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DOKUZ EYLUL UNIVERSTY

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER ENGINEERING

2021 - 2022
SPRING SEMESTER

CME 3208
PRINCIPLES OF EMBEDDED SYSTEMS

LAB 10 – 24.05.2022
PARK SENSOR

In this lab, you are asked to create a parking sensor, using HC-SR04 Ultrasonic Sensor, LCD display, buzzer and a LED. You will use ultrasonic sensor to calculate distance, print it out on LCD display and activate buzzer and LED according to ultrasonic sensor value you read.

The calculation of buzzer and LED activation frequency should be done according to variables and equation below.

These variables are for activation duration for buzzer and LED. We assume that buzzer and LED should activate up to 1000 milliseconds and deactivate for same time. However, according to our formula below, calculated new frequency could exceed "Buzzer_LED_Freq_Max" variable.

```
int Buzzer_LED_Freq_Max = 1000;
int Buzzer_LED_Freq_Min = 10;
```

These variables control the distance space we use on our equation. You can consider them as centimeters, to make it easier to program. However, our function could work if the distance is larger than 1 meter, giving a larger activation frequency than "Buzzer_LED_Freq_Max" variable.

```
int Dist_Max = 100;
int Dist_Min = 10;
```

These variables are used to store current distance returned by sensor and the result of current frequency calculation.

```
int Current_Dist = 0;
int Current_Freq = 0;
```

These variable are used to how frequently we should check the current distance and update "Current_Dist" variable and LCD display for values. You can assign these values but we should be able to check the behavior for different update values on your project.

```
int Update_Freq = 500;
int Update_LCD  = 200;
```

The formula below are used to calculate what the current frequency should be according to current distance measured by sensor.

$$Current_{Freq} = \left(\left(\frac{Current_{Dist} - Dist_{Min}}{Dist_{Max} - Dist_{Min}}\right) * \left(BuzzerLEDFreq_{Max} - BuzzerLEDFreq_{Min}\right)\right) + BuzzerLEDFreq_{Min}$$

As you can see, every "Update_Freq", "Current_Freq" is calculated and buzzer and LED are activated according to this variable. For out of bound cases where distance is smaller than 10 cm and larger than 100 cm, we can try to implement special rules. We can say that for distance values lower than "Dist_Min", the buzzer and LED should be activated without time limit, until "Current_Dist"is larger than "Dist_Min". We can also say that for distances larger than "Dist_Max", the program should not activate buzzer or LED, because it is not necessary.

If you wish you can change the formula or the values of variables above to make your program work better. That will allow us to see which formula and which initial values are better for this project.

You should make sure that you do not get a zero division or other mathematical errors on your formula. Include checks to prevent such scenarios.

You should print “Current_Dist” and “Current_Freq” on your LCD and it should be updated according to “Update_LCD” variable. An example LCD display is given below.

DEFAULT LCD SCREEN:

	00	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**
00	D	I	S	T	A	N	C	E		:					5	0
01	F	R	E	Q	U	E	N	C	Y	:				4	5	0

For measured distance 50 cm, “Current_Freq” is calculated to be 450 milliseconds according to the formula above. This means the buzzer and LED will activate for 450 milliseconds and deactivate for 450 milliseconds.

But what happens if we update the “Current_Dist” variable due to “Update_Freq” variable? Should we wait until this buzzer and LED cycle ends or should we reset it according to “Update_Freq”? If we wait for it to end, our program will not be responsive as we wish it to be. If we do not wait, it may cause buzzer activation without silent period due to frequent changes in “Current_Dist”. Try to implement the second case and if you can find a solution to make it more user friendly, like a real life park sensor, explain it in our lab class.

Make sure to use your buzzers in a quieter fashion, rather than very loud whistling sound. Because there will be a lot of different groups on our lab and it will create a very loud and uncomfortable class environment :).

If you have problems with LCD display, try to use serial monitor as an alternative. It will allow you to show your results but your grade would still be reduced due to not using a LCD display for your lab project.

If you wish to ask questions regarding this assignment, you can send emails or write it in class forums in SAKAI.

GOOD LUCK TO YOU ALL!