

ARDUINO
JOGLOSEMAR

Arduino & Internet of Things

Agfianto Eko Putra -- (<http://agfi.staff.ugm.ac.id>)

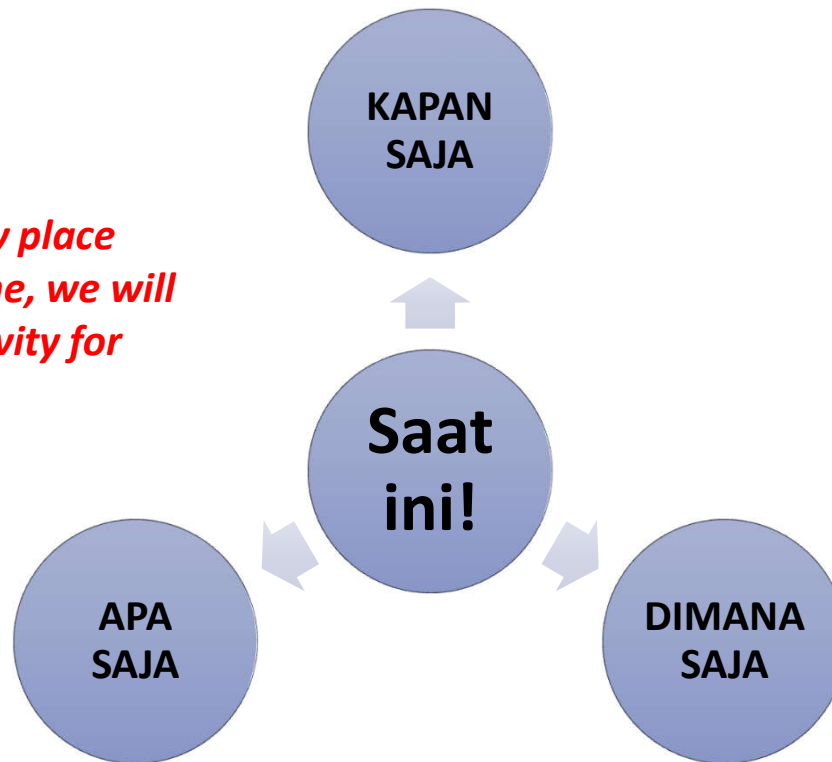
Dosen Prodi ELINS - Universitas Gadjah Mada

Sabtu, 01 April 2017 – Arduino Day

Mengapa IoT..?



*From any time ,any place
connectivity for anyone, we will
now have connectivity for
anything!*



Wearables

- Entertainment
- Fitness
- Smart watch
- Location and tracking



Building & Home Automation

- Access control
- Light & temp control
- Energy optimization
- Predictive maintenance
- Connected appliances



Smart Cities

- Residential E-meters
- Smart street lights
- Pipeline leak detection
- Traffic control
- Surveillance cameras
- Centralized and integrated system control



Smart Manufacturing

- Flow optimization
- Real time inventory
- Asset tracking
- Employee safety
- Predictive maintenance
- Firmware updates



Health Care

- Remote monitoring
- Ambulance telemetry
- Drugs tracking
- Hospital asset tracking
- Access control
- Predictive maintenance



Automotive

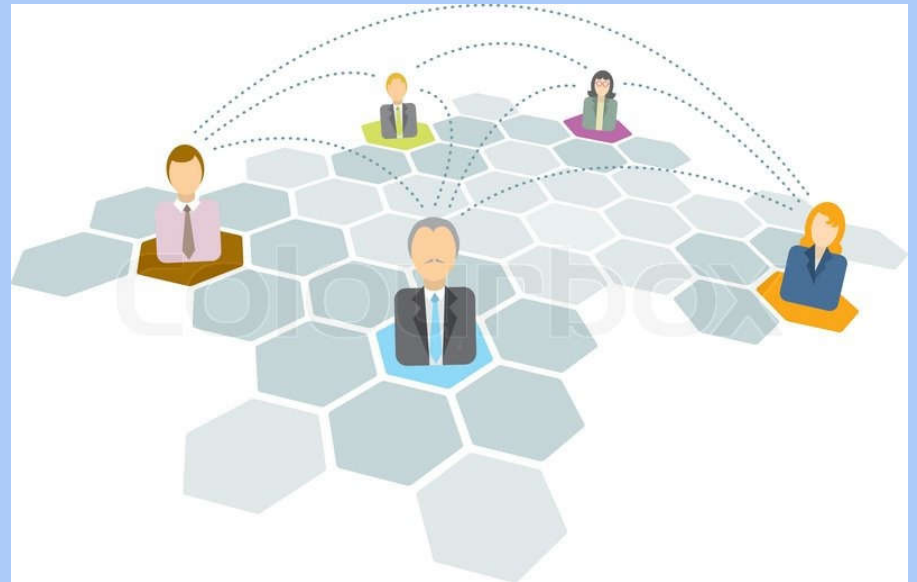
- Infotainment
- Wire replacement
- Telemetry
- Predictive maintenance
- C2C and C2I





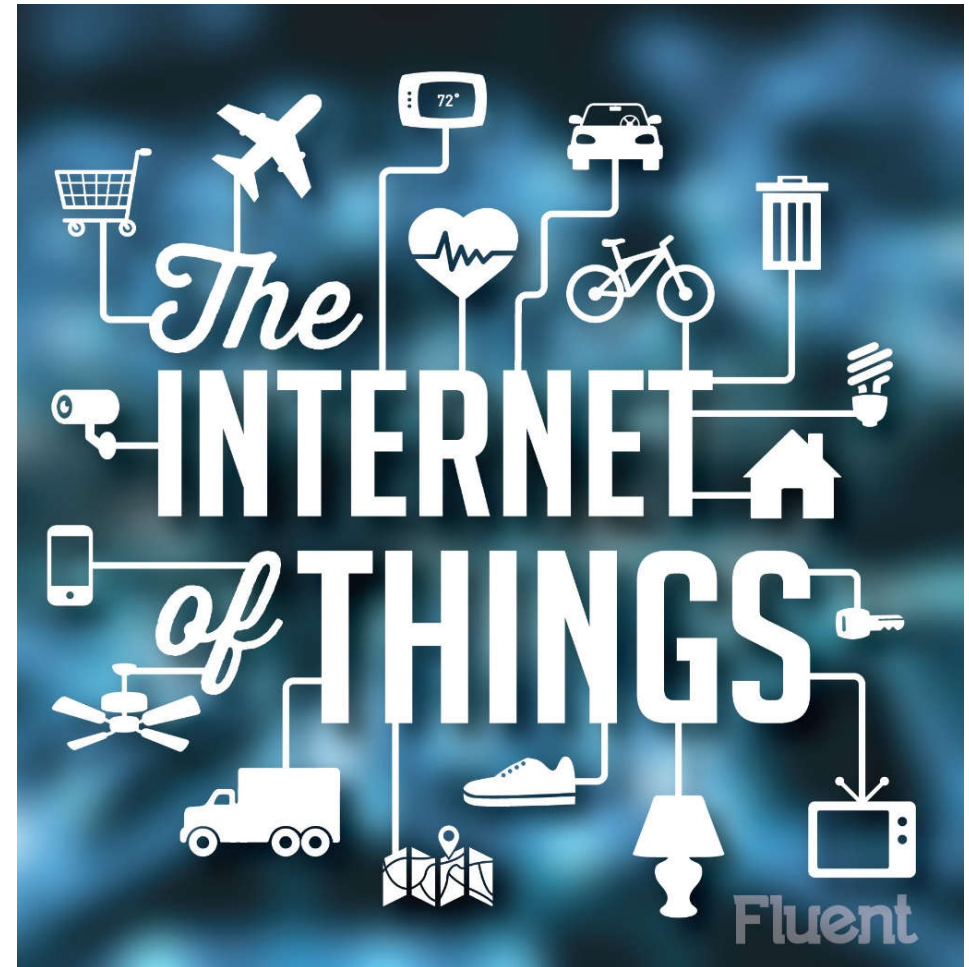
Bermula dari INTERNET...

- Internet ada dimana-mana...
- Menghubungkan antara satu orang dengan orang lainnya...
- ***“Connecting People”***



Apa itu “Internet of Things”?

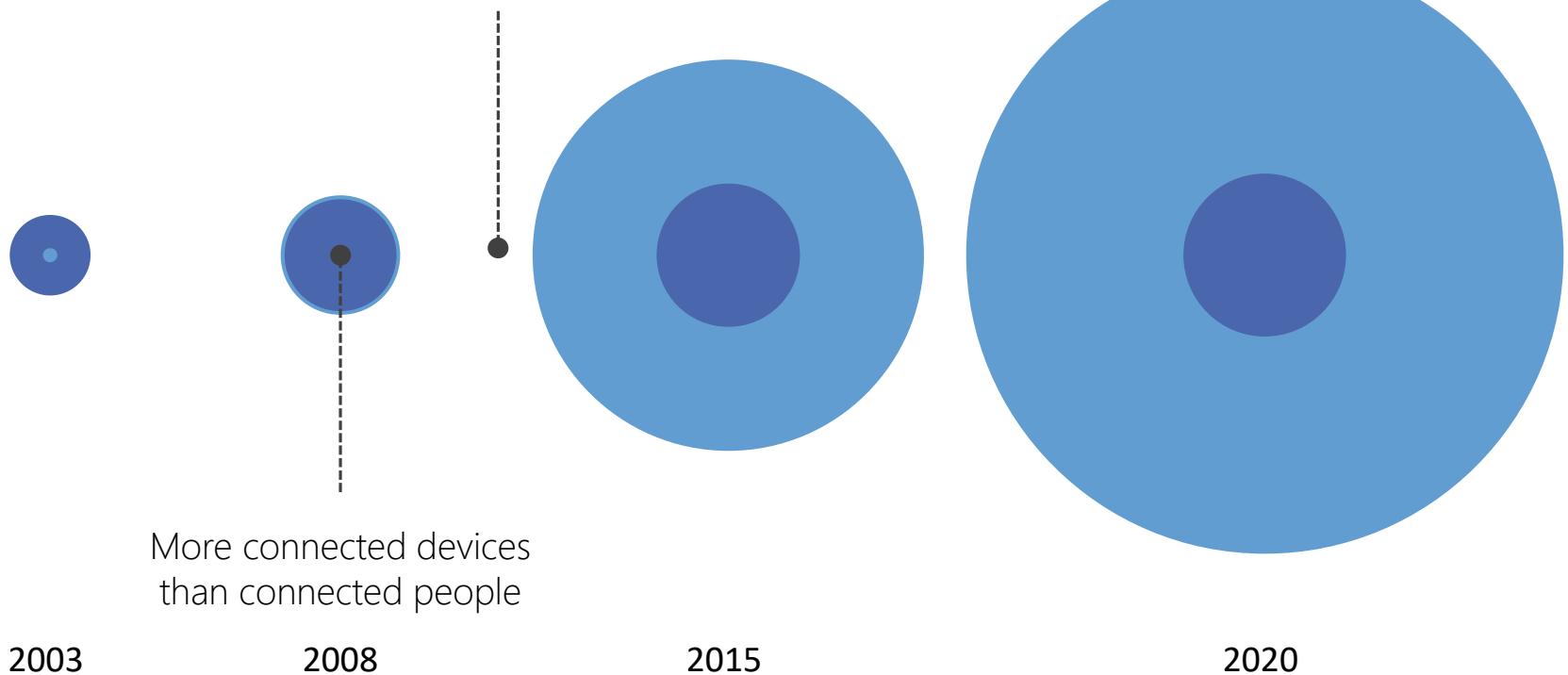
- Internet itu...
 - Menghubungkan semua orang → *“the Internet of People”*
- IoT itu ...
 - Menghubungkan segala “sesuatu” → **“the Internet of Things”**



CONNECTED “THINGS” vs people

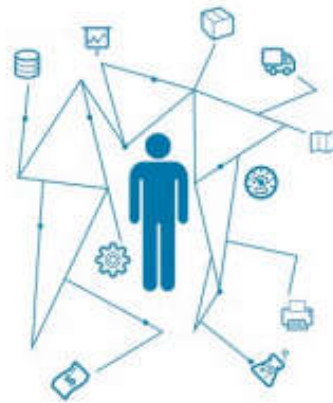
2013 - Est. *10 Billion CONNECTED Devices*
vs. Est. *7.14 Billion People World Population*

Est. 50 Billion connected devices in 2020



Source: [Cisco](#) & [Internet World Stats](#)

There will be as many as
**40 TO 80
BILLION**
connected objects
by 2020.



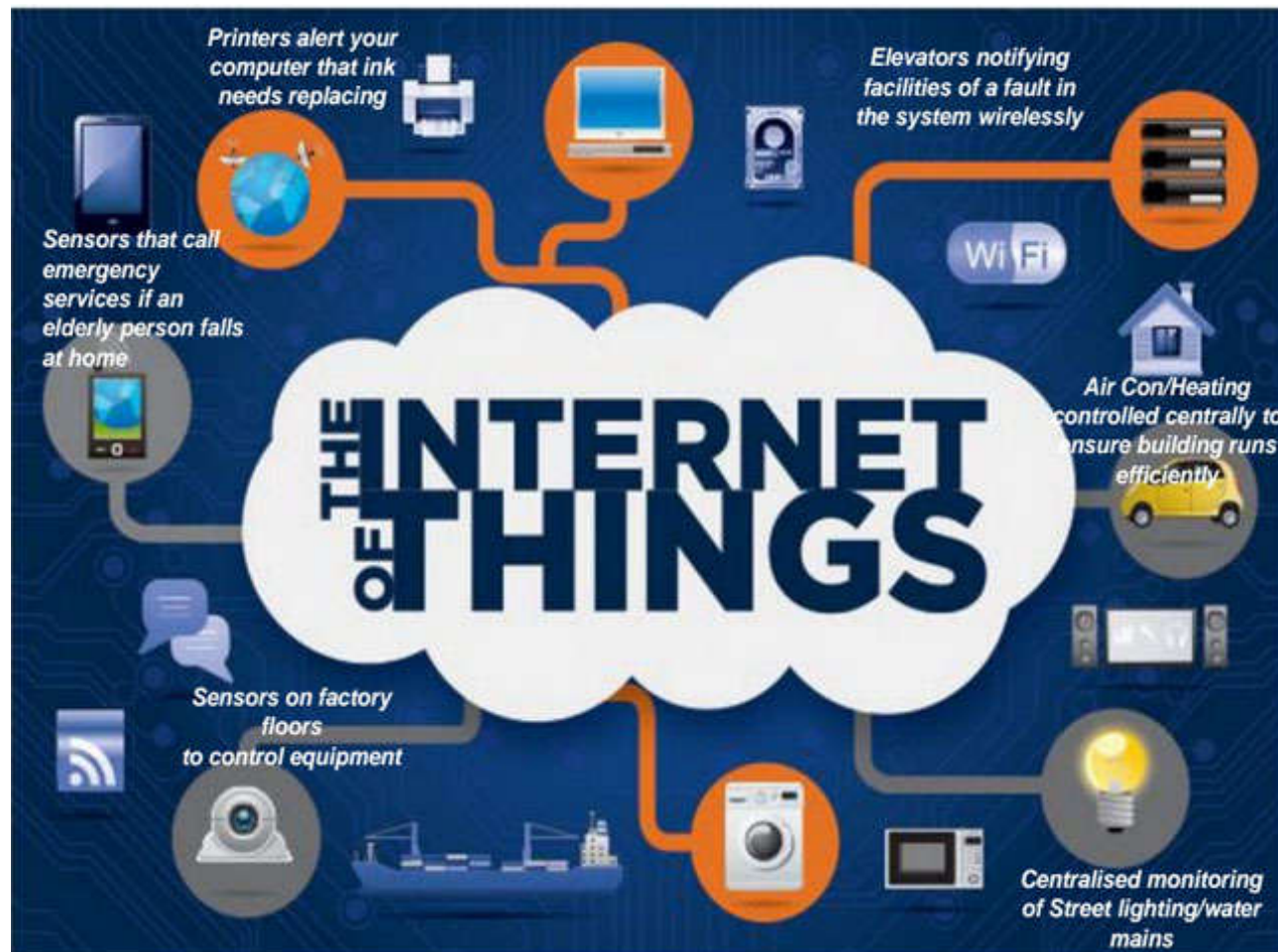
There will be
10 connected
objects
for every man,
woman, and child
on the **PLANET.**



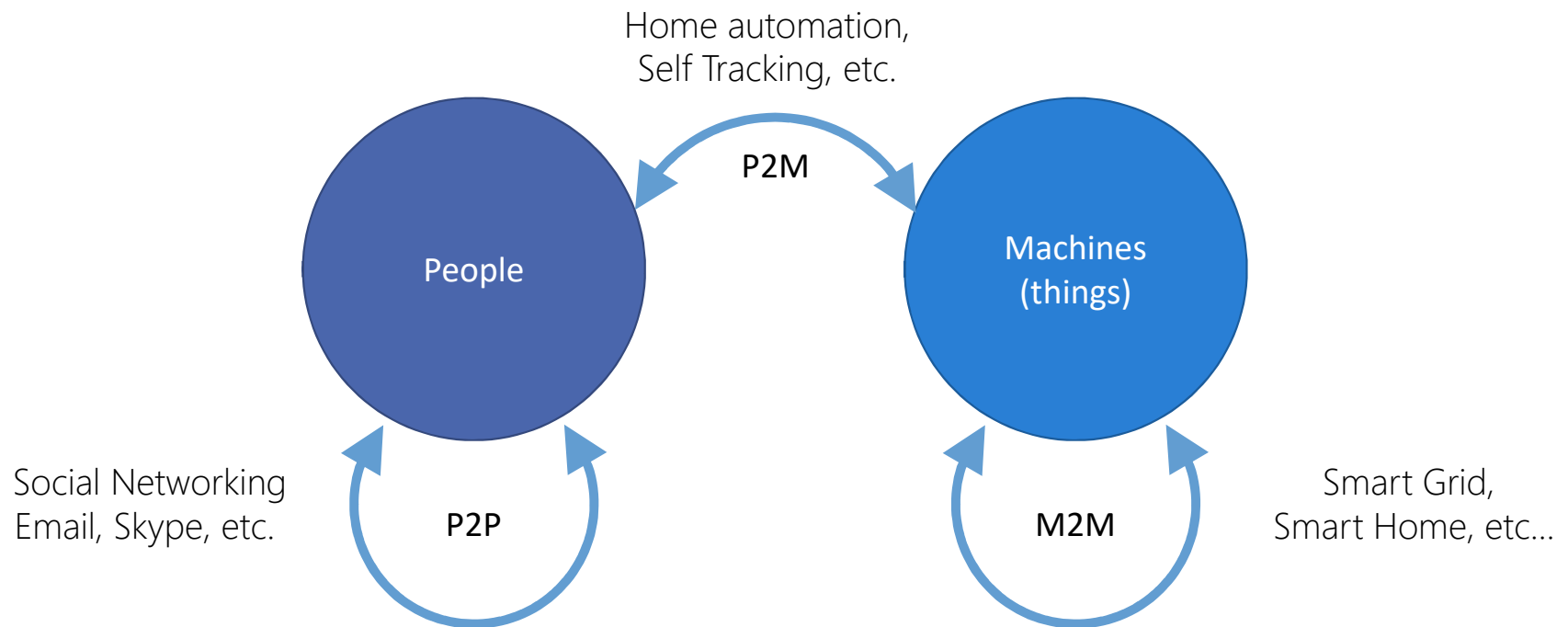
PEOPLE
— ARE —
“THINGS”
TOO!

A collection of small icons representing various IoT devices: a document, a magnifying glass, a database cylinder, a truck, a cube, a printer, a book, a gear, and a wrench.

Through the power of smart
devices, people will not only
consume data, but contribute
observed data to the IoT through
their phones and tablets as
human sensors



Jalur-jalur koneksi



Ruang alamat IPv4 (32bit)

4,294,967,295

atau

4.3 Milyar alamat

Ruang alamat IPv6 (128bit)

Remember, we're *only* talking about trillions of devices! and billions of people!

Undecillion Decillion Nonillion Octillion Septillion Sextillion Quintillion Quadrillion Trillion Billion Million Thousand Hundred

340,282,366,920,938,463,463,374,607,431,768,211,456

or

340.3 Undecillion Addresses

Wireless, SWARMS dan CLOUDS



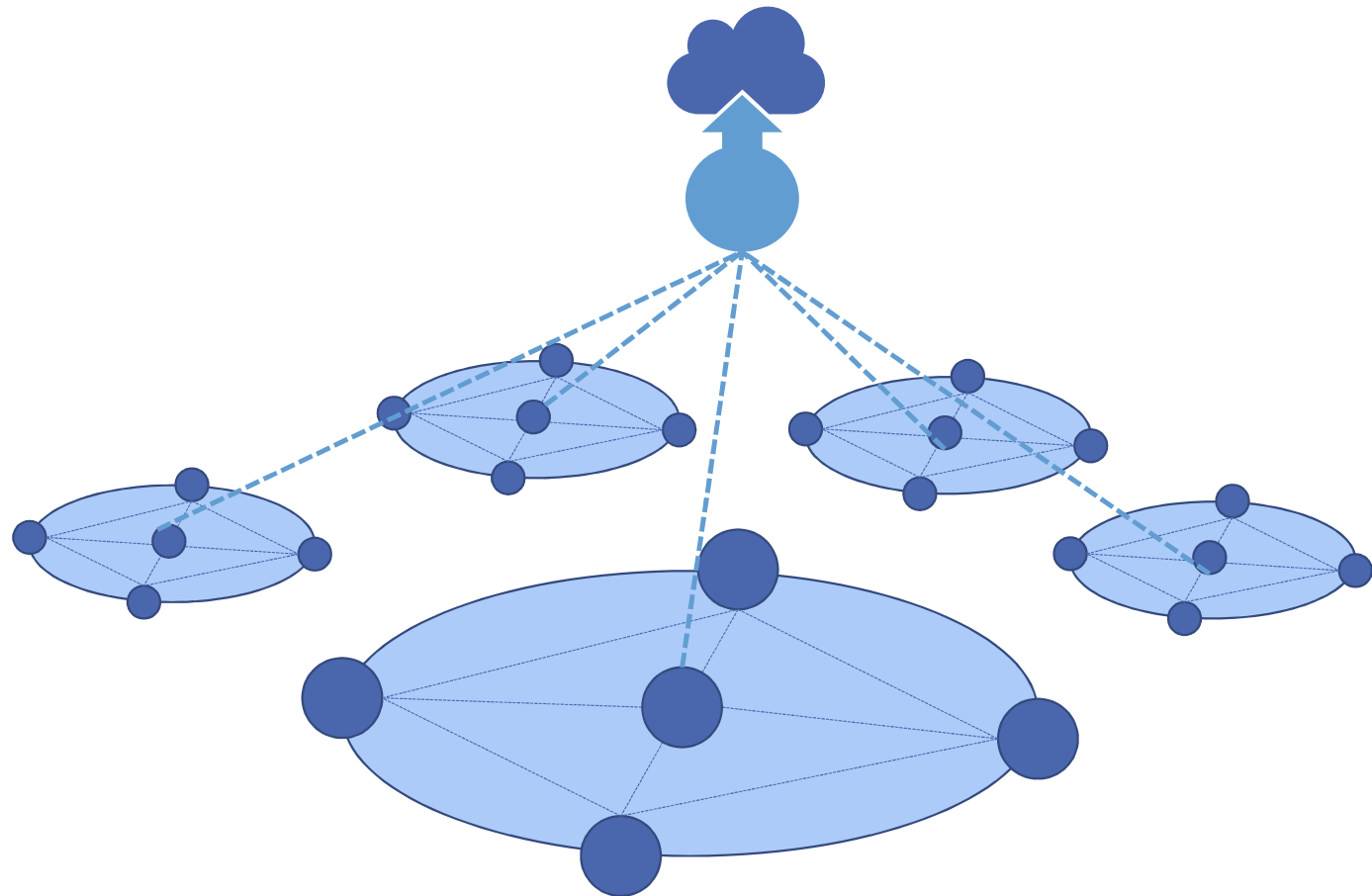
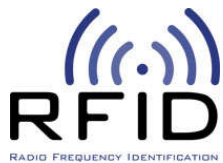
ZigBee®



Bluetooth®



NFC



Want to know more? Check out Cisco's Flavio Bonomi's ["Emerging Trends in Wireless in the Era of IoT"](#)

IoT Protocol: MQTT dan OMA



Created by *Dr. Andy Stanford-Clark* of IBM and *Arlen Nipper* of Arcom in 1999

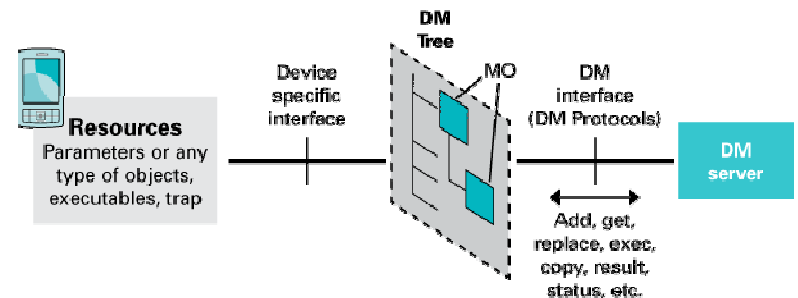
Undergoing the [OASIS](#) standardization process

Message Queuing Telemetry Transport (MQTT) is a lightweight broker-based publish/subscribe messaging protocol designed to be open, simple, lightweight and easy to implement.

- Where the network is expensive, has low bandwidth or is unreliable
- When run on an embedded device with limited processor or memory resources



The **OMA Device Management (DM)** Working Group specifies protocols and mechanisms to achieve the management of mobile devices, services access and software on connected devices.



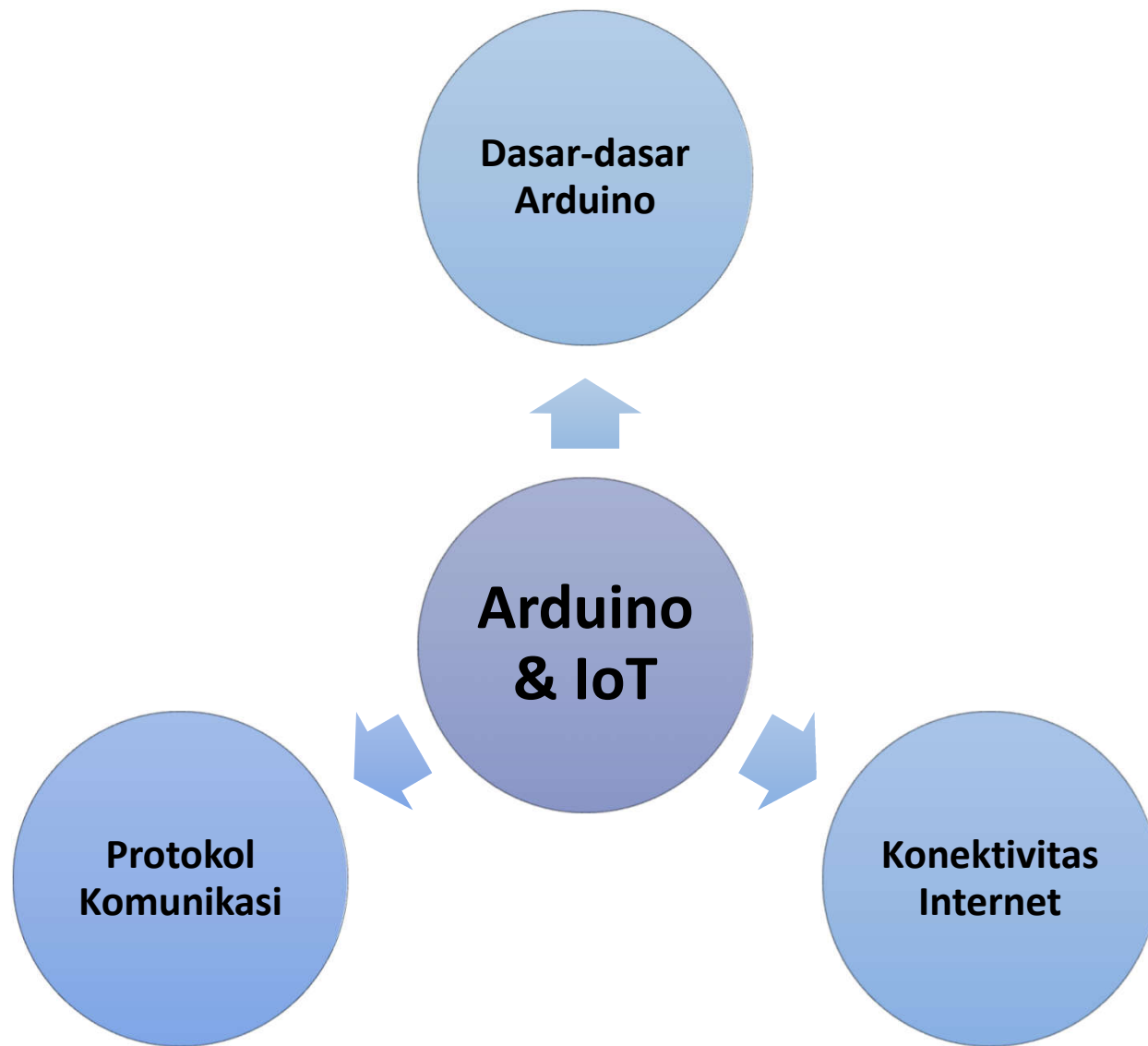
<http://openmobilealliance.org/about-oma/work-program/device-management/>



**Konsep
Internet of
Things (IoT)**

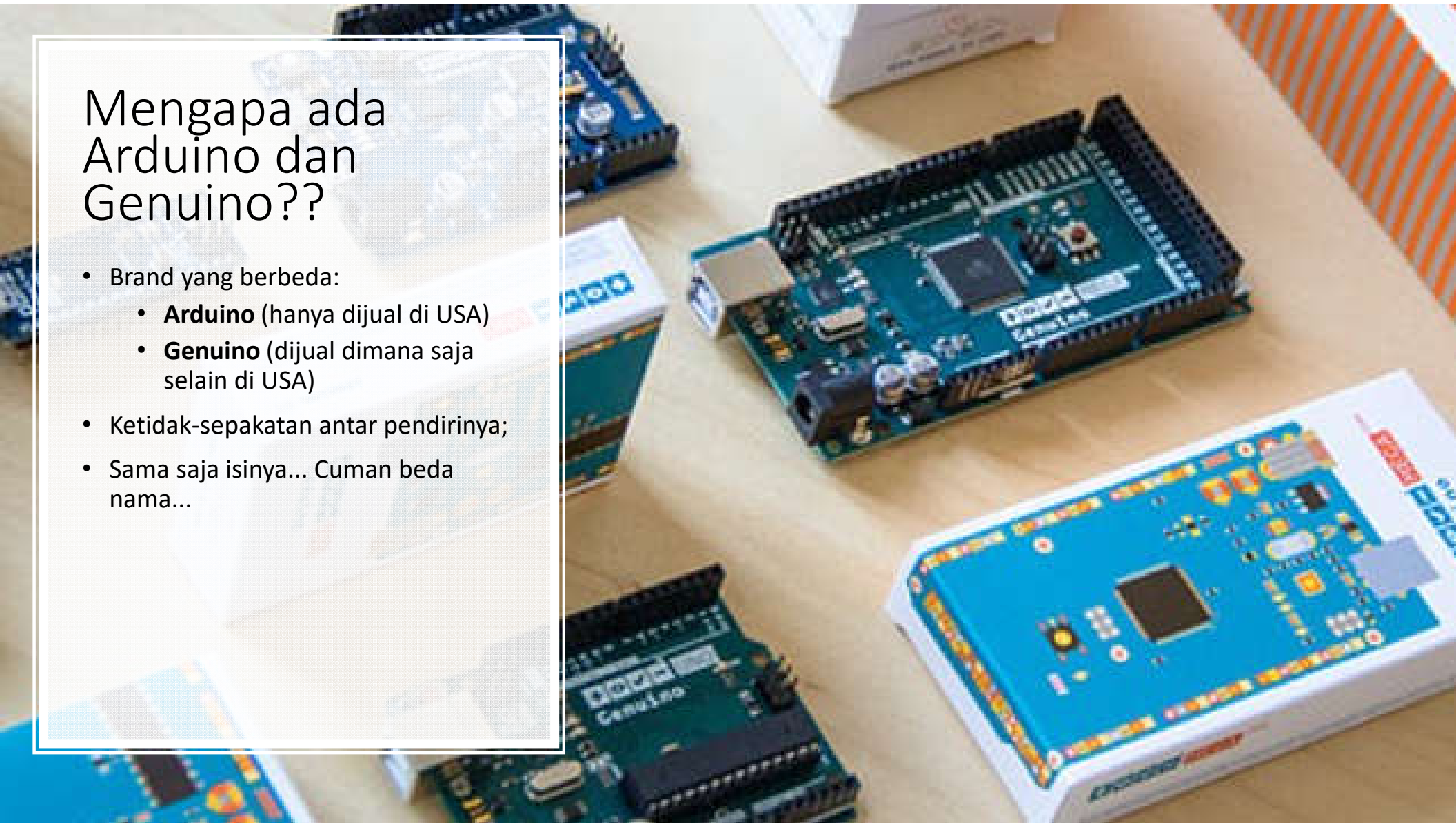
**Arduino &
Konektivitas**

**Contoh2
Purwarupa**



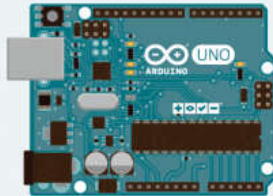
Mengapa ada Arduino dan Genuino??

- Brand yang berbeda:
 - **Arduino** (hanya dijual di USA)
 - **Genuino** (dijual dimana saja selain di USA)
- Ketidak-sepakatan antar pendirinya;
- Sama saja isinya... Cuman beda nama...

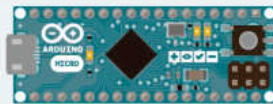


UNITED STATES

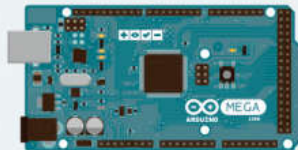
 **UNO**
ARDUINO



 **MICRO**
ARDUINO

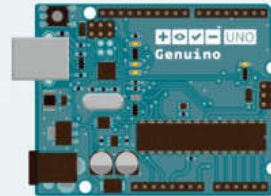


 **MEGA**
ARDUINO 2560

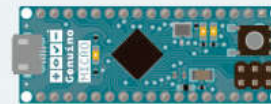


REST OF THE WORLD

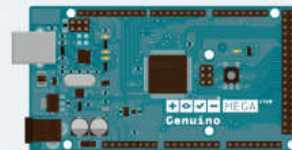
 **UNO**
Genuino

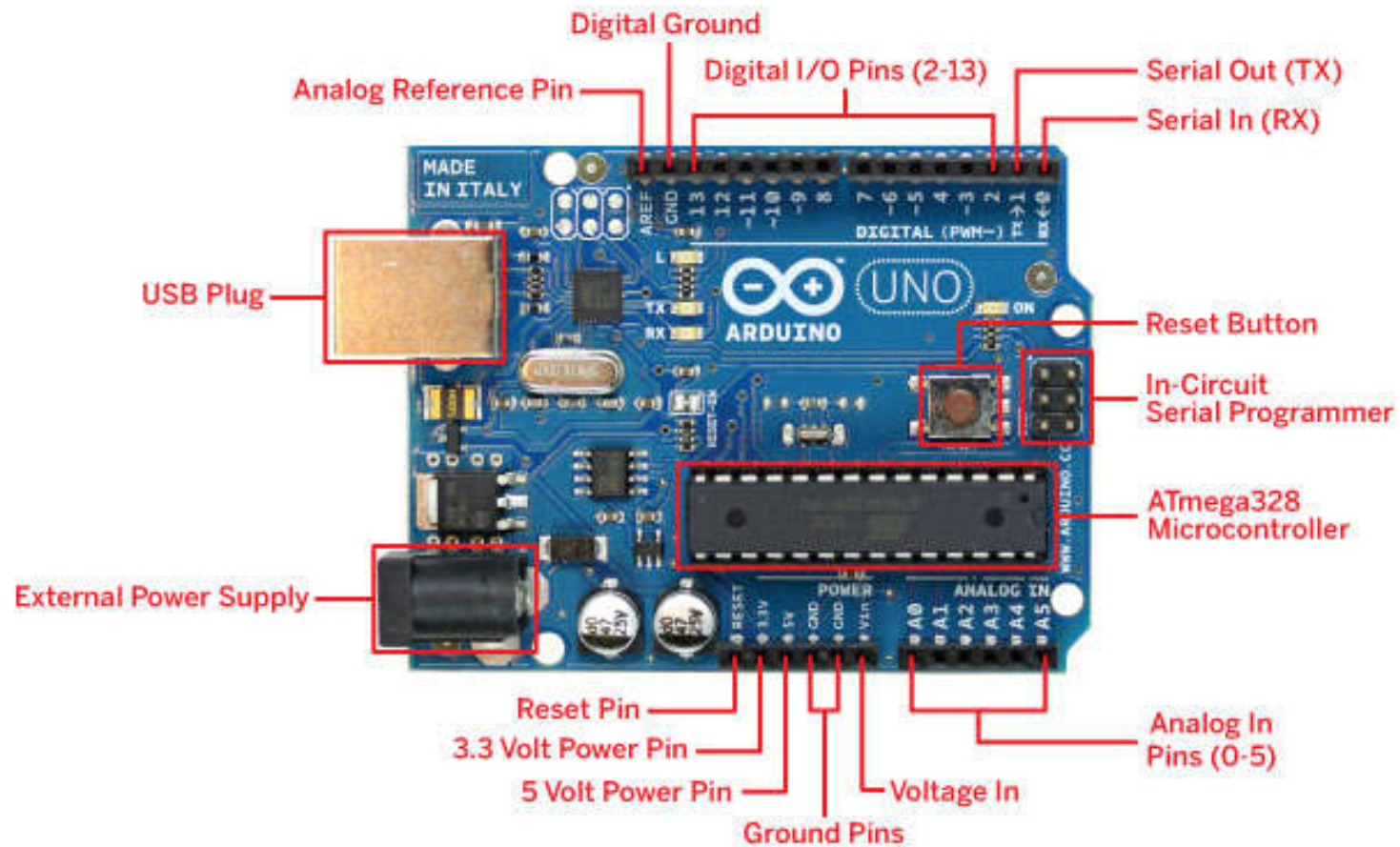


 **MICRO**
Genuino

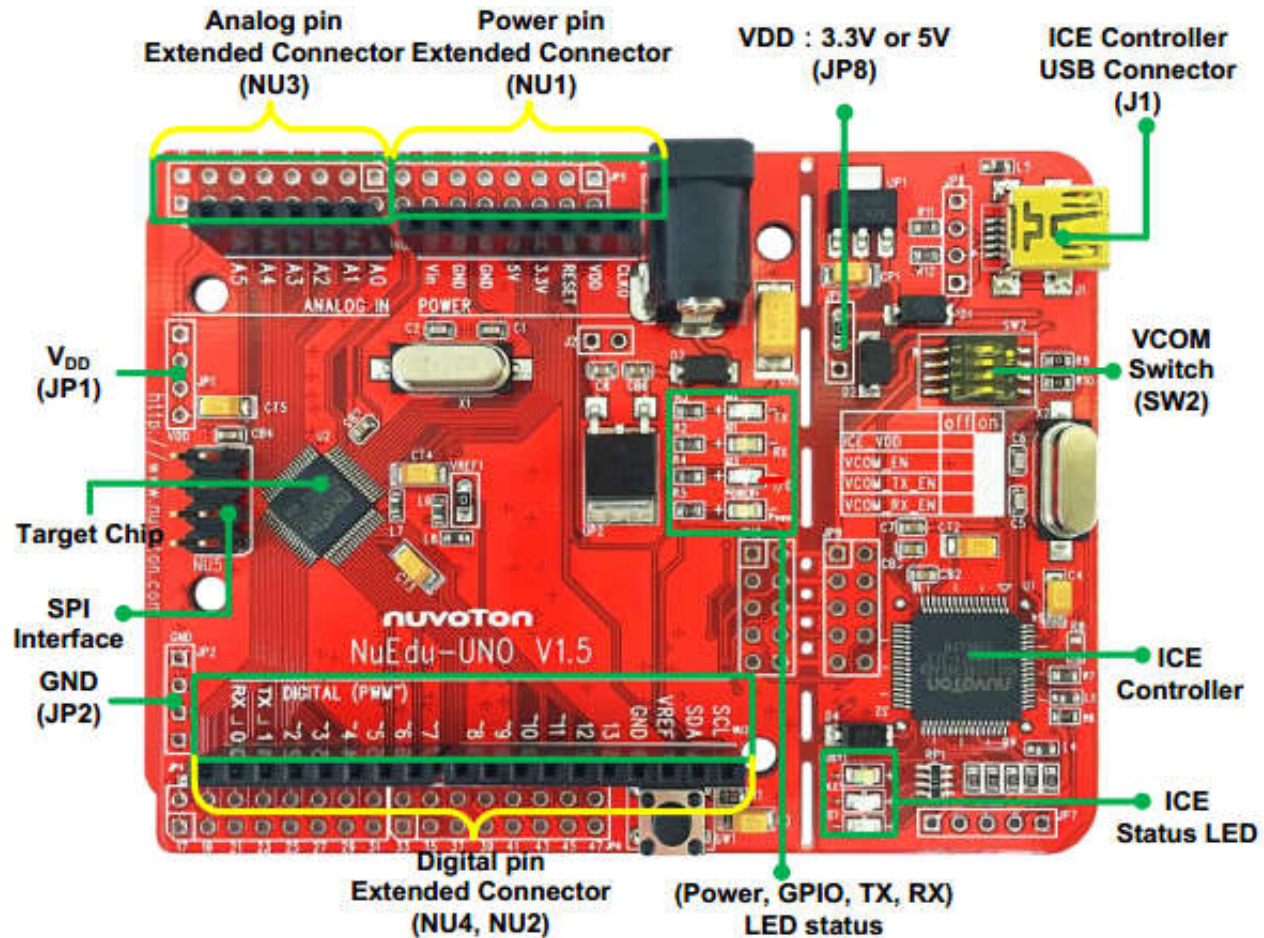


 **MEGA 2560**
Genuino





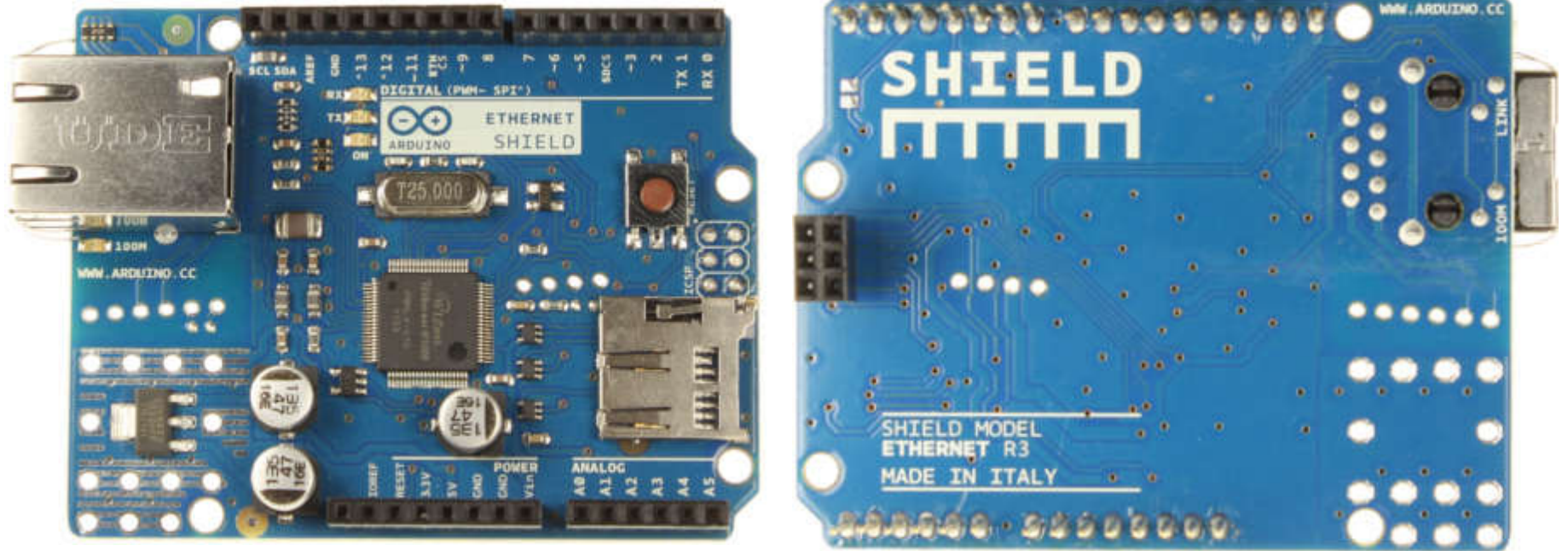
NuEDU UNO: Arduino dengan Cita Rasa ARM Cortex M0



Konektivitas untuk IoT

Pilihan Konektivitas	Contoh penggunaan
Kabel (Ethernet)	Pemantau suhu penyimpanan makanan
Nirkabel (WIFI)	Sensor kelembaban tanah
Data selular	Wildlife tracker

Konektivitas dengan Kabel (Ethernet)

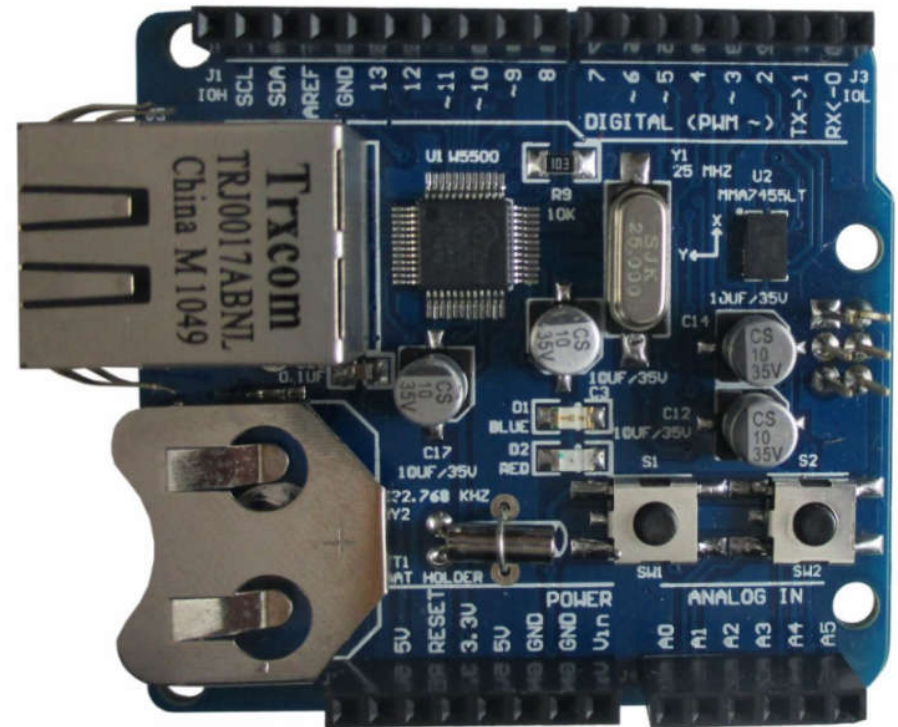


<https://www.arduino.cc/en/Guide/ArduinoEthernetShield>

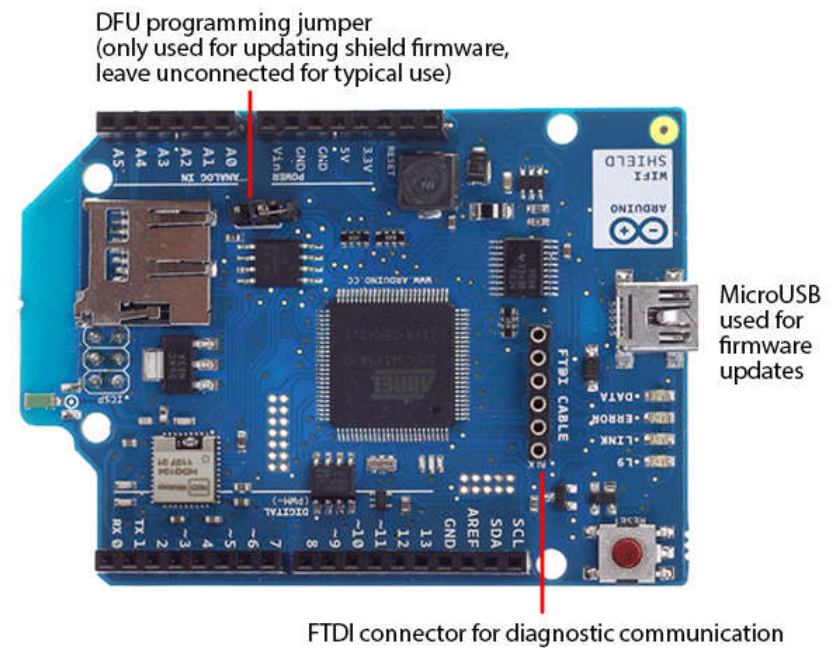
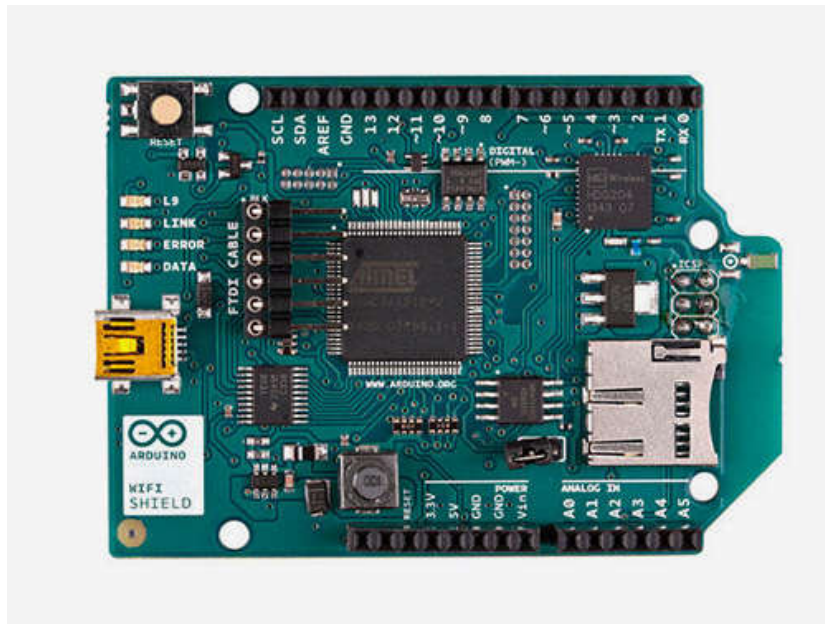
<https://www.arduino.cc/en/Reference/Ethernet>

EMS Basic Interface Shield

- **EMS Basic Interface Shield** merupakan sebuah modul add-on/shield untuk board Arduino™ / Arduino™ Compatible yang lain.
- Shield ini dapat digunakan untuk pembelajaran komunikasi ethernet (W5500), SPI (MMA7455L), I²C (DS1307), dan UART.

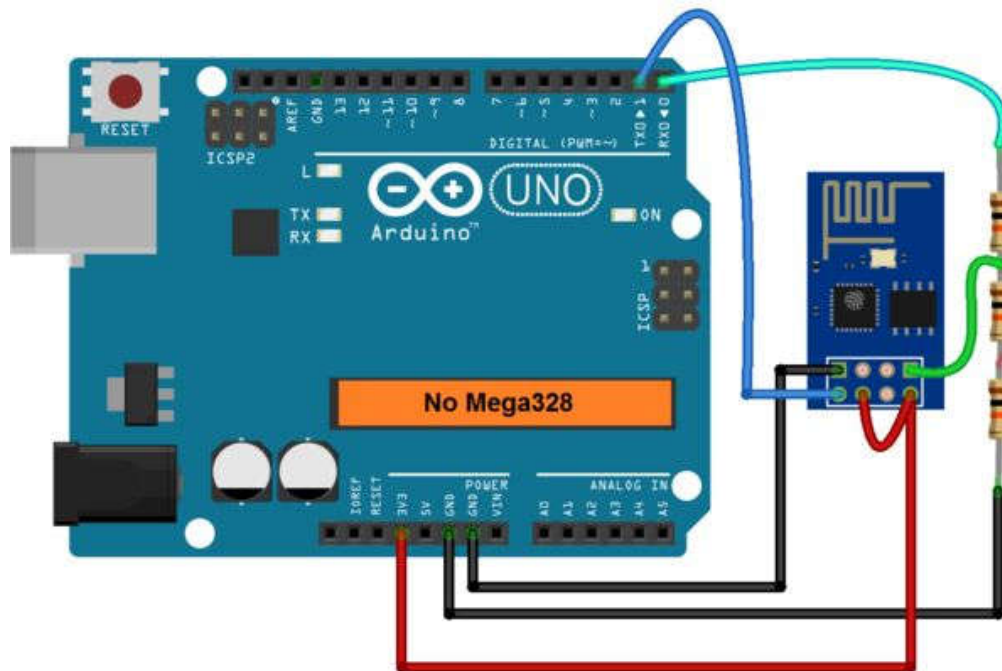


Konektivitas Nir-kabel (WIFI)



<https://www.arduino.cc/en/Guide/ArduinoWiFiShield>
<https://www.arduino.cc/en/Reference/WiFi>

Arduino dan modul ESP8266



Resistors are only for Voltage Dividers
3x 10K Resistors

Arduino UNO	ESP8266
(without Chip)	
TX <==> TX	
RX <==> RX (3.3 through Resistors)	
3.3v <==> Vcc	
3.3 <==> Ch_en	
Gnd <==> Gnd	

fritzing

<http://www.instructables.com/id/noobs-guide-to-ESP8266-with-Arduino-Mega-2560-or-U/>

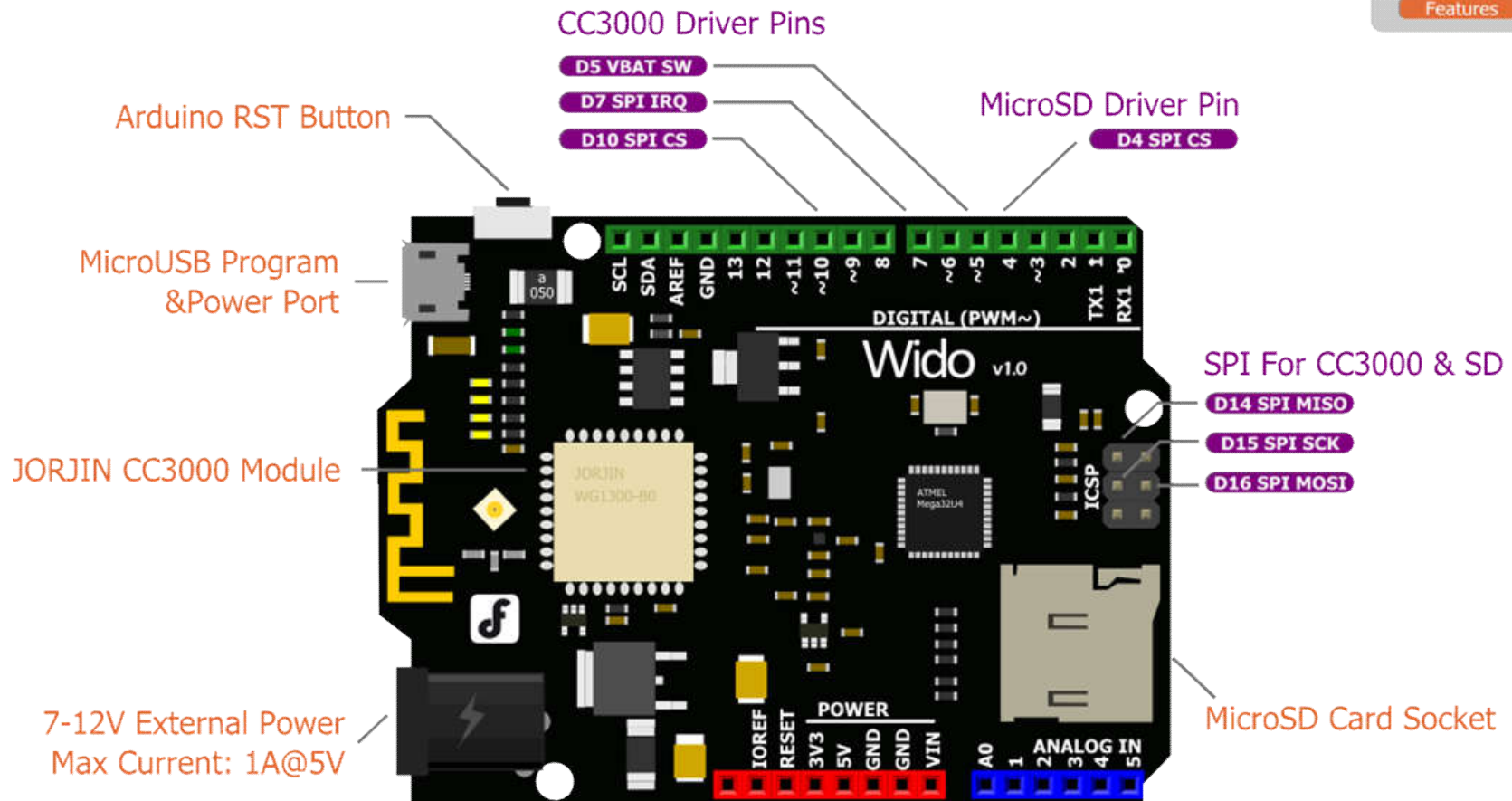
Wido — Open Source IoT Node

Pinout Diagram

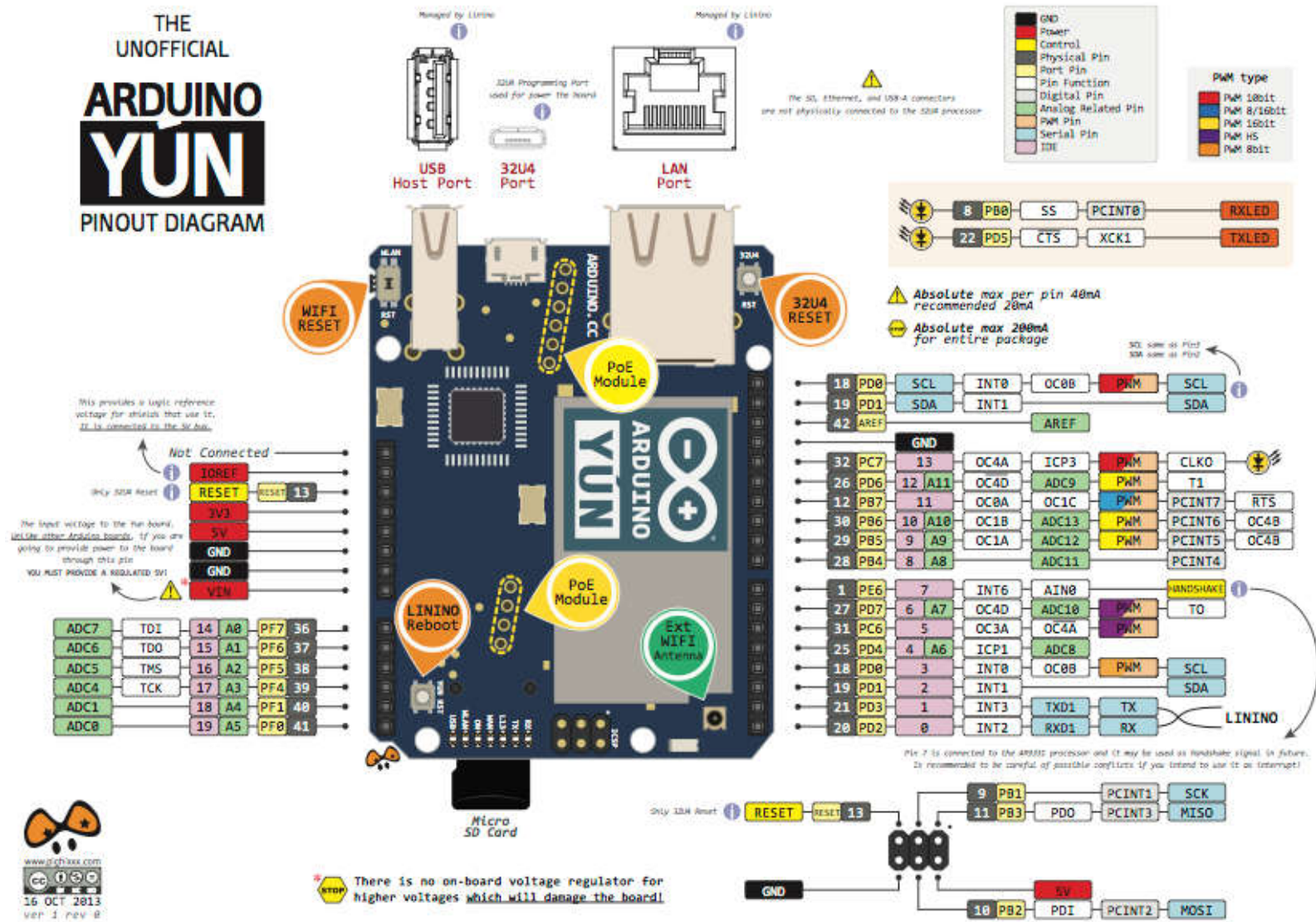
www.dfrobot.com



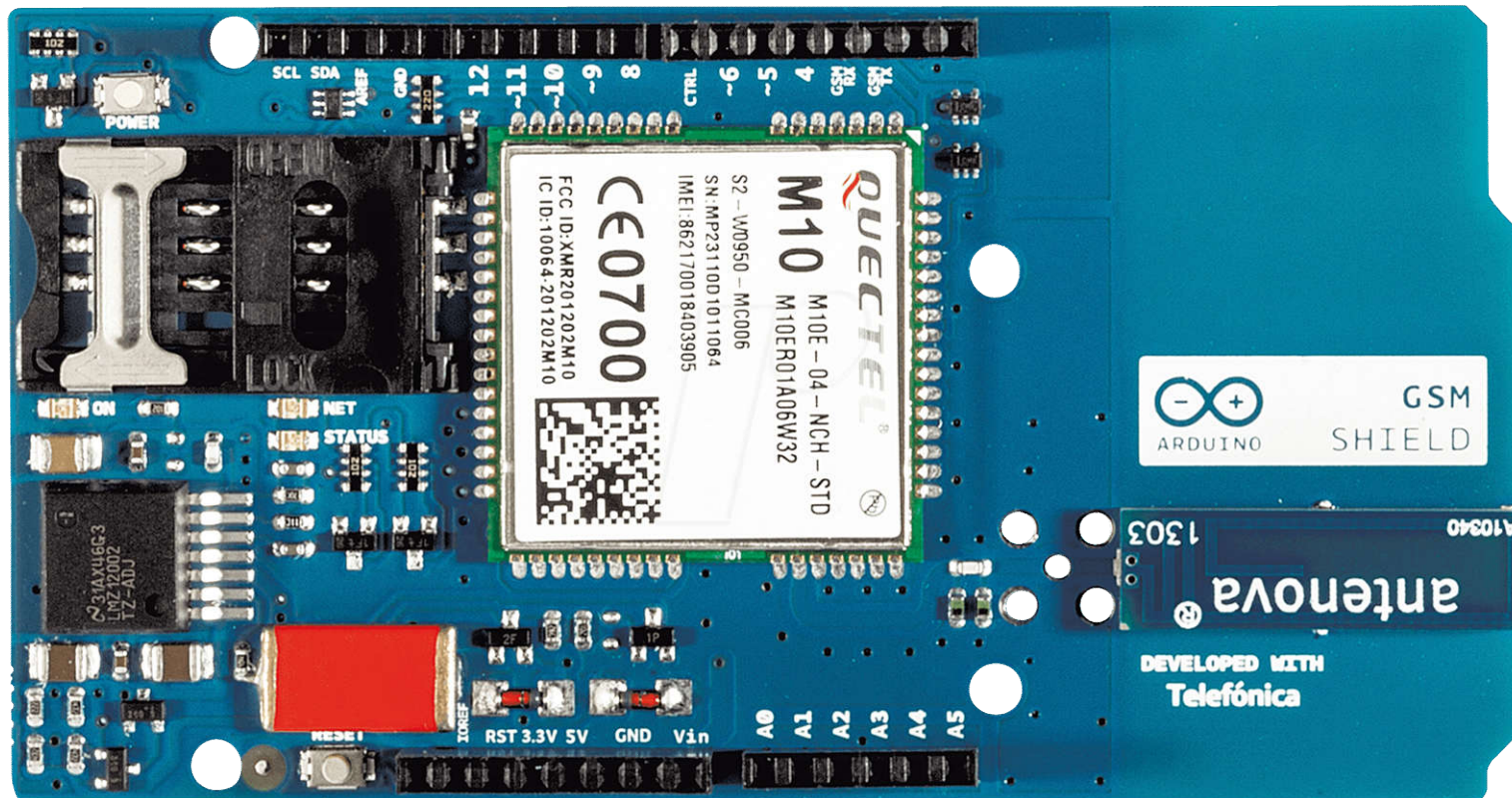
Legend	
Power	Power
Digital Pins	Digital Pins
Analog Pins	Analog Pins
Pins Used	Pins Used
Features	Features



THE UNOFFICIAL ARDUINO YUN PINOUT DIAGRAM

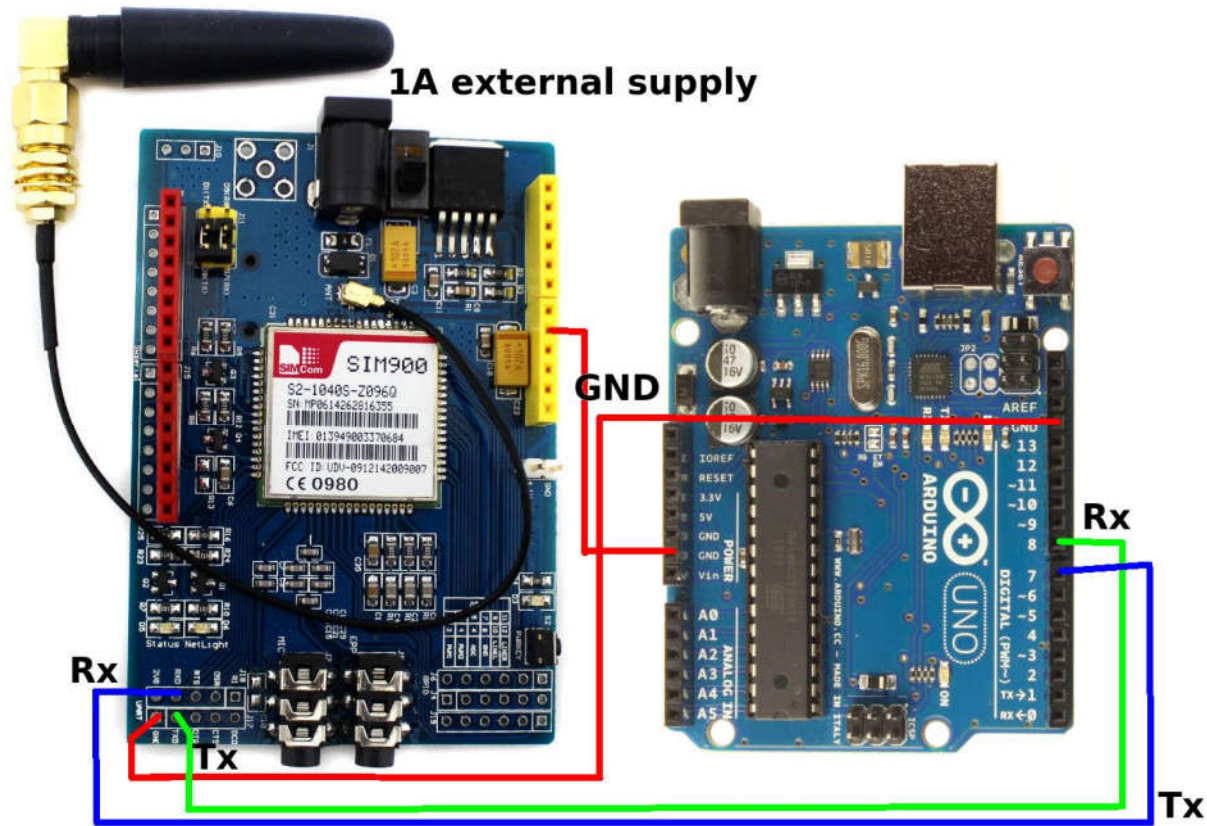


Konektivitas dengan *Data Cellular* (GSM)



<https://www.arduino.cc/en/Main/ArduinoGSMShield>

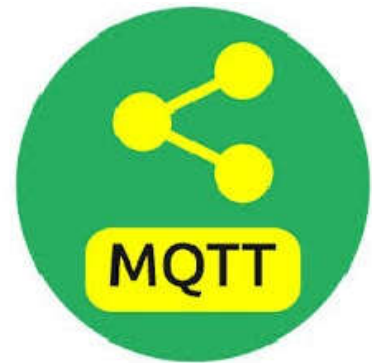
Konektivitas dengan *Data Cellular* (SIM900)

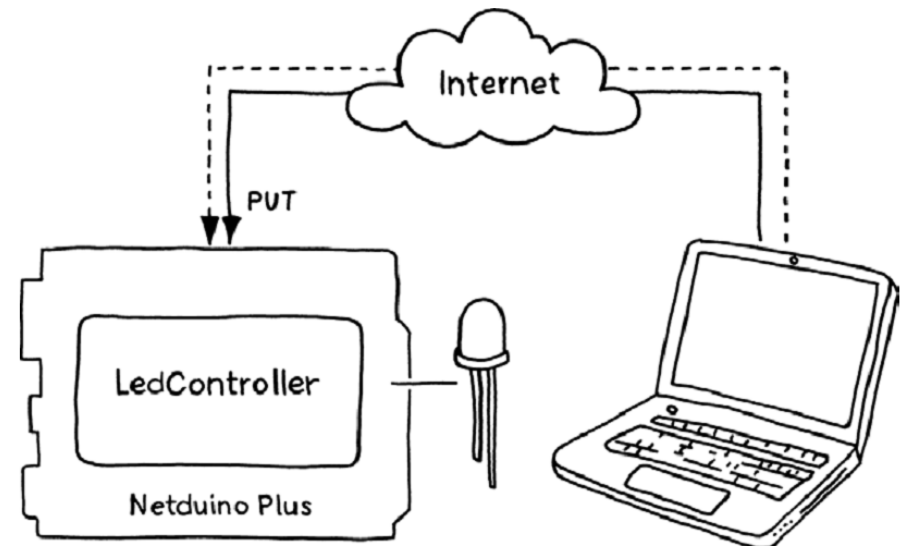
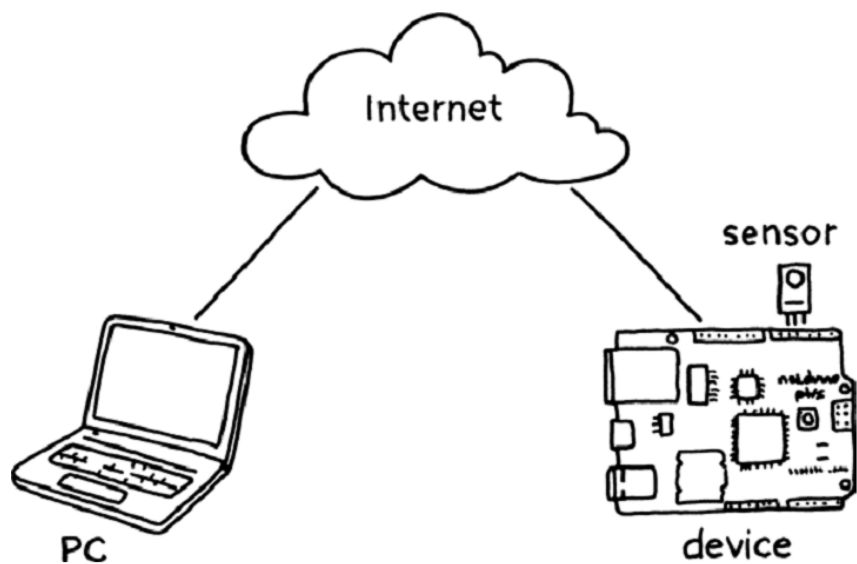


<http://arduino.stackexchange.com/questions/9483/how-to-communicate-the-arduino-board-with-sim900>

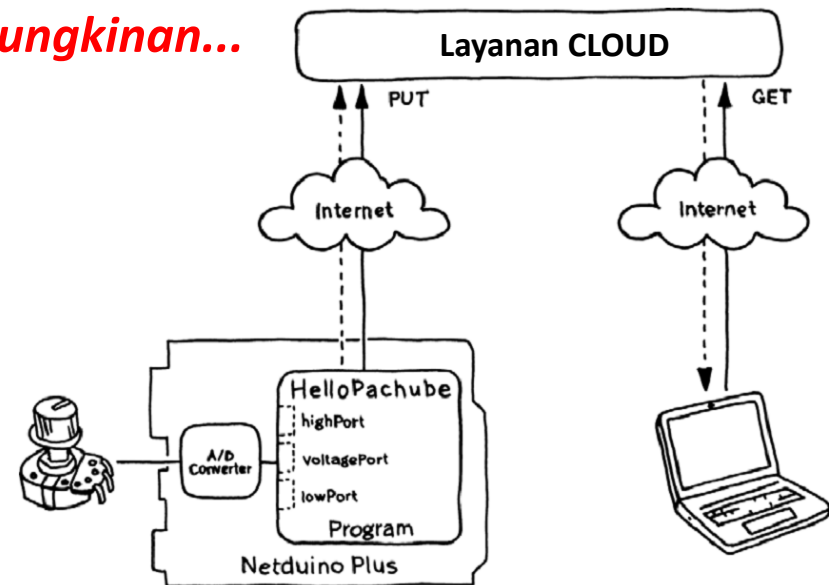
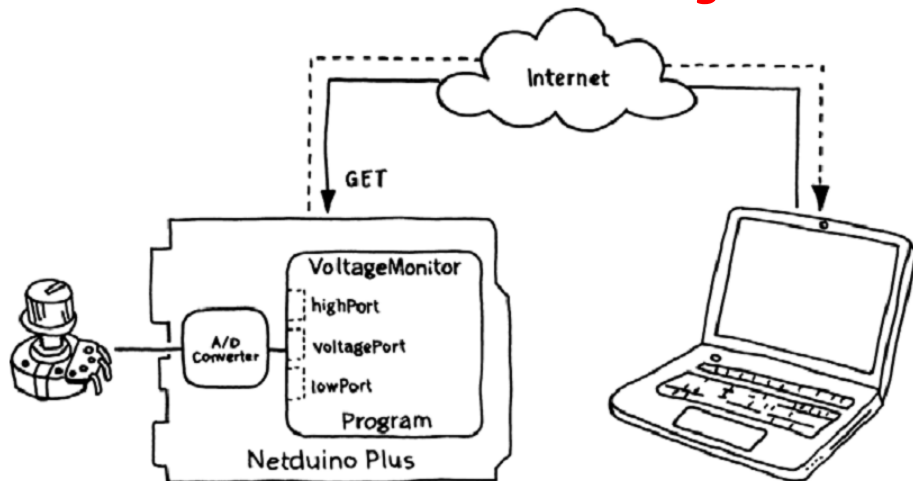
Protokol Komunikasi

- Protokol **HTTP** - *Hyper Text Transfer Protocol*
- Protokol **MQTT** - *Message Queuing Telemetry Transport*





Metode HTTP: Berbagai macam kemungkinan...



HTTP request: GET Method

```
void doHttpGet()
{
    // Prepare data or parameters that need to be posted to server
    String requestData = "requestVar=test";

    // Check if a connection to server:port was made
    if (client.connect(server, port))
    {
        Serial.println("[INFO] Server Connected - HTTP GET Started");

        // Make HTTP GET request
        client.println("GET /get?" + requestData + " HTTP/1.1");
        client.println("Host: " + String(server));
        client.println("Connection: close");
        client.println();
        Serial.println("[INFO] HTTP GET Completed");
    }
}
```

HTTP request: POST Method

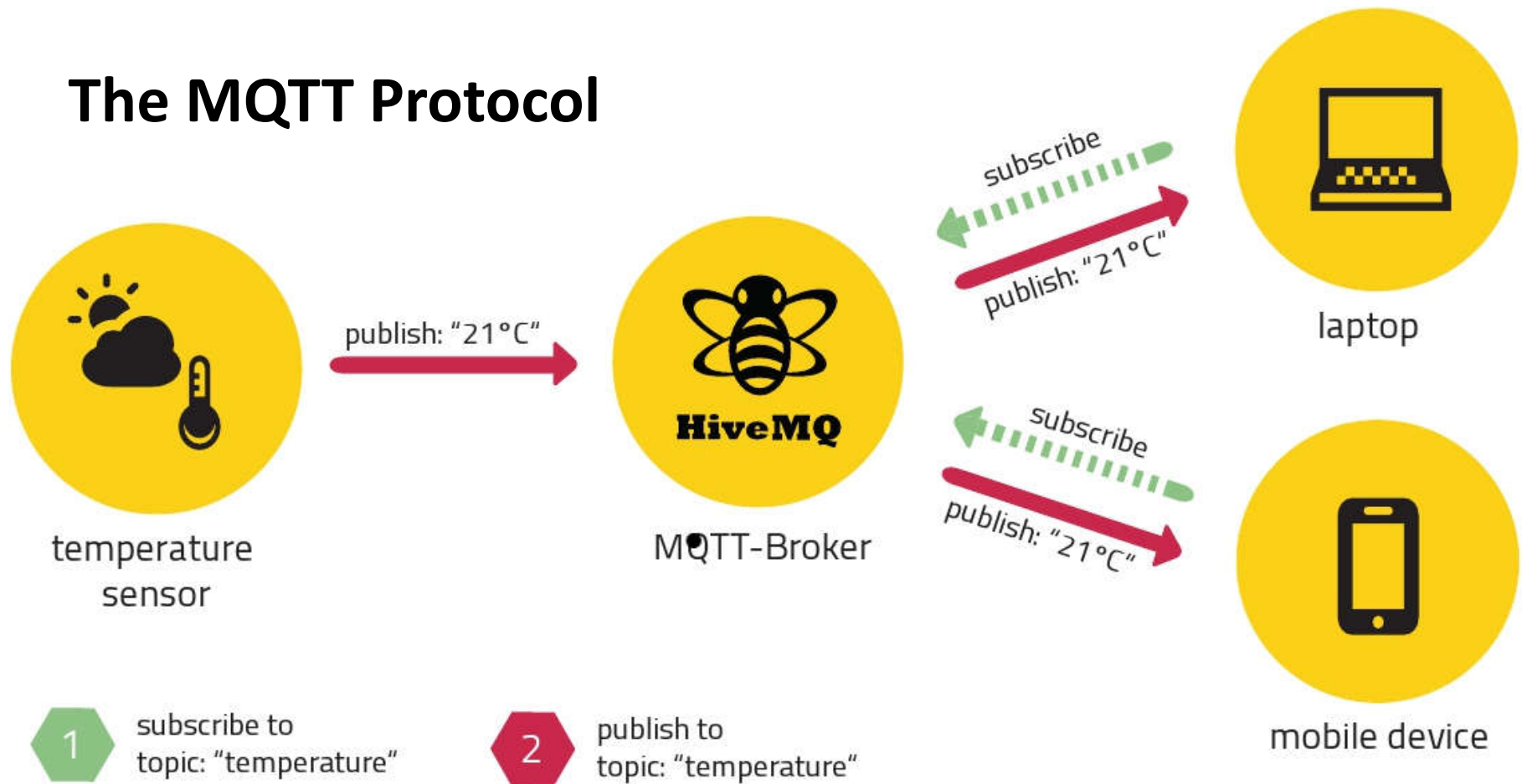
```
void doHttpPost()
{
    // Prepare data or parameters that need to be posted to server
    String requestData = "requestData={"requestVar:test\\"}";

    // Check if a connection to server:port was made
    if (client.connect(server, port))
    {
        Serial.println("[INFO] Server Connected - HTTP POST Started");

        // Make HTTP POST request
        client.println("POST /post HTTP/1.1");
        client.println("Host: " + String(server));
        client.println("User-Agent: Arduino/1.0");
        client.println("Connection: close");
        client.println("Content-Type: application/x-www-form-urlencoded;");
        client.print("Content-Length: ");
        client.println(requestData.length());
        client.println();
        client.println(requestData);

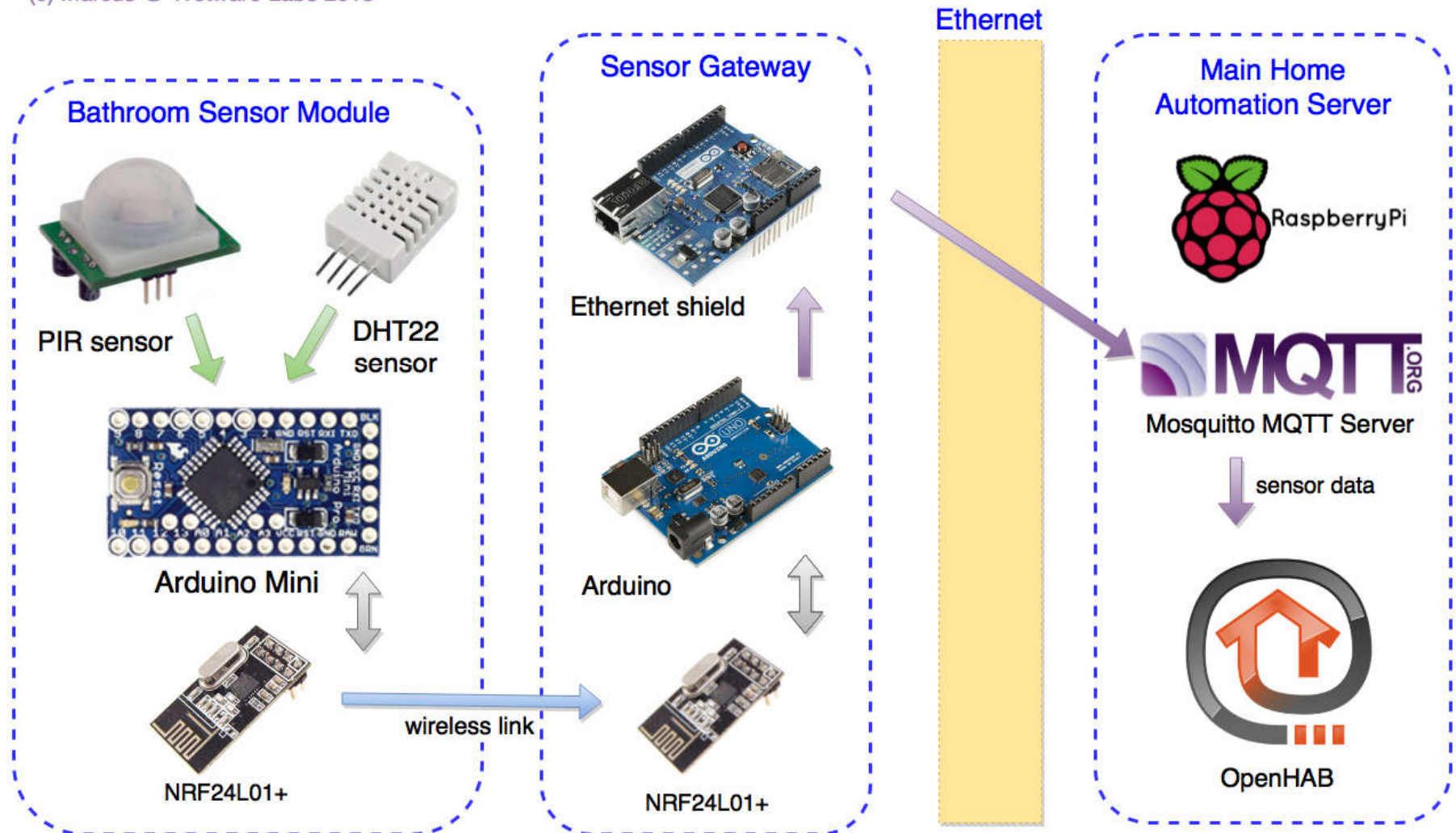
        Serial.println("[INFO] HTTP POST Completed");
    }
}
```


The MQTT Protocol



Home automation architecture #1

(c) Marcus @ Wetware Labs 2015



Components of the intrusion detection system



Device



MQTT Broker

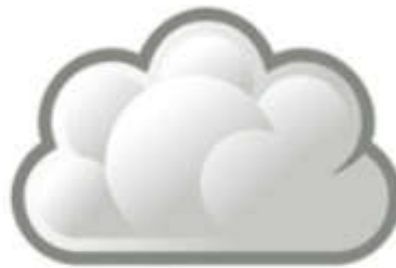


Mobile App

Components of the remote lighting control



Mobile App



MQTT Broker



Device

Listing 3-7. MQTT Setup

```
// IP address of the MQTT broker
char server[] = {"iot.eclipse.org"};
int port = 1883
char topic[] = {"codifythings/testMessage"};
```

Listing 3-6. External Libraries

```
#include <SPI.h>
#include <WiFi.h>
#include <PubSubClient.h>
```

Listing 3-8. MQTT Initialization and Callback Function

```
PubSubClient pubSubClient(server, 1883, callback, client);

void callback(char* topic, byte* payload, unsigned int length)
{
    // Print payload
    String payloadContent = String((char *)payload);
    Serial.println("[INFO] Payload: " + payloadContent);
}
```

<https://github.com/knolleary/pubsubclient/releases/tag/v2.3>

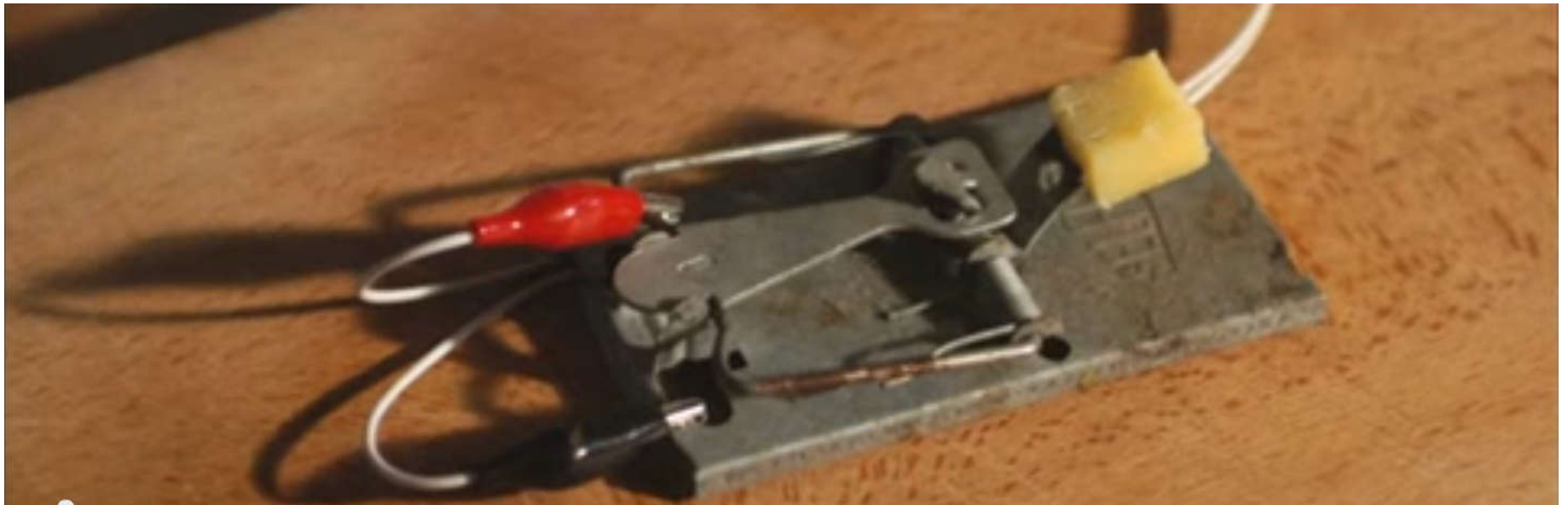


**Konsep
Internet of
Things (IoT)**

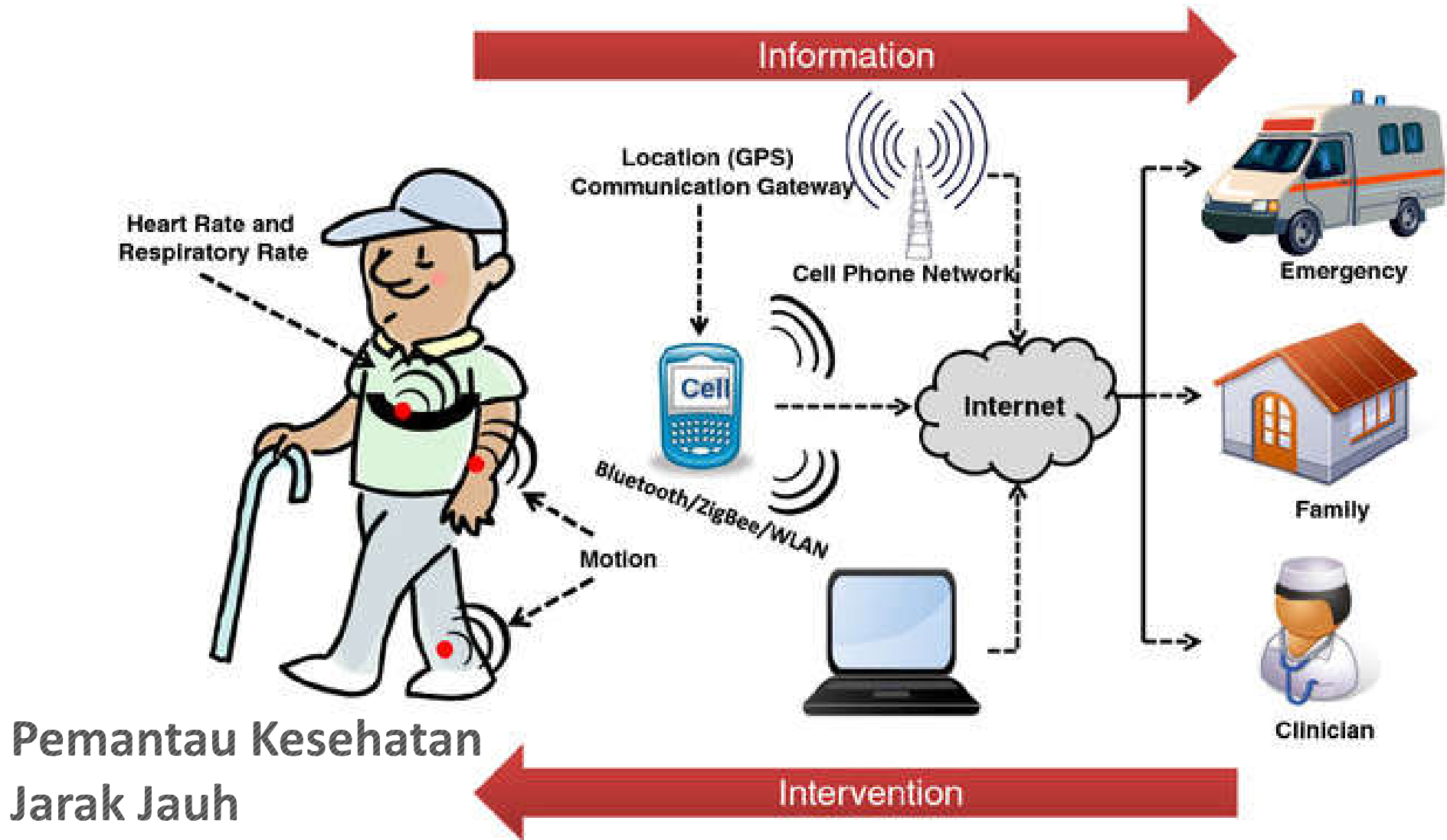
**Arduino &
Konektivitas**

**Contoh2
Purwarupa**

Bikin jebakan tikus yang keren...!



Source: "[TEDx Warwick – Andy Stanford-Clark – Innovation Begins at Home](#)"



Beberapa contoh prototipe/purwarupa

- Pengendalian Motor Langkah Menggunakan LabVIEW 7.0 berbasis TCP/IP (2008)
- Monitoring Akselerometer, RTC dan Tombol melalui Web Browser
- Pemantau Daya Listrik via Website (2014)
- Detektor Jatuh berbasis akselerometer dan Internet of Things (2016)
- IoT Patterns: Realtime Clients
- IoT Patterns: Remote Control

- Javeed, A., 2016, ***Building Arduino Projects for the Internet of Things: Experiments with Real-World Applications***, Apress Media, NY, USA

<http://agfi.staff.ugm.ac.id/blog/index.php/2008/12/pengendalian-motor-langkah-menggunakan-labview-70-berbasis-tcpip>

IoT bukan konsep yang Baru!

[Home](#) [Tentang Saya](#) [Buku-buku Saya](#) [Karya Ilmiah](#) [Pelatihan!](#)

DSP & Embedded Electronics

By Dr. Agfianto Eko Putra Cert. NNLP Pract.

[buku](#) [satelit](#) [Neurosains](#) [Lain-lain](#) [FPGA](#)



Pengendalian Motor Langkah Menggunakan LabView 7.0 berbasis TCP/IP

Tahun 2008!

PENDAHULUAN

Kemajuan dan perkembangan teknologi telah banyak memberi manfaat bagi kehidupan manusia. Kemajuan teknologi disebabkan karena semakin banyak tuntutan manusia yang harus dipenuhi untuk mendapatkan kemudahan-kemudahan, baik dalam hal kecepatan, ketepatan, maupun otomasi. Peralatan-peralatan dalam dunia industri beralih dari sitem manual menjadi sistem otomatis sekaligus memiliki kemampuan dapat dikendalikan dan diamati parameterparameternya dari jarak jauh. Salah satu aplikasi yang dibuat dalam penelitian ini adalah sistem pengendali motor langkah (berupa perangkat keras dan lunak) dari jarak jauh berbasis TCP/IP.

Motor langkah atau stepper motor, banyak digunakan dalam berbagai macam aplikasi,

Dec 2008

It's Me!



Nama:
Agfianto
'Embedded' Putra
Email:
agfi68@gmail.com
Status:
berapa kali aku
ucapkan "Ihdinash
shiroto!..."
Buat Lencana Anda

[Lihat Jadwal Saya](#)





December 2008

M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

« Nov Jan »

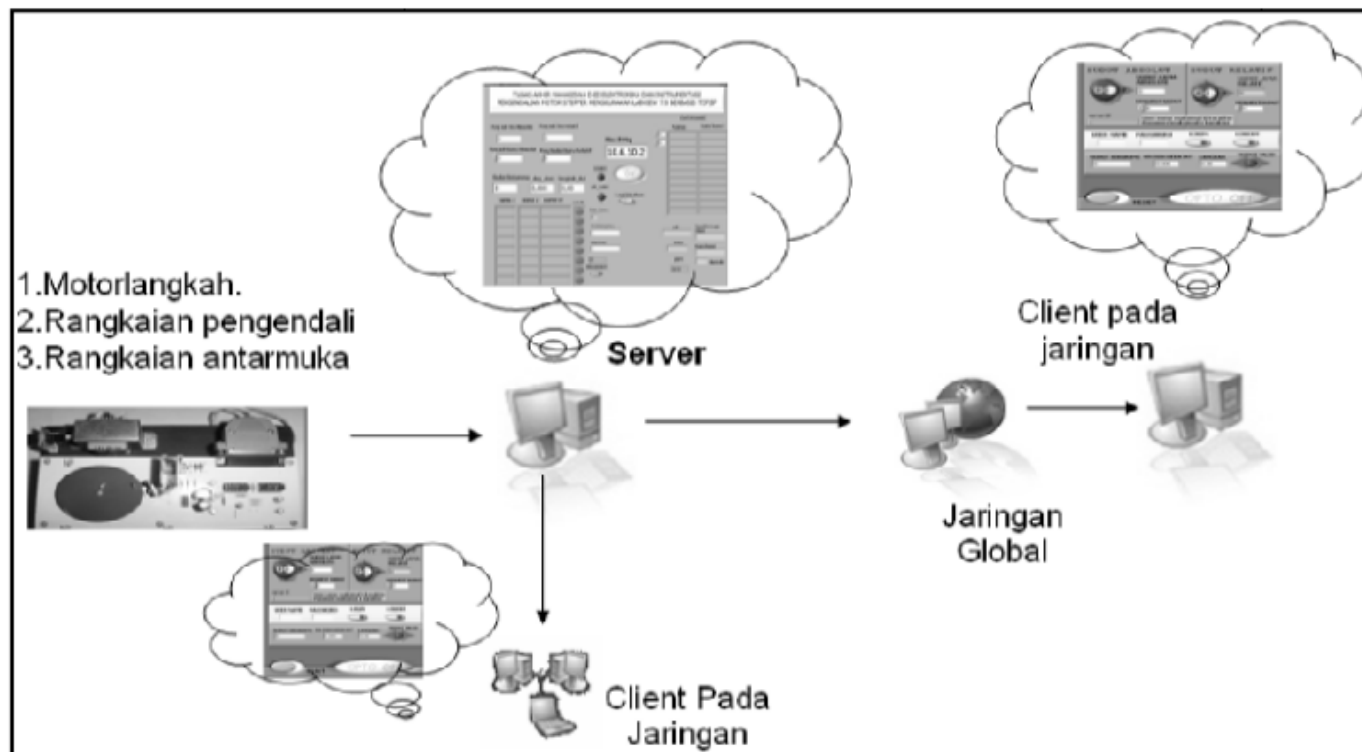


Bisnis Online
Produk-Produk
Laris & Inovatif

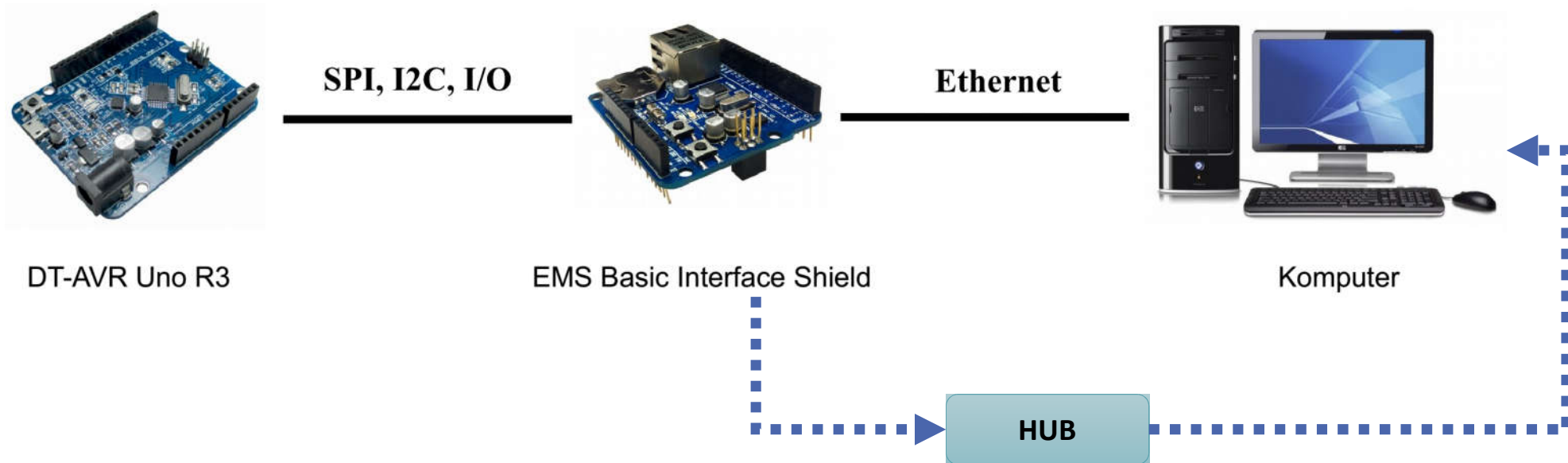
Tanpa Modal, Tanpa Stok,
dan Gratis Pendaftaran.

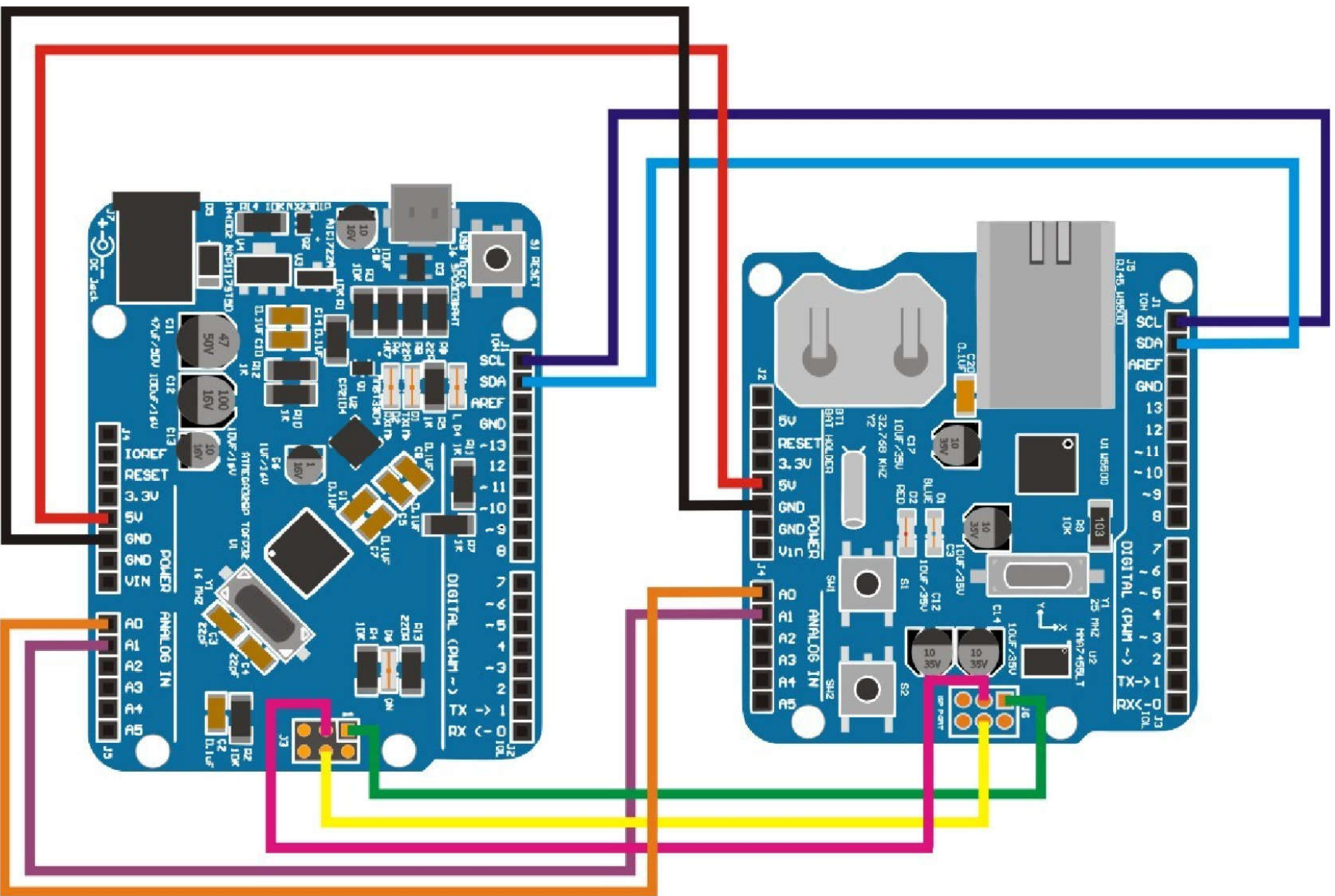


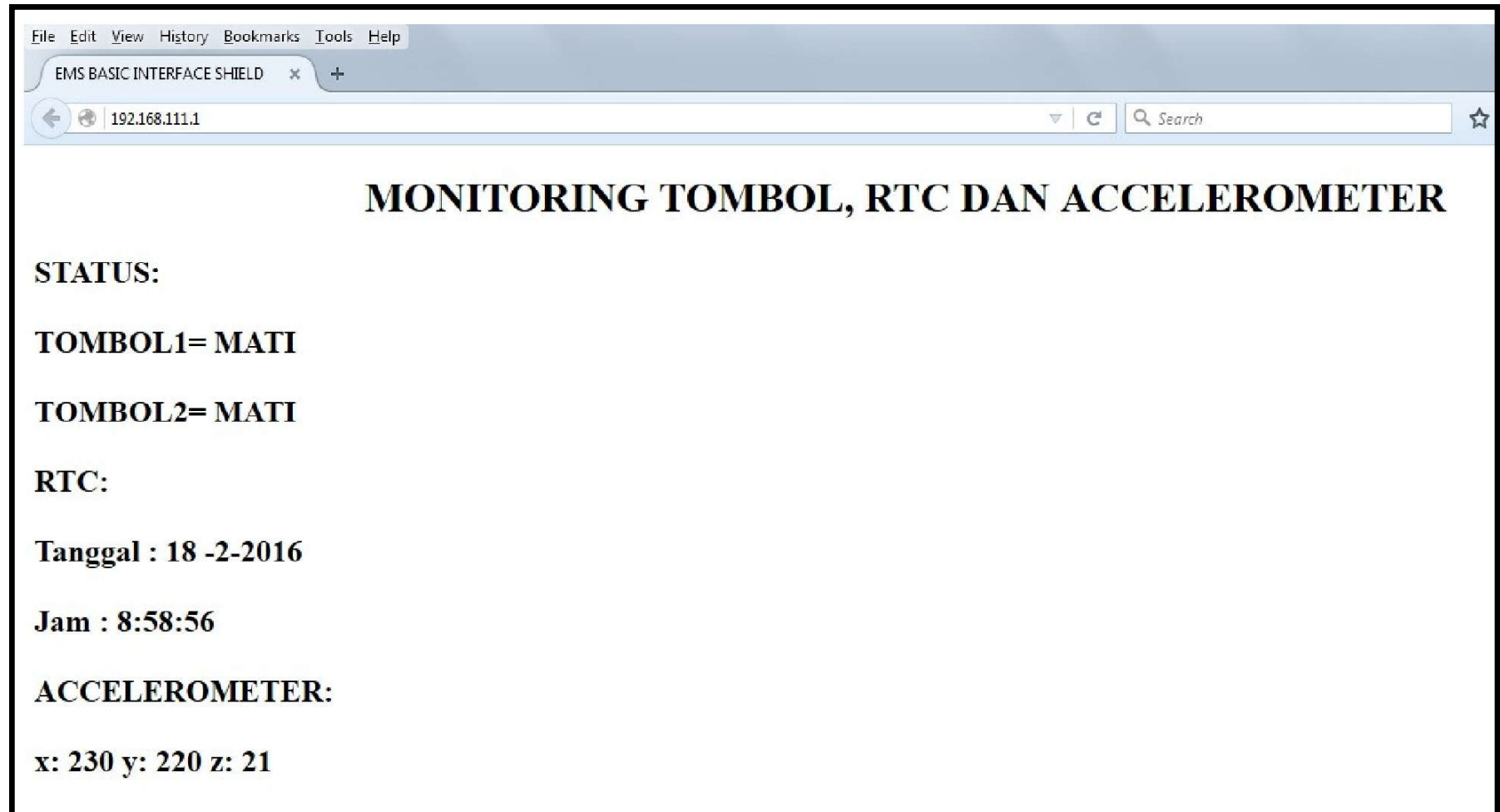
Pengendalian Motor Langkah Menggunakan LabVIEW 7.0 berbasis TCP/IP

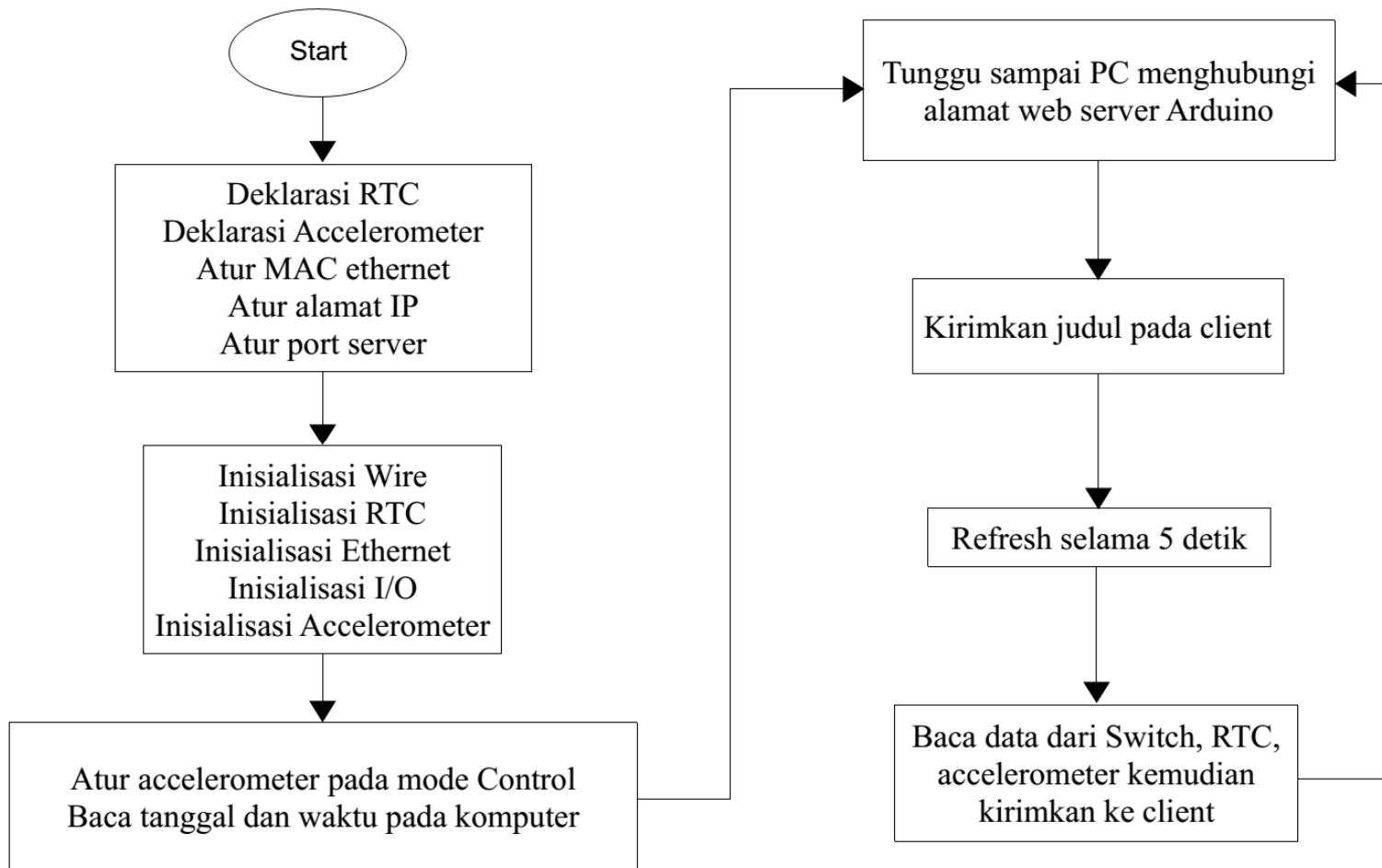


Monitoring Akselerometer, RTC dan Tombol melalui Web Browser









1. Deklarasi variable RTC, deklarasi variable accelerometer, pengaturan MAC, pengaturan alamat IP, dan *port server*.

```
RTC_DS1307 rtc;  
MMA7455 mmal(4);  
byte mac[] = { 0xDE, 0xAD, 0xBE, 0xEF, 0xFE, 0xED };  
IPAddress ip(192, 168, 111, 1);  
EthernetServer server(80);
```

2. Inisialisasi Wire, RTC, dan Ethernet.

```
Wire.begin();  
rtc.begin();  
Ethernet.begin(mac, ip);
```

3. Pengaturan switch sebagai input.

```
pinMode(A0, INPUT);  
pinMode(A1, INPUT);
```

4. Pengaturan kepekaan dan mode pada accelerometer.

```
mmal.setGLVL(GLVL2g);  
mmal.setMode(MCTL);
```

5. Atur jam dan tanggal agar sama dengan komputer.

```
rtc.adjust(DateTime(F(__DATE__), F(__TIME__)));
```

6. Tunggu sampai ada *client* yang terkoneksi dengan *server*.

```
EthernetClient client = server.available();
```

7. Kirim judul halaman web pada *client*.

```
client.println("<!DOCTYPE html>");  
client.println("<html>");  
client.println("<head>");  
client.println("<title>EMS BASIC INTERFACE SHIELD</title>");
```

8. Refresh data halaman selama 1 detik.

```
client.println("<meta http-equiv=\"refresh\" content=\"5\">");
```

9. Baca nilai kondisi Switch kemudian kirimkan datanya ke web *client*.

```
if (analogRead(A0)) {  
  cl.print("TOMBOL1= ");  
  cl.print("NYALA");  
}  
else {  
  cl.print("TOMBOL1= ");  
  cl.print("MATI");  
}
```

10. Tulis tanggal dan waktu pada RTC sama dengan komputer kemudian tampilkan pada *web client*.

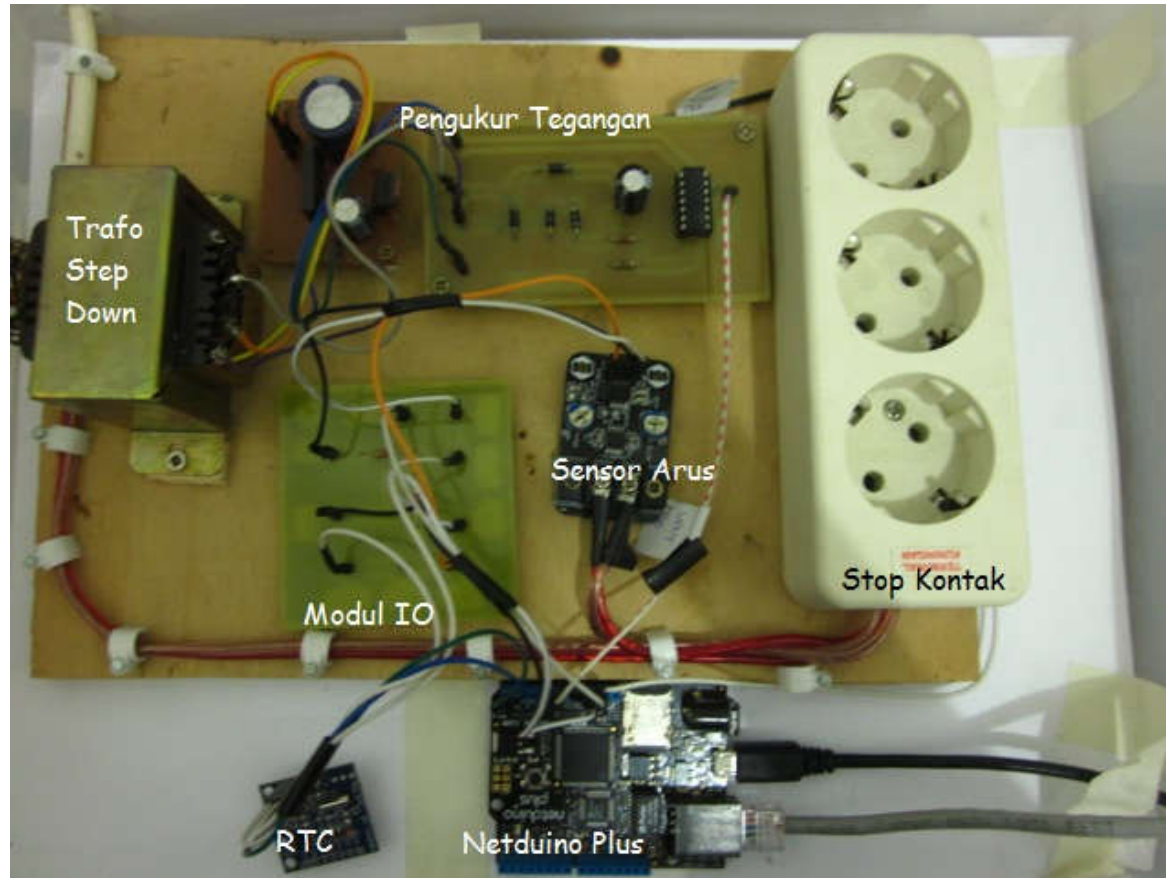
```
DateTime now = rtc.now();
cl.println("<p>RTC:  </p>");
cl.print("<p>Tanggal :  ");
cl.println(now.year(), DEC);
cl.print('-');
cl.print(now.month(), DEC);
cl.print('-');
cl.print(now.day(), DEC);
cl.print(' ');
cl.print("<p>Jam   :  ");
cl.print(now.hour(), DEC);
cl.print(':');
cl.print(now.minute(), DEC);
cl.print(':');
cl.print(now.second(), DEC);
cl.print("  ");
cl.println();
```

11. Kirimkan data hasil pengukuran Accelerometer pada *web client*.

```
cl.println("<p>ACCELEROMETER:  <p/>");  
cl.print("x: ");  
cl.print(mma1.read8Bit(XOUT8), DEC);    //read x-axis 8-bit data  
cl.print("    y: ");  
cl.print(mma1.read8Bit(YOUT8), DEC);    //read y-axis 8-bit data  
cl.print("    z: ");  
cl.print(mma1.read8Bit(ZOUT8), DEC);    //read z-axis 8-bit data  
cl.print("  ");  
cl.println();
```

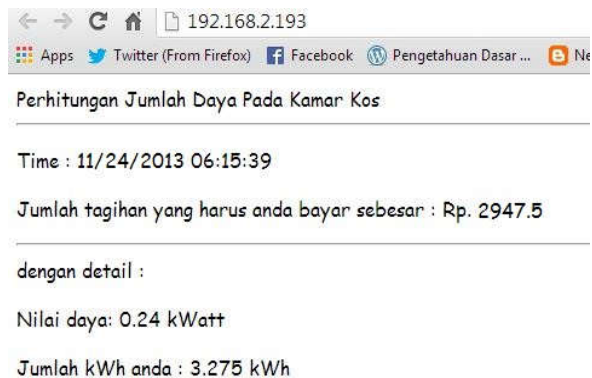
12. Program kembali ke perintah no.6.

Pemantau Daya Listrik via Website (2014)



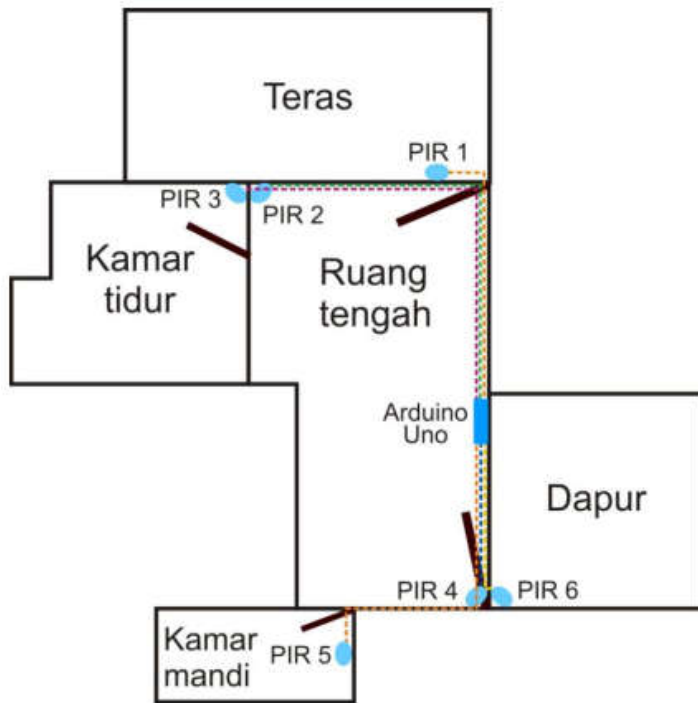
Cortesy of Irma Nirmalasari [09/283764/PA/12695] -- <https://journal.ugm.ac.id/ijeis/article/view/7150>

Pengujian web 3x24 Jam

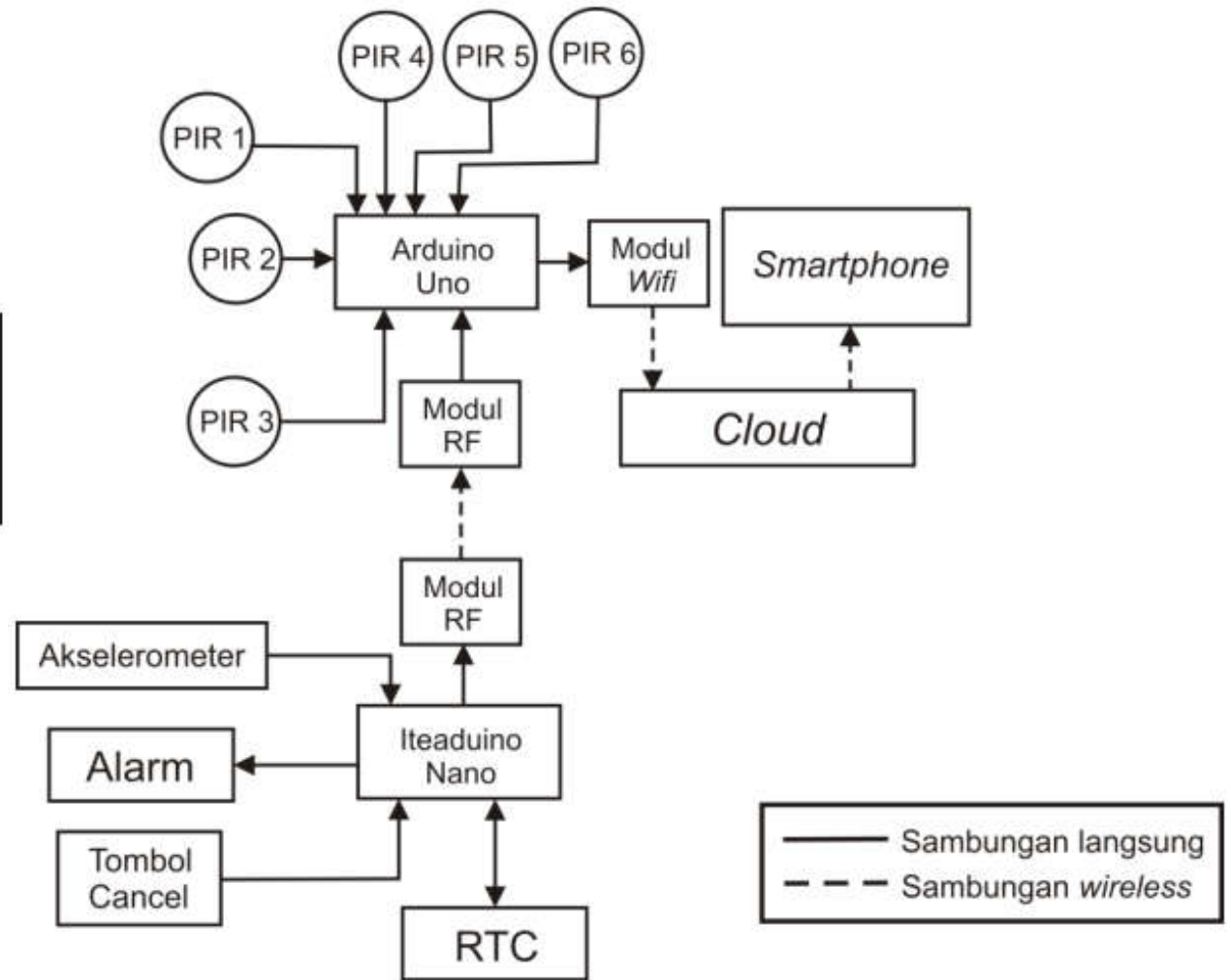


Pengujian ketika listrik padam





Detektor Jatuh berbasis akselerometer dan Internet of Things



Cortesy of Sayyidah K.N. [14/373745/PA/16421]



Dashboard

History 116

30 March 2016 at 23:20:44	FallDetection
30 March 2016 at 23:19:18	FallDetection
28 March 2016 at 11:56:37	FallDetection
28 March 2016 at 11:55:50	FallDetection
28 March 2016 at 11:54:33	FallDetection

Pushbullet

TEMAN

SAYA

MENIKUTI

FallDetection

Nenek jatuh pukul
_13:11_0/6/2016 di
kamar_mandi

FallDetection

Nenek jatuh pukul
_13:13_0/6/2016 di
kamar_mandi

FallDetection

Nenek jatuh pukul
_13:15_0/6/2016 di dapur

∞

Semua Perangkat

▼

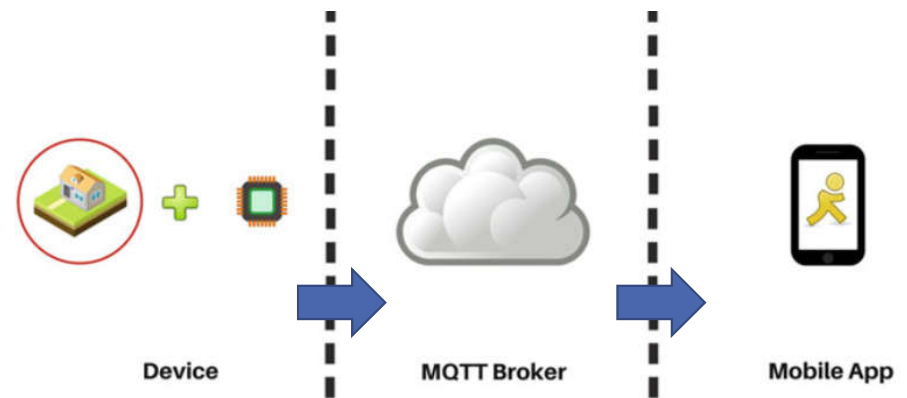
📎

Kirim sebuah pesan

➤

IoT Patterns: Realtime Clients

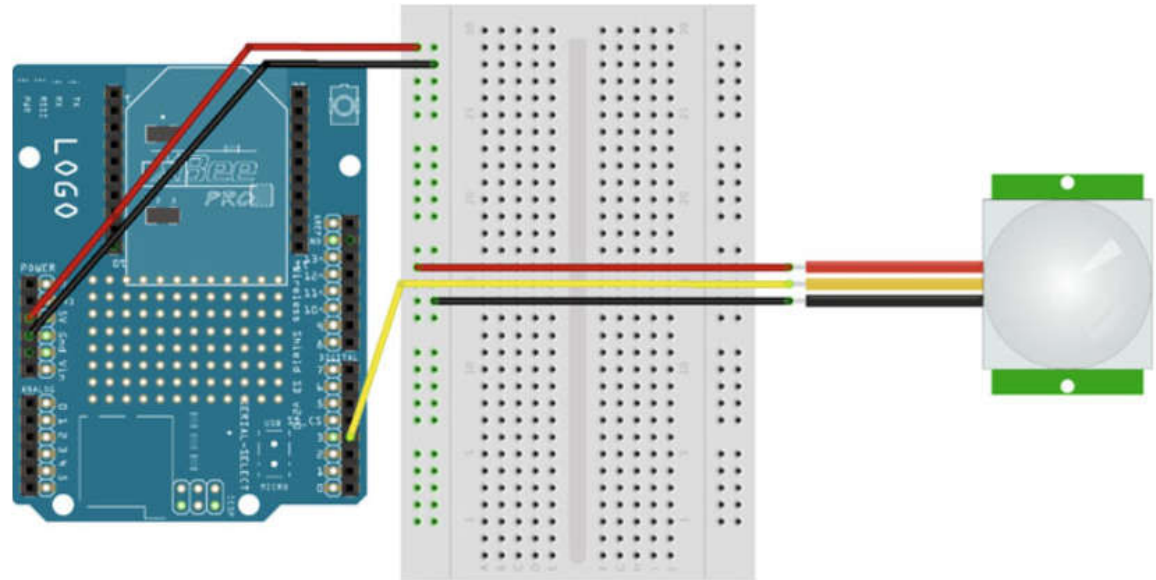
1. Lakukan pembacaan sensor gerak melalui Arduino;
2. Publikasikan hasil pembacaan ke broker MQTT;
3. Bikin aplikasi Android yang terkoneksi ke broker MQTT
4. Tampilkan notifikasi dalam aplikasi pada saat ada publikasi pembacaan sensor ke broker MQTT



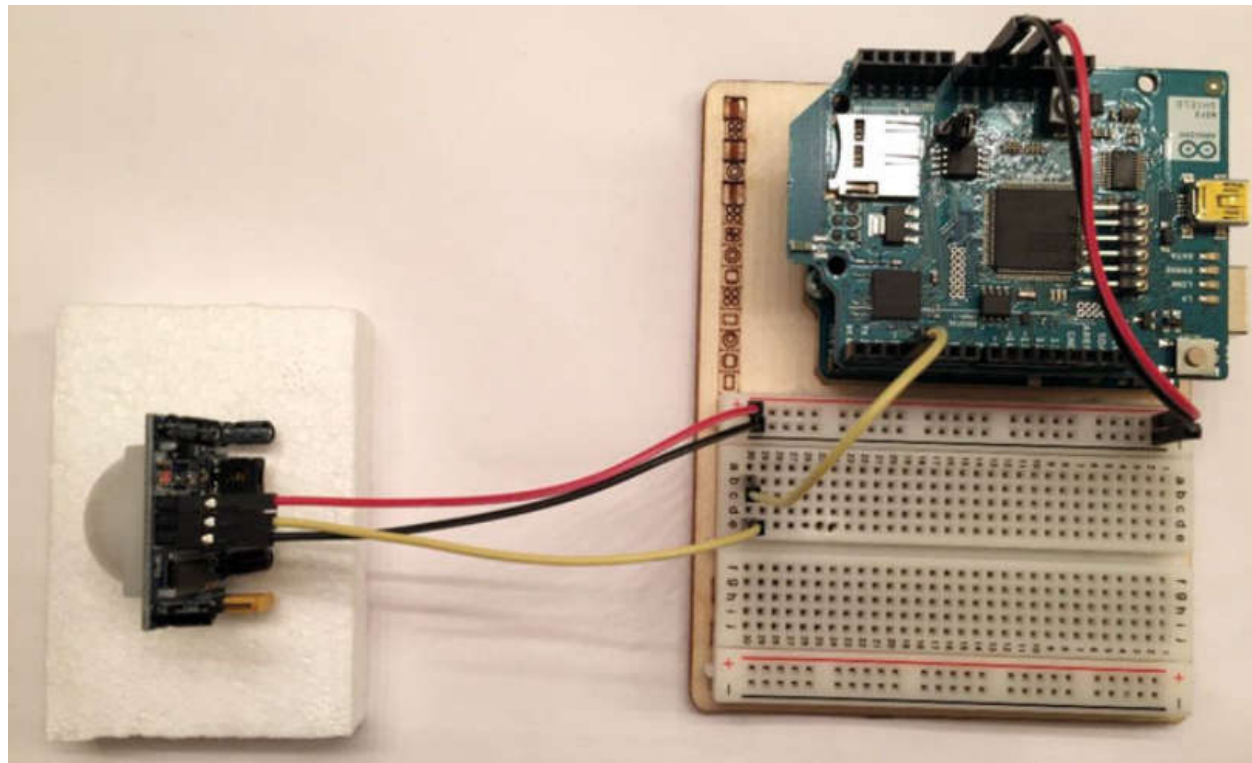
Javeed, A., 2016, *Building Arduino Projects for the Internet of Things: Experiments with Real-World Applications*, Apress Media, NY, USA

IoT Patterns: Realtime Clients

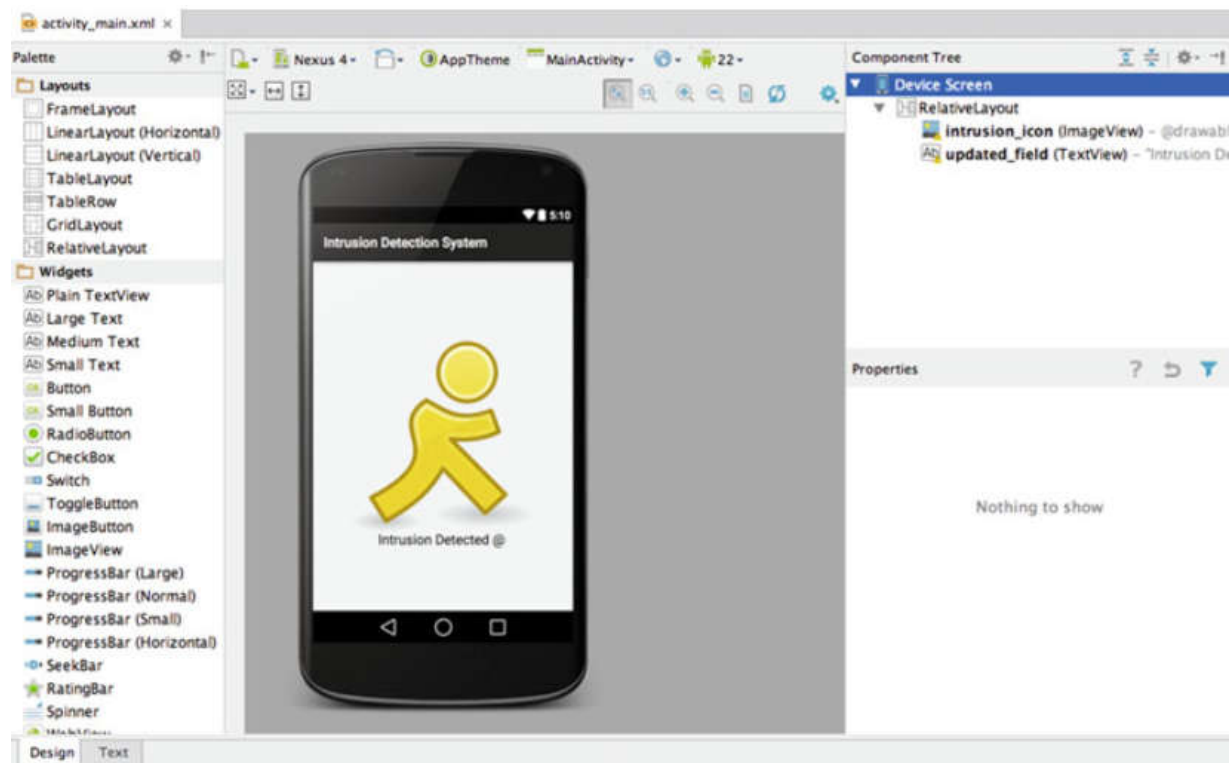
- Kode dalam Arduino
 - Pustaka2 eksternal;
 - Konektivitas Internet (WIFI);
 - Baca data sensor;
 - Publikasi ke MQTT, dan
 - Fungsi-fungsi standar



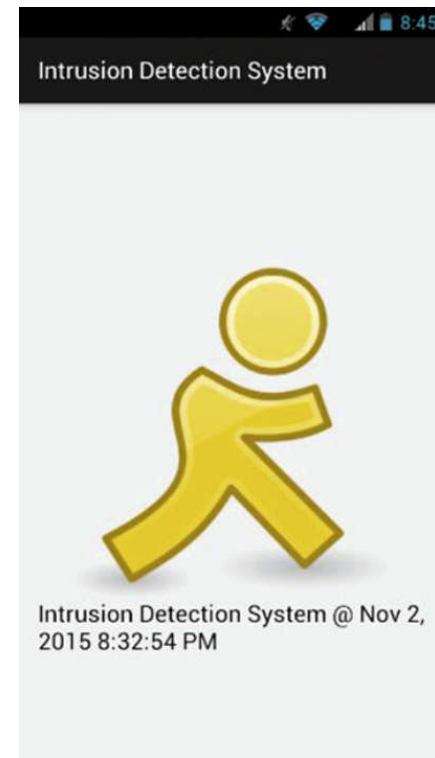
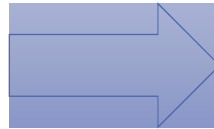
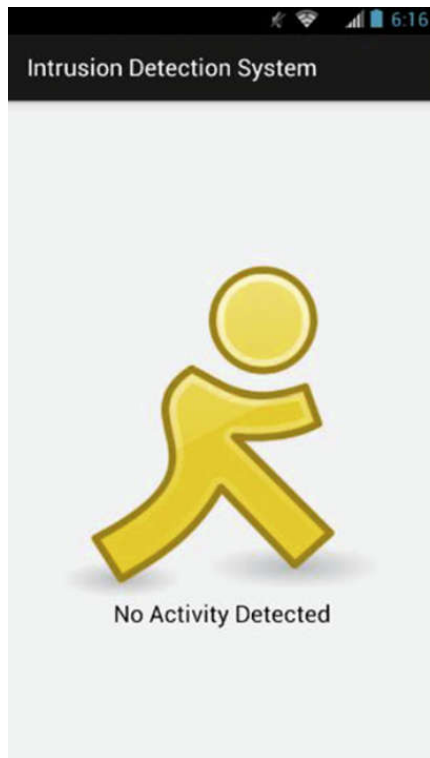
IoT Patterns: Realtime Clients



IoT Patterns: Realtime Clients

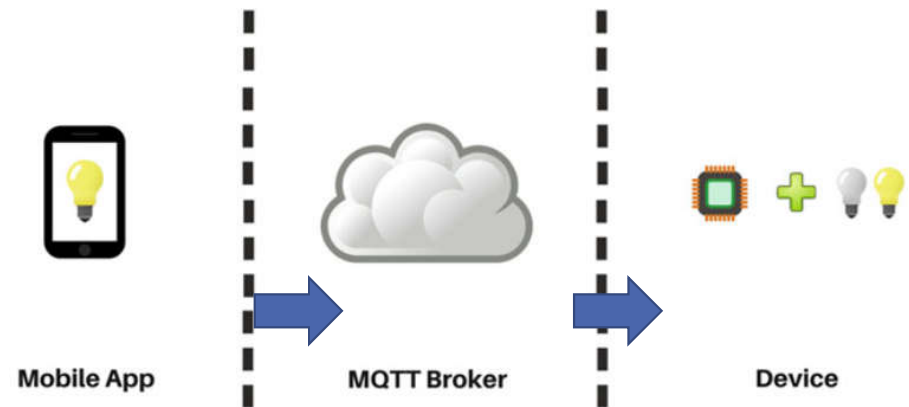


IoT Patterns: Realtime Clients



IoT Patterns: Remote Control

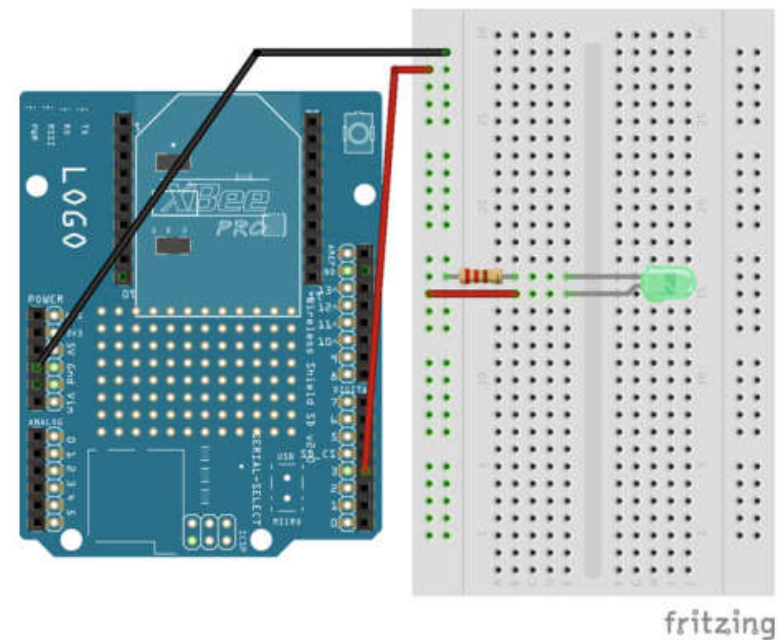
1. Lakukan pengontrolan LED ON maupun OFF melalui Arduino;
2. Mendaftarkan diri ke broker MQTT, dan
3. Buat aplikasi Android yang mampu mempublikasi ke broker MQTT



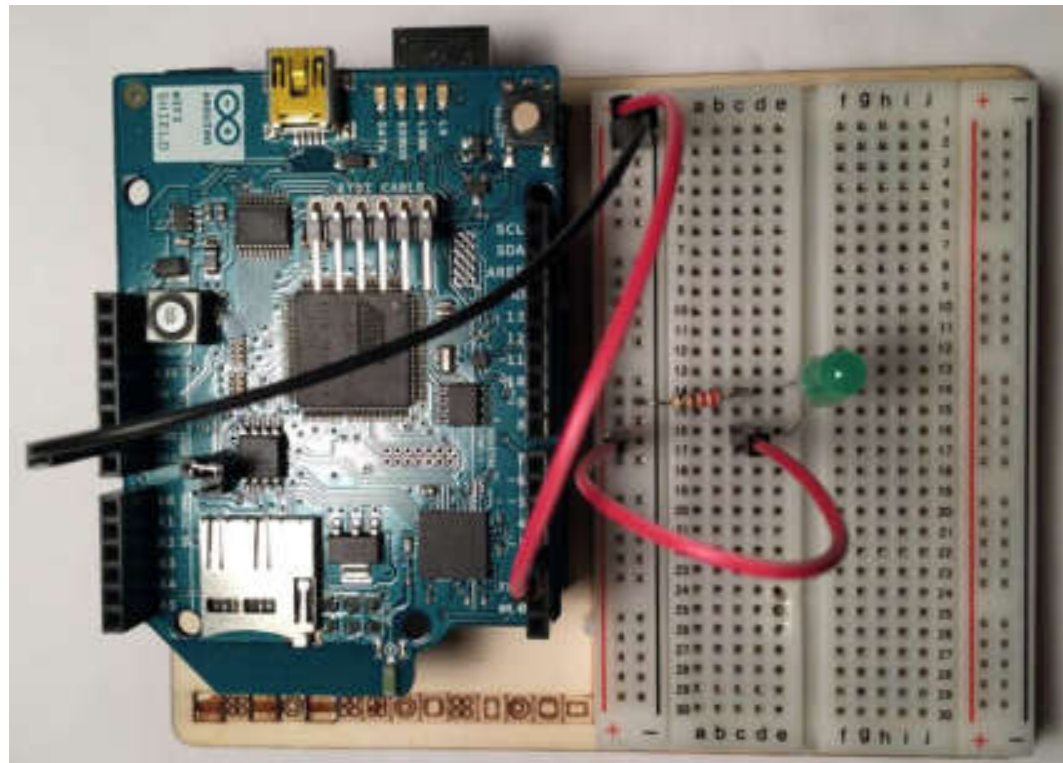
Javeed, A., 2016, *Building Arduino Projects for the Internet of Things: Experiments with Real-World Applications*, Apress Media, NY, USA

IoT Patterns: Remote Control

- Kode dalam Arduino
 - Pustaka2 eksternal;
 - Konektivitas Internet (WIFI);
 - MQTT subscribe;
 - Kontrol LED, dan
 - Fungsi-fungsi standar



IoT Patterns: Remote Control



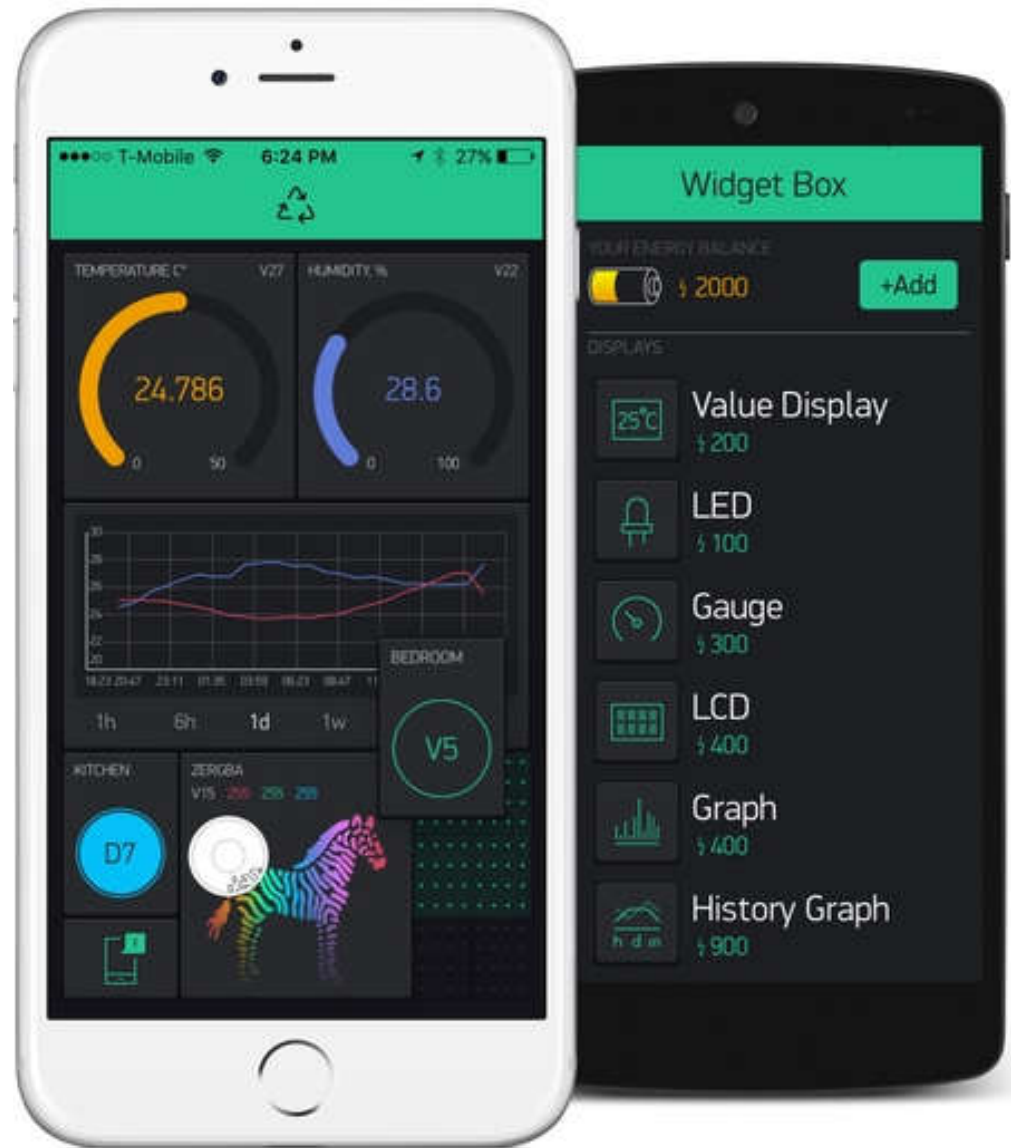
IoT Patterns: Remote Control



Menggunakan

<http://www.blynk.cc>

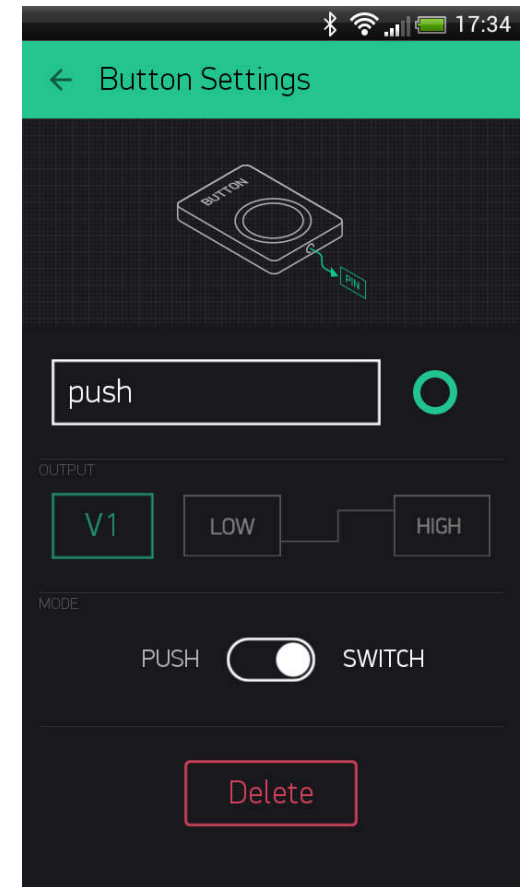
- Blynk merupakan suatu platform utk iOS dan Android untuk mengendalikan Arduino, Raspberry Pi dan lain sebagainya melalui internet.
- *It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets.*
- Blynk mendukung berbagai perangkat keras yang populer → Arduino, Raspberry Pi modul atau peripheral ESP8266, dst.
- Blynk menyiapkan Anda siap untuk **Internet Of Things**.



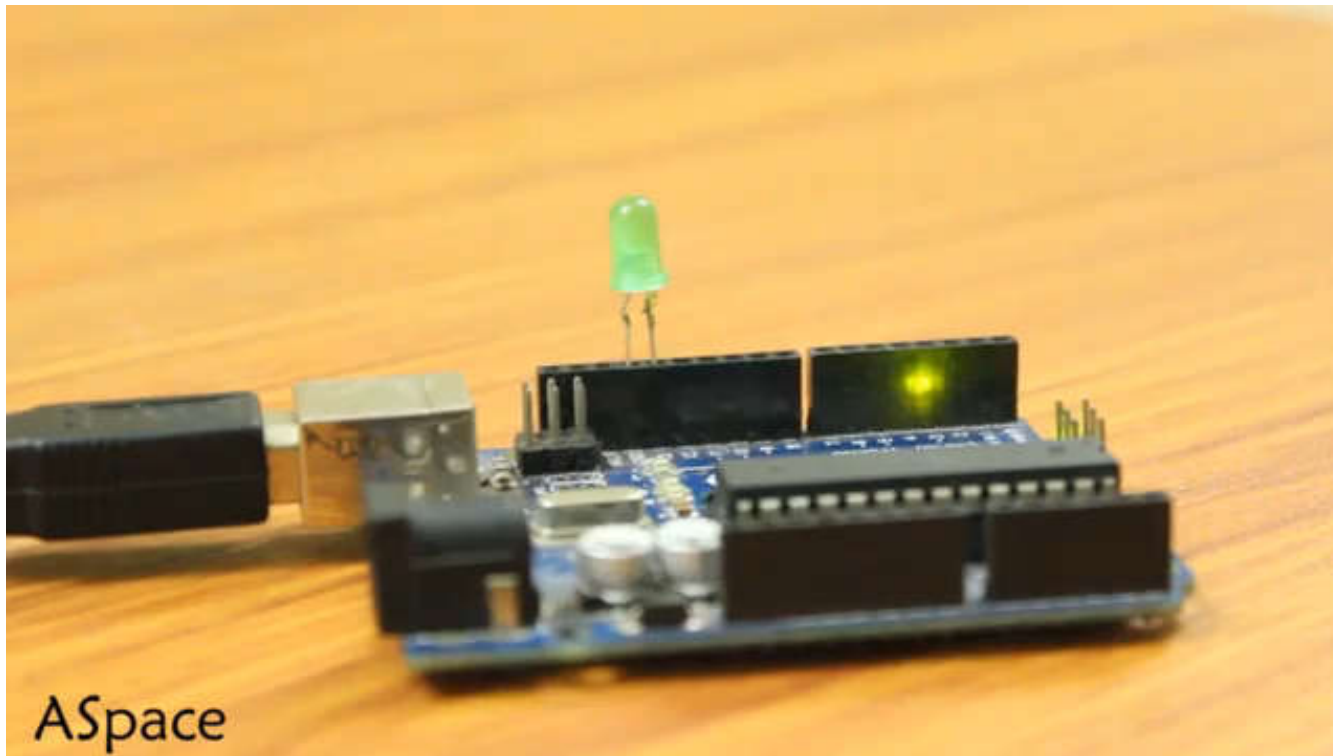
Menggunakan

<http://www.blynk.cc>

- Unduh aplikasi BLYNK (untuk iPhone atau Android);
- Unduh pustaka BLYNK untuk Arduino → lanjutkan instalasi;
- Bikin proyek pertama, menghidupkan dan mematikan LED pada pin 13 Arduino, dan
- Jalankan dan Nikmati...



Video contoh <http://www.blynk.cc>





Terima kasih!

Ada pertanyaan..?

Email: agfi@ugm.ac.id dan agfi68@gmail.com

