Motion Sensing Stopwatch

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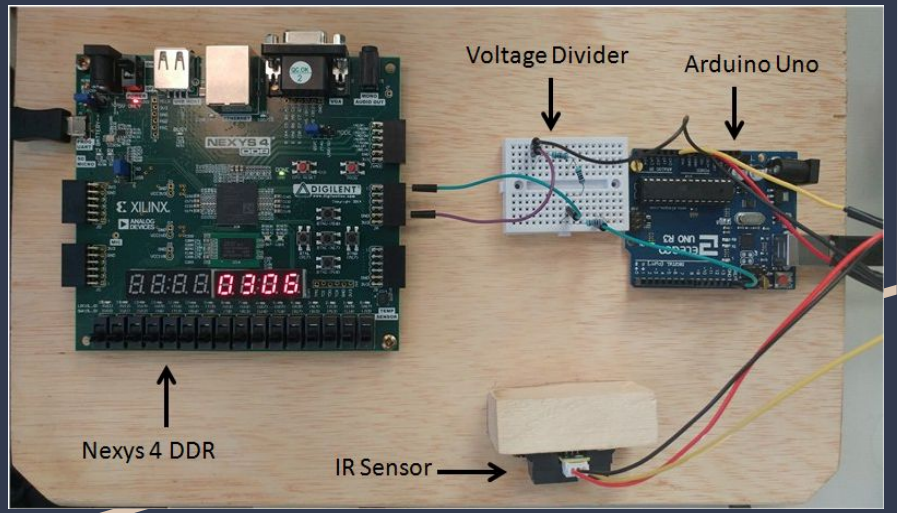
Functionality

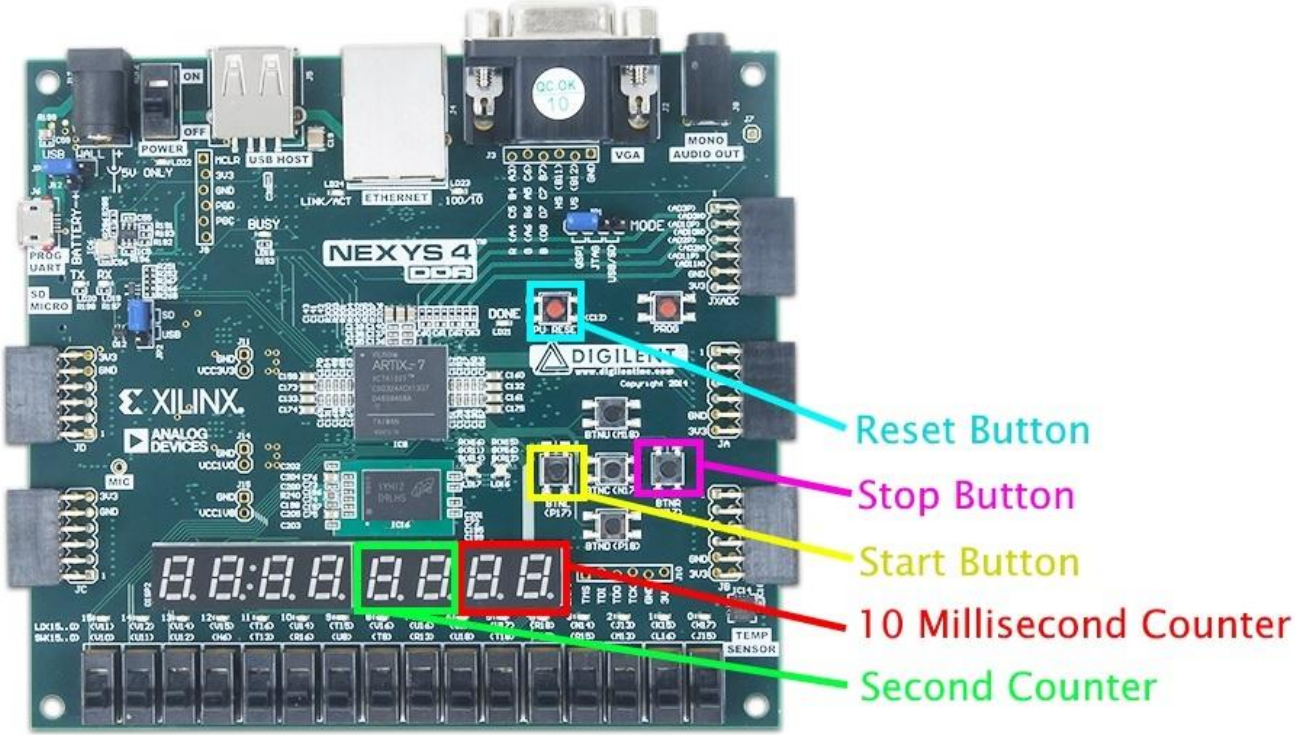


-The stopwatch functions as a 0-60 second display that counts in increments of 10ms.

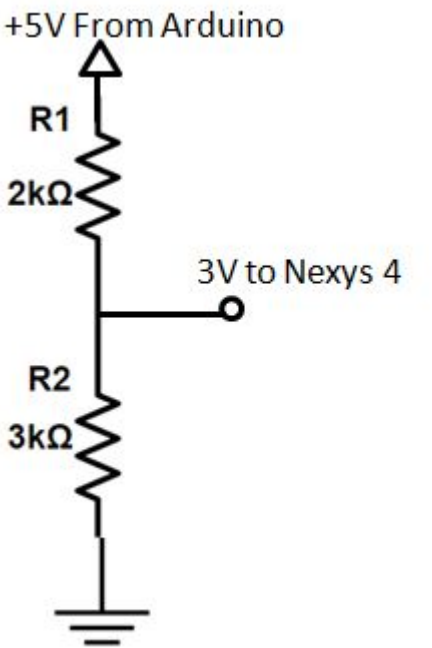
-A user can either use a button to start or stop the watch, or alternatively by passing in front of the IR sensor.
This feature is useful as it allows a user to record a time while removing the time spent pushing the start and stop button for a more accurate ‘lap’.

-In order to reset the watch, the cpu reset button on the Nexys is pressed.

Nexys 4 Board Layout



Voltage Divider Circuit



-The 5V signal from the Arduino needs to be brought down to 3V for the logic levels in the Nexys 4

-Nexys 4 reads 2-3.3V as logic high and 0-0.8V as logic low

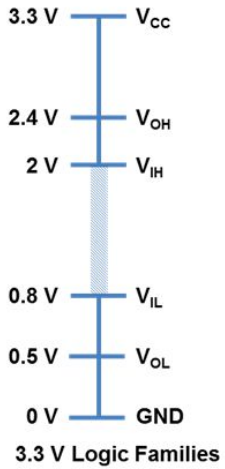
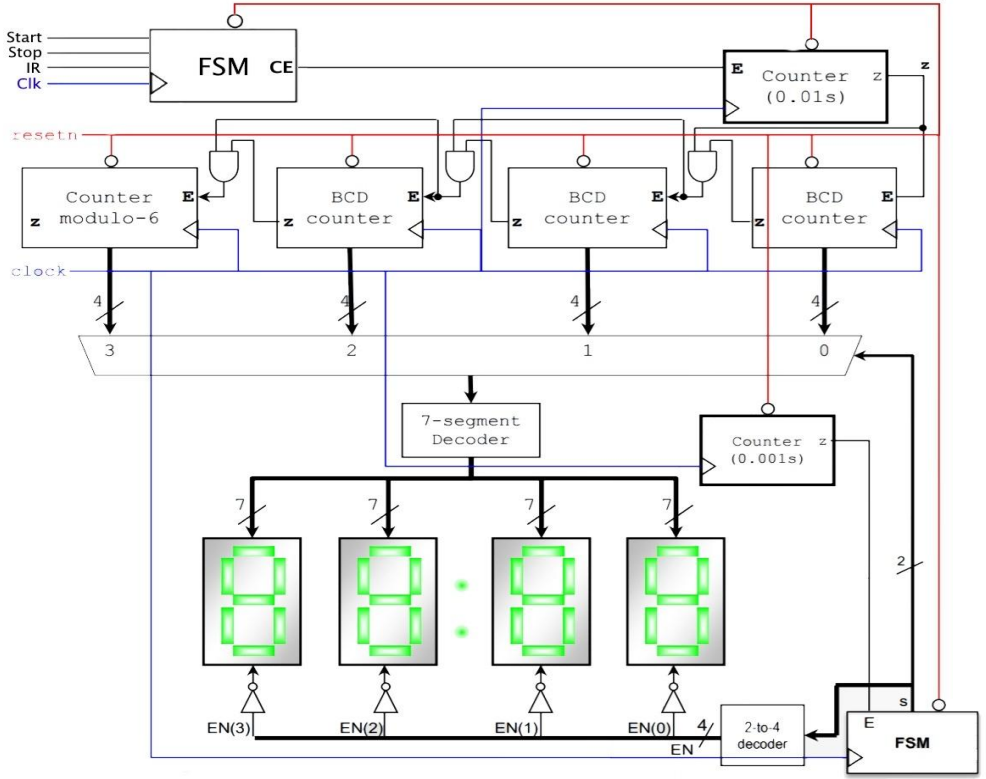


Fig 1 - 3.3 V CMOS Logic Levels. *Sparkfun Electronics*,learn.sparkfun.com/tutorials/logic-levels/33-v-cmos-logic-levels.

Component Diagram Overview



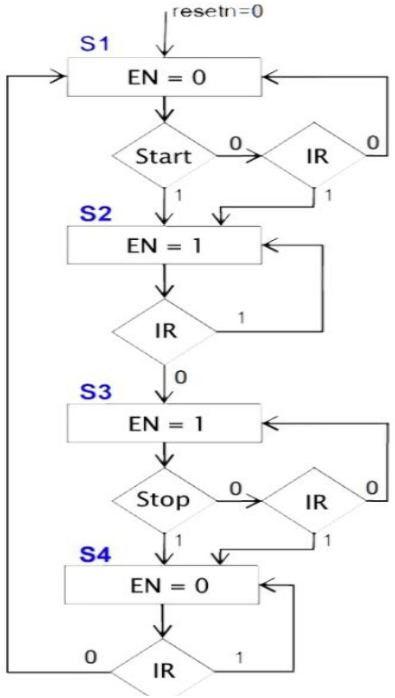
Components Used:

- Finite State Machines (FSM)
- Counters (0.001s, 0.01s, BCD, and Modulo 6)
- Multiplexer (4-to-1)
- Decoders (7-segment and 2-to-4)

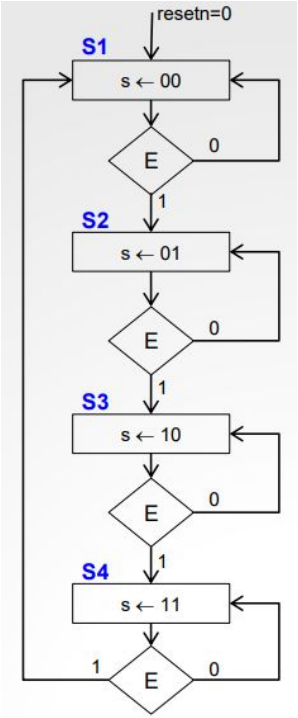
Finite State Machines

Two FSMs are used. One for controlling the 7-segment displays on the Nexys board, the other for controlling the logic that starts and stops the stopwatch.

The FSMs use case statements to provide a method for the program to determine what state the stopwatch should be in.



FSM for starting and stopping the stopwatch

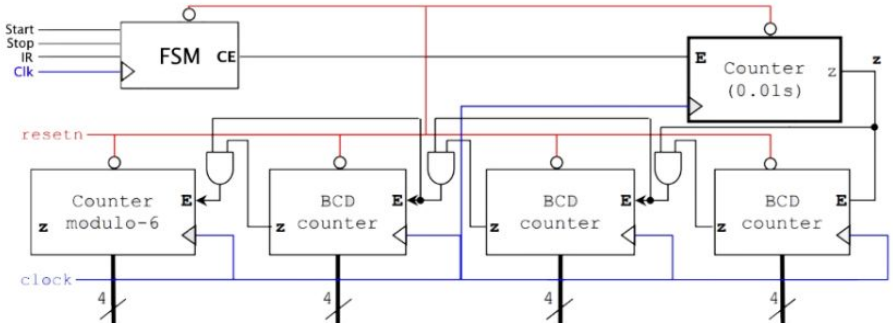


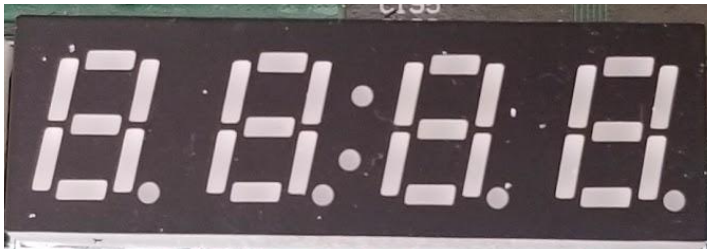
FSM for controlling 7-Segment Displays

Counters

Starting from increments of .01 second, the counters are used with the built in clock of the Nexys board to track time for the stopwatch.

A counter increments from 0 to 9, and once it hits 0 again, the next counter is enabled to increment by 1. This process is used to track time up to 60 seconds.

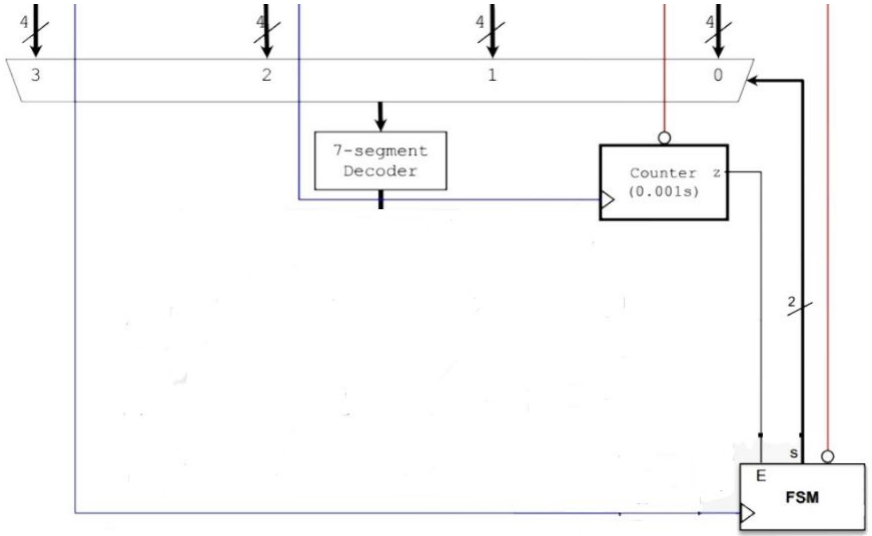




Multiplexer

One 4-to-1 multiplexer (MUX) is used to feed values from the counters into the 7-segment decoder.

A MUX functions using a select statement to pass different inputs as needed to a single output.



Decoders

Two Decoders are used in the code. One to 2-to-4 decoder to enable the 7-segment-displays as needed. The 7-segment decoder is used to convert the output of the counters to the 7 bit form needed to properly display numbers in each display.

A decoder functions by determining which output to use, based off pre-designated criteria from a single output.