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ROBOTICS ASSIGNMENT

ASSIGNMENT I - STUDYING DC MOTOR WITH ARDUINO UNO USING TINKERCAD

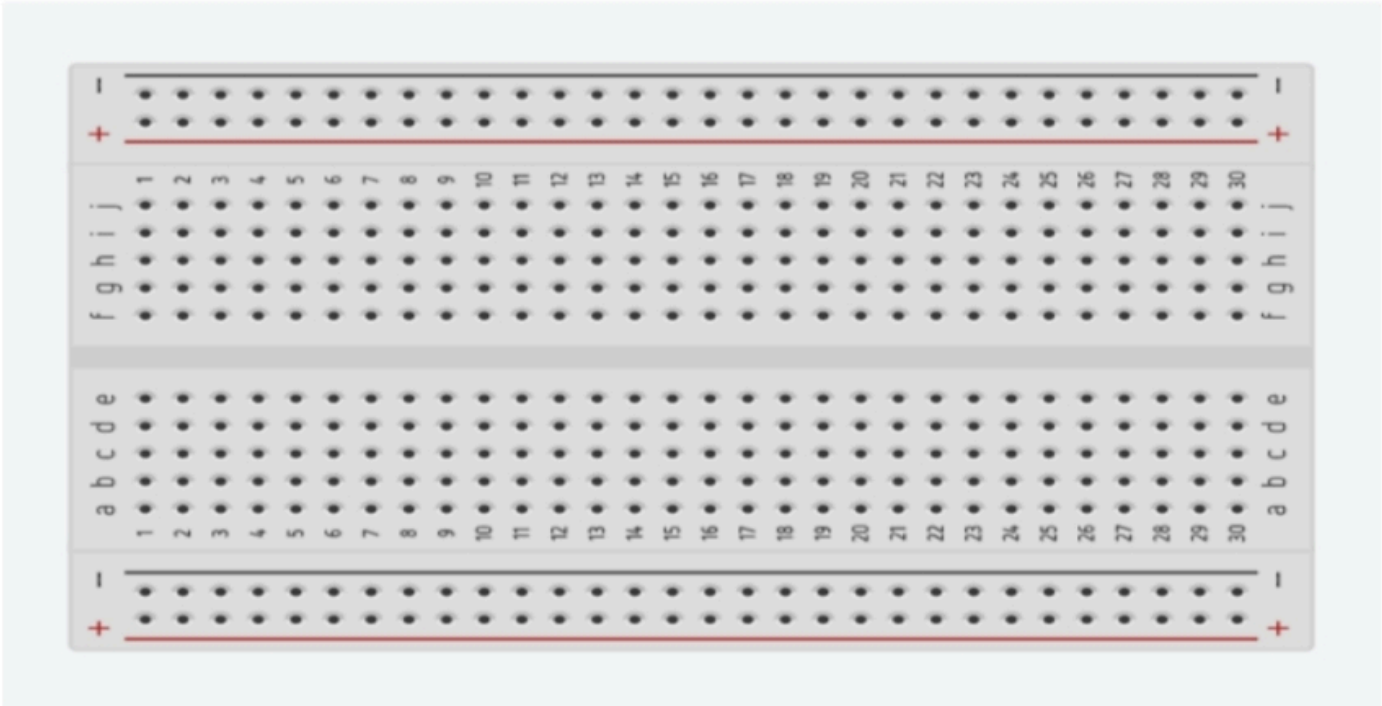
DC MOTOR WITH ARDUINO UNO

Introduction :

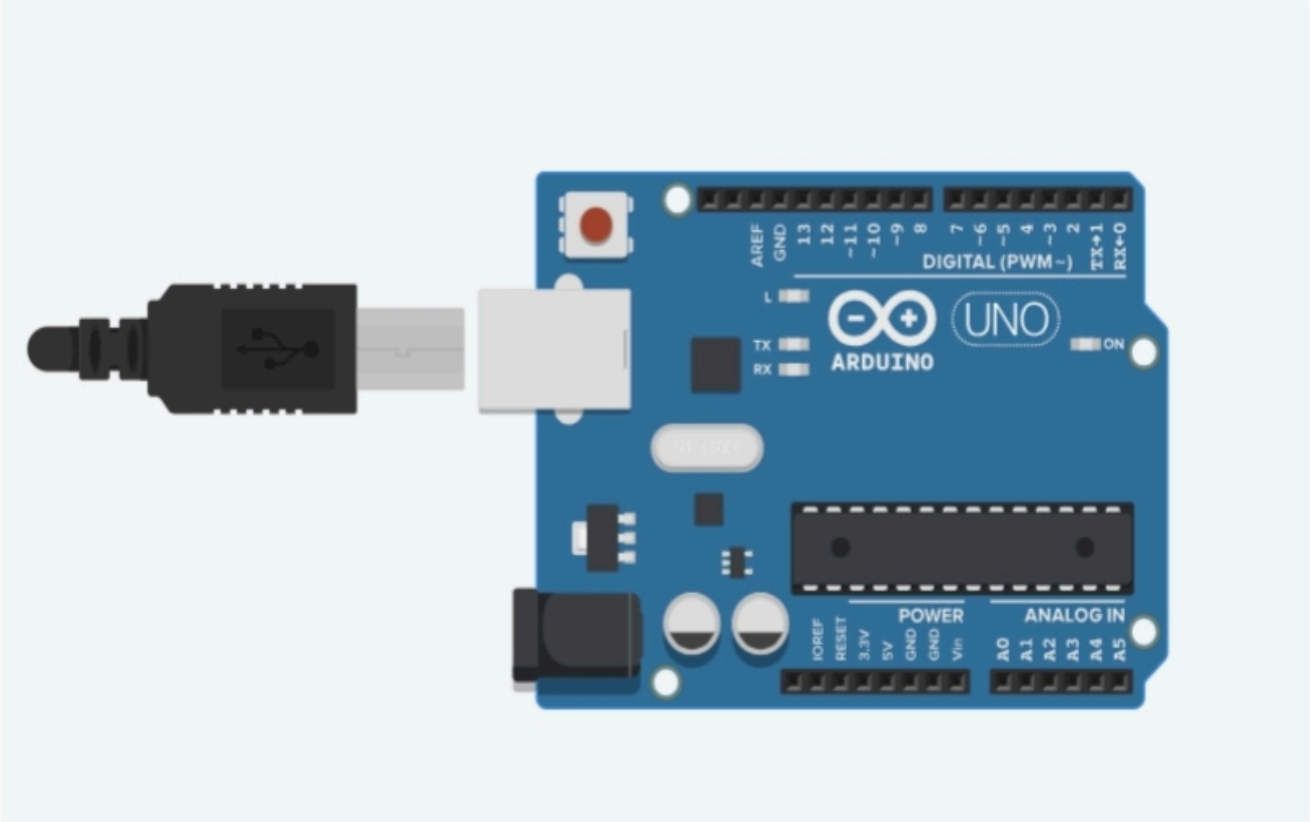
The speed of the DC motor, in general, is directly proportional to the supply voltage. Thus if the supply voltage is reduced to half, then the speed of the DC motor will also become half . But practically it is not possible to change the voltage to control the speed of the motor. Speed of motor can be changed using Pulse Width Modulation (PWM) by interfacing the DC motor with Arduino UNO.

Components Used :

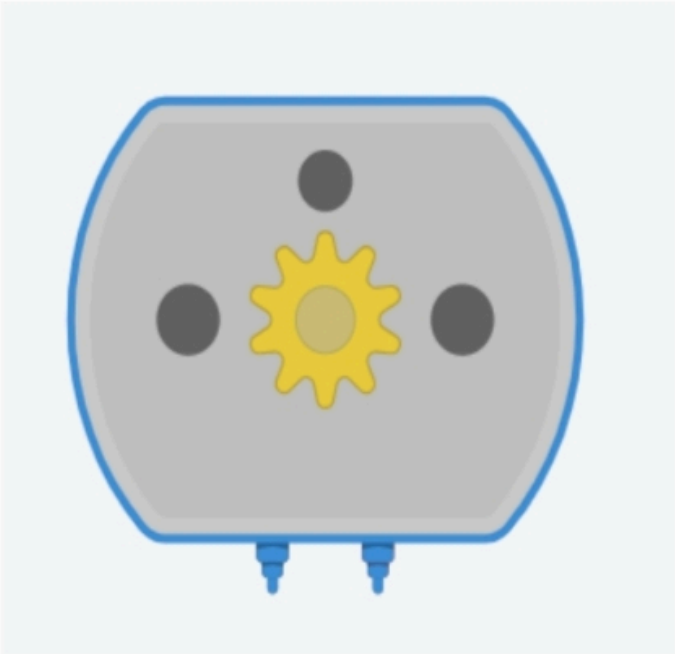
- **Breadboard :**



- **Arduino UNO :**



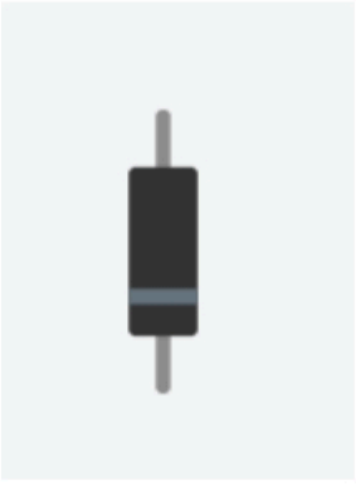
- **DC Motor :**



- **Resistor :**

- **Transistor :**

- **Diode :**



Definition :

- **Breadboard :**

A breadboard is a tool used for prototyping electronic circuits . It provides a grid of interconnected sockets where components can be placed and connected using wires.

- **Arduino UNO :**

Arduino UNO is an open-source microcontroller board . It is widely used for building electronics projects.

- **DC Motor :**

It is a type of electrical machine that converts electrical energy into mechanical energy. It takes electrical power through direct current and converts this energy to mechanical rotation.

- **Resistor :**

A resistor is an electronic component that resists the flow of electrical current, measured in ohms (Ω). In Arduino projects, resistors are often used to:

- Control the current flowing through an LED.
- Protect the Arduino board and connected components by limiting excessive current.

- **Transistor :**

It is a semiconductor device used to amplify or switch electronic signals. In motor control circuit, a transistor is used to switch a DC motor on or off, acting as a high-power switch controlled by the low-power signal from an Arduino pin.

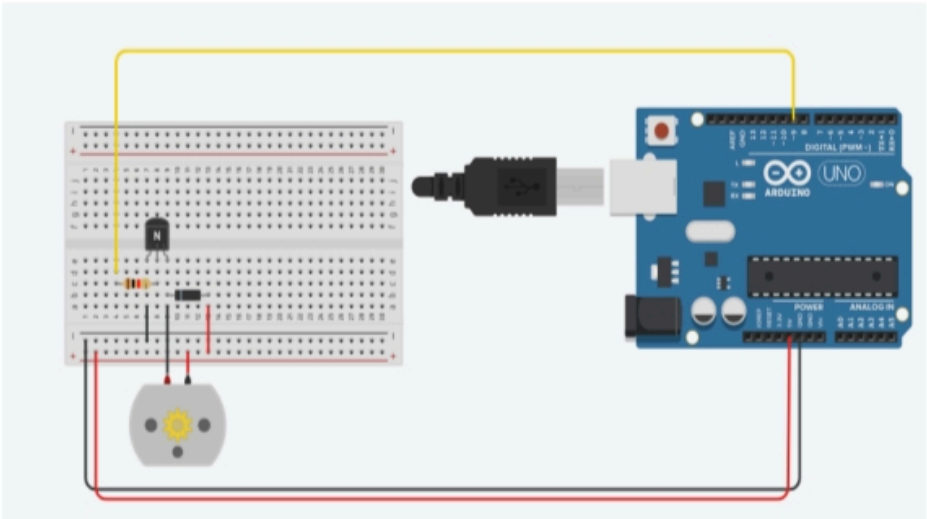
- **Diode :**

A diode is a semiconductor device that allows current to flow in one direction only. In motor circuits, a diode is placed in parallel with the motor to protect the circuit from back EMF generated when the motor turns off.

Circuit Connection :

- Initially, PIN of the Arduino UNO is used to supply the PWM signal to the base of the NPN transistor via a 220-ohm resistor.
- The Collector of the transistor is connected to terminal 1 of the DC motor.
- The Emitter of the transistor is connected to the ground.
- Terminal 1 of the DC motor is also connected to the diode which is further connected to the 5V supply.
- Terminal 2 of the DC motor is directly connected to the 5V supply.
- Power to the circuit will be provided by the Arduino UNO.

Connections :



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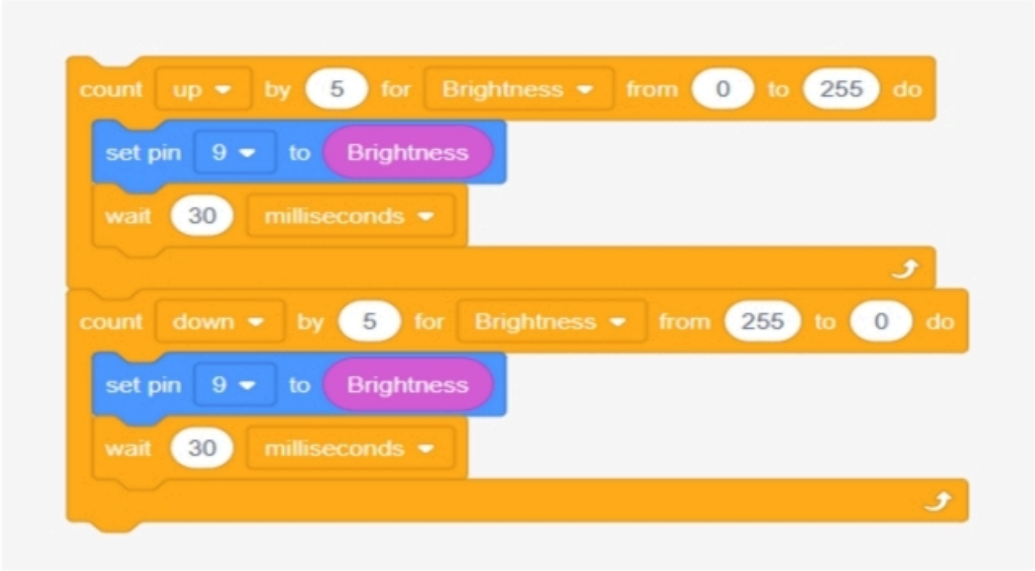


Text Code :

```
int Brightness = 0;

void setup()
{
  pinMode(9, OUTPUT);
}

void loop()
{
  for (Brightness = 0; Brightness <= 255; Brightness += 5) {
    analogWrite(9, Brightness);
    delay(30);
  }
  for (Brightness = 255; Brightness >= 0; Brightness -= 5) {
    analogWrite(9, Brightness);
    delay(30);
  }
}
```

Working Principle :

1. Arduino Controls the Transistor:
   - The Arduino UNO ,when controlling a DC motor, sends either a HIGH or LOW signal to a transistor (e.g., a NPN transistor).
   - The digital pin on the Arduino is connected to the base of the transistor. When the Arduino sends a HIGH signal (5V) to the transistor, the transistor turns ON, allowing current to flow from the collector to the emitter.
   - The emitter of the transistor is connected to ground (GND), and the collector is connected to the negative terminal of the motor.
2. Controlling the Motor with the Transistor:
   - When the transistor is ON, the motor can complete its circuit and receive current from an external power supply (e.g., 12V) connected to the positive terminal of the motor. The current flow through the motor causes it to rotate.
   - If the Arduino sends a LOW signal to the base of the transistor, the transistor is OFF, and no current flows to the motor. Thus, the motor stops.
3. Back EMF Protection with a Diode:
   - When the DC motor is running and then suddenly turned off, it generates back electromotive force (back EMF). It can damage the components in the circuit.
   - To protect the circuit, a diode is placed in parallel with the motor. The anode of the diode is connected to the negative terminal of the motor, and the cathode is connected to the positive terminal of the motor.
   - When the motor turns off, the diode allows the back EMF current to safely dissipate through the motor, protecting the circuit.

Conclusion :

By using Arduino UNO and a transistor, we can easily control a DC motor in Tinkercad. You can turn the motor on and off. The combination of Arduino and a NPN transistor makes it a simple yet powerful setup for controlling motors.

ASSIGNMENT II - STUDYING DC MOTOR AND HOW WE CAN USE IT WITH ARDUINO UNO USING TINKERCAD

SERVO MOTOR WITH ARDUINO UNO

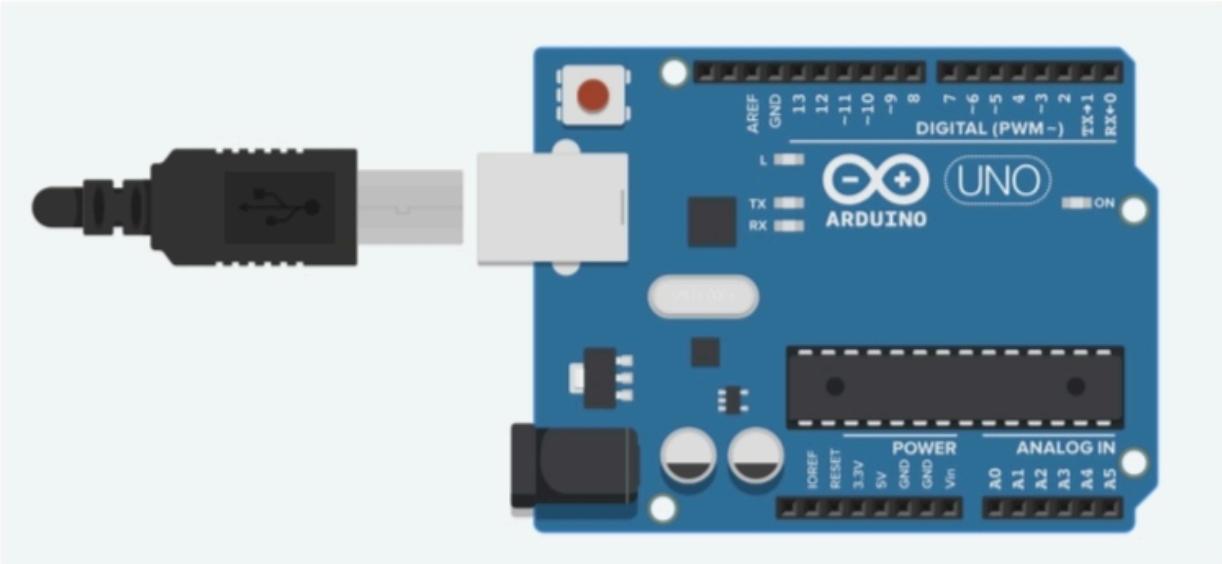
Servo Motor is basically an electric motor that is capable of providing very precise control of its angular position, velocity, and acceleration. It has wide applications in robotics, automation, and control systems where requiring the position and movements for desired purposes are proper sequences of actions. A servo motor is a special type of electric motor that has incorporated control circuitry within the main body. This is capable of receiving specific control commands, including moving to a preferred position.

The Servo library is a great library for controlling servo motors.

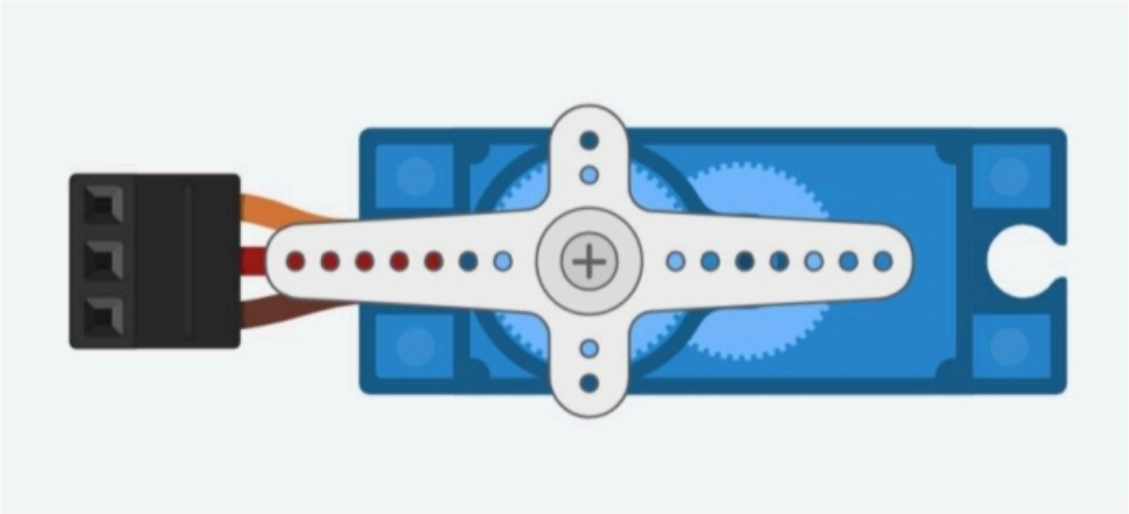
The controls the position of an RC (hobby) servo motor with Arduino. The sweeps the shaft of an RC servo motor back and forth across 180 degrees.

Components Used :

- Arduino Board :



- Servo Motor :



Definations :

Servo Motor: A kind of electrical motor operating at a certain position following a control signal, often in the form of PWM.

PWM: PWM (Pulse Width Modulation) is a control method of supplying an electrical device by varying the amount of power with the change in width of pulses in the signal.

Arduino UNO: microcontroller board programmable to output PWM in order to control motors, light, sensors, and many more.

Servo Library: This is one of the Arduino libraries that tends to simplify setting servo motors and can also be very helpful in a program for moving servo motors to specific angles.

Working Principle of Servo Motor with Arduino :

PWM Signal: The Arduino uses a PWM signal to communicate with the servo. This signal consists of a series of electrical pulses, where the width (duration) of the pulse determines the position of the servo.

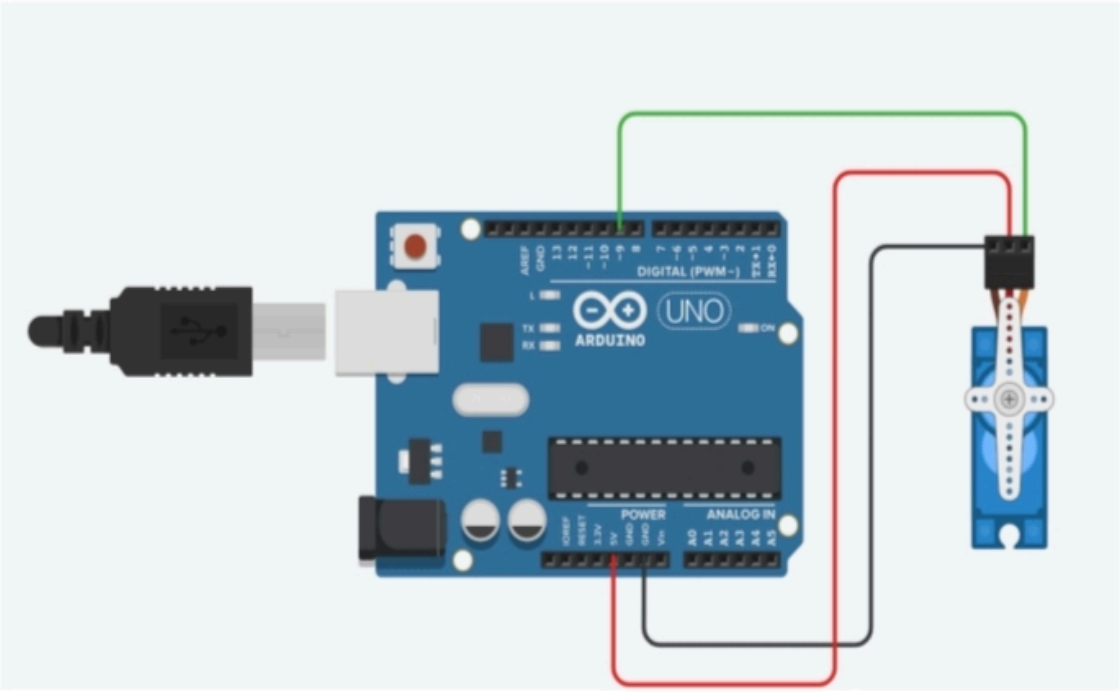
- A typical servo motor uses a pulse every 20 milliseconds (50Hz frequency).
- The duration of the pulse determines the servo's angle. For example:
  - A 1ms pulse may correspond to 0°.
  - A 1.5ms pulse may correspond to 90°.
  - A 2ms pulse may correspond to 180°.

Angle Control: The PWM signal is sent to the servo motor's control circuit, which adjusts the motor's internal gears to turn the shaft to the desired angle. The servo will attempt to hold that position until a new command is received.

Connect the Servo Motor :

- Red wire (power) of the servo motor connects to the 5V pin of the Arduino.
- Black/Brown wire (ground) of the servo motor connects to the GND pin on the Arduino.
- Yellow/White wire (signal) of the servo motor connects to Pin 9 on the Arduino.

Connections :



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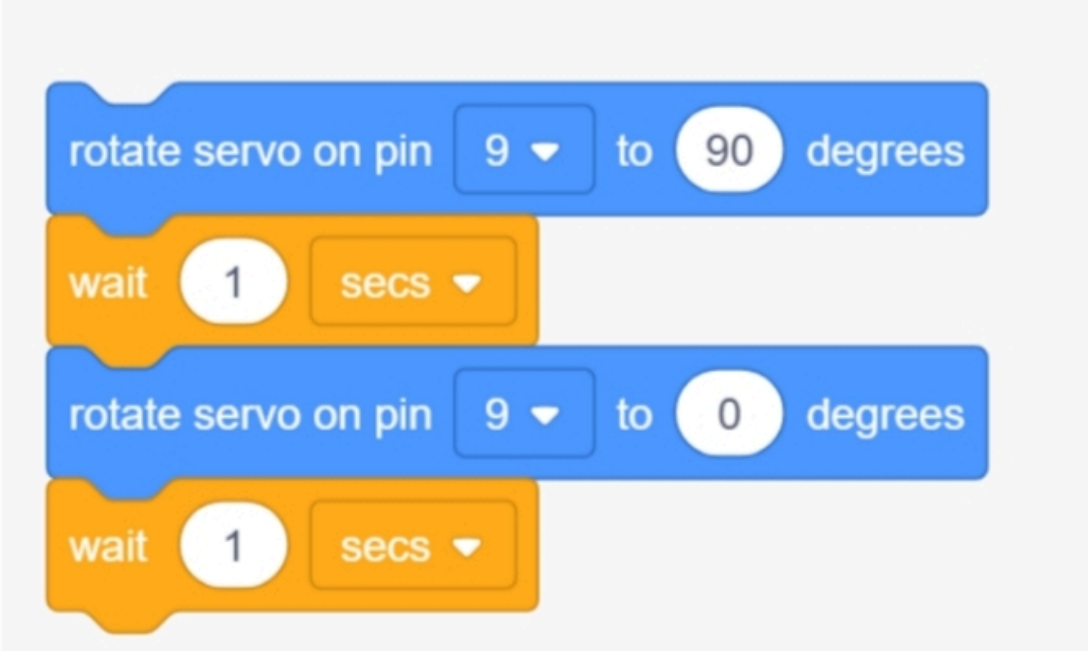

Text code :

```
// C++ code
//
#include <Servo.h>

Servo servo_9;

void setup()
{
  servo_9.attach(9, 500, 2500);
}

void loop()
{
  servo_9.write(90);
  delay(1000); // Wait for 1000 millisecond(s)
  servo_9.write(0);
  delay(1000); // Wait for 1000 millisecond(s)
}
```

Servo Motors: Realistic Applications :

Servo motors are used in many practical applications, such as:

Robotics: As a control device for joints and actuators of robot arms and legs.

RC Cars: To operate steering and throttle.

CNC Machines: Controls the motion and location of the tool.

Camera Gimbals: Drones mounted with stabilizing camera systems, used to achieve smooth camera control.

Conclusion :

In this assignment, we learned about servo motors, their working principle, and how to control them using an Arduino UNO. By simulating the circuit in TinkerCAD, we were able to visualize the process and understand how PWM signals are used to control the motor's position. This type of setup is useful in robotics, automation, and many other precise control applications.