

## COL215 LAB Assignment 6 : Stopwatch

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## 1 Aim

Design a stopwatch and implement it on BASYS 3 board, using its 7-segment display and push buttons. Since the display has only 4 digits, assign these as follows - 1 digit for minutes, two digits for seconds and one digit for tenths of a second. Use three push buttons as follows:

- Start/Continue ● Pause ● Reset

## 2 Design

Input is taken from 3 push buttons :

left(pause), right(start/resume) and center(reset).

Initially the stopwatch shows "0000" and is paused.

On pressing start/resume button, the clock starts.

The left most digit shows minutes. The right most shows tenth of a second and two in the center shows seconds.

Pressing pause, stops the clock and can be resumed only after pressing resume button.

Resetting clock at any state resets the time time "0000" and also pauses the stop watch.

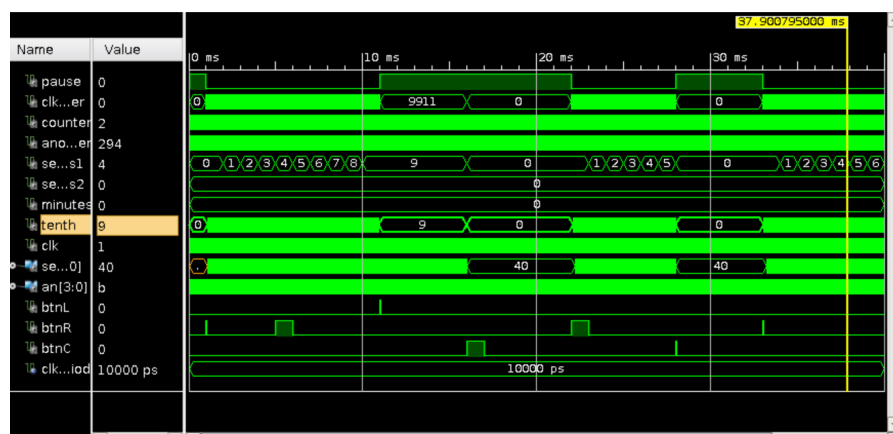
Though the display only have an accuracy of tenth of a second. But the stopwatch actually works with an accuracy of 10 ns on the inside(FPGA board's clk frequency). So if stopwatch is paused at 20 second and 540 ms then it would be showing "0205" in display and on resume it will change to "0206" withing 60 ms(and not 100 ms).

### 3 Simulation

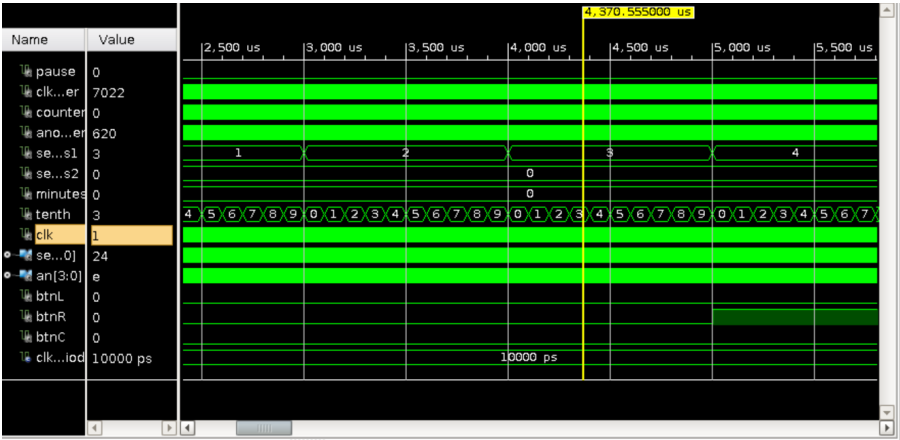
The code is simulated on test-bench created by the name test.vhd.

The simulation is done by making the clock run 1000 times faster than normal speed to reduce simulation time.

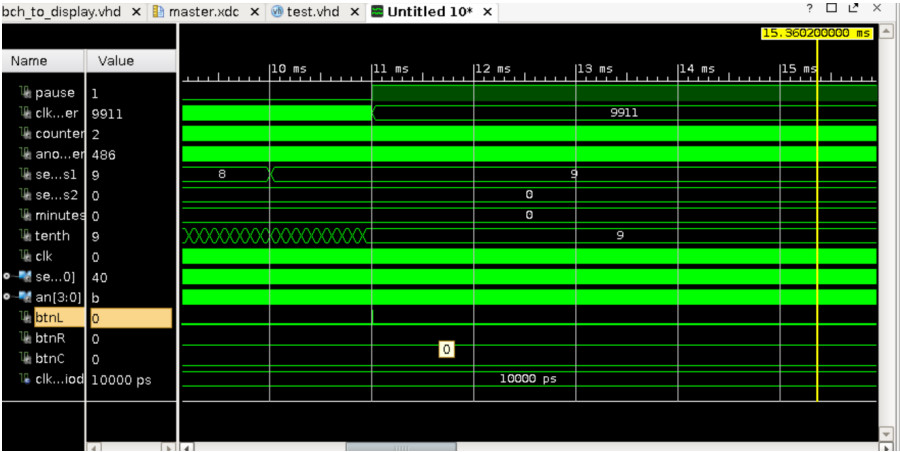
This full view shows how all the buttons effect the output and signals:



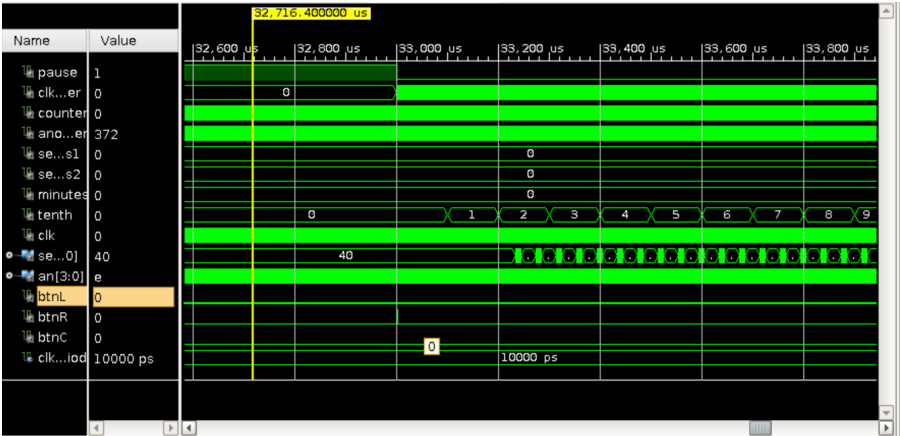
Pressing resume button when stopwatch is already running or pressing pause button when stopwatch is already paused does not do anything:



Pause:



Resume:



## 4 Utilisation Report

87 LUT's are used (as logic)

75 registers are used as flip-flops.

15 Input Output Blocks are used (1 clock input(clk) and 7 segment outputs(seg) and 4 display outputs(an) and 3 buttons(btnL,btnR,btnC))

1 BUFGCTRL is used (to enable clock)

Ref Name	Used	Functional Category
FDRE	75	Flop & Latch
LUT2	33	LUT
LUT4	25	LUT
LUT1	20	LUT
LUT6	13	LUT
LUT3	12	LUT
OBUF	11	IO
CARRY4	10	CarryLogic
IBUF	4	IO
LUT5	2	LUT
BUFG	1	Clock

(Utilisation report is also given in the submission.)