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Day 3:
ESP32 Hands-on Training
Sensor Integration using Wokwi

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Today's Learning Objectives

- Read digital inputs
- Generate PWM signals
- Read analog inputs
- Build a mini project

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Today's Agenda

- Push Button
- RGB LED
- Buzzer
- Potentiometer
- LDR
- DHT

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Push Button

A push button is a simple electromechanical switch mechanism used to control an aspect of a machine or process. Actuated by physically pressing the button, it either completes (closes) or interrupts (opens) an electrical circuit, allowing or stopping the flow of current.

Structure and Operating Principle of a Push Button

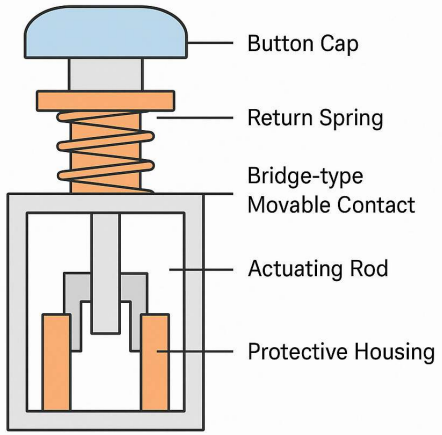

Figure: Structure and operating principle of a push button

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Types of Push Buttons

When you press a push button, the internal contacts move to connect or disconnect the terminals. Depending on the application, a push button can be configured in two main ways:

- **Normally Open (NO):** The default state is open (no current flows). Pressing the button closes the circuit to activate the device.
- **Normally Closed (NC):** The default state is closed (current flows). Pressing the button breaks the circuit to stop the device.

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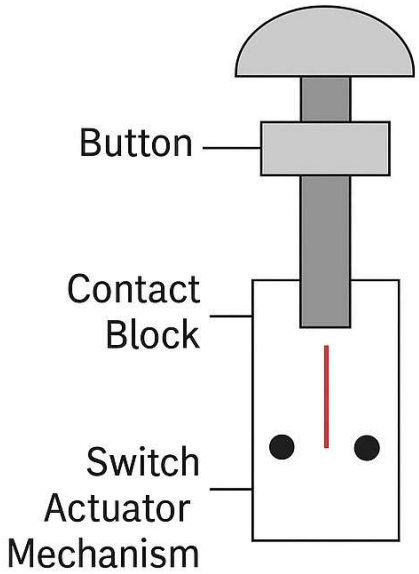
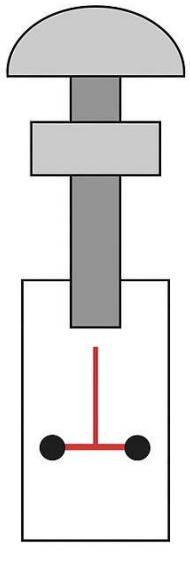
NO (Normally Open) Push Button Switch



NC (Normally Closed) Push Button Switch



Push ButtWorking Principles of NO-Push Button Switch

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Pull-up and pull-down resistors are used in digital circuits to ensure that an input pin always has a stable, defined voltage state (either High or Low) when no active signal is present. This prevents the pin from "floating" and picking up erratic electrical noise.

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Pull-Up Resistors

- **What it does:** Connects the input pin to a positive voltage source (like \(V_{CC}\) or 5V) through a resistor.

Default State: The pin reads **HIGH** (logic 1).**Action:** When a switch (or button) is pressed, it connects the pin directly to the ground, overriding the resistor and causing the pin to read **LOW** (logic 0).

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Pull-Down Resistors

- **What it does:** Connects the input pin directly to the ground (GND) through a resistor.
- **Default State:** The pin reads **LOW** (logic 0).
- **Action:** When a switch (or button) is pressed, it connects the pin to a positive voltage source, overriding the resistor and causing the pin to read **HIGH** (logic 1).

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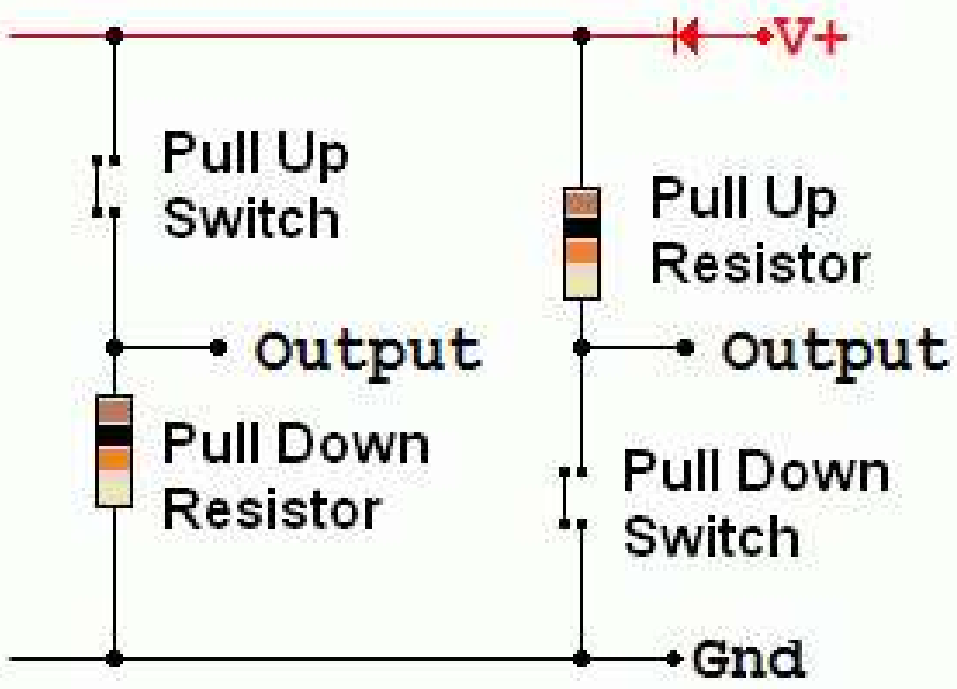

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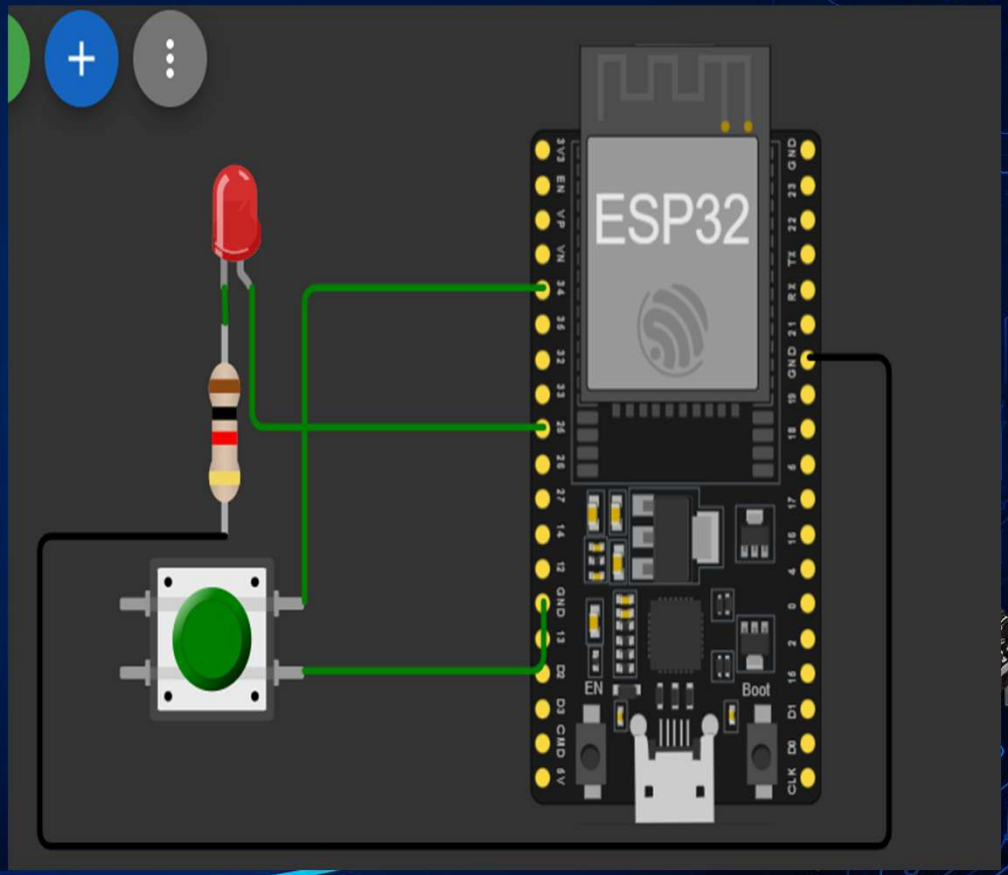
```ino
const int buttonPin = 34;
const int ledPin = 25;

void setup() {
  pinMode(buttonPin, INPUT_PULLUP);
  pinMode(ledPin, OUTPUT);
}

void loop() {
  int buttonState = digitalRead(buttonPin);

  if (buttonState == LOW) {
    digitalWrite(ledPin, HIGH);
  } else {
    digitalWrite(ledPin, LOW);
  }
}
```



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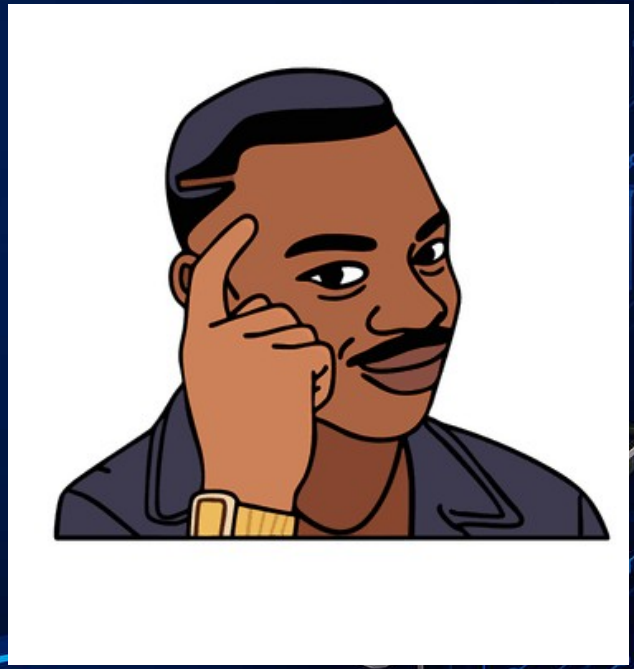
Challenge : Add This Logic to Print Button Status on Serial Monitor

```
 if(buttonState == LOW)
{
digitalWrite(ledPin,HIGH);
Serial.println("Button Pressed");
}
else{
digitalWrite(ledPin,LOW);
Serial.println("Button Released");
}
```



Share screenshot on Whatsapp Group

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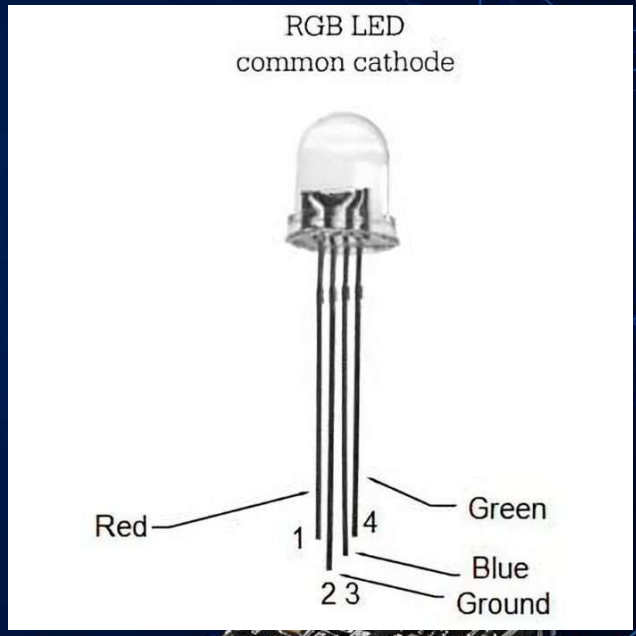
RGB LED

What is an RGB LED?

An RGB LED is a single LED package that contains **three LEDs**:

- Red
- Green
- Blue

By varying the brightness of each color using **PWM (Pulse Width Modulation)**, millions of colors can be created.



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Types of RGB LEDs

Type	Common Pin	Logic
Common Cathode	GND	HIGH = ON
Common Anode	3.3V/5V	LOW = ON

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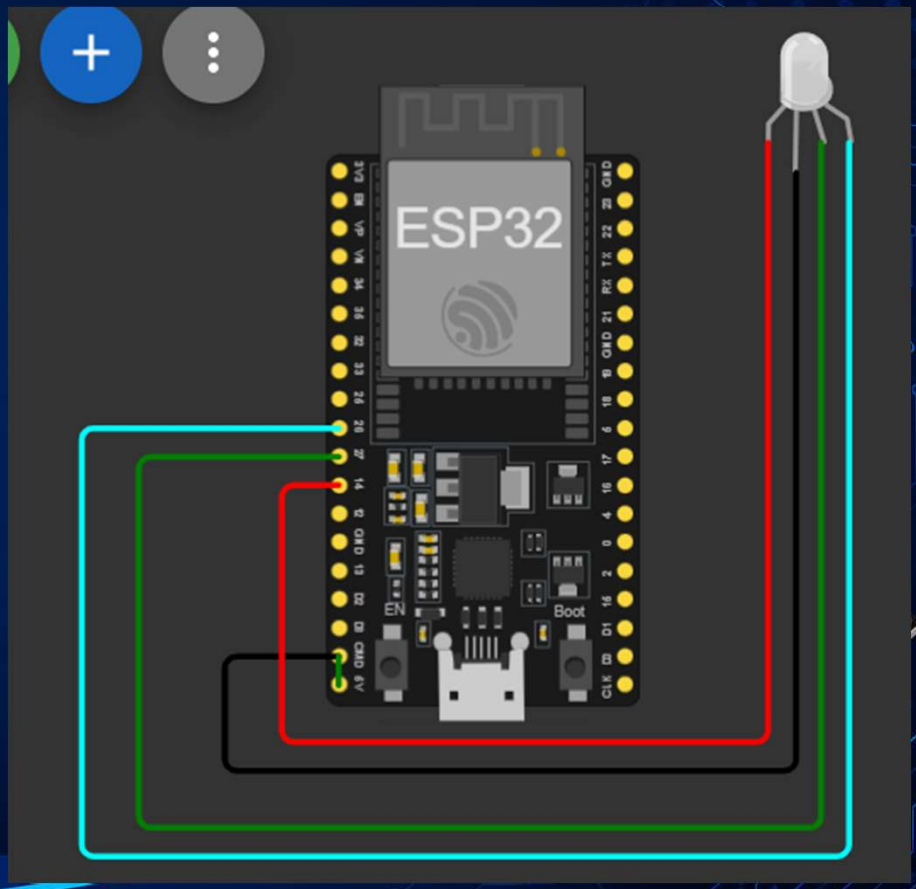
```
const int redPin = 14;
const int greenPin = 27;
const int bluePin = 26;

void setup() {
  pinMode(redPin, OUTPUT);
  pinMode(greenPin, OUTPUT);
  pinMode(bluePin, OUTPUT);
}


void loop() {

  // Red
  digitalWrite(redPin, HIGH);
  digitalWrite(greenPin, LOW);
  digitalWrite(bluePin, LOW);
  delay(1000);

  // Green
  digitalWrite(redPin, LOW);
  digitalWrite(greenPin, HIGH);
  digitalWrite(bluePin, LOW);
  delay(1000);

  // Blue
  digitalWrite(redPin, LOW);
  digitalWrite(greenPin, LOW);
  digitalWrite(bluePin, HIGH);
  delay(1000);

}
```



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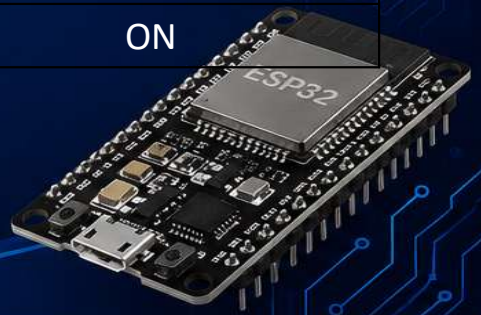
Challenge : Implement The Logic to display these Colours

Color	Red	Green	Blue
Red	ON	OFF	OFF
Green	OFF	ON	OFF
Blue	OFF	OFF	ON
Yellow	ON	ON	OFF
Cyan	OFF	ON	ON
Magenta	ON	OFF	ON
White	ON	ON	ON



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Buzzer

A buzzer is an electronic output device that converts electrical signals into sound. It is commonly used for alerts, alarms, and notifications in embedded systems.

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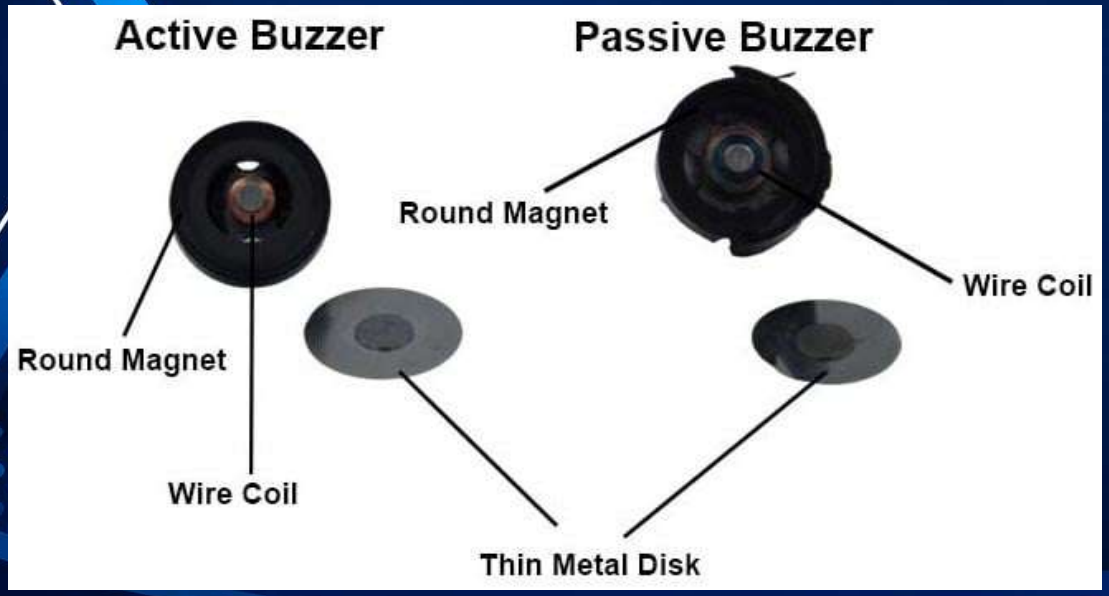
Types of Buzzers



Active Buzzer

- Has a built-in oscillator
- Produces sound by simply applying HIGH
- Easy to use

Passive Buzzer

- No internal oscillator
- Requires PWM or tone frequency
- Can play different notes and melodies

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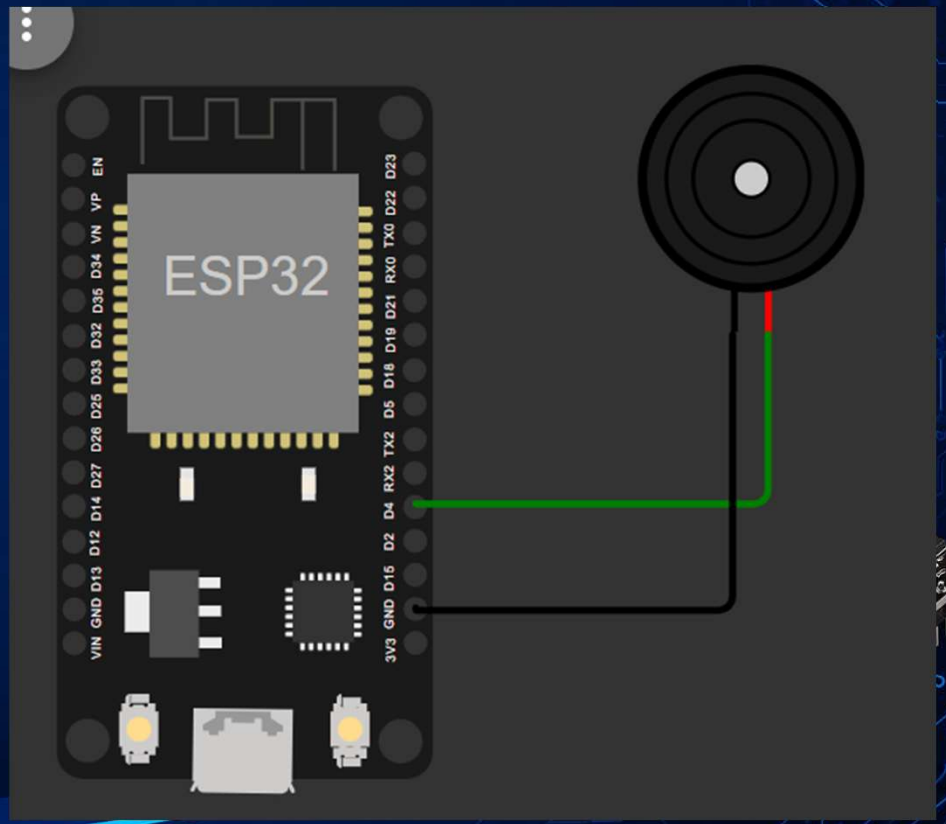
```ino
#define Buzzer 4
void setup(){
    Serial.begin(115200);
    Serial.println("Hello Buzz!");
    pinMode(Buzzer, OUTPUT);
}

void loop(){
    delay(1000);
    digitalWrite(Buzzer, HIGH);
    delay(1000);
    digitalWrite(Buzzer, LOW);
}
```



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Check How Melody Can play With Buzzer

https://wokwi.com/projects/468602899721643009

Bonus Challenge

- Add the RGB LED from the previous module.
- When the button is pressed:
  - RGB LED turns Green
  - Buzzer sounds
- Display **"Door Bell Activated"** in the Serial Monitor.

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Potentiometer

A potentiometer is a **variable resistor** used to adjust voltage manually. It is one of the most common analog input devices used with microcontrollers.

Working Principle

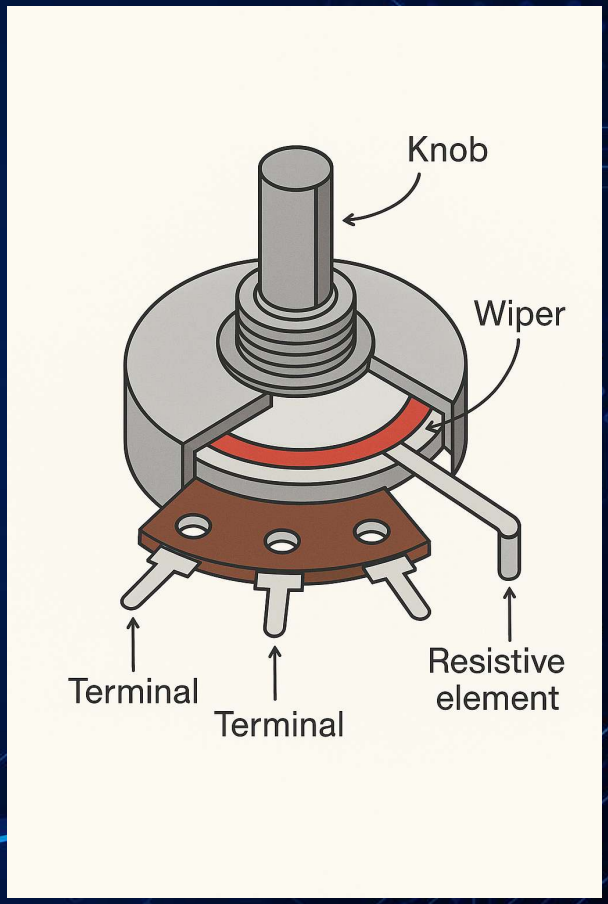
A potentiometer has **3 terminals**:

- **VCC (3.3V)**
- **GND**
- **Wiper (Signal Output)**

As the knob rotates, the voltage at the wiper changes from **0V to 3.3V**, which the ESP32 reads as an analog value.

Analog Range (ESP32)

- Minimum: **0**
- Maximum: **4095** (12-bit ADC)



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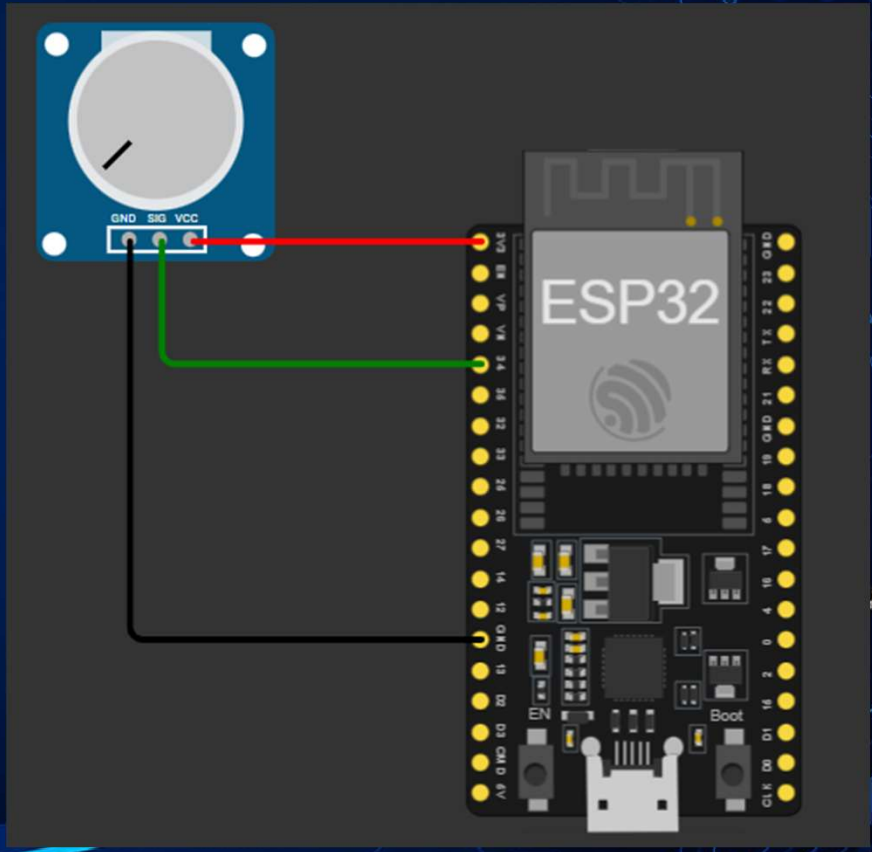
```ino
const int POT_PIN = 34;

void setup() {
  Serial.begin(115200);
}

void loop() {
  int rawValue = analogRead(POT_PIN);
  int percent  = map(rawValue, 0, 4095, 0, 100);
  Serial.print("Raw: ");
  Serial.print(rawValue);
  Serial.print("  |  Percent: ");
  Serial.print(percent);
  Serial.println("%");

  delay(300);
}
```



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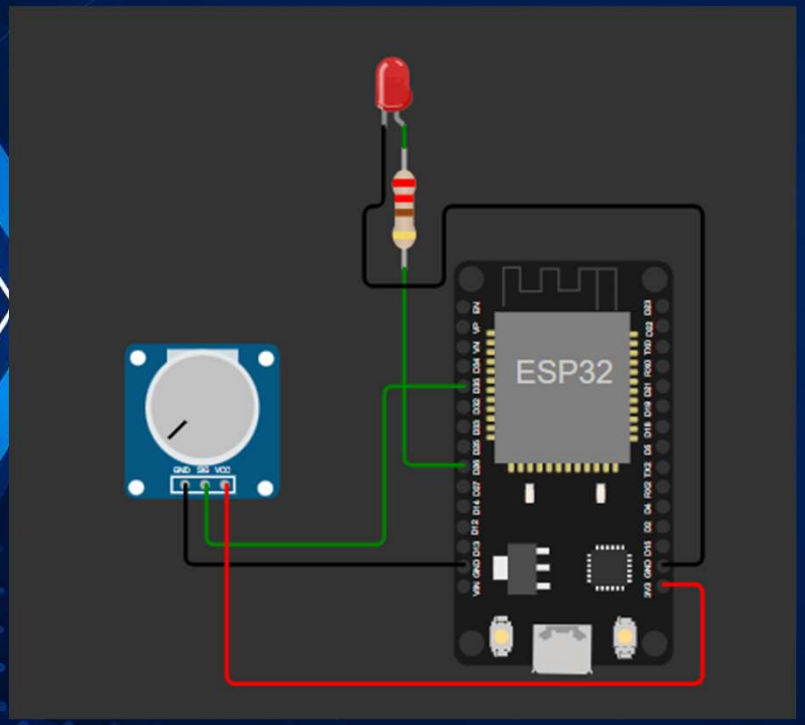

Challenge : Brightness Control using Potentiometer (PWM) ?