Task-4: Introduction to timers and delay generation

Experiment 1: A Counter with precise delay

The aim of this experiment is to get you familiar with Timer/Counter module on the Atmega 2560 based Firebird V robotic kit. In this experiment, you will write code to display an integer counter going from "00" to "10" (base 10).

Your task is to display the text " **Counter**" starting from the 1st line 1st column of the LCD. An up counter going from "**00**" to "**10**" should be displayed on the 2^{nd}line 2nd column of the LCD. After every 2 seconds, the counter should increment by 2.Once the counter reaches "**10**", it should stop counting, retain this value and turn ON the buzzer for 1 second to indicate this. The delay between counter increments has to be generated using **Timer1**.

Note:
Buzzer control pin is connected to Pin no. 4 of Port C (PC3).
You may use inbuilt delay function to turn ON buzzer for 1 second.

Procedure:

Step-1: Open Experiment-1 folder. Open the given project, named **"Experiment_1.aps"**,in AVR Studio.
Note: If the file does not open, start AVR Studio 4, click on Project, then click on "Open Project" and browse the "**Experiment_1.aps**" file to open the given project.

Step-2: You will notice some pre-written function stubs and also a header file named "**lcd.h**" included for your assistance. Write code to complete the functions with the help of function description and inline comments.

The **"lcd.h"** file contains essential function definitions needed to configure LCD and send command/data to the LCD registers. A brief overview of functions in **"lcd.h"** is given below:

• **lcd_set_4bit ()**
This function is used to configurethe LCD to work in 4 bit mode.

Example call: lcd_set_4bit ();

• lcd_init ()
This functionis used to Initialize LCD i.e. sets mode as 4bit, turns on display and cursor etc.
Example call: lcd_init();

• lcd_wr_command (unsigned char cmd)
This function is used to select the command register and transfer desired commands to the LCD for its operation.
Example call: lcd_wr_command(command in hex);

• lcd_wr_data (char letter)
This function is used to select the data register and transfer the desired data to be displayed on the LCD.
Example call: lcd_wr_data(ASCII value of data);

• lcd_string (char *str)
This function is used to display a string (i.e. array of characters) on the LCD.
Example call: lcd_string(ASCII values of characters to be displayed)

• lcd_cursor(char row, char column)
This function can be used to set the LCD cursor at the desired position.
Example call: lcd_cursor (row number, column number)

• lcd_print(char row, char column, unsigned int value, int digits)
This function can be used to display integer variable values at the desired position on the LCD with required precision.
Example call: lcd_print (row number, column number, variable to be displayed, digits)
The argument "**digits**" specifies the number of digits using which the given integer value has to be displayed.

Step-3: Check and debug your code on the robot. Ensure that code performs as expected.

Step-4: Save the project and create a .zip file.

Step-5: Upload the .zip file of your saved project on the portal for evaluation

Click on this link: https://www.youtube.**com/watch?v=M9qh7ofyKCM to see the expected output for this experiment.**

Note: We request you to strictly adhere to the code layout as given in the project C file and avoid adding any new functions. However, you can declare and define new variables, if required.

Grading:
Maximum marks for this experiment are **10,** divided as follows among the following tasks.
1. Initialization of Timer 1 as mentioned. (3 marks)
2. Displaying the counter values as mentioned with specified delay. (4 marks)
3. Turning on the buzzer for 1 second, once the counter reaches "**10**". (3 marks)

Experiment 2: Indicating counter values on the bargraph LED module.

The aim of this experiment is to get you familiar with Timer/Counter module on Atmega 2560 and bargraph LED present on Firebird V robotic kit. In this experiment, you will write a program to indicate counter values on bargraph LED going from "0" to "8".

Your task is to indicate the integer value of the counter by glowing/turning ON the corresponding number of bargraph LED(s). The counter should start from "0" increment by and count up to "8**″** and use the bar graph LEDs to indicate these values. For example, to indicate the value "7" on the bargraph, seven bargraph LEDs should be turned ON. The counter should increment by 1 after every second. Buzzer should be turned ON for **1 second** once the counter reaches "8**″**. The delay between counter increments has to be generated using **Timer1**.

Note:

There are a total of 10 bargraph LEDs, of which 8 are connected to PORTJ and remaining 2 are not connected.

Check Jumper "J3", it should be connected/shorted, otherwise bargraph LED will remain disabled.

Procedure:

Step-1: Open Experiment-1 folder. Open the given project, named **"Experiment_2.aps"**,in AVR Studio.

Note: If the file does not open, start AVR Studio 4, click on Project, then click on "Open Project" and browse the "**Experiment_2.aps**" file to open the given project

Step-2: Check and debug your code on the robot. Ensure that code performs as expected.

Step-3: Save the project and create a .zip file.

Step-4: Upload the .zip file of your saved project on the portal for evaluation

Click on this link: https://youtu.be/132-2T1owiE **to see the expected output for this experiment.**

Note: We request you to strictly adhere to the code layout as given in the project C file and avoid adding any new functions. However, you can declare and define new variables, if required.

Grading:
Maximum marks for this experiment are **10,** divided among the following tasks.
1. Initialization of Timer 1 as mentioned. (3 marks)
2. Correct initialization of DDRJ and PORTJ for bargraph LEDs (1 mark)
3. Displaying the counter values as mentioned with specified delay. (3 marks)
4. Turning on the buzzer for 1 second, once the counter reaches "**8**" (i.e. all the 8 bargraph LEDs have been turned ON). (3 marks)