ELEC2220 Computer Systems Spring 2021

Homework #8 (Submit as a single PDF file (Cnavas) by 10:50 a.m. on 4/9/21)

In this homework, you are to make the changes described below to the homework 7, adding the component `IT_keyboard` which is used to enter the initial pattern index *l*. With a proper configuration and set-up, the `IT_keyboard` generates the IRQ interrupt when a key is pressed. Then, the corresponding interrupt service routine (ISR) is executed which identifies the key pressed and returns the value of the key through the memory variable `Key_value`. The assembly code of the ISR is provided in the Homework folder.

- Initially, all of the LED's are to be off, i.e., lit green once your program starts.
- Your program waits until a (valid) initial pattern index is entered through the keyboard.
- When a valid initial pattern index (0, 1, 2, 3, 4, 5, 6, 7) is entered, the initial pattern is displayed immediately and the corresponding sequence of patterns starts being displayed.
- A sequence is repeated indefinitely until another initial pattern index is entered.
- If an invalid initial pattern index or the initial pattern index the same as the one for the current sequence is entered, it is ignored.
- An initial pattern index can be entered at any time, which initiates the new sequence immediately.
- The rate at which the pattern is changed must be set such that the sequence length in time is the same independent of the initial pattern index *l*.
- The timer basic function must be used in controlling the rate, i.e., implementing the subroutine `delay`.
- Use the ports B (address: 1) and E (address: 8) for the rows and columns of the `IT_keyboard`. The vector number to be entered in the `IT_keyboard` configuration window is 6. The interrupt vector address for the IRQ interrupt is $FFF2.
- The first 5 memory variables allocated must be `LEDS`, `DIRECTION`, `NTOFS`, `Key_flag` and `Key_value`, in this specific order. `Key_flag` and `Key_value` must be initialized to 0 and $FF, respectively.

Assemble the program and execute it using the Start/Continue button with the contents of `LEDS` displayed in *binary*, and `DIRECTION`, `NTOFS`, `Key_flag` and `Key_value` displayed in *decimal* in the data window, and `IO_LED` and `IT_keyboard` shown. Also, the memory window should show all memory variables in *binary.* Take screen-captures (the source, data, register and memory windows) including the IO_LED component at the following time instances:

- Right after the IO_LED is set up as an output port (i.e., DDRA is programmed).
- When $B(l_{max})$ in the sequence for the initial pattern $B(3)$ is displayed.
- When $B(l_{min})$ in the sequence for the initial pattern $B(3)$ is displayed.
- When $B(l_{max})$ in the sequence for the initial pattern $B(4)$ is displayed.

- When $B(l_{min})$ in the sequence for the initial pattern $B(4)$ is displayed.

Include the following items in your submission:

- The list file of your code
- The 5 sets of screen-captures in the above order.