ROB-GY-5103 Mechatronics: Project 2

Problem 1: Using BS2, appropriately-sized resistors, LEDs, and buttons, create a circuitry that interfaces two buttons to BS2 pins P0 and P1 and two LEDs to BS2 pins P4 and P5. Next, write a PBasic program that queries the status of two buttons "simultaneously" and activates the corresponding LEDs (B1→LED1, B2→LED2, etc.) simultaneously. Note: Inactive button → LED off and active button → LED on.
Caution: Make sure to use appropriate resistors to limit current from/into BS2.

Problem 2: Cold and Hot Game A player guesses a number between 0 and 99. Each time the player enters a guess; s/he will get feedback in the form of cold (too low), hot (too high), or win (correct guess). Three LEDs and two buttons will be used. The LEDs stand for the feedback (one for cold, one for win, and one for hot). A number between 0 and 99 can be selected using two buttons the same way as in the hint below. Also, the guesses and the feedback must be displayed on the debug window. The player has three chances to guess the correct answer. When the game is over, turn on all the LEDs.

Hint: Let the two buttons be denoted as B1 and B2. Using B1 and B2, a user can input a number from 0 to 99. Specifically, the button B1 is used to input the tens digit and the button B2 is used to input the ones digit. Thus, e.g., by pressing B2 three times and B1 two times, the user enters the number 23.

Problem 3: RCTime Measurement Construct a series RC circuit. For "R" use a 5KΩ resistor. For "C" you are to use (i) 0.1μF, (2) 1μF, and (3) 10μF. Using BS2, appropriate circuitry, and PBasic program, determine the RCtime value returned by the PBasic command "RCTIME" for the three series RC-circuit. Analytically compute the RCtime value that ought to be returned by BS2. Comment if there are any discrepancies between analytical and experimental values and ascribe the reasons for same.

Problem 4: Chapter 4 of Parallax's Basic Analog and Digital Manual considers digital to analog (D2A) conversion using a resistive ladder circuit. Specifically, Fig 4.1 provides the schematic for a 4-bit D2A convertor. Compare this schematic with the one given in Lecture Topic 4 notes (Lecture #5, slide #34). The one in the notes is a correct implementation. Now, implement the 4-bit D2A convertor and record voltage output produced for all 16 possible states of 4-bit D2A convertor. Also perform analytical computation to obtain voltage output produced when only one bit at a time is turned on (others off). That is obtain voltage output for b0=1, (b1=b2=b3=0); b1=1, (b0=b2=b3=0); b2=1, (b0=b1=b3=0); and b3=1, (b0=b1=b2=0).