xrysav25 / Digital-electronics-1

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main

Digital-electronics-1 / 04-segment / README.md

xrysav25 Update README.md

1 contributor

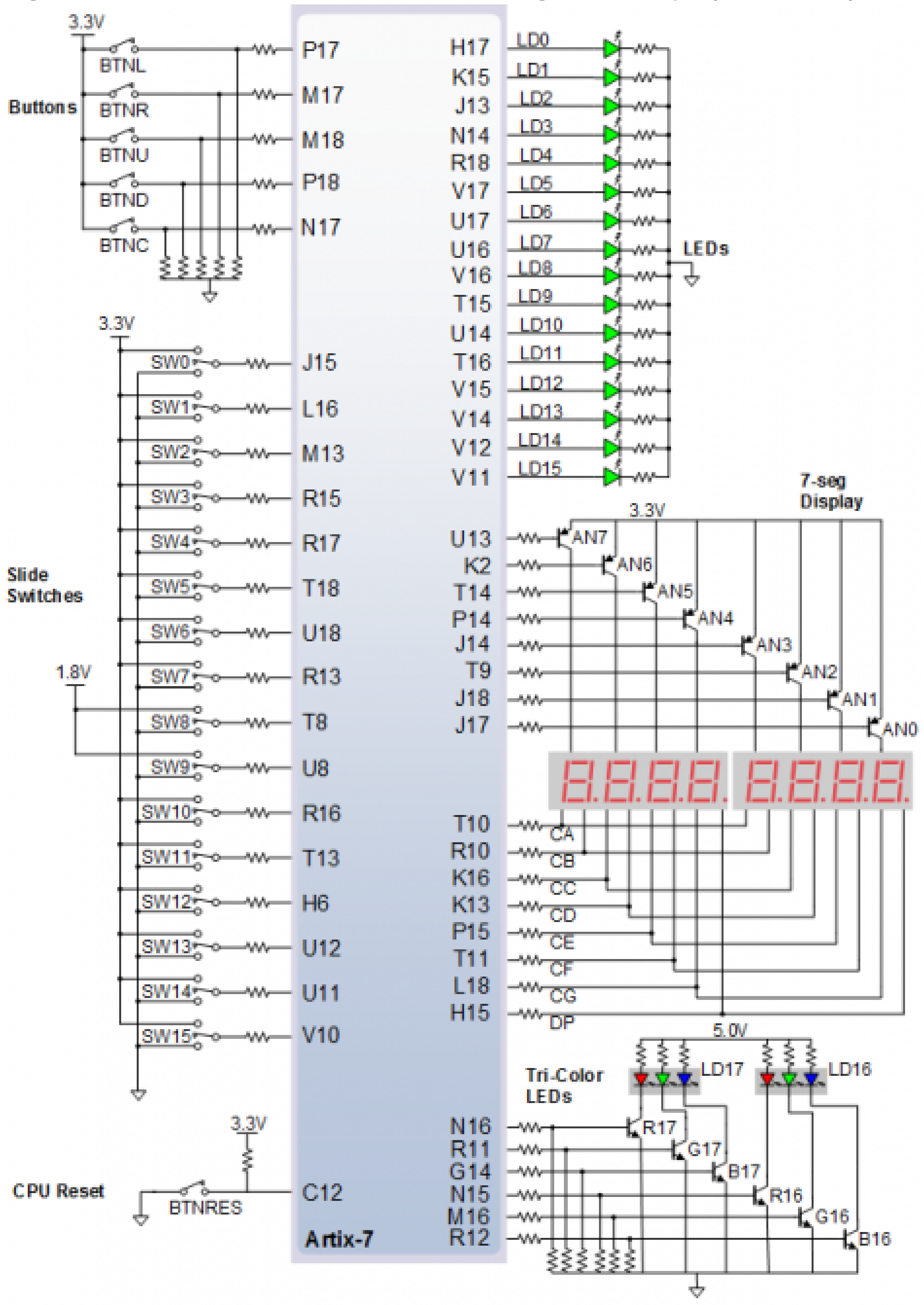
Raw Blame

175 lines (168 sloc) | 6.25 KB

Lab 4

1. Preparation tasks

- Figure or table with connection of 7-segment displays on Nexys A7 board



- Decoder truth table common anode

Hex	Inputs	A	B	C	D	E	F	G
0	0000	0	0	0	0	0	0	1
1	0001	1	0	0	1	1	1	1
2	0010	0	0	1	0	0	1	0
3	0011	0	0	0	0	1	1	0
4	0100	1	1	0	1	1	0	0
5	0101	0	1	0	0	1	0	0

Hex	Inputs	A	B	C	D	E	F	G
6	0110	0	1	0	0	0	0	0
7	0111	0	0	0	1	1	1	1
8	1000	0	0	0	0	0	0	0
9	1001	0	0	0	0	1	0	0
A	1010	0	0	0	1	0	0	0
b	1011	1	1	0	0	0	0	0
C	1100	0	1	1	0	0	0	1
d	1101	1	0	0	0	0	1	0
E	1110	0	1	1	0	0	0	0
F	1111	0	1	1	1	0	0	0

2. Seven-segment display decoder

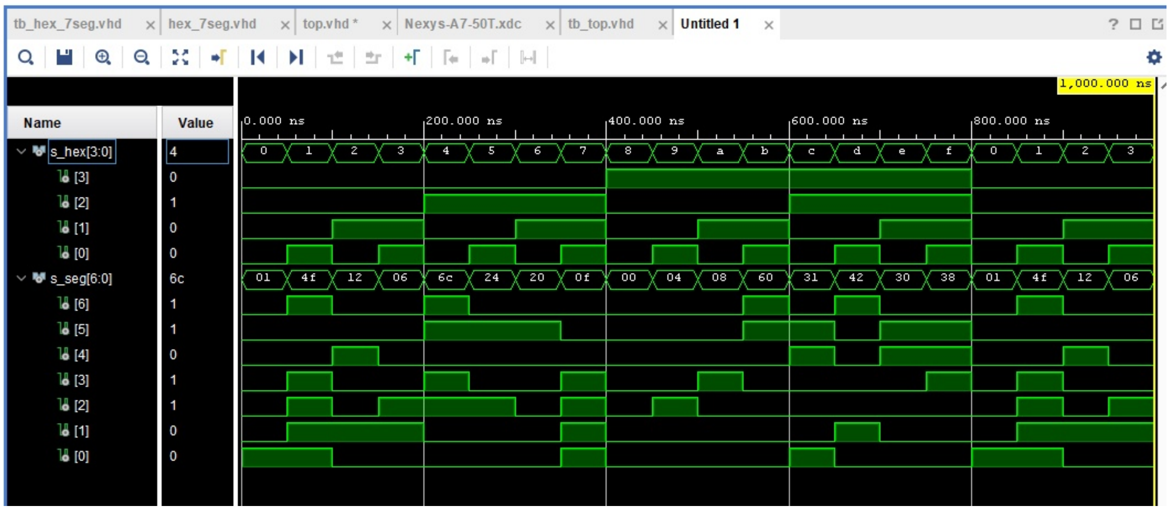
- architecture

```
p_7seg_decoder : process(hex_i)
begin
    case hex_i is
        when "0000" =>
            seg_o <= "0000001";     -- 0
        when "0001" =>
            seg_o <= "1001111";     -- 1
        when "0010" =>
            seg_o <= "0010010";     -- 2
        when "0011" =>
            seg_o <= "0000110";     -- 3
        when "0100" =>
            seg_o <= "1101100";     -- 4
        when "0101" =>
            seg_o <= "0100100";     -- 5
        when "0110" =>
            seg_o <= "0100000";     -- 6
        when "0111" =>
            seg_o <= "0001111";     -- 7
        when "1000" =>
            seg_o <= "0000000";     -- 8
        when "1001" =>
            seg_o <= "0000100";     -- 9
        when "1010" =>
            seg_o <= "0001000";     -- A
        when "1011" =>
            seg_o <= "1100000";     -- B
        when "1100" =>
            seg_o <= "0110001";     -- C
        when "1101" =>
            seg_o <= "1000010";     -- D
        when "1110" =>
            seg_o <= "0110000";     -- E
        when others =>
            seg_o <= "0111000";     -- F
    end case;
end process p_7seg_decoder;
```

- stimulus

```
p_stimulus : process
begin
    s_hex <= "0000"; wait for 50ns;
    assert (s_seg = "0000001") report "Test failed for hex input combination: 000
    s_hex <= "0001"; wait for 50 ns;
    assert (s_seg = "1001111") report "Test failed for hex input combination: 000
    s_hex <= "0010"; wait for 50 ns;
    assert (s_seg = "0010010") report "Test failed for hex input combination: 001
    s_hex <= "0011"; wait for 50 ns;
    assert (s_seg = "0000110") report "Test failed for hex input combination: 001
    s_hex <= "0100"; wait for 50 ns;
    assert (s_seg = "1101100") report "Test failed for hex input combination: 010
    s_hex <= "0101"; wait for 50 ns;
    assert (s_seg = "0100100") report "Test failed for hex input combination: 010
    s_hex <= "0110"; wait for 50 ns;
    assert (s_seg = "0100000") report "Test failed for hex input combination: 011
    s_hex <= "0111"; wait for 50 ns;
    assert (s_seg = "0001111") report "Test failed for hex input combination: 011
    s_hex <= "1000"; wait for 50 ns;
    assert (s_seg = "0000000") report "Test failed for hex input combination: 100
    s_hex <= "1001"; wait for 50 ns;
    assert (s_seg = "0000100") report "Test failed for hex input combination: 100
    s_hex <= "1010"; wait for 50 ns;
    assert (s_seg = "0001000") report "Test failed for hex input combination: 101
    s_hex <= "1011"; wait for 50 ns;
    assert (s_seg = "1100000") report "Test failed for hex input combination: 101
    s_hex <= "1100"; wait for 50 ns;
    assert (s_seg = "0110001") report "Test failed for hex input combination: 110
    s_hex <= "1101"; wait for 50 ns;
    assert (s_seg = "1000010") report "Test failed for hex input combination: 110
    s_hex <= "1110"; wait for 50 ns;
    assert (s_seg = "0110000") report "Test failed for hex input combination: 111
    s_hex <= "1111"; wait for 50 ns;
    assert (s_seg = "0111000") report "Test failed for hex input combination: 111
end process p_stimulus;
```

- testbench



- top.vhd

```
architecture Behavioral of top is

begin
    --------------------------------------------------------------------
    -- Instance (copy) of hex_7seg entity
    hex2seg : entity work.hex_7seg
        port map(
            hex_i    => SW,
            seg_o(6) => CA,
            seg_o(5) => CB,
            seg_o(4) => CC,
            seg_o(3) => CD,
            seg_o(2) => CE,
            seg_o(1) => CF,
            seg_o(0) => CG
        );

    -- Connect one common anode to 3.3V
    AN <= b"1111_0111";

    -- Display input value on LEDs
    LED(3 downto 0) <= SW;
```

3. LED(7:4) indicators

- truth table

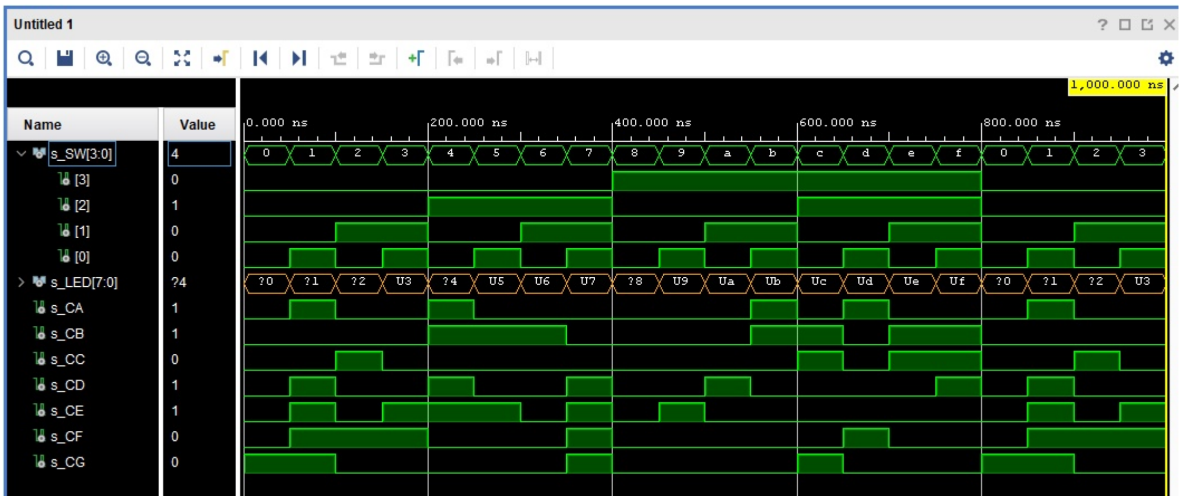
Hex	Inputs	LED4	LED5	LED6	LED7
0	0000	1	0	0	0
1	0001	0	0	1	1

Hex	Inputs	LED4	LED5	LED6	LED7
2	0010	0	0	0	1
3	0011	0	0	1	0
4	0100	0	0	0	1
5	0101	0	0	1	0
6	0110	0	0	0	0
7	0111	0	0	1	0
8	1000	0	0	0	1
9	1001	0	0	1	0
A	1010	0	1	0	0
b	1011	0	1	1	0
C	1100	0	1	0	0
d	1101	0	1	1	0
E	1110	0	1	0	0
F	1111	0	1	1	0

- code

```
-- LED(7:4) indicators
-- Turn LED(4) on if input value is equal to 0, ie "0000"
-- WRITE YOUR CODE HERE
LED(4) <= '1' when (SW= "0000") else '0';
-- Turn LED(5) on if input value is greater than "1001", ie 9
-- WRITE YOUR CODE HERE
LED(5) <= '1' when (SW= "1001") else '0';
-- Turn LED(6) on if input value is odd, ie 1, 3, 5, ...
-- WRITE YOUR CODE HERE
LED(6) <= '1' when (SW(0)= '1') else '0';
-- Turn LED(7) on if input value is a power of two, ie 1, 2, 4, or 8
-- WRITE YOUR CODE HERE
LED(4) <= '1' when (SW = "0001") else
         '1' when (SW = "0010") else
         '1' when (SW = "0100") else
         '1' when (SW = "1000") else
         '0';
```

- testbench


Untitled 1
Name
Value
s_SW[3:0] 4
[3] 0
[2] 1
[1] 0
[0] 0
s_LED[7:0] ?4
s_CA 1
s_CB 1
s_CC 0
s_CD 1
s_CE 1
s_CF 0
s_CG 0
0.000 ns
200.000 ns
400.000 ns
600.000 ns
800.000 ns
1,000.000 ns
0 1 2 3 4 5 6 7 8 9 a b c d e f 0 1 2 3
?0 ?1 ?2 U3 ?4 U5 U6 U7 ?8 U9 Ua Ub Uc Ud Ue Uf ?0 ?1 ?2 U3