CSSE2010/CSSE7201 – Introduction to Computer Systems
Semester Two, 2021

Lab 15 Preparation Task

You should do the exercises below before your **lab 15 session (Tue on week 10**).

Task 1

Draw a state diagram for a stopwatch controller which controls a timer/counter counting in milliseconds. The controller has 2 inputs:

- S – a start-stop button which is 1 when the button is held down and 0 when released
- R – a reset button which is 1 when the button is held down and 0 when released

The controller has three outputs:

- C – clear counter – this output is 1 when the timer/counter is to be reset to a zero count, 0 otherwise
- T – timing – this output is 1 when the timer/counter is to be counting; if the output is 0, then the timer/counter maintains its current value
- D – display – this output is 1 when the display is live (digits are shown) and 0 when the display is to be blank

The behaviour of the stopwatch controller is as follows:

- Initially, and when reset (see below), the timer/counter is to have 0 value and the display should be blank. The display is then only ever blanked after a reset.
- When the start/stop button is pressed, then the timer/counter should start counting and the display should be live. (Timing starts as soon as the button is pressed, don't wait for the button to be released.)
- When the start/stop button is pressed again, the timer/counter should stop counting and hold its current value. The display should continue to display the count value. (Timing stops as soon as the button is pressed, not when it is released.)
- After timing is stopped, timing can be started and stopped again as desired by pressing the start/stop button.
- If the reset button is pressed, then the timer/counter should be reset to 0 value and the display should be blanked. This should happen when the reset button is released, not when it is pressed. The reset button overrides the start/stop button.

State any assumptions you make if you believe there is ambiguity in the specification above.

Task 2

Consider an AVR ATmega324A microcontroller clocked by a 8MHz clock. For timer counter 1 (16-bit timer) what clock select bits (prescaler choice) and output compare register values should be chosen to time the following periods of time:

- 100 microseconds
- 1 millisecond
- 10 milliseconds
- 100 milliseconds
- 500 milliseconds
- 1 second
- 3 seconds
- 5 seconds

If more than one option exists, just choose one. If the time can't be matched exactly, choose the closest value and indicate the timing difference that will result.