



Faculty of Engineering and Technology - Electrical & Computer Engineering Department
Real-time and embedded systems Laboratory - ENCS 514, Second Semester 2021/22

Midterm exam – All sections – duration: 75 minutes

Name:

ID:

We need to design a simple control system using a PIC microcontroller that controls and reads an encrypted message on a CD recorder (signal generator). Every character of the encrypted message is represented by a square signal whose period varies among characters. Assume the letter 'a' is represented by a signal that has a period `period_a`, the letter 'b' is represented by a signal that has a period `period_b`, the space character is represented by a signal that has the period `period_space`, etc (see the example and lookup table on next page). Of course, the characters must be represented with square signals of different periods. When the letter '.' is encountered, the processing of the encrypted message ends.

Your design of the controller should contain the following components:

- PIC16F877A,
- A stop/resume/reset/restart push button,
- 16X2 LCD,
- A green LED.

Your system should behave as follows:

1. The stop/resume/reset/restart push button should stop/resume reading, reset reading and restart reading the recorded message on the CD ROM consecutively. The stop/resume works on a single click (odd single-clicks represent a stop order, even single-clicks represent a resume order) the reset reading on a double-click and the restart reading on a triple-click.

Hint: Think of using TMRO to detect the single, double and triple clickings of the push button.

2. The green LED is initially OFF and goes into full intensity after reading the 100th word of the encrypted message and stays at that intensity until reading the encrypted message is over. Assume the PWM signal has a frequency of 15KHZ. Of course, the green LED should go OFF after a reset or a restart.
3. The LCD should display the characters as they get decrypted by the controller on the first and second row. When the LCD is full (32 characters displayed), the controller should stop processing the encrypted message on the CD ROM until the push button stop/resume/reset/restart is clicked.
4. Once the controller finishes processing the encrypted message, it must display on the screen the following:

- On the first LCD row, total number of processed words & the total number of processed characters.
- On the second LCD row, the highest 3 encountered characters while processing the encrypted message on the CD ROM (e.g. $i = 20$, $v = 18$, $y = 15$).

What you should do

- Build a schematic using Proteus for the above-described system. Once done, make a print-screen and save it as an image called "schematic" in a folder of your creation called "midterm".
- Under MPLAB, write the C-code for the above-described system. Make sure you place all project files under the folder you created above.
- Once exam time is over, zip the folder "midterm" and send it through ritaj as an attachment while replying to the memo entitled "encs514 – midterm – second semester, 2021".

Example:

Assume the encrypted message represent the phrase: the baby is too cute.

After processing, the output on the LCD should look like the following:

words = 5, char = 21

t = 3, b = 2, e = 2

The characters have the following periods:

Character	Period (ms)
a	10
b	15
c	20
d	25
.	.
.	.
.	.
x	125
y	130
z	135
space	140
.	145