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| ELEC402 Introduction to VLSI Systems |
| Electric Washer & Dryer 2 in 1 Machine |
| Assignment 1 Report |

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2.General Description

The finite state machine in this assignment is designed to be used in a laundry machine which has the functions of washing and drying. According to the state diagram (Figure 1) below, the machine is initially at the ‘idle’ state, and the door sensor starts to check whether the door of drum is closed. After the user puts the clothes in and closes the door, the FSM prompts the user to choose a mode. Then, the FSM outputs a ‘*in\_water*’ signal to the controller to add water into the drum. The FSM starts to check whether the water reaches the desired level. If the water is not enough, the FSM goes back to the ‘Water\_in’ state and adds more water. When the water in the drum reaches the target water level, the water level sensor inputs a ‘1’ to the FSM and the FSM goes to the ‘Rotate’ state to make the drum spin by outputting a ‘*spin*’ signal to the controller. After rotating, the state goes to ‘Water\_Out’. At this state, the FSM outputs a ‘*channel\_open*’ signal to the controller to open the valve of the drum to drain away the water. Meanwhile, the water level sensor detects the water level in the drum. If it is empty, the state goes to ‘Wait\_for\_dry’. This is one complete washing cycle. In this design, Normal mode has two washing cycles, Heavy mode has three washing cycles, and Delicate mode has one washing cycle. At ‘Wait\_for\_dry’ state, the FSM checks if the *count* number is 0. The *count* number depends on different modes (Normal is 2, heavy is 3, delicate is 1). When the *count* is not 0, the state goes back to ‘Water\_in’ and starts a new washing cycle. If the *count* is 0, the FSM goes to ‘Dryer’ state to check whether the dryer will be used. If the user wants to dry (mode[0] = 1), the state goes to ‘Heater\_On’ and the FSM outputs a *heat* signal to the controller to turn on the heater. After heating, the machine finished all the laundry cycles and goes to ‘Finished’ state. While at the ‘dryer’ state, if the user doesn’t use the dryer function (mode[0] = 0), the states goes to ‘Finished’ state directly. At ‘Finished’ state, the machine is waiting for the user to take clothes. When the user open the drum door, the door sensor inputs a *!door\_lock* signal to the FSM. Then the FSM goes to ‘idle’ state and is waiting for the next use.

3.Testbench

4.Block Diagram of FSM

5.Block Diagram of How FSM and Testbench connected

6. A State Diagram with data flow

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**Figure 1** shows the state diagram of the FSM with data flow. The inputs and outputs signals are shown in blue and green color respectively. The inputs signals *door\_lock* and *water* are from the sensor to detect if the door is closed and if the water in the drum reaches the desired water level. The *mode* signal is an input from users. The last bit of ‘*mode*’ represents the use of dryer (mode[0] = 0 means the dryer will not be used). The Normal mode sets the *count* signal to 2’b10; Heavy mode sets the *count* signal to 2’b11; Delicate mode sets the *count* signal to 2’b01. The green output signals only indicate the output value at the current state, otherwise is 0. The black signals represent the wires.

7.Copy of code (separate file, size font 8)

8.Simulation waveform result.