Principles of Measurement & Instrumentation I Laboratory

PHYS417

Laboratory Report

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Experiment 6 - User Interfaces

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Question 1: Read the Documentation on Tkinter:

Tk/Tcl is an integral part of Python and it provides a robust and platform-independent windowing toolkit that is available with the Tkinter package. Tkinter is a thin Object-oriented layer on top of Tcl/Tk. To use Tkinter one does not need to write code for Tcl, but one needs to consult Tk documentation, and sometimes Tcl documentation. Tkinter is a set of wrappers that implement the Tk widgets as Python classes.

Tcl

Tcl is a dynamic interpreted programming language, just like Python. Though it can be used on its own as a general-purpose programming language, it is commonly embedded into C applications as a scripting engine or an interface to the Tk toolkit. The Tcl library has a C interface to create and manage one or more instances of a Tcl interpreter, run Tcl commands and scripts in those instances. For each event queue, there is an interpreter, and there are facilities to send events to it and process them. Unlike Python, Tcl's execution model is designed around cooperative multitasking, and Tkinter bridges this difference.

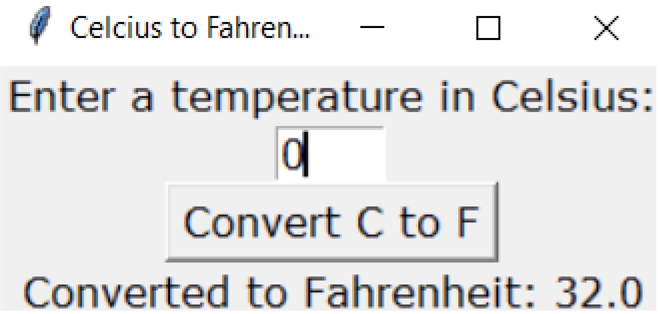
Tk

Tk is a Tcl package implementation in C that adds custom commands that create and manipulate GUI widgets. Each Tk object embeds its own Tcl interpreter instance with Tk loaded into it. Tk's widgets are highly configurable, though at cost of a dated appearance. Tk uses Tcl's event queue to generate and process GUI events.

Ttk

Themed Tk (Ttk) is a newer family of Tk widgets that provide a greater appearance on different platforms than many of the classic Tk widgets. Ttk is a distributed part of Tk, starting with Tk version 8.5. Python bindings are provided in a separate module, (tkinter.ttk).

Question 2: write a program that converts Celsius temperature to Fahrenheit by getting the user input:

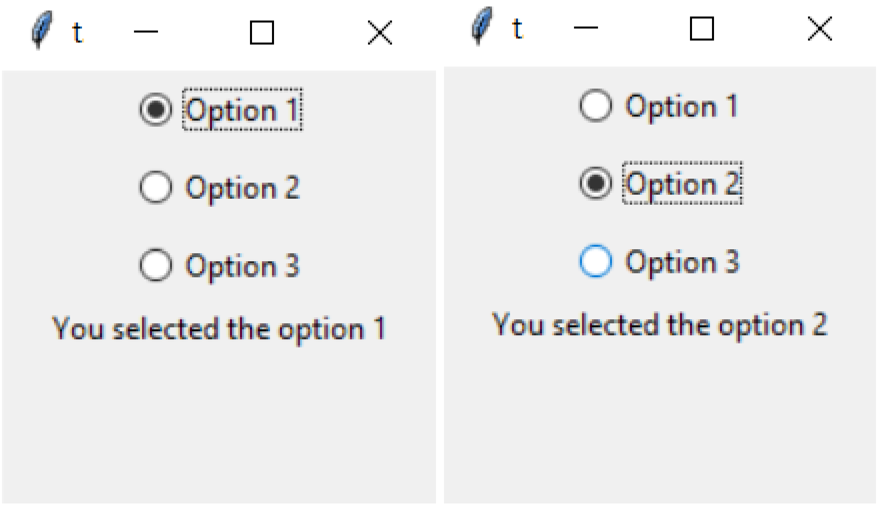


Enter a temperature in Celsius:

0

Converted to Fahrenheit: 32.0

Question 3: Write a program using Tkinter package that choose between different Radiobuttons and show which option is being chosen using Tkinter Label class:



t

● Option 1
○ Option 2
○ Option 3

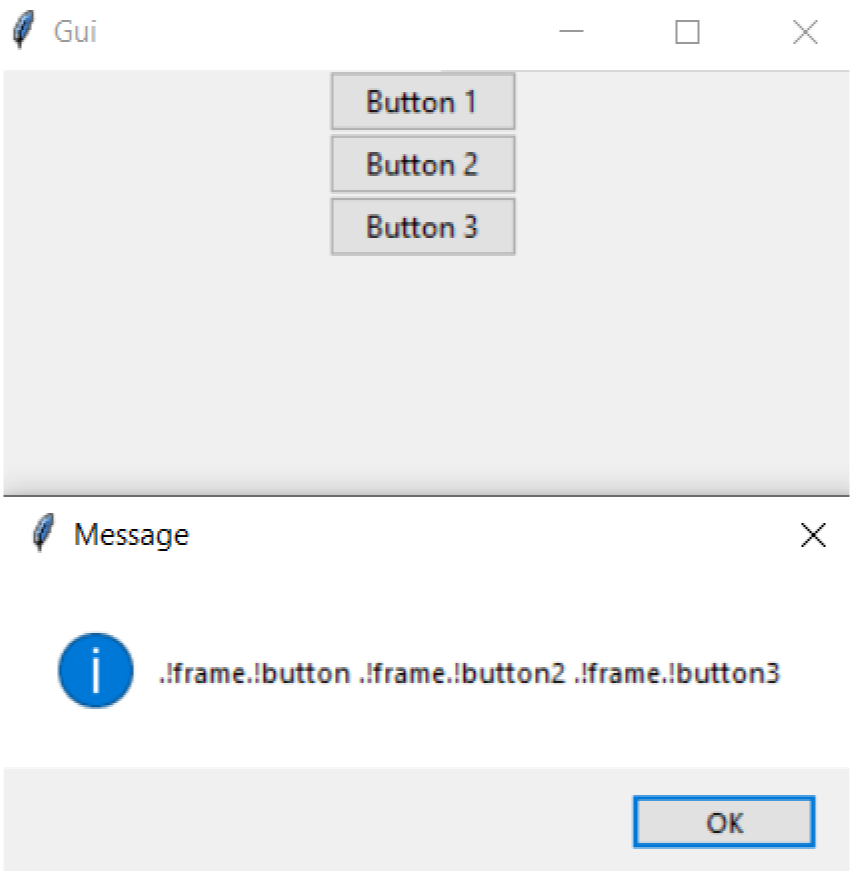
You selected the option 1

t

○ Option 1
● Option 2
○ Option 3

You selected the option 2

Question 4: Repeat the previous program but choose Buttons instead of Radiobuttons :



Gui

Message

.!frame.!button .!frame.!button2 .!frame.!button3

Question 5: Calculate the current limiting resistor for a red LED:

The calculation of the value of a current limiting resistor is different for single LED, in series and in parallel, it is also different in arrays of LED's.

For single LED formula is $R = \frac{V_{batt} - V_{led}}{I_{led}}$; Vbatt is the voltage across the resistor and the LED. Vled is the forward voltage of the LED. Iled is the forward current of the LED.

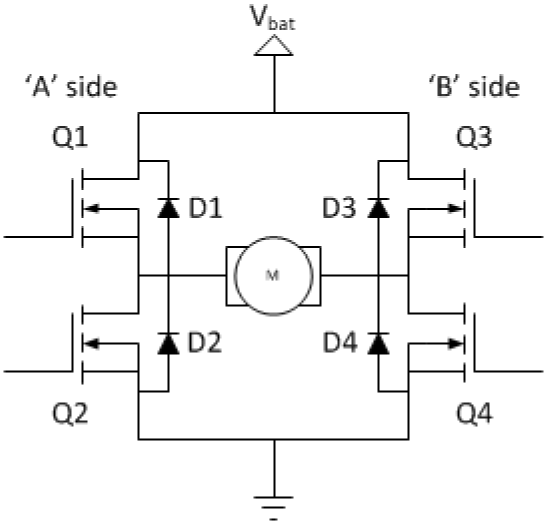
LEDs in Series $R = \frac{V_{batt} - nV_{led}}{I_{led}}$ in here n is the number of LEDs in series.

LEDs in parallel $R = \frac{V_{batt} - V_{led}}{mI_{led}}$ m is the number of LEDs in parallel.

LEDs in arrays $R = \frac{V_{batt} - nV_{led}}{mI_{led}}$ its important that there are n LEDs in series and m LEDs in parallel.

Question 6: Explain in details the working principle of the H-Bridge circuit and how to operate it:

H-bridge is not a heavily complex circuit, it contains four switch elements, with the load at the center:



The switching elements are Q1 to Q4 and these elements are usually bi-polar or FET transistors, they can be used in some high voltage applications IGBTs. Integrated solutions exist for the case but the control circuit part is not important most of the time.

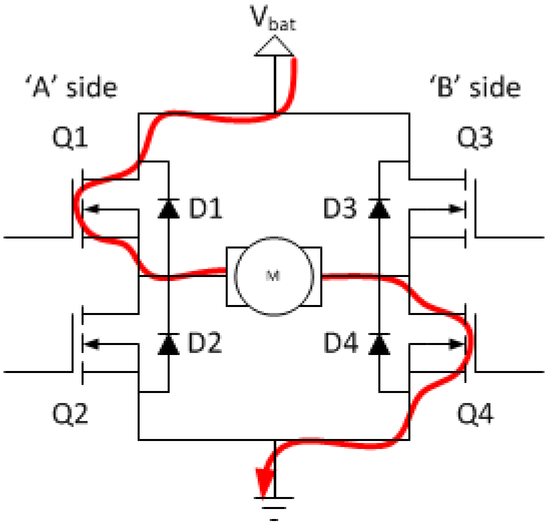
The diodes that are named D1 to D4 are called catch diodes and are usually type Schottky.

The top-end of the H-bridge is connected to a power supply such as battery and the bottom-end is grounded. All four switching elements can be turned on and off independently, though there are some obvious restrictions. Though the load can in theory be anything you want, by far the most widely used application is if H-bridge is with a brushed DC or bipolar stepper motor (these steppers are in need of two H-bridges per motor) load.

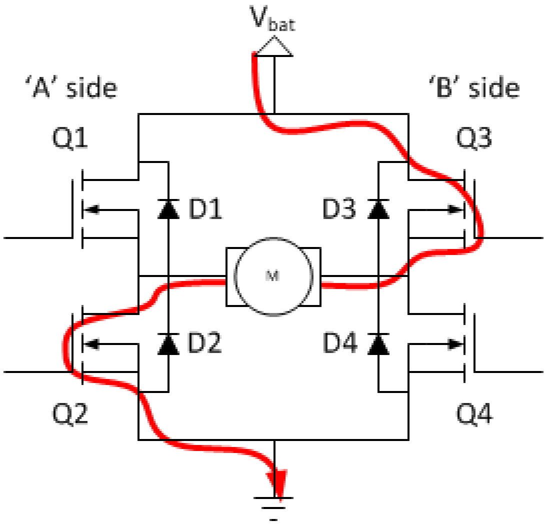
Here is the details given in brushed DC motor driver.

Static Operation

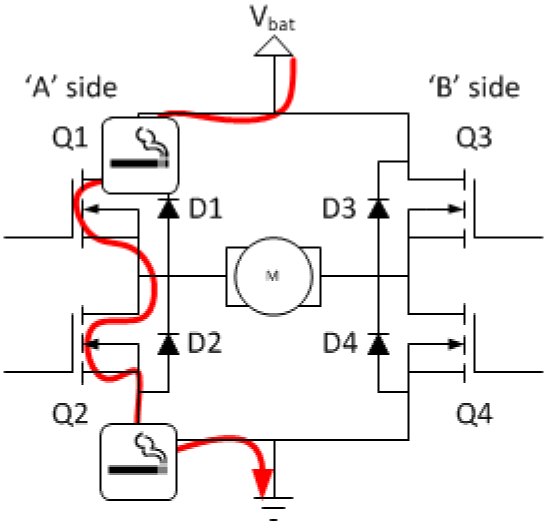
Basic operating mode of an H-bridge is if the switches on the Q1 and Q4 are turned on, the left lead of the motor will be connected to the power supply, while the right side is connected to the ground. This makes current to start flowing through the motor and one can say that this energizes the motor in let's say the forward direction and the motor shaft starts spinning.



Also this could be done for Q2 and Q3 too, which will lead the reverse of this operation to happen hence go in the reverse direction, and the shaft will start spinning let's say backwards this time.



One must never close one side of the bridge at the same time, e.g Q1 and Q2 together or Q3 and Q4 together. This will make a low resistance path between power and GND, which may lead the bridge to burn, this condition is called "Shoot-through" and it can also destroy the bridge and valuable parts.



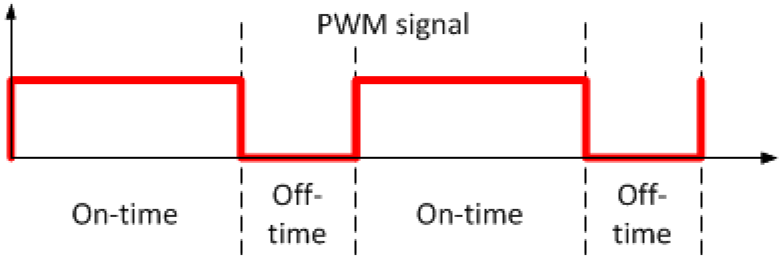
So it only make sense to use bridges without opening one side fully.

Motor Model

DC motor is a motor that is a conversion device for energy, it takes electrical energy and turns it into mechanical energy. When operated as a generator, it does the opposite: in which it converts mechanical energy into electrical energy. In this simple motor model, mechanical parameters are completely ignored. On the electrical side, the motor basically contains numerous inductors that move in a magnetic field. The inductors themselves of course have an inductance, and some internal resistances. Their movement in the field will generate voltage, which is named as generator voltage and denoted as v_g across the inductors. V_g is solely dependent on the speed by which the inductors move in the filed, i.e. rotational speed of the motor.

Drive Modes

If any speed needed than the full-speed operation. The switches are controlled in a PWM fashion. A PWM signal has two phases, the “on-time” and the “off-time”.



PWM is a periodic signal, with a constant frequency. The information content that is used to change the operating parameters of the bridge is the ratio between the on-time and the off-time.

The difference between a diode and the switch (independent of switch technology) is that while your switching elements (when they’re closed) have a relatively constant and low resistance, a conducting diode has a relatively constant voltage drop on it. This means that the power dissipated on the switch is proportional to the square of the current:

Pswitch = Vswitch * I = Rswitch * I2

while the power on the diode scales linearly:

Pdiode = Vf * I (where Vf is the forward voltage drop of the diode)

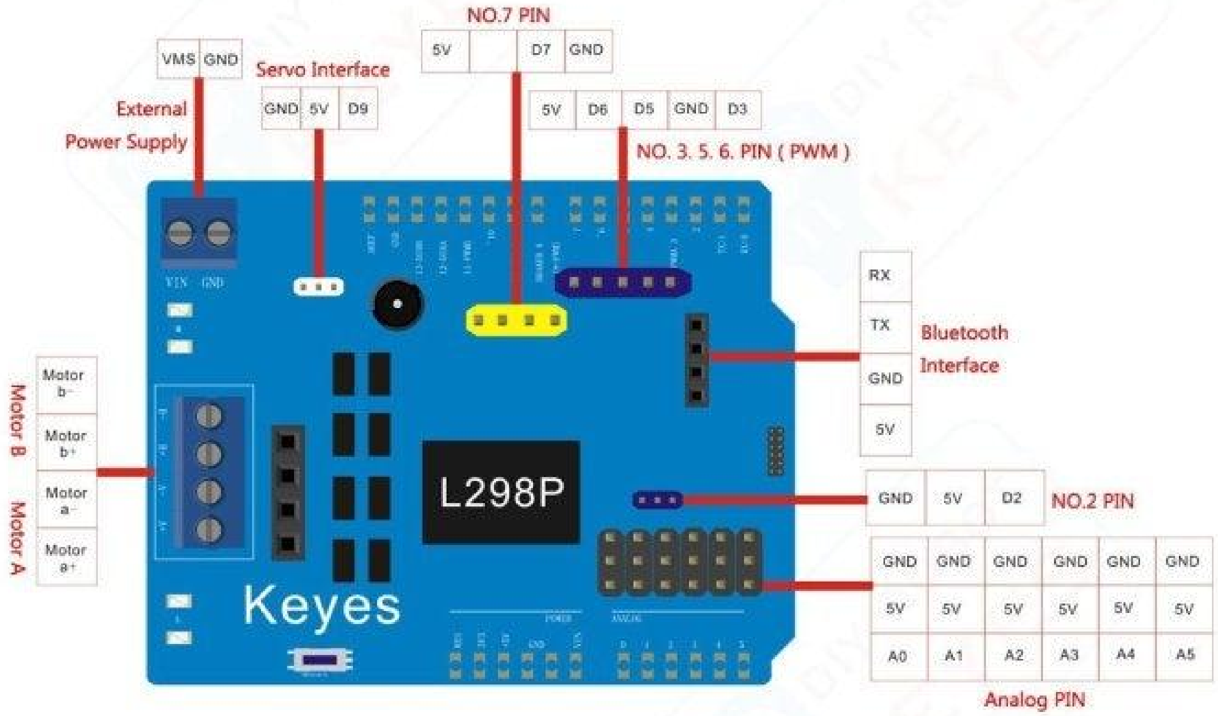
Question 7: Explore the L298N Motor driver shield:

It is based on L298 motor driver integrated circuit, a full-bridge motor driver. It can drive two separate 2A DC motors or 1 2A step motor. Motor's velocity and directions are controlled separately and also there are 6 connectors connected to Arduino analog pins. This motor driver shield with PWM speed control mode and the PLL mode, using jumper to switch.

It's features are: 5V input, onboard buzzer (D4), can set the astern alarm ringtone, sig digital interfaces that are not occupied(D2,D3,D5,D6,D7,D9)

Six analog interfaces (A0,A1,A2,A3,A4,A5)

It also has indicators for forward and backward changing direction.


NO.7 PIN
5V
D7
GND
VMS
GND
Servo Interface
GND
5V
D9
External
Power Supply
5V
D6
D5
GND
D3
NO. 3. 5. 6. PIN (PWM)
VIN
GND
RX
TX
GND
5V
Bluetooth
Interface
Motor B
Motor
b-
Motor
b+
Motor
a-
Motor
a+
Motor A
L298P
GND
5V
D2
NO.2 PIN
Keyes
GND
GND
GND
GND
GND
GND
5V
5V
5V
5V
5V
5V
A0
A1
A2
A3
A4
A5
Analog PIN

Code

First part

```
from tkinter import *


def convert_temperature():
    temp = float(entry.get())
    if (temp >= -273.15):
        temp = 9/5 * temp+32
                output_label.configure(text  =  '  Converted  to  Fahrenheit:  {:.1f}  '
.format(temp))
    else:
        output_label.configure(text = ' Temperature below the absolute zero.')


main_window = Tk()
main_window.title("Celcius to Fahrenheit")
message_label = Label(text= 'Enter a temperature in Celsius:' ,
font=('Verdana', 12))
output_label = Label(font=('Verdana', 12))
entry = Entry(font=('Verdana' , 12), width=4)
```

```
calc_button = Button(text= 'Convert C to F' , font=('Verdana', 12),
command=convert_temperature)
message_label.grid(row=0, column=0)
entry.grid(row=1, column=0)
calc_button.grid(row = 2, column=0)
output_label.grid(row=3, column=0, columnspan=3)
mainloop()
```

Second part

```
# Importing Tkinter module
from tkinter import *
from tkinter.ttk import *


def sel():
   selection = "You selected the option " + str(v.get())
   label.config(text = selection)

# Creating master Tkinter window
master = Tk()
master.geometry("175x175")

# Tkinter string variable
# able to store any string value
```

```
v = StringVar(master, "1")


# Dictionary to create multiple buttons
values = {"Option 1" : "1",
          "Option 2" : "2",
          "Option 3" : "3"}


# Loop is used to create multiple Radiobuttons
# rather than creating each button separately
for (text, value) in values.items():
    Radiobutton(master, text = text, variable = v,
                value = value, command = sel).pack(side = TOP, ipady = 5)


# Infinite loop can be terminated by
# keyboard or mouse interrupt
# or by any predefined function (destroy())


label = Label(master)
label.pack()
mainloop()
```

Third part

```
from tkinter import *
from tkinter import messagebox
from tkinter import ttk



def show_msg():
   messagebox.showinfo("Message", frm.winfo_children())



tkWindow = Tk()
frm = Frame(tkWindow)
tkWindow.geometry("175x175")
tkWindow.title('Gui')



# Dictionary to create multiple buttons
values = {"Option 1" : "Button 1",
          "Option 2" : "Button 2",
          "Option 3" : "Button 3"}



Button_1 = ttk.Button(frm, text= values["Option 1"], command = show_msg).pack()
Button_2 = ttk.Button(frm, text= values["Option 2"], command = show_msg).pack()
```

```
Button_3 = ttk.Button(frm, text= values["Option 3"], command = show_msg).pack()

frm.pack()

tkWindow.mainloop()

# couldn't solve message problem.
```

Fourth part (Operate DC motor direction of rotation and speed)

```
const int pwm = 2 ;  //initializing pin 2 as pwm

const int in_1 = 8 ;

const int in_2 = 9 ;

//For providing logic to L298 IC to choose the direction of the DC motor

void setup()

{

pinMode(pwm,OUTPUT) ;   //we have to set PWM pin as output

pinMode(in_1,OUTPUT) ;  //Logic pins are also set as output

pinMode(in_2,OUTPUT) ;

}

void loop()
```

```
{
//For Clock wise motion , in_1 = High , in_2 = Low

digitalWrite(in_1,HIGH) ;
digitalWrite(in_2,LOW) ;
analogWrite(pwm,255) ;

/*setting pwm of the motor to 255
we can change the speed of rotaion
by chaning pwm input but we are only
using arduino so we are using higest
value to driver the motor  */

//Clockwise for 3 secs
delay(3000) ;

//For brake
digitalWrite(in_1,HIGH) ;
digitalWrite(in_2,HIGH) ;
delay(1000) ;

//For Anti Clock-wise motion - IN_1 = LOW , IN_2 = HIGH
digitalWrite(in_1,LOW) ;
digitalWrite(in_2,HIGH) ;

delay(3000) ;


//For brake

digitalWrite(in_1,HIGH) ;

digitalWrite(in_2,HIGH) ;

delay(1000) ;

 }
```

References

GUI Programming with Python: Radiobuttons in Tkinter (python-course.eu)

RadioButton in Tkinter | Python - GeeksforGeeks

Python GUI Programming With Tkinter – Real Python

Graphical User Interfaces with Tk — Python 3.10.1 documentation

Python - Tkinter Radiobutton (tutorialspoint.com)

python 3.x - How to make tkinter::pack() place label on top left corner in below program? - Stack Overflow

GUI Programming with Python: Checkboxes in Tkinter (python-course.eu)

How to Call Function on Tkinter Button Click? - Python Examples

Determine which Button was pressed in Tkinter (tutorialspoint.com)

How To Control DC Motor Using An Arduino (circuits-diy.com)

Calculating Current Limiting Resistor Values for LED Circuits | Nuts & Volts Magazine (nutsvolts.com)

H-Bridges – the Basics | Modular Circuits

PCB Motor Driver Circuit (H-Bridge) : 7 Steps - Instructables