Project 1: phase one

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Group: 1

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The Finite state machine:

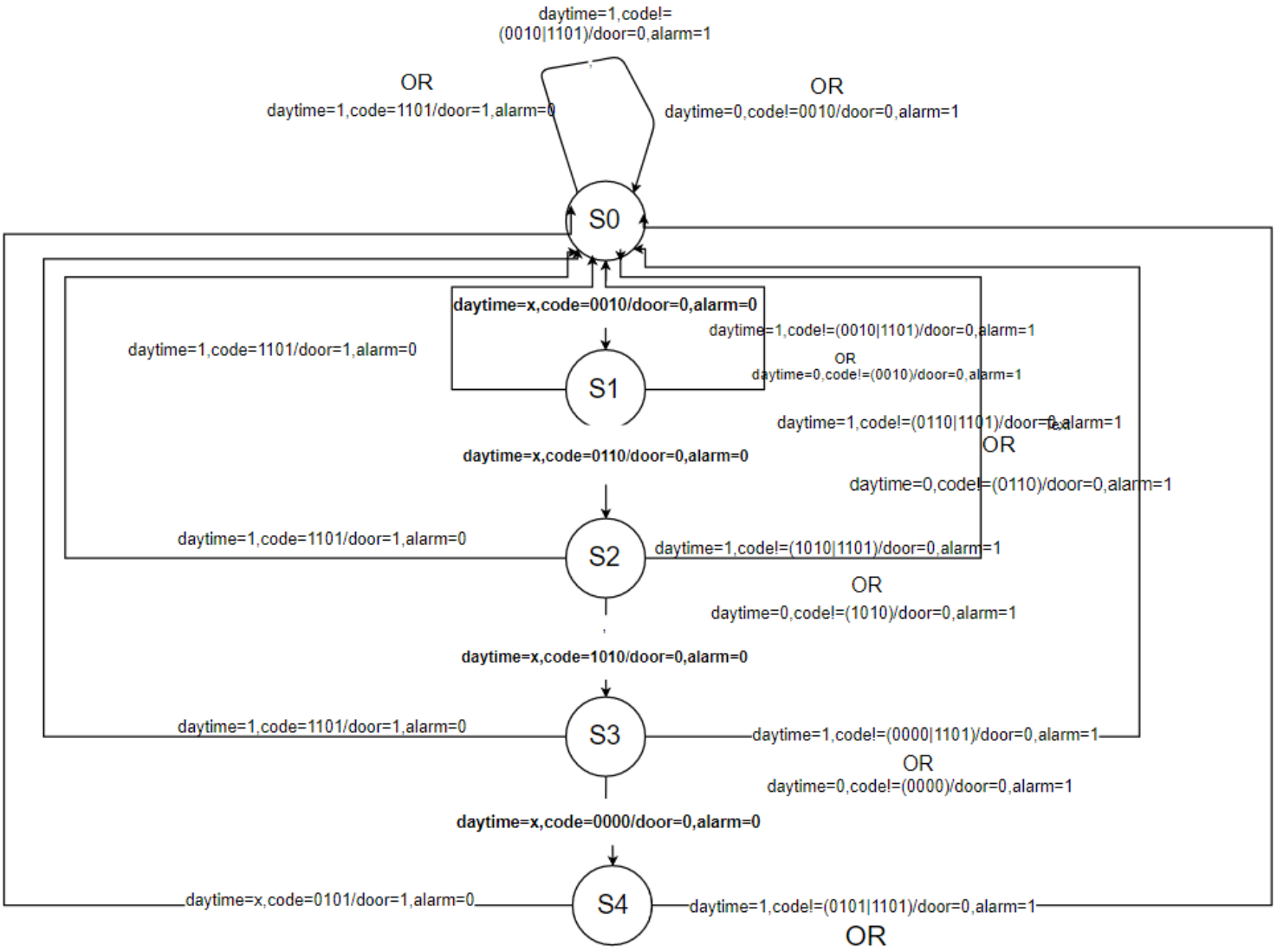


Table:

Current state	Daytime	Code	reset	New State	Door	Alarm
X	X	X	1	S0	0	0
S0	1	1101	0	S0	1	0
S0	X	0010	0	S1	0	0
S0	1	!(0010 |1101)	0	S0	0	1
S0	0	!(0010)	0	S0	0	1
S1	1	1101	0	S0	1	0
S1	X	0110	0	S2	0	0
S1	1	!(0110 |1101)	0	S0	0	1
S1	0	!(0110)	0	S0	0	1
S2	1	1101	0	S0	1	0
S2	X	1010	0	S3	0	0
S2	1	!(1010 |1101)	0	S0	0	1
S2	0	!(1010)	0	S0	0	1
S3	1	1101	0	S0	1	0
S3	X	0000	0	S4	0	0
S3	1	!(0000 |1101)	0	S0	0	1
S3	0	!(0000)	0	S0	0	1
S4	1	1101	0	S0	1	0
S4	X	0101	0	S0	1	0
S4	1	!(0101 |1101)	0	S0	0	1
S4	0	!(0101)	0	S0	0	1

The Code:

```
library Sxlib_ModelSim;
library IEEE;
use IEEE.STD_LOGIC_1164.ALL;
use IEEE.STD_LOGIC_UNSIGNED.ALL;
use ieee.NUMERIC_STD.all;
entity project1 is
port  (
   clk     : in       bit;
           code   : in        bit_vector(3 downto 0) ;
           daytime     : in bit;
           reset : in         bit;
           vdd   : in         bit;
           vss   : in         bit;
           door     : out    bit;
           alarm   : out     bit
      );
end project1;
architecture FSM of project1 is
  type STATE_TYPE is (S0, S1,s2,s3,s4);
  signal NS, CS : STATE_TYPE;
  begin
  p1: process (CS, code, daytime, reset)
  begin
if (reset='1') then
   NS<=S0;
   door<='0';
```

```
  alarm<='0';
else
  case CS is
     when s0=>
          if(daytime='1') then
                  if(code="1101") then
                     door <= '1';
                     alarm <= '0';
                     NS <=s0;
                   elsif(code="0010") then
                     door<='0';
                     alarm<='0';
                     NS<=s1;
                    else
                     door<='0';
                     alarm<='1';
                     NS <= S0;
                end if;
          elsif (daytime='0')then
                  if(code="0010") then
                     door<='0';
                     alarm<='0';
                     NS<=s1;
                  else
                     door<='0';
                     alarm<='1';
                     NS <= S0;
```

```
                end if;
        end if;

         ------------------------------
when s1=>

        if(daytime='1') then
                if(code="1101") then
                    door <= '1';
                    alarm <= '0';
                    NS <=s0;
                elsif(code="0110") then
                    door<='0';
                    alarm<='0';
                    NS<=s2;
                else
                    door<='0';
                    alarm<='1';
                    NS <= S0;
             end if;
        elsif (daytime='0') then
                if(code="0110") then
                    door<='0';
                    alarm<='0';
                    NS<=s2;
                else
```

```
                door<='0';
                alarm<='1';
                NS <= S0;

            end if;
        end if;
         --------------------------------
    when s2=>
        if(daytime='1') then
            if(code="1101") then
                door <= '1';
                alarm <= '0';
                NS <=s0;
            elsif(code="1010") then
                door<='0';
                alarm<='0';
                NS<=s3;
            else
                door<='0';
                alarm<='1';
                NS <= S0;
            end if;
        elsif (daytime='0') then
            if(code="1010") then
                door<='0';
                alarm<='0';
                NS<=s3;
```

```
                else
                    door<='0';
                    alarm<='1';
                    NS <= S0;

                end if;
        end if;
         --------------------------------
    when s3=>
        if(daytime='1') then
                if(code="1101") then
                    door <= '1';
                    alarm <= '0';
                    NS <=s0;
                elsif(code="0000") then
                    door<='0';
                    alarm<='0';
                    NS<=s4;
                else
                    door<='0';
                    alarm<='1';
                    NS <= S0;
                end if;
        elsif (daytime='0')then
                if(code="0000") then
                    door<='0';
                    alarm<='0';
```

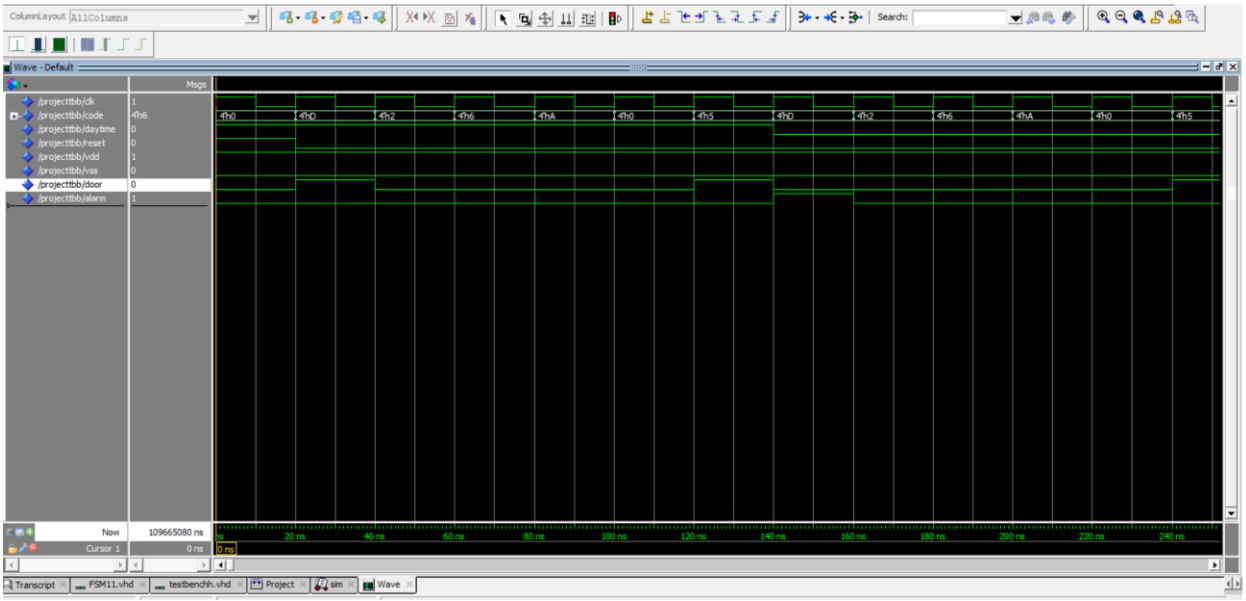
```
                NS<=s4;
            else
                door<='0';
                alarm<='1';
                NS <= S0;

            end if;
        end if;

         --------------------------------
when s4=>
        if(daytime='1') then
            if(code="1101") then
                door <= '1';
                alarm <= '0';
                NS <=s0;
            elsif(code="0101") then
                door<='1';
                alarm<='0';
                NS<=s0;
            else
                door<='0';
                alarm<='1';
                NS <= S0;
            end if;
        elsif (daytime='0') then
            if(code="0101") then
```

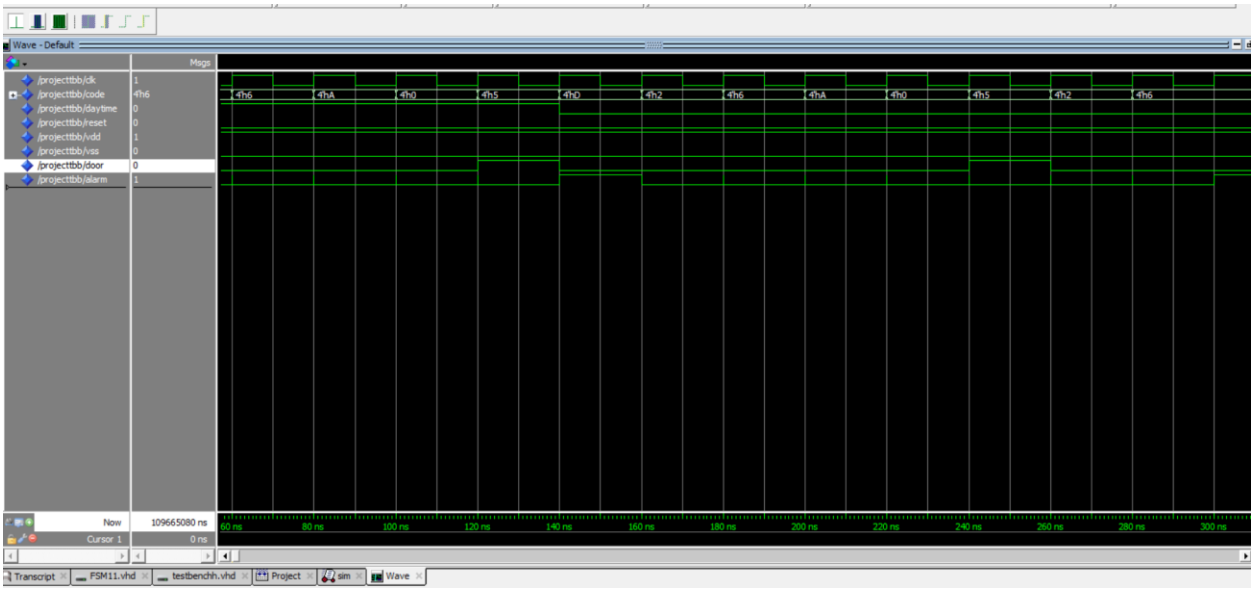
```
                door<='1';
                alarm<='0';
                NS<=s0;
            else
                door<='0';
                alarm<='1';
                NS <= S0;

            end if;
        end if;
          ---------------------------------

         end case;
         end if;
         end process;
p2: process(clk)
 begin
        if(clk = '1' and clk'event)then

   CS <= NS;
  end if;
 end process;
end FSM;
```

The test bench:

Test number	Daytime	Code	Reset	Expected Door	Expected Alarm	Door	Alarm
Reset test	X	X	1	0	0	0	0
O with dt=1 (test case 1)	1	1101	0	1	0	1	0
Full input with dt=1 (test case 2)	1	0010	0	0	0	0	0
	1	0110	0	0	0	0	0
	1	1010	0	0	0	0	0
	1	0000	0	0	0	0	0
	1	0101	0	1	0	1	0
O with dt=0 (test case 3)	0	1101	0	0	1	0	1
Full input with dt=0 (test case 4)	0	0010	0	0	0	0	0
	0	0110	0	0	0	0	0
	0	1010	0	0	0	0	0
	0	0000	0	0	0	0	0
	0	0101	0	1	0	1	0
Incorrect input (test case 5)	0	0010	0	0	1	0	1
	0	0110	0	0	1	0	1
	0	0110	0	0	1	0	1

The output:


Wave - Default
Msgs
/projecttbb/clk
/projecttbb/code
/projecttbb/daytime
/projecttbb/reset
/projecttbb/vdd
/projecttbb/vss
/projecttbb/door
/projecttbb/alarm
Now
109665080 ns
Cursor 1
0 ns
Transcript
FSM11.vhd
testbenchh.vhd
Project
sim
Wave


Wave - Default
Msgs
/projecttbb/clk
/projecttbb/code
/projecttbb/daytime
/projecttbb/reset
/projecttbb/vdd
/projecttbb/vss
/projecttbb/door
/projecttbb/alarm
Now
109665080 ns
Cursor 1
0 ns
Transcript
FSM11.vhd
testbenchh.vhd
Project
sim
Wave

The code:

```
library Sxlib_ModelSim;
library IEEE;
use IEEE.STD_LOGIC_1164.ALL;
use IEEE.STD_LOGIC_UNSIGNED.ALL;
use ieee.NUMERIC_STD.all;
ENTITY projecttbb IS
END ENTITY projecttbb;
ARCHITECTURE fsmtbb OF projecttbb IS
component project1 is
port  (
   clk    : in      bit;
          code   : in       bit_vector(3 downto 0) ;
          daytime    : in bit;
          reset : in        bit;
          vdd   : in        bit;
          vss   : in        bit;
          door    : out    bit;
          alarm   : out    bit
     );
end component;
FOR dut: project1 USE ENTITY WORK.project1 (FSM);
SIGNAL clk    : bit := '0';
SIGNAL code    : bit_vector(3 downto 0) := "0000";
SIGNAL daytime    : bit := '1';
SIGNAL reset : bit := '1';
SIGNAL vdd   : bit := '1';
```

```
SIGNAL vss   : bit := '0';
signal door : bit:= '0';
signal alarm : bit := '0';
begin
dut: project1 PORT MAP (clk, code, daytime, reset, door, alarm, vdd, vss);
 clk_process :process
begin
      clk <= '1';
      wait for 10 ns;
      clk <= '0';
      wait for 10 ns;

  end process;
p1:process is begin
wait For 20 ns;
ASSERT door = '0' and alarm ='0'
REPORT "1 error"
SEVERITY error;
---- first testbensh
daytime<='1';
code<="1101";
reset<='0';
wait For 20 ns;
ASSERT door = '1' and alarm ='0'
REPORT "2 error"
SEVERITY error;
---------second testbench
```

```
daytime<='1';
code<="0010";
reset<='0';
wait For 20 ns;
ASSERT door = '0' and alarm ='0'
REPORT " 3 error"
SEVERITY error;
-------------------------
daytime<='1';
code<="0110";
reset<='0';
wait For 20 ns;
ASSERT door = '0' and alarm ='0'
REPORT " 4 error"
SEVERITY error;
-------------------------
daytime<='1';
code<="1010";
reset<='0';
wait For 20 ns;
ASSERT door = '0' and alarm ='0'
REPORT " 5 error"
SEVERITY error;
--------------------------
daytime<='1';
code<="0000";
reset<='0';
```

```
wait For 20 ns;
ASSERT door = '0' and alarm ='0'
REPORT " 6 error"
SEVERITY error;
-------------------------
daytime<='1';
code<="0101";
reset<='0';
wait For 20 ns;
ASSERT door = '1' and alarm ='0'
REPORT " 7 error"
SEVERITY error;
-----------third testbench
daytime<='0';
code<="1101";
reset<='0';
wait For 20 ns;
ASSERT door = '0' and alarm ='1'
REPORT "8 error"
SEVERITY error;
-------------fourth testnech
daytime<='0';
code<="0010";
reset<='0';
wait For 20 ns;
ASSERT door = '0' and alarm ='0'
REPORT "9 error"
```

```
SEVERITY error;
----------------------------
daytime<='0';
code<="0110";
reset<='0';
wait For 20 ns;
ASSERT door = '0' and alarm ='0'
REPORT "10 error"
SEVERITY error;
----------------------------
daytime<='0';
code<="1010";
reset<='0';
wait For 20 ns;
ASSERT door = '0' and alarm ='0'
REPORT "11 error"
SEVERITY error;
----------------------------
daytime<='0';
code<="0000";
reset<='0';
wait For 20 ns;
ASSERT door = '0' and alarm ='0'
REPORT "12 error"
SEVERITY error;
----------------------------
daytime<='0';
```

```
code<="0101";
reset<='0';
wait For 20 ns;
ASSERT door = '1' and alarm ='0'
REPORT "13 error"
SEVERITY error;
----------fifth testbench
daytime<='0';
code<="0010";
reset<='0';
wait For 20 ns;
ASSERT door = '0' and alarm ='0'
REPORT "14 error"
SEVERITY error;
---------------------------
daytime<='0';
code<="0110";
reset<='0';
wait For 20 ns;
ASSERT door = '0' and alarm ='0'
REPORT "15 error"
SEVERITY error;
---------------------------
daytime<='0';
code<="0110";
reset<='0';
wait For 20 ns;
```

```
ASSERT door = '0' and alarm ='1'
REPORT "16 error"
SEVERITY error;
----------------------------
WAIT;
END PROCESS ;
END ARCHITECTURE ;
```