

## HW4: Follow the Light

CMPE311

In this project, you will use a mechanical servo mounted with a Light-Sensitive resistor to mechanically respond to a moving light.

The servo's movement range is about 180 degrees and is controlled with a PWM signal. The frequency should be around 125 Hz and the pulse width should correspond to approximately 6% to 30% duty cycle (experiment a little to find what works best for you). The servo moves the arm in the range according to the width of the pulse.

The system is primarily defined by two behaviors FULLSWEEP, LOCALSWEEP and two modes, FOLLOW THE LIGHT and AVOID THE LIGHT.

### Modes

In one mode, **Follow the Light**, the objective is to find the angle of most illumination. In the other mode, **Avoid the Light**, the objective is to find the angle of least illumination.

The mode is set via a user menu using the onboard joystick and LCD. The mode should be displayed as FTL (follow the light) or ATL (avoid the light). Up and down button presses select the mode of operation. A right button press should initiate a full sweep.

### Behaviors

In each mode, there are two behaviors: **FULLSWEEP** and **LOCALSWEEP**. The **FULLSWEEP** behavior is automatically followed by the **LOCALSWEEP** behavior. While in the **FULLSWEEP** behavior, the system should not respond to any button presses.

**FULLSURVEY.** A full sweep of the range should be performed starting at  $0^\circ$  and sweep to  $180^\circ$  in about  $20^\circ$  increments. An illumination measurement should be taken at each step. The optimum angle (most light or least light depending on the mode) is decided and called the initial **primary angle** and is displayed on the left 3 character positions on the LCD as a value in the range [0,180]. The next behavior should then commence.

**LOCALSWEEP.** Starting at the **primary angle**, the servo should continuously move in the cycle given below, finding the optimum of the three angles.

$$\text{primary angle} \rightarrow (\text{primary angle} - 10^\circ) \rightarrow (\text{primary angle} + 10^\circ)$$

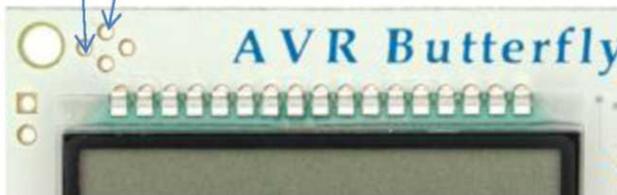
After each cycle, a new **primary angle** should be decided and displayed. If the **primary angle** is at the limit of the servo range, the local search pattern will not involve one of the  $+10^\circ$  or  $-10^\circ$  measurements.

### **Further Requirements and Instructions:**

- Up and Down and Right button presses must be detected with Pin Change Interrupts
- Floating point operations are not permitted (unless you make a case you need it).
- The servo control PWM signal must be driven by the Timer 0 waveform generator hardware on PB4.

The light measurement is done by mounting the light sensor I provide you to the servo (with tape) and connecting wires from it to your board as shown below. I have provided all the ADC code you need. You only need to add the line "return ADC;" to the GetADC function (I left this out so that you at least look at the ADC code). Also, In the ADCSetup() function, modify the ADC Mux channel (variable muxSel\_5b) to select the Light Sensor on channel 2. You only need to know that more light corresponds to a smaller value from the ADC and less light corresponds to a larger value.

Where the light sensor wires connect to Butterfly.



This is the light sensor, simply taped on, with wire wires going to the Butterfly

**black** : ground, **red** : 4.8 to 6V, **white** : PWM signal from Microcontroller

**Power Supplies will be provided in ITE 375 or loan upon request.**