

ECE 476/676 - Homework #5

Graphic Display & Touch Screen- Due Monday, October 6th

DC Servo Motor (Take 1)

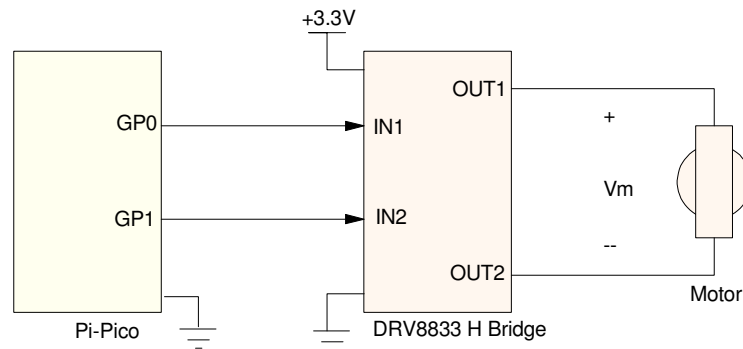
1) Hardware: Connect the DC servo motor to your Pico through an H-bridge.

Verify that the Motor can be driven clockwise and conter-clockwise

- Forward ($IN1 = 1, IN2 = 0$)
- Stop ($IN1 = 0, IN2 = 0$), and
- Reverse ($IN1 = 0, IN2 = 1$)

Measure the voltage V_m for all three conditions

- note: you might need to use 3.3V for the H-bridge. This limits the speed of the motor and the current draw (max current for this H-bridge is 1.5A)



-100%	0%	+100%
-2.670V	0.000V	2.650V

2) Software: Write a Python program which uses the analog input (joystick) to control the motor speed:

- $3.3V = +100\%$
- $1.65V$ (center) = 0%
- $0V = -100\%$

Display the motor's status on the graphics display

```
from machine import Pin, PWM, ADC
from time import sleep_ms
from math import sin, pi
import LCD_16x24 as LCD

# initialize PWM outputs
Mp = PWM(Pin(16))
Mp.freq(100)
Mp.duty_u16(0)
Mm = PWM(Pin(17))
Mm.freq(100)
Mm.duty_u16(0)

# initialize analog inputs
a2d0 = ADC(0)
a2d1 = ADC(1)
k = 10 / 65520

# initialize the LCD display
LCD.Init()
Black = LCD.RGB(0,0,0)
White = LCD.RGB(250,250,250)
Grey = LCD.RGB(100,100,100)

LCD.Clear(Black)

pct = 0
ax0 = a2d0.read_u16()
ay0 = a2d1.read_u16()

LCD.Box(1,1,478,318,White)
LCD.Text3('Homework #6: DC Motor Control', 5, 5, White, Black)
LCD.Text3('% Speed', 15, 50, White, Black)
X = 240

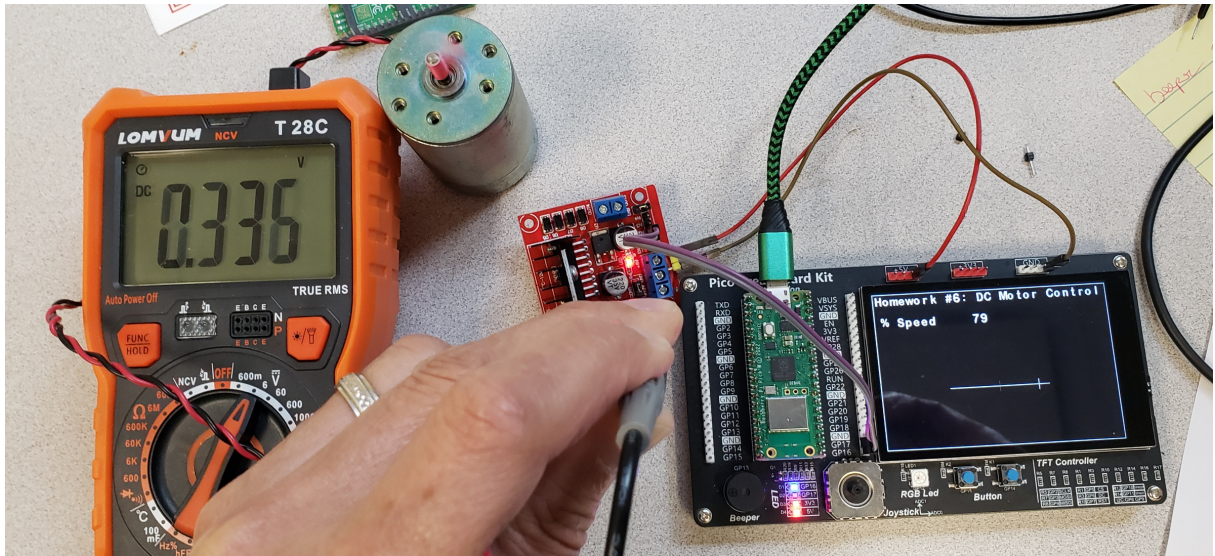
while(1):
    ax = a2d0.read_u16() - ax0
    ay = a2d1.read_u16() - ay0

    pct += k*ay
    pct = max(-100, pct)
    pct = min(100, pct)
    LCD.Text3(str(int(pct)) + ' ', 200, 50, White, Black)
    if(pct > 0):
        Mp.duty_u16(int(655*pct))
        Mm.duty_u16(0)
    else:
        Mp.duty_u16(0)
        Mm.duty_u16(int(-655*pct))
    LCD.Line(X,190,X,210,Black)
    X = int(240 + pct)
    LCD.Line(X,190,X,210,White)
    LCD.Line(240,190,240,210,Grey)
    LCD.Line(140,200,340,200,White)

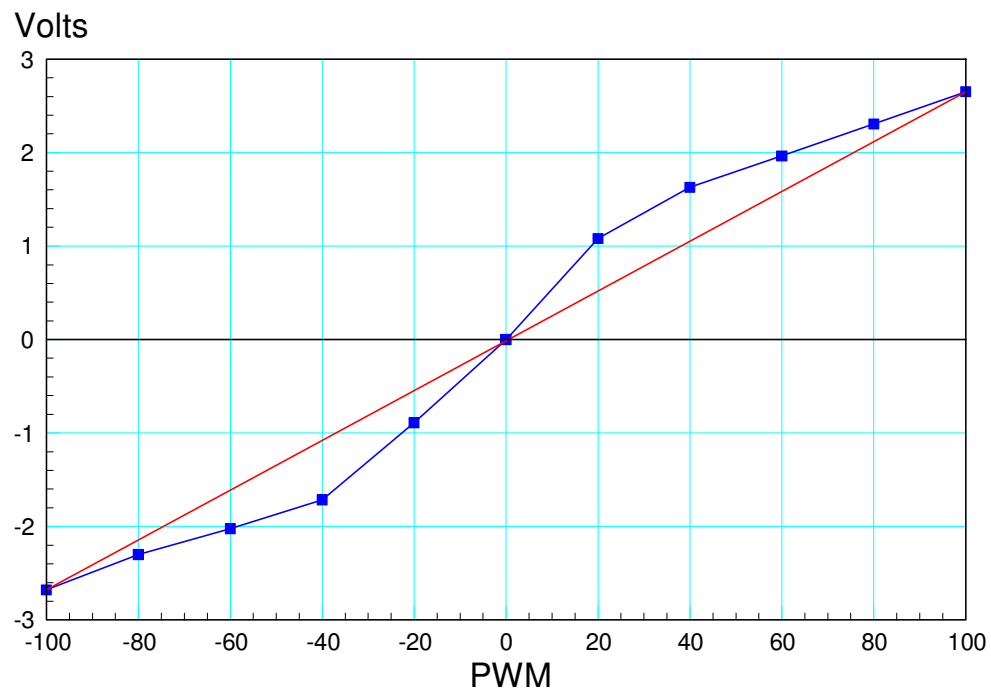
    print(pct)
    sleep_ms(100)
```

3) Verify your code is working properly

- The code accepts the analog input
- The voltage at V_m varies as $+V_x$, 0, $-V_x$ (V_x is the voltage of the motor)
- The LCD display shows the motor's status (-100% to +100%)



-100%	-80%	-60%	-40%	-20%	0%	20%	40%	60%	80%	100%
-2.678V	-2.300V	-2.023V	-1.715V	-0.898V	0V	1.080V	1.629V	1.965V	2.305V	2.650V



DC Motor (take 2): Touch Screen

4) Software: Write a Python program which uses the touch screen to control the motor speed:

- Input a number from -100 to +100 via the touch screen, or
- Use a slider to vary the motor speed, or
- Any other way to input data via the touch screen

Display the motor's status on the graphics display

```
from machine import Pin, PWM, ADC, I2C
from time import sleep_ms
from math import sin, pi
import LCD_16x24 as LCD
from gt911 import GT911

# initialize PWM outputs
Mp = PWM(Pin(16))
Mp.freq(100)
Mp.duty_u16(0)
Mm = PWM(Pin(17))
Mm.freq(100)
Mm.duty_u16(0)

# initialize analog inputs
a2d0 = ADC(0)
a2d1 = ADC(1)

# Touch Screen Initialization

rst_pin = Pin(10, Pin.OUT)
irq_pin = Pin(11)
sda_pin = Pin(8)
scl_pin = Pin(9)

touch = GT911(
    I2C(0, scl=scl_pin, sda=sda_pin, freq=100_000),
    rst_pin,
    irq_pin
)

touch.init(touch_points=1, refresh_rate=50)

def Analog_In(pct):
    k = 10 / 65520

    ax = a2d0.read_u16() - ax0
    ay = a2d1.read_u16() - ay0

    pct += k*ay
    pct = max(-100, pct)
    pct = min(100, pct)
    return(pct)

def Touch_Input(pct, ref):
    num_points, points_data = touch.read_points()
    if(num_points > 0):
        tx = (points_data[0][0])
        ty = (points_data[0][1])
        ref = (tx - 240)
        ref = min(max(-100, ref), 100)
        d_pct = min(max(-3, ref - pct), 3)
        pct += d_pct
    return([pct, ref])
```

```

# initialize the LCD display
LCD.Init()
Black = LCD.RGB(0,0,0)
White = LCD.RGB(250,250,250)
Grey = LCD.RGB(100,100,100)

LCD.Clear(Black)

ax0 = a2d0.read_u16()
ay0 = a2d1.read_u16()

LCD.Box(1,1,478,318,White)
LCD.Text3('Homework #6: DC Motor Control', 5, 5, White, Black)
LCD.Text3('% Speed', 15, 50, White, Black)
X = 240
ref = pct = 0

while(1):
    [pct, ref] = Touch_Input(pct, ref)

    LCD.Text3(str(int(pct)) + ' ', 200, 50, White, Black)
    if(pct > 0):
        Mp.duty_u16(int(655*pct))
        Mm.duty_u16(0)
    else:
        Mp.duty_u16(0)
        Mm.duty_u16(int(-655*pct))
    LCD.Line(X,190,X,210,Black)
    X = int(240 + pct)
    LCD.Line(X,190,X,210,White)
    LCD.Line(240,190,240,210,Grey)
    LCD.Line(140,200,340,200,White)

    sleep_ms(100)

```

5) Verify your code is working properly

The code accepts the touch screen input

- You can slide the bar on the screen left and right by touching the screen

The voltage at V_m varies as $+V_x$, 0, $-V_x$ (V_x is the voltage of the motor)

- The voltage varies as it did in the previous section
- $-100\% = -2.6V$
- $+100\% = +2.6V$

The LCD display shows the motor's status (-100% to +100%)

- Yup



Demonstration

6) Demonstrate one of these programs

- In-Person
- With a video

