CPE 0907333

Embedded Systems Project

Spring 2020

A certain embedded system has two PIC16F877A microcontrollers: MC1 (factory) and MC2 (command station). The 16F877A has more PORTS than the 16F84A. It has for example two additional 8-bit ports: PORTC and PORTD which you can configure exactly the same way as the ones you already learnt (PORTA and PORTB). The system operates as follows:

The 16F877A MC1 is interfaced to 10 production lines in a factory. The production lines are numbered from 0 to 9. When a production line requires some supervisor attention, it sets a signal line that is connected to the MC1 microcontroller to logic one. You have no control over this signal. Two or more production lines can require supervisor attention at the same time. So it is possible that one or more lines are set to logic one at the same time. However, production lines have priorities. High-numbered production lines have higher priority than lower-numbered production lines. So if the controller receives a signal from production line 8 (PL8) and production line 5 (PL5) simultaneously, it will have to process the request of PL8 first.

All these production line signals are connected through an OR gate to the external interrupt pin. So whenever a production line sends a signal that it needs attention, the MC1 PIC will know because of the interrupt. On each interrupt, the microcontroller will read the PORT(s) and determine which production line to service first. The controller code will function as a 10-to-4 priority encoder. It will process the incoming data as illustrated in Table 1:

Table 1: Production Line (PL) Signal to Line Number Encoding

PL9	PL8	PL7	PL6	PL5	PL4	PL3	PL2	PL1	PL0	Output			
0	0	0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	1	x	0	0	0	1
0	0	0	0	0	0	0	1	x	x	0	0	1	0
0	0	0	0	0	0	1	x	x	x	0	0	1	1
0	0	0	0	0	1	x	x	x	x	0	1	0	0
0	0	0	0	1	x	x	x	x	x	0	1	0	1
0	0	0	1	x	x	x	x	x	x	0	1	1	0
0	0	1	x	x	x	x	x	x	x	0	1	1	1
0	1	x	x	x	x	x	x	x	x	1	0	0	0
1	x	x	x	x	x	x	x	x	x	1	0	0	1

The MC1 processed output is then sent through another parallel port to the other controller found at the central command station. The MC2 continuously reads the values from the port. It also has a set of four LEDs connected to it. It will flash the number of the production line on the LEDs ON and OFF to draw the supervisor attention. The flashing duration is 0.75 seconds. Assume both controllers are operating on an external oscillator clock of 4MHz. You

must use hardware timers with interrupts to operate the LEDs. The MC2 is also interfaced to a common anode 7-segment display. The display will also show the number of the production line.

The supervisor will send a worker to the line that needs attention. Once he/she completes their job, they will reset the (service) signal to MC1.

BONUS: Students who successfully build a **working** prototype for their project in Proteus Simulator will get 3 points.

Submission Guidelines

1) You can work on this project in groups of two students.
2) Submit the ASM and HEX files, and the Proteus project file in one compressed zip file to:
   Dr. Ramzi: r.saifan@ju.edu.jo
   Dr. Ashraf a.suyyagh@ju.edu.jo
3) The email should be received before 23:00 PM on Thursday 30th/April/2020. Submissions after the deadline are ignored. Late submissions are not acceptable.
4) Don't take others' solutions. Your instructor might ask you for a short discussion (could be online discussion or in person depending on the circumstances). If you don't show up on time, you will get an instant zero.
5) Cheating is not tolerable. If we find out that you copied others work or had somebody do the project for you, then you subject yourself to the punishments listed in the university regulations.