23+6=29

邏輯設計實驗 Lab11 結報

104060012 邱怡庭

Design Specification:(2/2)
block diagram of the design or Logic Diagram:(8/8)
I/O pin assignment :(2/2)
Discussion +Conclusion:(3/3)
Function explanation:(6/10)

1 LCD display example.

1.1 Follow the lecture. Create the ROM block to … given in the example file "picture.coe". There are … the last 7 are empty. Study the file.

1.2 Integrate the given example files "ct_clkdivid… "lcd_ctrl.v", lcd_display.v", and use the given pin a…ignment file "lcd_display.ucf" to build the whole LCD display example.

1.3 The animation displays 10 pictures repeatedly. Among them, the 10th picture is an empty one. Fix the design to show 9 pictures repeatedly and ignore the 10th picture. Therefore, the result animation will be smoother.

1.4 Modify the design by inserting an additional 2-second delay after showing the last (9th) picture. You should do that by adding one extra state with a pause counter.

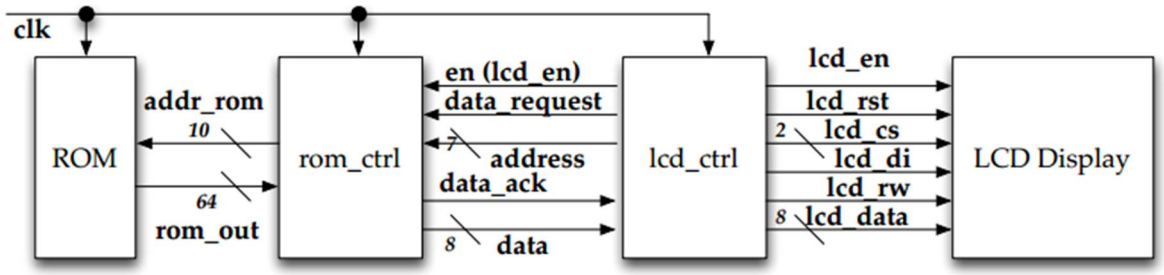
Design Specification

output : lcd_rst; // LCD reset
[1:0] lcd_cs; // LCD frame selection
lcd_rw; // LCD read/write control
lcd_di; // LCD data/instruction
[7:0] lcd_d; // LCD data
lcd_e; // LCD enable
data_ack; //data re-arrangement buffer ready indicator
data_request; // request for the memory data

input : clk, // clock from crystal
rst_n, // active low reset

wire : clk_50k; // Divided 50k clock
clk_d;
[7:0] data; // byte data transfer from buffer
[6:0] addr; // Address for each picture

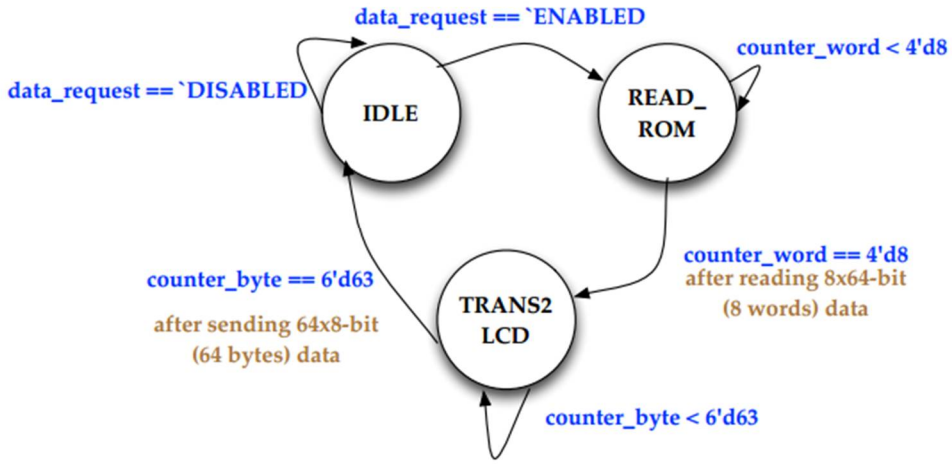
block diagram:



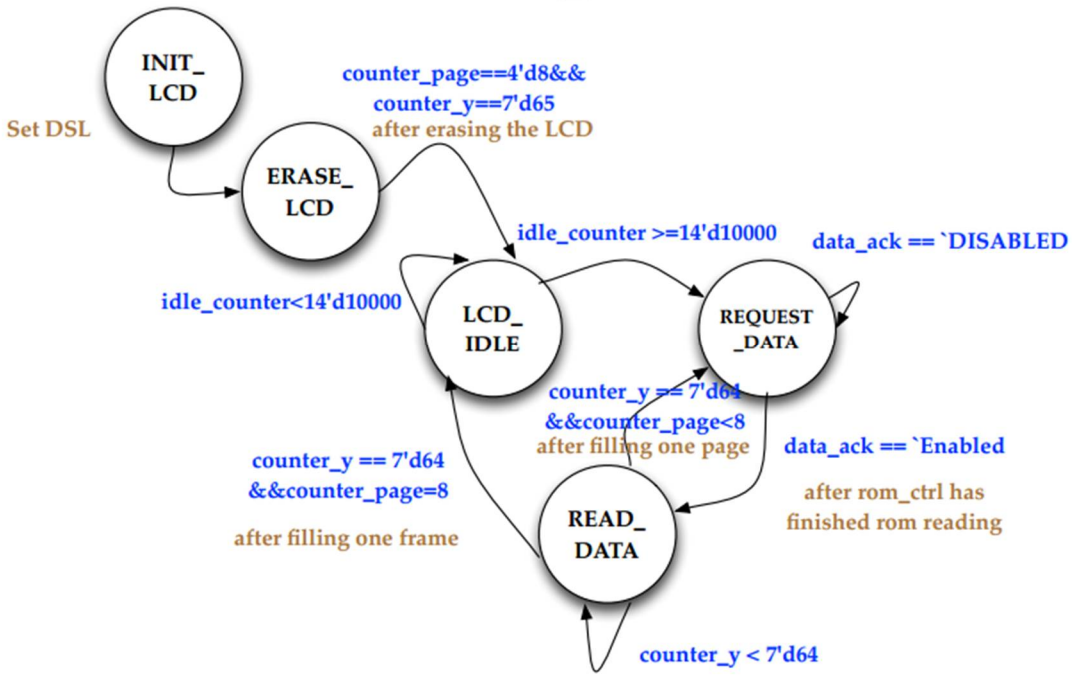
Design Implementation

logic function / logic diagram:

rom_ctl:



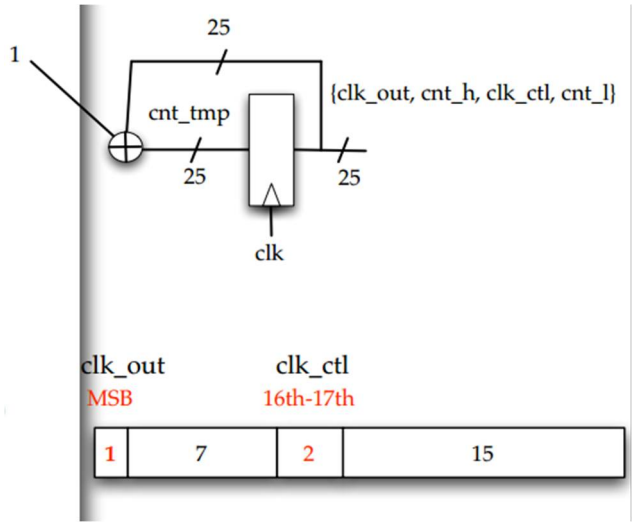
lcd_ctl:



clock_divider:

將 40MHz 的 clk divide 成 50kHz

freq_div:



用 1Hz 控制 lcd_ctl 中 LCD_PAUSE state 的 cnt，使當 LCD 顯示第 8 張圖時，停留兩秒後再返回第一張。

I/O pin assignment:

```
## pin mapping
   NET "clk"    LOC = "R10";
   NET "rst_n"    LOC = "N3";
## LCD control signals
   NET "LCD_RST"    LOC = "E3";
   NET "LCD_CS[1]"    LOC = "E1";
   NET "LCD_CS[0]"    LOC = "F4";
   NET "LCD_D[7]"      LOC = "F3";
   NET "LCD_D[6]"      LOC = "D2";
   NET "LCD_D[5]"      LOC = "D1";
   NET "LCD_D[4]"      LOC = "H7";
   NET "LCD_D[3]"      LOC = "G6";
   NET "LCD_D[2]"      LOC = "E4";
   NET "LCD_D[1]"      LOC = "D3";
   NET "LCD_D[0]"      LOC = "F6";
   NET "LCD_E"    LOC = "F5";
   NET "LCD_RW"    LOC = "C2";
   NET "LCD_DI"    LOC = "C1";
```

NET "data_request" LOC = "H5";
NET "data_ack" LOC = "H6";

Discussion:

設置一 counter 使其自動改變音高並結合 speaker_ctl 和 buzzer_ctl 產生一段旋律。

bonus:2

2 (Bonus) Modify the pictures and put your signature on top of the given animation. You can use the space around. You name can be either English or Chinese.

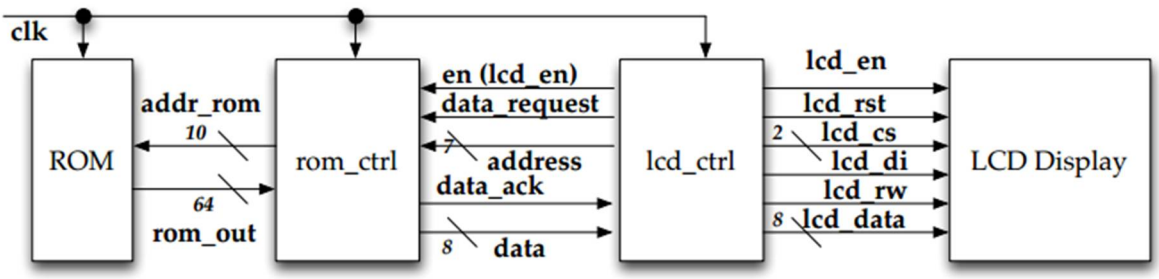
Design Specification

output : lcd_rst; // LCD reset
[1:0] lcd_cs; // LCD frame selection
lcd_rw; // LCD read/write control
lcd_di; // LCD data/instruction
[7:0] lcd_d; // LCD data
lcd_e; // LCD enable
data_ack; //data re-arrangement buffer ready indicator
data_request; // request for the memory data

input : clk, // clock from crystal
rst_n, // active low reset

wire : clk_50k; // Divided 50k clock
clk_d;
[7:0] data; // byte data transfer from buffer
[6:0] addr; // Address for each picture

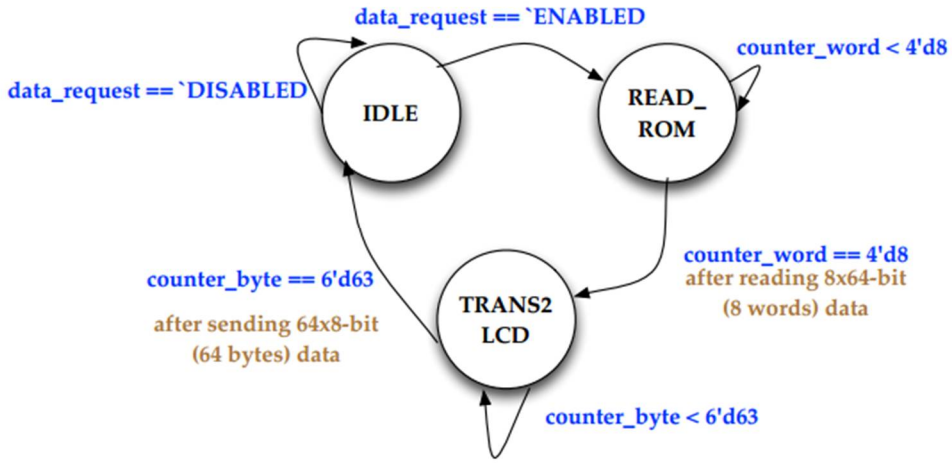
block diagram:



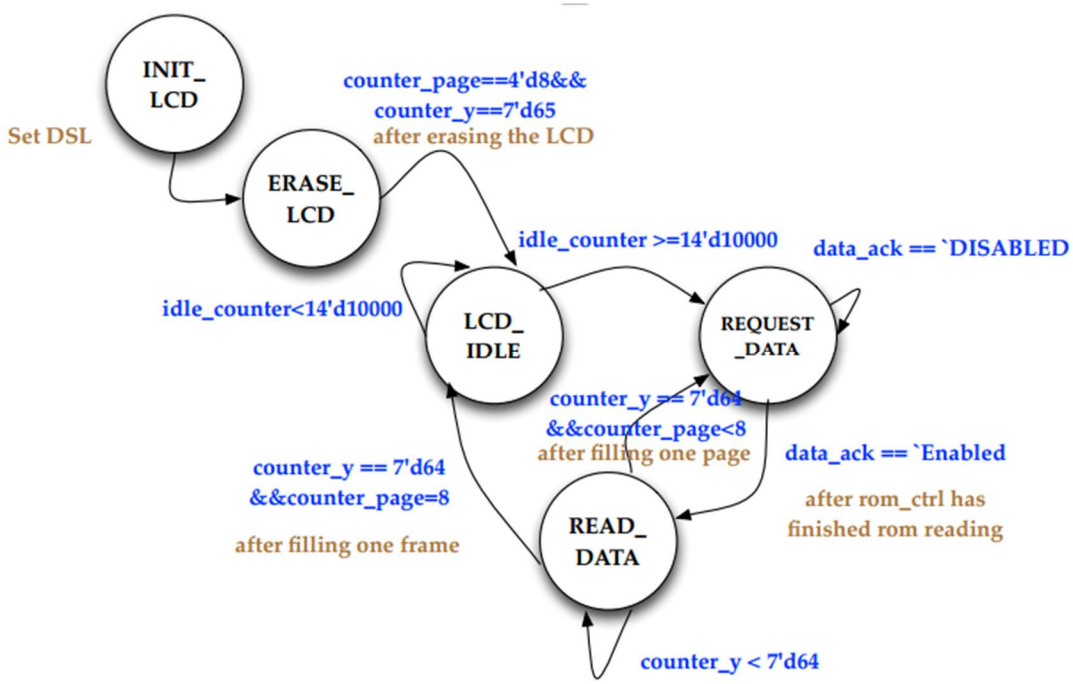
Design Implementation

logic function / logic diagram:

rom_ctl:



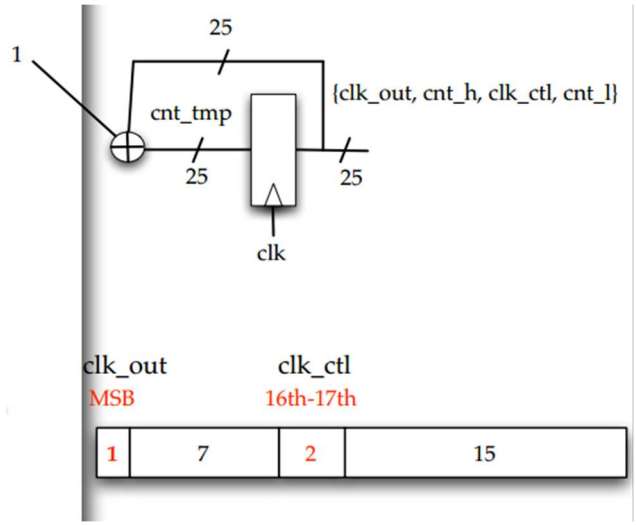
lcd_ctl:



clock_divider:

將 40MHz 的 clk divide 成 50kHz

freq_div:



用 1Hz 控制 lcd_ctl 中 LCD_PAUSE state 的 cnt，使當 LCD 顯示第 8 張圖時，停留兩秒後再返回第一張。

I/O pin assignment:

```
## pin mapping
   NET "clk"    LOC = "R10";
   NET "rst_n"    LOC = "N3";
## LCD control signals
   NET "LCD_RST"    LOC = "E3";
   NET "LCD_CS[1]"    LOC = "E1";
   NET "LCD_CS[0]"    LOC = "F4";
   NET "LCD_D[7]"      LOC = "F3";
   NET "LCD_D[6]"      LOC = "D2";
   NET "LCD_D[5]"      LOC = "D1";
   NET "LCD_D[4]"      LOC = "H7";
   NET "LCD_D[3]"      LOC = "G6";
   NET "LCD_D[2]"      LOC = "E4";
   NET "LCD_D[1]"      LOC = "D3";
   NET "LCD_D[0]"      LOC = "F6";
   NET "LCD_E"    LOC = "F5";
   NET "LCD_RW"    LOC = "C2";
   NET "LCD_DI"    LOC = "C1";
   NET "data_request"    LOC = "H5";
   NET "data_ack"    LOC = "H6";
```

Discussion:

同 lab11_1，利用 notepad 更改 coe 檔的圖。

Conclusion:

利用 ROM 去讀取圖片以顯示在 LCD 上。