Embedded and Realtime Systems

Laboratory 3 Name:_____

INSTRUCTIONS

Before attempting this lab, be sure you are familiar with the ADC tutorial. This laboratory should be completed within the 3 hours allocated and submitted to Moodle as a single file. If you have multiple files, archive them together e.g. zip them into one file, before submitting. Be sure to include your names on all your work.

Create a document for answers to parts 1, 2, 3 and 4 of the laboratory exercise. Be sure to include a copy of your source code with your answers, either as a separate file or append at the end of your answers. Get a Demonstrator to verify part 5 of the lab.

DETAILS

Figure 1 below depicts a basic configuration of an embedded system based around the PIC16F877A.

The circuit consists of the following:

Fosc :	4 Mhz
LDR :	Light Dependant Resistor
SW1:	Switch 1
LED1 :	Green LED Output on RC0
LED2 :	Red LED Output on RC1
LCD :	2 x 16 Alphanumeric LCD display

ADC setup:
ADC input on RA2.
ADC voltage references Vdd and Vss.
ADC sampling rate should be ~10 samples per second.
ADC result should be left justified and use ADRESH only.
ADC interrupts disabled (interrupts are not used in this Lab).

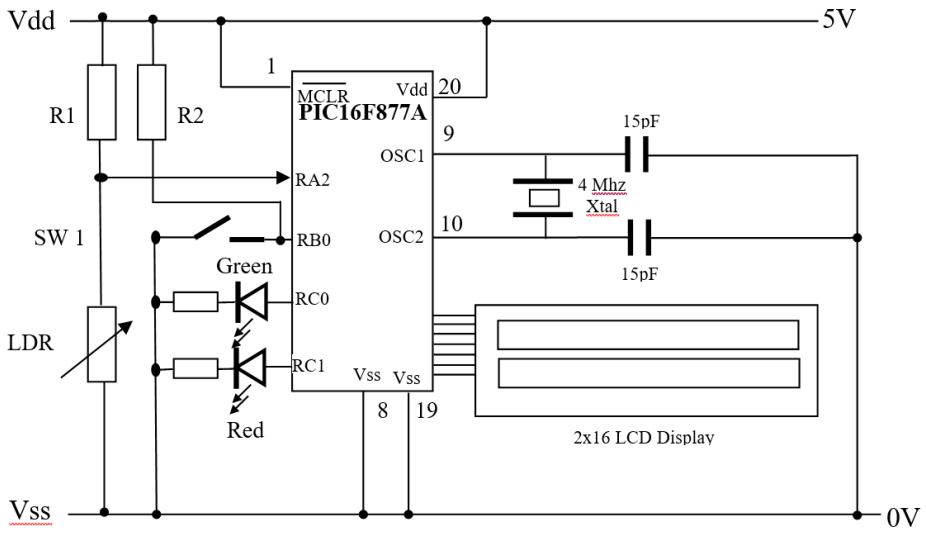

Figure 1

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The desired function of the circuit is as follows:

1. On start up display a title on both lines of the LCD display i.e.

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2. When SW1 is pressed the program should continue by displaying the ADC voltage. The voltage should be displayed to one decimal point.

ADC Voltage is x.x V

3. When the light to the LDR changes the ADC voltage displayed should change accordingly. Note the display should only be updated if the ADC value has changed.

4. Set a voltage threshold in your program so that by default the Red LED is on and the Green LED is off when the LDR is not covered. Then when the light to the LDR is reduced the Red LED is off and the Green LED is on. The LEDs should revert back to the previous state once the light returns to the LDR

Laboratory Exercise

1. Using Pseudo code, outline the design of the program for the above. **(15 marks)**

2. How is the ADC sampling rate set in the superloop? What considerations should be given to the functions in the superloop in order to achieve the desired ADC sampling rate of ~10 samples per second. **(10 marks)**

3. In special function register ADCON1 (page 128 of the PIC16F877A datasheet) bits 3-0 are used to set the A/D Port Configuration Control bits. Identify all lines of the table which meet our requirements, i.e.

   - RA2/AN2 : Analog input
   - RE0/AN5, RE1/AN6 and RE2/AN7 must be Digital I/O for the LCD
   - Vref+ and Vref- should be set to Vdd and Vss. **(10 marks)**

4. (a) List the Special Function Registers (SFR) associated with this program task and detail the bit configuration for each.
   (b) Explain what each SFR does.
   (c) What ADC channel is used in the circuit in figure 1? What changes are required to use ADC channel AN3 instead? **(15 marks)**

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5. Using MPLAB X create a project and write the C program for the above. **Include good comments and a title section for your code. (30 marks)**

6. Download your program to the PIC DIP-40 board and verify the function of the program using the PICKit 3 debugger. Demonstrate your working program to a lab demonstrator. **(20 marks)**