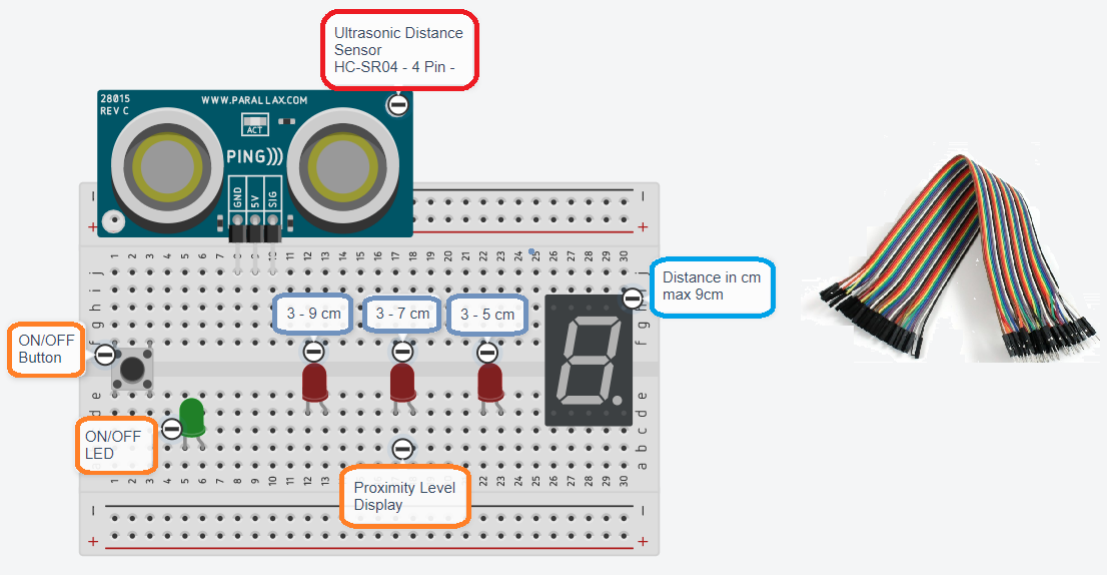
Assignment #3: Proximity Level Control with Ultrasonic Sensor

Marmara Uni. EEE Dept. CSE 2037 System Programming

Due date: December 16, 2022 23:59

Ultrasonic sensors can measure the distance by generating and sensing the ultrasound energy. The working mechanism is basically similar to the distance perception of bats. In this assignment, you will build a proximity level control board for a UGV as given in below figure and you should obtain all the components. Then, you have to arrange the inputs and outputs (I/O) in an STM32 micro-controller. (You can use either your own STM32 MCUs or STM32F407VG Discovery in our Lab.)



Operation Sequence:

1. All the LEDs and the 7-segment display must be turned off initially.
2. When the push button is pressed, green LED is turned on and 7-segment displays the initial distance between 0-9. Moreover, the proximity level LEDs should be turned on constantly (not blinking) in accordance with the levels provided in below table and above figure. Hint: ADC should be used.
3. When an object gets closer to the ultrasonic sensor, 7-segment should display the integer part of the distance. For instance, when the distance between the UGV and the wall is 8.65 cm, 7-segment just displays '8'. Moreover, most-left LED must be turned on.
4. Be careful about the proximity levels given in figure. When the distance is less than 3 cm, blink all of the proximity level LEDs with 100 ms delay.
5. If the distance is more than 9 cm, 7-segment displays dash sign, i.e., '-'. However, all the proximity level LEDs should be turned off when the distance more than 9 cm.

Distance	Left-most LED	Middle LED	Right-most LED
3-9 cm	ON	OFF	OFF
3-7 cm	ON	ON	OFF
3-5 cm	ON	ON	ON
0-3 cm	blink (100ms)	blink (100ms)	blink (100ms)

Table 1: Proximity Level Displays

6. When the ON/OFF button is pressed to close, all system should be turned off.

Be careful about:

- the LEDs and the push button. You may be needed to add pull-up or pull-down resistors,
- the jumper types. They should be male-to-female jumpers as given in the figure if you are going to use the STM32 Discovery Board in our Lab.

Ground Rules:

1. You will program the STM32 MCUs in C language. You should install STM32Cube IDE and ST-Link Utility (driver) in your computers.
2. $2 \leq$ number of team members ≤ 4.
3. Write a report that includes following chapters:

   Ch. 1: Explain your algorithm briefly and provide a flow chart that illustrates your algorithm. (You can find a flow chart example in here.)

   Ch. 2: Copy and paste only the codes you have developed in **C**. Do NOT copy the auto-generated comment parts in the code. (Screenshots for the codes will be punished.)

   Ch. 3: Image of your circuit board while running must be provided. (For example, take a photo while green LED is turned on and 7-segment displays the distance to a certain obstacle with a scaling object which its length is known. (a ruler perhaps...))
4. Each team should prepare a single report. (You should include all the team members in the document.)
5. Your report should not exceed the total pages of 4. No need for cover page, just write all the team members and the assignment number at the top of the first page as we did in this assignment doc.
6. No hard copy needed. Send your reports in **.pdf** format to the mail address of ee.cse2037@gmail.com. We will only consider the submissions to this mail address !!!
7. Only 1 (one) student should send the project report and s/he must add all team members to the CC of the mail !!!
8. We will also do a demo in an appropriate time. We will announce the schedule later.
9. Late submissions will not be considered! (Even 1 min.)