4-Way Traffic Light Controller

Rafil Yousif, Yuan Wei, Joe Kocenda

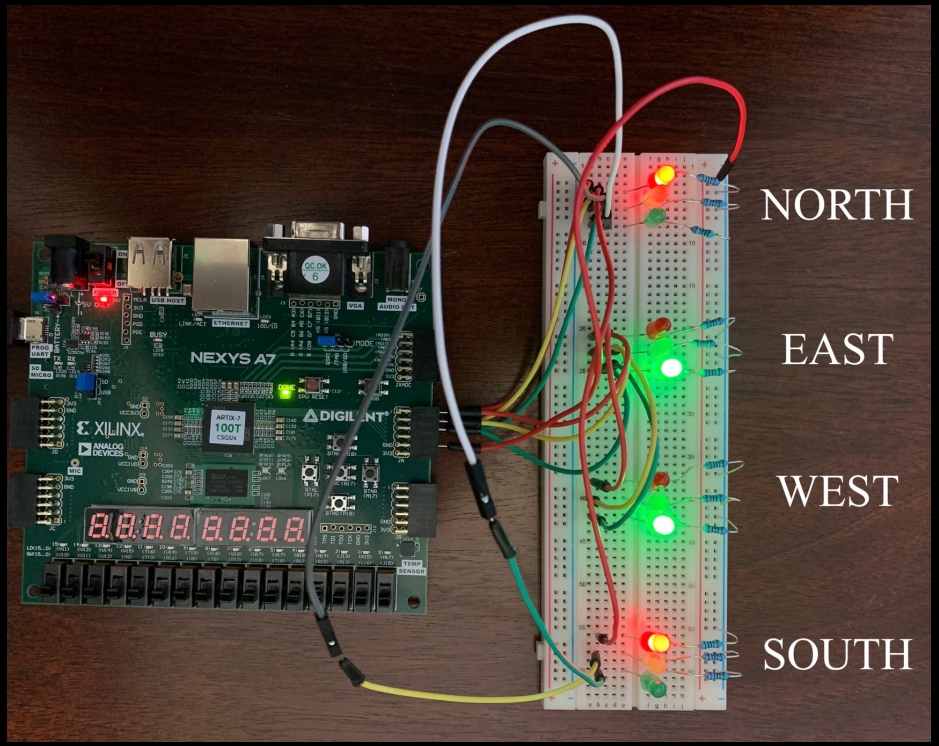
ECE 2700 Final Project - Daniel Llamocca

What Does it Do?

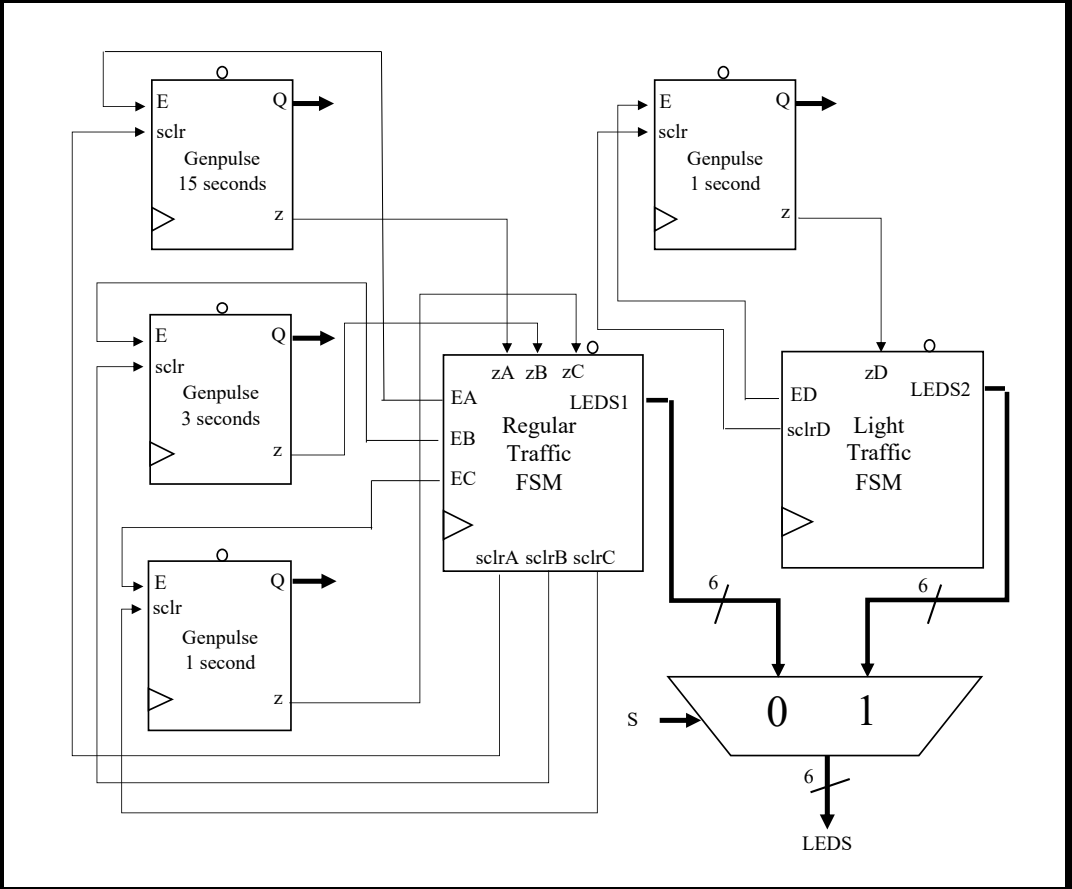
- 4-way traffic light controller simulating a real-life 4-way intersection
- Switches between two modes (regular and light traffic)
  - **Regular Traffic Mode:**
    - 15 second duration for the following states
      - N/S = Green & E/W = Red
      - N/S = Red & E/W = Green
    - 3 second duration for the following states
      - N/S = Yellow & E/W = Red
      - N/S = Red & E/W = Yellow
    - 1 second duration for the following state
      - N/S = Red & E/W = Red
  - **Light Traffic Mode:**
    - 1 second flashing yellow and red
      - N/S = Yellow & E/W = Red

Components

- Nexys A7-100T with Vivado Software
- 4 Counters (15 sec, 3 sec, 1 sec 2x)
- 2 Finite State Machines
- 1 2-to-1 MUX
- Breadboard
- 12 Light Emitting Diodes (LED)
- 12 220 Ohm Resistors



Schematic/Block Diagram

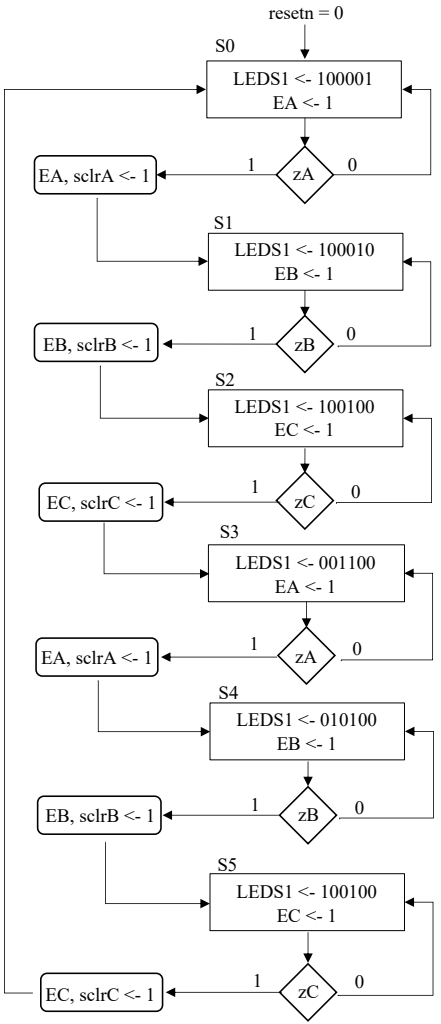


Circuit Functionality

- 4 total counters determine the amount of time elapsed.
  - 15 seconds, 3 seconds, 1 second x2
- The FSM’s control the shifting of lights/states based on the outputs of the counters.
- Multiplexer is used to switch between the regular and light traffic modes (2 FSM’s)

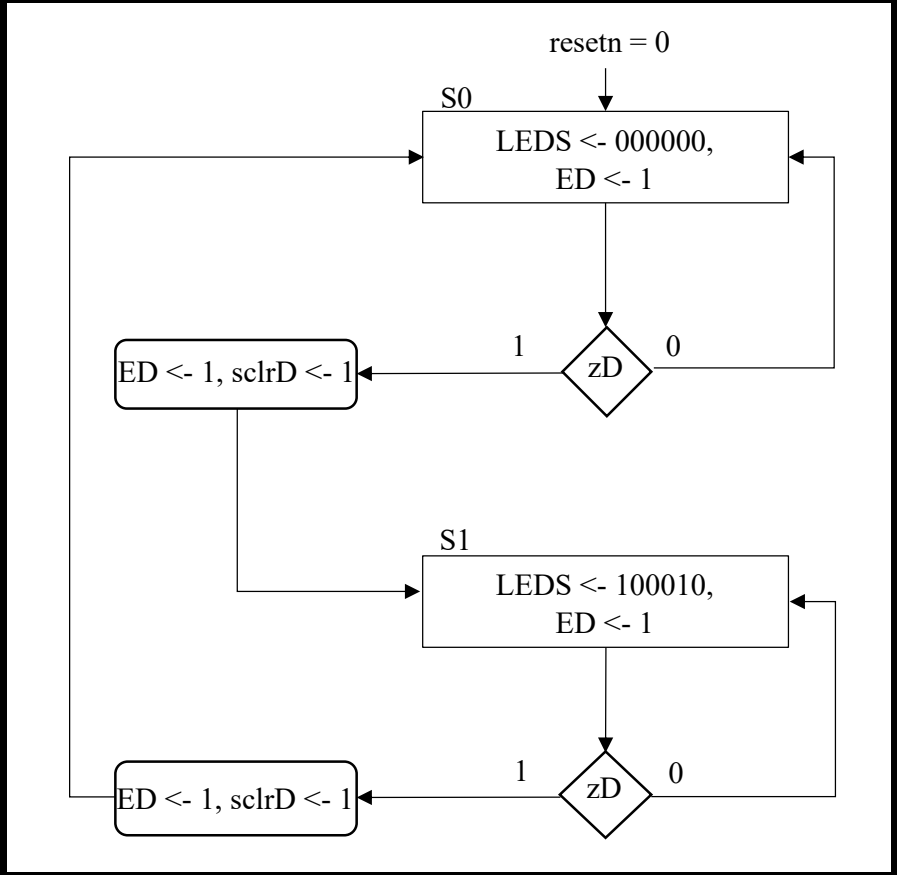
Regular Traffic ASM

- **State 0:** North/South = Red, East/West = Green
  - Utilizes 15 second counter → zA
- **State 1:** North/South = Red, East/West = Yellow
  - Utilizes 3 second counter → zB
- **State 2:** North/South = Red, East/West = Red
  - Utilizes 1 second counter → zC
- **State 3:** North/South = Green, East/West = Red
  - Utilizes 15 second counter → zA
- **State 4:** North/South = Yellow, East/West = Red
  - Utilizes 3 second counter → zB
- **State 5:** North/South = Red, East/West = Red
  - Utilizes 1 second counter → zC



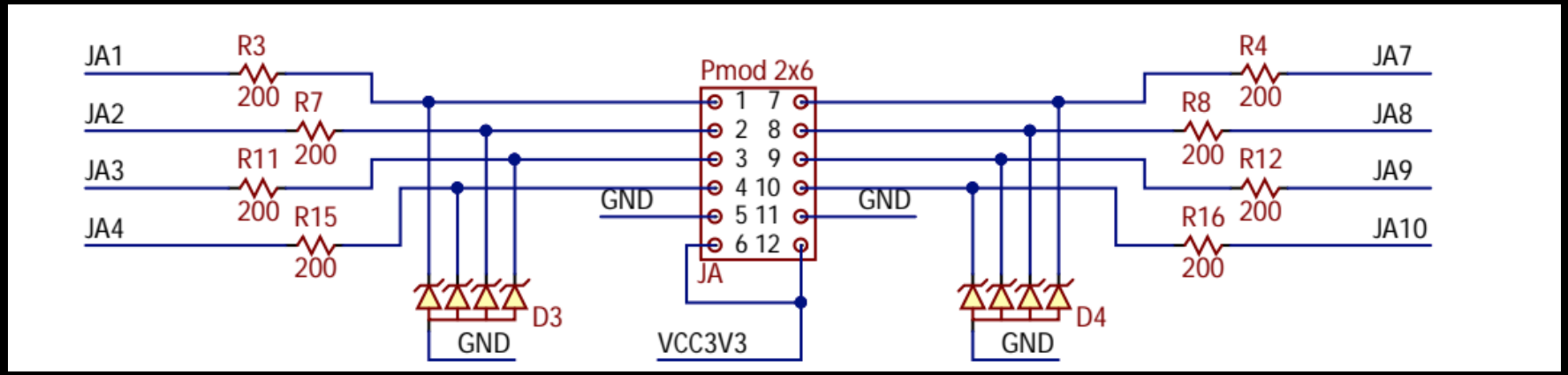
Light Traffic ASM

- Flashing Yellow/Red Mode
  - **State 0:** North/South = OFF, East/West = OFF
  - **State 1:** North/South = Yellow, East/West = Red
    - Both utilize 1 second counter → zD



PMOD LED Implementation

- Allows for the connection between peripheral modules and the FPGA board.
- The PMOD port JA on the Nexys board was used to send signals to the LEDS on the breadboard.
  - Pins 1, 2, 3, 7, 8, and 9 were used for the 6-bit output, with pin 5 as GND.



Issues and Improvements

Issues

- Went through multiple different designs.
- Originally used only 1 FSM, but was too difficult to configure the flashing yellow mode, thus led to using 2 FSM’s.
- Attempted to use the same 1 second counter for both FSM’s, but coding had numerous issues.
- Implementing the circuit on a peripheral/outside source (breadboard) offered challenges as we never utilized the PMOD ports previously.
- During simulation, the regular traffic FSM wasn’t transitioning between states at first and debugging the code took longer than expected.

Improvements

- Could have implemented a crosswalk system using more counters, or possibly the 7-segment display.
- Could have implemented left and right turns using more FSM’s and counters.

Demonstration Video

https://youtu.be/NsFO6DjWaTg