# Actuator

KU1202 Pengantar Rekayasa dan Desain

K-20

Sekolah Teknik Elektro dan Informatika
Institut Teknologi Bandung

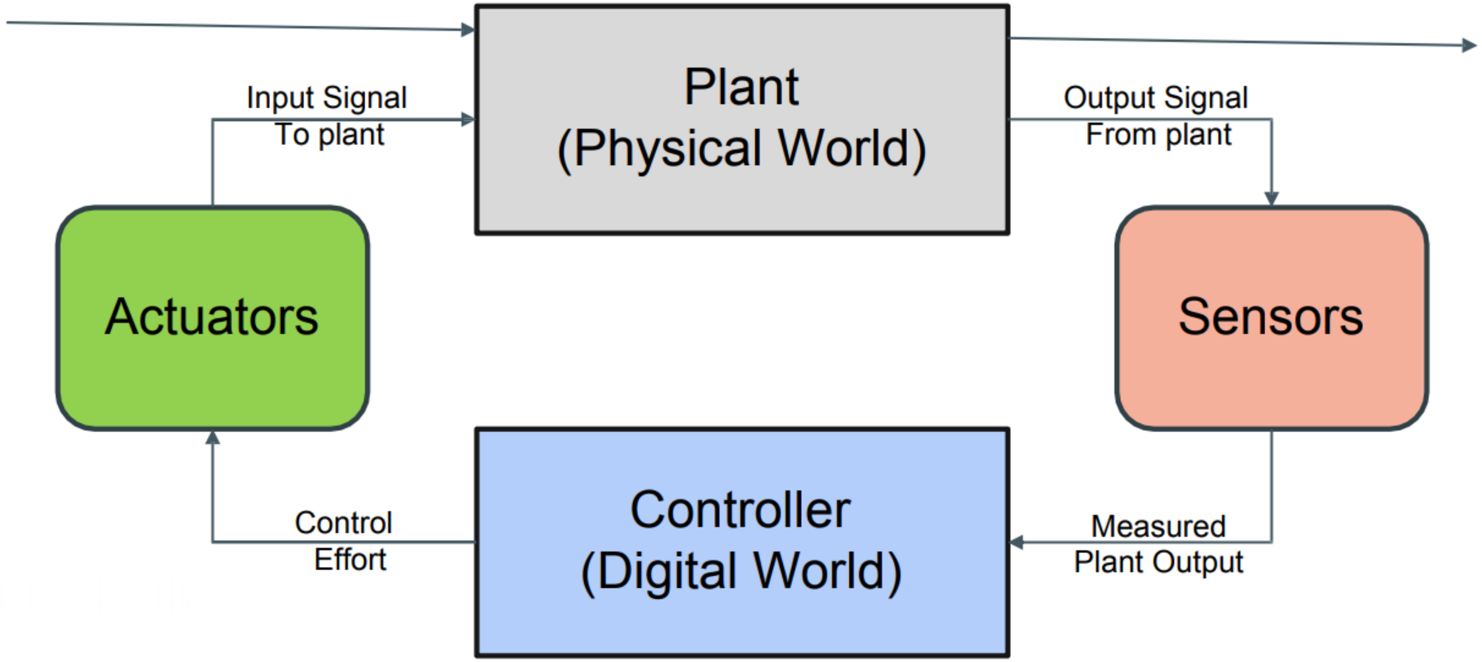
Update: 20 April 2021 15:29:33

# Overview

- Actuator
- DC Motor
- Servo Motor

# Introduction

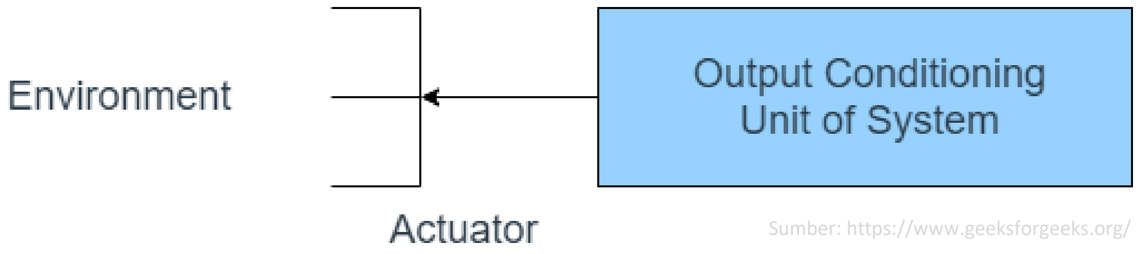
# System Hardware




Sumber: https://roboticsclubiitk.github.io/

# Actuator

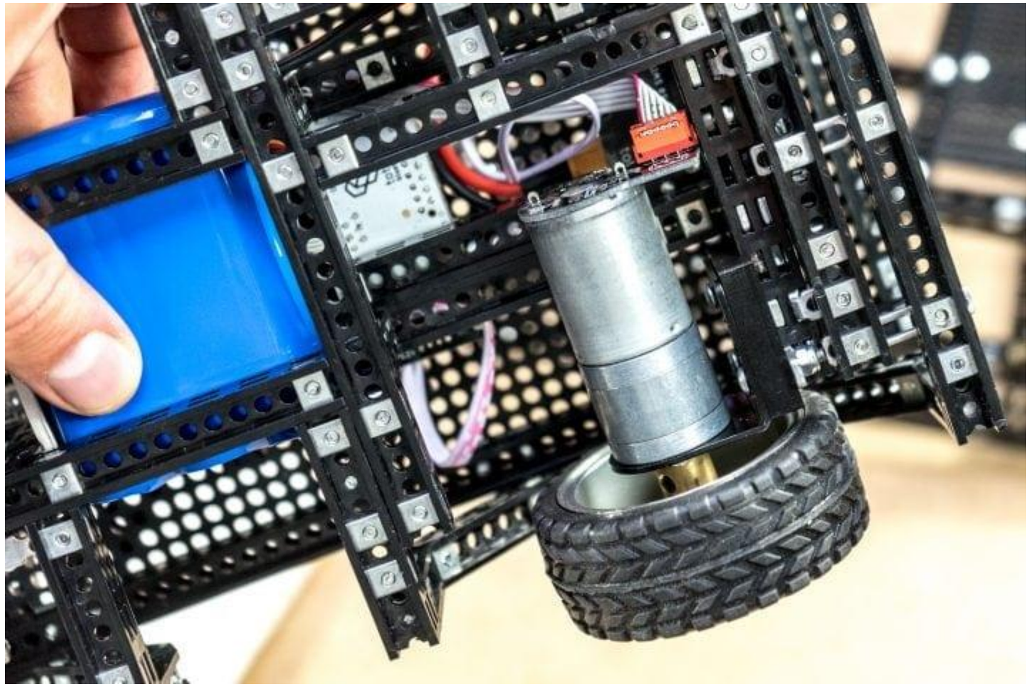
- **Konversi** sinyal listrik menjadi karakteristik fisik.
- Mengambil **input** dari output (dari sistem).
- Memberikan **output** ke lingkungan (*environment*).
- **Menghasilkan** gerak atau panas.
- Disimpan di **port** output (dari sistem).
- Menerima perintah untuk melakukan sesuatu.




Sumber: https://www.geeksforgeeks.org/

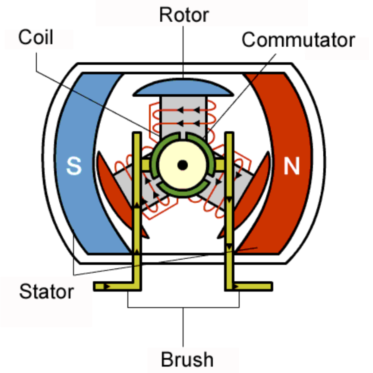
# DC Motor

# DC Motor

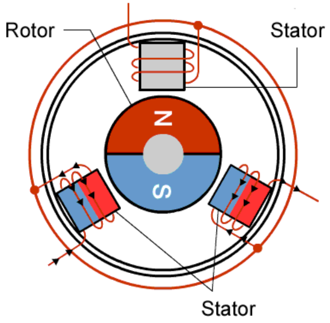


Sumber: https://totemmaker.net/

## Brushed DC Motor

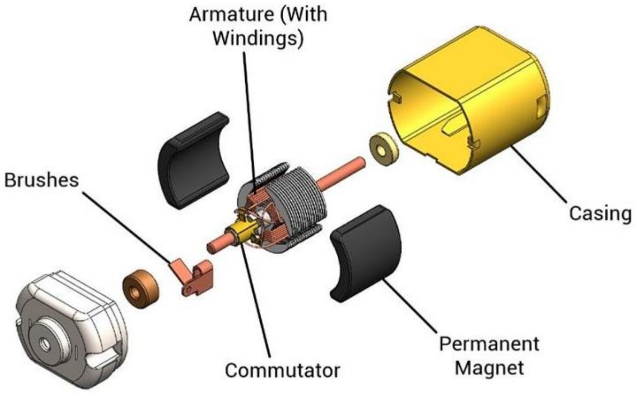




## Brushless DC Motor

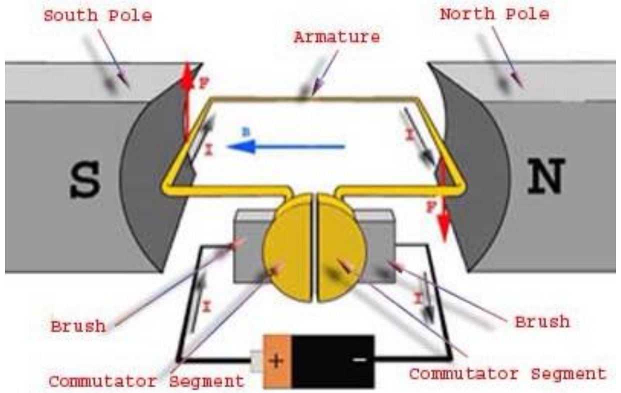


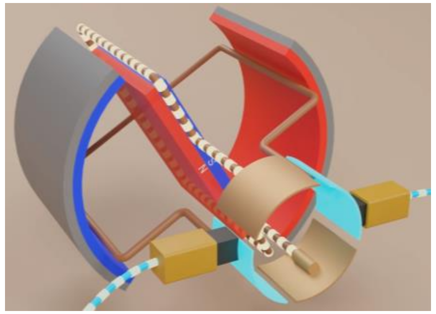

Sumber: https://www.seeedstudio.com/

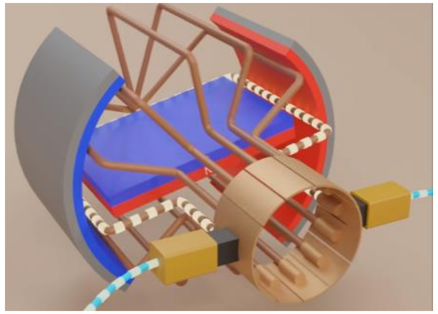
# DC Motor (Brushed)

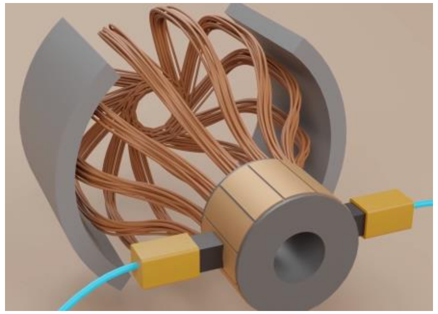


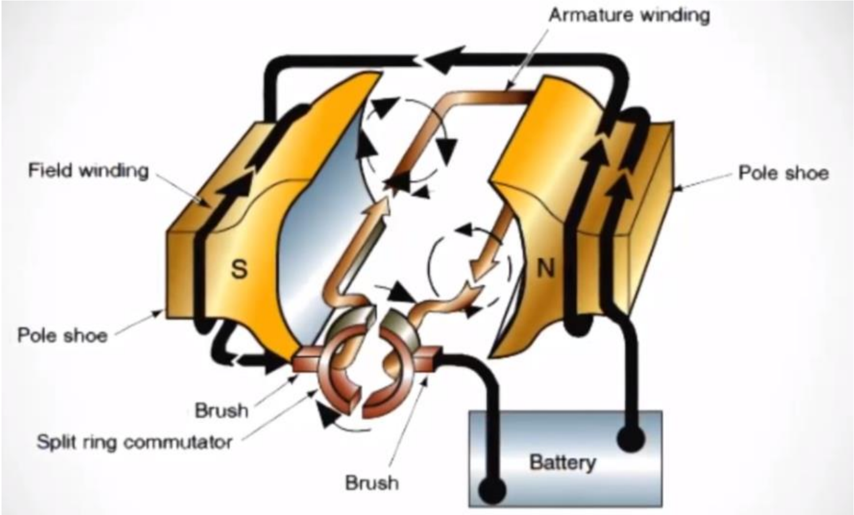
Sumber: https://www.progressiveautomations.com/



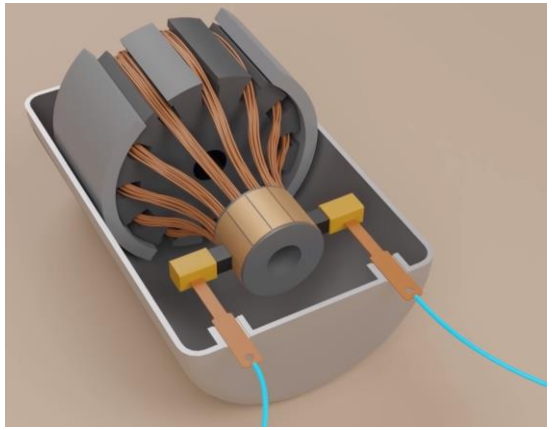









Sumber: https://www.youtube.com/watch?v=MIkilvsNtVQ

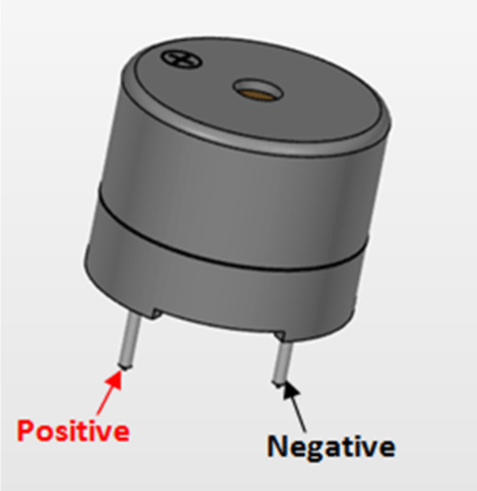

Sumber: https://www.youtube.com/watch?v=CWulQ1ZSE3c

# Exercise #1

**DC Motor**

Format Nama Desain: 12_NIM_01, contoh: 12_16520999_01

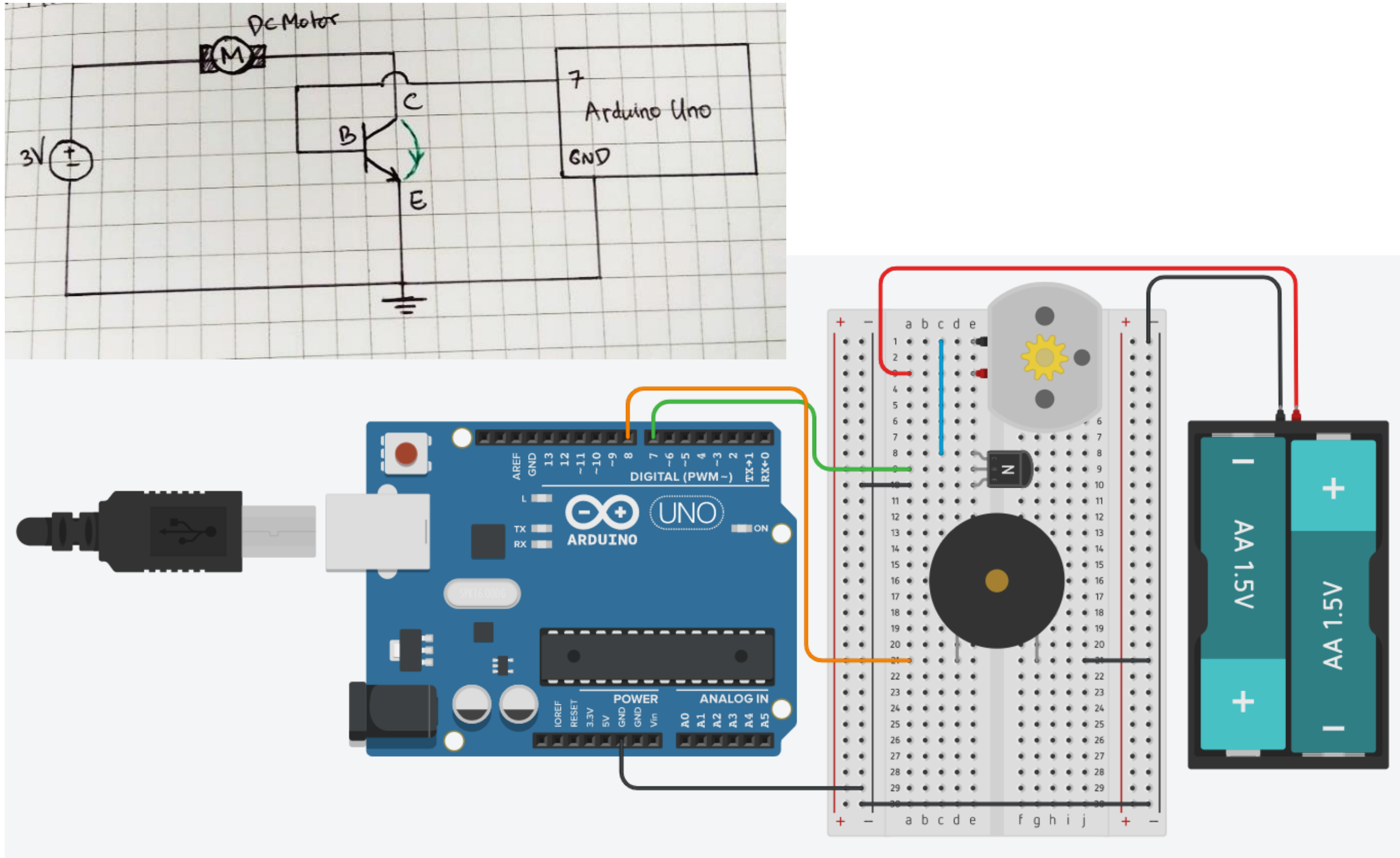
# Buzzer




| Pin Number | Pin Name | Description |
|---|---|---|
| 1 | Positive | Power |
| 2 | Negative | Ground |

Sumber: https://components101.com/

# Circuit Design




| Name | Quantity | Component |
|---|---|---|
| U1 | 1 | Arduino Uno R3 |
| M1 | 1 | DC Motor |
| T1 | 1 | NPN Transistor (BJT) |
| Bat2 | 1 | 2 batteries, AA, 1.5V Battery |

# Program Design

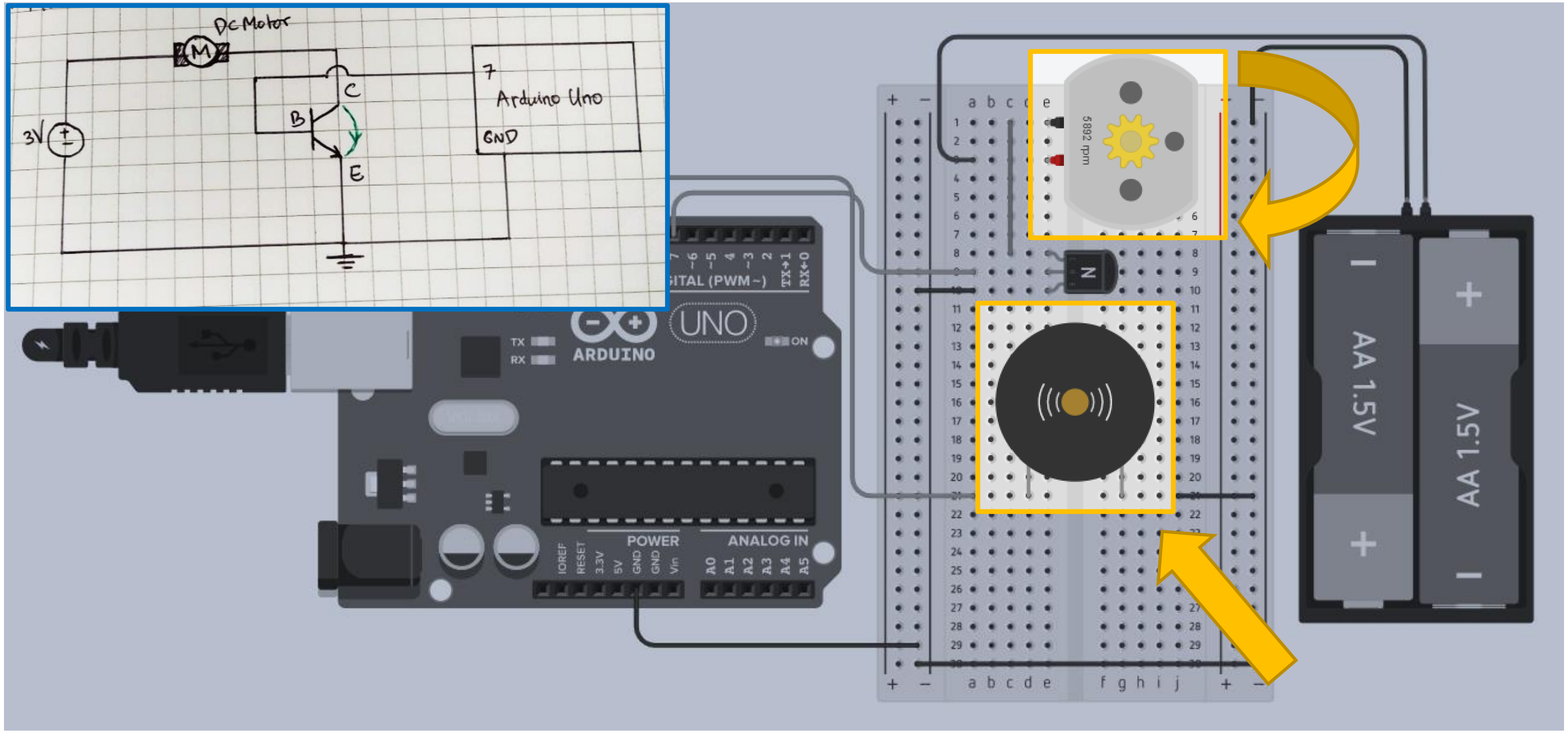
- **Program**: DC Motor
- **Input**: -
- **Output**: Buzzer ON/OFF, motor berputar
- **Process**:
    1. Buzzer ON/OFF, motor berputar selama 5 detik
    2. Motor diam selama 5 detik

# Code

```
int npnPin = 7;                   // pin Arduino yang terhubung ke NPN Transistor
const int buzzPin = 8;            // pin Arduino yang terhubung ke Buzzer

void setup() {
  pinMode(npnPin, OUTPUT);        // atur pin sebagai OUTPUT
  pinMode(buzzPin, OUTPUT);       // atur pin sebagai OUTPUT
  Serial.begin(9600);             // memulai port serial
}

void loop() {
  tone(buzzPin, 523, 500);        // putar nada (f = 523 Hz, durasi = 500 ms)
  Serial.println("Start");
  digitalWrite(npnPin, HIGH);     // motor ON
  delay(5000);                    // tunggu 5 detik
  Serial.println("Stop");
  digitalWrite(npnPin, LOW);      // motor OFF
  delay(5000);                    // tunggu 5 detik
}
```

Format Nama File Kode: 12_NIM_01.ino, contoh: 12_16520999_01.ino

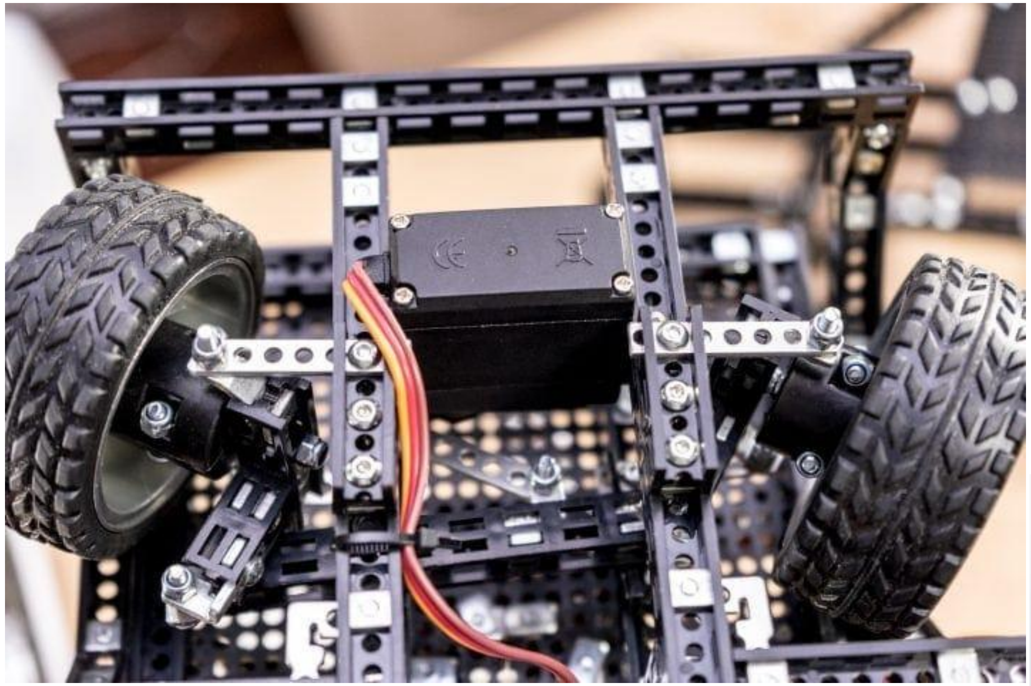
# Simulation



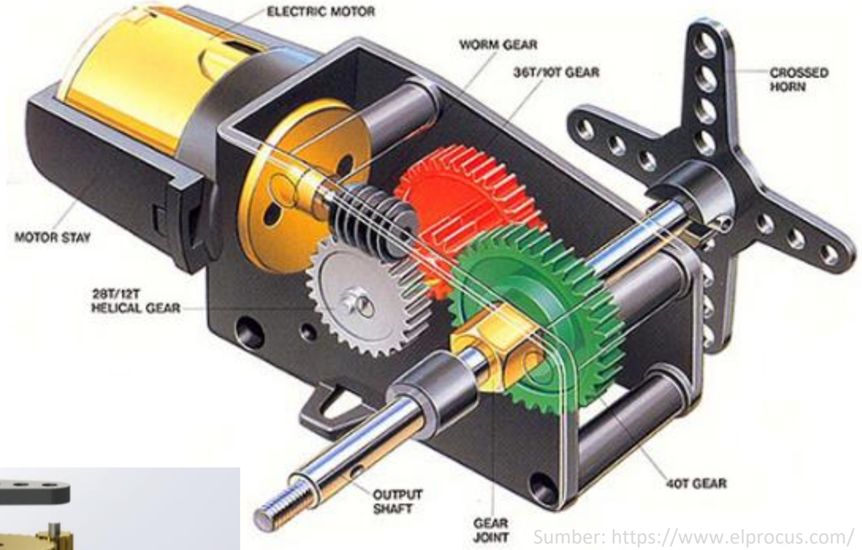
Dc Motor
M
3V
C
B
E
7
Arduino Uno
GND
DIGITAL (PWM~)
UNO
ARDUINO
TX
RX
ON
POWER
ANALOG IN
IOREF
RESET
3.3V
5V
GND
GND
Vin
A0
A1
A2
A3
A4
A5
5892 rpm
AA 1.5V
AA 1.5V

# Servo Motor

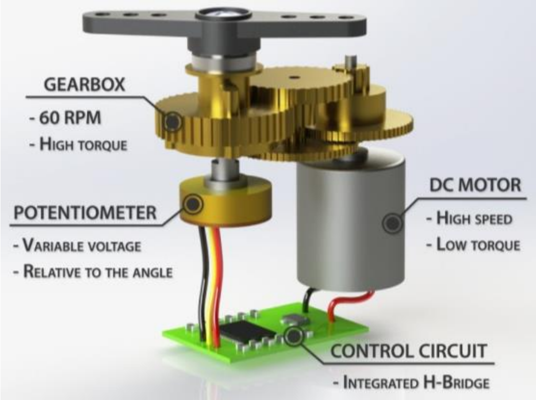
# Servo Motor



Sumber: https://totemmaker.net/



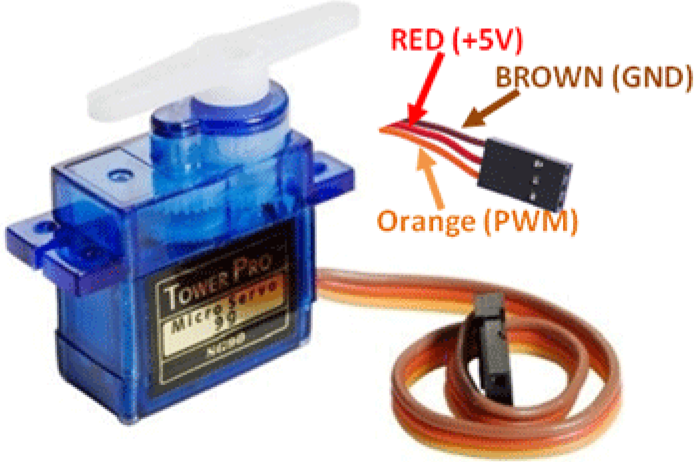

Sumber: https://www.elprocus.com/




Sumber: https://youtu.be/LXURLvga8bQ


Sumber: https://www.seeedstudio.com/

# Positional Micro Servo


| Wire Number | Wire Colour | Description |
|---|---|---|
| 1 | Brown | Ground |
| 2 | Red | Power |
| 3 | Orange | PWM signal |

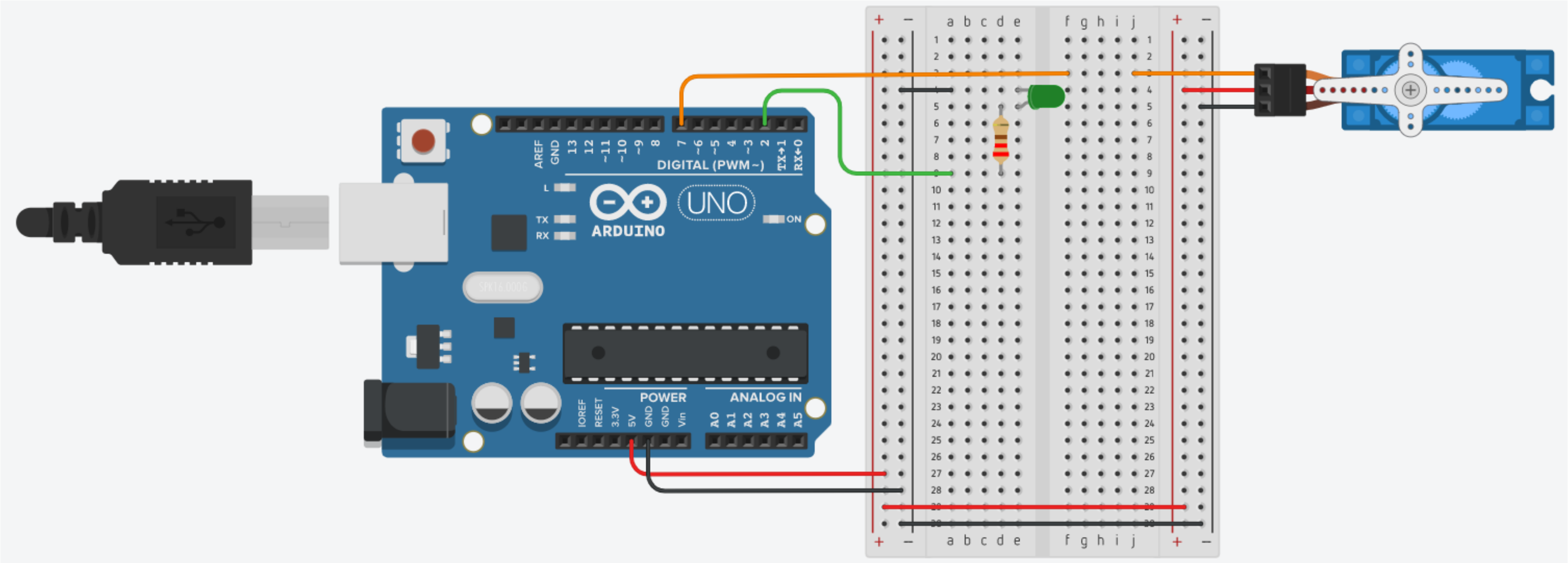
Sumber: https://components101.com/

# Exercise #2

**Servo Motor**

Format Nama Desain: 12_NIM_02, contoh: 12_16520999_02

# Circuit Design




| Name | Quantity | Component |
|---|---|---|
| U1 | 1 | Arduino Uno R3 |
| SERVO1 | 1 | Positional Micro Servo |
| D1 | 1 | Green LED |
| R1 | 1 | 220Ω Resistor |

# Program Design

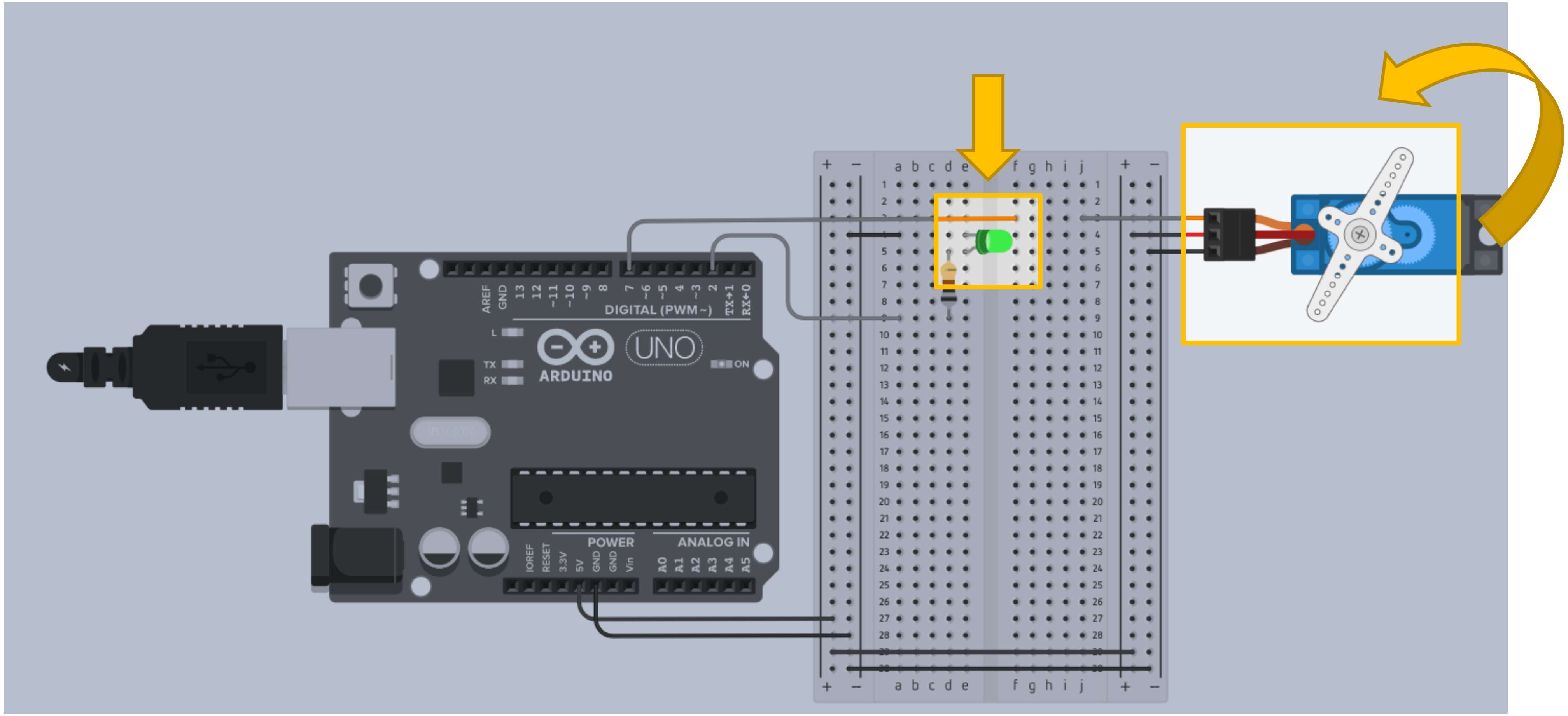
- **Program**: Motor Servo
- **Input**: -
- **Output**: LED ON/OFF, servo berputar
- **Process**:
    1. LED ON/OFF, servo berputar 90 derajat
    2. servo berputar -90 derajat

# Code

```
#include <Servo.h>
Servo servo_0;                    // deklarasi Servo yang dipakai (bisa 1 atau lebih)
const int servoPin = 7;           // pin Arduino yang terhubung ke Servo 0
const int ledPin = 2;             // pin Arduino yang terhubung ke LED
int pos = 0;                      // variabel untuk simpan nilai posisi (derajat)

void setup()
{
  pinMode(ledPin, OUTPUT);        // atur pin sebagai OUTPUT
  servo_0.attach(servoPin);       // lokasi servo dipasang
  servo_0.write(pos);             // inisialisasi posisi awal Servo 0
}

void loop()
{
  digitalWrite(2, HIGH);          // LED ON
  for (pos = 0; pos <= 90; pos += 1) {
    servo_0.write(pos);           // minta servo agar menuju posisi di variabel 'pos'
    delay(15);                    // tunggu 15 ms untuk servo mencapai posisi
  }
  delay(2000);                    // tunggu 2 detik

  digitalWrite(2, LOW);           // LED OFF
  for (pos = 90; pos >= 0; pos -= 1) {
    servo_0.write(pos);           // minta servo agar menuju posisi di variabel 'pos'
    delay(15);                    // tunggu 15 ms untuk servo mencapai posisi
  }
  delay(2000);                    // tunggu 2 detik
}
```

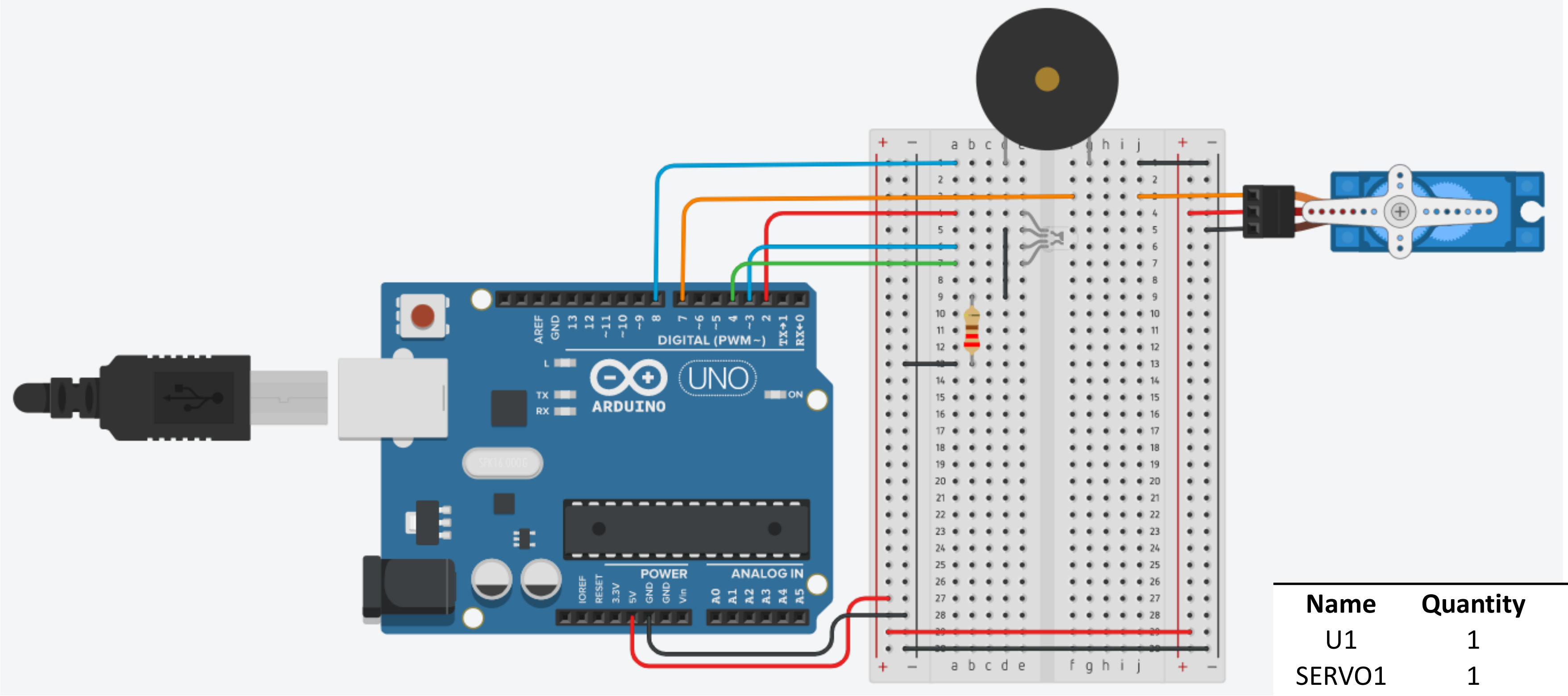
Format Nama File Kode: 12_NIM_02.ino, contoh: 12_16520999_02.ino

# Simulation



# Others

# Servo Motor with RGB LED [1/4]




| Name | Quantity | Component |
|---|---|---|
| U1 | 1 | Arduino Uno R3 |
| SERVO1 | 1 | Positional Micro Servo |
| PIEZO1 | 1 | Piezo |
| R1 | 1 | 220Ω Resistor |
| D1 | 1 | LED RGB |

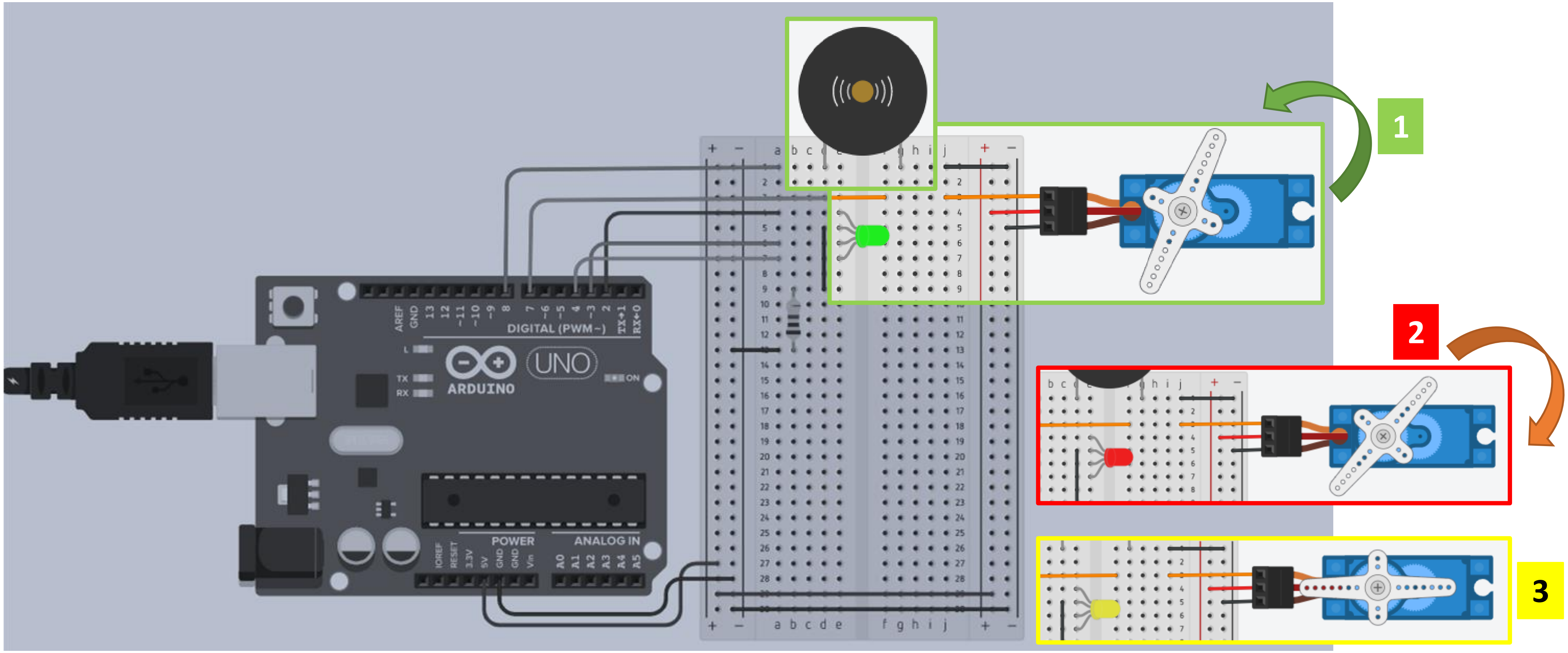
# Servo Motor with RGB LED [2/4]

- **Program**: Servo with Buzzer
- **Input**: -
- **Output**: LED ON/OFF, buzzer bersuara, servo berputar
- **Process**:
    1. LED ON/OFF (hijau), buzzer on, servo berputar 90 derajat
    2. LED ON/OFF (merah), servo berputar -90 derajat
    3. LED ON (kuning), servo tidak berputar (posisi awal)

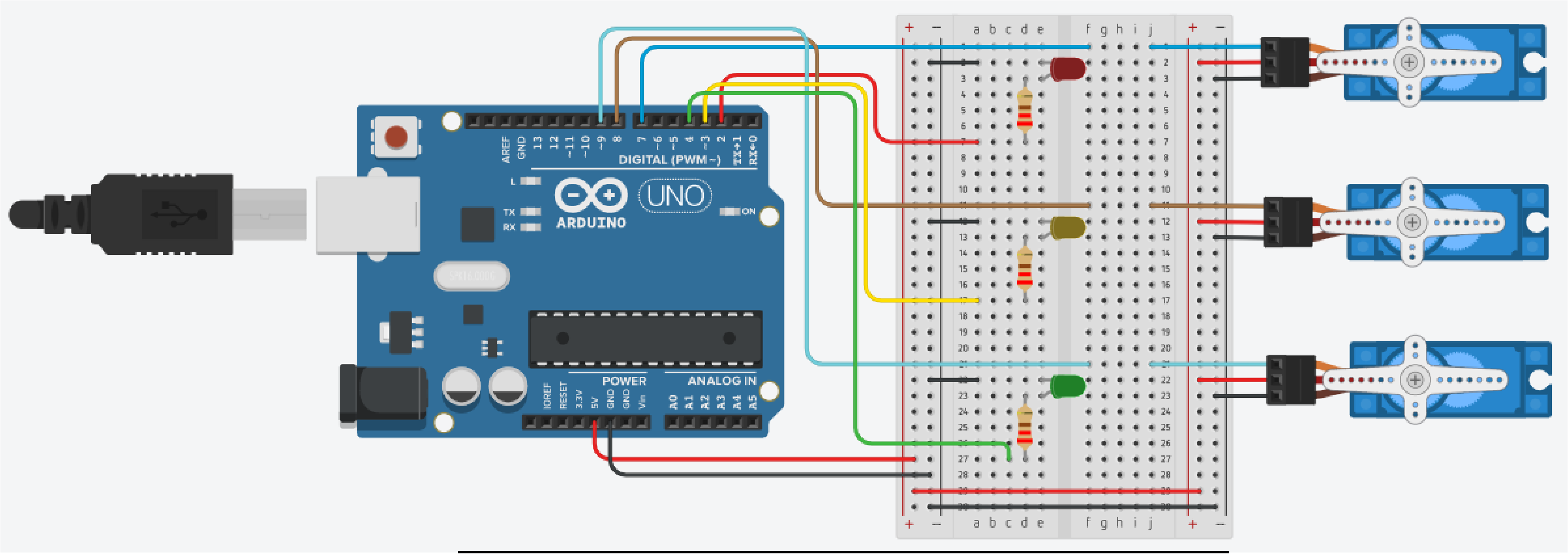
# Servo Motor with RGB LED [3/4]

```
#include <Servo.h>
Servo servo_0;                    // deklarasi Servo yang dipakai (bisa 1 atau lebih)
const int servoPin = 7;           // pin Arduino yang terhubung ke Servo 0
const int ledR_Pin = 2;           // pin Arduino yang terhubung ke LED(Red)
const int ledB_Pin = 3;           // pin Arduino yang terhubung ke LED(Blue)
const int ledG_Pin = 4;           // pin Arduino yang terhubung ke LED(Green)
const int buzzPin = 8;            // pin Arduino yang terhubung ke Buzzer
int pos = 0;                      // variabel untuk simpan nilai posisi (derajat)

void setup()
{
  pinMode(ledR_Pin, OUTPUT);      // atur pin sebagai OUTPUT
  pinMode(ledB_Pin, OUTPUT);      // atur pin sebagai OUTPUT
  pinMode(ledG_Pin, OUTPUT);      // atur pin sebagai OUTPUT
  pinMode(buzzPin, OUTPUT);       // atur pin sebagai OUTPUT
  servo_0.attach(servoPin);       // lokasi servo dipasang
  servo_0.write(pos);             // inisialisasi posisi awal Servo 0
}

void loop()
{
  tone(buzzPin, 523, 500);        // putar nada (f = 523 Hz, durasi = 500 ms)
  digitalWrite(4, HIGH);          // LED Green ON
  for (pos = 0; pos <= 90; pos += 1) {
    servo_0.write(pos);           // minta servo agar menuju posisi di variabel 'pos'
    delay(15);                    // tunggu 15 ms untuk servo mencapai posisi
  }
  delay(2000);                    // tunggu 2 detik
  digitalWrite(4, LOW);           // LED Green OFF
  digitalWrite(2, HIGH);          // LED Red ON
  for (pos = 90; pos >= 0; pos -= 1) {
    servo_0.write(pos);           // minta servo agar menuju posisi di variabel 'pos'
    delay(15);                    // tunggu 15 ms untuk servo mencapai posisi
  }
  digitalWrite(4, HIGH);          // LED Green ON --> Yellow
  delay(2000);                    // tunggu 2 detik
  digitalWrite(2, LOW);           // LED Red OFF --> Green
}
```

# Servo Motor with RGB LED [4/4]

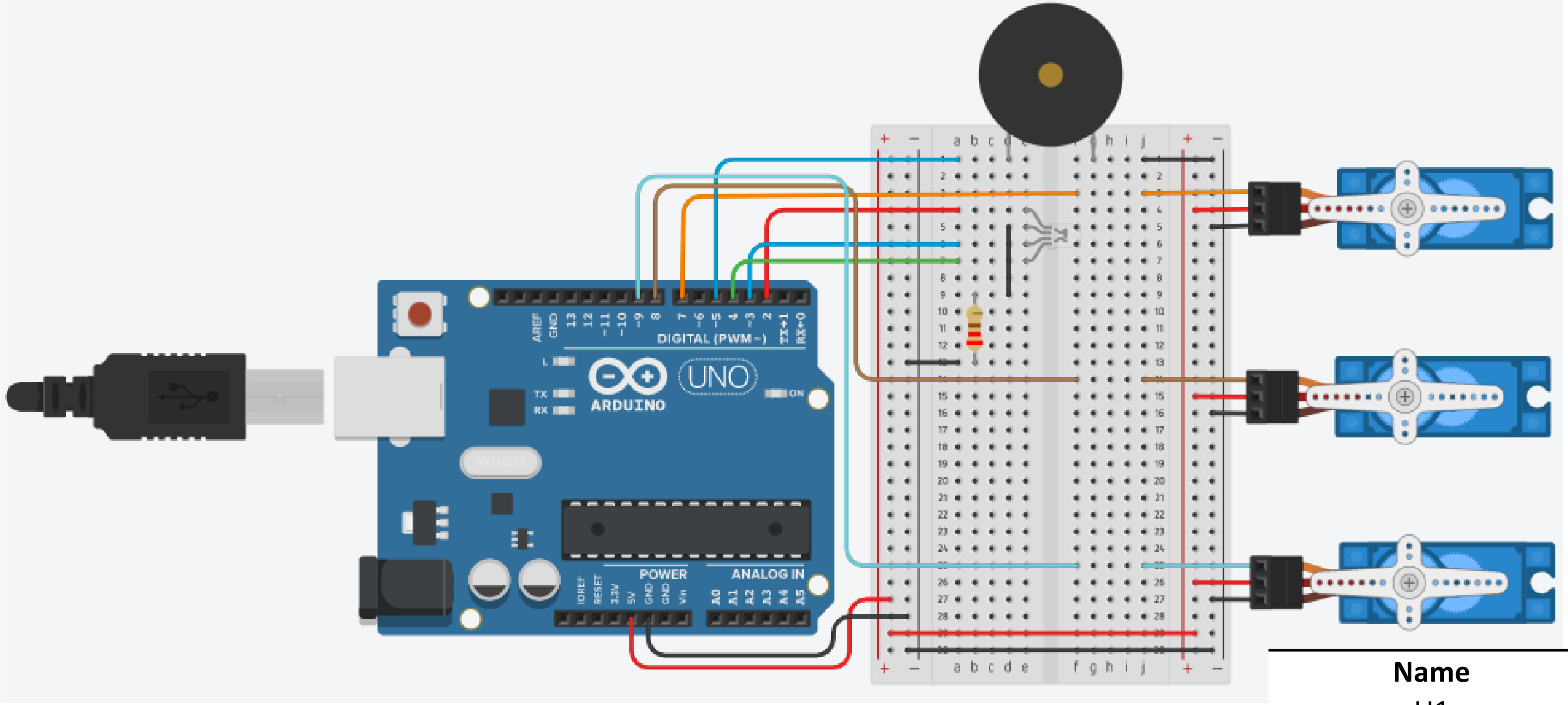


# 3 Servo Motor with 3 LED



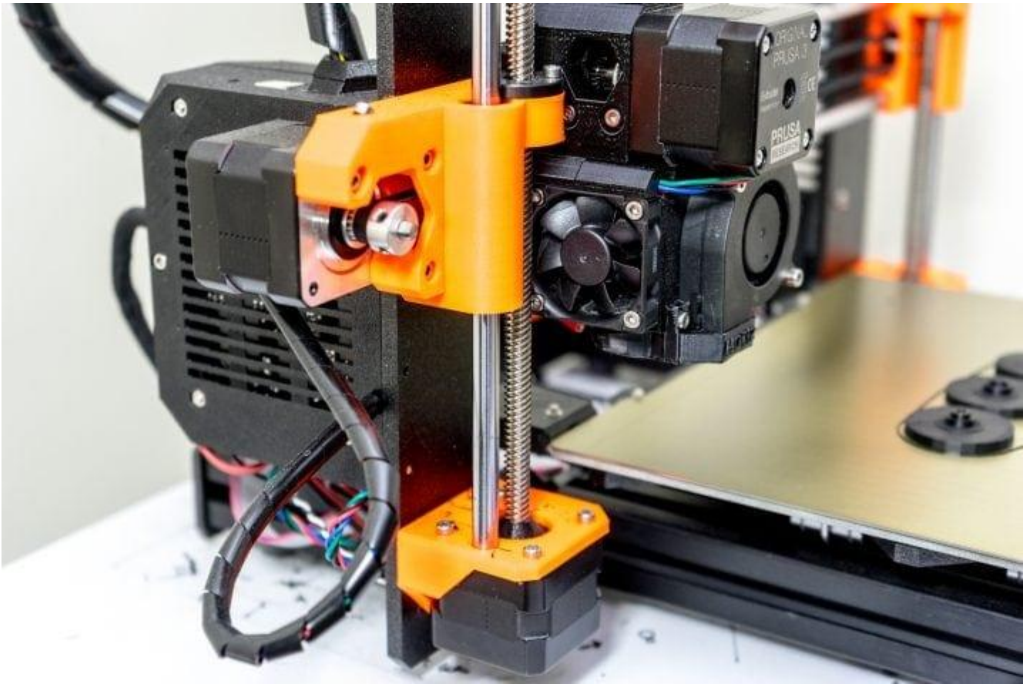

| Name | Quantity | Component |
|---|---|---|
| U1 | 1 | Arduino Uno R3 |
| SERVO1,SERVO2,SERVO3 | 1 | Positional Micro Servo |
| D1 | 1 | Red LED |
| D2 | 1 | Yellow LED |
| D3 | 1 | Green LED |
| R1,R2,R3 | 1 | 220Ω Resistor |

# 3 Servo Motor with RGB LED

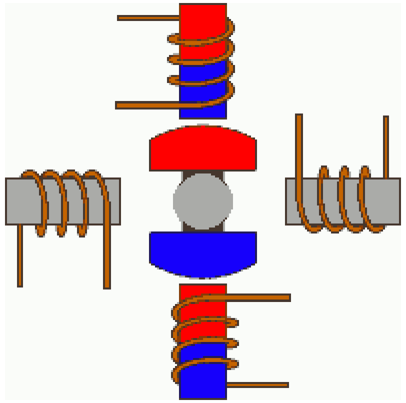



| Name | Quantity | Component |
|---|---|---|
| U1 | 1 | Arduino Uno R3 |
| SERVO1,SERVO2,SERVO3 | 1 | Positional Micro Servo |
| PIEZO1 | 1 | Piezo |
| R1 | 1 | 220Ω Resistor |
| D1 | 1 | LED RGB |

# Stepper Motor



Sumber: https://totemmaker.net/



Sumber: https://www.seeedstudio.com/

# Penutup

# Kesimpulan

- Actuator
  - Perangkat untuk mengubah sinyal listrik menjadi gerak/panas.
- Motor
  - **DC Motor**: mudah dikendalikan, putaran kontinu
  - **Servo Motor**: banyak variasi, putaran akurat (sudut terbatas)

# Terima Kasih