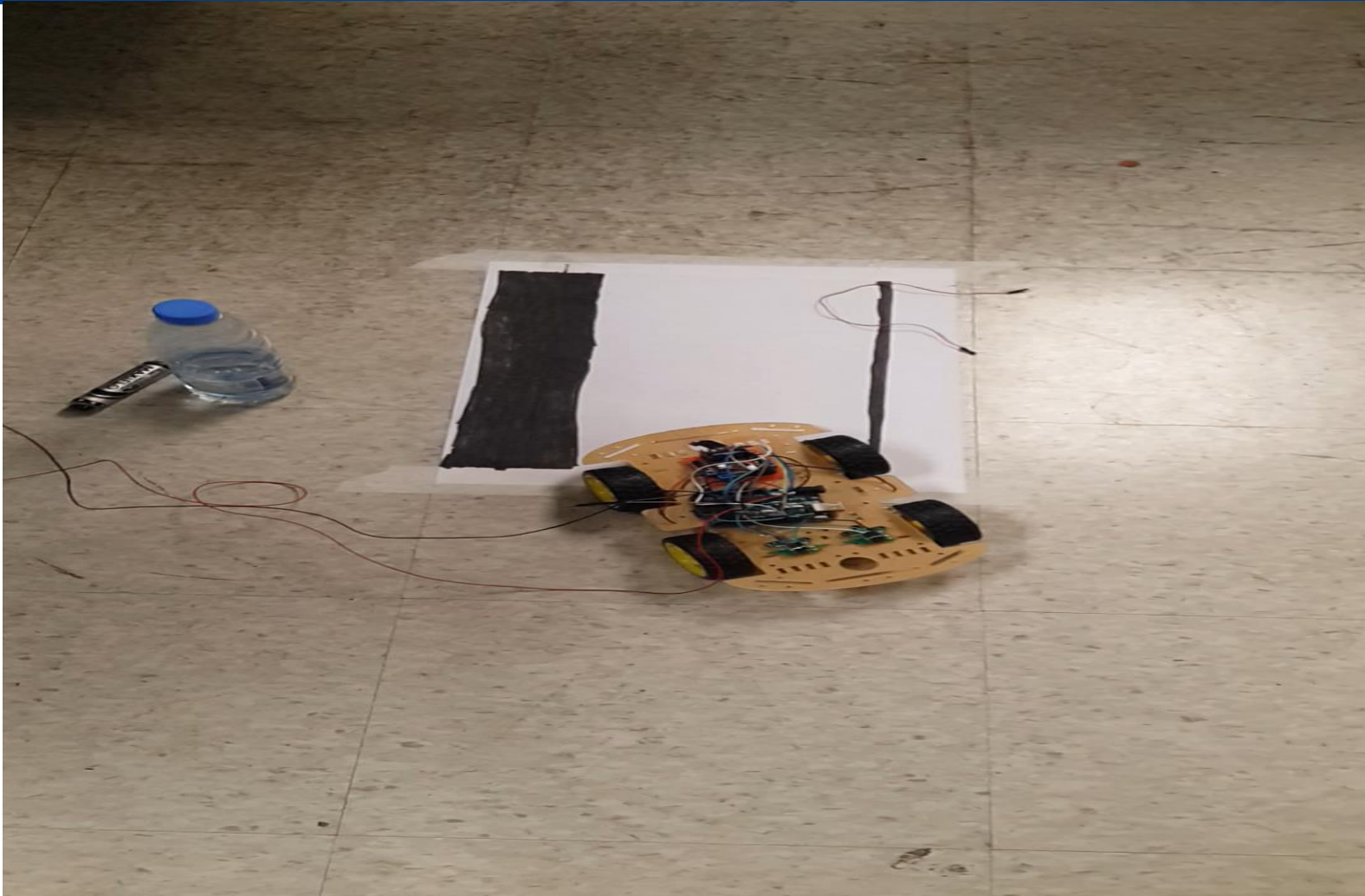


Welcome to

# Mobile Robot Manipulation

# Motivation



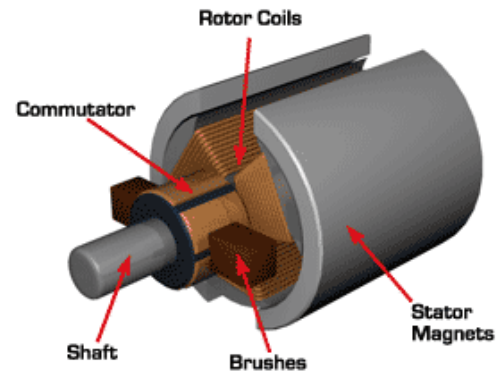
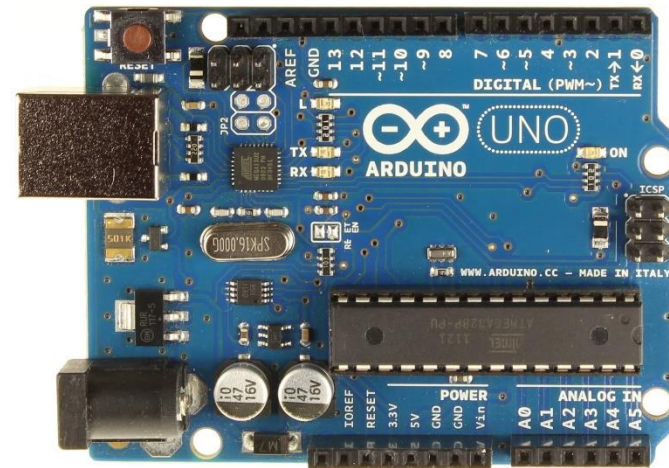
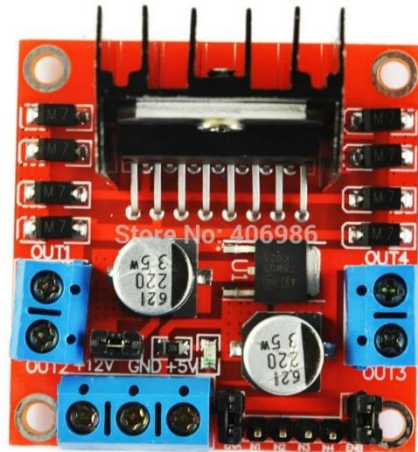
# Outline

- Components to be used
  - Electronics
  - Sensors
- Testing Components
- Line Tracking
  - On/ OFF controller
  - P controller

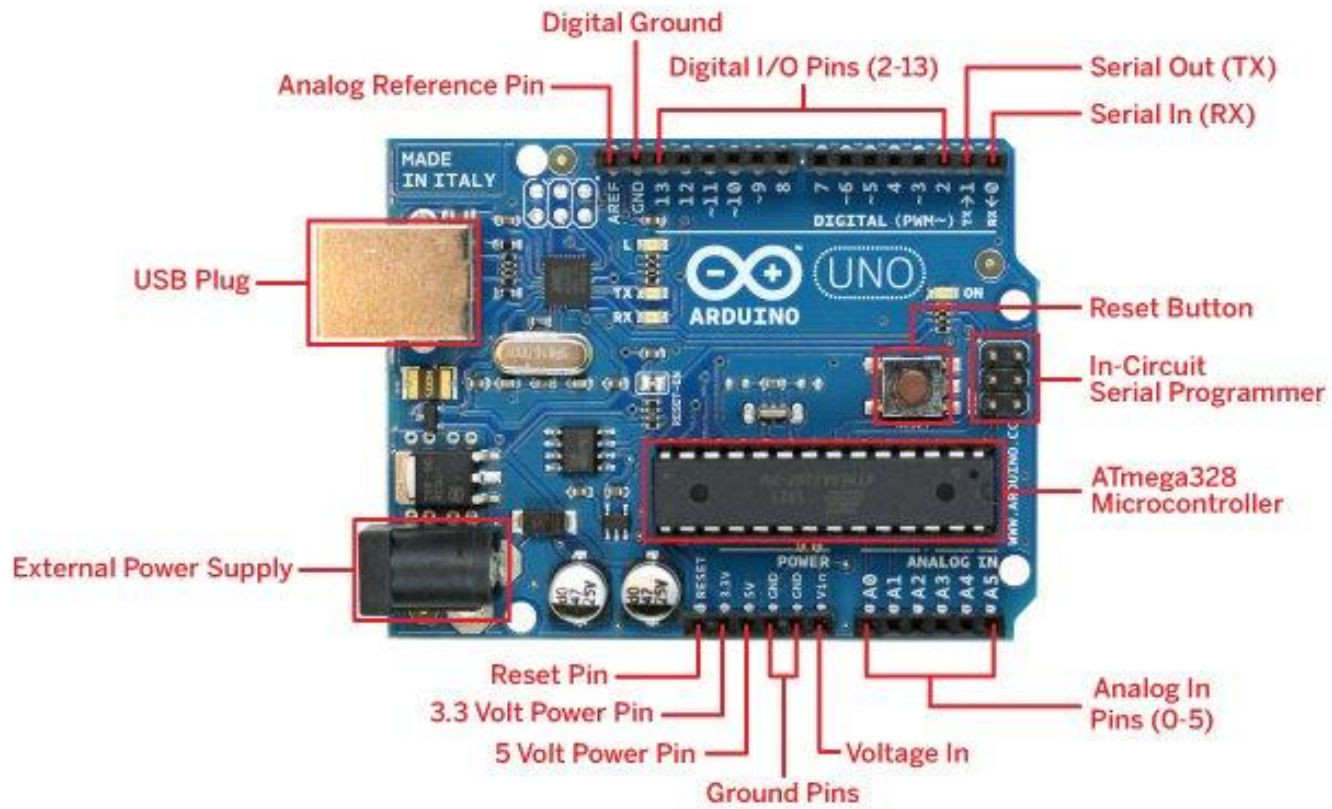
# Components needed

- Electronics:
  - Microcontroller: Arduino
  - Motors
  - H-Bridge
- Sensors
  - Encoders
  - Line Tracker
  - Accelerometer

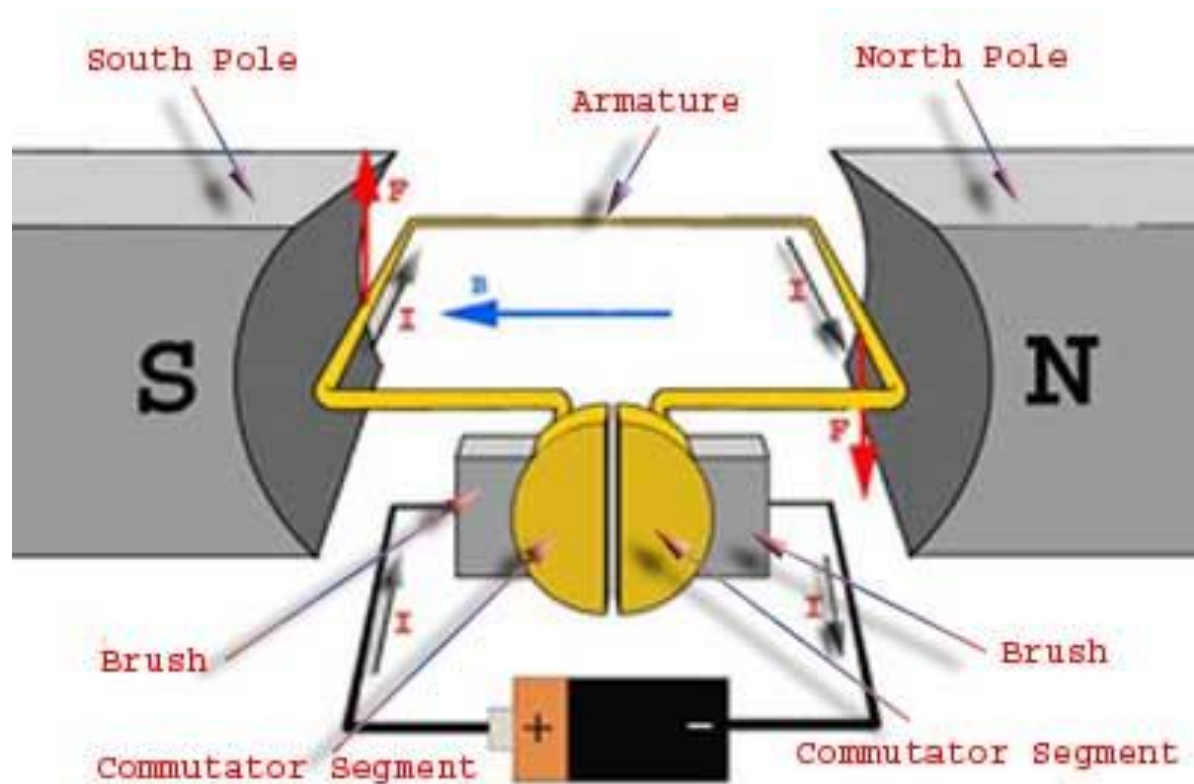
# Electronics



# Arduino

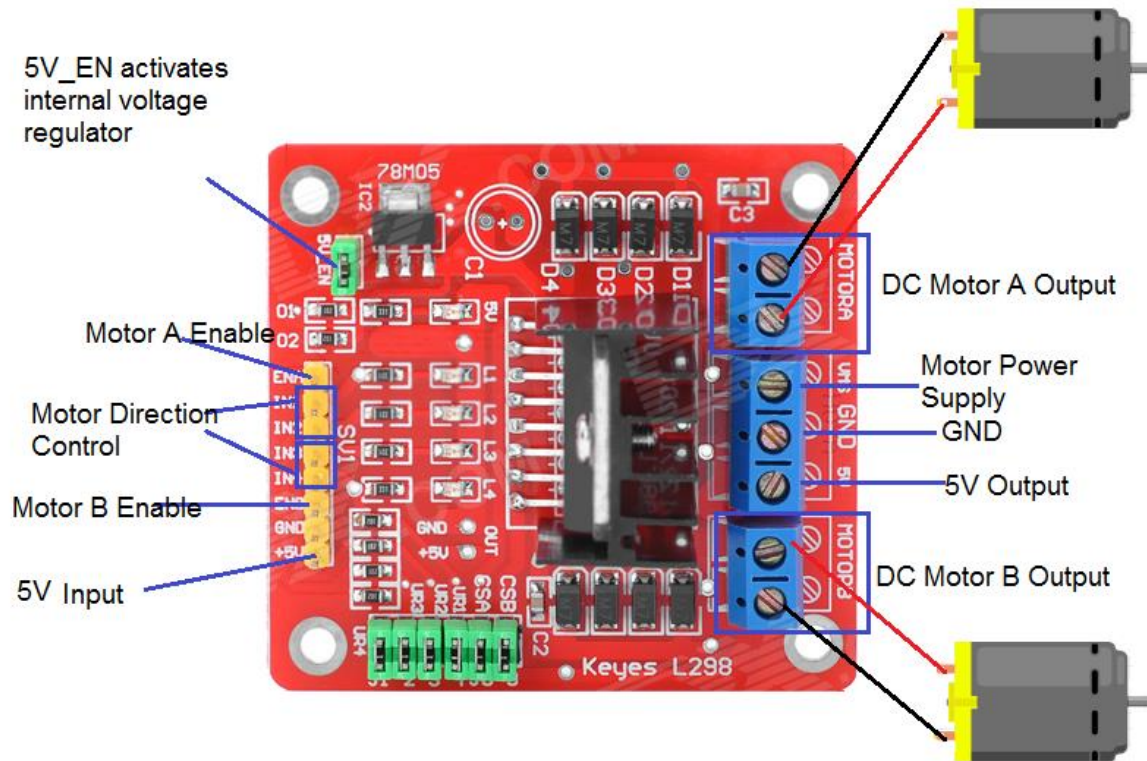


# DC motors





# H-Bridge





# Testing H-Bridge

- Digital pins: 6
  - PWM 2
  - Direction 4
- Motor 1 output
- Motor 2 output
- Power supply

```
int E1 = 10;    //M1 Speed Control
int E2 = 9;    //M2 Speed Control
int M1 = 4;    //M1 Direction Control
int M11 = 5;

int M2 = 7;    //M1 Direction Control
int M22 = 6;

void stop(void)           //Stop
{
    digitalWrite(E1,0);
    digitalWrite(M1,LOW);
    digitalWrite(M11,LOW);
    digitalWrite(E2,0);
    digitalWrite(M2,LOW);
    digitalWrite(M22,LOW);
}

void advance(char a,char b) //Move forward
{
    analogWrite (E1,a);    //PWM Speed Control
    digitalWrite(M1,HIGH);
    digitalWrite(M11,LOW);
    analogWrite (E2,b);
    digitalWrite(M2,HIGH);
    digitalWrite(M22,LOW);
}
```

# Sensors

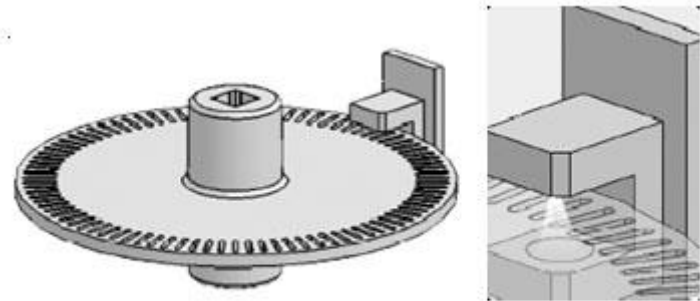
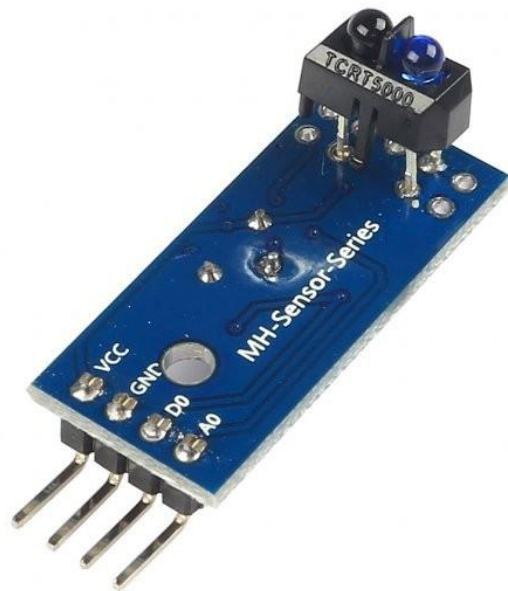
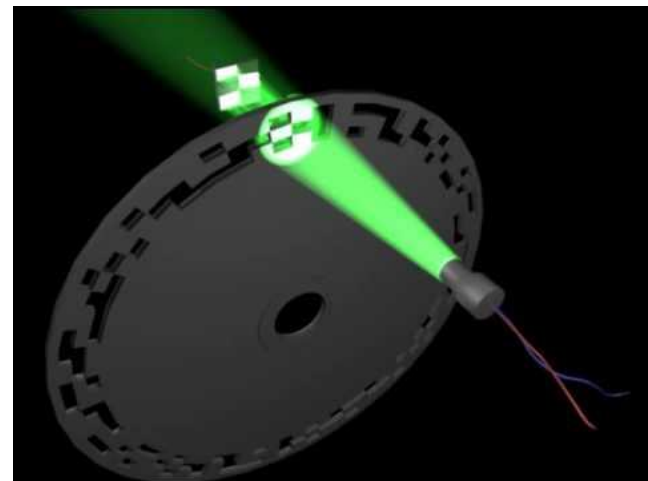
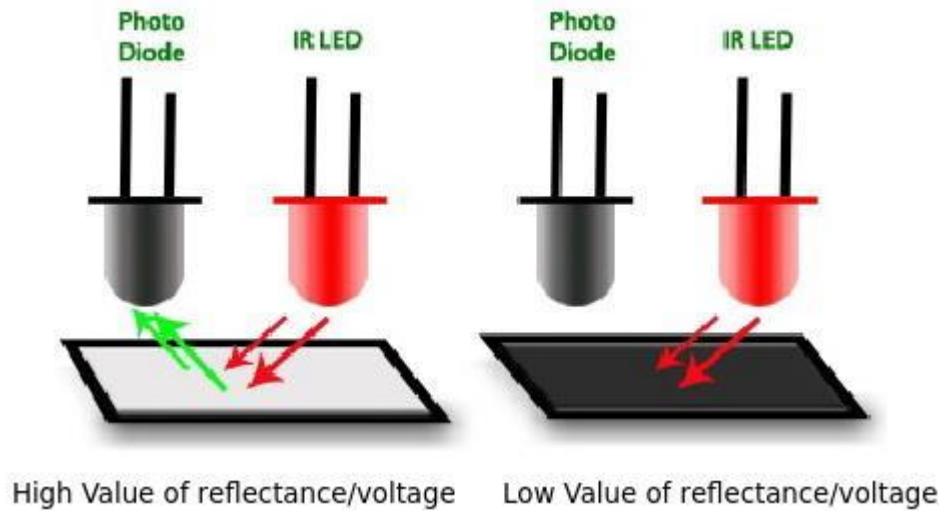


Figure 2. Optical shaft encoder disk



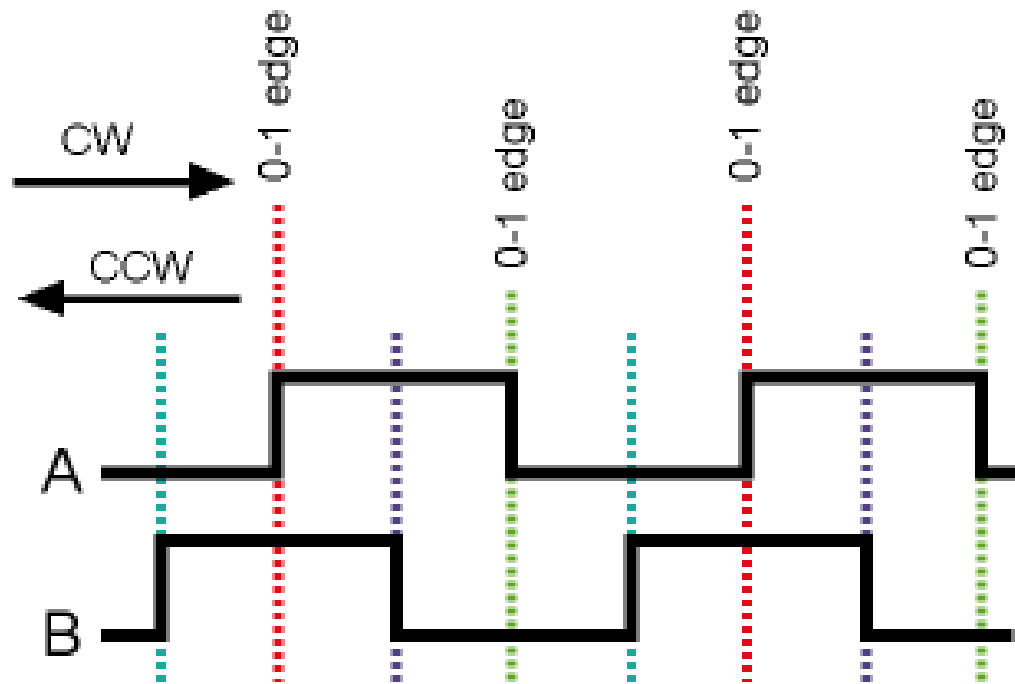
# Line Tracking Sensor



# Testing Line Tracker

- 5V, GND, Do, Ao
- ```
if(digitalRead(Dopin)==1){  
    Display;  
}
```
- ```
Serial.println(analogRead(0));
```

# Encoders



# Testing Encoder

- Interrupts:
  - Increment Clicks
- Linear distance =  $2 * \pi * r * (\text{delta ticks}) / (\text{total number of ticks})$

```
Wokrshop_main $  
  
//  
attachInterrupt(digitalPinToInterrupt(2), rtEncoderInterrupt, RISING);  
attachInterrupt(digitalPinToInterrupt(3), ltEncoderInterrupt, RISING);  
  
}  
  
void loop(void)  
{  
  digitalWrite(12, HIGH);  
  
}  
  
void rtEncoderInterrupt()  
{  
  Rindex++;  
  delay(50);  
  if(Rindex > 300){  
    Rindex = 0;  
  }  
}  
  
void ltEncoderInterrupt()  
{  
  Lindex++;  
  delay(50);  
  if(Lindex > 300){  
    Lindex = 0;  
  }  
}  
  
}
```

# Line Tracking – ON/OFF

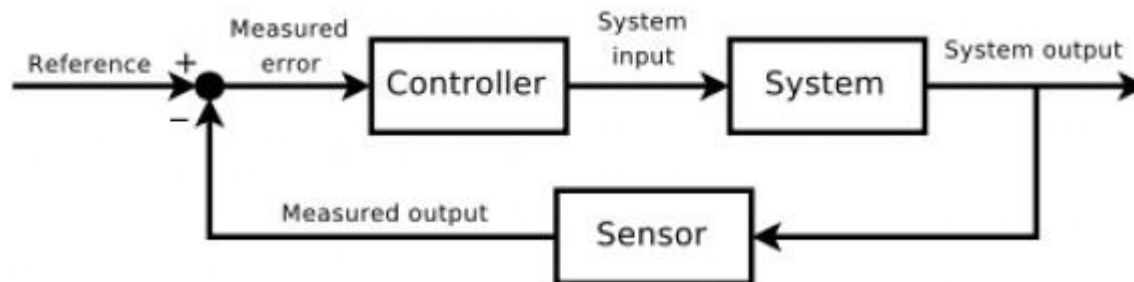
- ON / OFF
- Line Tracking Digital
- ON: move right
- OFF: move left
- Zig Zag motion

```
if(digitalRead(11) == HIGH){  
  mshee(125,0);  
  Serial.println("Hi you");  
}  
  
else{  
  mshee(0,125);  
  Serial.println("Bye you!");  
}
```



# Line Tracking – P controller

- Control Theory
- Line Tracking Analog
- Error between desired and current value



# Line Tracking

```
Serial.println(analogRead(0));
int error = 700 - analogRead(0);
double kerror = error*kp;
double actsig1 = bias + kerror;
double actsig2 = bias - kerror;

if(actsig1 < 0){
  actsig1 =0;
}
else if(actsig1 > 255){
  actsig1 = 255;
}

if(actsig2 < 0){
  actsig2 =0;
}
else if(actsig2 > 255){
  actsig2 = 255;
}

mshee(actsig2,actsig1);

Serial.print(actsig1);Serial.print(" ");Serial.println(actsig2);
```

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