Engr354 Project Autumn, 2020

T-Bird Tail Lights

DUE: Tuesday, November 24, 8am

Objectives

- Design, construct, and test a multi-input state machine;
- Gain experience in defining and building a real-life digital logic system;
- Gain sequential logic design experience;
- Gain maturity in the construction and debugging of logic circuits.

Description

An experiment is under way at Ford to simulate tail light operation of the venerable Thunderbird automobile. The simulation is proposed so that consumer interest can be measured before any cars are built.

Your task is to design and build a circuit that does this simulation. Using your logic interface board, assign six LED's to simulate the six tail lights (three on each side of the car) and use two switches for the turn signals. One switch should be used to indicate a left turn, one switch for a right turn. If both switches are set, the emergency flasher should be activated.

For a right turn, the three right-hand lights should be activated and the left-hand lights should be off. The three lights should cycle as shown in Figure 1. Operation for the left-hand lights is analogous. When the emergency flasher is activated, all six taillights should flash on and off in unison.

o ON
OFF

(left hand) (right-hand)
ooo oo o o oo ooo

Figure 1. Taillight sequence

Your circuit should also emulate brake lights. Use a switch to simulate the brake pedal. When the brakes are on, all six taillights should be on continuously, except if the right or left turn signal is on. In that case, the three taillights for the turn signal should operate normally, and the other three should be on continuously. Note that the brakes override the emergency flasher.

Procedure

Design and build the circuit to implement the tail lights as described above. Use RET D flip-flops as the memory elements. Demonstrate your circuit to class on the due date.

Notes

- Before doing construction, create good design documentation, i.e. block diagram, state diagram, next state logic equations, and a logic diagram labeled with part ID and pin numbers.
- Project challenges:
  - Define what are the inputs;
  - Define what are the outputs;
  - Define the necessary logic states.
- The sum of all branching conditions leaving each state must equal one;
- An output can be active, at most, once per state;
- You decide what to do with don't care states;

Project and grading Criteria

Here are the guidelines for how the final project points will be allocated:

- Hardware checkout
  You must show your project to the class room at the final test time and demonstrate it to the instructor.

  Each student must turn in a report. The report must contain the following elements at a minimum:
  - Cover page;
  - Introduction;
  - Design – include neatly drawn design diagrams and elaborate on your design process;
  - Results – include the final status of the hardware as wells as a final parts list;
  - Lessons learned;
  - Schematics and pictures.
- Demonstration, we hope it works

To Turn In

- Each student must turn in a report.