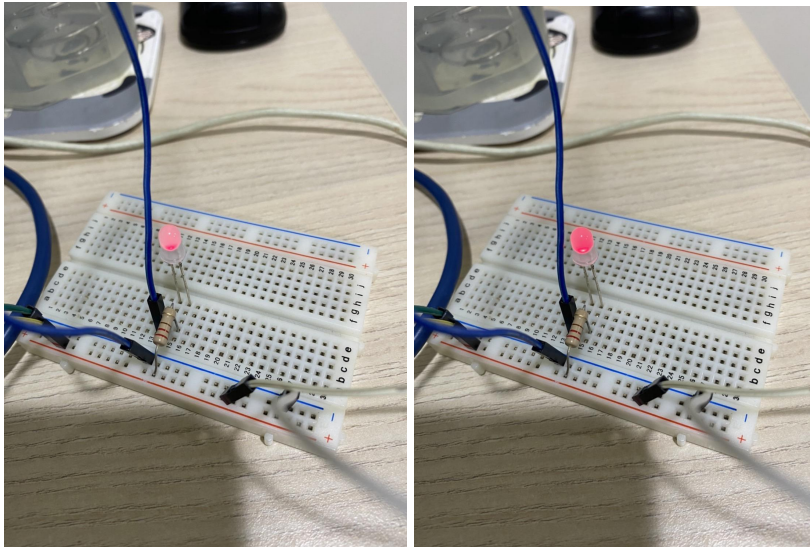


Homework 2 LCD, Serial Port and RTOS

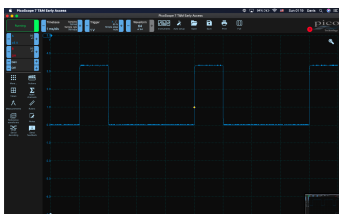
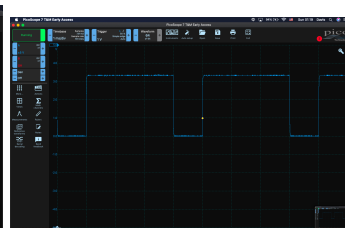
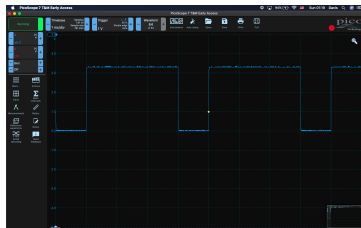
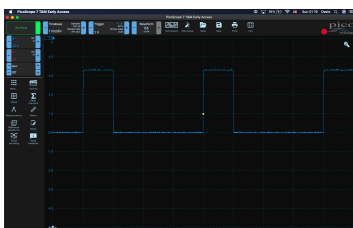
1. Please write a mbed program to use the User Button as an interrupt source.
 - Set up the mbed and circuit board like lab 5.3, since we want the messaging function to be called with an EventQueue. We need to use an Eventqueue and thread. when the button is pressed it triggers led1. 'Trig_led1' will execute in IRQ context. Inside the void trig_led1, queue.call(led1_info) will be used, it will execute later in user context. led1_info print hello world in the ulcd, I use cls to clear ULCD after the button is pressed so when the button is pressed again the context will show again. The message can't be called in trig_led1 or else there will be an error since it's not allowed in ISR context.



2. Please write a mbed program to generate a sweeping PWM waveform for controlling the breathing LED.
 - Set up the mbed and circuit board like lab 4.2, since our PWM1 is connected to D6, PwmOut PWM1(D6) will be our variable. The led will be turned on and controlled by the period. Since the period is fix I will just gonna make it 4ms by writing like this PWM1.period_ms(4); PWM1.pulsewidth_ms(width) is just the alternative to led.write, set duty cycle time in milliseconds. The width formula is equal to $(\text{offset} * (\cos(\text{rads} + \pi)) + \text{offset})$. Pi is constant and since the offset is equal to the period/2 we can just declare it at the top. For rad we will uses a for loop from 0 to 360, and $\text{rads} = (\pi * i) / 180.0$. When running the led will light up brighter and brighter until it reaches a point and then it will be more dim and dim. If we set the period bigger we can see it more clearly that the brightness of the LED changes. The left picture is when the width is small and the right picture is when the width is almost at the max number.



3. Please write a mbed program to use the light sensor AO (analog output) to capture the LED strength controlled by a sweeping PWM waveform from the previous problem.
 - We connect the light sensor to the circuit board. The light sensor has 4 pins: VCC, GND, DO (digital output) and AO. By connecting VCC to 3.3V and GND to GND on mbed. And connecting AO to D6 the DOLED greenlight will light up. We are also using a thread for this one. I put the code of generating sweeping PWM waveforms in an independent thread called `led2_thread()` and inside the main function I have two for loops. Print the ADC values in one loop and generate `PWM1 = width` and `ADCdata[i] = width` in another loop. We separate print since it may affect the program. The loop will be from 0 until the sample in this case I use 128. The program will print a number starting from 0 until 4 and then back to 0, basically the period. The waveform from the picoscope looks like the photo below.



4. Please write a Python program to plot the above AO output samples sent from the mbed.
- mbed will continuously send the ADC values to a Python program. But since there will only be 128 samples, the one we set by yourself. The time will be the x axis, the y axis should be the amount of voltage in each sample. Once mbed sends a fixed number of samples, e.g., 128, `line=s.readline` will read the line from the serial in mbed and set a total of 128 samples to the Python plot of the signal waveform. Since the max number is about 3.9 it won't exceed above it and if the loop continues the wave will also continue in the same pattern. Mine graph is like this because of the amount of sample I choose

