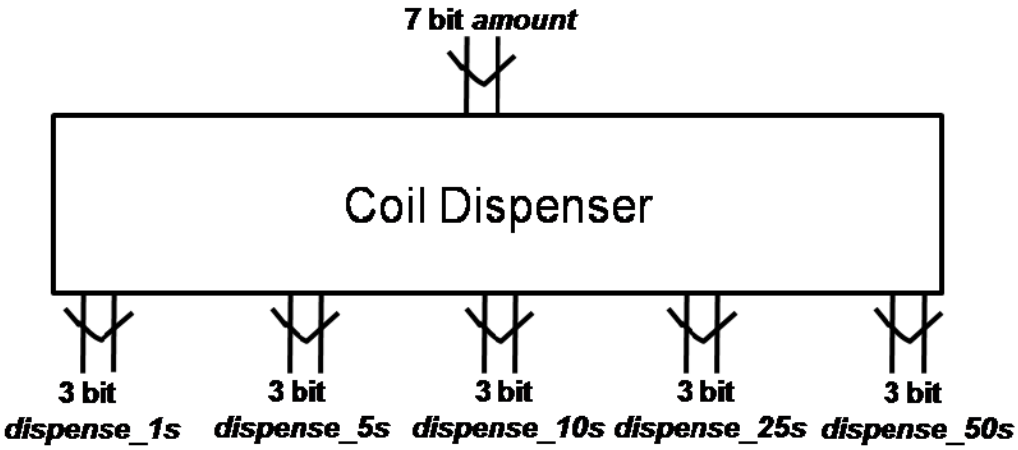
Project 2 (Change Dispenser)

Please make sure that all your designs and print-outs are obtained using the simulator package, Xilinx Project Navigator. A simple tutorial for it is available on the website. Also you can get a CD of this software from the lab manager Mr. Yalçın Turgay (yalcin.turgay@boun.edu.tr, 359-6923), who is always in the Network and Electrical Measurement Laboratory. Please check your operating system of your computer whether it is appropriate for the version of the simulator package. You should sent your work to course e-mail address (boun.ee142@gmail.com) before the deadline of the project. Demonstration date will be announced on future days.

Description

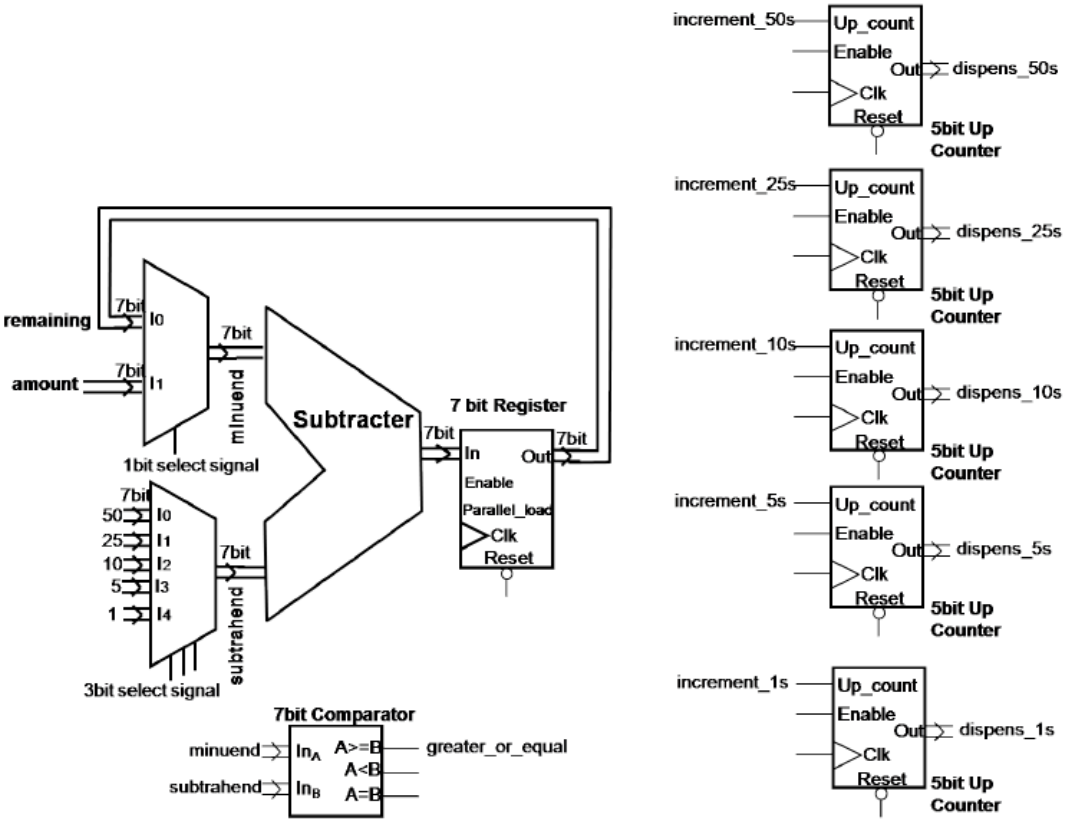
The purpose of this CAD assignment is to design a sequential circuit operating as a change dispenser. In a change dispenser you are supposed to return a given change amount ranging from 1 to 100 Kuruş (KR) in multiples of 1 KRs, 5 KRs, 10 KRs, 25 KRs and 50 KRs. The amount that you are supposed to return is a 7-bit binary number, enough to represent values from 1 KR to 100 KR. The change dispenser has 5 different boxes holding 1s, 5s, 10s, 25s and 50s separately. Assume that in each box you have infinite amount of coins. Depending on the amount that the machine is supposed to return, the machine activates the signals at its outputs to dispense the coins. Outputs, dispense_1s, dispense_5s, dispense_10s, dispense_25s and dispense_50s are 3-bit binary numbers specifying how many of that coin is supposed to be dispensed. For example, dispense_1s=100 means, 4 of 1 KRs will be dispensed. These outputs are connected to a mechanical set-up that does the specified amount of dispensing. The inputs and outputs to the state machine are summarized in the picture below (where coil should have been coin).



This machine should try to give the least amount of coins. That is, dispensing should start from 50s. If the amount is greater than 50 KR, then one 50 KR should be dispensed. If not, no 50s should be dispensed. For example, if the amount to be dispensed is 87 KR (1010111), this amount should be compared to 50 KR. Since 87 is larger than 50, dispense_50s should be 001. After this operation, 87-50= 27 KR is left to dispense. Since 27 is smaller than 50 KR, comparison must be made with 25 KR. 27 Kr is larger than 25 KR, therefore, dispense_25s should be 001. 2 KR is left after this operation. Afterwards, 2 KR is compared to 10 and 5 Kr in order. Since 2 Kr is less than both 10 and 5 KR, dispense_10s becomes 000 and dispense_5s becomes 000. Finally, dispense_1s becomes 010.

Your design must be a synchronous circuit using a single clock signal. You can use any combinational (adder, subtractor, decoder, comparator, multiplexer…etc.) or sequential component (flip-flops, registers, shift registers, counters…etc.) from library. You do not have to build these components.

In this project, you may want to use multiplexers, parallel loadable registers, subtractor, comparator and control signals that control them. A possible data path unit can be as below:



In the data path unit above, certain components are shown with their control signals. Here, control signals should initialize all the registers and counters and select amount as minuend initially. Then, minuend should be selected as remaining. Initially, 50 must be selected as subtrahend. Next, depending on the comparator result, 25, 10, 5, and 1 will be selected as the subtrahend. Furthermore, after every successful subtraction, a counter that corresponds to the coin value subtracted at that moment from the minuend can be incremented by one. This way, the output values are determined.

Assignment

- Complete and draw your data path unit with the control signals you plan to use.
- Show how you would generate these control signals by drawing the schematic of the circuit generating these signals. This circuit can be a state machine or you may propose a different solution. If it is a state machine, draw its state diagram; write down

the state table and coding you use for the states. Design and draw the circuit schematic of this state machine.

- Implement and simulate the whole sequential system. Test it for critical conditions. For example, test dispense values for amount values 0, 99,…etc.

Deadline

You have to return the report of this project by your discussion session on----------,

Friday, to your TA (Engin Afacan, Beta Lab). There will be absolutely no extension! The

demonstration will be made in the Network and Electrical Measurement Laboratory to your TA.