Dyson School of Design Engineering, Imperial College London

DE1.3 Electronics 1

Open-ended Challenges

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Introduction

Labs 0 to 4 were designed to teaching you something. In these Labs, you were more or less told what to do, and often how to do them. Now you should be in a position to approach solving practical problems in electronics by yourself.

This document is NOT a lab, but it contains various suggestions on possible challenges that you might take on yourself. You are required to attempt at least one of these challenges. DO NOT do more than, say, two – you will not have time. Pick one that you think you can achieve quickly before attempting another one.

They are also arranged in order of increasing levels of difficulties (Level 1 to 4). During the Lab Oral on Thursday 25 June, you will asked by your assessor to show what you have achieved and part of that assessment is linked to your achievement in this challenge and the level of difficulties. You are of course also encouraged to create your own challenge or modify any of the suggestions shown here.

Finally, since you will only bring back the Home Lab Kit to College in the Autumn Term, you are encourage to explore some of these challenges at your own leisure during the long summer break. You will not do this for credit, but for your own sheer enjoyment.

Suggestion 1: Rotary encoderMe controlling the intensity of LEDs (Level 1)

If you have completed Lab4B, Task 3, step 4, you have already done this challenge. You have to use the rotary encode to adjust the level of light intensity of the two LEDs while displaying the intensity (between 0 and 100) on the OLED display. You may want to go further and control the intensity of the Neopixel Strip as well.

Suggestion 2: Traffic light (Level 1)

Use the Red and the Green LED, working with the push button switch of the rotary encoder, write a problem such that each time your press the switch, you go through the sequence: Red ON, Green OFF -> Both OFF -> Green ON, Red OFF -> Both OFF … etc.

Suggestion 3: DC Motor controller (Level 1)

Write an application so that you can use the rotary switch knob to control the speed and direction of the DC motor directly while displaying the speed on the OLED display.

Suggestion 4: Reaction Meter (Level 2)

Start with both LEDs off, turn on both Red and Green LEDs after a random delay. Measure and display on the OLED display the speed of your reaction between seeing the LEDs turning ON and you pressing the rotary switch. Pressing the switch again starts another cycle of measurement.

Suggestion 5: Message to Mars (Level 2 or 4)

In the movie “The Martian”, NASA communicated with Matt Damon by sending to him messages using hexadecimal code. Two hexadecimal digits form one ASCII character. They send the message to control the angle of motor pointing to one of 16 angles indicating the hexadecimal code. You can create that method of communication with your servo motor (Level 2) and send the message “Hello Peter”. You may also try to link this to your Computing 2 module by entering any message on your computer, send this over ESP32’s wifi (Level 4).

Suggestion 6: A Simple Light Show (Level 2)

Write a program that shows an interesting sequence of colour patterns on the neopixel strip, and cycle through the sequence continuously.

Suggestion 7: Sound level meter (Level 3 to 4)

Amplify your microphone signal using what you learned in Lab 3, measure the peak voltage of the signal (you would need to use a diode, a resistor and a capacitor to make a peak detector that leaks). Measure this via a ADC input to the ESP32, and indicate the level of sound with the neopixel strip.

Suggestion 8: Disco Dancing Light (Level 3 to 4)

Write a program for ESP32 that catch the music through the microphone and somehow translate the music into interesting light sequence. Unlike the earlier challenge, this should be dynamic and the light pattern should change with music.

Suggestion 9: SOS Messaging (Level 4)

Mount the neopixel on a card board or similar, so that this can rotate like a pendulum. The “pendulum” should be mounted on the 10k ohm potentiometer so that you can measure the angle of rotation. Based on the angle you are at, light up the neopixel so that it shows the message “SOS” as you swing the pendulum to and fro.

Suggestion 10: A Musical Instrument (Level 4)

This involves something you have not learned in your Labs. Many ESP32 input pins can be programmed as touch sensor inputs. Use the audio amplifier in Lab 3, generate different musical notes depending on which input is “touched”, or you may use the potentiometer or the digital encoder as input devices, or even the key board of your computer (via the USB-UART cable). You now have a simple muscial instrument.