EE-334
Digital System Design

Discussion for Lab 2
PWM for Color LEDs Coded in VHDL

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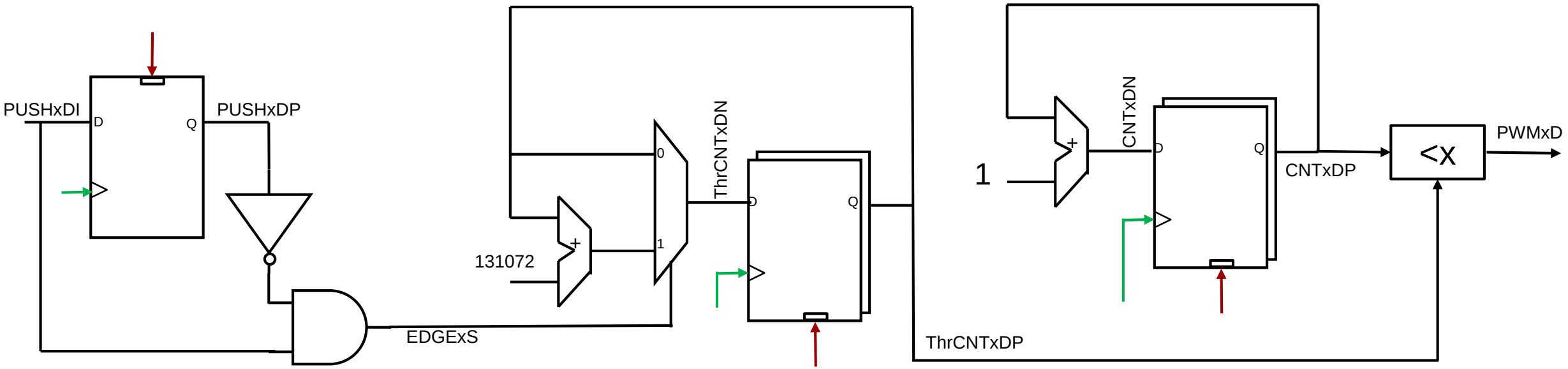
PWM Block Diagram

- Block diagram serves as starting point for HDL coding



PWM Block Diagram

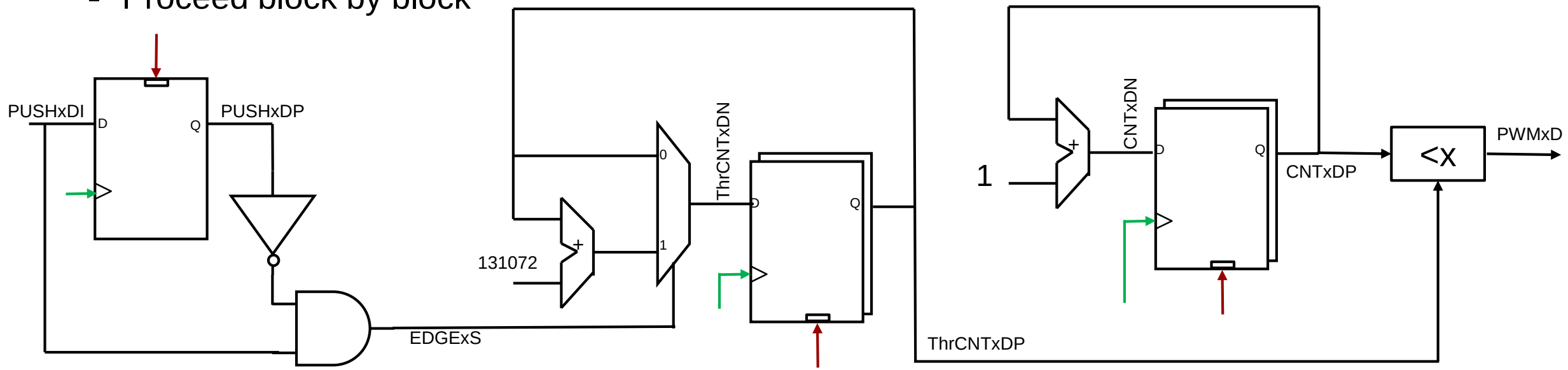
- Block diagram serves as starting point for HDL coding
  - Start with entity and signal declaration

```
entity pwm is
    port (
        CLKxCI  : in std_logic;
        RSTxRI  : in std_logic;
        PushxDI : in std_logic;

        LedxDO : out std_logic
    );
end pwm;
```

```
signal EdgexSO                : std_logic;                  -- Edge signal
signal PushxDN, PushxDP       : std_logic;                  -- Push button signals (registered)
signal ThrCntxDN, ThrCntxDP   : unsigned(20-1 downto 0);    -- Threshold signals (registered)
signal PWMCntxDN, PWMCntxDP   : unsigned(20-1 downto 0);    -- PWM signals (registered)
signal PWMxD                  : std_logic;                  -- PWM Pulse signal
```

  - Proceed block by block

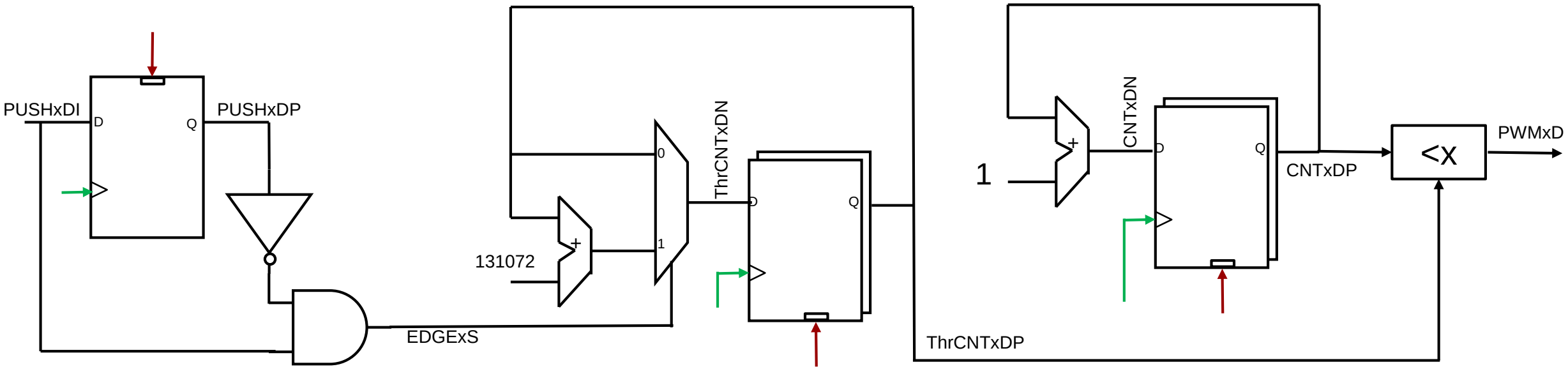


PWM Block Diagram

```
-- Edge detection
process(CLKxCI, RSTxRI)
begin
    if (RSTxRI = '1') then
        PushxDP <= '0';
    elsif CLKxCI'event and CLKxCI = '1' then
        PushxDP <= PushxDN;
    end if;
end process;

PushxDN <= PushxDI;

EdgexSO <= PushxDN and (not PushxDP);
```



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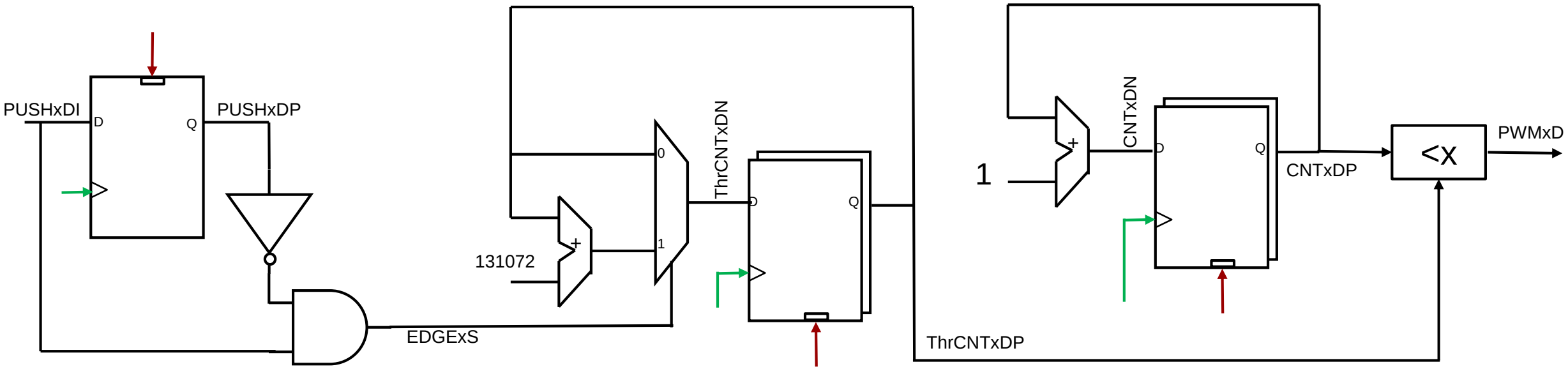
        PushxDP <= PushxDN;
    end if;
end process;

PushxDN <= PushxDI;

EdgexSO <= PushxDN and (not PushxDP);
```

```
-- Threshold generation
process(CLKxCI, RSTxRI)
begin
    if (RSTxRI = '1') then
        ThrCntxDP <= (others=>'0');
    elsif CLKxCI'event and CLKxCI = '1' then
        ThrCntxDP <= ThrCntxDN;
    end if;
end process;

-- 131072 = 2^17, leading to overflow after 8
with EdgexSO select ThrCntxDN <=
    ThrCntxDP + 131072 when '1',
    ThrCntxDP when others;
```



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with EdgexSO select ThrCntxDN <=
    ThrCntxDP + 131072 when '1',
    ThrCntxDP when others;
```

```
-- PWM pulse
process(CLKxCI, RSTxRI)
begin
    if (RSTxRI = '1') then
        PWMCntxDP <= (others=>'0');
    elsif CLKxCI'event and CLKxCI = '1' then
        PWMCntxDP <= PWMCntxDN;
    end if;
end process;

PWMCntxDN <= PWMCntxDP + 1;
PWMxD <= '1' when (PWMCntxDP < ThrCntxDP) else
         '0';
LedxDO <= PWMxD;
```