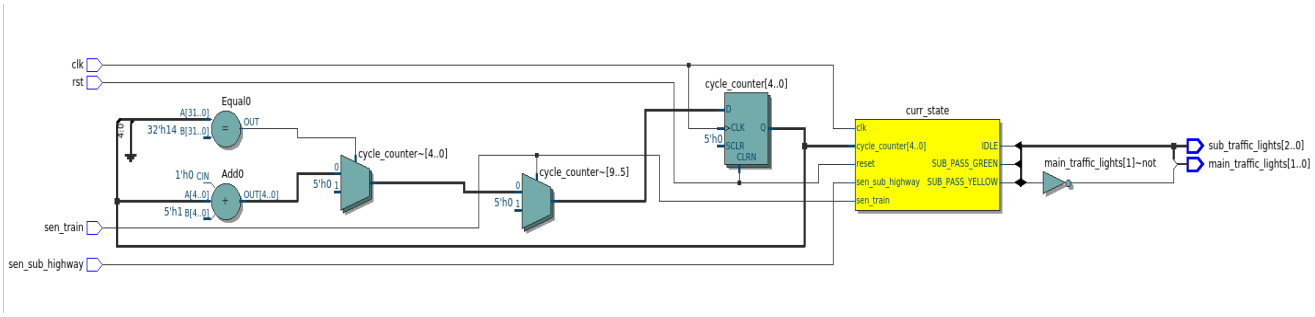
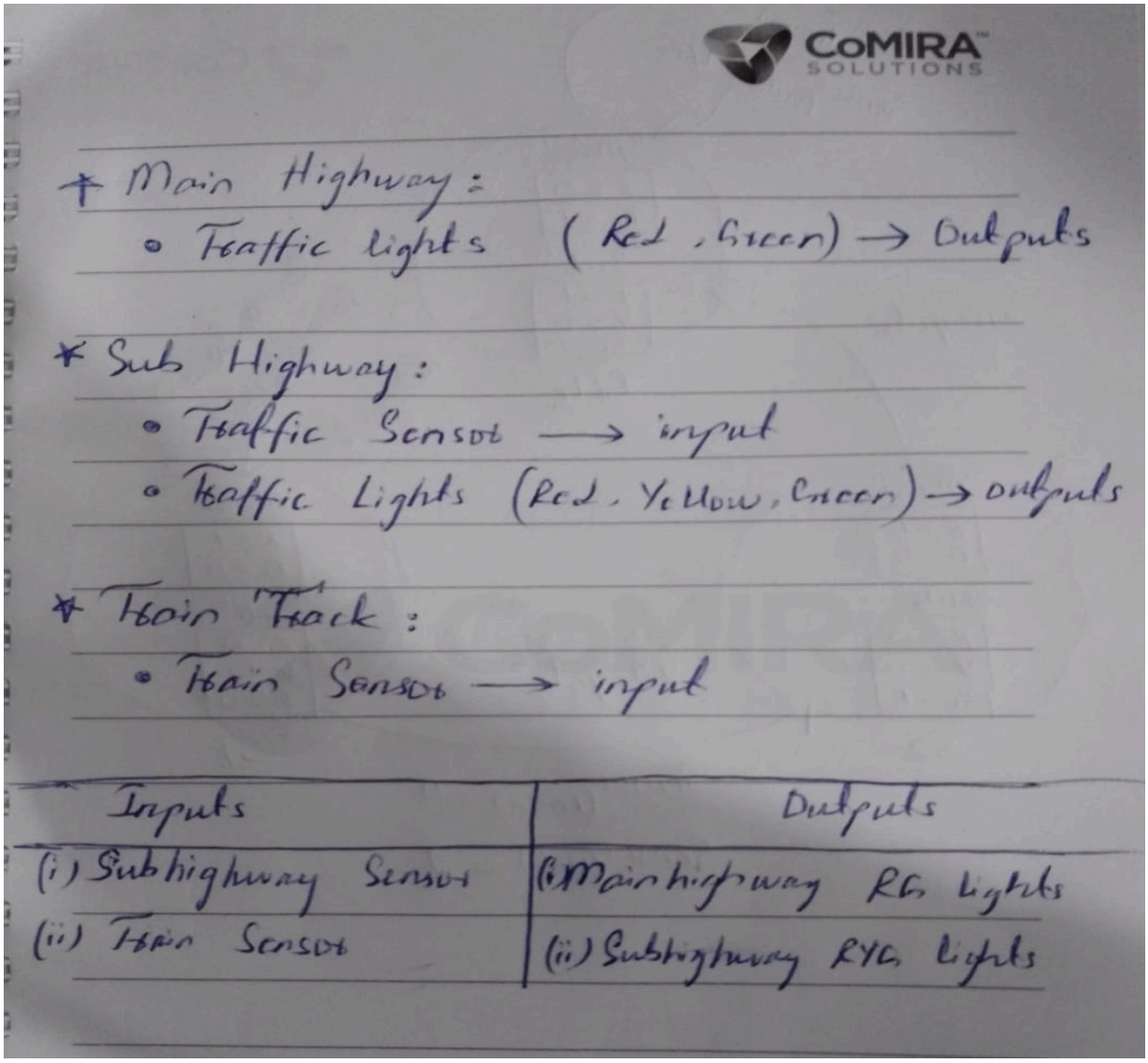
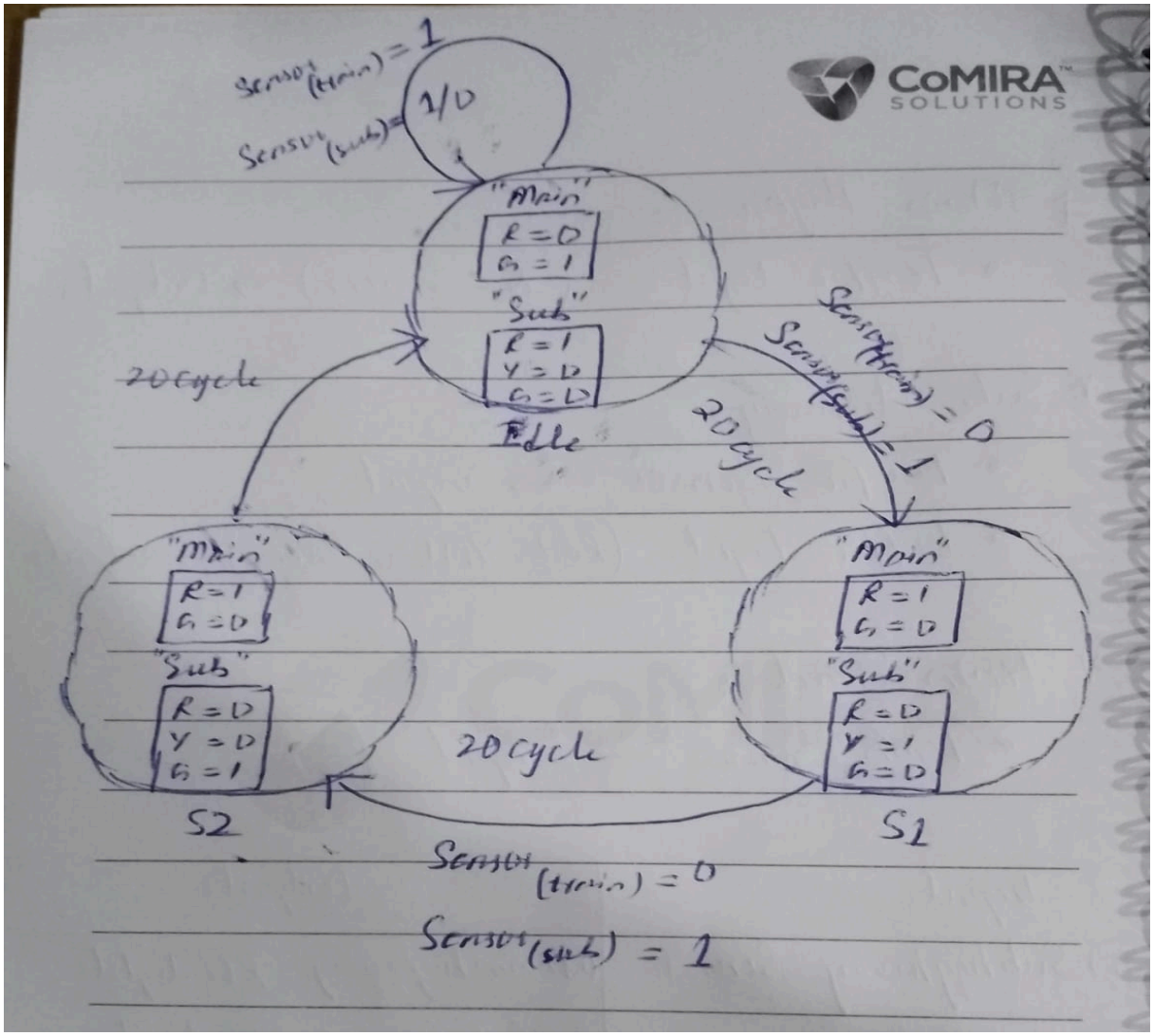
“Traffic Controller System”

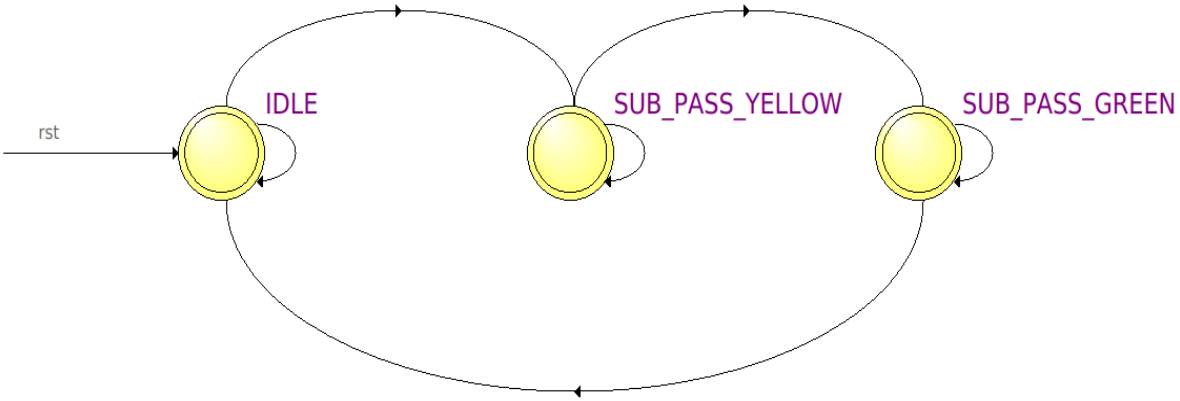
‘Moore Finite State Machine (FSM)’

Design:



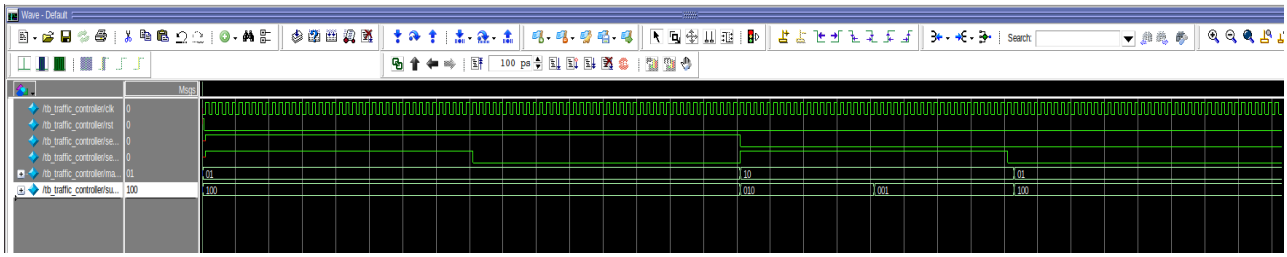



Sensor(Main) = 1
Sensor(Sub) = 1
1/0
"Main"
R = 0
G = 1
"Sub"
R = 1
Y = 0
G = 0
Idle
20 cycle
Sensor(Main) = 0
Sensor(Sub) = 1
20 cycle
"Main"
R = 1
G = 0
"Sub"
R = 0
Y = 0
G = 1
S2
20 cycle
"Main"
R = 1
G = 0
"Sub"
R = 0
Y = 1
G = 0
S1
Sensor(main) = 0
Sensor(sub) = 1


rst
IDLE
SUB_PASS_YELLOW
SUB_PASS_GREEN

- The traffic controller is built as a moore finite state machine with three states (IDLE, SUB_PASS_YELLOW, SUB_PASS_GREEN) to manage light changes between the main and sub-highway.
- A cycle counter ensures each state lasts for a fixed number of clock cycles, resetting when a train is detected or the cycle completes.
- Sensor inputs drive transitions: train presence keeps the system idle, while sub-highway requests trigger yellow then green phases.
- Output logic assigns the correct light signals for both highways in each state, ensuring safe and coordinated traffic flow.

Verification:



- The testbench instantiates the traffic controller and drives clock, reset, and sensor inputs to simulate highway and train conditions.
- A loop cycles through all four sensor combinations (sen_train, sen_sub_highway) to test every traffic scenario.
- The state_display task prints the current state of both main and sub-highway lights, showing how outputs respond to sensors.
- The simulation runs with timed delays (400ns), ensuring each condition is observed.

Results:

```
VSIM 24> run -all
# Train is passing on track, while traffic is present on subhighway
# Main Highway :: RED : 0, GREEN : 1
# Sub Highway :: RED : 1, YELLOW : 0, GREEN : 0
# Train is passing on track, while traffic is present on subhighway
# Main Highway :: RED : 0, GREEN : 1
# Sub Highway :: RED : 1, YELLOW : 0, GREEN : 0
# Train is passing on track, while no traffic is present on subhighway
# Main Highway :: RED : 0, GREEN : 1
# Sub Highway :: RED : 1, YELLOW : 0, GREEN : 0
# Train is passing on track, while no traffic is present on subhighway
# Main Highway :: RED : 0, GREEN : 1
# Sub Highway :: RED : 1, YELLOW : 0, GREEN : 0
# Train is not passing on track, while traffic is present on subhighway
# Main Highway :: RED : 1, GREEN : 0
# Sub Highway :: RED : 0, YELLOW : 1, GREEN : 0
# Train is not passing on track, while traffic is present on subhighway
# Main Highway :: RED : 1, GREEN : 0
# Sub Highway :: RED : 0, YELLOW : 0, GREEN : 1
# Train is not passing on track, while traffic is not present on subhighway
# Main Highway :: RED : 0, GREEN : 1
# Sub Highway :: RED : 1, YELLOW : 0, GREEN : 0
# Train is not passing on track, while traffic is not present on subhighway
# Main Highway :: RED : 0, GREEN : 1
# Sub Highway :: RED : 1, YELLOW : 0, GREEN : 0
```