

Driving Different Motors with Arduino



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Outline I

1 Basic AC/DC Motor

Basics of Motors

Analog Control

Digital Control

2 Stepper Motor

3 Servo Motor

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Basic Principle of Motors

Theorem (Biot-Savart Law)

$$\mathbf{B} = \frac{\mu_0}{4\pi} \oint_{C_1} \frac{I d\mathbf{l}' \times \hat{\mathbf{R}}}{R^2}$$

Theorem (Lorentz's equation)

$$\mathbf{F} = q\mathbf{v} \times \mathbf{B}$$

AC vs DC Motors

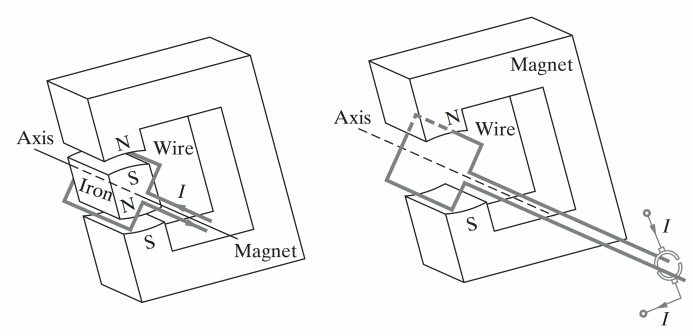


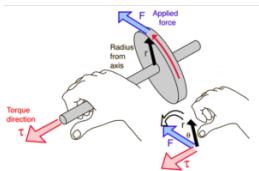
Figure: Simple dc motor. (Inan 2015)

Torque and Power

How much torque is needed to lift this?

Theorem (Torque)

$$\tau = F \times r$$



(Linear Motion Tips)

How much power do I need to drive this motor?

Theorem (Power)

$$P = I \times V$$

(Energy per unit time)

Analog Control

Theorem (Ohm's Law)

$$V = A \times R$$

, or

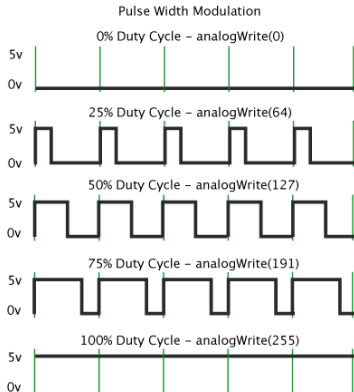
$$A = \frac{V}{R}$$

- Simple, accurate, predictable
- Power source = control unit
- Hard to implement on microcontroller

Digital Control: PWM

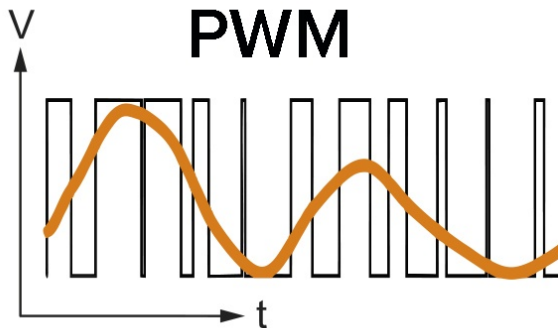
Pulse Width Modulation

- Easy to implement on microcontroller
- Easy manipulation
- Inaccurate approximation
- Power and control unit saperated



(Arduino)

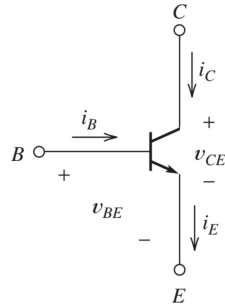
PWM Approximation



(Thomson Linear)

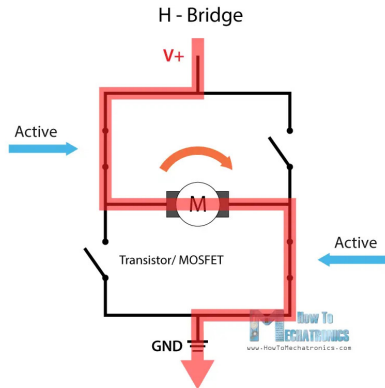
Saperated Power and Control Unit

- Scale of current:
 - 2A: Fry a human
 - 0.35A: DC Motor
 - 20mA: Arduino Pinout
- Saperate power and signal circuit
 - MOSFET
 - Bipolar Junction Transistor
 - Relay
 - H-Bridge



BJT. (Hambly 2018)

L298N Motor Driver



(HowToMechatronics.com)

- ENA to pin 9 (PWM)
- IN1, IN2 to pin 5, 6
- GND and 12V to pwr supply
- OUT1, OUT2 to motor

PWM Implementation

```
1  int speed = 255;
2  String inputStr = "";
3  bool clean = false;
4
5  void setup() {
6      inputStr.reserve(200);
7      Serial.begin(9600);
8      // put your setup code here, to run once:
9      pinMode(5, OUTPUT);
10     pinMode(6, OUTPUT);
11     pinMode(9, OUTPUT);
12
13     digitalWrite(5, 1);
14     digitalWrite(6, 0);
15 }
```

analogWrite()

```
1 void loop() {  
2     // put your main code here, to run repeatedly:  
3     if (clean) {  
4         analogWrite(9, inputStr.toInt());  
5         Serial.println(inputStr.toInt());  
6         // clear the string:  
7         inputStr = "";  
8         clean = false;  
9     }  
10  
11 }
```

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