IoT Research Group

AI RESEARCH GROUP

I-oT.net

UNIVERSITAS PEMBANGUNAN NASIONAL "VETERAN" JAWA TIMUR

ITTelkom Surabaya

Pemrograman Robot Cerdas Berbasis Internet of Things (IoT)

Dr. Helmy Widyantara,S.Kom, M.Eng

Agenda

- Apakah IoT - Arsitektur dan Sistemnya
- Riset Berbasis Cloud IoT
  - thingspeak.com
  - cloudmqtt.com
  - i-ot.net
- **Pengendalian Robot Cerdas Berbasis Cloud i-ot.net**
- Demo

Apakah IoT?

Internet of Things (IoT) adalah area yang muncul di mana milyaran objek pintar saling berhubungan satu sama lain menggunakan internet untuk berbagi data dan sumber daya

(Chahal, Kumar and Batra, 2020)

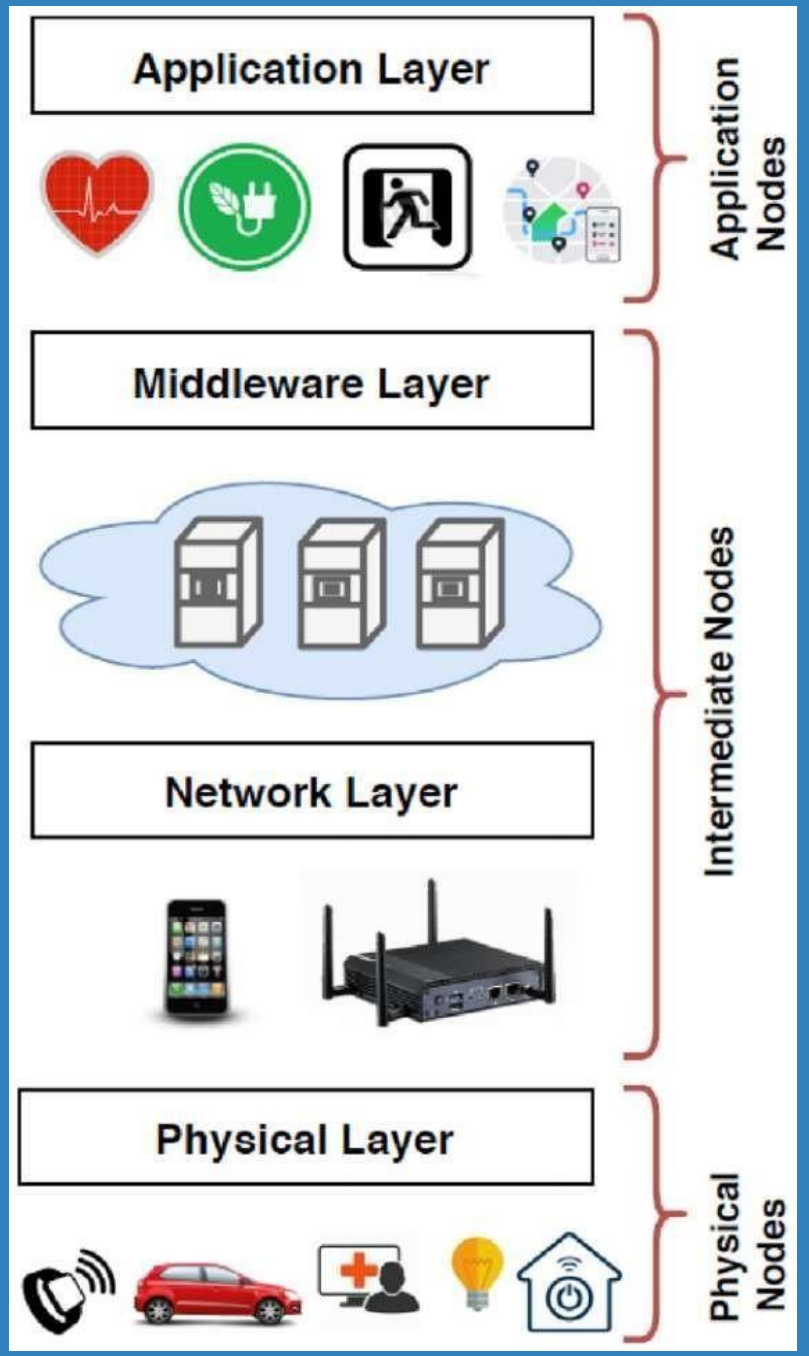
Dimanapun, ada IoT!

(Horn, G. , 2017)

Arsitektur IoT

- **Application Layer**
  - ✓ Layanan ke user
  - ✓ Komunikasi dengan middleware
  - ✓ Antarmuka user akses layanan
- **Middleware Layer**
  - ✓ konektivitas dan interoperabilitas dalam ekosistem IoT.
- **Network Layer**
  - ✓ Mendukung jaringan dan transfer data antar simpul.
  - ✓ Protokol komunikasi yang diperlukan untuk pertukaran data dalam ekosistem IoT
- **Physical Layer**
  - ✓ Mengkarakterisasi kemampuan penginderaan dan kontrol dari sistem IoT
  - ✓ Berupa simpul fisik seperti sensor dan aktuator yang merasakan lingkungan dan berinteraksi dengannya dalam menanggapi perubahan atau permintaan user

(Ravidas *et al.*, 2019)

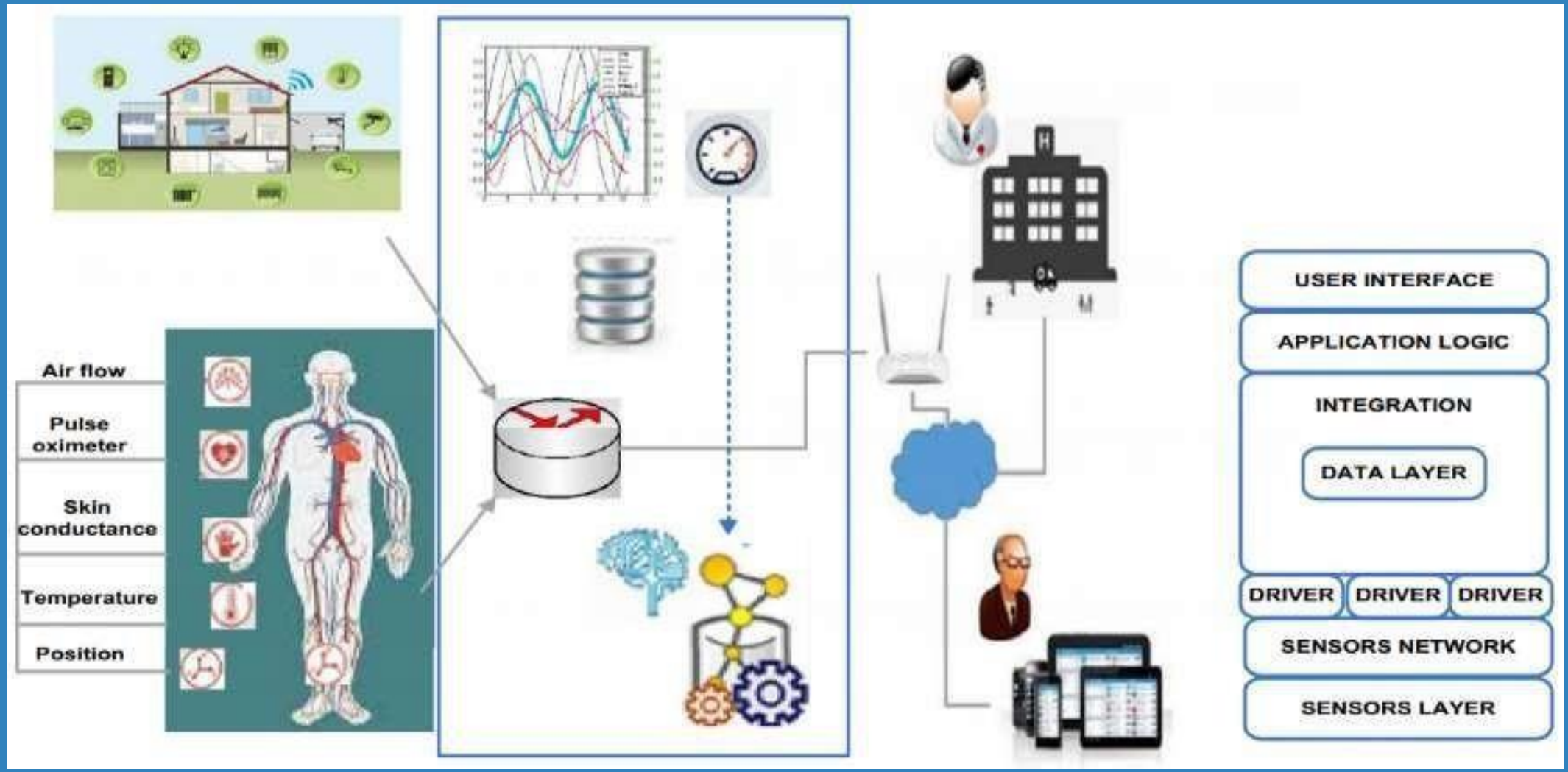


Beberapa Contoh Aplikasi IoT

- ***Smart Home*** (sistem keamanan rumah berbasis internet, dapat mengetahui keadaan rumah serta mengontrol peralatan rumah tangga melalui jaringan internet).
- ***Smart Farming*** (sistem pertanian cerdas berbasis internet, untuk pemantauan dan pengendalian kualitas air dan tanah pertanian serta pertumbuhan tanaman melalui jaringan internet).
- **Internet industry** (pemantauan dan pengendalian peralatan serta proses di industri)
- **Kesehatan** (pemantauan kondisi kesehatan seseorang).
- **Transportasi** (majemen dan informasi lalulintas).

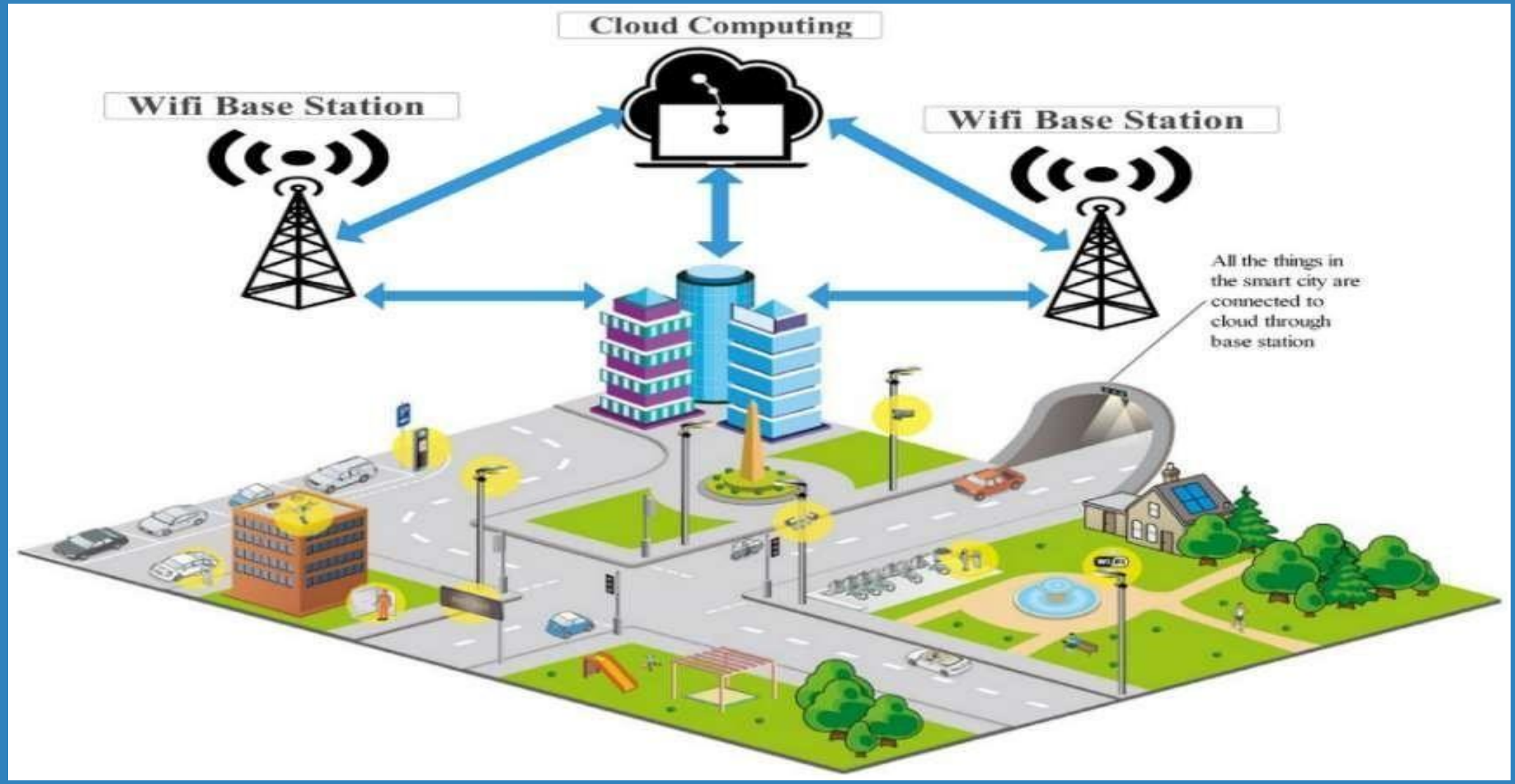
Arsitektur Berbasis IoT untuk Bidang Kesehatan

(Zeadally and Bello, 2019)



Penerapan IoT pada Smart City

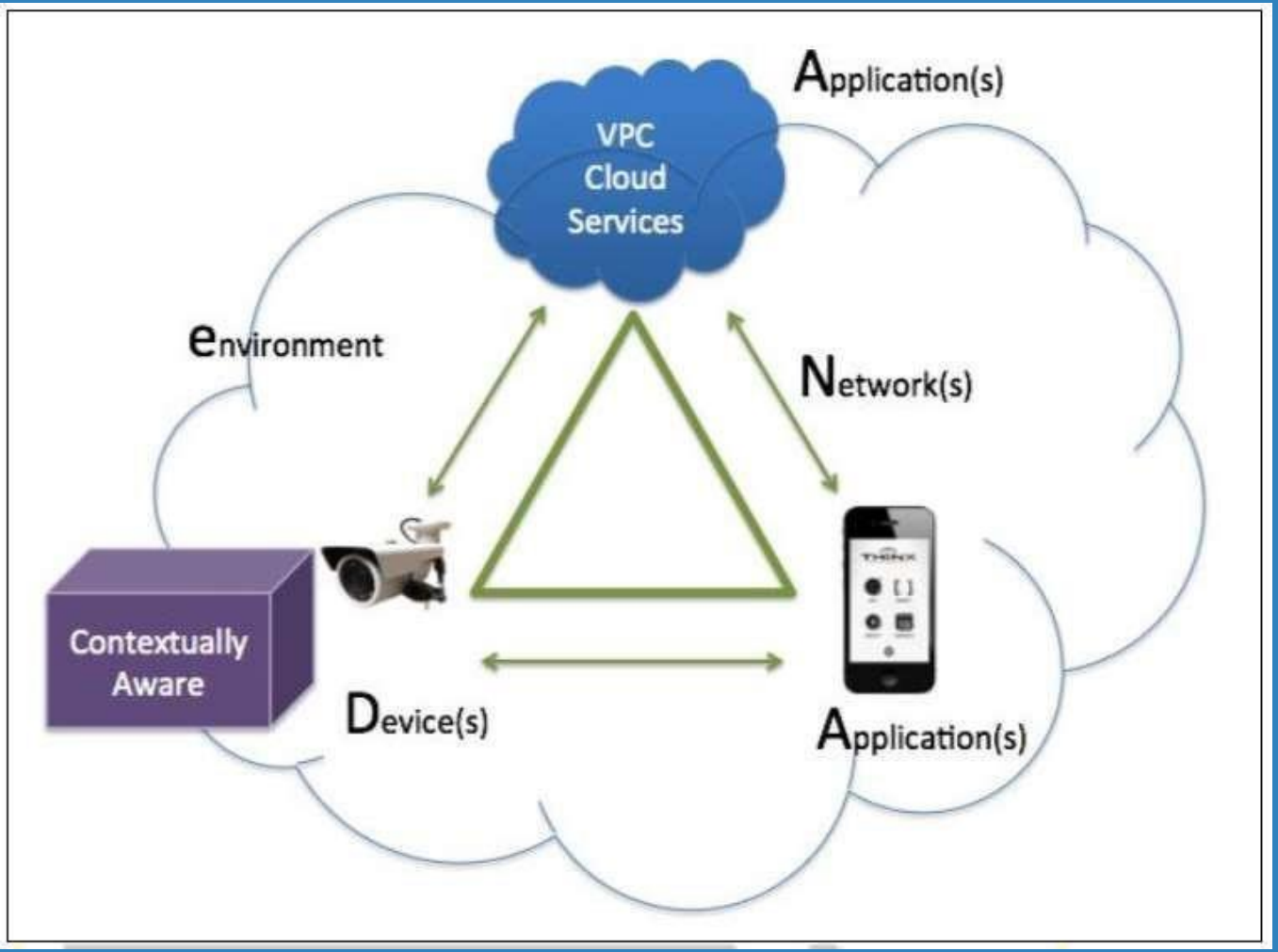
(Gheisari, Wang and Chen, 2020)



Sistem IoT

Sistem dasar dari IoT, yaitu:

1. Hardware/fisik (*Things*).
2. Koneksi internet.
3. *Cloud data center* sebagai tempat untuk menyimpan atau menjalankan aplikasinya.



Yang dibutuhkan

Application

Silahkan diinstall IoT MQTT Panel dari PlayStore di HP Android

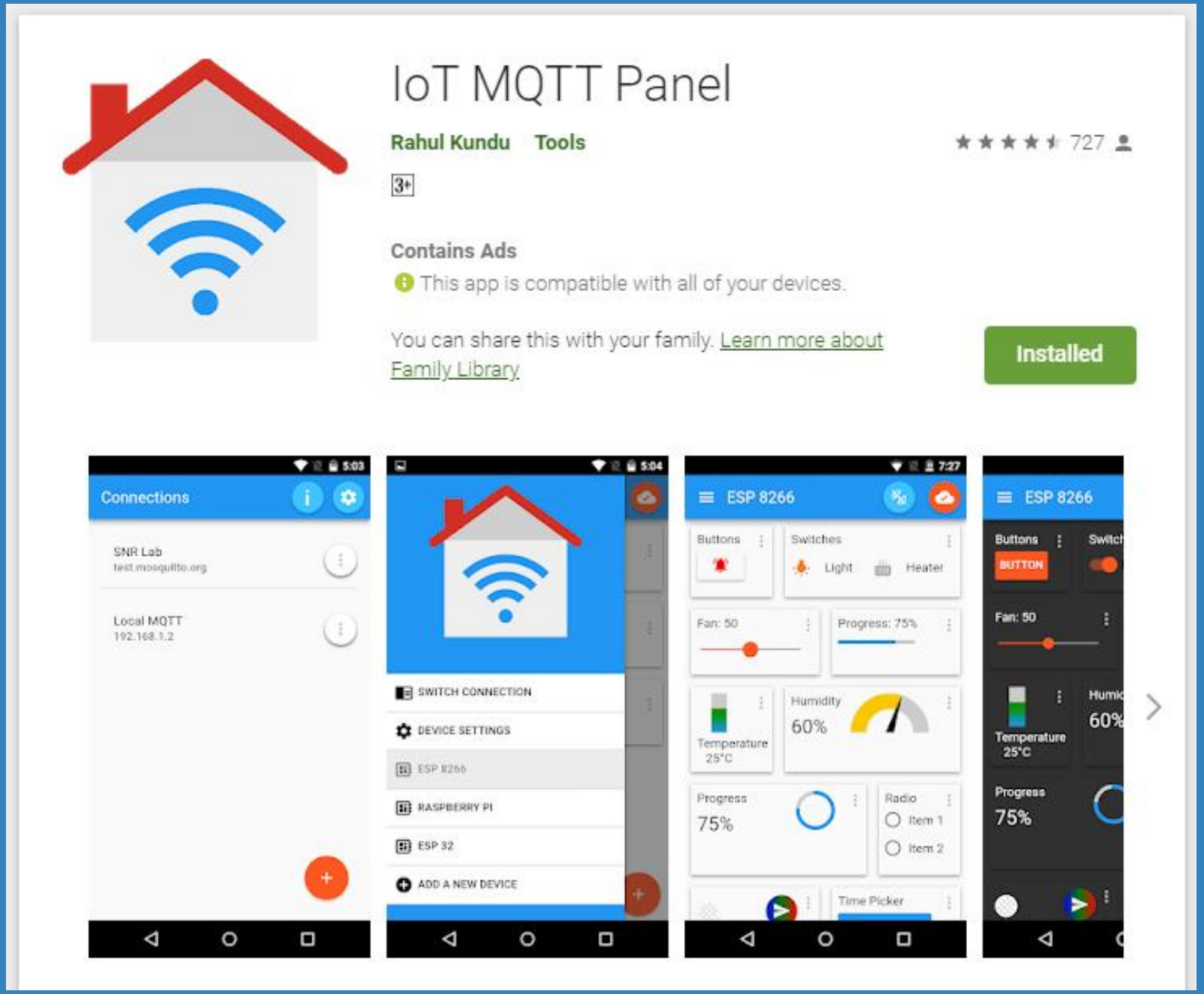
Cloud IoT

Kami perkenalkan Cloud IoT Pendatang Baru di Indonesia (i-ot.net)
→ Cita-citanya menggantikan cloudmqtt.com / thingspeak.com

Device

Bisa digunakan IoT Starker Kit Produk Tokotronik atau Rakit Sendiri

IoT MQTT Panel



Cloud IoT thingspeak.com

https://thingspeak.com

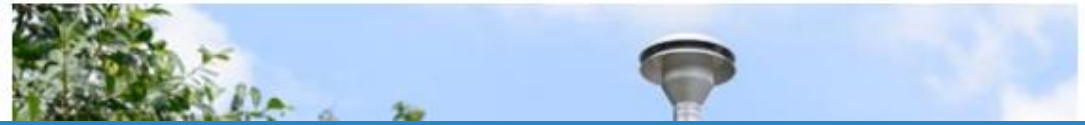
ThingSpeak™ Channels Apps Support Commercial Use How to Buy

ThingSpeak for IoT Projects

Data collection in the cloud with advanced data analysis using MATLAB

Get Started For Free

Learn More



Cloud IoT cloudmqtt.com → Sudah tidak Gratis..!

cloudmqtt.com

CloudMQTT

Pricing Documentation Support Blog Log in

Hosted message broker for the Internet of Things

Perfectly configured and optimized message queues for IoT, ready in seconds.

Cloud IoT cloudmqtt.com

Administrative Contact

Name:	On behalf of cloudmqtt.com administrative contact
Organization:	Whois Privacy Service
Street:	P.O. Box 81226
City:	Seattle
State:	WA
Postal Code:	98108-1226
Country:	US
Phone:	+1.2065771368
Email:	admin-10992937@cloudmqtt.com.whoisprivacyservice.org

cloudmqtt.com/plans.html

Plans & Pricing

Dedicated Instances

Your own broker on a dedicated server.

Power Pug

- Up to 10 000 connections
- No artificial limitations
- Support by e-mail
- Support by phone

$ 299

PER MONTH

Get Now

Loud Leopard

- Up to 1 000 connections
- No artificial limitations
- Support by e-mail

$ 99

PER MONTH

Get Now

Keen Koala

- Up to 100 connections
- No artificial limitations
- Support by e-mail

$ 19

PER MONTH

Get Now

Shared Instances

For development or small hobby projects. Not recommended for production due to variable performance.

Humble Hedgehog

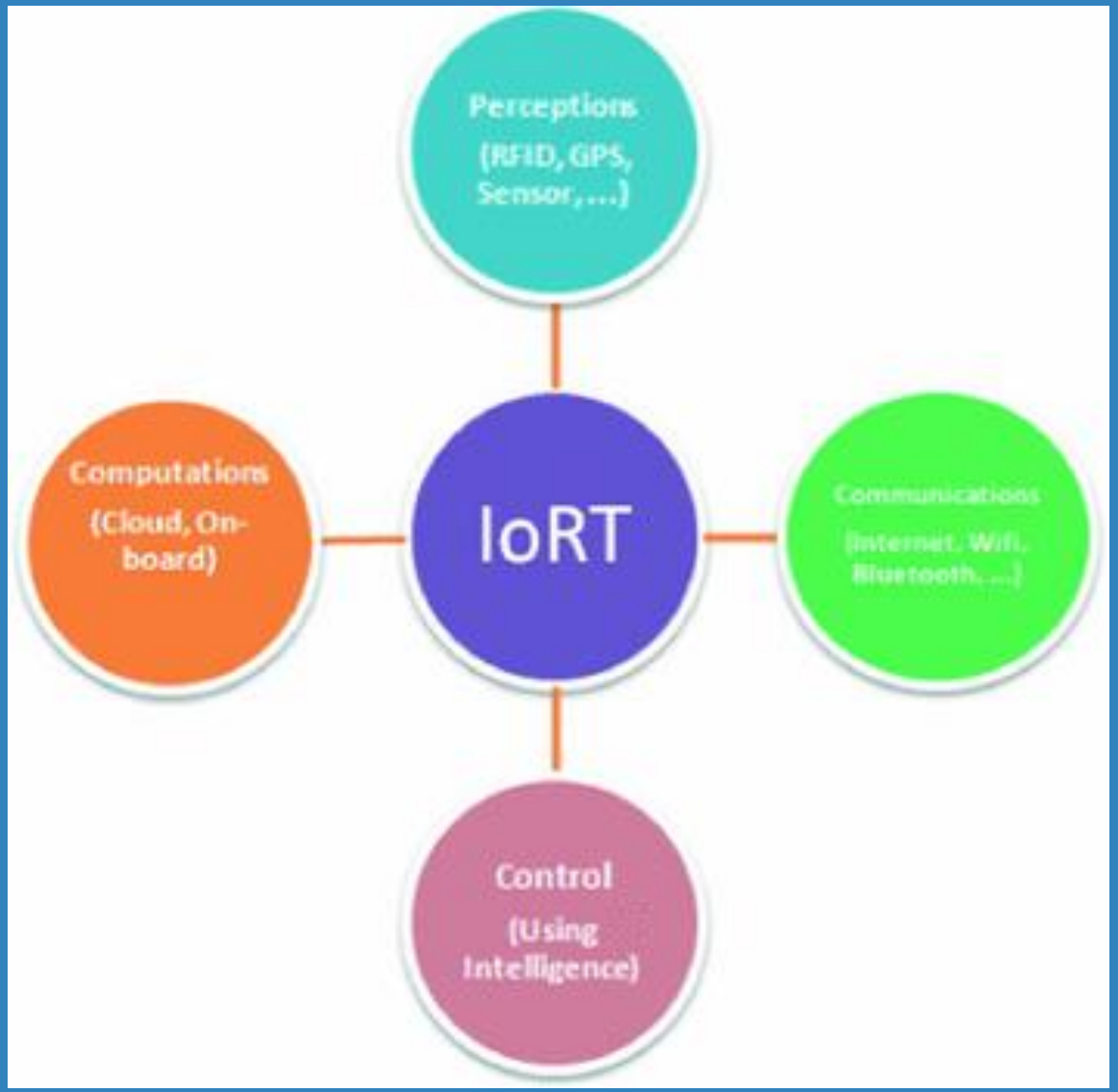
- 25 users/acl rules/connections
- 20 Kbit/s
- 3 bridges
- Support by e-mail

$ 5

PER MONTH

Get Now

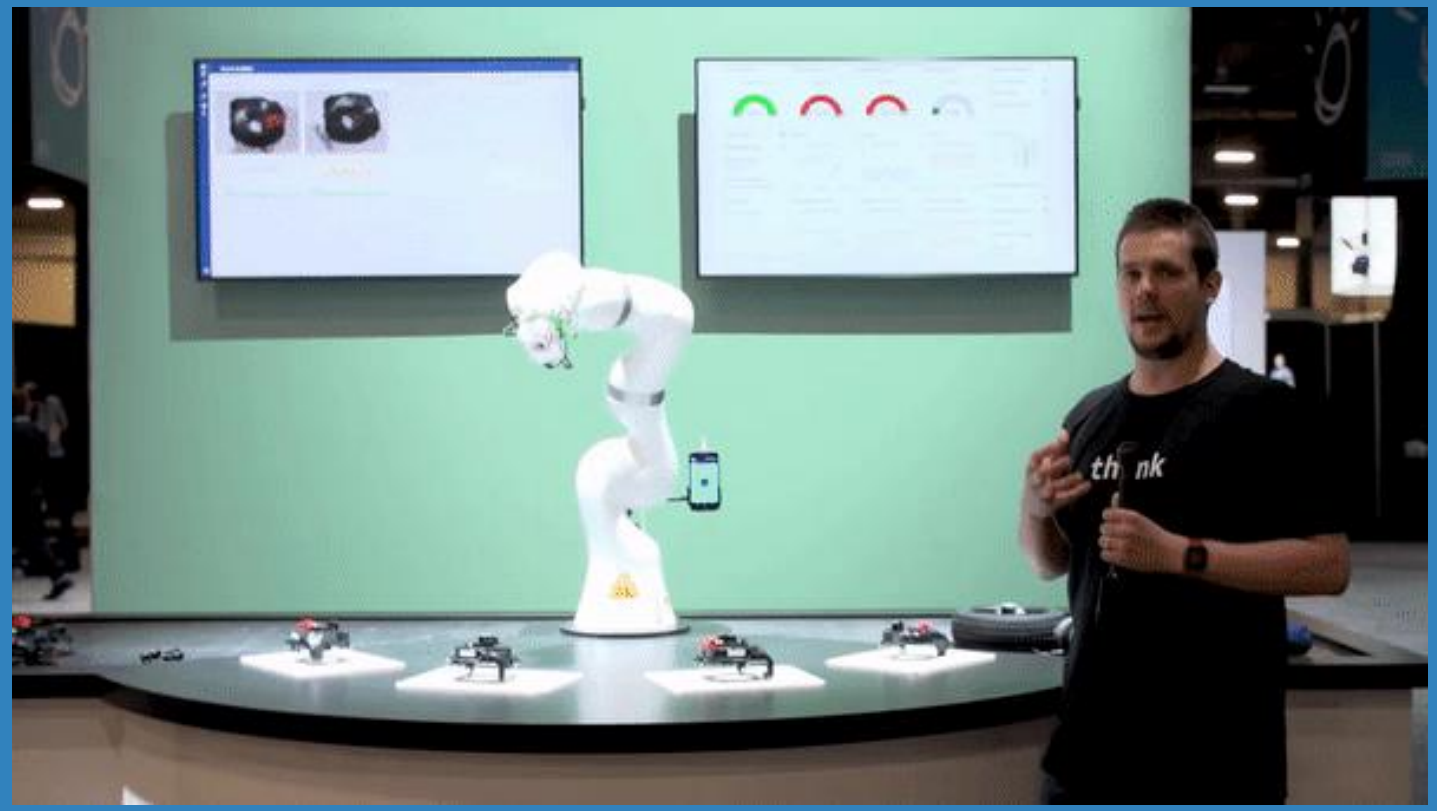
Internet-of-Robotic-Things



Aplikasi Internet-of-Robotic-Things di Industri

CESS ILP

Aplikasi Internet-of-Robotic-Things di Industri



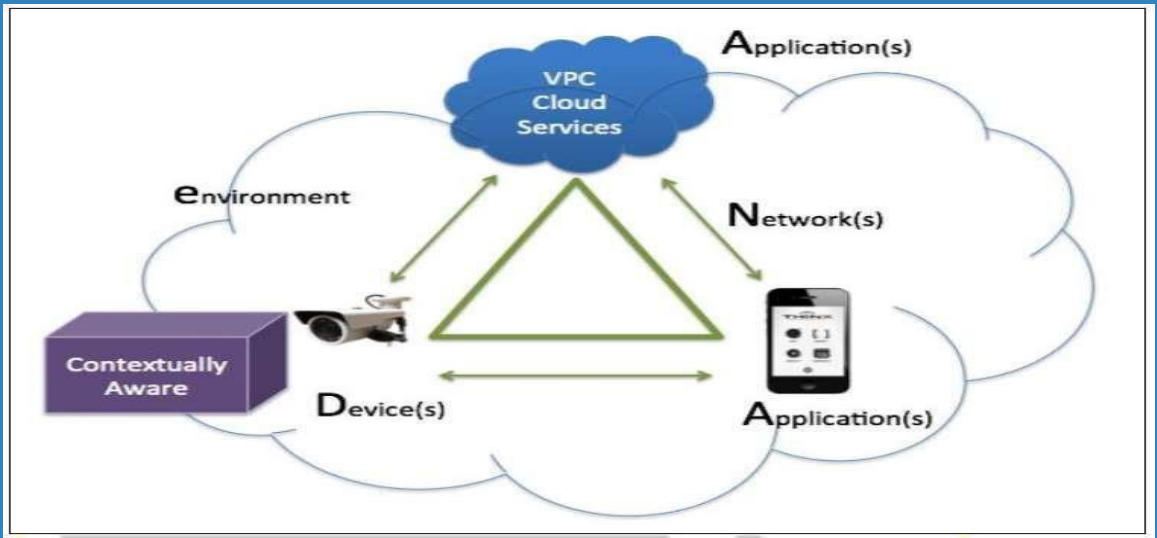
IBM

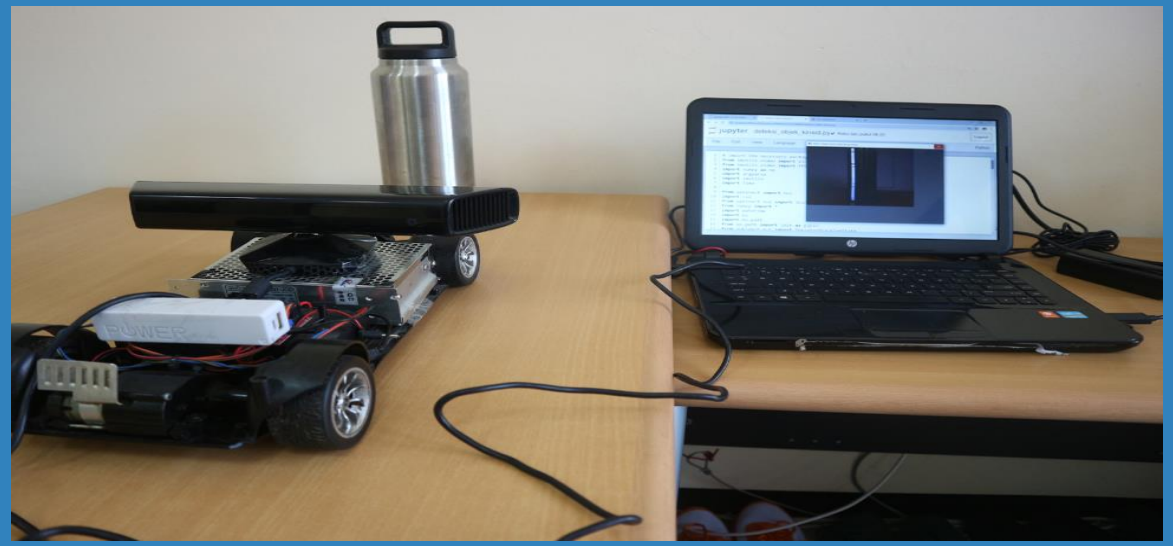
Aplikasi Internet-of-Robotic-Things di Industri

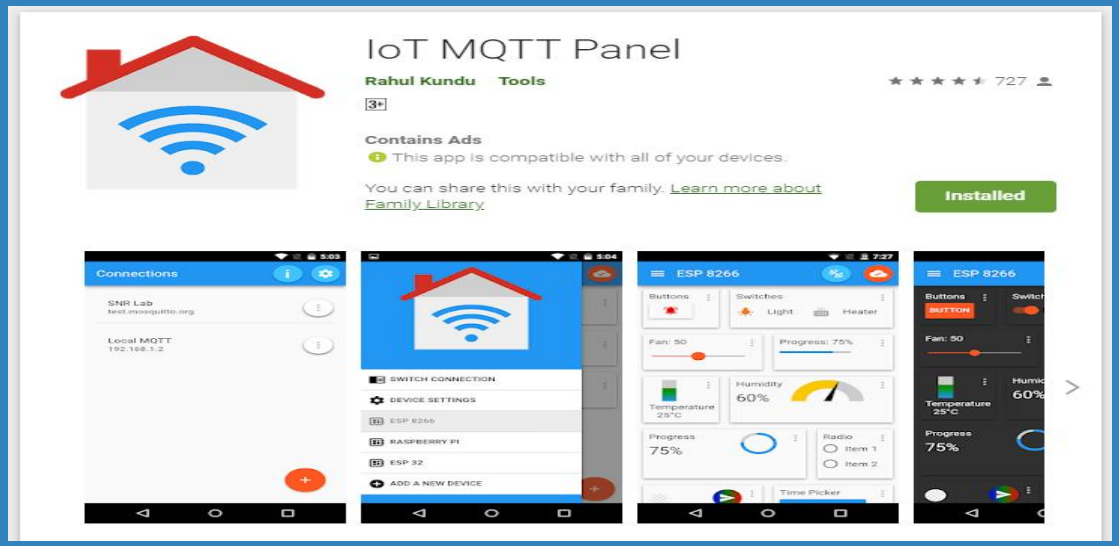
BotJunkie

Cloud IoT i-ot.net

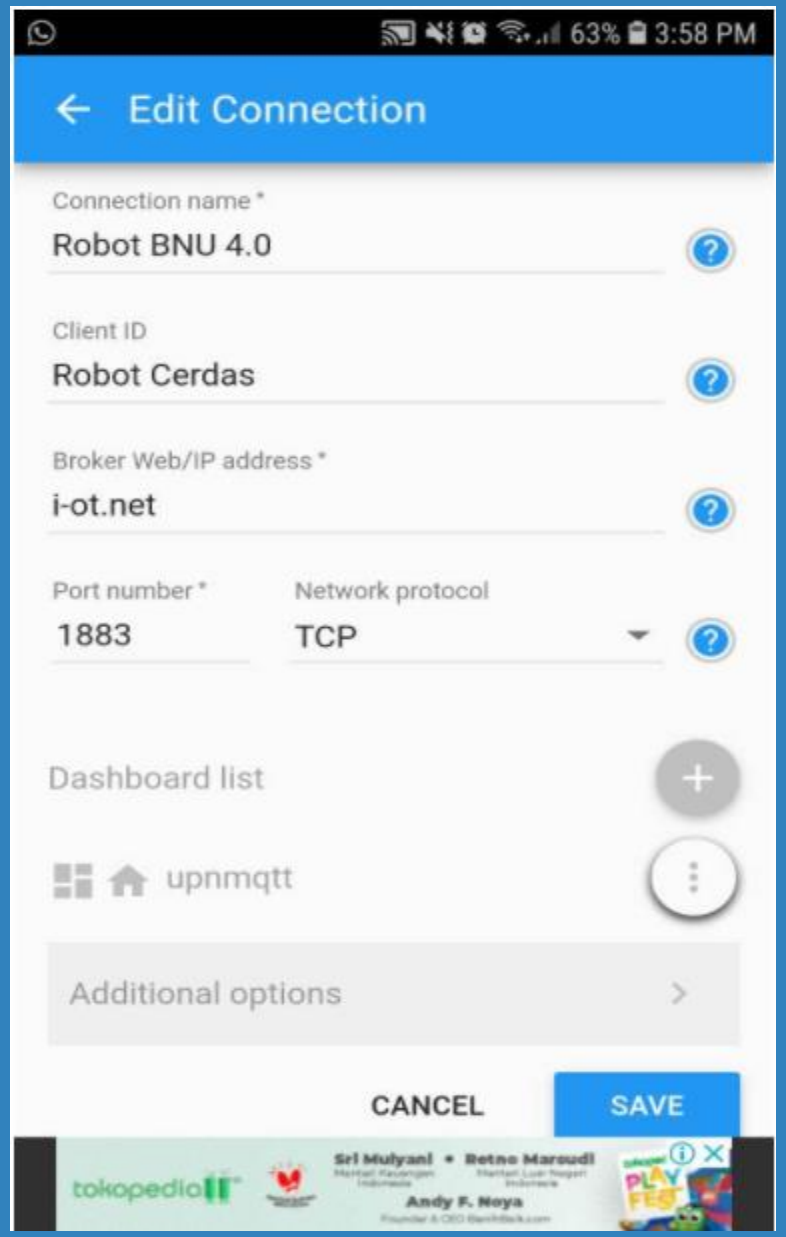
Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

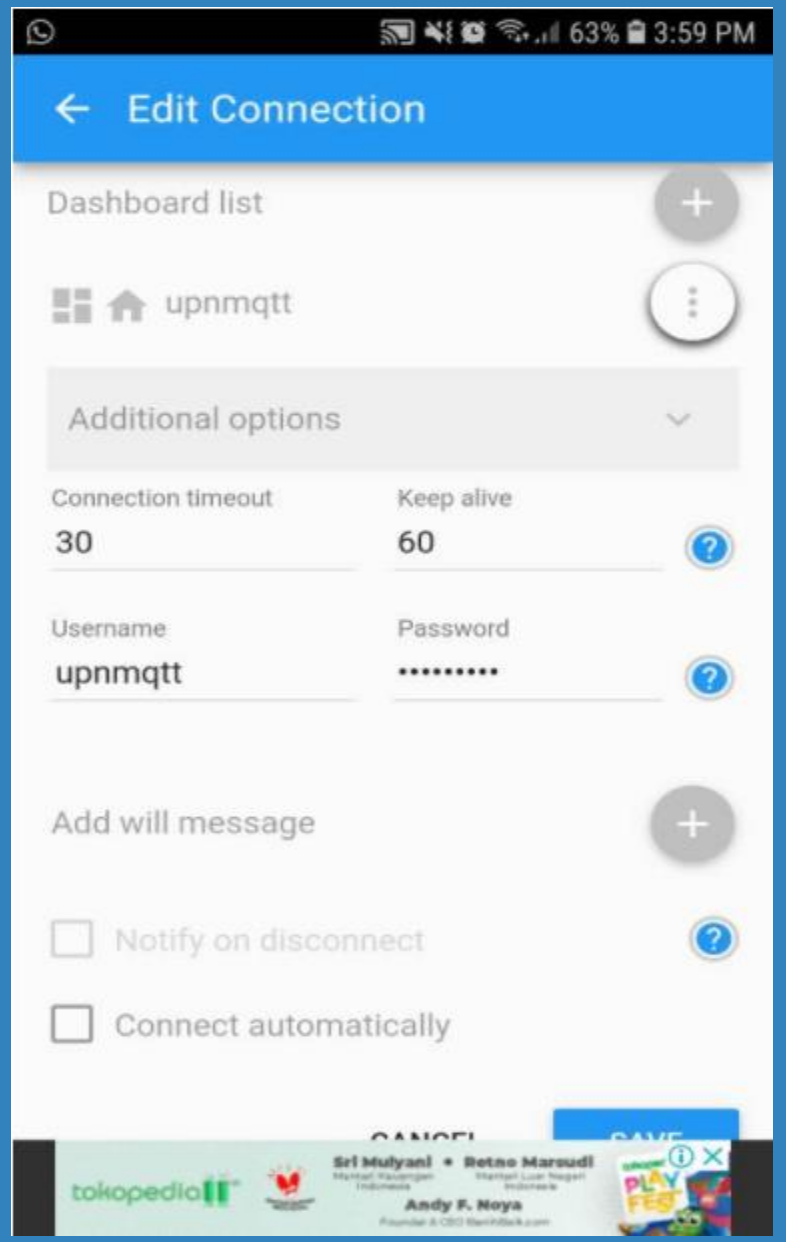






Seting Cloud IoT (i-ot.net) di IoT MQTT Panel





Isikan:

Port 1883

TCP

User:
upnmqtt
Password:
20upnmqtt

Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

Preferences

Settings | Network

Sketchbook location:

C:\Users\Documents\Arduino — Browse

Editor language: System Default (requires restart of Arduino)

Editor font size: 32

Interface scale: ☑ Automatic 100 % (requires restart of Arduino)

Theme: Default theme (requires restart of Arduino)

Show verbose output during: ☑ compilation ☑ upload

Compiler warnings: Default

☐ Display line numbers
☑ Verify code after upload
☑ Check for updates on startup
☐ Use accessibility features

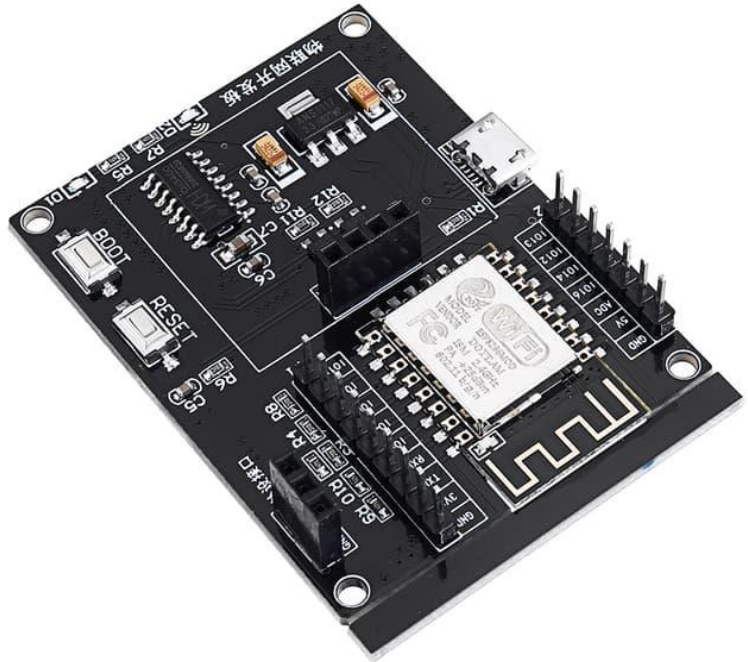
☐ Enable Code Folding
☐ Use external editor
☑ Save when verifying or uploading

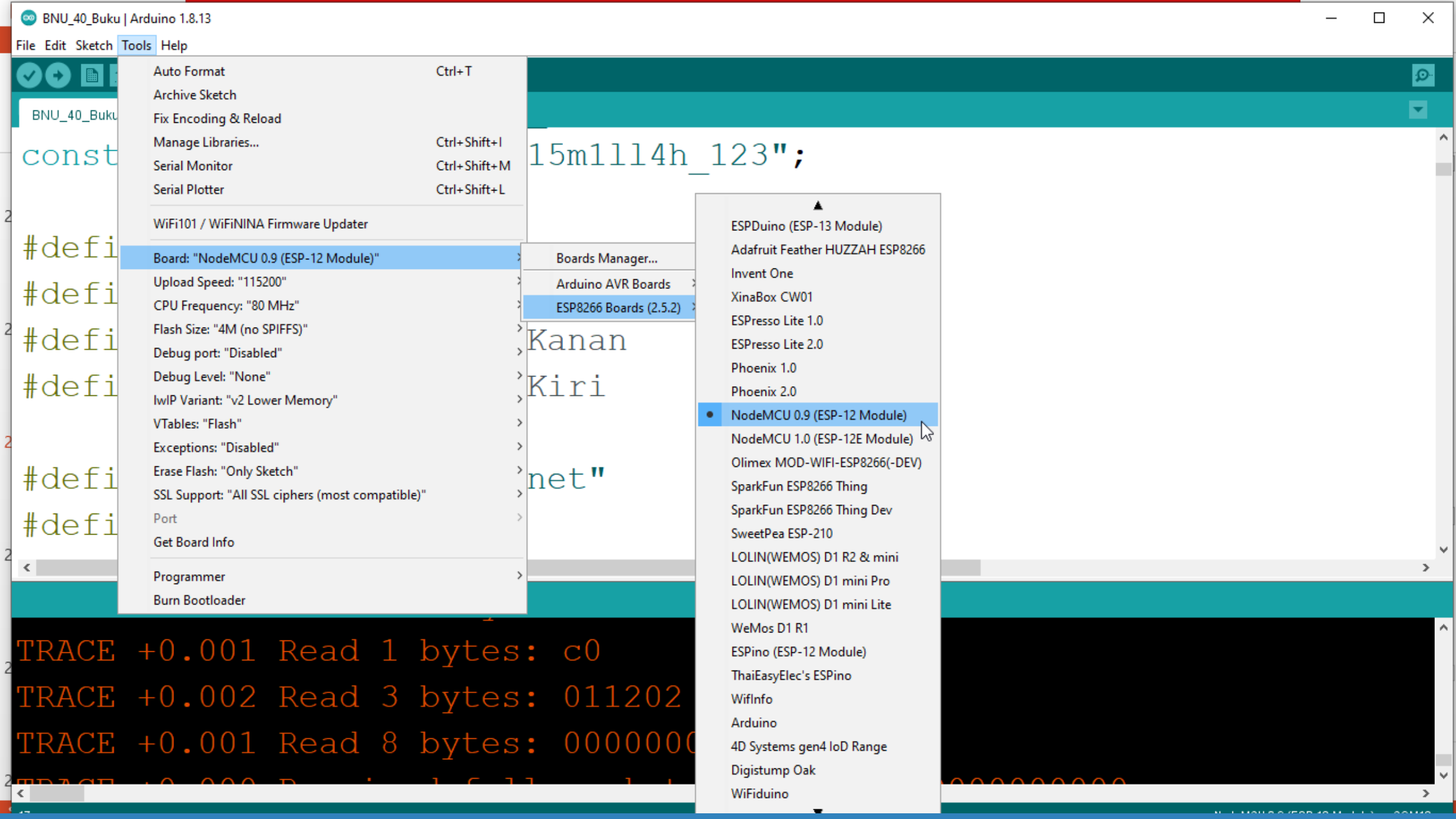
Additional Boards Manager URLs: http://arduino.esp8266.com/stable/package_esp8266com_index.json

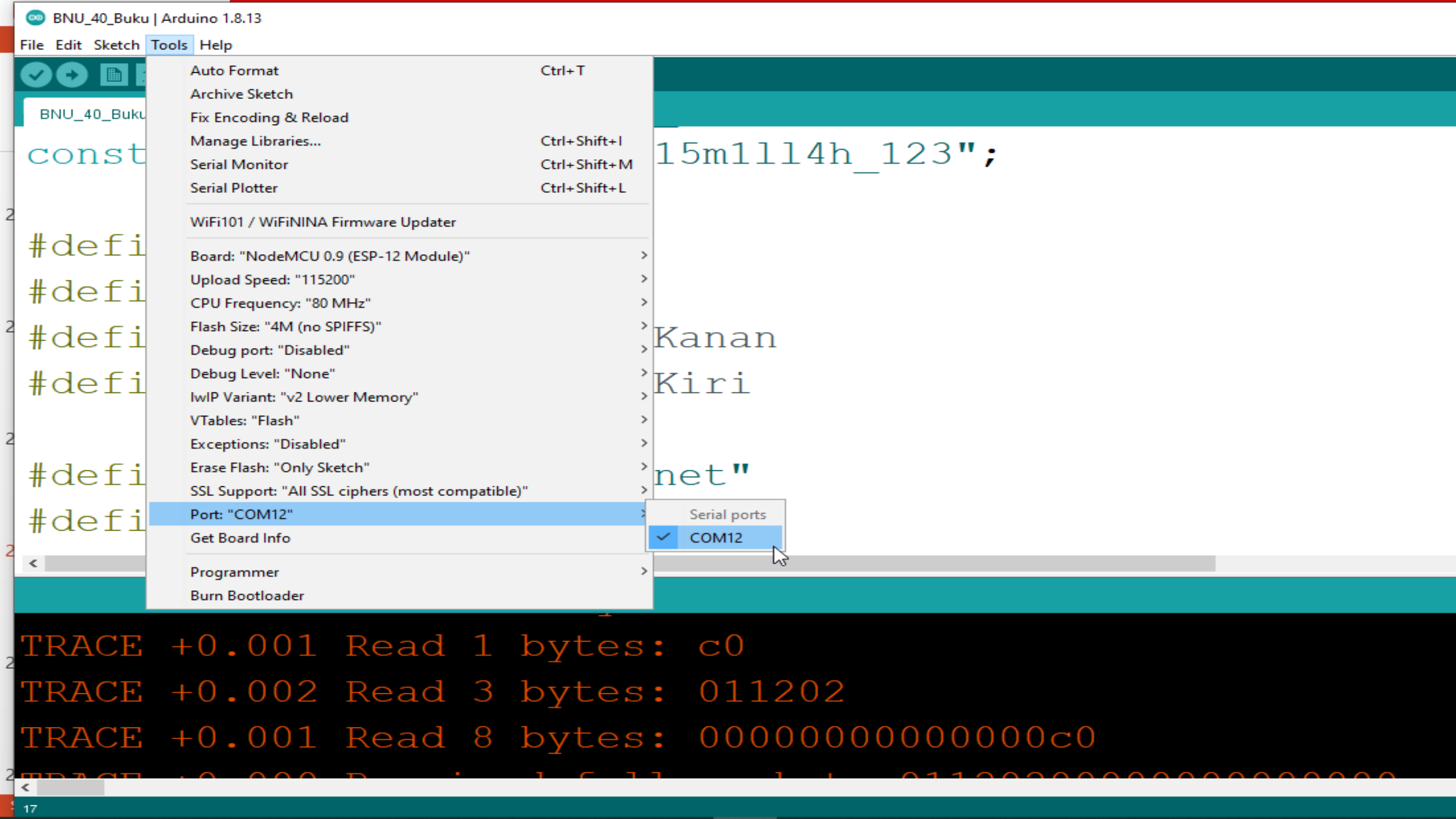
More preferences can be edited directly in the file

C:\Users\Basuki Rahmat\AppData\Local\Arduino15\preferences.txt

(edit only when Arduino is not running)




BNU_40_Buku | Arduino 1.8.13
File Edit Sketch Tools Help
Auto Format Ctrl+T
Archive Sketch
Fix Encoding & Reload
Manage Libraries... Ctrl+Shift+I
Serial Monitor Ctrl+Shift+M
Serial Plotter Ctrl+Shift+L
WiFi101 / WiFiNINA Firmware Updater
Board: "NodeMCU 0.9 (ESP-12 Module)"
Upload Speed: "115200"
CPU Frequency: "80 MHz"
Flash Size: "4M (no SPIFFS)"
Debug port: "Disabled"
Debug Level: "None"
lwIP Variant: "v2 Lower Memory"
VTables: "Flash"
Exceptions: "Disabled"
Erase Flash: "Only Sketch"
SSL Support: "All SSL ciphers (most compatible)"
Port
Get Board Info
Programmer
Burn Bootloader
Boards Manager...
Arduino AVR Boards
ESP8266 Boards (2.5.2)
ESPDuino (ESP-13 Module)
Adafruit Feather HUZZAH ESP8266
Invent One
XinaBox CW01
ESPresso Lite 1.0
ESPresso Lite 2.0
Phoenix 1.0
Phoenix 2.0
NodeMCU 0.9 (ESP-12 Module)
NodeMCU 1.0 (ESP-12E Module)
Olimex MOD-WIFI-ESP8266(-DEV)
SparkFun ESP8266 Thing
SparkFun ESP8266 Thing Dev
SweetPea ESP-210
LOLIN(WEMOS) D1 R2 & mini
LOLIN(WEMOS) D1 mini Pro
LOLIN(WEMOS) D1 mini Lite
WeMos D1 R1
ESPino (ESP-12 Module)
ThaiEasyElec's ESPino
WifInfo
Arduino
4D Systems gen4 IoD Range
Digistump Oak
WiFiduino
BNU_40_Buku
15m1114h_123";
Kanan
Kiri
net"
TRACE +0.001 Read 1 bytes: c0
TRACE +0.002 Read 3 bytes: 011202
TRACE +0.001 Read 8 bytes: 0000000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VTables: "Flash"
Exceptions: "Disabled"
Erase Flash: "Only Sketch"
SSL Support: "All SSL ciphers (most compatible)"
Port: "COM12"
Get Board Info
Programmer
Burn Bootloader
Serial ports
COM12
15m1l14h_123";
Kanan
Kiri
net"
TRACE +0.001 Read 1 bytes: c0
TRACE +0.002 Read 3 bytes: 011202
TRACE +0.001 Read 8 bytes: 00000000000000c0

Boards Manager

Type All esp8266

esp8266

by **ESP8266 Community** version **2.5.2** **INSTALLED**

Boards included in this package:

Generic ESP8266 Module, Generic ESP8285 Module, ESPDuino (ESP-13 Module), Adafruit Feather HUZZAH ESP8266, Invent One, XinaBox CW01, ESPresso Lite 1.0, ESPresso Lite 2.0, Phoenix 1.0, Phoenix 2.0, NodeMCU 0.9 (ESP-12 Module), NodeMCU 1.0 (ESP-12E Module), Olimex MOD-WIFI-ESP8266(-DEV), SparkFun ESP8266 Thing, SparkFun ESP8266 Thing Dev, SparkFun Blynk Board, SweetPea ESP-210, LOLIN(WEMOS) D1 R2 & mini, LOLIN(WEMOS) D1 mini Pro, LOLIN(WEMOS) D1 mini Lite, WeMos D1 R1, ESPino (ESP-12 Module), ThaiEasyElec's ESPino, WifInfo, Arduino, 4D Systems gen4 IoD Range, Digistump Oak, WiFiduino, Amperka WiFi Slot, Seeed Wio Link, ESPectro Core, Schirmilabs Eduino WiFi, ITEAD Sonoff, DOIT ESP-Mx DevKit (ESP8285).

More Info

Select version Install Update Remove

Close

Library Manager

Type All Topic All PubSubClient

PubSubClient

by **Nick O'Leary** Version **2.8.0** **INSTALLED**

A client library for MQTT messaging. MQTT is a lightweight messaging protocol ideal for small devices. This library allows you to send and receive MQTT messages. It supports the latest MQTT 3.1.1 protocol and can be configured to use the older MQTT 3.1 if needed. It supports all Arduino Ethernet Client compatible hardware, including the Intel Galileo/Edison, ESP8266 and TI CC3000.

More info

Select version Install

PubSubClientTools

by Simon Christmann

Tools for easier usage of PubSubClient Provides useful tools for PubSubClient, however they may consume more power and storage. Therefore it's recommended for powerful microcontrollers like ESP8266.

More info

ThingsBoard

by ThingsBoard Team

ThingsBoard library for Arduino. A library for connecting to the ThingsBoard IoT platform. Thin wrapper on PubSubClient.

Close

Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

```
/**********************************************************
 * Program : ROBOT BNU 4.0
Sesuai Buku – Pemrograman Robot Cerdas dengan Arduino
 * **********************************************************/

#include <ESP8266WiFi.h>
#include <PubSubClient.h>

String Topic;
String Payload;

const char* ssid = “Wifi";   // Koneksi ke Wifi apa
const char* password = “Password_Wifi";  // Password Wifi yg digunakan

#define IN_1 D3 // Maju
#define IN_2 D4 // Mundur
#define IN_3 D7 // Belok Kanan
#define IN_4 D8 // Belok Kiri
```

Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

```
#define mqttServer "i-ot.net"
#define mqttPort 1883
#define mqttUser "devmqtt"
#define mqttPassword "20devmqtt"

WiFiServer server(80);
WiFiClient espClient;
PubSubClient client(espClient);

void receivedCallback(char* topic, byte* payload, unsigned int length) {
 Serial.print("Message received: ");
 Serial.println(topic);
 Serial.print("payload: ");

 for (int i = 0; i < length; i++) {
  Serial.print((char)payload[i]);
 }
 Serial.println();
```

Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

```
 /* we got '1' -> Maju */
  if ((char)payload[0] == '1') {
    digitalWrite(IN_1, HIGH);
    delay(100);
    digitalWrite(IN_1, LOW);
  }

/* we got '2' -> Kiri */
  if ((char)payload[0] == '2') {
    digitalWrite(IN_4, HIGH);
    delay(300);
    digitalWrite(IN_1, HIGH);
    delay(100);
    digitalWrite(IN_4, LOW);
    digitalWrite(IN_1, LOW);
  }
```

Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

```
 /* we got '3' -> Kanan */
  if ((char)payload[0] == '3') {
    digitalWrite(IN_3, HIGH);
    delay(300);
    digitalWrite(IN_1, HIGH);
    delay(100);
    digitalWrite(IN_3, LOW);
    digitalWrite(IN_1, LOW);
  }

  /* we got '4' -> Mundur */
  if ((char)payload[0] == '4') {
    digitalWrite(IN_2, HIGH);
    delay(100);
    digitalWrite(IN_2, LOW);
  }
}
```

Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

```
void setup() {
  Serial.begin(115200);
  delay(10);
  pinMode(IN_1, OUTPUT);
  pinMode(IN_2, OUTPUT);
  pinMode(IN_3, OUTPUT);
  pinMode(IN_4, OUTPUT);

  digitalWrite(IN_1, LOW);
  digitalWrite(IN_2, LOW);
  digitalWrite(IN_3, LOW);
  digitalWrite(IN_4, LOW);

  // Connect to WiFi network
  Serial.println();
  Serial.println();
  Serial.print("Connecting to ");
  Serial.println(ssid);
  WiFi.begin(ssid, password);
```

Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

```
while (WiFi.status() != WL_CONNECTED) {
  delay(500);
  Serial.print(".");
 }
 Serial.println("");
 Serial.println("WiFi connected");

 server.begin();
 Serial.println("Server started");

 Serial.print("Use this URL to connect: ");
 Serial.print("http://");
 Serial.print(WiFi.localIP());
 Serial.println("/");
```

Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

```
// Connect to Server IoT (CloudMQTT)

 client.setServer(mqttServer, mqttPort);
 client.setCallback(receivedCallback);

 while (!client.connected()) {
  Serial.println("Connecting to CLoudMQTT...");

  if (client.connect("ESP32Client", mqttUser, mqttPassword )) {

    Serial.println("connected");

  } else {
    Serial.print("failed with state ");
    Serial.print(client.state());
    delay(2000);
  }
}
```

Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

```
 client.subscribe("Maju");
  client.subscribe("Kiri");
  client.subscribe("Kanan");
  client.subscribe("Mundur");
}

void loop() {

  client.loop();

  WiFiClient client = server.available();
  if (!client) {
    return;
  }

  Serial.println("new client");
  while(!client.available()){
    delay(1);
  }
```

Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

```
String request = client.readStringUntil('\r');
 Serial.println(request);
 client.flush();

 if (request.indexOf("/IN_1on") > 0)  {
   digitalWrite(IN_1, HIGH);
   delay(100);
   digitalWrite(IN_1, LOW);
 }
 if (request.indexOf("/IN_1off") >0)  {
   digitalWrite(IN_1, LOW);
 }
  if (request.indexOf("/IN_2on") > 0)  {
   digitalWrite(IN_2, HIGH);
   delay(100);
   digitalWrite(IN_2, LOW);
 }
```

Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

```
if (request.indexOf("/IN_2off") >0)  {
  digitalWrite(IN_2, LOW);
 }
  if (request.indexOf("/IN_3on") > 0)  {
  digitalWrite(IN_3, HIGH);
  delay(300);
  digitalWrite(IN_1, HIGH);
  delay(100);
  digitalWrite(IN_3, LOW);
  digitalWrite(IN_1, LOW);
 }
 if (request.indexOf("/IN_3off") >0)  {
  digitalWrite(IN_3, LOW);
 }
```

Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

```
if (request.indexOf("/IN_4on") > 0)  {
   digitalWrite(IN_4, HIGH);
   delay(300);
   digitalWrite(IN_1, HIGH);
   delay(100);
   digitalWrite(IN_4, LOW);
   digitalWrite(IN_1, LOW);
 }
 if (request.indexOf("/IN_4off") >0)  {
   digitalWrite(IN_4, LOW);
 }
```

Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

```
// Return the response
 client.println("HTTP/1.1 200 OK");
 client.println("Content-Type: text/html");
 client.println("");
 client.println("<!DOCTYPE HTML>");
 client.println("<html>");
 client.println("<head>");
 client.println("<meta name='apple-mobile-web-app-capable' content='yes' />");
 client.println("<meta name='apple-mobile-web-app-status-bar-style' content='black-
translucent' />");
 client.println("</head>");
 client.println("<body bgcolor = \"#f7e6ec\">");
 client.println("<hr/><hr>");
 client.println("<h4><center> Robot BNU 4.0  </center></h4>");
 client.println("<hr/><hr>");
 client.println("<br><br>");
 client.println("<br><br>");
 client.println("<center>");
```

Eksperimen – Pengendalian Robot Berbasis Cloud i-ot.net

```
client.println("ROBOT");
 client.println("<a href=\"/IN_1on\"\"><button>Maju </button></a>");
 client.println("<a href=\"/IN_2on\"\"><button>Mundur </button></a><br />");
 client.println("</center>");
 client.println("<br><br>");
 client.println("<center>");
 client.println("ROBOT");
 client.println("<a href=\"/IN_3on\"\"><button>Belok Kanan </button></a>");
 client.println("<a href=\"/IN_4on\"\"><button>Belok Kiri </button></a><br />");
 client.println("</center>");
 client.println("<br><br>");
 client.println("<center>");
 client.println("<table border=\"5\">");
 client.println("<tr>");
 //====================
```

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```
if (digitalRead(IN_1))
      {
       client.print("<td>Maju = ON</td>");
      }
 else
      {
       client.print("<td>Maju = OFF</td>");
      }
 client.println("<br />");
 //=====================
 if (digitalRead(IN_2))
      {
       client.print("<td>Mundur = ON</td>");
      }
 else
      {
       client.print("<td>Mundur = OFF</td>");
      }
 client.println("</tr>");
```

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```
if (digitalRead(IN_3))
        {
         client.print("<td>Belok Kanan = ON</td>");
        }
 else
        {
          client.print("<td>Belok Kanan = OFF</td>");
        }
 client.println("<br />");
 //=======================
 if (digitalRead(IN_4))
        {
         client.print("<td>Belok Kiri = ON</td>");
        }
 else
        {
          client.print("<td>Belok Kiri = OFF</td>");
        }
 client.println("</tr>");
```

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```
 client.println("<tr>");
  client.println("</table>");
  client.println("</center>");
  client.println("</html>");
  delay(1);
  Serial.println("Client disonnected");
  Serial.println("");
}
```

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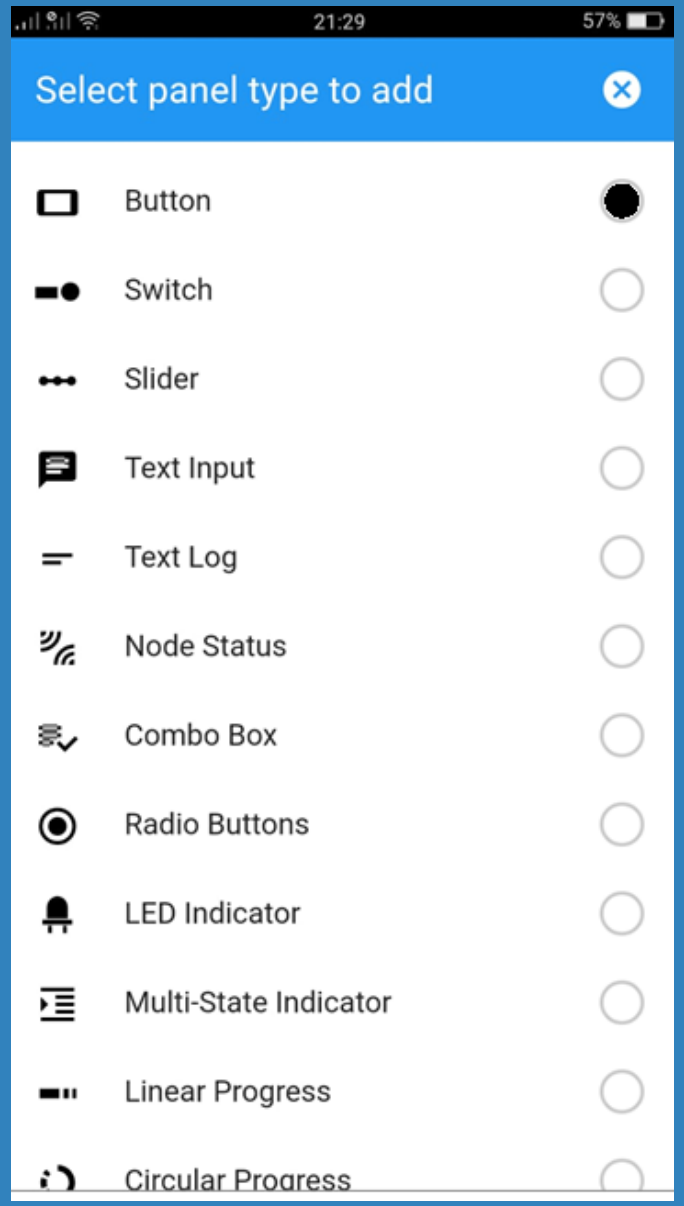

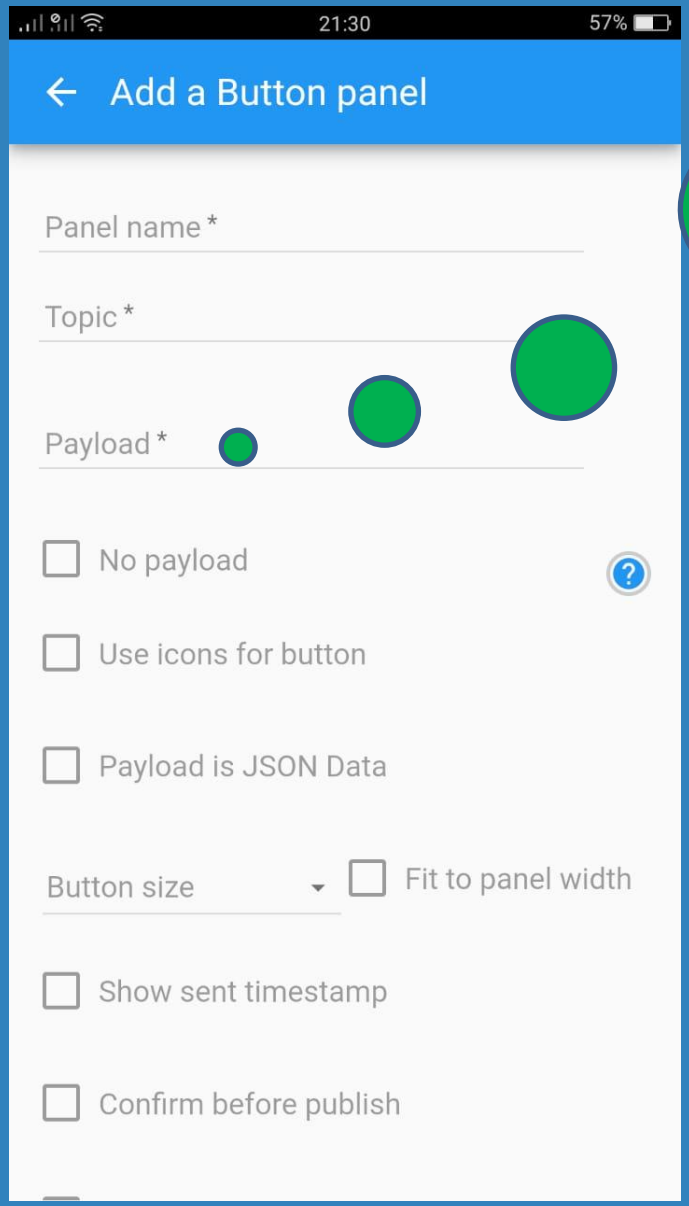

Maju = Payload 1
Kiri = Payload 2
Kanan = Payload 3
Mundur = Payload 4

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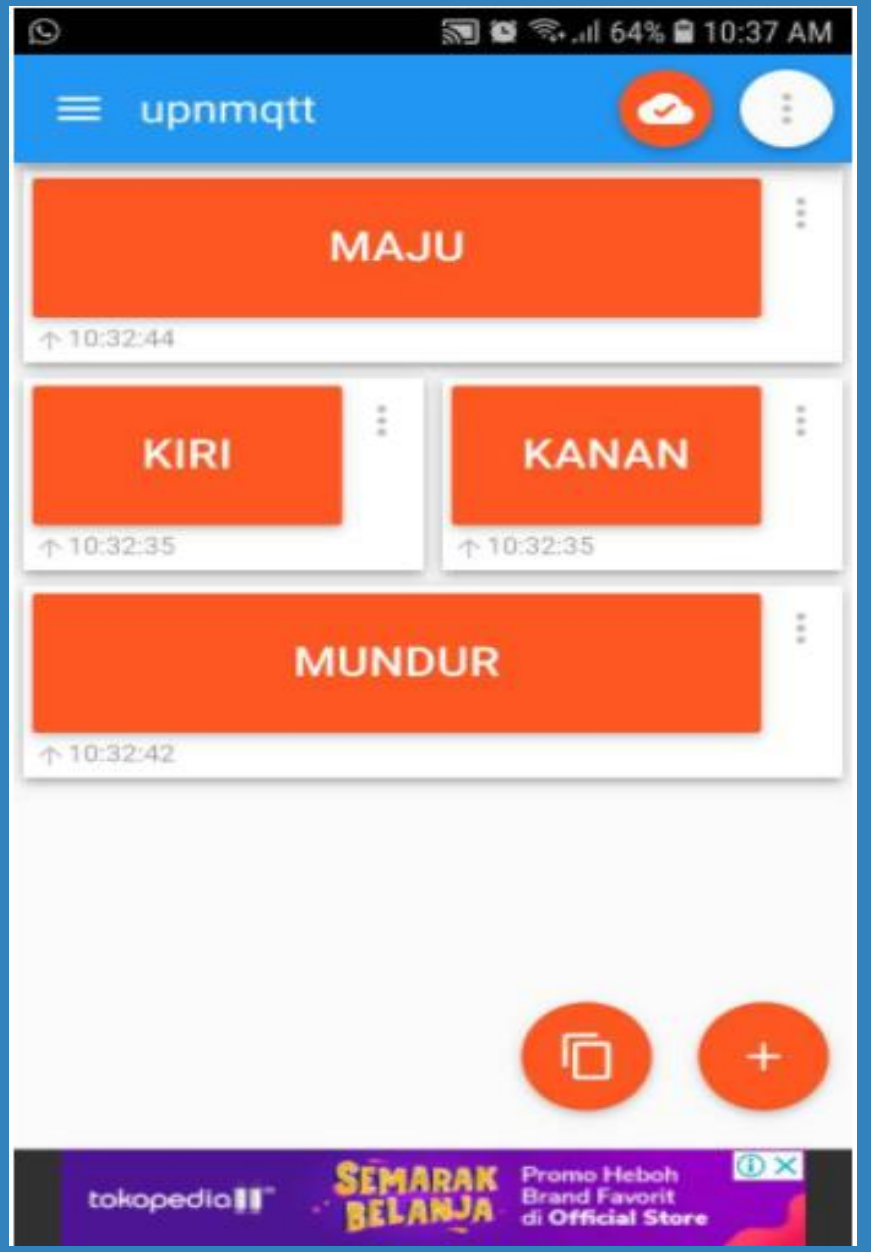

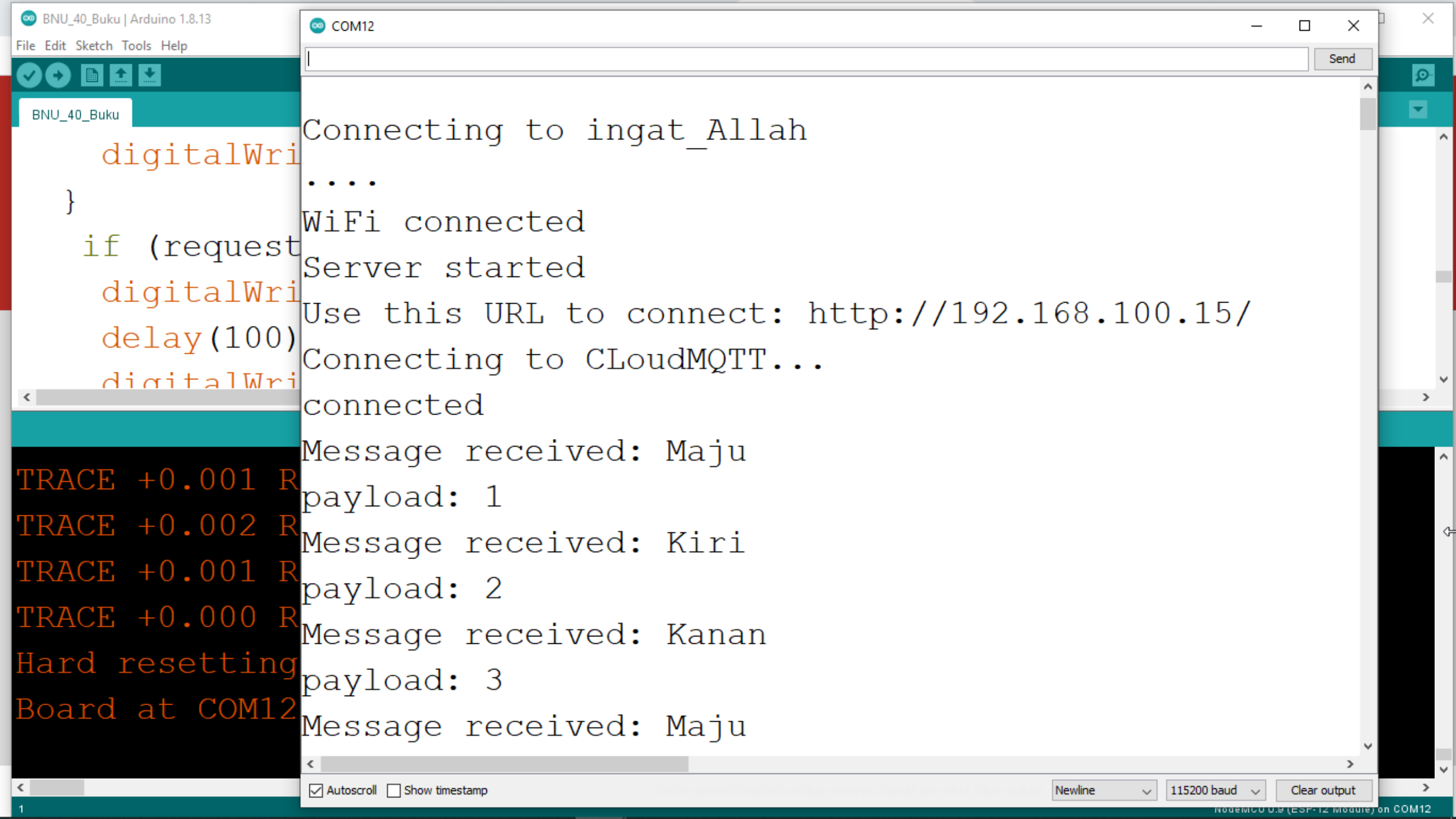
BNU_40_Buku | Arduino 1.8.13
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BNU_40_Buku
digitalWri
}
if (request
digitalWri
delay(100)
digitalWri
TRACE +0.001 R
TRACE +0.002 R
TRACE +0.001 R
TRACE +0.000 R
Hard resetting
Board at COM12
COM12
Send
Connecting to ingat_Allah
....
WiFi connected
Server started
Use this URL to connect: http://192.168.100.15/
Connecting to CLoudMQTT...
connected
Message received: Maju
payload: 1
Message received: Kiri
payload: 2
Message received: Kanan
payload: 3
Message received: Maju
Autoscroll
Show timestamp
Newline
115200 baud
Clear output

DEMO

Terima kasih