CSE461 Lab Report

Lab Number: 3

Title: Introducing servo motor using Raspberry Pi

Group Number: 4

Section: 4

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1. Description:

This lab report explores the operational aspects of a servo motor by utilizing a Raspberry Pi 4 to achieve controlled rotation, targeting various positions. We initially assembled our equipment and noted the connections we needed to make. We are using here the MG996r Model and it rotates from 0 to 180 degrees. This motor has three wires which are red, brown, and orange. Red and brown are used for connecting to the 5V power supply and GND respectively. The orange wire is used for transmitting the PWM signal. Moreover, the duration of the PWM signal depends on its duty cycle. The duty cycle refers to the fraction of the period in which a signal or system is ON.

Duty cycle =pulse width*frequency

The position of the servo depends on the “ON” part of the cycle. The Higher the Duty Cycle of a signal, the greater the “ON” time of that PWM signal. We convert the upper and lower duration of the duty cycle to the servo’s direction in angle. Besides, the values of the Duty Cycles usually vary slightly from one servo to another. So, we have to find DC through an experimental process. We can also find our desired angle through a linear equation. To find it, at first, we have to find the slope with the help of the coordinate(Angle) that we have found through the experimental process. There we will find by calibrating the duty cycle with respect to the servo motor direction. Then we can generate the equation from the slope and put their desired angle, we will get the corresponding Duty cycle.

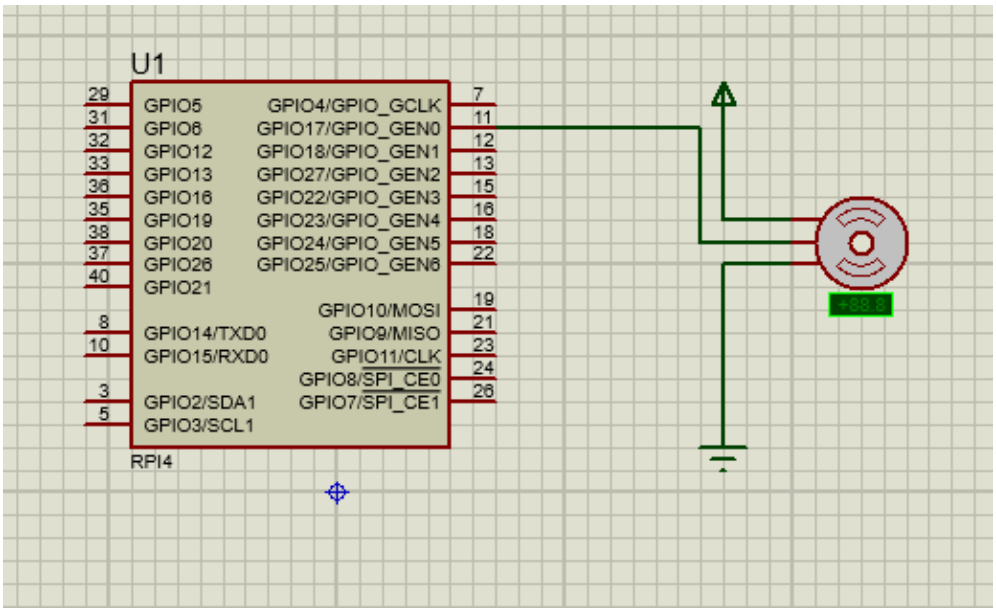
<u>Equation of a straight line:</u>

$y - y1 = m (x - x1)$

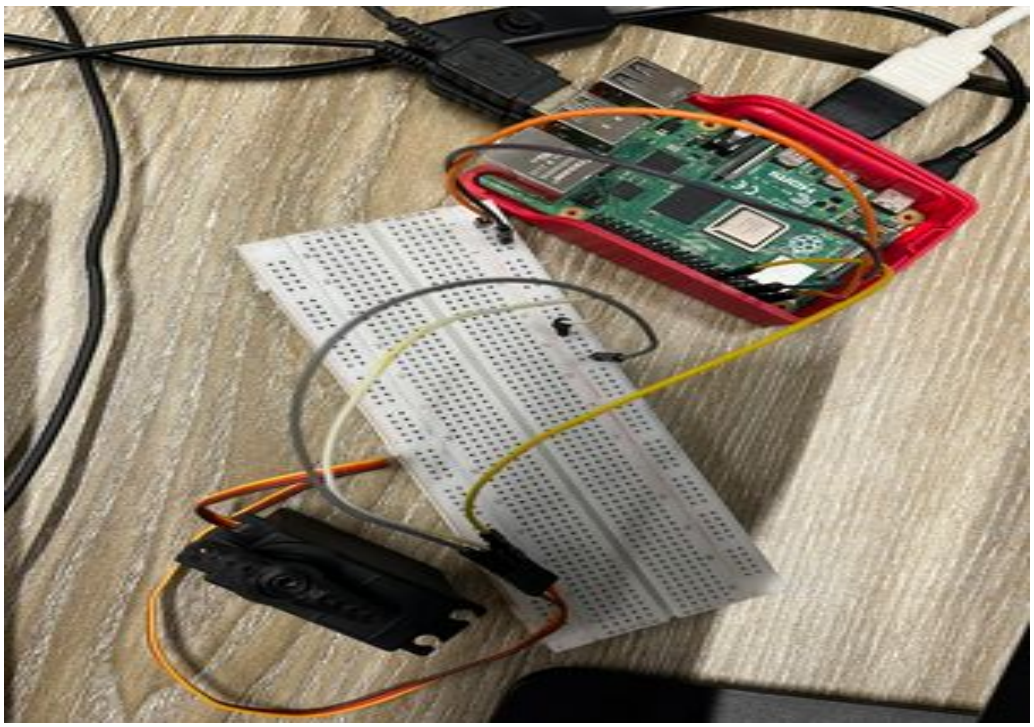
2. Components:

- Raspberry Pi 4
- Breadboard
- Servo Motor
- Jumper wires (male-to-male, male-to-female, female-to-female)
- Micro SD Card
- Keyboard, Mouse, and Monitor

3. Circuit Diagram:



4. Circuit Setup:



5. Explanation:

We are using here the MG996r Model and it rotates from 0 to 180 degrees. The motor has three wires and to initiate the rotation of the motor, we have to connect the Red wire to a +5V power source. Thus we connected it with The Raspberry Pi's 5V and linked the Brown wire to the Raspberry Pi's Ground. Besides, to transmit PWM signals from the Orange wire, we connected

it with GPIO 17(actual PIN 11).To find an accurate duty cycle, we followed up on the servo. Thus we got:-

Duty Cycle of 12.1% yielded the full left position (180 degrees)

Duty Cycle of 2.5% yielded the full left position (0 degree)

In order to find the slope we calibrated the duty cycle and found the coordinates of two extreme points. Then we generated the equation

slope=m=(12.1-2.5)/(180-0) =0.053

y-2.5 = 0.053(x - 0)

y=0.0533*x+2.5

After that, we just put our desired angle to x and got the respective Duty Cycle.
We've configured a time delay of 2 seconds to enhance the visibility of the servo's rotation.

6. Code:

```
import Rpi.GPIO as GPIO
import time

GPIO.setmode(GPIO.BCM)
pin=17
GPIO.setup( pin,GPIO.OUT)
pwm = GPIO.PWM( pin,50)
pwm.start(0)

// for calibration

pwm.ChangeDutyCycle(2.5)
time.sleep(2)
pwm.ChangeDutyCycle(12.1)
time.sleep(2)
pwm.ChangeDutyCycle(2.5)
time.sleep(2)


x=90
y=0.0533*x+2.5
print(y)
pwm.ChangeDutyCycle(y)
time. sleep(2)

pwm.stop()
GPIO.cleanup ()
```