

Секундомер

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I. АЖЛЫН ЗОРИЛГО

Spartan 3е хавтан нь бусад Spartan хавтангуудаас илүү сажруулсан хавтан юм. Энэхүү хавтанд нэмэлт 7 сегменттэй хавтанг холбон секундомер хийх даалгаврыг гүйцэтгэнэ.

II. Даалгавар

1. 7 сегментийн дисплейгээр секундомер хийж гүйцэтгэ. Нэг товчлуураар секундомерыг эхлүүлдэг, нөгөө товчлуураар зогсоодог, нөгөө нэгээр нь тэглэдэг байна. Системийн клокийг 1.842МГц ашиглан хэрэгтэй давтамжаа гаргаж авахыг анхаарна уу.

```
library IEEE;
use IEEE.STD_LOGIC_1164.ALL;
use IEEE.STD_LOGIC_ARITH.ALL;
use IEEE.STD_LOGIC_UNSIGNED.ALL;

entity sec is
    Port ( mclk, start, stop, rst : in STD_LOGIC;
          anode : out STD_LOGIC_VECTOR (3 downto 0);
          ssg : out STD_LOGIC_VECTOR (6 downto 0) );
end sec;

architecture Behavioral of sec is
    signal digit: std_logic_vector(3 downto 0) := "0000";
    signal clkdiv: std_logic_vector(25 downto 0) := (others => '0');
    signal cclk: std_logic;
    signal button_clk: std_logic;
    signal anode_i: std_logic_vector(3 downto 0) := "1110";
    signal dig: std_logic_vector(6 downto 0) := "0000000";
    signal second: std_logic_vector(3 downto 0) := "0000";
    signal second1: std_logic_vector(3 downto 0) := "0000";
    signal minute: std_logic_vector(3 downto 0) := "0000";
    signal minutel: std_logic_vector(3 downto 0) := "0000";
    signal running: std_logic := '0';
begin
    anode <= anode_i;
    dig <= "0111111" when digit = "0000" else
           "0000110" when digit = "0001" else
```

```
"1011011" when digit = "0010" else
"1001111" when digit = "0011" else
"1100110" when digit = "0100" else
"1101101" when digit = "0101" else
"1111101" when digit = "0110" else
"0000111" when digit = "0111" else
"1111111" when digit = "1000" else
"1101111" when digit = "1001" else
"0001000";

ssg <= not dig;

process(mclk)
begin
    if (mclk = '1' and mclk'Event) then
        clkdiv <= clkdiv + 1;
    end if;
end process;

cclk <= clkdiv(15);
button_clk <= clkdiv(25);

process(button_clk)
begin
    if (button_clk = '1' and button_clk'Event)
    then
        if rst = '1' then
            second <= "0000";
            minute <= "0000";
            second1 <= "0000";
            minutel <= "0000";
            running <= '0';
        elsif start = '1' then
            running <= '1';
        elsif stop = '1' then
            running <= '0';
        elsif running = '1' then
            if second = "1001" then
                second <= "0000";
                if second1 = "0101" then
                    second1 <= "0000";
                    if minute = "1001" then
                        minute <= "0000";
                        if minutel = "0101"
                        then
                            minutel <= "0000";
                        else
                            minutel <= minutel
                            + 1;
                        end if;
                    end if;
                else
                    minute <= minute + 1;
                end if;
            else
                second1 <= second1 + 1;
            end if;
        end if;
    end process;
```

```

else
    second <= second + 1;
end if;
end if;
end if;
end process;

process(cclk, rst)
begin
    if rst = '1' then
        anode_i <= "1110";
        digit <= "0000";
    elsif (cclk = '1' and cclk'Event) then
        case anode_i is
            when "1110" =>
                digit <= second(3 downto 0);
                anode_i <= "1101";
            when "1101" =>
                digit <= second1(3 downto 0);
                anode_i <= "1011";
            when "1011" =>
                digit <= minute(3 downto 0);
                anode_i <= "0111";
            when "0111" =>
                digit <= minutel(3 downto 0);
                anode_i <= "1110";
            when others =>
                digit <= "0000";
                anode_i <= "1110";
            end case;
        end if;
    end process;
end Behavioral;

```

Код 1: Секундомер

```

NET "anode<0>" LOC="D7";
NET "anode<1>" LOC="C7";
NET "anode<2>" LOC="F8";
NET "anode<3>" LOC="E8";
NET "ssg<0>" LOC="B4";
NET "ssg<1>" LOC="A4";
NET "ssg<2>" LOC="D5";
NET "ssg<3>" LOC="C5";
NET "ssg<4>" LOC="A6";
NET "ssg<5>" LOC="B6";

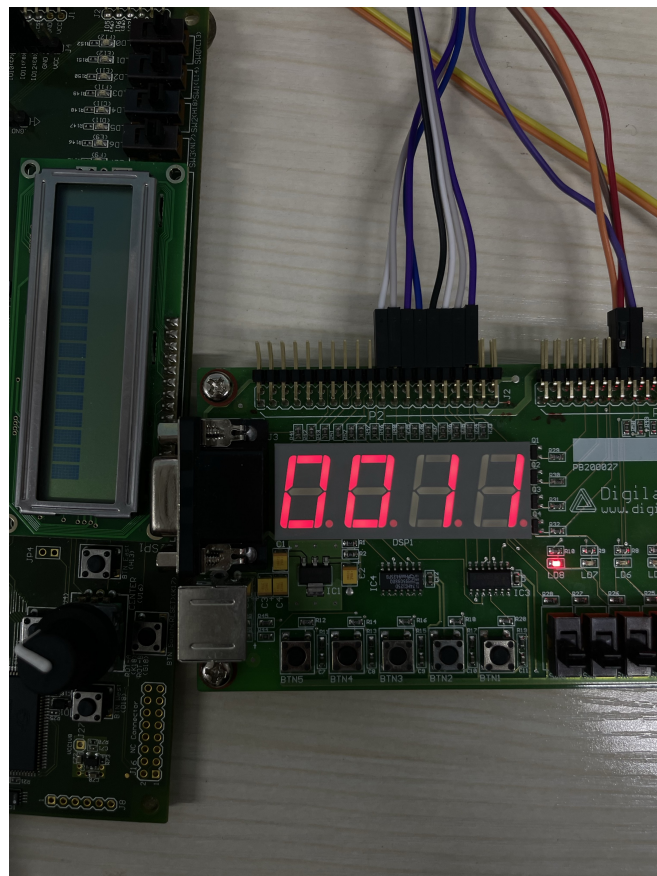
```

```

NET "ssg<6>" LOC="E7";
NET "mclk" LOC="C9";
NET "start" LOC="H13";
NET "rst" LOC="D18";
NET "stop" LOC="V4";

```

Код 2: UCF



Зураг 1: Ажиллаж буй явц