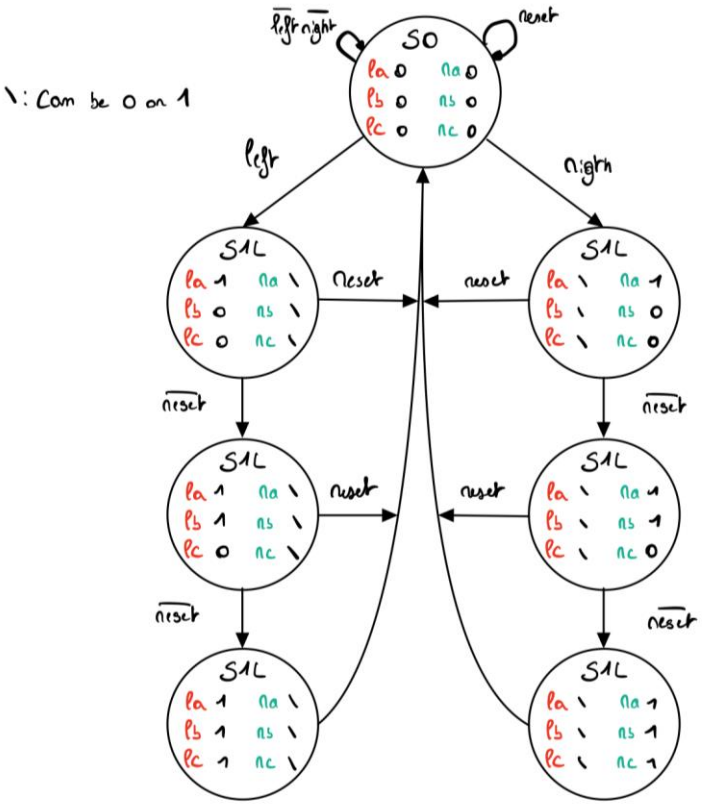
1. **FSM design**



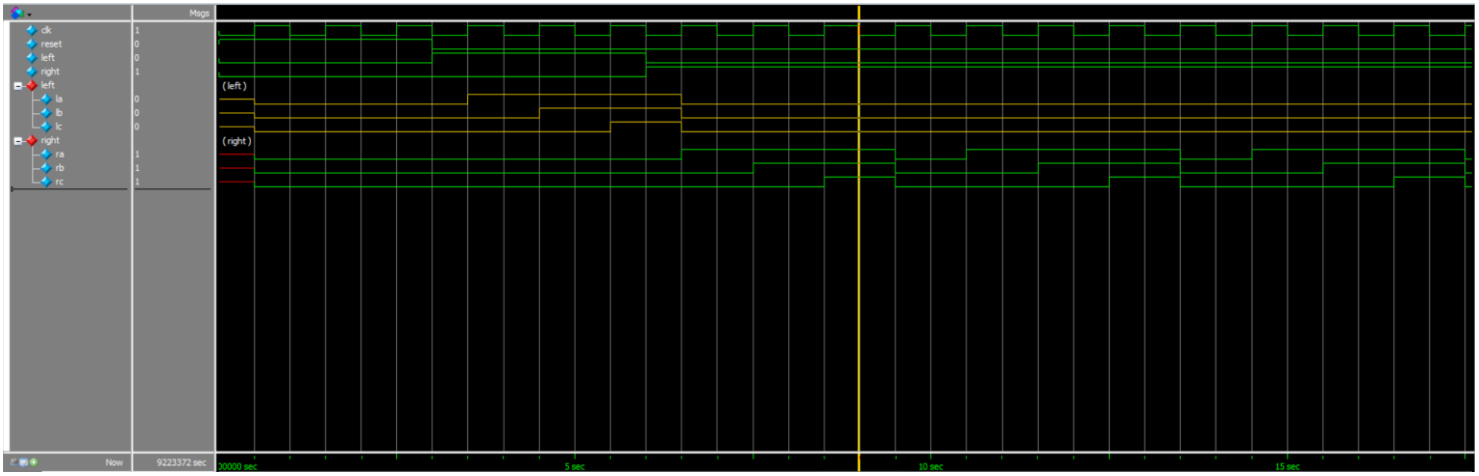
2. **Homework_3.sv**

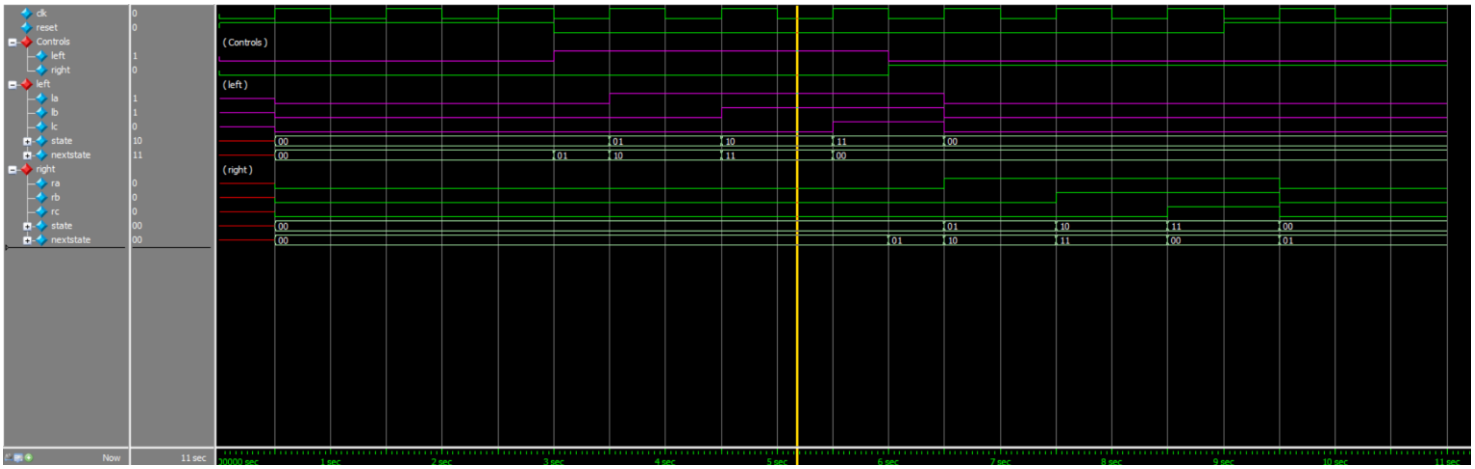
```
module Homework_3(input logic clk,
    input logic reset,
    input logic left, right,
    output logic la, lb, lc, ra, rb, rc);

Thunderbird TBleft(
    .clk(clk),
    .reset(reset),
    .active(left),
    .a(la),
    .b(lb),
    .c(lc)
);

Thunderbird TBright(
    .clk(clk),
    .reset(reset),
    .active(right),
    .a(ra),
    .b(rb),
    .c(rc)
);

endmodule

module Thunderbird(input logic clk,
    input logic reset,
    input logic active,
    output logic a, b, c);

    reg [1:0] state, nextstate;

    parameter S0 = 2'b00;
    // parameter S1 = 2'b01;
    // parameter S2 = 2'b10;
    // parameter S3 = 2'b11;

    always_ff @(posedge clk) begin
        if (reset) state <= S0;
        else state <= nextstate;
    end

    always_comb
        case (state)
            S0: nextstate = (active) ? state + 1 : state;
            default: nextstate = state + 1;
        endcase

    assign a = state[0] | state[1];
    assign b = state[1];
    assign c = state[0] & state[1];

endmodule
```

3. **Homework_3_tb.sv**

```
`timescale 1ms/1ms

module testbench_homework_3();

    logic clk, reset, left, right;
    logic la, lb, lc, ra, rb, rc;

    Homework_3 hw3(
        .clk(clk),
        .reset(reset),
        .left(left),
        .right(right),
        .la(la),
        .lb(lb),
        .lc(lc),
        .ra(ra),
        .rb(rb),
        .rc(rc)
    );

    always
        begin
            clk = 0;
            #500;
            clk = 1;
            #500;
        end

    initial begin
        clk = 0;
        reset = 1;
        left = 0;
        right = 0;
        #3000
        reset = 0;
        left = 1;
        #3000
        left = 0;
        right = 1;
        #3000
        reset = 1;
        #2000

        $stop;
    end

endmodule
```

4. **Modelsim**





5. **Registers and I/O pins**

I have 2x2 of two bits registers and 10 I/O pins. The registers are used for the current state and the next state which are both two bits and they are used for the right tail lights and left tail so we multiply the number of register by two. For the I/O pins, there is six for the LEDs, two for the clock and for the reset and finally two for the left and right controls.