END SEMESTER ASSESSMENT (ESA)
B.TECH. (CSE)
III SEMESTER

UE22CS251A – DIGITAL DESIGN & COMPUTER ORGANIZATION LABORATORY

PROJECT REPORT

ON

"CAR PARKING SYSTEM"

SUBMITTED BY

NAME	*SRN*
1) Suprith S	PES2UG22CS600
2) Siri N Shetty	PES2UG22CS556
3) Suryavanshi Prem	PES2UG22CS605
4) Soumya Ranjan Mishra	PES2UG22CS571

AUGUST – DECEMBER 2023

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

ELECTRONIC CITY CAMPUS,

BENGALURU – 560100, KARNATAKA, INDIA

TABLE OF CONTENTS

ABSTRACT OF THE PROJECT:

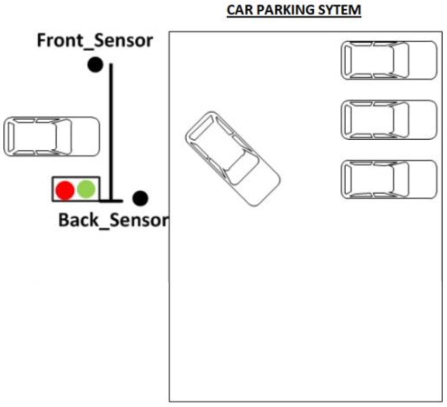
As urbanization continues to rise, the demand for efficient and automated parking solutions has become increasingly imperative. This project leverages Verilog, a hardware description language, to create a smart and automated car parking system that optimizes space utilization and enhances the overall parking experience.

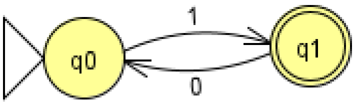
This Verilog module car_parking_system represents a simple car parking system with eight parking spaces. The module takes an 8-bit input vector sensors, where each bit corresponds to a sensor for a particular parking space. The module outputs an 8-bit vector parking spaces, indicating the occupancy status of each parking space.

The testbench includes multiple test cases covering various scenarios, such as no cars present, cars in specific spaces, and all spaces occupied. Each test case sets the sensor inputs accordingly and observes the expected output in terms of parking space occupancy.

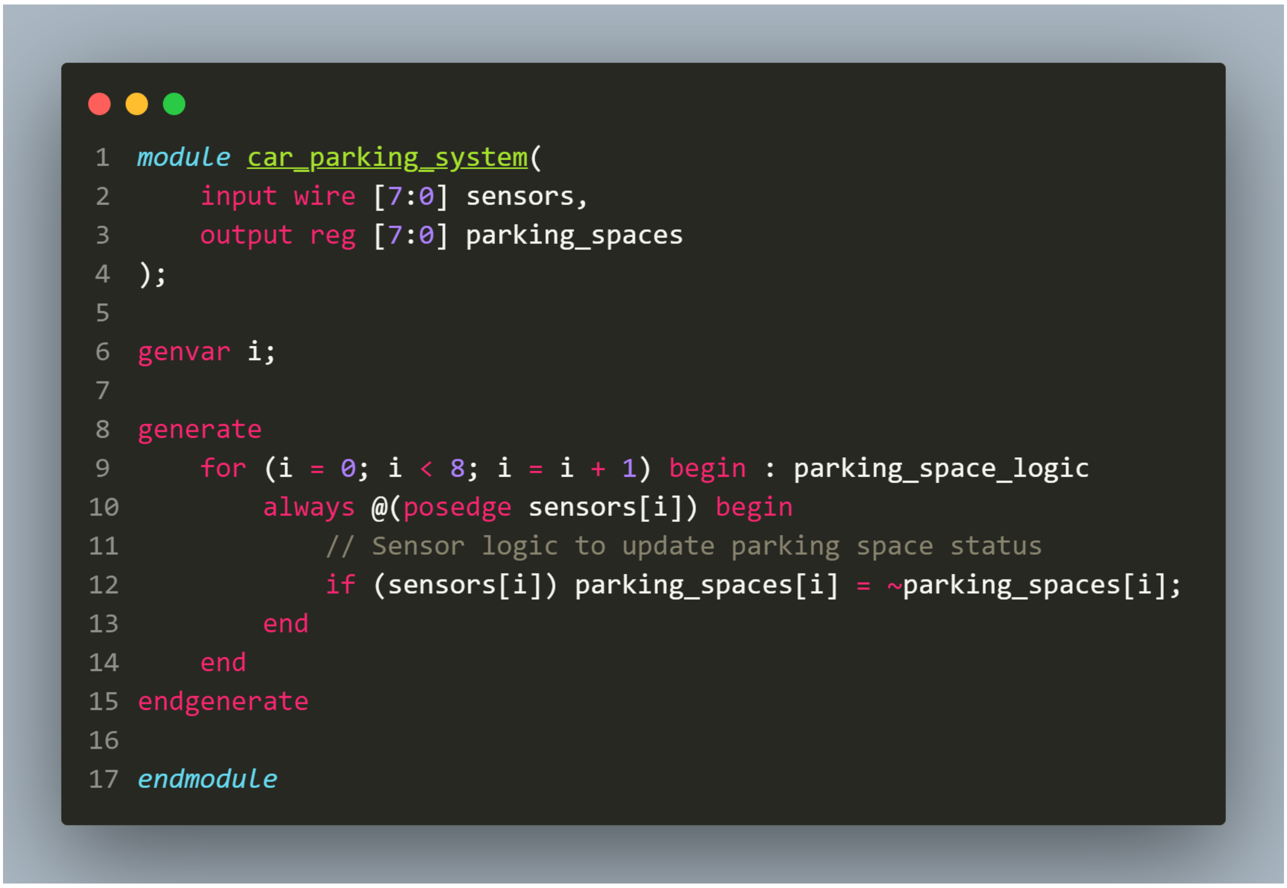
Simulation results are captured in a VCD (Value Change Dump) file, and the GTK Wave is employed for visualizing and analyzing the simulation waveforms.

CIRCUIT DIAGRAM:



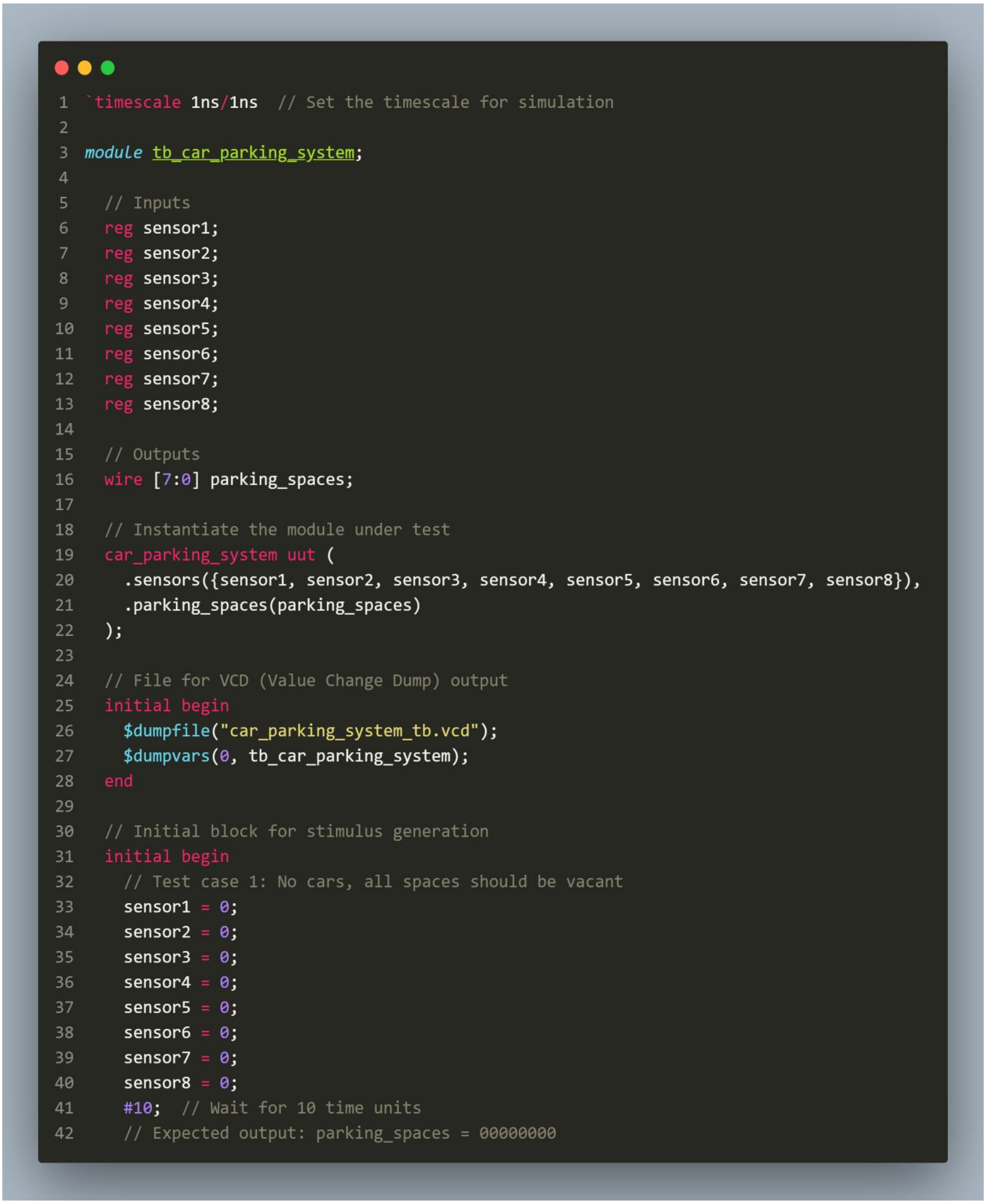


MAIN VERILOG CODE:

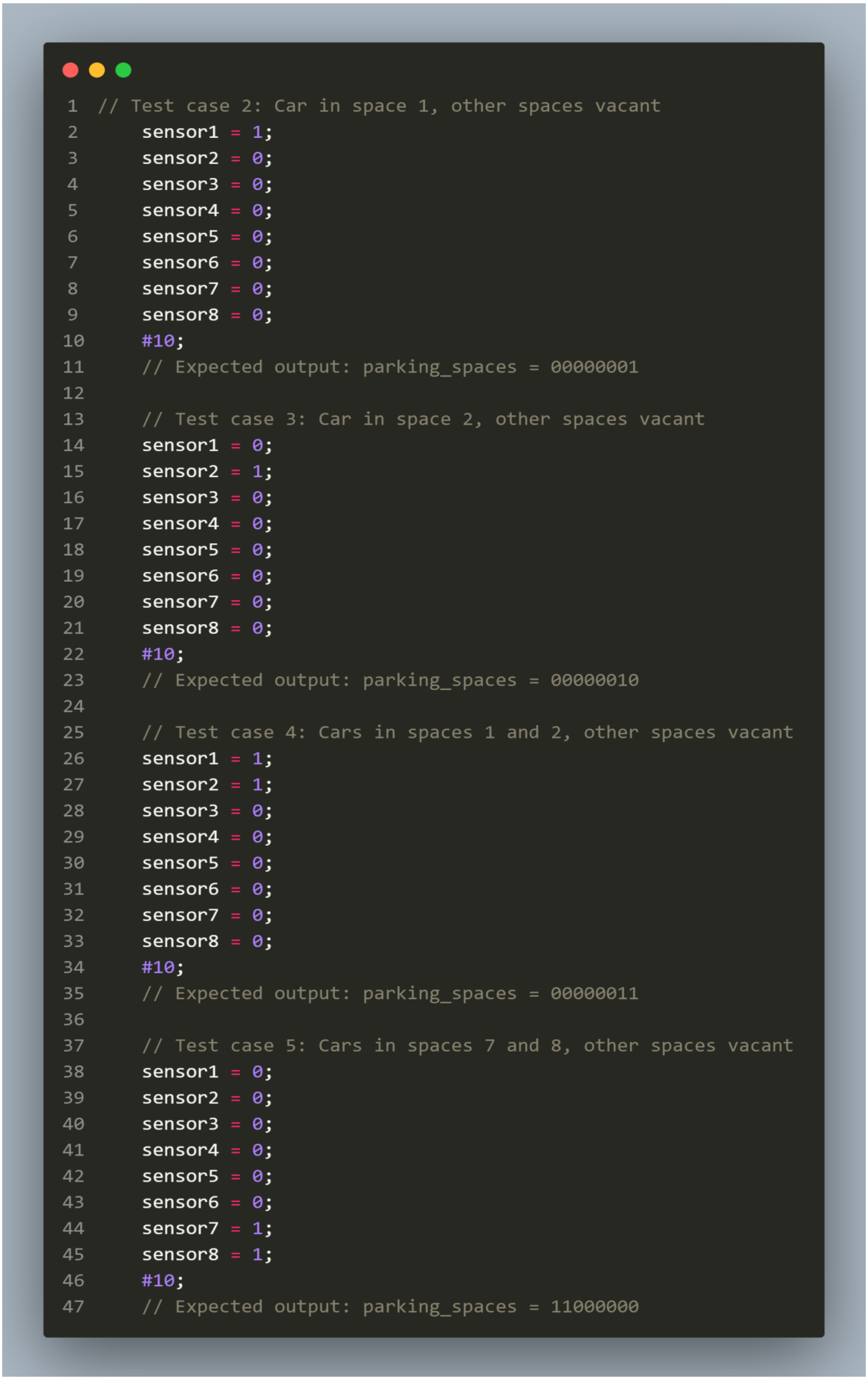


```
module car_parking_system(
    input wire [7:0] sensors,
    output reg [7:0] parking_spaces
);

genvar i;

generate
    for (i = 0; i < 8; i = i + 1) begin : parking_space_logic
        always @(posedge sensors[i]) begin
            // Sensor logic to update parking space status
            if (sensors[i]) parking_spaces[i] = ~parking_spaces[i];
        end
    end
endgenerate

endmodule
```

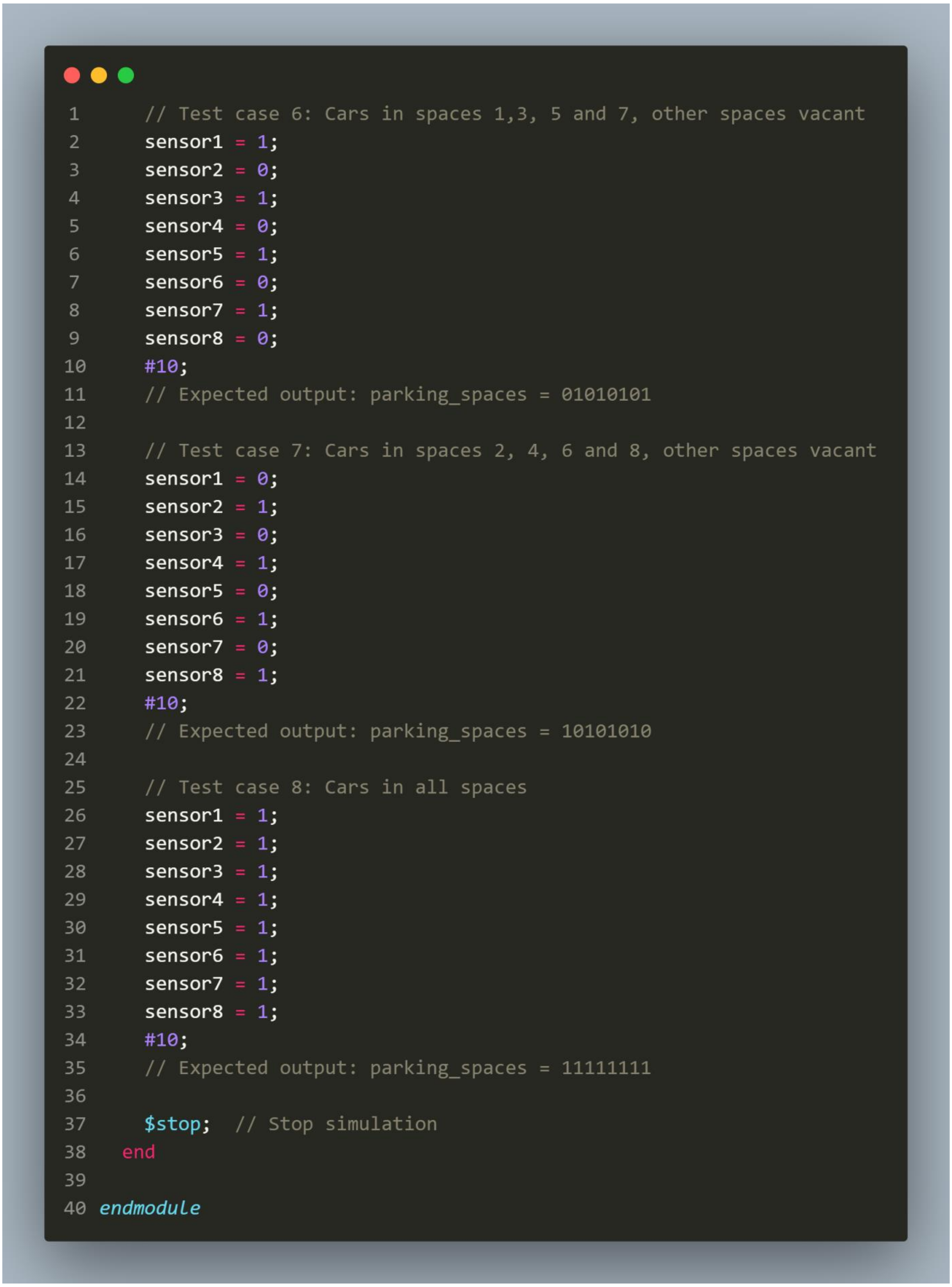
TEST BENCH FILE:



```verilog
`timescale 1ns/1ns  // Set the timescale for simulation

module tb_car_parking_system;

  // Inputs
  reg sensor1;
  reg sensor2;
  reg sensor3;
  reg sensor4;
  reg sensor5;
  reg sensor6;
  reg sensor7;
  reg sensor8;

  // Outputs
  wire [7:0] parking_spaces;

  // Instantiate the module under test
  car_parking_system uut (
    .sensors({sensor1, sensor2, sensor3, sensor4, sensor5, sensor6, sensor7, sensor8}),
    .parking_spaces(parking_spaces)
  );

  // File for VCD (Value Change Dump) output
  initial begin
    $dumpfile("car_parking_system_tb.vcd");
    $dumpvars(0, tb_car_parking_system);
  end

  // Initial block for stimulus generation
  initial begin
    // Test case 1: No cars, all spaces should be vacant
    sensor1 = 0;
    sensor2 = 0;
    sensor3 = 0;
    sensor4 = 0;
    sensor5 = 0;
    sensor6 = 0;
    sensor7 = 0;
    sensor8 = 0;
    #10;  // Wait for 10 time units
    // Expected output: parking_spaces = 00000000
```

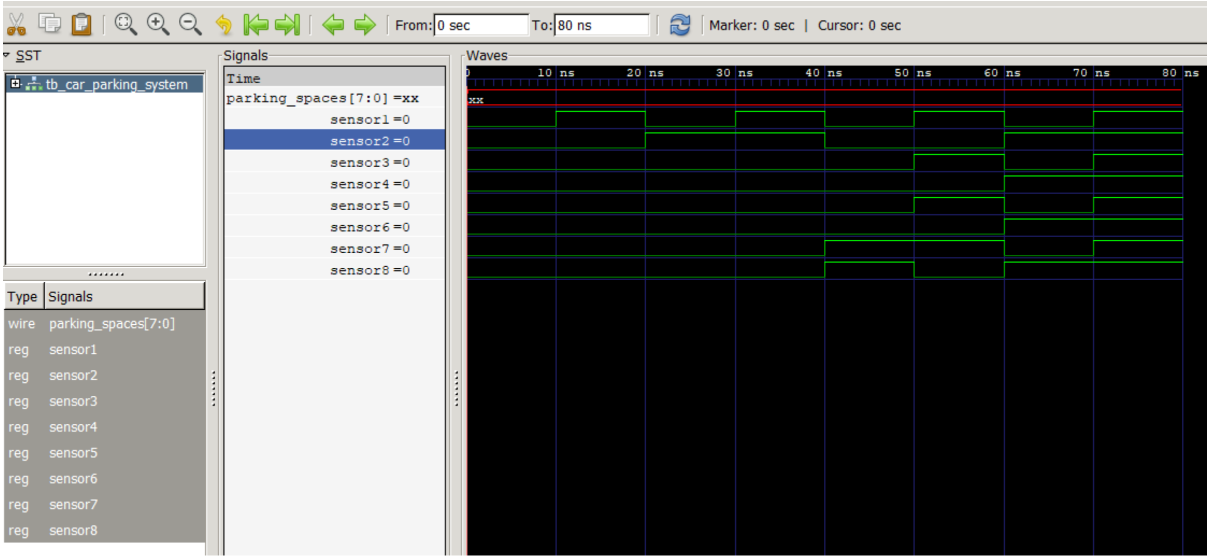


```
// Test case 2: Car in space 1, other spaces vacant
    sensor1 = 1;
    sensor2 = 0;
    sensor3 = 0;
    sensor4 = 0;
    sensor5 = 0;
    sensor6 = 0;
    sensor7 = 0;
    sensor8 = 0;
    #10;
    // Expected output: parking_spaces = 00000001

    // Test case 3: Car in space 2, other spaces vacant
    sensor1 = 0;
    sensor2 = 1;
    sensor3 = 0;
    sensor4 = 0;
    sensor5 = 0;
    sensor6 = 0;
    sensor7 = 0;
    sensor8 = 0;
    #10;
    // Expected output: parking_spaces = 00000010

    // Test case 4: Cars in spaces 1 and 2, other spaces vacant
    sensor1 = 1;
    sensor2 = 1;
    sensor3 = 0;
    sensor4 = 0;
    sensor5 = 0;
    sensor6 = 0;
    sensor7 = 0;
    sensor8 = 0;
    #10;
    // Expected output: parking_spaces = 00000011

    // Test case 5: Cars in spaces 7 and 8, other spaces vacant
    sensor1 = 0;
    sensor2 = 0;
    sensor3 = 0;
    sensor4 = 0;
    sensor5 = 0;
    sensor6 = 0;
    sensor7 = 1;
    sensor8 = 1;
    #10;
    // Expected output: parking_spaces = 11000000
```



```
    // Test case 6: Cars in spaces 1,3, 5 and 7, other spaces vacant
    sensor1 = 1;
    sensor2 = 0;
    sensor3 = 1;
    sensor4 = 0;
    sensor5 = 1;
    sensor6 = 0;
    sensor7 = 1;
    sensor8 = 0;
    #10;
    // Expected output: parking_spaces = 01010101

    // Test case 7: Cars in spaces 2, 4, 6 and 8, other spaces vacant
    sensor1 = 0;
    sensor2 = 1;
    sensor3 = 0;
    sensor4 = 1;
    sensor5 = 0;
    sensor6 = 1;
    sensor7 = 0;
    sensor8 = 1;
    #10;
    // Expected output: parking_spaces = 10101010

    // Test case 8: Cars in all spaces
    sensor1 = 1;
    sensor2 = 1;
    sensor3 = 1;
    sensor4 = 1;
    sensor5 = 1;
    sensor6 = 1;
    sensor7 = 1;
    sensor8 = 1;
    #10;
    // Expected output: parking_spaces = 11111111

    $stop;  // Stop simulation
  end

endmodule
```

SCREEN SHOT OF THE OUTPUT:



From: 0 sec To: 80 ns Marker: 0 sec | Cursor: 0 sec

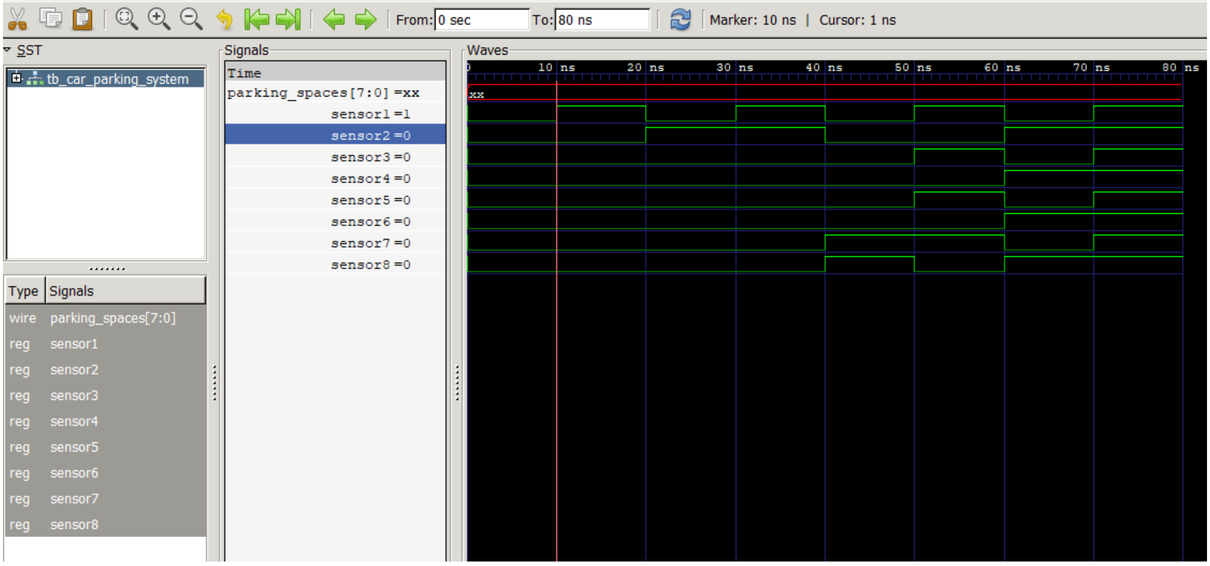
SST

tb_car_parking_system

Type	Signals
wire	parking_spaces[7:0]
reg	sensor1
reg	sensor2
reg	sensor3
reg	sensor4
reg	sensor5
reg	sensor6
reg	sensor7
reg	sensor8

Signals

```
Time
parking_spaces[7:0] =xx
            sensor1 =0
            sensor2 =0
            sensor3 =0
            sensor4 =0
            sensor5 =0
            sensor6 =0
            sensor7 =0
            sensor8 =0
```



From: 0 sec To: 80 ns Marker: 10 ns | Cursor: 1 ns

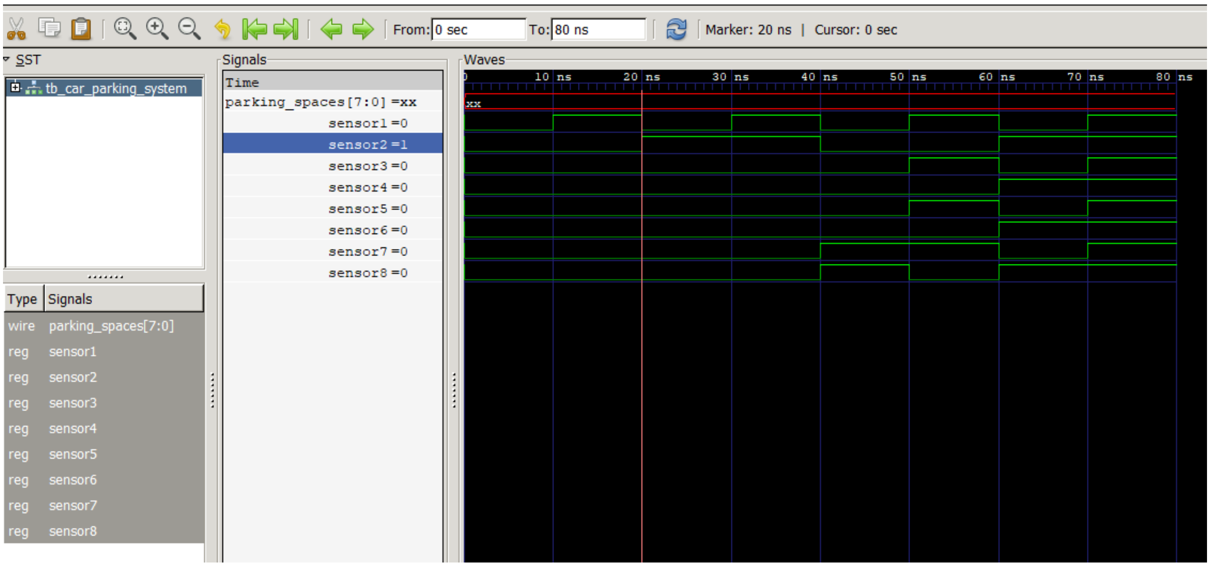
SST

tb_car_parking_system

Type	Signals
wire	parking_spaces[7:0]
reg	sensor1
reg	sensor2
reg	sensor3
reg	sensor4
reg	sensor5
reg	sensor6
reg	sensor7
reg	sensor8

Signals

```
Time
parking_spaces[7:0] =xx
            sensor1 =1
            sensor2 =0
            sensor3 =0
            sensor4 =0
            sensor5 =0
            sensor6 =0
            sensor7 =0
            sensor8 =0
```

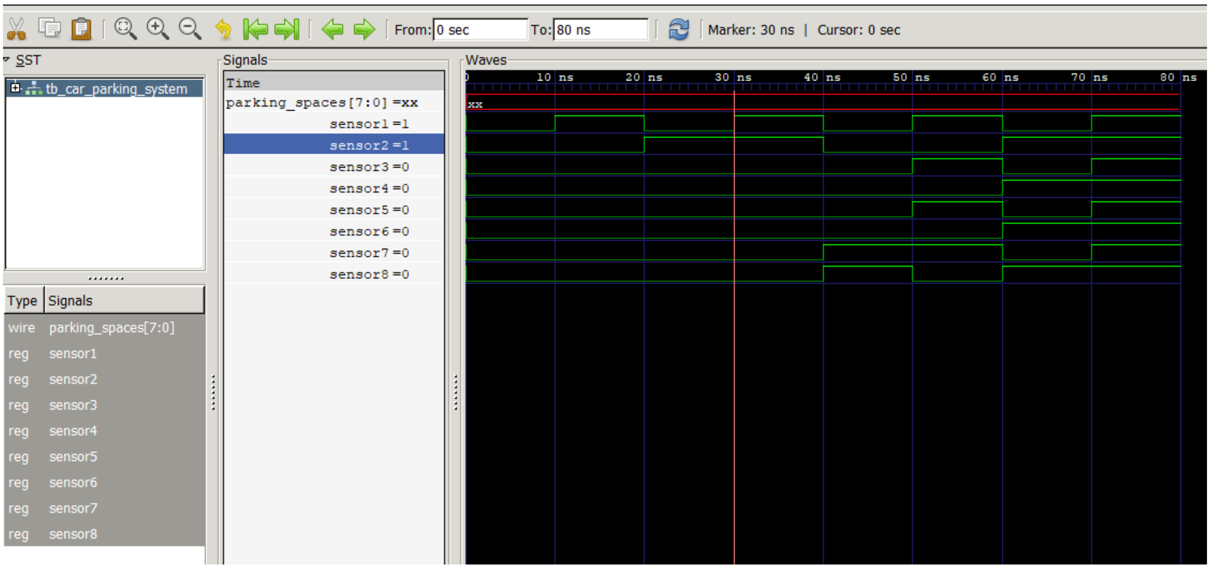


From: 0 sec To: 80 ns | Marker: 20 ns | Cursor: 0 sec

SST
tb_car_parking_system

Type	Signals
wire	parking_spaces[7:0]
reg	sensor1
reg	sensor2
reg	sensor3
reg	sensor4
reg	sensor5
reg	sensor6
reg	sensor7
reg	sensor8

```
Signals
Time
parking_spaces[7:0] =xx
            sensor1 =0
            sensor2 =1
            sensor3 =0
            sensor4 =0
            sensor5 =0
            sensor6 =0
            sensor7 =0
            sensor8 =0
```

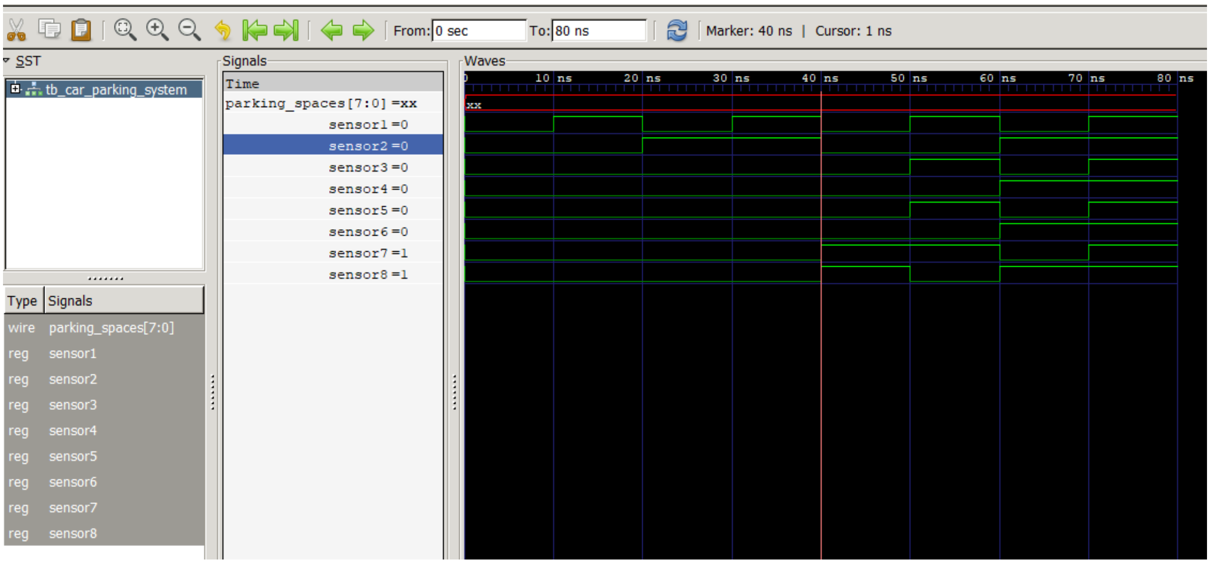


From: 0 sec To: 80 ns | Marker: 30 ns | Cursor: 0 sec

SST
tb_car_parking_system

Type	Signals
wire	parking_spaces[7:0]
reg	sensor1
reg	sensor2
reg	sensor3
reg	sensor4
reg	sensor5
reg	sensor6
reg	sensor7
reg	sensor8

```
Signals
Time
parking_spaces[7:0] =xx
            sensor1 =1
            sensor2 =1
            sensor3 =0
            sensor4 =0
            sensor5 =0
            sensor6 =0
            sensor7 =0
            sensor8 =0
```

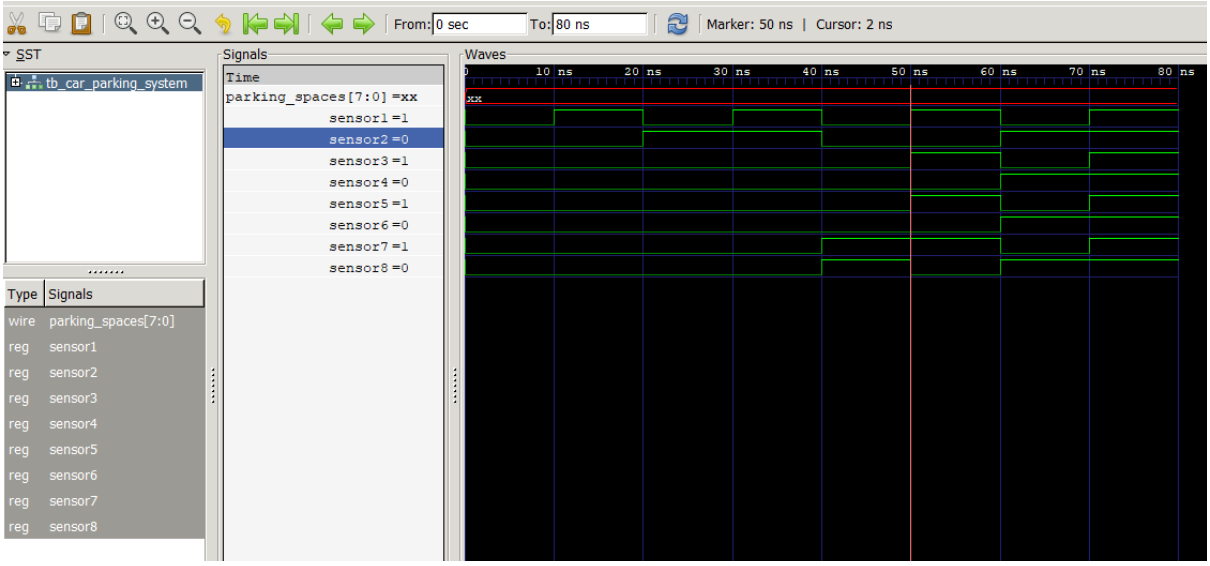


From: 0 sec To: 80 ns | Marker: 40 ns | Cursor: 1 ns

SST
tb_car_parking_system

Type	Signals
wire	parking_spaces[7:0]
reg	sensor1
reg	sensor2
reg	sensor3
reg	sensor4
reg	sensor5
reg	sensor6
reg	sensor7
reg	sensor8

```
Signals
Time
parking_spaces[7:0] =xx
            sensor1 =0
            sensor2 =0
            sensor3 =0
            sensor4 =0
            sensor5 =0
            sensor6 =0
            sensor7 =1
            sensor8 =1
```



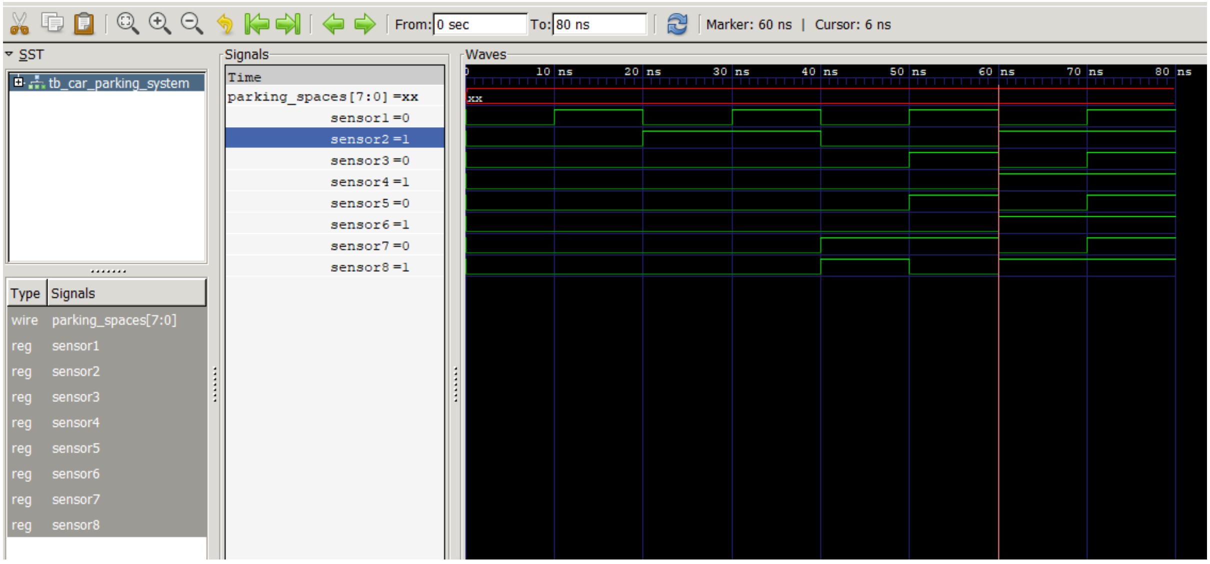
From: 0 sec To: 80 ns Marker: 50 ns | Cursor: 2 ns

SST

tb_car_parking_system

Type	Signals
wire	parking_spaces[7:0]
reg	sensor1
reg	sensor2
reg	sensor3
reg	sensor4
reg	sensor5
reg	sensor6
reg	sensor7
reg	sensor8

```
Signals
Time
parking_spaces[7:0] =xx
           sensor1 =1
           sensor2 =0
           sensor3 =1
           sensor4 =0
           sensor5 =1
           sensor6 =0
           sensor7 =1
           sensor8 =0
```



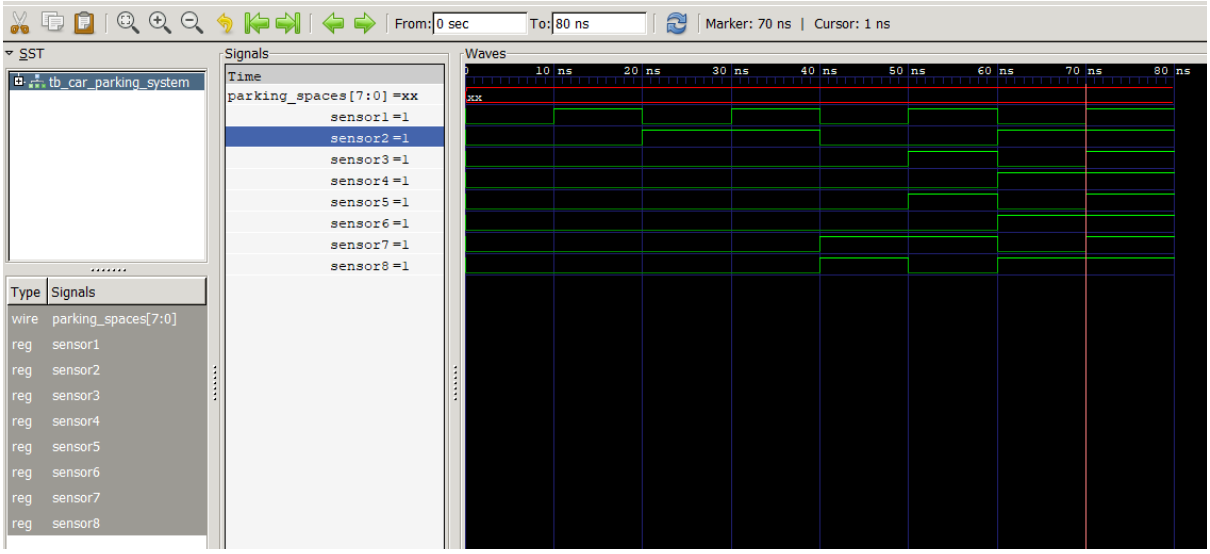
From: 0 sec To: 80 ns Marker: 60 ns | Cursor: 6 ns

SST

tb_car_parking_system

Type	Signals
wire	parking_spaces[7:0]
reg	sensor1
reg	sensor2
reg	sensor3
reg	sensor4
reg	sensor5
reg	sensor6
reg	sensor7
reg	sensor8

```
Signals
Time
parking_spaces[7:0] =xx
           sensor1 =0
           sensor2 =1
           sensor3 =0
           sensor4 =1
           sensor5 =0
           sensor6 =1
           sensor7 =0
           sensor8 =1
```



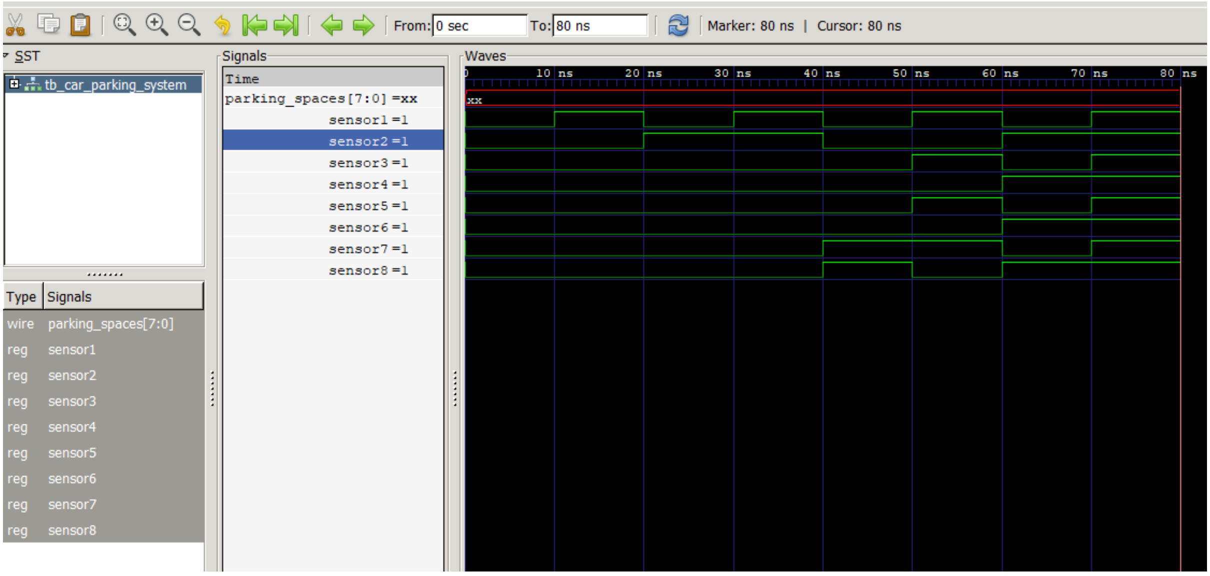
From: 0 sec To: 80 ns Marker: 70 ns | Cursor: 1 ns

SST

tb_car_parking_system

Type	Signals
wire	parking_spaces[7:0]
reg	sensor1
reg	sensor2
reg	sensor3
reg	sensor4
reg	sensor5
reg	sensor6
reg	sensor7
reg	sensor8

```
Signals
Time
parking_spaces[7:0] =xx
           sensor1 =1
           sensor2 =1
           sensor3 =1
           sensor4 =1
           sensor5 =1
           sensor6 =1
           sensor7 =1
           sensor8 =1
```



From: 0 sec To: 80 ns

Marker: 80 ns | Cursor: 80 ns

SST

tb_car_parking_system

Signals

```
Time
parking_spaces[7:0] =xx
           sensor1 =1
           sensor2 =1
           sensor3 =1
           sensor4 =1
           sensor5 =1
           sensor6 =1
           sensor7 =1
           sensor8 =1
```

Type	Signals
wire	parking_spaces[7:0]
reg	sensor1
reg	sensor2
reg	sensor3
reg	sensor4
reg	sensor5
reg	sensor6
reg	sensor7
reg	sensor8
