

University of California at Berkeley
College of Engineering
Department of Electrical Engineering and Computer Science

EECS 150
Spring 2004

R. H. Katz

Problem Set # 6 (Assigned 4 March, Due 12 March)

1. Consider the design of a simple digital alarm clock. The clock displays the current time in HH:MM notation using 24-hour notation (i.e., 11 PM is 2300 and midnight is 0000). There are several control inputs for setting the current time and the alarm time. The TIME SET HH button allows you to rapidly advance through the hours 0 through 23. The time advances one hour each time the button is pressed. The TIME SET MM button does the same thing for the minutes 00 through 59. In addition, the clock has a toggle input that indicates CLOCK in one position and ALARM in the other. This refers to which time is being set by the TIME SET buttons: either the current time (CLOCK) or the alarm time (ALARM). If the ALARM button is set, the clock displays the last set alarm time. There is another input controlled by a push button: ALARM ON when pushed in and ALARM OFF when popped out. A final button is labeled SNOOZE. If the alarm is set and actively ringing, then pressing SNOOZE halts the alarm for five minutes. Your job is the following: Define the state diagram for the clock controller. It should support normal clock display (when CLOCK is set), alarm display (when ALARM is set), set current time (CLOCK + TIME SET buttons), set alarm time (ALARM + TIME SET buttons), and of course, the alarm should sound when current time equals alarm time. The ALARM is silenced for 5 minutes if the SNOOZE button is pressed while the ALARM is sounding.
 - (a) Identify your inputs, outputs, and name and describe your states.
 - (b) Identify essential elements of the system's datapath, including registers and counters. Give these names and indicate the control signals that make them operate like count and load.
 - (c) Draw a symbolic state diagram for your design, labeling all state transitions and indicating the control signals asserted in each state.
 - (d) Write Verilog for the Alarm Clock Controller.
2. Professor Katz has one of those incredibly complicated European Miele clothes dryers. The machine has dryer settings for three mutually exclusive option settings, one of which MUST be selected: *Cotton fabrics* (with six subsettings described as: Extra Dry, Normal+, Normal, Hand Iron, Hand Iron Damp, Machine Iron Wet), *Permanent Press fabrics* (described as: Normal+, Normal, Hand Iron), or *Timed Drying* (15 minutes, 20 minutes, 30 minutes). When in the *Cotton* or *Permanent Press* modes, the dryer has an embedded humidity sensor that determines how wet the wash is. When this sensor value is reached, the dryer can advance to the next phase. Similarly, after the *Timed Drying* period has expired, the dryer enters the next phase. This is *Cool Down*, which turns off the drying action until the clothes reach a predetermined "cool" temperature. The final phase is *Anticrease*, which intermixes a tumbling action with periods for which nothing happens (e.g., 10 second spin followed by 30 seconds of nothing). This goes on for five minutes. The machine then advances to *Stop*, and is ready for the next load. In addition, the dryer has two more control knobs: *Temperature*, which can be set to high or low, and *Alarm*, which can be on or off. The former allows for two different temperature settings. The latter allows for an audible alarm to be sounded when the dryer enters the Stop phase.
 - (a) Identify your inputs, outputs, and name and describe your states.
 - (b) Identify essential elements of the system's datapath, including registers and counters. Give these names and indicate the control signals that make them operate like count and load.
 - (c) Draw a symbolic state diagram for your design, labeling all state transitions and indicating the control signals asserted in each state.
 - (d) Write Verilog for the Dryer Controller.