Experiment 8 Fall 2012

Count UP/DOWN Timer Using The SPI Subsystem and LCD Display

NOTE: Late work will be severely penalized - (-7 points per day starting directly at the official end time of your lab section. No exceptions! If your lab ends at 10:50 am and you demo and turn in your report at 10:51 am you loose 7 points automatically. Be disciplined, start early, and get the work done on time.)

Due: Week 10 lab Sessions (10/30/2011)

Design and implement a two-digit one second interval count down/up timer system with the following specification:

I. Input:

    1. 4X4 Matrix Keypad

        a. Keys 0 - 9 used for single digit numeric input
        b. Assign XIRQ pin for START/STOP
        c. Assign IRQ pin for UP/DOWN
        d. Assign RESET pin to Reset

II. Output:

    1. Display output on a LCD display.

    Go here for more LCD info

    The LCD will be driven by a SIPO IC which is driven by the NanoCore12 SPI system pins.

III. Operation:

    At power up the display should give instructions about how to use the Count UP/DOWN timer.

    1. When entering digit keys the most significant digit (tens place) should be entered first followed by the units digit. (Like a calculator.
    2. Implement a CLEAR key (backspace-delete) so that corrections can be made.
    3. Press UP/DOWN to set the count direction. (This key should also function while counting is in progress.)
    4. Press the START/STOP key and timer should begin to count down (or up) in one second intervals. If START/STOP is pressed again the counting should pause. The counting should resume when START/STOP is pressed again. So, START/STOP is a toggle function. If the UP/DOWN key is pressed during counting the counting should change directions. So, UP/DOWN is also a toggle function.

5. When the count reaches 00 (note: count up sequence is 98,99,00) the display should flash the 00 off and on rapidly 3 times and then the display should go blank.
6. The display should continuously display both the counting direction (Counting Up or Counting Down) and the operation mode (Running or Stopped.) You may also display any other information as you see fit.

Note: If START/STOP is pressed after only a single digit has been pressed then countdown (or up) should commence from the single digit.

We will need to reduce the number of output lines we have been using to make lines available for other purposes. To do do this you are required to use the SPI subsystem of the NanoCore12. We will output serial data to a Serial-In-Parallel-Out (SIPO) IC. The output of the SIPO will go to the LCD display data lines.

We need three pins from PortM for the SPI system so the three other PortM pins can be used for the three required control lines.

Data sheet for the 74HC595 SIPO IC is here.

Some of the special pins on the SIPO:
10 - SCLR' = Serial Clear (active low) Clear all bits of the shift register
11 - SCK = Serial Clock (Shift Clock) Active on rising edge
12 - RCK = Register Transfer Signal. Moves all bits (in parallel) from the Shift register to the Output Latch. Active on rising edge.
13 - G' = Output enable (active Low)
14 - SER = Serial Data Input Line

Report: Your lab report must include the following:
1. A cover page with: Experiment Name and number, ECE 367 Spring 2012, Your name, Your UIN, the date submitted, and your TA's name.
2. Your assembler code with your name, course, date, experiment number, program explanation and comments for every line of code. The program explanation should include the NanoCore12 pin assignments and an explanation of the organization of the data table, etc.
3. A logic diagram of the circuit
4. An electric circuit diagram of the complete system
5. A user manual to explain how to use the system.
6. Conclusions: Does your circuit meet the specifications and function properly? What problems did you encounter during the coding or construction of the circuit? How would you do this project differently? What extra features or functionality could you have included? What did you learn from working on this project?

Last modified: Mon Oct 22 11:40:30 2012

ECE 367: Experiment 8
Count UP/DOWN Timer Using the SPI Subsystem and LCD Display
Semester: Fall 2012
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Due Date: 2012 October 30
Lab Section: T11
TA: Chenjie Tang

User Manual:
This program is a count up/down timer. The user should first supply power to the circuit and then press the reset button to clear the display. On startup, the counter is a slow count up counter that starts at 00. The user has an option of inputting the 2 digits where the counter should begin. The user has an option on pressing 'F' to speed up the counter to pressing 'A' to restore the slow counter speed. The user also has the option to clear ('C') or backspace ('B') the current input. The user finally has the option of pressing the up/down button for the counter to count up or down. When the user is ready, the user should press the start/stop key to start the timer. The user may adjust count direction during the counter, but other options require the timer to be paused before adjusting.

Conclusion:
  Yes, my circuit meets the specifications and function properly.

  I had trouble with the timings because many of the commands on the LCD required delays for the command to execute. Therefore, I had to revise my timers. I had trouble setting up the SPI because I initially had to setup code for the SPI before I set the direction of port M. I also had trouble with getting the LCD to show stopped/running and count direction because I only updated the count direction every so often.

  I would do this project differently by using a loop to go through the instructions as opposed to manually writing the string for each line and manually traversing through the instructions.

  The extra feature I have implemented is the speed option and both the clear (clears all digit) and backspace (only backspace one digit) key.

  I learned about setup code precedence, strings, the LCD display, timing adjustments.