Finite State Machine Design for Traffic Light Controller

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***Abstract*—This paper describes the design of a finite state machine that explains a system installed at a road intersection which takes input from two traffic sensors and accordingly displays the required colors on two traffic light signals. Each sensor will show TRUE if there are cars on the respective road and FALSE otherwise. Each traffic light signal displays three colors – green, yellow, red. This FSM could replace the role of traffic police by automating the task which results in less labor costs and efficient functioning.**

***Keywords*—Traffic Light Controller, Finite State Machine, Moore FSM**

I. Description

Finite state machine (FSM) is one of the most important classes of synchronous sequential circuits. FSMs are of two types – Moore, where the output depends on only the current state of the machine, and Mealy, which depends on the current inputs as well.

Traffic Light Controller is a real world example of an FSM.

We have two single-bit inputs (S_A and S_B), a clock, a reset and two outputs (L_A and L_B). The controller takes the input from the sensors at every 10 seconds. When it is reset, the traffic lights turn green on Vyoma road and red on Nielit road. The intersection is shown in figure 1.

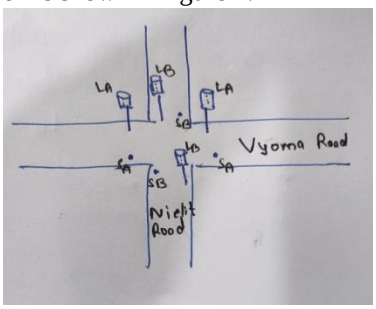

Fig. 1. Traffic Light Intersection

II. State Diagram

The state diagram of the desired system is shown in figure 2. The design is done as a Moore FSM. Four states are used to keep track of the four combinations of the two traffic light signals. Initial state is the reset state as described earlier. It remains in the same state as longs as sensor S_A is HIGH. When there are no cars on Vyoma road, S_A turns low and the system goes to the next state where light L_A turns yellow and ten seconds later, it turns red and light L_B turns green and stays as it is until there are no cars on Nielit road, then it goes to the last state where L_B turns yellow and ten seconds later it goes into the reset state. This keeps continuing until reset is HIGH in which case it returns to the S0 state.

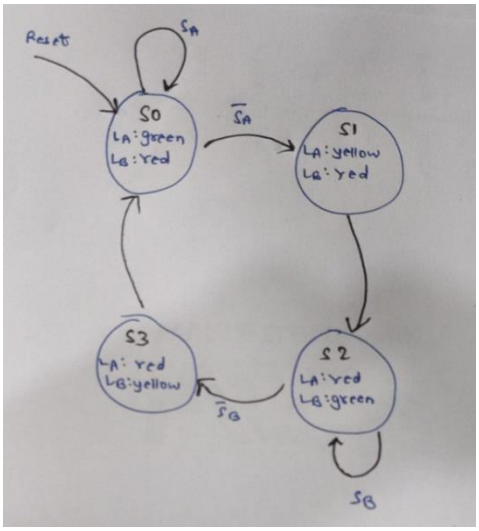

Fig. 2. State diagram for Traffic Light Controller Logic

III. Waveform

The figure 3 shows the sample functioning of the design described in figure 2.

The system is first reset and then works according to the input from the sensors. Some delay is also taken into consideration.

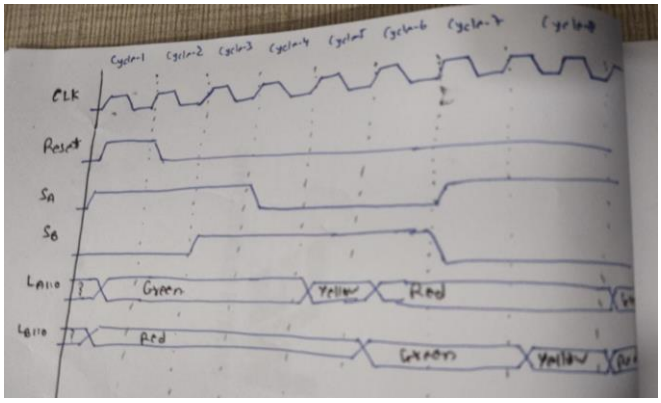

Fig. 3. Traffic Light Controller in action

References

[1]S. L. Harris and D. Harris, "Digital Design and RISC-V Computer Architecture Textbook," *2021 ACM/IEEE Workshop on Computer Architecture Education (WCAE)*, 2021, pp. 1-5, doi: 10.1109/WCAE53984.2021.9707615.