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Stopwatch

Approach

Seven Segment Decoder
This module takes a 4-bit input and outputs a 7-bit vector which denotes the LEDs to turn on in the seven segment display. Instead of using don't care values for 10-15 we have displayed their hexadecimal values (A,b,C,d,E,F) (Though these have no practical use in the stopwatch).

Timing Circuit
This module uses the inbuilt clock $(100\,MHz)$ of the basys3 board, contains a counter which takes this clock and sets the frequency of the driver clock to $1\,kHz$. This entity contains 3 outputs- mux selector to send to the multiplexer, an to activate the current anode signal.

4 to 1 Multiplexer
This module takes in the selector provided by the timing circuit and the values of each time unit (tenth of seconds, seconds, tens of seconds and minutes) and outputs the value to be displayed on the corresponding display and a signal dp which determines whether the decimal point at that location is to be on.

Modulo N Counters
We have implemented 2 separate counters- the first takes an input clock (and run and reset as well) and only outputs another clock with frequency N times smaller than the input, the second also outputs the count of the internal counter along with the frequency divided clock.
The 1st counter is used in two places- in the timing circuit to provide a frequency of $1\,kHz$ to the display and to provide a frequency of $10\,Hz$ to the tenth of seconds counter.
The 2nd counter is used to generate the inputs for the 4 seven segment displays. The 1st of thes takes the clock generated from the above specified counter and outputs the current tenth of seconds. The other 3 use the clocks provided by the unit just below them and output their corresponding time unit (seconds, tens of seconds and minutes).
Combine module is the combination of all clocked counters.
Note: In all these counters, reset is asynchronous whereas start/continue and stop are synchronous.

Debouncer
The overall circuit contains 3 debouncers (one for each button). This module takes the inbuilt clock and the button signal. If the button signal remains HIGH for 10^6 cycles $(10\,ms)$ then the output of the debouncer is set to HIGH else it remains low.

Block Diagram