INTRODUCTION TO FPGA PROGRAMMING

LESSON 09A: THE 7-SEGMENT DISPLAY

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INTRODUCTION TO THE 7-SEGMENT DISPLAY

- The Basys 3 board has one 7-segment displays with four digits.
- Each digit composed by seven segments arranged in a figure 8 pattern, with an LED embedded in each segment.
    - Segments can be individually illuminated
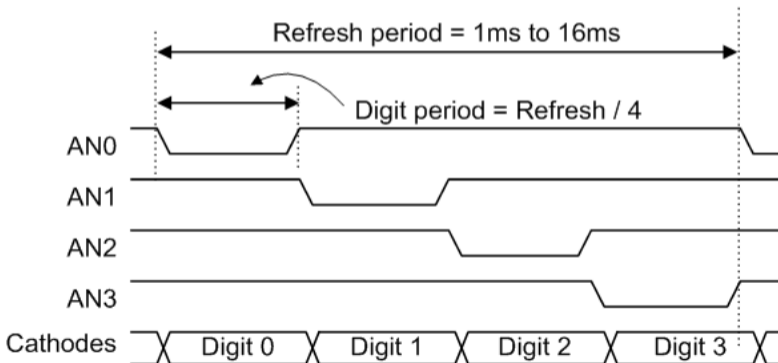   - 128 possible patterns, including 10 for decimal digits
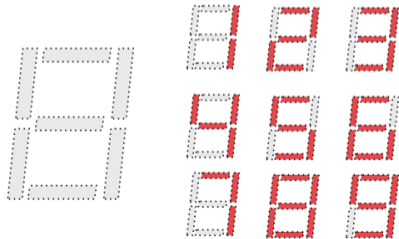
7-SEGMENT DISPLAY BASICS

- One common anode for all the seven LEDs forming a digit
- Cathodes are separated for each segment, to allow individual activation.
- Cathodes are common for all four digits.
  - CA-CG plus DP for the points.


Four-digit Seven Segment Display
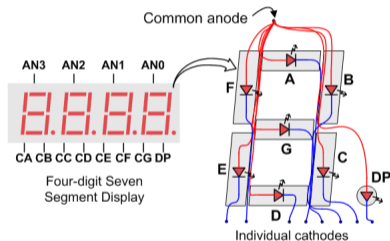
HOW TO ILLUMINATE A SEGMENT?

- To illuminate a segment, you should drive the anode input of the chosen digit low.
- Also set low the signals for the chosen segment cathodes, to illuminate the segment.
- Since, the human eye can not detect rate faster than 45 Hz, you can implement a circuit (FSM) that updates the value of digits one at the time.

Refresh period = 1ms to 16ms

Digit period = Refresh / 4

AN0

AN1

AN2

AN3

Cathodes   Digit 0   Digit 1   Digit 2   Digit 3

HOW TO ILLUMINATE A SEGMENT?

- For each digits to appear continuously illuminated, they all should be driven once every 1 to 16ms, for a refresh frequency of about 1KHz to 60Hz.
- For example, in a 62.5Hz refresh scheme, the entire display would be refreshed once every 16ms, and each digit would be illuminated for 1/4 of the refresh cycle, or 4ms.
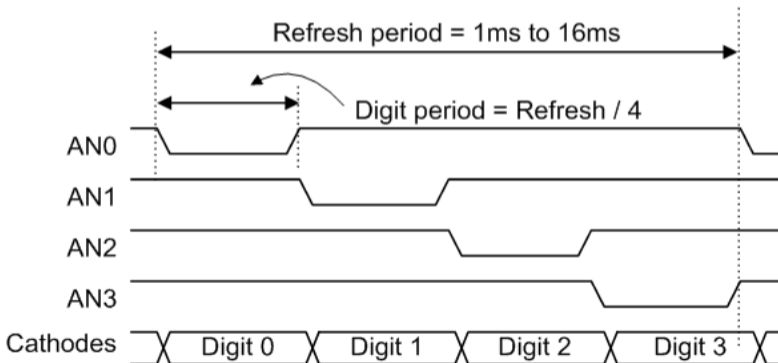
LAB 15: DESIGN A STOP WATCH

The figures in these slides are taken from:

- Digital Design: Principles and Practices, Fourth Edition, John F. Wakerly, ISBN 0-13- 186389-4.

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- Stephen A. Edwards, Columbia University, Fundamentals of Computer Systems, Spring 2012

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