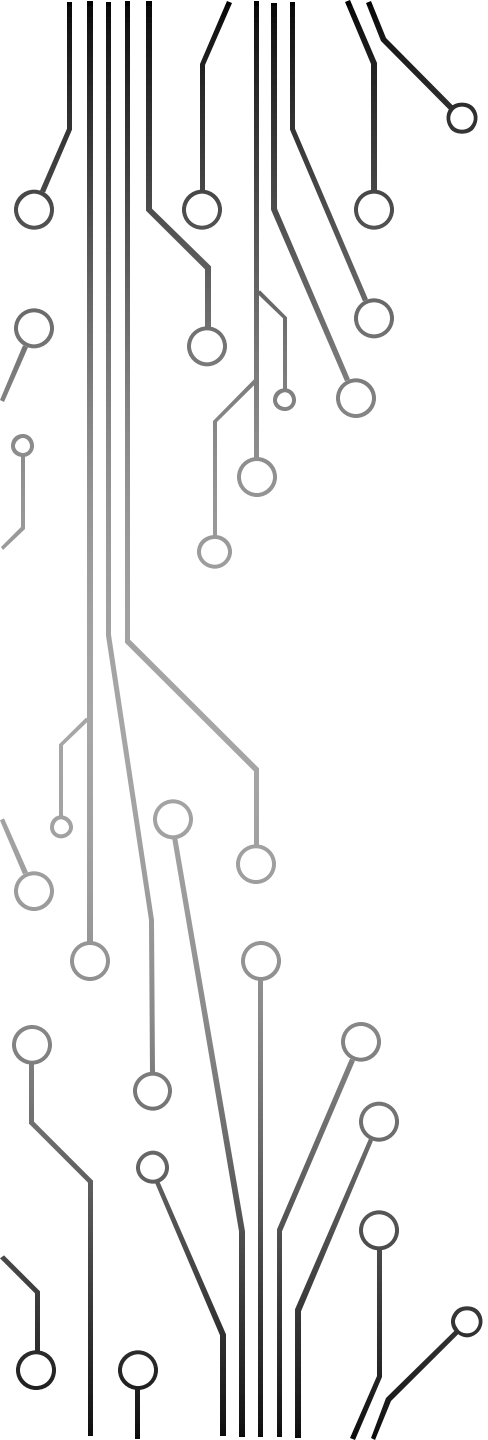
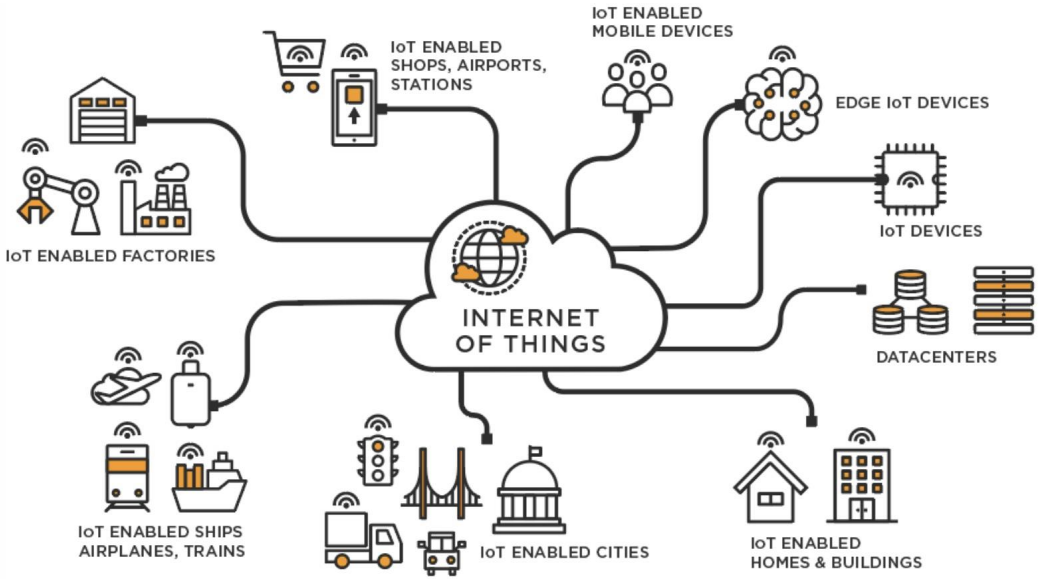


PlatformIO

WOKWi



IoT Bootcamp #1

Pandega Abyan Zumarsyah

Tak Kenal Maka Kenalan

Pandega Abyan Zumarsyah, S.T., M.Eng.

Magelang, 15 Agustus 2000

Software engineer with experience in various programming languages and frameworks related to web development, machine learning, and more

Programming Skills 💻

- **Fields:** Web Development ★★★★★ | Machine/Deep Learning ★★★★★ | Image Processing ★★★★☆ | Android ★★★☆☆
- **Languages:** SQL ★★★★★ | Python ★★★★★ | JavaScript/Typescript ★★★★★ | Go ★★★★☆ | C/C++ ★★★☆☆ | Kotlin ★★★☆☆
- **Frameworks:** PyTorch ★★★★★ | React ★★★★★ | TensorFlow ★★★★☆ | Express ★★★★☆ | Gin ★★★★☆ | Flask ★★★★☆

Organisasi, Asdos & Asprak, Proyek Kuliah ML & IoT

Kuliah S1 TE

Proyek Web Dev & IoT

Kerja di CAD-IT

Riset ML

Kuliah S3 TE

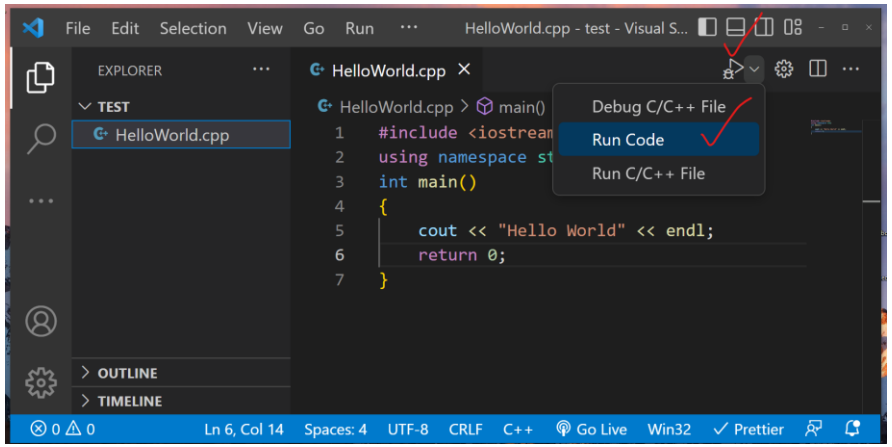
Riset ML

Kuliah S2 TI

Aug 2018 **Aug 2022** **Aug 2023** **now**

Terkait Coding

C/C++, Java, Python, JavaScript adalah di antara general purpose programming language yang paling populer. Ketika kita sudah menguasai satu bahasa, biasanya tidak sulit untuk belajar lainnya



Visual Studio Code (VS Code) adalah salah satu IDE yang paling populer. Suatu IDE (integrated development environment) adalah software dengan berbagai fitur untuk memudahkan software development. Singkatnya, VS Code adalah tempat ngoding “terbaik”

GitHub is a code hosting platform for version control and collaboration (docs.github.com)

Materi Kita

#1

- Intro to IoT
- Intro to Arduino & ESP32
- Basic Programming using Arduino & MicroPython in Wokwi & PlatformIO

#2

- Concept of Analog Signal & Button
- Arduino with Temperature Sensor, Button, and LCD
- ESP32 with DHT Sensor and WiFi
- Blynk for Control and Monitoring

#3

- Concept of MQTT and Implementation in ESP32
- Concept of Firebase and Implementation in ESP32
- Introduction to Node-RED

Resource: [IoT Bootcamp – GitHub pandegaabyan]

Coaching & Project

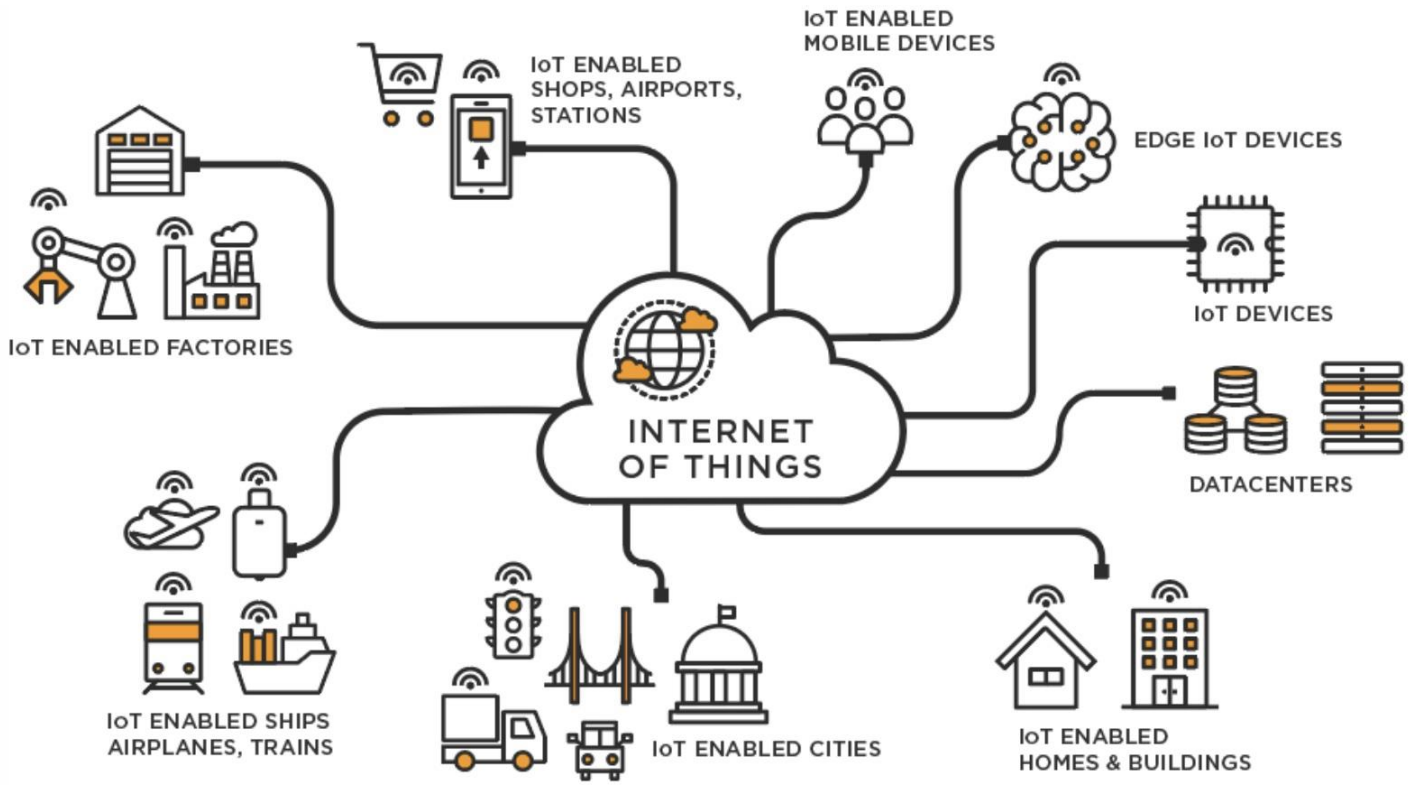
#1
- Project Definition
- Idea Exploration and Discussion

#2
- Report
- Feedback and Troubleshooting

#3
- Report
- Suggestion for Presentation

Project

Sensor + Aktuator (?) + ESP32 + Dashboard



Intro to IoT

IoT Bootcamp – Pandega Abyan Z

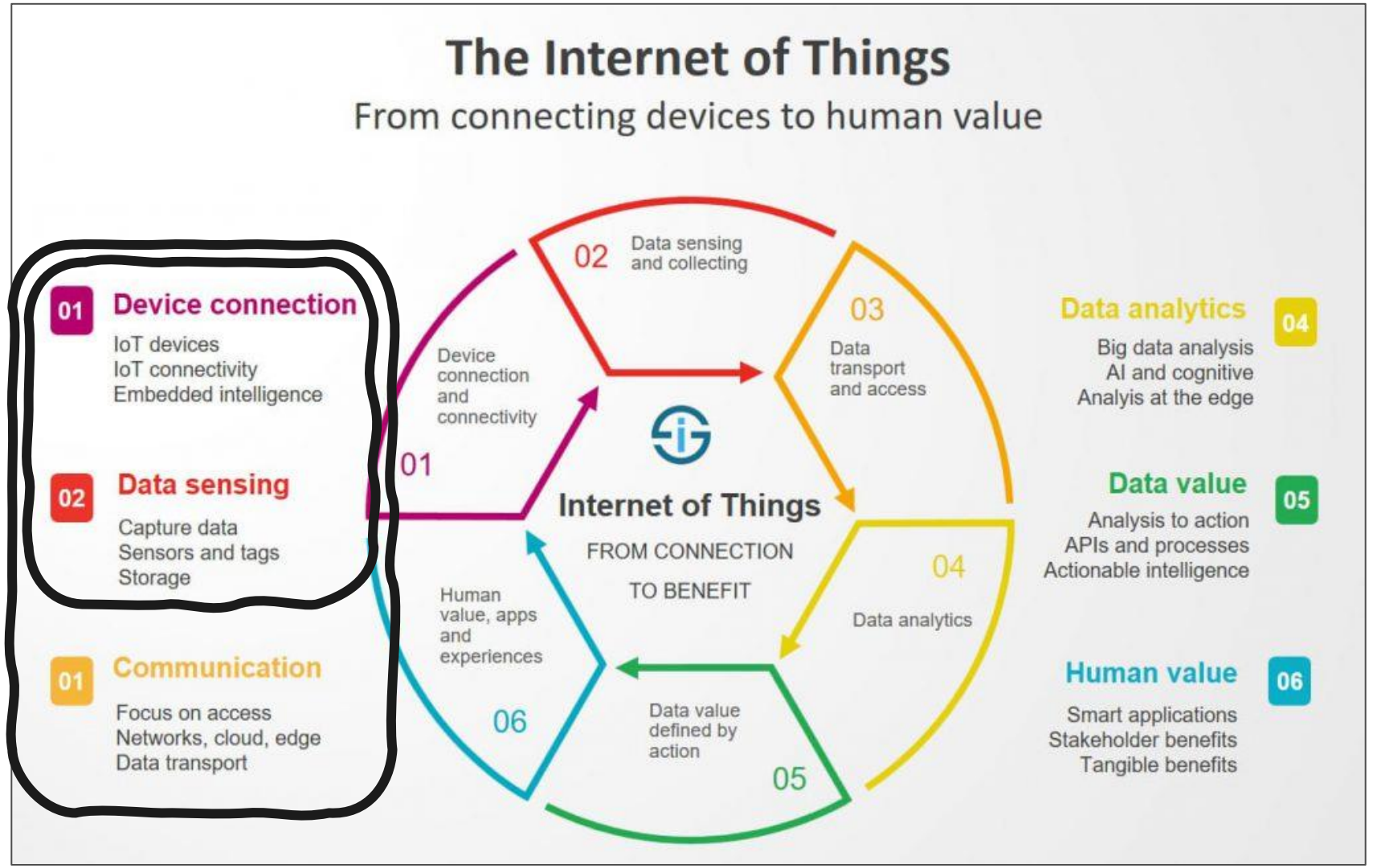
Apa itu Internet of Things ?

- IoT describes **devices** with sensors, processing ability, software and other technologies that **connect** and **exchange data** with other devices and systems over the Internet or other **communications networks** (wikipedia.com)

- Sangat umum, can be many **things**
- Nggak harus terhubung ke **internet publik**, bisa **jaringan**/**network** lainnya
- Mencakup **banyak bidang** terkait TE/TI

  Electronics, Embedded System, Signal Processing, Networking, Data Analytics, Software Dev, etc.

Berbagai Domain IoT



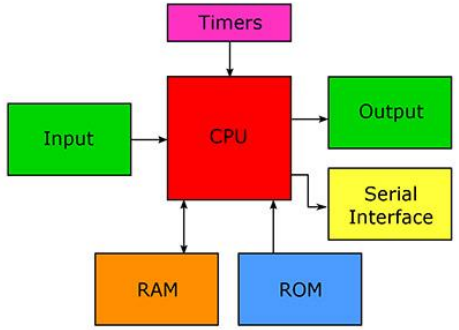
devopsschool.com

Devices: Microcontroller as the Brain

Microprocessor	Microcontroller
Center of a general computer system.	Center of embedded system.
Memory and I/O components are external to it.	Memory and I/O components are internal to it.
Higher cost	Lower Cost
High Power Consumption	Low Power Consumption
Mainly present in personal computers.	Mainly present in washing machines, music players, and embedded systems.
RAM, ROM, and other peripherals are absent.	RAM, ROM, and other peripherals are present.
Ideal for general purpose to handle more data.	Ideal for the specific applications.
Complex and Expensive	Simple and affordable

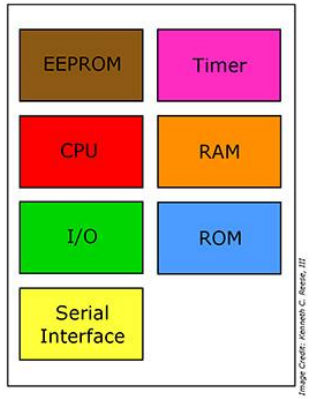
mechanical-farm.com

Microprocesser: CPU and several supporting chips.



microcontrollertips.com

Microcontroller: CPU on a single chip.



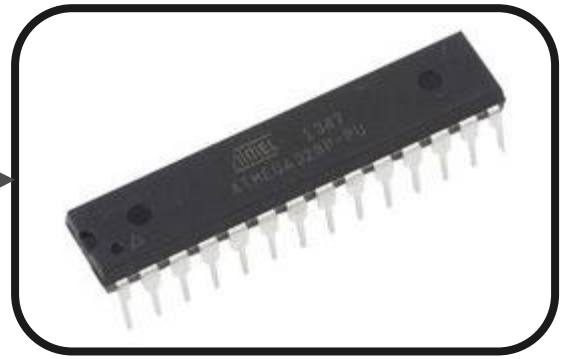
Embedded System is a computer system (processor, memory, input/output) that has a dedicated function within a larger mechanical or electronic system (wikipedia.com)

Devices: Boards for Easy Development

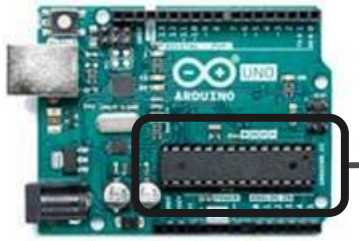
Arduino Nano 33

Arduino Nano Every

Arduino Nano 33 Ble



The Microcontroller



Arduino UNO

Teensy 4.0

Tessel 2

Onion Omega2s+

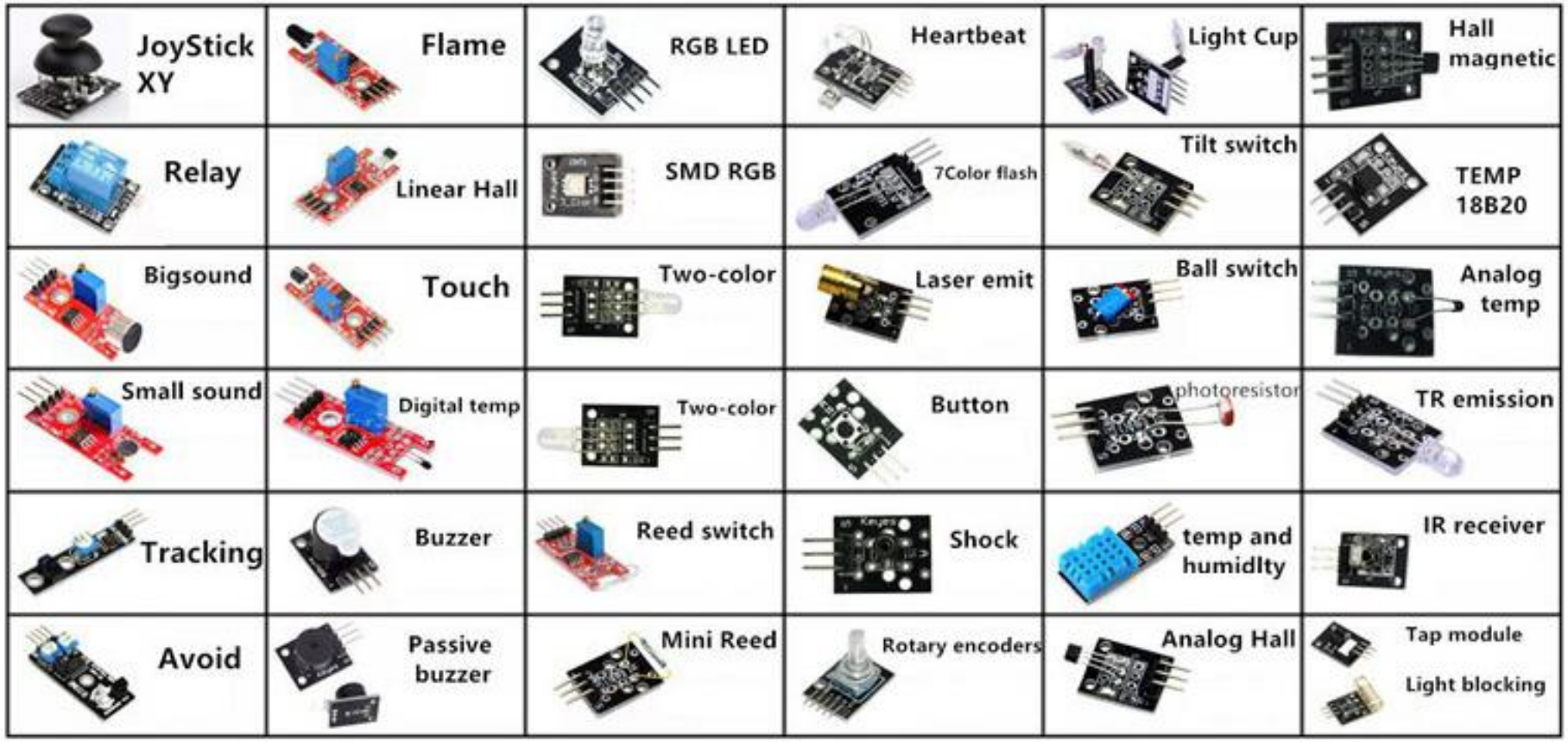
ESP32

Particle Argon

components101.com

- Inti dari Dev Board adalah Microcontroller
- Dev Board memiliki berbagai komponen, modul, input/output, dsb. untuk memudahkan development

Sensor for Sensing and Actuator for Acting



eitkw.com

Ada berbagai jenis modul yang bisa dihubungkan dengan Dev Board:

sensor/input vs actuator/output, sederhana vs kompleks, murah vs mahal, analog vs digital, raw signal vs processed signal

Connect & Communicate

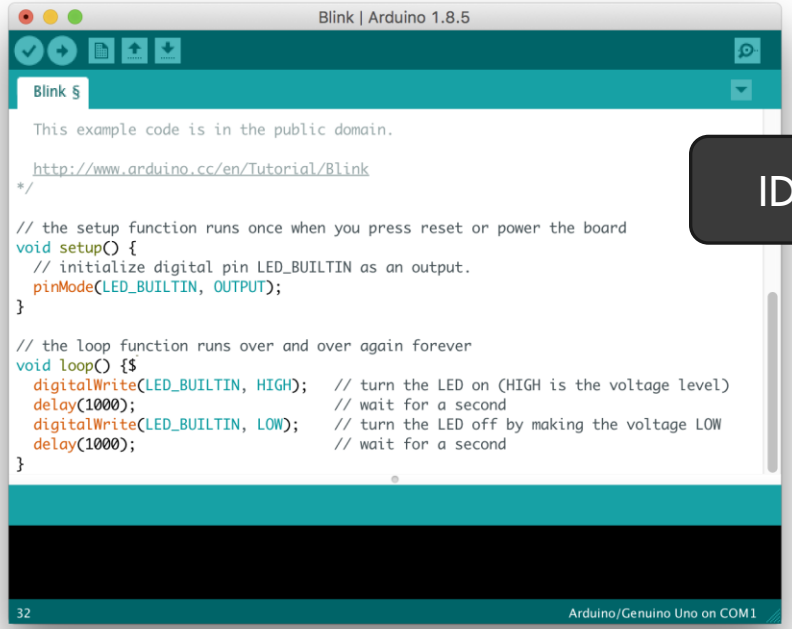
Ada berbagai protokol atau metode untuk membuat berbagai komponen bisa terhubung dan berkomunikasi sehingga memungkinkan kontrol jarak jauh, pengiriman data, fitur notifikasi, dsb.

Intro to Arduino & ESP32

IoT Bootcamp – Pandega Abyan Z

Apa itu Arduino ?

Development Board



IDE

Arduino Language

The Arduino Language is the de-facto standard for embedded programming on hundreds of architectures and hardware platforms. It is a domain-specific language implemented using a subset of the C++ syntax which makes it abstract enough to be ported to any other programming language. The aim is to provide a full abstraction API over the lower level calls required by the various platforms
promoting reusable content and examples that can be ported easily on a

Programming Language

Spesifikasi Board Arduino Uno

Boards	Arduino Uno
Microcontroller	ATmega328P
RAM	2KB
Internet Connectivity	Ethernet Shield
Bluetooth Connectivity	not present
Software	C, C++
Operating Voltage	5V
Operating Frequency	16 MHz
Flash Memory	32 KB
GPIO	14 (6 PWM Pins) + 6
Analog Input (ADC) & Output (DAC)	6 Input & 0 Output

Ada banyak board Arduino, yang sangat terkenal adalah Arduino Uno ini

Shield adalah board tertentu yang bisa dengan mudah dipasang di board Arduino

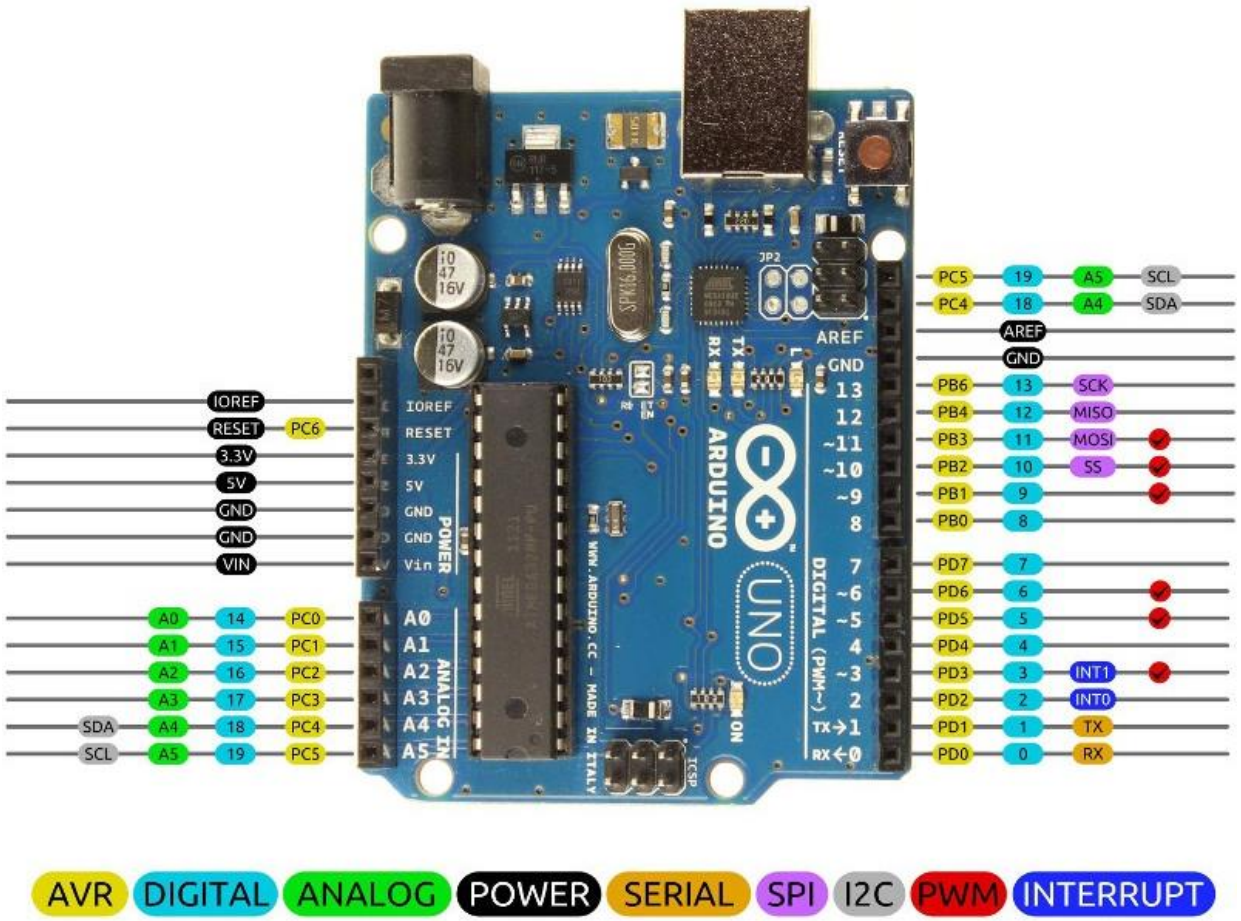
Frekuensi berkaitan dengan kecepatan pengolahan

Flash Memory berkaitan dengan memori untuk menyimpan program

GPIO adalah General Purpose Input-Output
Setiap GPIO umumnya bisa untuk sinyal digital.
Sebagian GPIO punya fungsi tambahan, seperti Analog dan PWM.
Sebagian GPIO hanya Input only

simplyiotsensors.com
dengan penyesuaian dari sumber lain

Pin pada Board Arduino Uno



AVR DIGITAL ANALOG POWER SERIAL SPI I2C PWM INTERRUPT

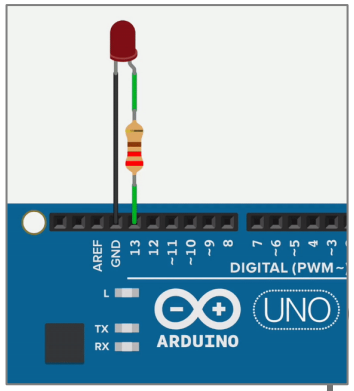
roboticsbackend.com

Note

- Board di gambar adalah Arduino Uno R3 yang populer
- Board Arduino Uno lainnya tidak jauh berbeda

Power

- Pin **GND** sebagai ground
- Pin **3.3V** & Pin **5V** untuk memberi daya ke komponen
- Pin **Vin** untuk memberi daya pada board, bisa juga lewat USB



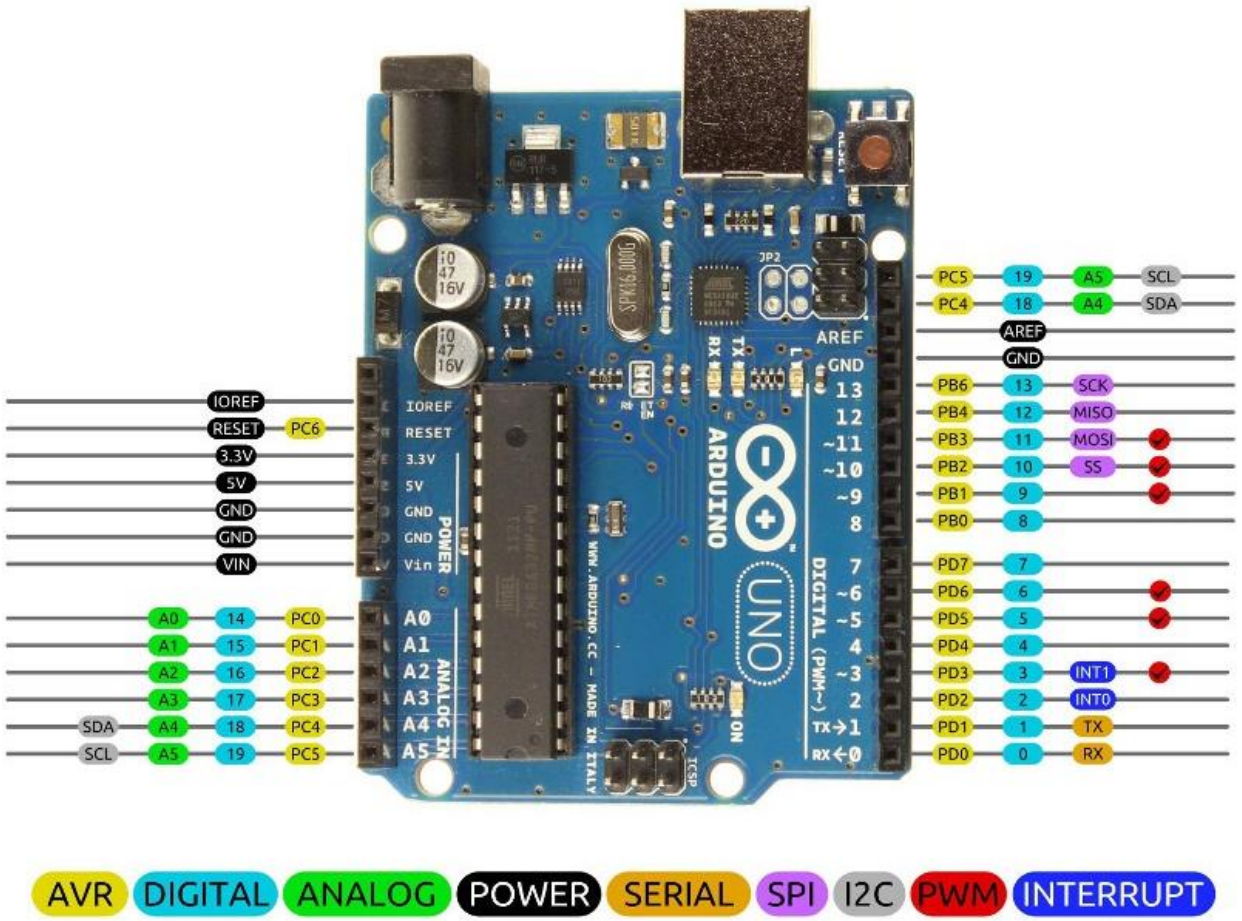
Digital

- Dua nilai: **HIGH** (5V) dan **LOW** (0V)
- Bisa sebagai Input atau Output

Interrupt

- Pin digital khusus yang bisa dipakai untuk interupsi jalannya kode

Pin pada Board Arduino Uno

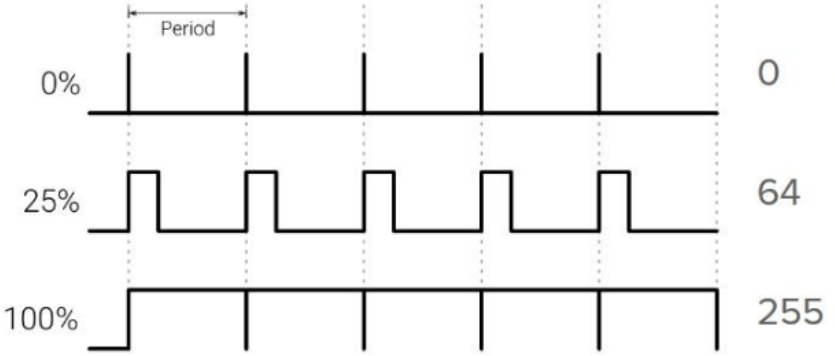


AVR DIGITAL ANALOG POWER SERIAL SPI I2C PWM INTERRUPT

roboticsbackend.com
arduinotogo.com

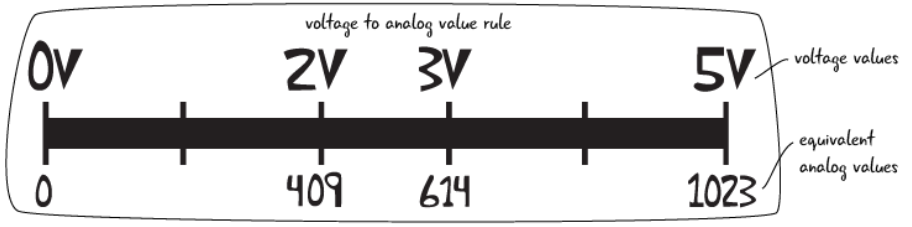
PWM

- Output dengan Pulse Width Modulation
- Informasi disampaikan dengan modulasi lebar sinyal

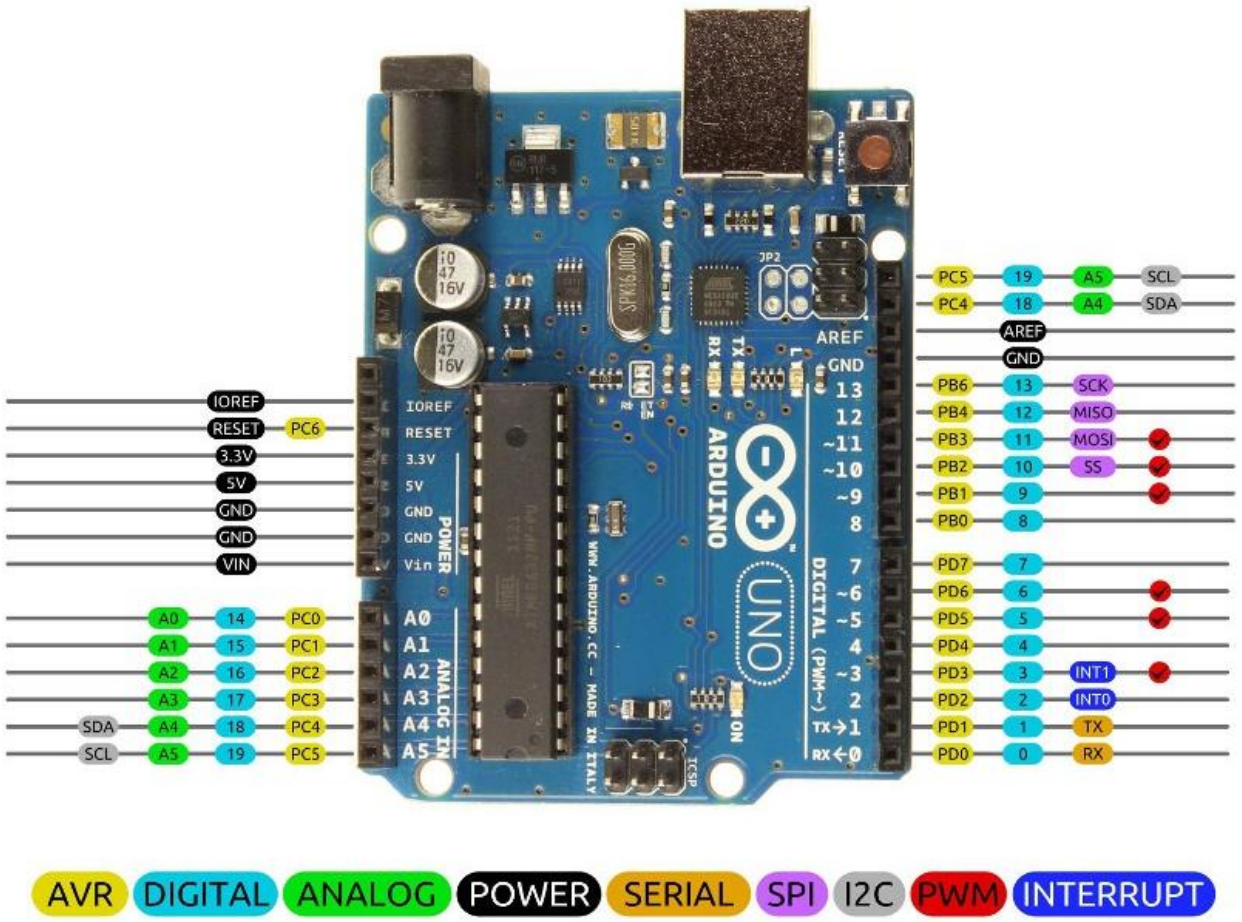


Analog

- Input Tegangan Analog
- Tegangan analog dibaca sebagai nilai integer



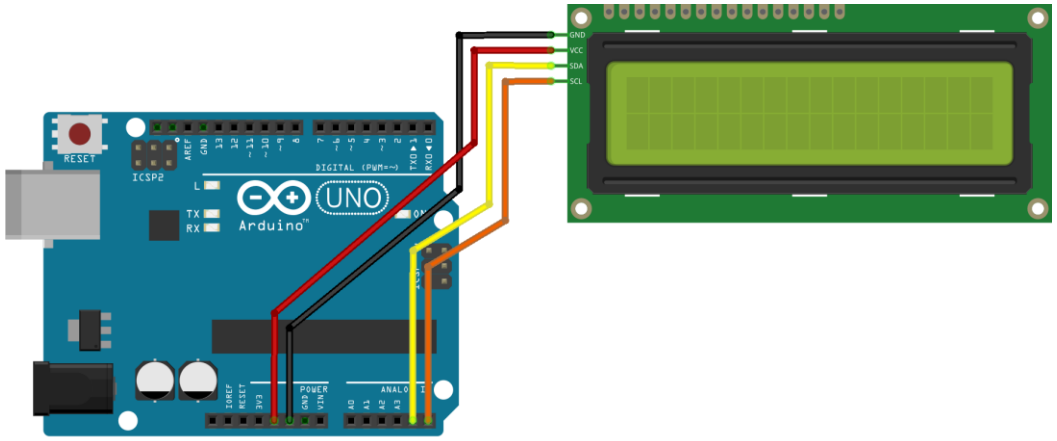
Pin pada Board Arduino Uno



roboticsbackend.com
sinauprogramming.com

Communication Protocols

- **SERIAL** atau UART, **I2C,** dan **SPI** adalah Pin yang menerapkan protokol komunikasi
- Itu memungkinkan komunikasi antara board dengan modul kompleks
- Misalnya, **I2C** sering dipakai untuk menghubungkan board dengan LCD

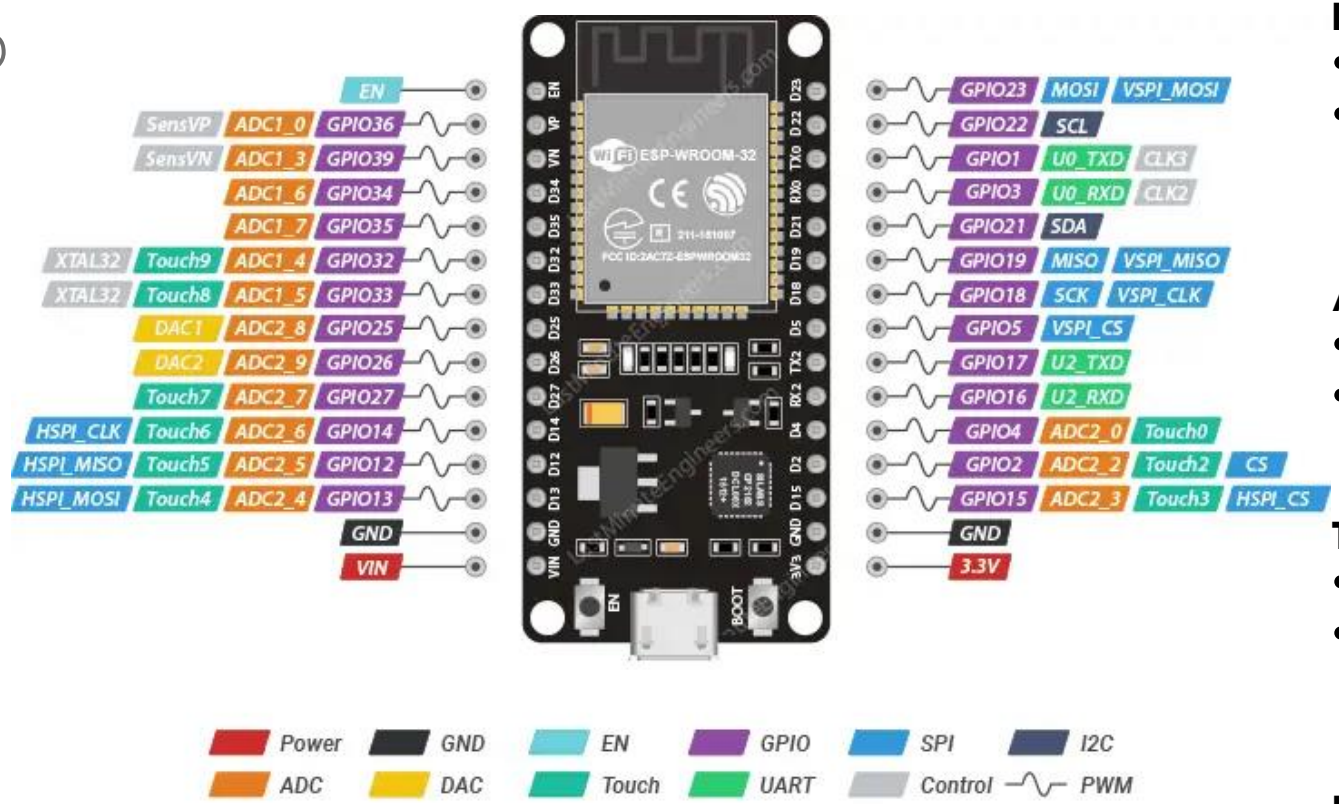


Board Arduino Uno vs Board ESP32

Boards	Arduino Uno	ESP32
Microcontroller	ATmega328P	Tensilica Xtensa LX6
RAM	2KB	520KB
Internet Connectivity	Ethernet Shield	Built-in WiFi & Ethernet port
Bluetooth Connectivity	not present	Present
Software	C, C++	MicroPython, Python, C, C++
Operating Voltage	5V	3.3V
Operating Frequency	16 MHz	Up to 240 MHz
Flash Memory	32 KB	Typically 4MB (can vary)
GPIO	14 (6 PWM Pins) + 6	Around 30 (16 PWM Channels)
Analog Input (ADC) & Output (DAC)	6 Input & 0 Output	18 Input & 2 Output

simplyiotsensors.com
dengan penyesuaian dari sumber lain

Pin pada Board ESP32



lastminuteengineers.com

Note

- Board di gambar adalah ESP32 devkit v1 30 pin
- Board ESP32 lain memiliki jumlah pin berbeda, tetapi pin dengan nama sama memiliki fungsionalitas serupa

ADC & DAC

- ADC: tegangan 0 – 3.3 V jadi integer 0 – 4095 (12-bit)
- DAC: integer 0 – 255 (8-bit) jadi tegangan 0 – 3.3 V

Touch

- Capacitive Touch Pins
- Bisa dihubungkan dengan bahan tertentu untuk membuat Touch Pad

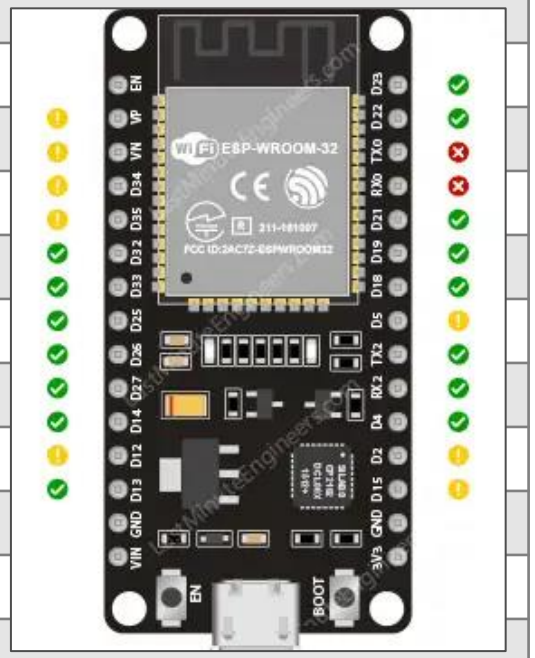
Enable

- Pin untuk enable/disable board ESP32
- Status default nya adalah enable

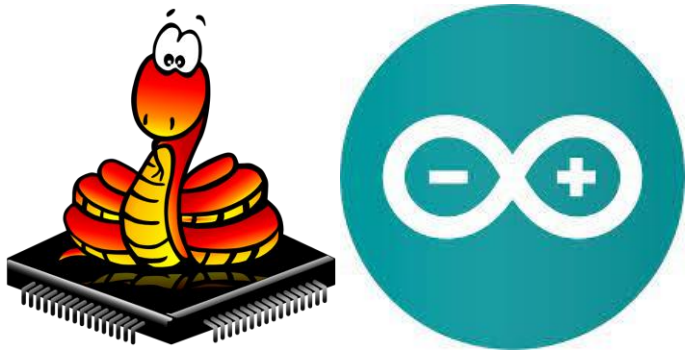
Pin pada Board ESP32

Label	GPIO	Safe to use?	Reason
D0	0	⚠	must be HIGH during boot and LOW for programming
TX0	1	✗	Tx pin, used for flashing and debugging
D2	2	⚠	must be LOW during boot and also connected to the on-board LED
RX0	3	✗	Rx pin, used for flashing and debugging
D4	4	✓	
D5	5	⚠	must be HIGH during boot
D6	6	✗	Connected to Flash memory
D7	7	✗	Connected to Flash memory
D8	8	✗	Connected to Flash memory
D9	9	✗	Connected to Flash memory
D10	10	✗	Connected to Flash memory
D11	11	✗	Connected to Flash memory
D12	12	⚠	must be LOW during boot
D13	13	✓	
D14	14	✓	
D15	15	⚠	must be HIGH during boot, prevents startup log if pulled LOW
RX2	16	✓	

Label	GPIO	Safe to use?	Reason
TX2	17	✓	
D18	18	✓	
D19	19	✓	
D21	21	✓	
D22	22	✓	
D23	23	✓	
D25	25	✓	
D26	26	✓	
D27	27	✓	
D32	32	✓	
D33	33	✓	
D34	34	⚠	Input only GPIO, cannot be configured as output
D35	35	⚠	Input only GPIO, cannot be configured as output
VP	36	⚠	Input only GPIO, cannot be configured as output
VN	39	⚠	Input only GPIO, cannot be configured as output



lastminuteengineers.com



Basic Programming using Arduino & MicroPython in Wokwi & PlatformIO

IoT Bootcamp – Pandega Abyan Z

About Wokwi

[Welcome to Wokwi! | Wokwi Docs]

Sebagai software engineer, biasakan baca dokumentasi !!!

Itu akan lebih up-to-date, lebih lengkap, lebih enak dibaca, dibanding materi dari pemateri

Example using Arduino in Wokwi

Arduino Simple Blink

Arduino Simple Button

Arduino Simple Potentiometer

Arduino LED with Analog Write

- Fungsi **setup()** berjalan sekali ketika mulai, di sini perlu inisiasi pin, serial, atau lainnya
- Fungsi **loop()** berjalan terus menerus
- **delay()** menghentikan program selama waktu tertentu, kadang kurang disarankan karena program jadi berhenti
- Pin di **pinMode()** bisa berupa integer **0 – 13, A0 – A5**, atau **LED_BUILTIN** yang berhubungan dengan pin 13
- **digitalWrite()** untuk mengatur value, hanya bisa **HIGH** dan **LOW**
- **digitalRead()** untuk membaca value, antara **HIGH** atau **LOW**
- **Serial** sangat berguna untuk logging atau debugging, bahkan bisa untuk plotting, di awal perlu mengatur rate
- **analogRead()** pada dasarnya ADC, sinyal tegangan analog diubah jadi integer digital
- **analogWrite()** sebenarnya tidak menghasilkan sinyal analog, tapi sinyal digital dengan PWM
- Penggunaan variable dan function dengan penamaan yang jelas membuat kode mudah dipahami

Read Arduino Docs

Let's Try

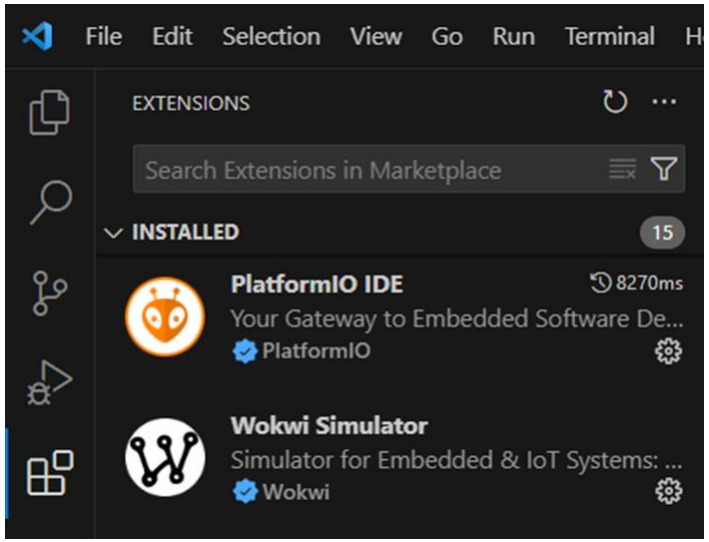
Create New Wokwi Project

Problem with Wokwi on the Browser

- Tidak ada Intellisense, Syntax Error Detection, dsb.
- Tidak ada Version Control
- Tidak bisa customize tampilan, fitur, dan lainnya

```ino
int pushButton = 2;

void setup() {
  Serial.begin(9600)
  pinMode(pushButon, INPUT);
}

void loop() {
  int buttonState = digitalRead(pushButton);
  Serial.println(buttonState);
  delay(1000);
}
```

Solusi ?

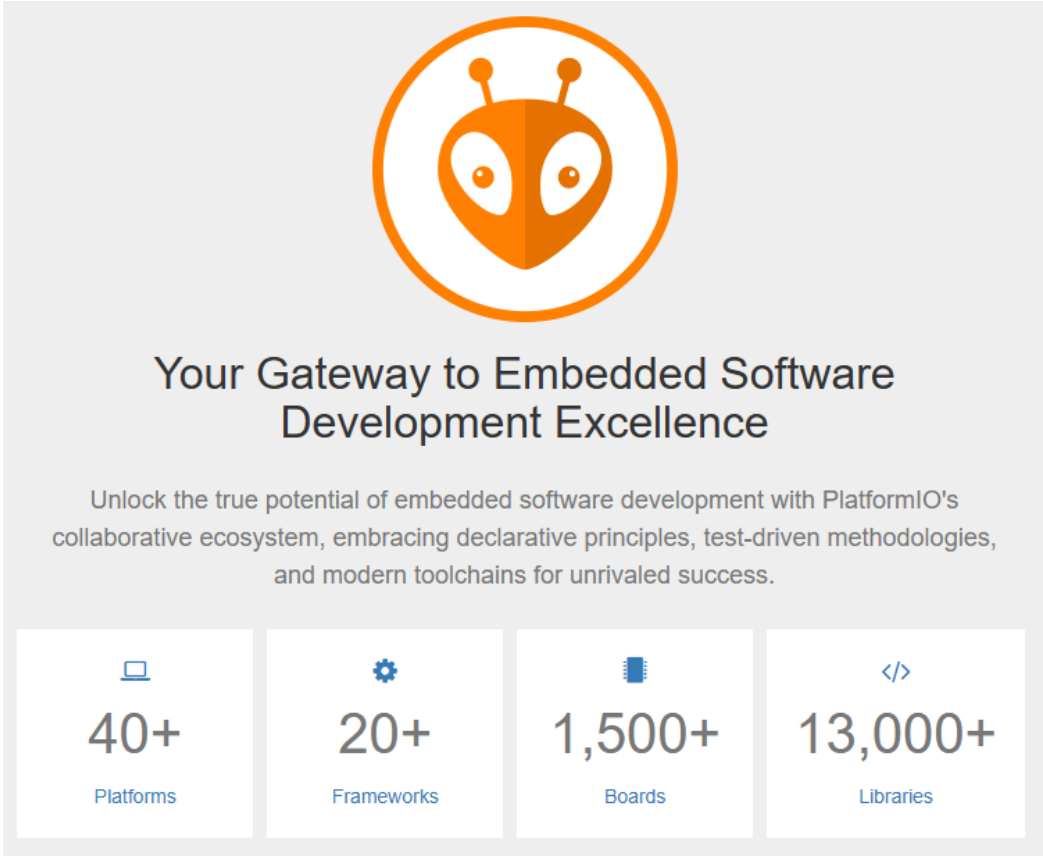



```ino
void ledPattern2() {
  for (int i = 0; i < 4; i++) {
    tone(buzzerPin, tones[i], 500);
    digitalWrite(ledPins[i], HIGH);
    delay(1000);

    digitalWrite(ledPins[i], LOW);
  }
}
```

```ino
void ledPattern2() {
  for (int i = 0; i < 4; i++) {

    digitalWrite(ledPins[i], HIGH);
    tone(buzzerPin, tones[i], 1000);
    delay(2000);
    digitalWrite(ledPins[i], LOW);
  }
}
```

VS Code + Wokwi Extension
+ PlatformIO Extension

About PlatformIO



[PlatformIO Documentation]

Let's Try

Develop using VS Code + Wokwi + PlatformIO