

LAB 3 - EEE333 Hardware Design Language/Programming Logic

Alarm Clock Design

In this lab, you will design an Alarm Clock using System Verilog and implement it on the DE0- CV board using HEX displays. Bonus points (10%) will be given to the first 5 teams.

Design Specifications for the Alarm Clock:

0. Overall goal

- The overall goal of this lab is to implement an Alarm Clock with two times 'Current time' and 'Alarm time'.
- Current time can be set, and it keeps running.
- Alarm time can be set and should trigger when it's being set.

1. Time should be displayed on 4 of the 7-segment display:

- Display time in "military time" format that is time goes from 00:00 to 23:59 (24 Hr format). Display the minutes on right two hex displays (HEX 0 and HEX 1) and hours on left two hex displays (HEX 2 and HEX 3).
- Switch SW2 can be used to "set alarm". When it is turned on the 7-segment display should show the alarm time instead of current time.
- Whenever the current time reaches the alarm time, LED7 should turn ON and OFF continuously.
- Whenever "Alarm clear" button KEY0 is pressed LED7 should stop blinking.

2. Timing / Clock generation: Divide down the 50MHz clock as necessary

3. Switch functions:

- SW0 will act as a global reset (highest priority). Both the current time and the alarm time should be reset to zero.
- SW1 is the "current time set" switch. When it is on, the display freezes at whatever the time was when the button was pushed, and by pressing KEY3 and KEY2, one can set the time to a new value. KEY2 increments time (in minutes) and KEY3 the time (in hours). After you set the current time (SW1 goes from ON to OFF), the clock begins to count up from the set time.
- SW2 is the "alarm set" switch. When it is on, the display shows alarm time (00:00 after reset), which can be adjusted with KEY3 and KEY2 in the same way as the current time. Once SW2 is turned off, the displays should go back to the current time. When the alarm time is being set, the current time should keep running.
- SW4 is a 120x speed demo/debug mode switch. In this setting, the minutes of current time will increment at a half second speed.

4. LED functions:

- LED9 should continually blink at a 1 second interval once current time starts counting.

- LED7 is essentially the alarm. Whenever the current time becomes equal to the alarm time, this LED7 should blink ON and OFF along with LED9 until KEY0 is pressed to clear the alarm.

5. Button Function:

- KEY0 is the “alarm clear” button. Whenever it is pressed, alarm time goes back to “0000” (no matter if alarm is triggered).
- If the alarm gets triggered, pressing KEY0 will clear the alarm which means LED7 will stop blinking and display goes back to current time.

6. Other considerations:

- SW1 and SW2 are mutually exclusive (one-hot). Only one should be active at a time. If both are active at the same time, the behavior should be the same as if neither of them was active.
- Similarly, KEY2 and KEY3 are mutually exclusive (one-hot). Only one should be active at a time. If both are active at the same time, the behavior should be the same as if neither of them was active.

Rubric:

- 20% Working of Alarm clock.
- 20% Working of Current time.
- 20% Working of LEDs.
- 20% Working of Switch.
- 20% Working of reset.
- 10% extra credit for first 5 groups/individuals.