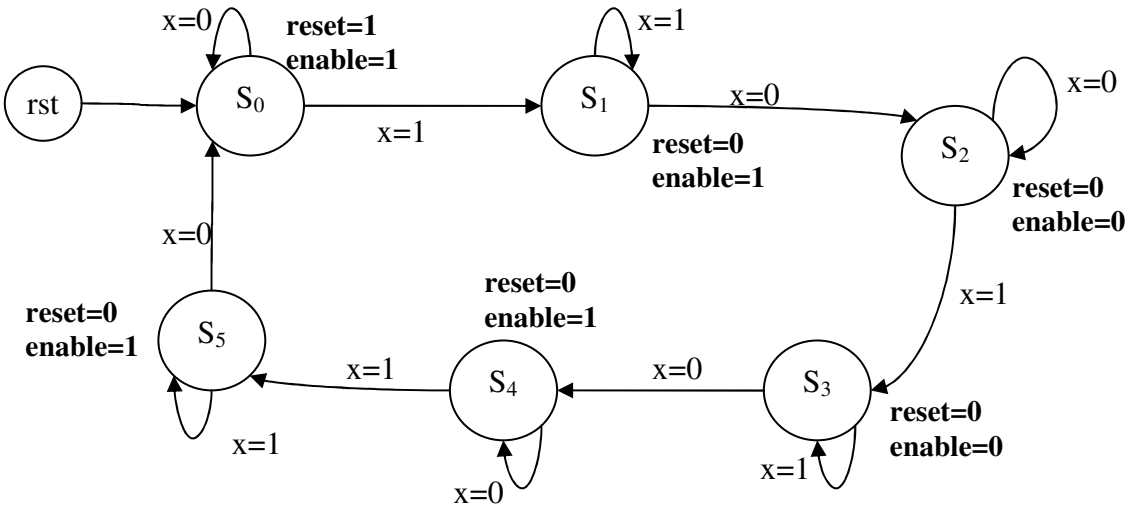
Lab 10 – Application III: Stopwatch ELE202 FALL2007

Objectives

- Learn how to design a finite state machine or sequential circuit.
- Learn how a complex digital circuit is built from separate part.
- Build, and test Stopwatch.

Overview

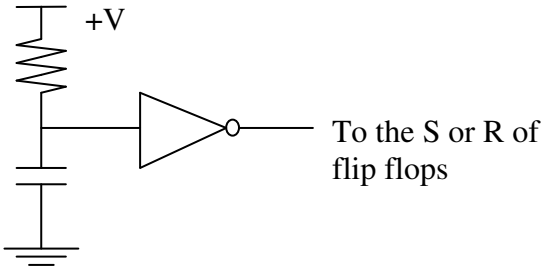
In this third and final part of the stopwatch project, we will design and implement a finite state machine, or sequential circuit, that will take the command from the pushbutton switch, and generate signal to control the reset and counting of the BCD counters built in Lab 8. The example state diagram of this state machine is shown below:



You may derive your own state diagram with your understanding of the problem. The "rst" state in the above diagram represents the "power-on reset" circuitry described later. The input X is from the pushbutton (or momentary) switch, which should be connected as a single throw switch as in Lab 2. There is no need for a debounced circuit since your state machine will run at a very low speed. Note that X=1 mean the switch is on and vice versa. The state machine will wait until X=0 before checking for X=1.The two outputs: reset and enable are signals to control the 4510 BCD counters.

Power-On Reset

The power-on reset circuitry is shown below. When the power is first turned on, the capacitor holds no charge (voltage) and thus the inverter output is '1' or high. However, the resistor will start to charge up the capacitor and eventually force the inverter output to go '0' or low. The time to build up charge on the capacitor is determined by the values of the resistor and the capacitor. Choose C > 1μF and R>470KΩ give good result.



State Assignments
We will conduct a raffle during class time so each student will get a different state assignment. However, you are free to choose the type of flip flops in your design. Remember that you will need flip flops with set (S) and reset (R) inputs.

Verification
During the last day of the lab (Monday Section: 12/10; Tuesday Section: 12/4; Wednesday Section: 12/5 and Thursday Section: 12/6), I will be in the laboratory to verify your completion of the stop watch project. If unfinished, I will verify the percentage of completion. I will not verify your project before or after the date of your last lab.
Remember, the last day of the lab (at 4:45PM) is your absolute deadline.

Report submission deadline
The final report format is described as follows. You have up to one week from your last lab, as stated above, to submit your final report. No late report is accepted. You may send your report electronically via email; or hand in the hardcopy.

ELE202 Report Requirement
Lab 10 – Stopwatch

This is a full report submission:

- The report begins with a cover page. It should include the title of the lab, your name, your lab section, and the date the lab was submitted.
- Next, write a short abstract to summarize the lab – this should be 3 sentences or less.
- The main body of your report should include:
    1. The state diagram with your state assignments.
    2. Show the design procedure: state table, Karnaugh maps, Boolean equations, logic circuit diagram with IC numbers and pin numbers clearly marked.
    3. A list of IC's used in your implementation.
- The last part of your report is a summary of:
    1. The obstacles and observations of the lab. Mention anything you do differently from what were described in this manual.
    2. Lesson learned.