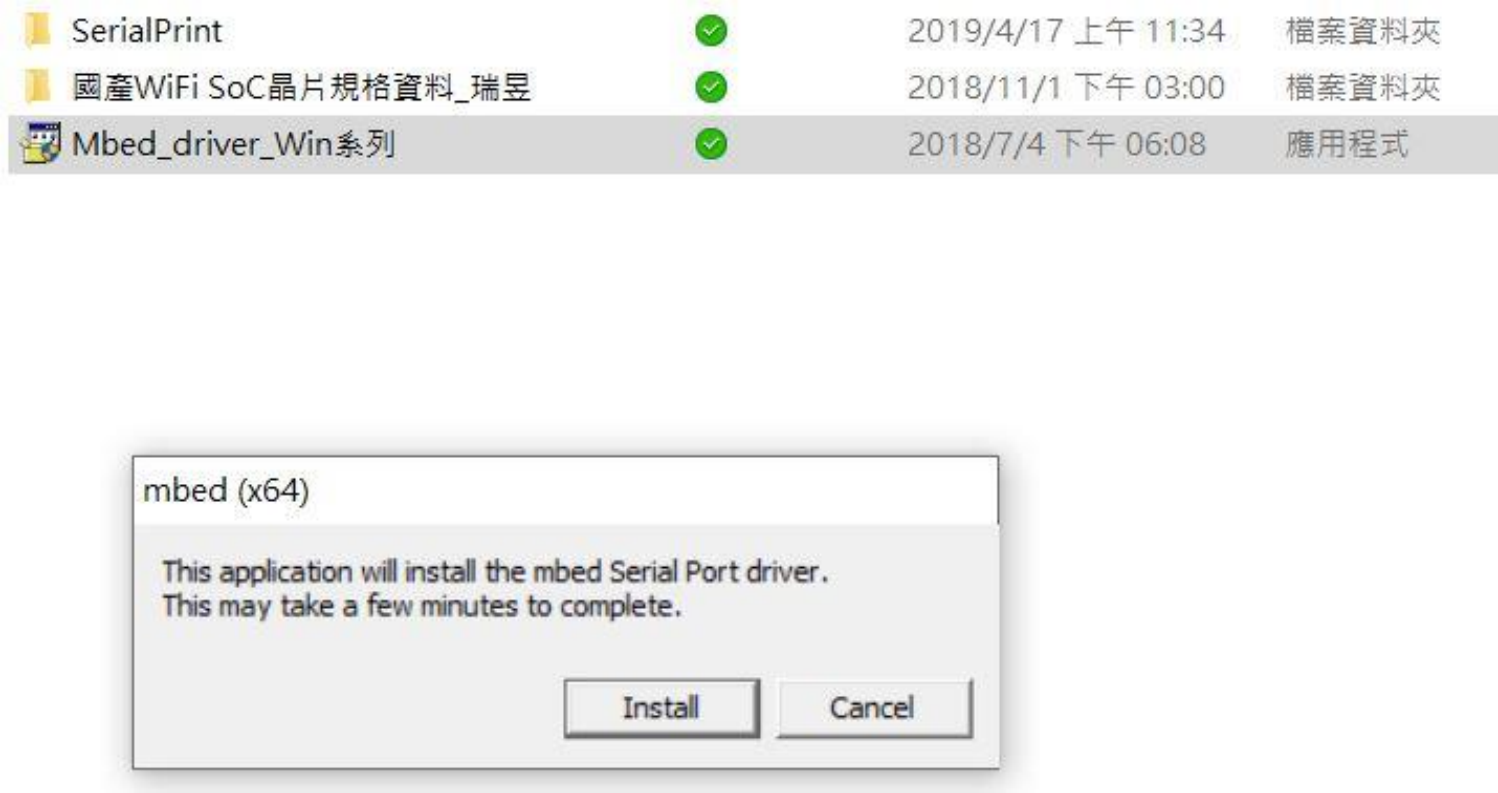
(Image Source：Yi-Hsien Li)

Chapter 3 Software Overview

For Windows 10

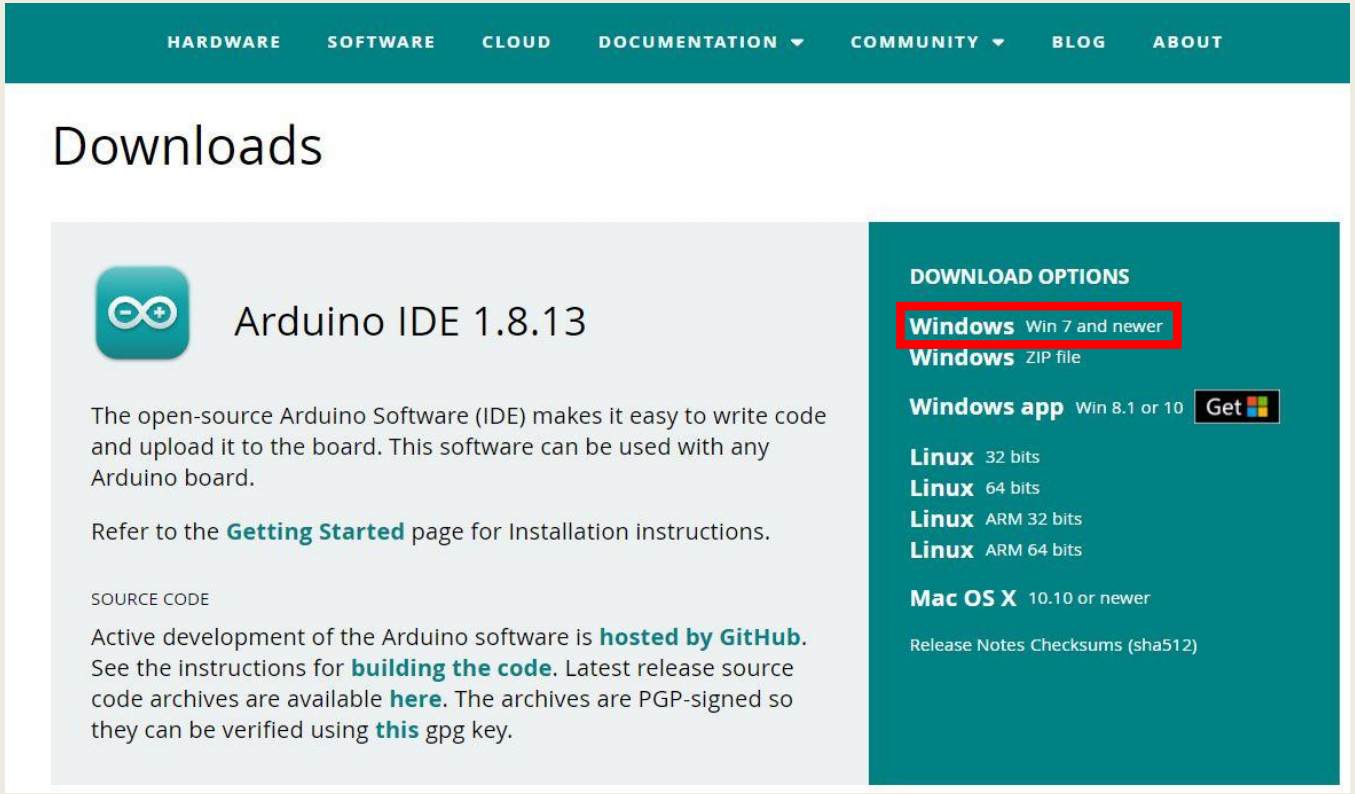
3-1	3-2	3-3	3-4	3-5	3-6
Install Mbed Driver	Arduino IDE	Programing	MQTTBox	IDEAS Chain dashboard	Line Noitfy
Driver for DSI5168	IDE setup	C program	Test MQTT connectivity	Set up the Platform	SSL protocol

3-1 Install Mbed Driver

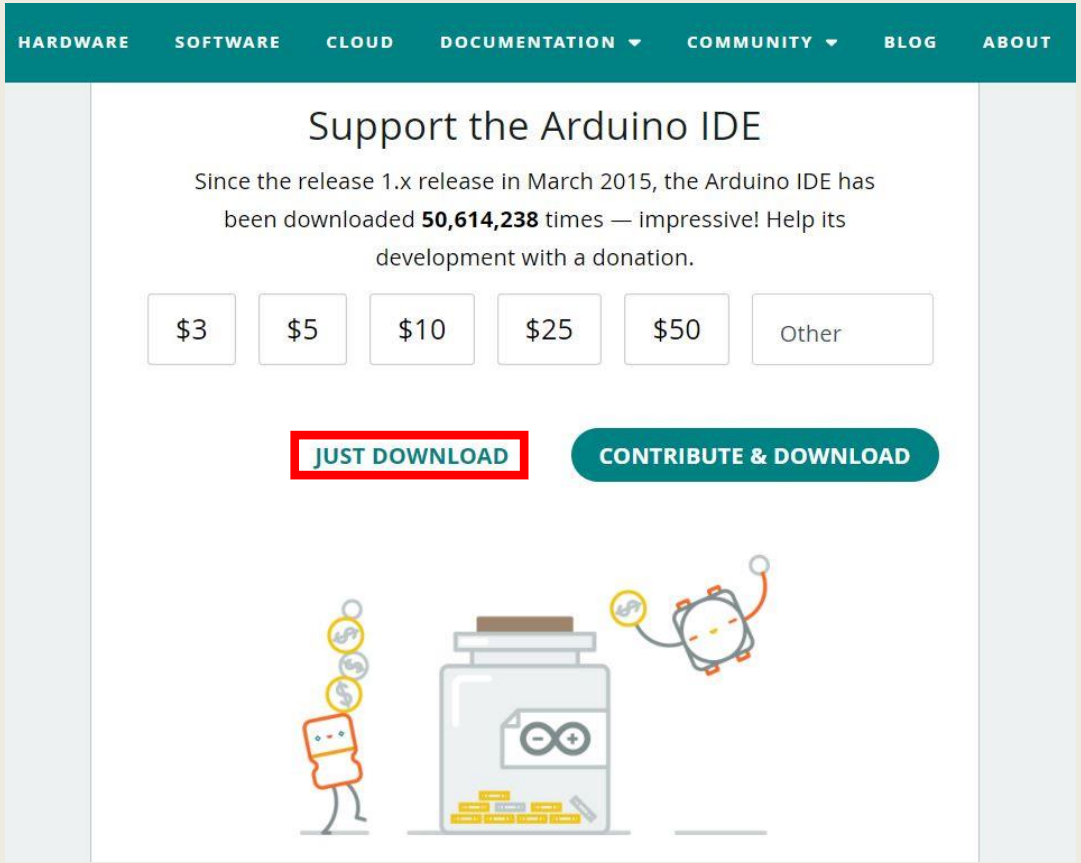


First, Wiring DSI5168 with your computer.
Execute the driver “mbedWinSerial_16466.exe”. Then, Open “Device Manager” to check Mbed Disk and Com Port. You’ll find the port of DSI5168.

3-2-a Install the Arduino IDE

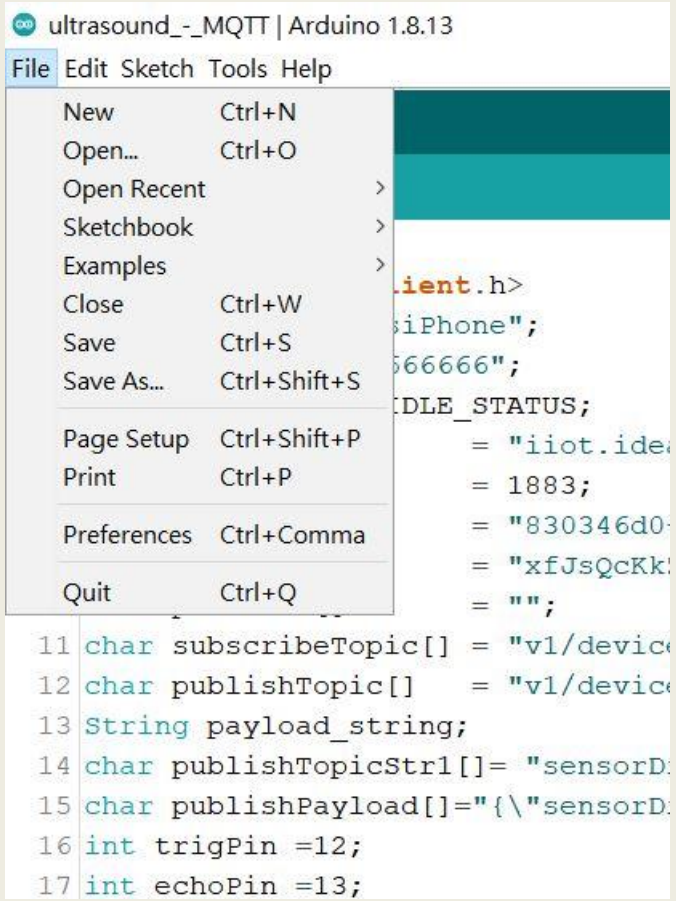


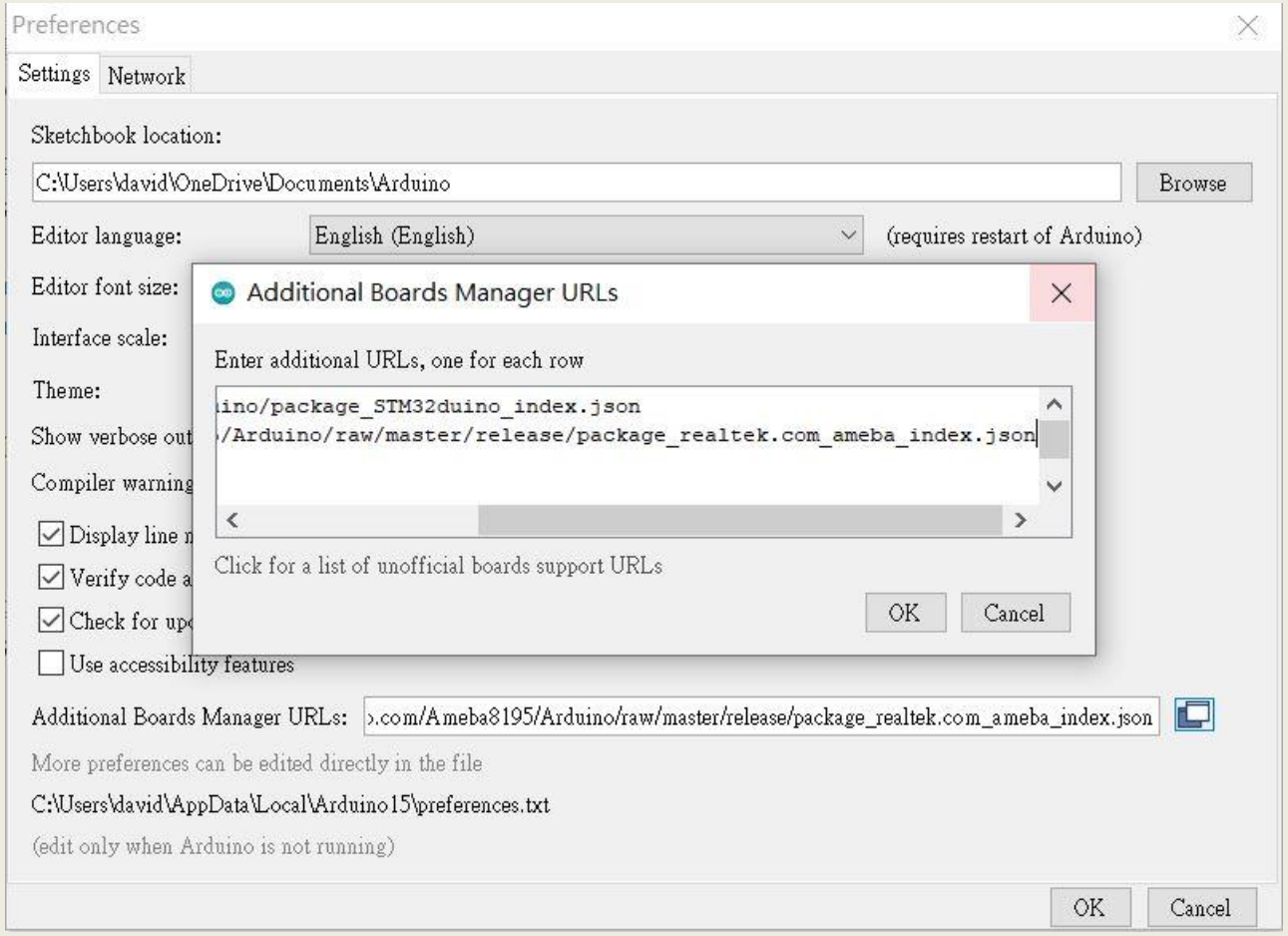
Click the following link to download Arduino IDE:
https://www.arduino.cc/en/software



You can choice whether you want to contribute Arduino or not. If you don't want to contribute, just click "JUST DOWNLOAD".

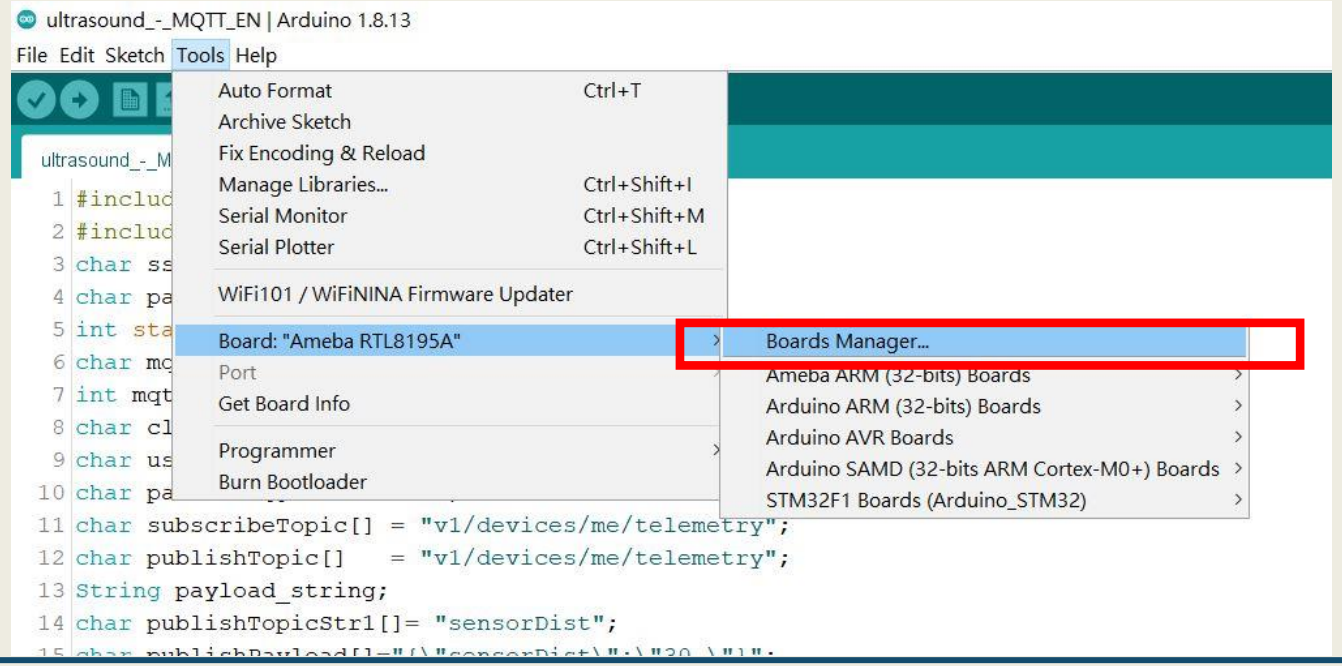
3-2-b Arduino IDE Setting





Find “Additional Boards Manager URLs “ and enter the following URL：
https://github.com/Ameba8195/Arduino/raw/master/release/package_realtek.com_ameba_index.json

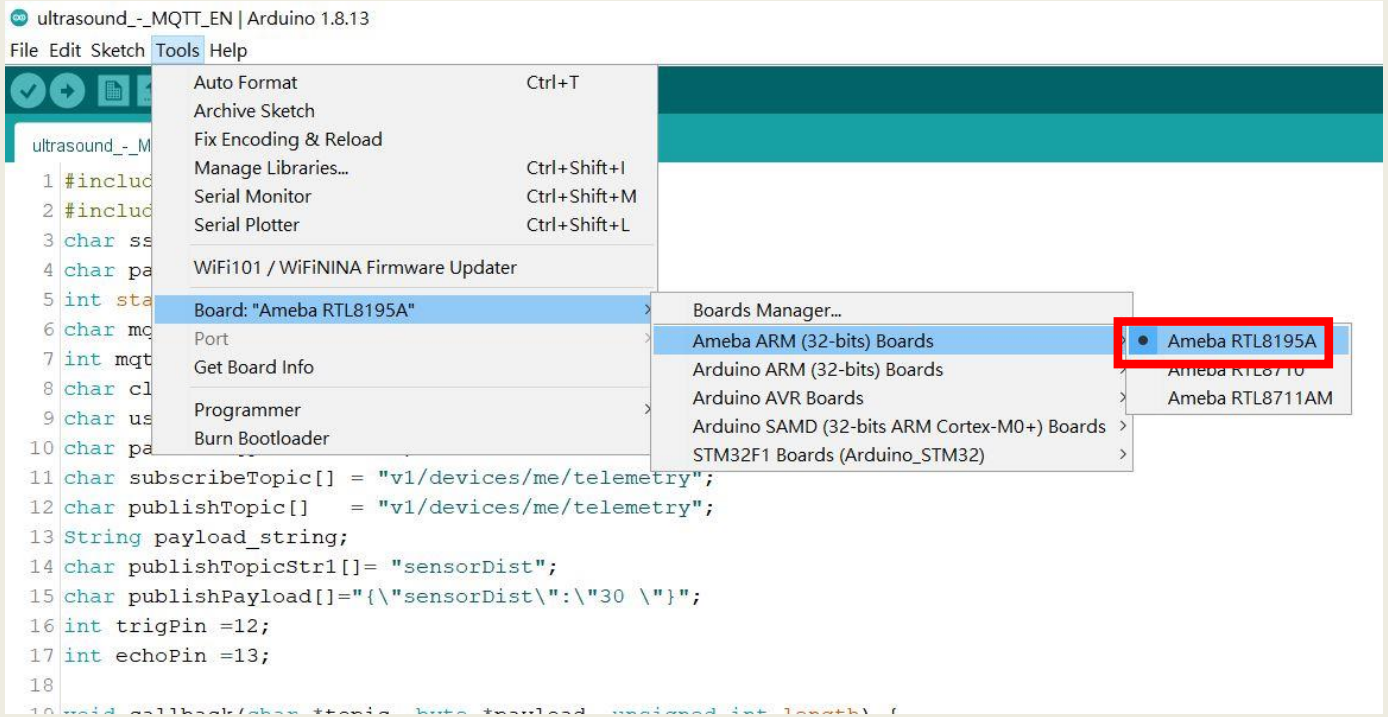
3-2-c Arduino IDE Setting



Find “Tools” and choose Boards Manager.

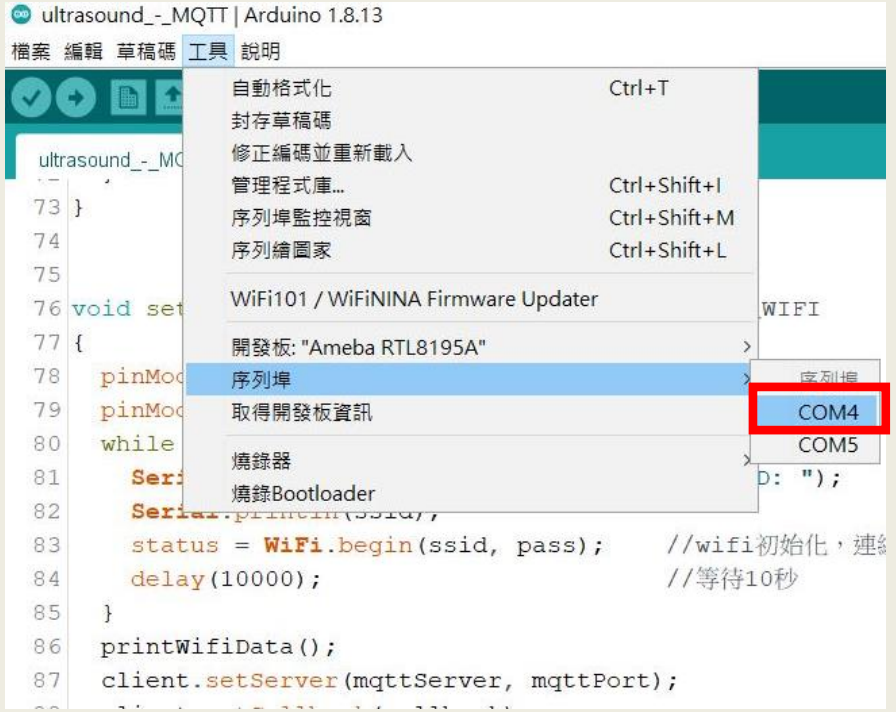
Enter “Realtek” and install “Realtek Ameba Boards (32-bit ARM Cortex-M3)”

3-2-d Arduino IDE Setting



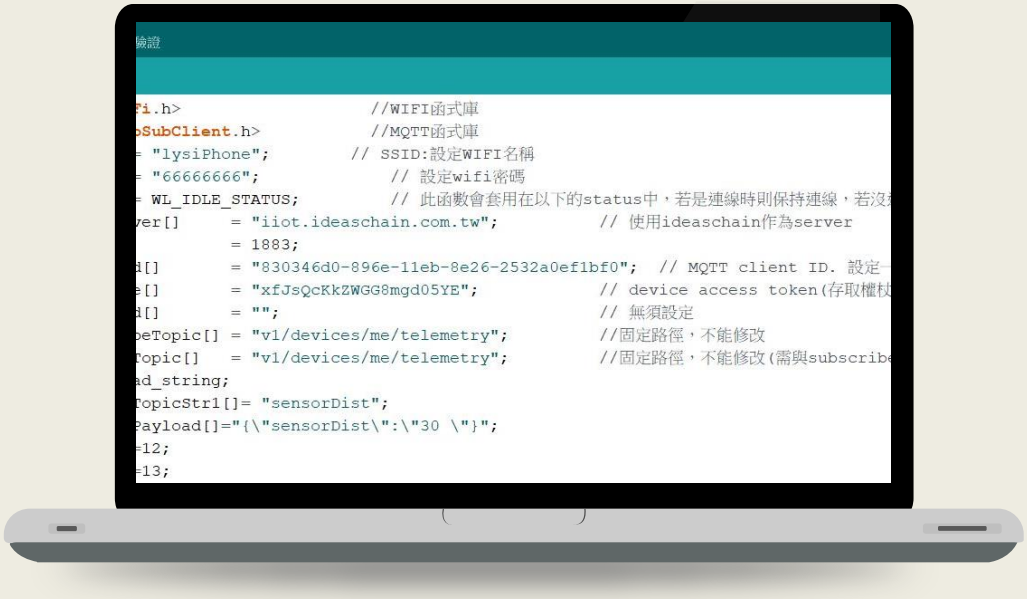
Choose Board “Ameba RTL8195A”

Choose Port “COM X”
(You can check the port from Device Manager)



3-3 Programing

Using Arduino IDE



Ameba Library

<WiFi.h>

This library allows the board to connect to the internet. It can serve as either a server accepting incoming connections or a client making outgoing ones.

<PubSubClient.h>

This library allows you to send and receive MQTT messages.
MQTT is a lightweight messaging protocol ideal for small devices.

<AmebaServo.h>

This library is the same as <servo.h>. Allows DSI5168 to control a variety of servo motors.

3-3-a Coding

程式碼下載: https://github.com/Lys-0929/DSI5168_MQTT-SSL

```
#include <WiFi.h>                    //WIFI library
#include <PubSubClient.h>            //MQTT library
char ssid[] = "********";        // SSID:router name
char pass[] = "********";             // pass:router password
String Linetoken = "****************************************"; //Change your own “LINE Notify token”
int status  = WL_IDLE_STATUS;         // keep connecting
char mqttServer[]     = "iiot.ideaschain.com.tw";          // Take ideaschain as server
int mqttPort          = 1883;
char clientId[]       = "********";  // MQTT client ID. Create an unique ID.
char username[]       = "********";      // device access token(change your own access token of IDEASChain)
char password[]       = "";                              // don't need to set up
char subscribeTopic[] = "v1/devices/me/telemetry";         //fixed topic, do not modify
char publishTopic[]   = "v1/devices/me/telemetry";         //as the same as subscribeTopic
String payload_string;
char publishTopicStr1[]= "sensorDist";
char publishPayload[]="{\"sensorDist\":\"30 \"}";
WiFiSSLClient client1;
char host[] = "notify-api.line.me";//LINE Notify API URL
int trigPin =12;
int echoPin =13;
```

3-3-b Coding

```
void callback(char *topic, byte *payload, unsigned int length) {//recept the data from server
    Serial.print("Message arrived in topic: ");
    Serial.println(topic);
    Serial.print("Message:");
    for (int i=0; i<length; i++) {
       Serial.print( (char) payload[i]);                // convert *byte to string
    }

    Serial.println();
    Serial.println("-----------------------------------");
}

WiFiClient wifiClient;
PubSubClient client(wifiClient);                            //define the client's name
```

3-3-c Coding

```
void publishData( char*publishTopicStr, float sensorValue){
char sensorDist [30];
sprintf (sensorDist ,"{\"%s \":\"%.2f \"}", publishTopicStr,sensorValue);
Serial.println(sensorDist);
while(!client.connected()){
  Serial.println("Attempting MQTT connection Attempt to connect...");
  if(client.connect (clientId, username, password)){
     Serial.println("MQTT connected");
     client.publish(publishTopic,sensorDist);
     client.subscribe(subscribeTopic);
}
  else{
Serial.print("failed rc= ");
Serial.print(client.state());
Serial.println("try again in 5 seconds ");
delay(5000);
}
}
}
```

3-3-d Coding

```
void reconnect() {                          // client connect to the MQTT server

  while (!client.connected()) {                          //while(disconnect),then run the loop continually
    Serial.println("Attempting MQTT connection...");
    if (client.connect(clientId, username, password)) {     // try to connect
      Serial.println("MQTT connected");                    //after connected, publish the topic & payload
      client.publish(publishTopic, "payload_string");
      client.subscribe(subscribeTopic);                    //resubscribe the topic
    } else {
      Serial.print("failed, rc=");
      Serial.print(client.state());
      Serial.println(" try again in 5 seconds");
      delay(5000);                                  //wating for 5 second to reconnect
    }
  }
}
```

3-3-e Coding

```
void setup()                    //set up the pinmode and WIFI
{
  pinMode(trigPin ,OUTPUT);
  pinMode(echoPin ,INPUT);
  while (status != WL_CONNECTED) {
    Serial.print("Attempting to connect to SSID: ");
    Serial.println(ssid);
    status = WiFi.begin(ssid, pass);    //initialize wifi setting
    delay(10000);                       //wating for WiFi connecting for 10 second
  }
  printWifiData();
  client.setServer(mqttServer, mqttPort);
  client.setCallback(callback);
  delay(1500);
}

void printWifiData() {
  IPAddress ip = WiFi.localIP();
  Serial.print("IP Address: ");
  Serial.println(ip);
}
```

3-3-f Coding

```
void loop()
{

  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  float duration_us = pulseIn(echoPin, HIGH);//Measure the integral time of pulse triging and receiving.
  float distance_cm = 0.017 * duration_us;   //Change the integral into distance.
  Serial.print("distance: ");
  Serial.print(distance_cm);
  Serial.println(" cm");
  delay(500);
  if(isnan(duration_us) ){
   Serial.println("Failed to read from sensor!");
   return;
   }
```

3-3-g Coding

```
if (distance_cm <= 50) {
    String message = " <Warning>: The patient is getting out of bed!"; //The content of line message.
    message += "\n The distance between patient and bed head=" + String(((float)distance_cm)) + " cm";
    Serial.println(message);
    if (client1.connect(host, 443)) {
      int LEN = message.length();
      String url = "/api/notify";  //POST header
      client1.println("POST " + url + " HTTP/1.1");
      client1.print("Host: "); client1.println(host);
      //Access token
      client1.print("Authorization: Bearer "); client1.println(Linetoken);
      client1.println("Content-Type: application/x-www-form-urlencoded");
      client1.print("Content-Length: "); client1.println( String((LEN + 8)) );
      client1.println();
      client1.print("message="); client1.println(message);
      client1.println();
      delay(2000);
      String response = client1.readString();
      Serial.println(response); //Display the result of responsing
      client1.stop(); //Disconnecting
    }
    else {
      Serial.println("connected fail");
    }
  }
  delay(5000);
 if(!client.connected()){
  reconnect();
  delay(2000);
  }
  client.disconnect();
  client.loop();
  delay(300);
  publishData(publishTopicStr1,distance_cm);
  client.loop();
}
```

3-4-a Test MQTT Connectivity

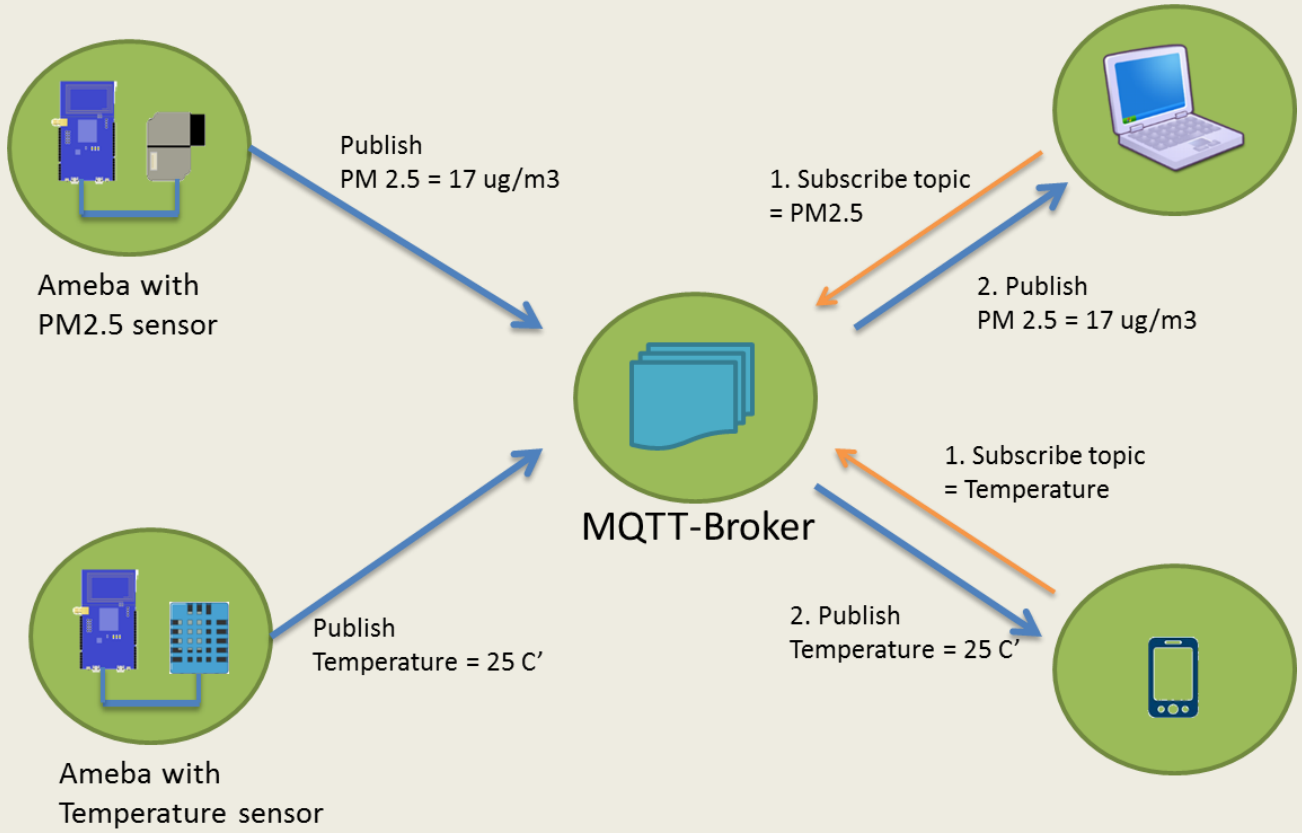
The tool is used t to test MQTT server. Therefore, we can know whether the server works or not.

Subscribe

Platform subscribe the MQTT message from server.

Publish

DSI5168 publish the MQTT message. Note that the massage should be sent in Json form.



(Image Source : amebaiot.com)

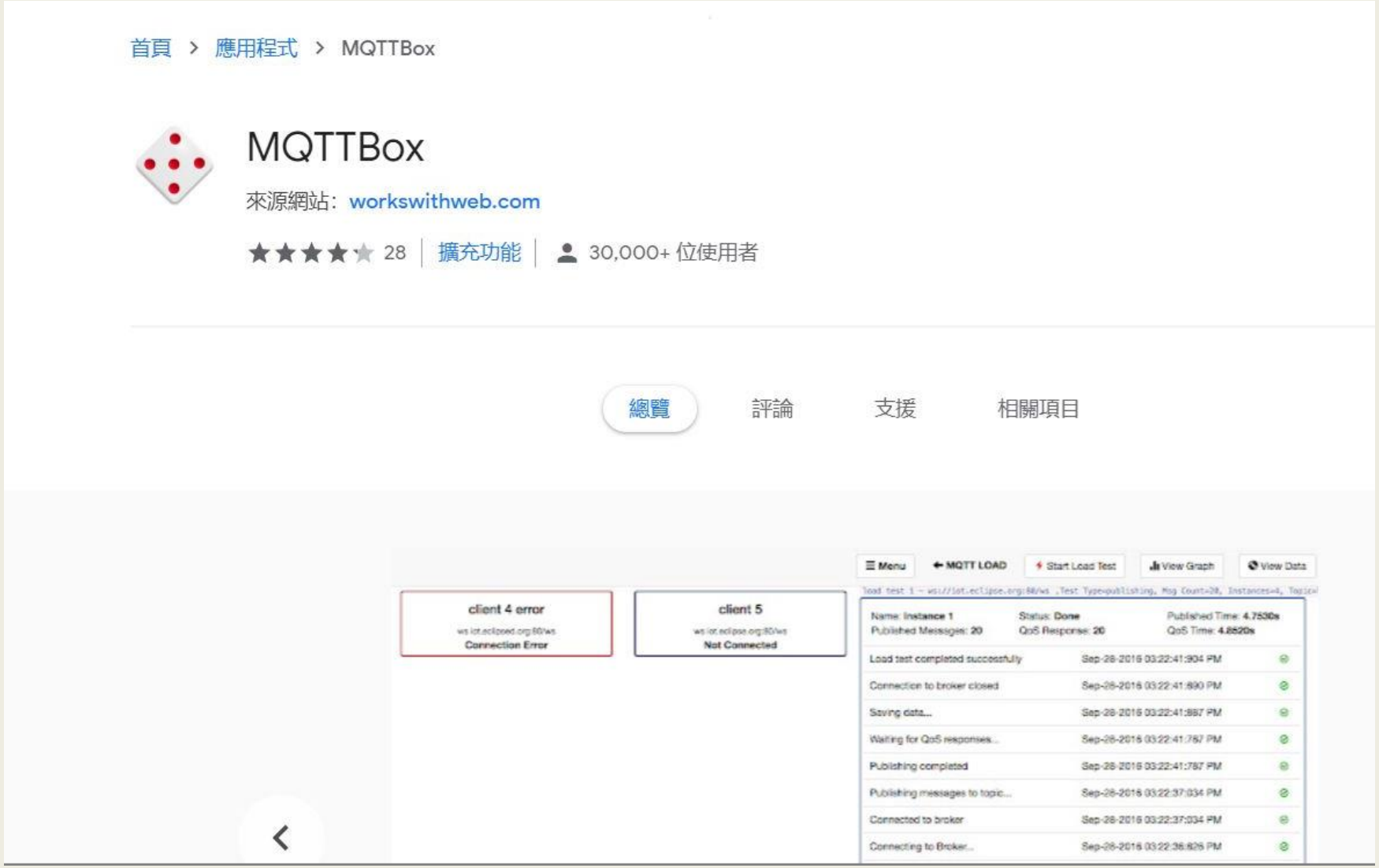
3-4-b Test MQTT Connectivity

Step 1

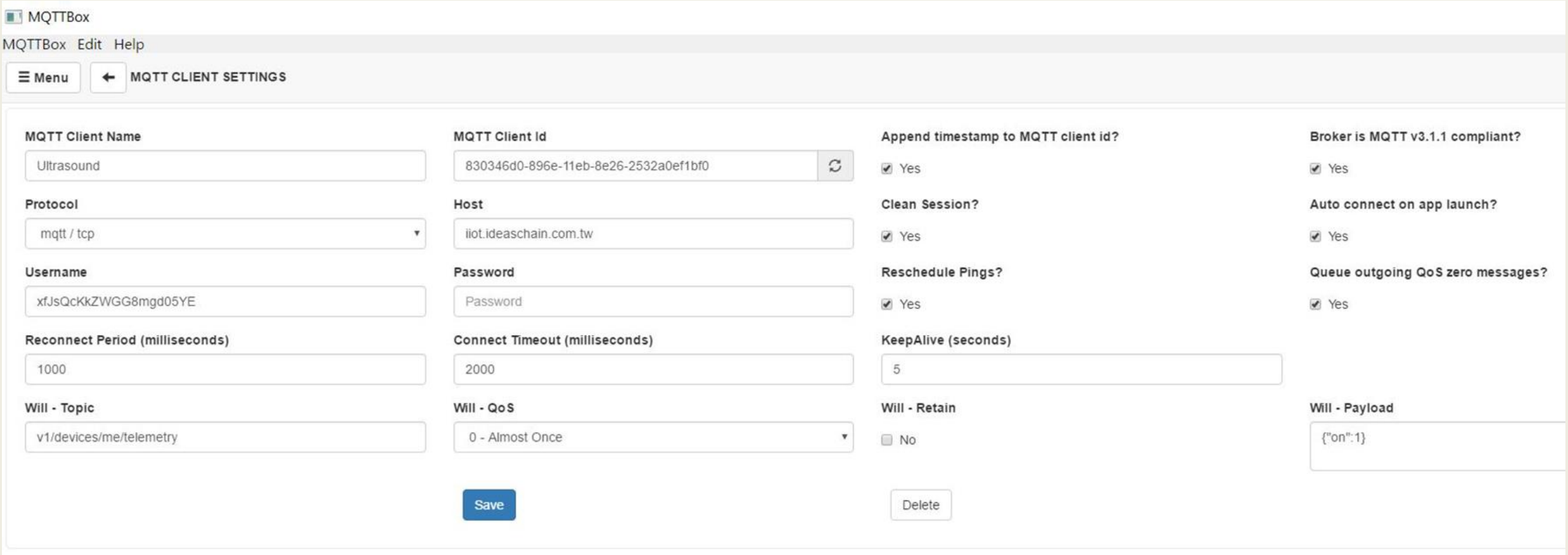
Open the Google Chrome Web store.

Step 2

Find “MQTTbox” and install it.



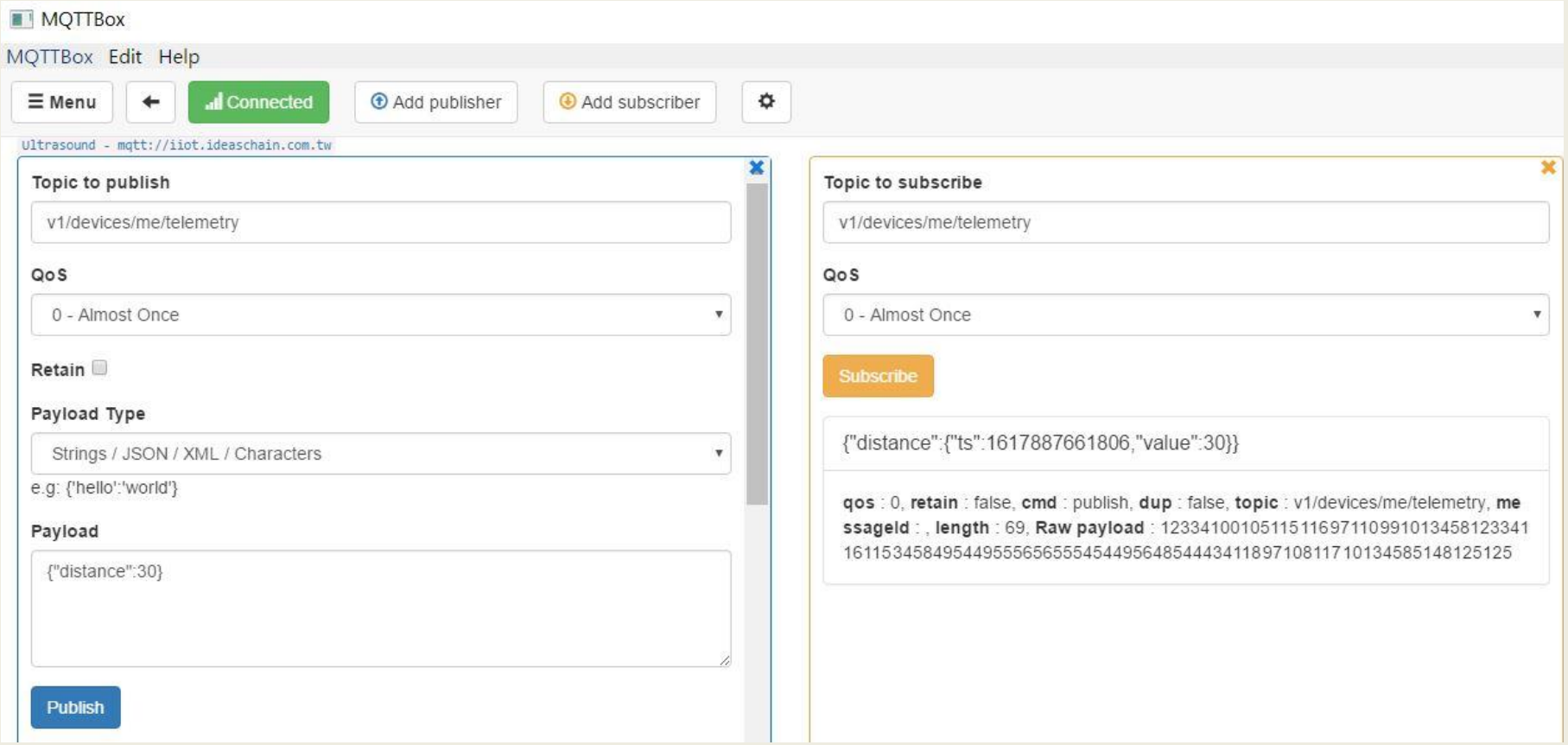
3-4-c MQTTbox Setting



MQTT Client Name: Type the project name.
Username: device access token(refer to 3-5-e)
MQTT Client Id: Give it a unique name.

Host: https://ideaschain.com.tw
(Use “IDEAS Chain” as Server and platform)

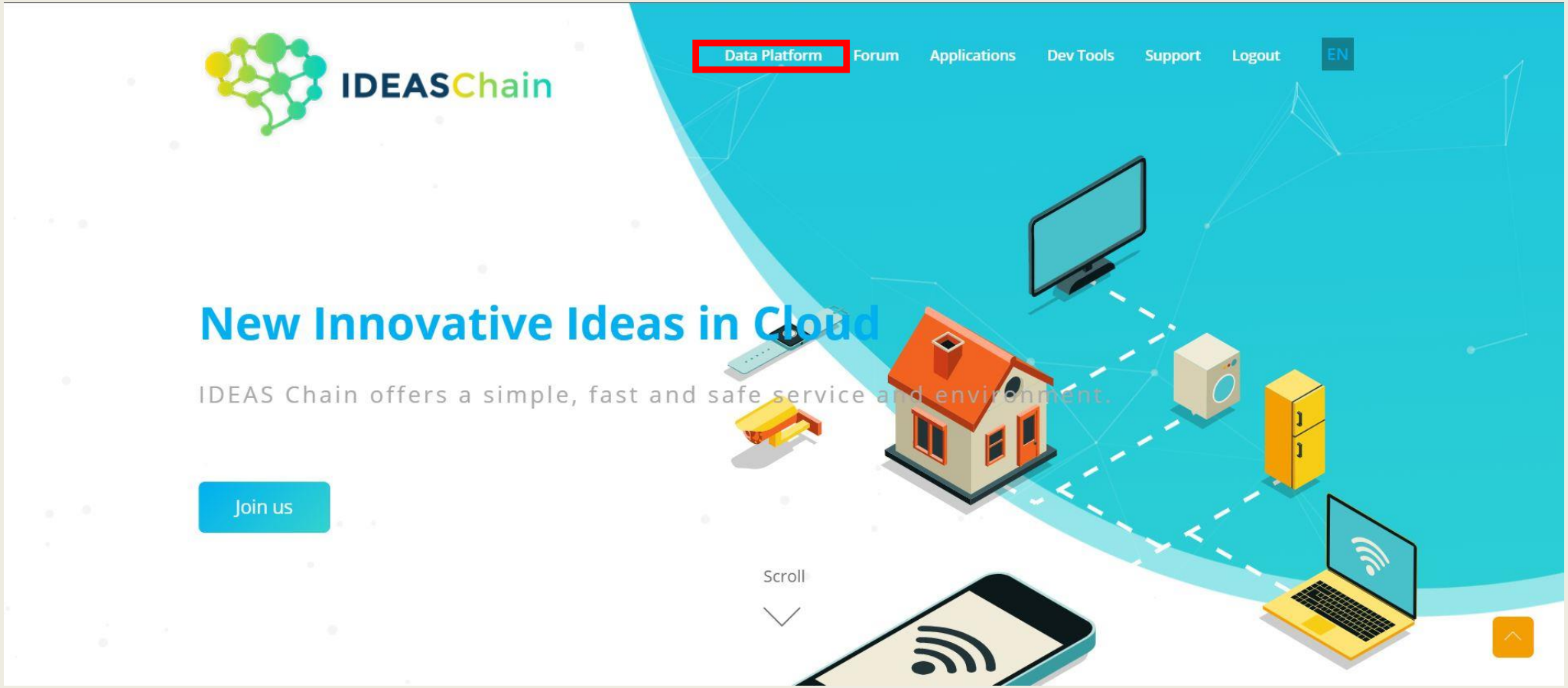
3-4-d MQTTbox Testing



Topic: “v1/devices/me/telemetry” It’s a specific path for IDEAS Chain.
Payload: The massage should be sent in Json form.
Click “Subscribe”, and click “Publish” afterwards.
If you can successfully receive the payload, it means that the server is working normally.

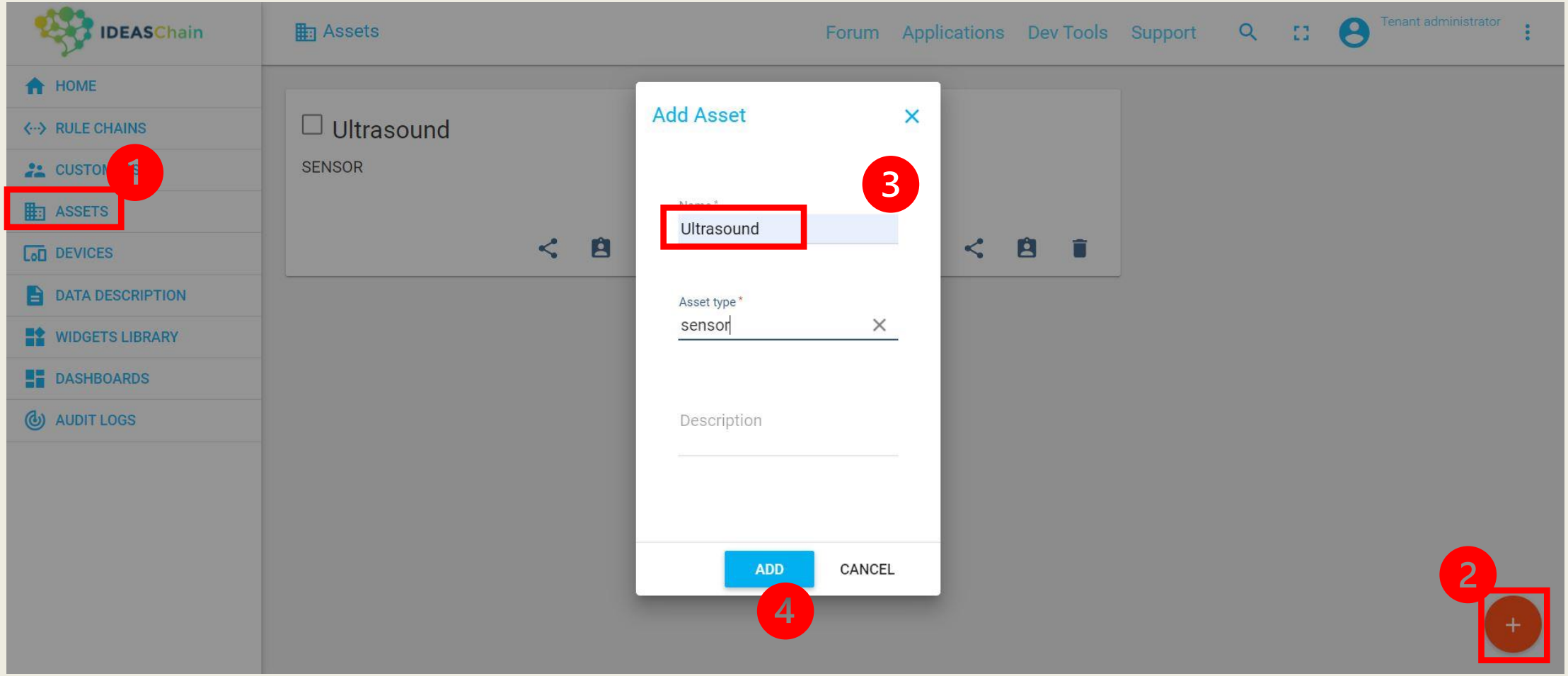
3-5-a MQTT Platform

Step1. Click on the following URL" https://iiot.ideaschain.com.tw/home "
Open IDEAS Chain and click on "Data Platform"



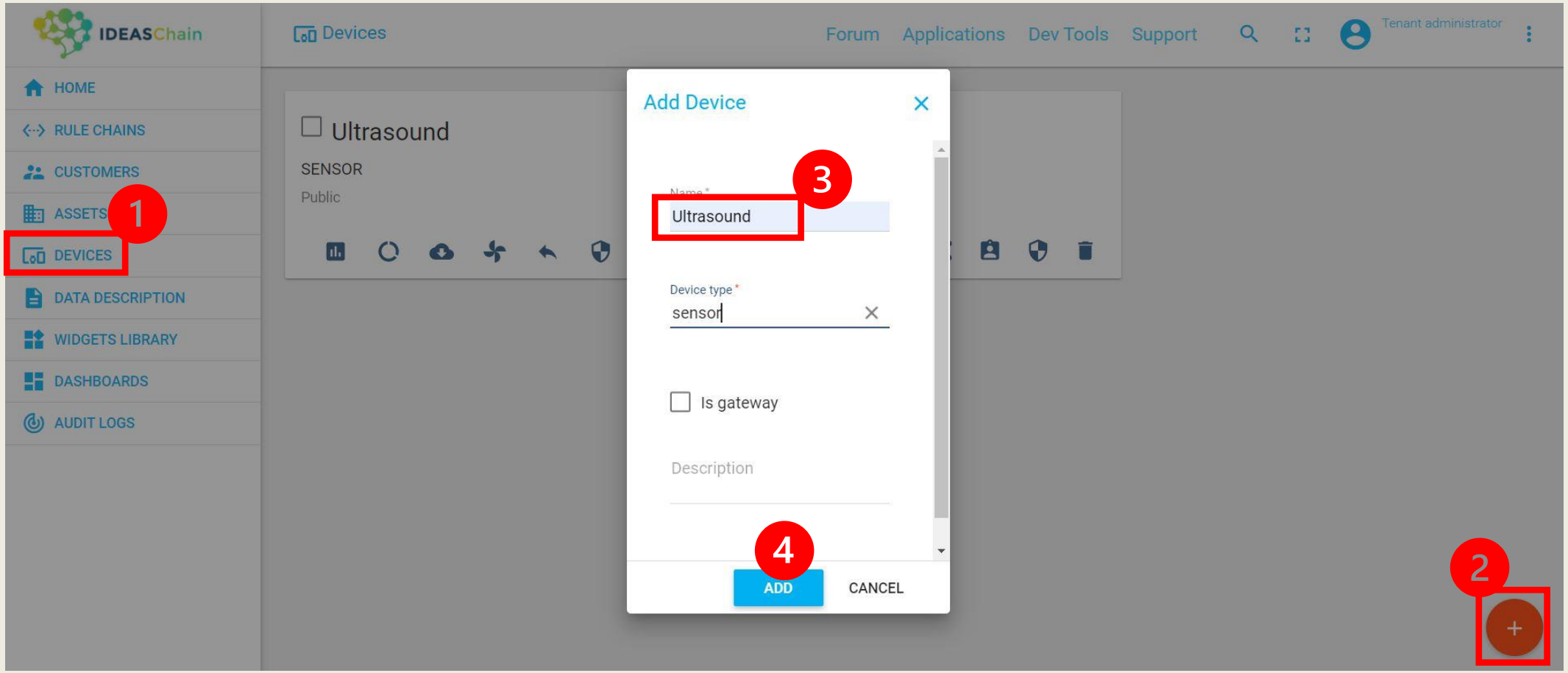
3-5-b MQTT Platform

Step2. Click on "ASSETS" on the left side.
Then, follow the steps below.



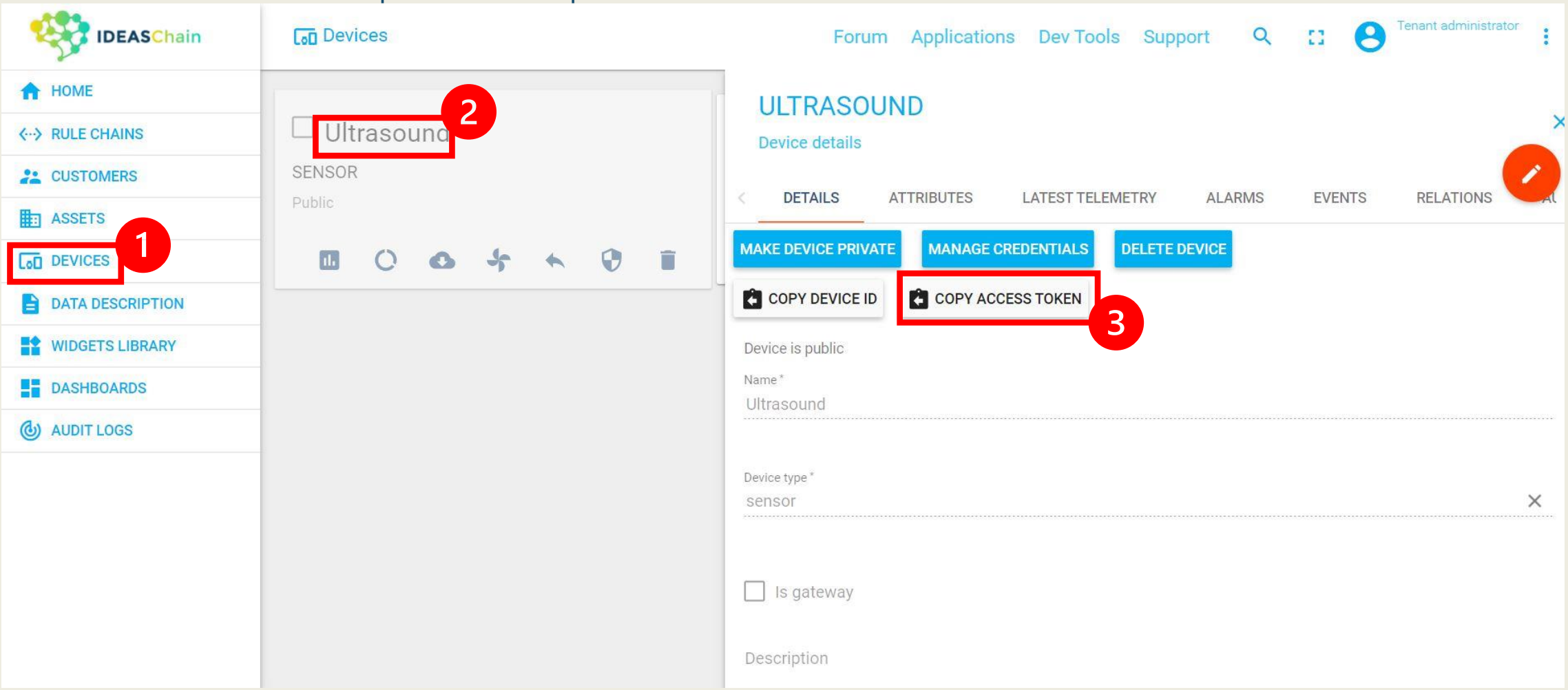
3-5-d MQTT Platform

Step3. Click on "DEVICES" on the left side.
Then, follow the steps below.



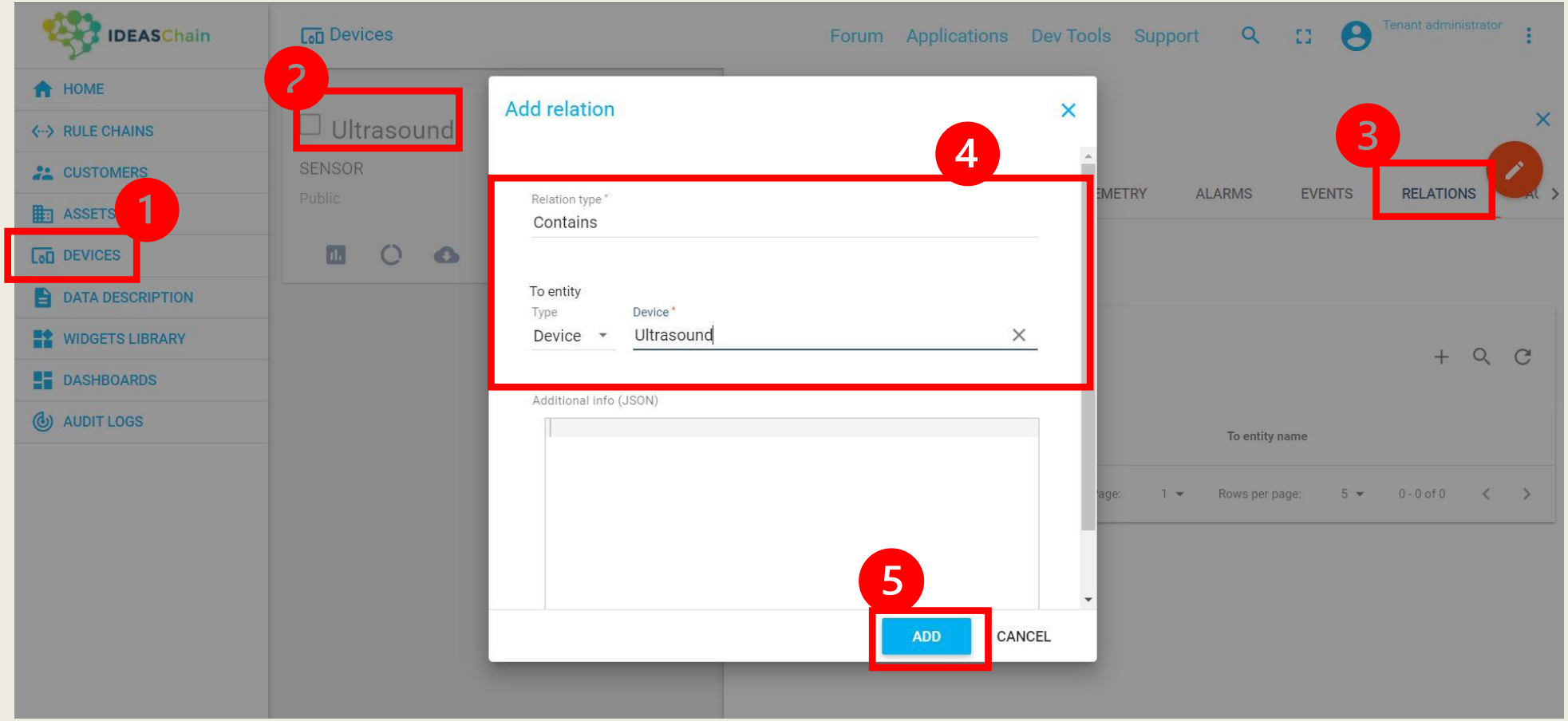
3-5-e MQTT Platform

Step4. Click on "DEVICES" on the left side.
Then, follow the steps below and paste the "ACCESS TOKEN" into the code.



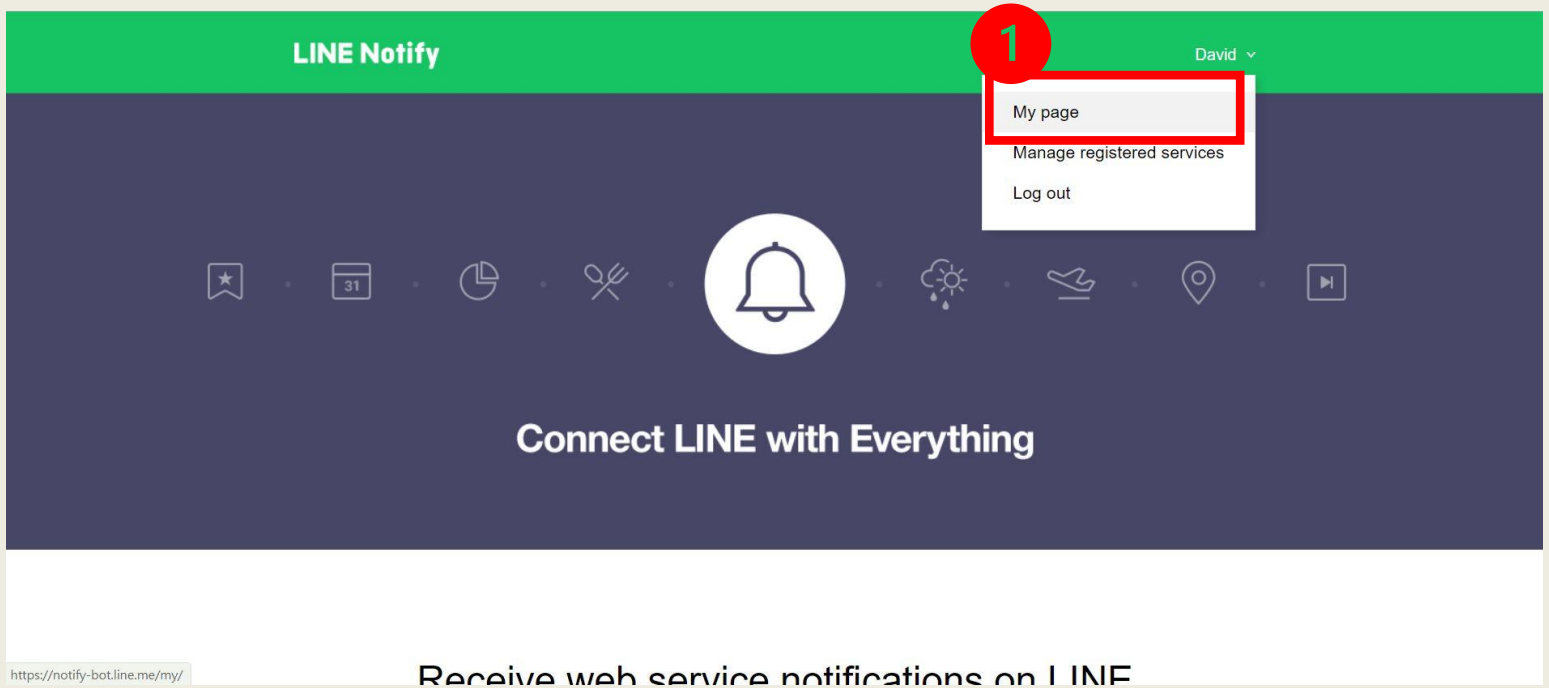
3-5-f MQTT Platform

Step5. Click on "DEVICES" on the left side.
Then, follow the steps below and add the relation.

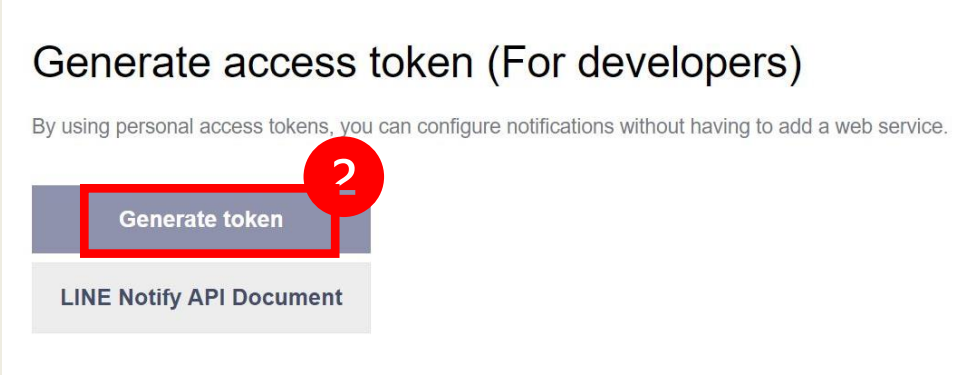


3-6 Line Notify

Step1. Go to the website of Line Notify . After you sign in with your account, click “My page” .

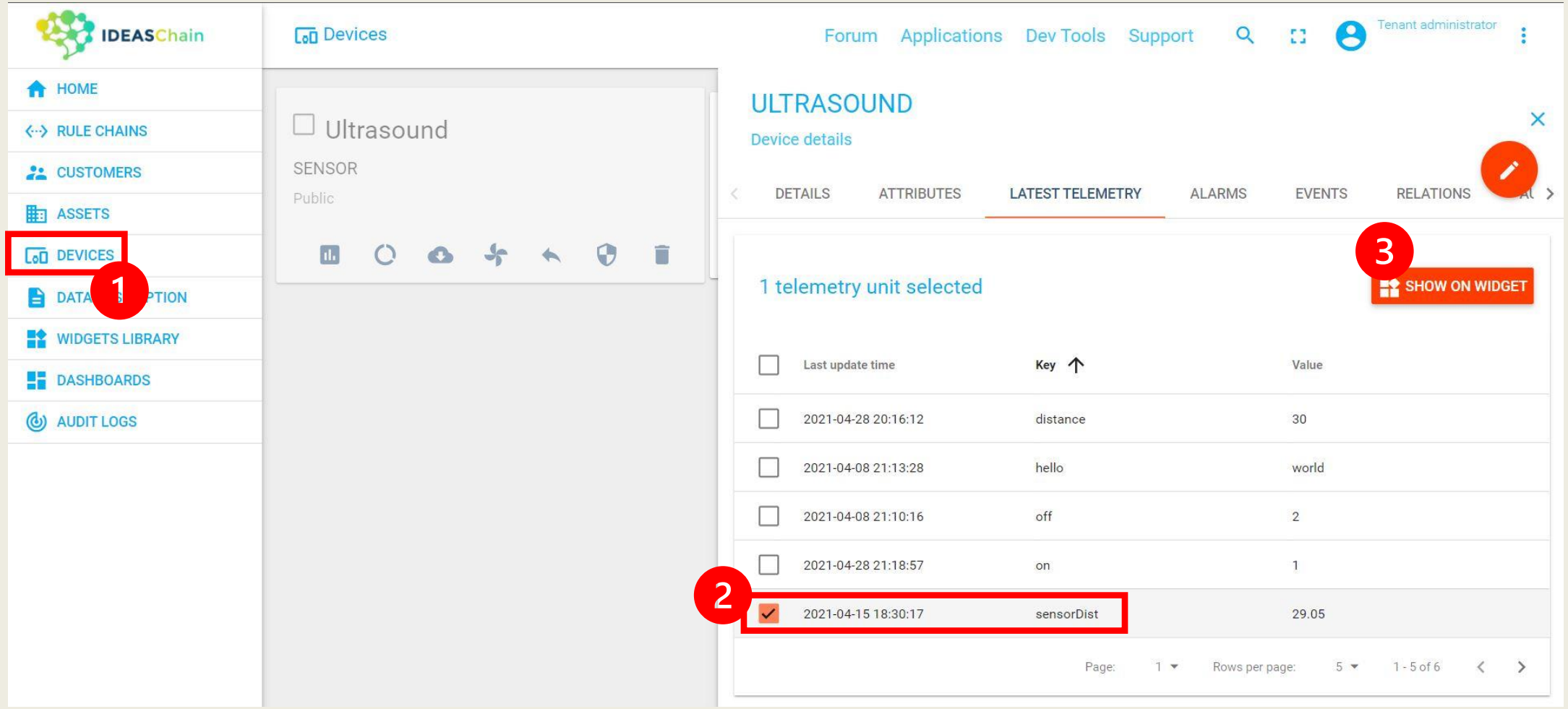


Step2. Click “Genarate token” and paste it into your program.

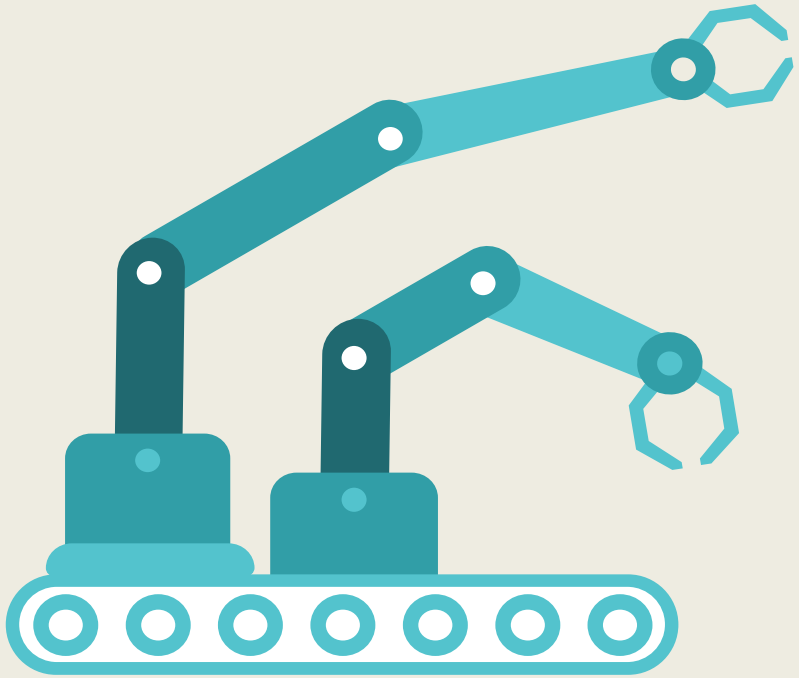


3-5-g MQTT Platform

Step6. Click on “DEVICES” on the left side.
Then, follow the steps below and you can check the data in “DASHBOARDS”.



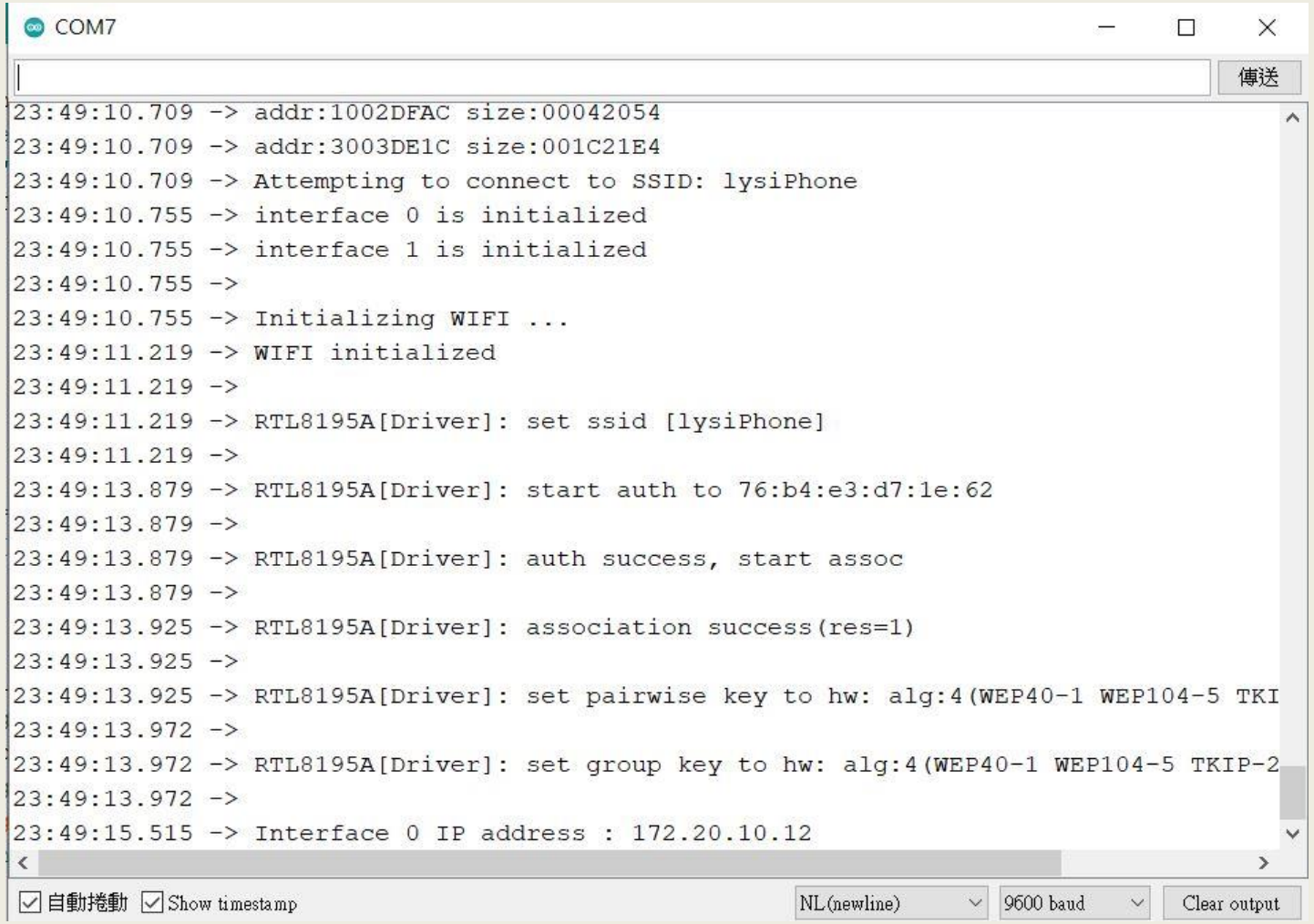
Chapter 4 Demonstration



4-1	WiFi Connection - Monitoring of Serial Port
4-2	MQTT Connection - Monitoring of Serial Port
4-3	Model of this Project
4-4	Situational simulation
4-5	IDEAS Chain dashboard
4-6	LINE Notify

4-1 WiFi Connection – Monitoring of Serial Port

Verify and upload the code in Arduino IDE. And push the RST button on DSI5168, then you can view the connecting status of Wi-Fi in the Serial Monitor.



4-2 MQTT Connection - Monitoring of Serial Port

After DSI5168 has connected Wi-Fi successfully, you can check the MQTT connection status at the same Serial Monitor. Also, you can see the distance detected by the sensor afterward.

COM7

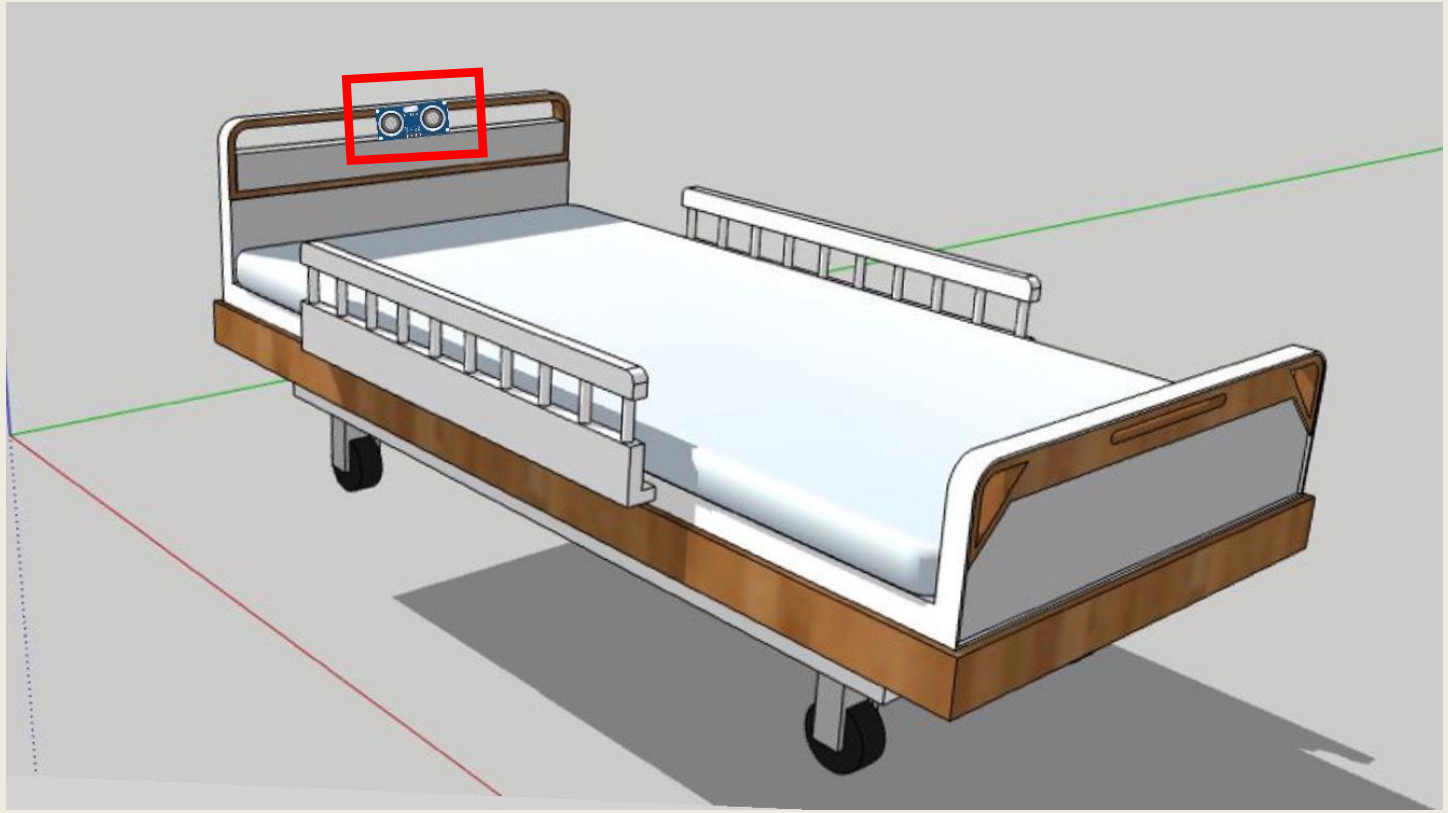
傳送

```
23:49:51.840 -> Connect to Server successful!
23:49:51.887 -> MQTT connected
23:49:52.351 -> distance: 203.37 cm
23:49:53.188 -> {"sensorDist ":"203.37 "}
23:49:53.188 -> Attempting MQTT connection Attempt to connect...
23:49:53.235 ->
23:49:53.235 -> Connect to Server successful!
23:49:53.235 -> MQTT connected
23:49:53.421 -> distance: 207.52 cm
23:49:54.298 -> {"sensorDist ":"207.52 "}
23:49:54.298 -> Attempting MQTT connection Attempt to connect...
23:49:54.345 ->
23:49:54.345 -> Connect to Server successful!
23:49:54.345 -> MQTT connected
23:49:54.481 -> distance: 164.46 cm
23:49:55.362 -> {"sensorDist ":"164.46 "}
23:49:55.362 -> Attempting MQTT connection Attempt to connect...
23:49:55.408 ->
23:49:55.408 -> Connect to Server successful!
23:49:55.408 -> MQTT connected
23:49:55.548 -> distance: 94.42 cm
```

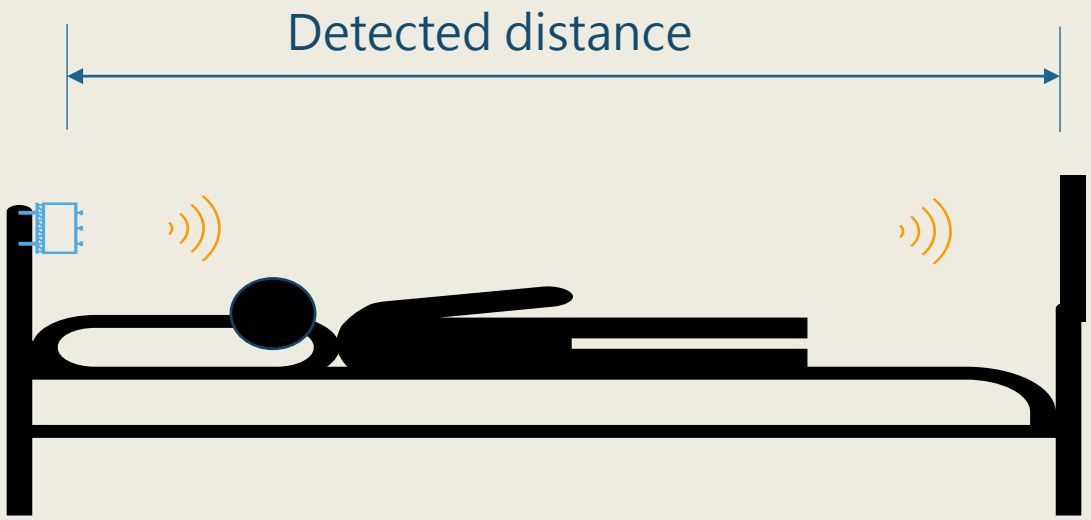
自動捲動 Show timestamp NL(newline) 9600 baud Clear output

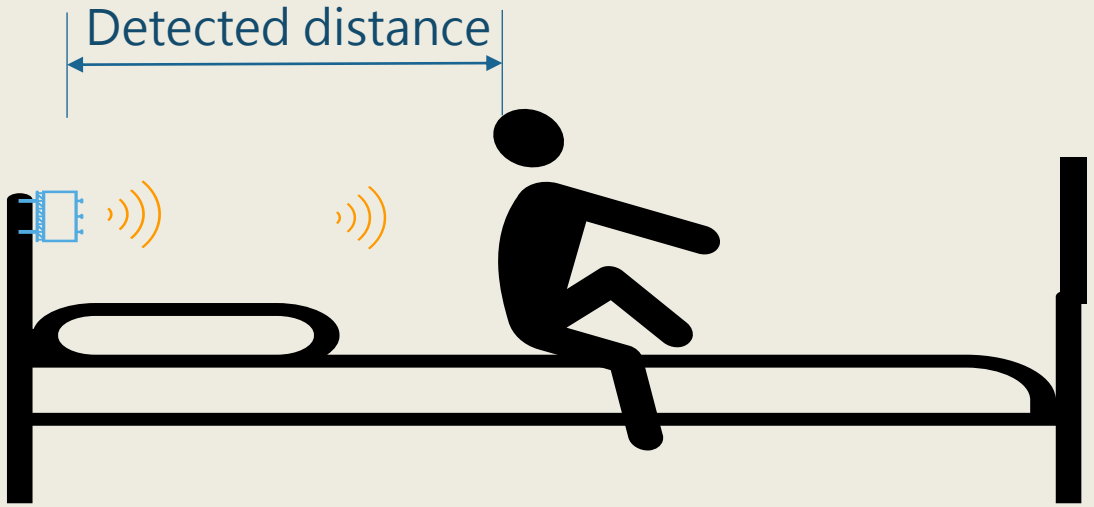
4-3 Model of this Project

In this project, I set the Ultrasonic sensor in front of the bed. If the bedridden gets up, the distance detected by the sensor will reduce. So that, we can get the latest information about the bedridden.

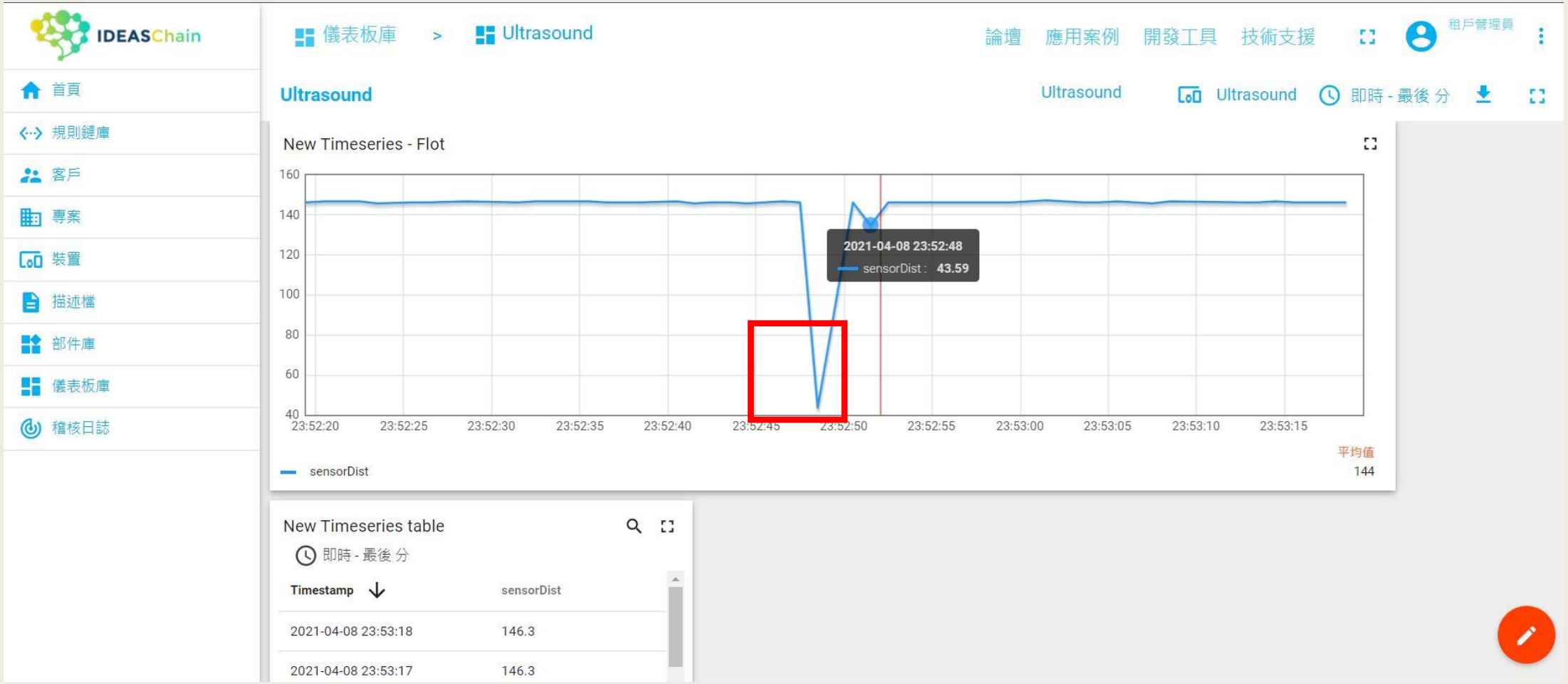


4-4 Situational simulation





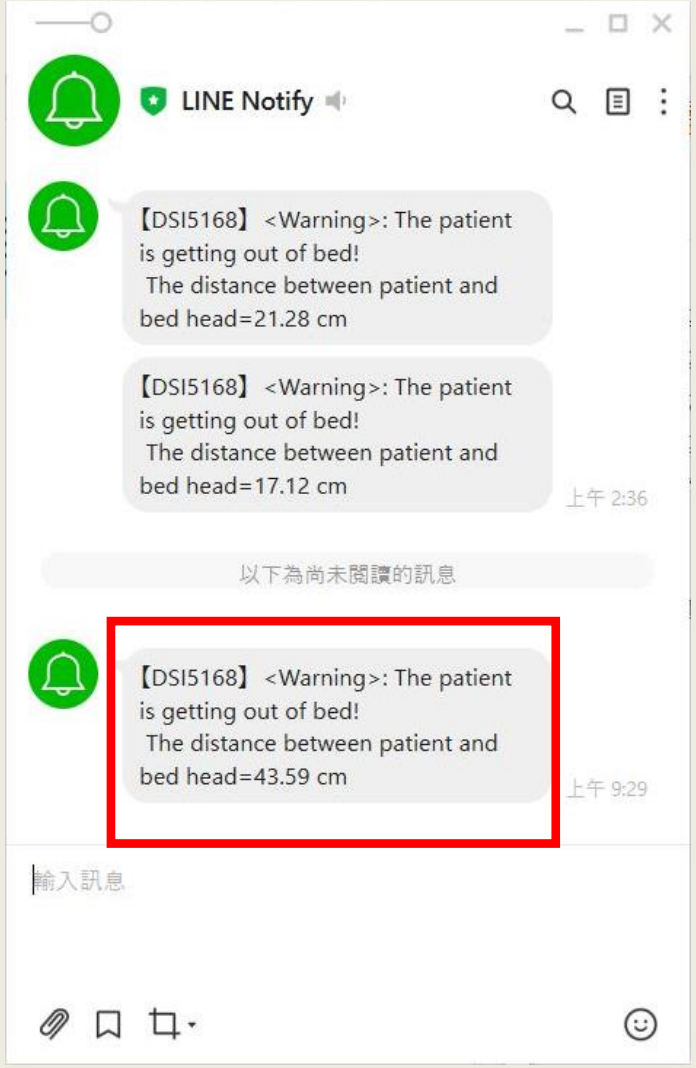
4-5 Ideaschain dashboard



Open the page of the “DASHBOARDS” in IDEAS Chain, and you can get the latest information posted by DSI5168. If the distance decrease in a sudden, it means that the bedridden is getting up.

4-6 LINE Notify

If the detected value decreases in a sudden, until it lower than 50cm,the dev board will send an alarm message to LINE Notify by using SSL protocol.
Therefore, even if the caregivers are not on-site, they can get the notification by LINE Notify.



<< Thank you >>