**邏輯設計實驗Lab11結報**

**104060012邱怡庭**

**1 LCD display example.**

**1.1 Follow the lecture. Create the ROM block to store the graphs given in the example file “picture.coe”. There are 16 64x64 pictures but the last 7 are empty. Study the file.**

**1.2 Integrate the given example files “ct\_clkdivider.v”, “rom\_ctrl.v”, “lcd\_ctrl.v”, lcd\_display.v”, and use the given pin assignment 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

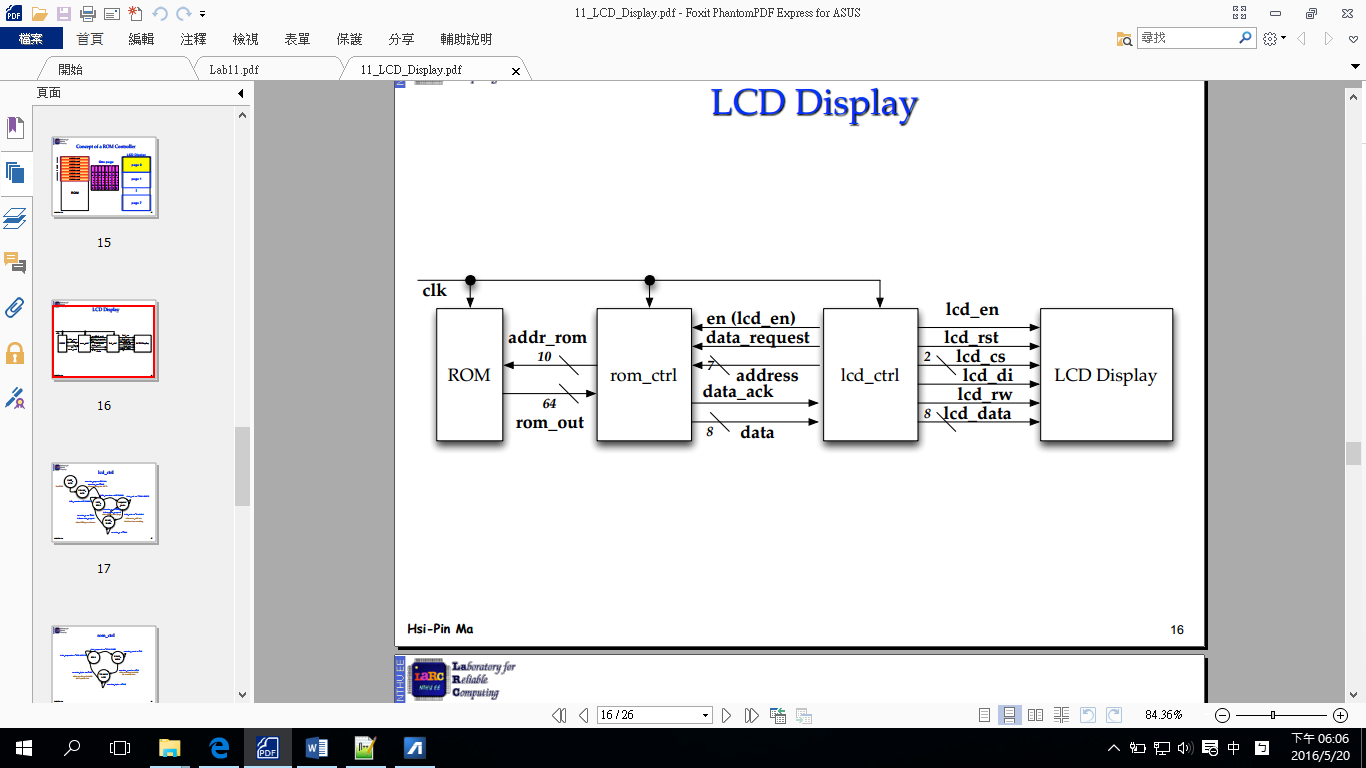
**wire** : clk\_50k; // Divided 50k clock

clk\_d;

[7:0] data; // byte data transfer from buffer

[6:0] addr; // Address for each picture

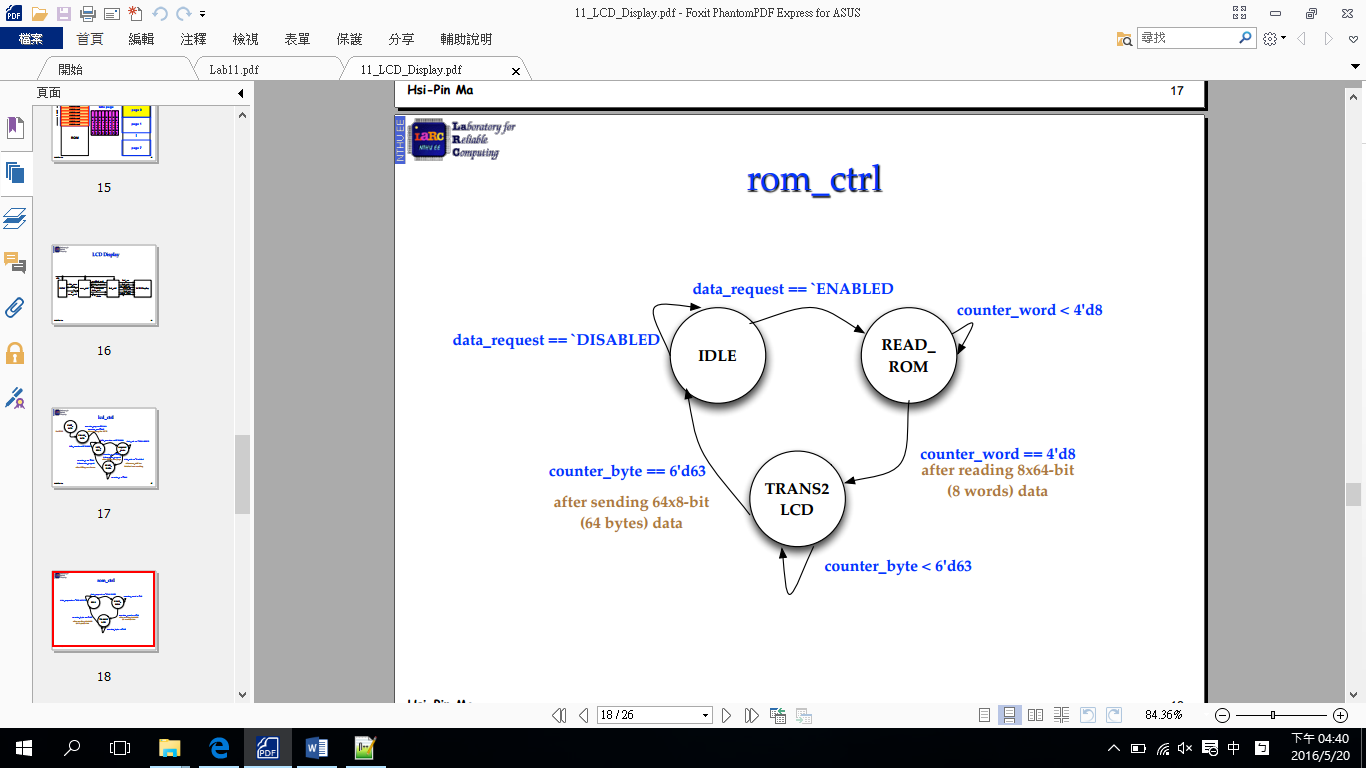
**block diagram:**

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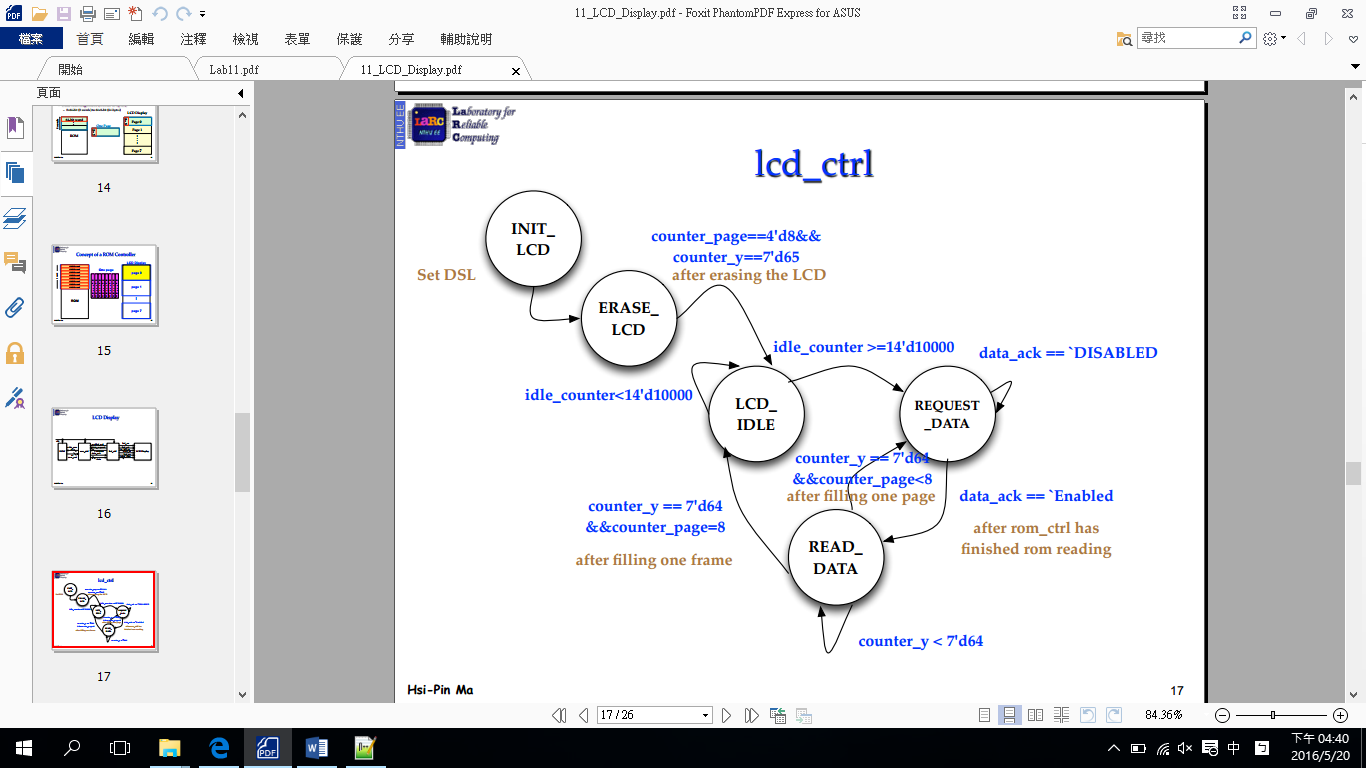
**Design Implementation**

**logic function / logic diagram**:

***rom\_ctl:***



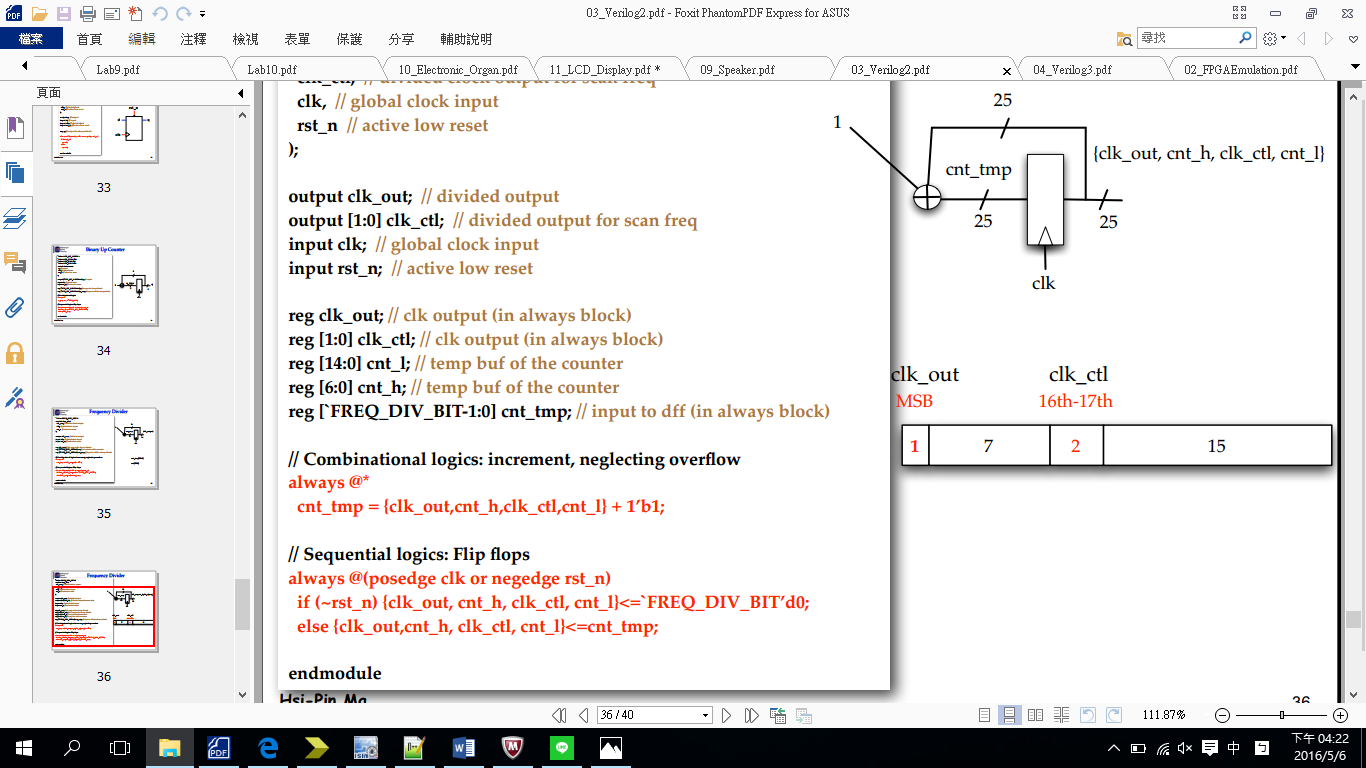
***lcd\_ctl:***

**

***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。

**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.**

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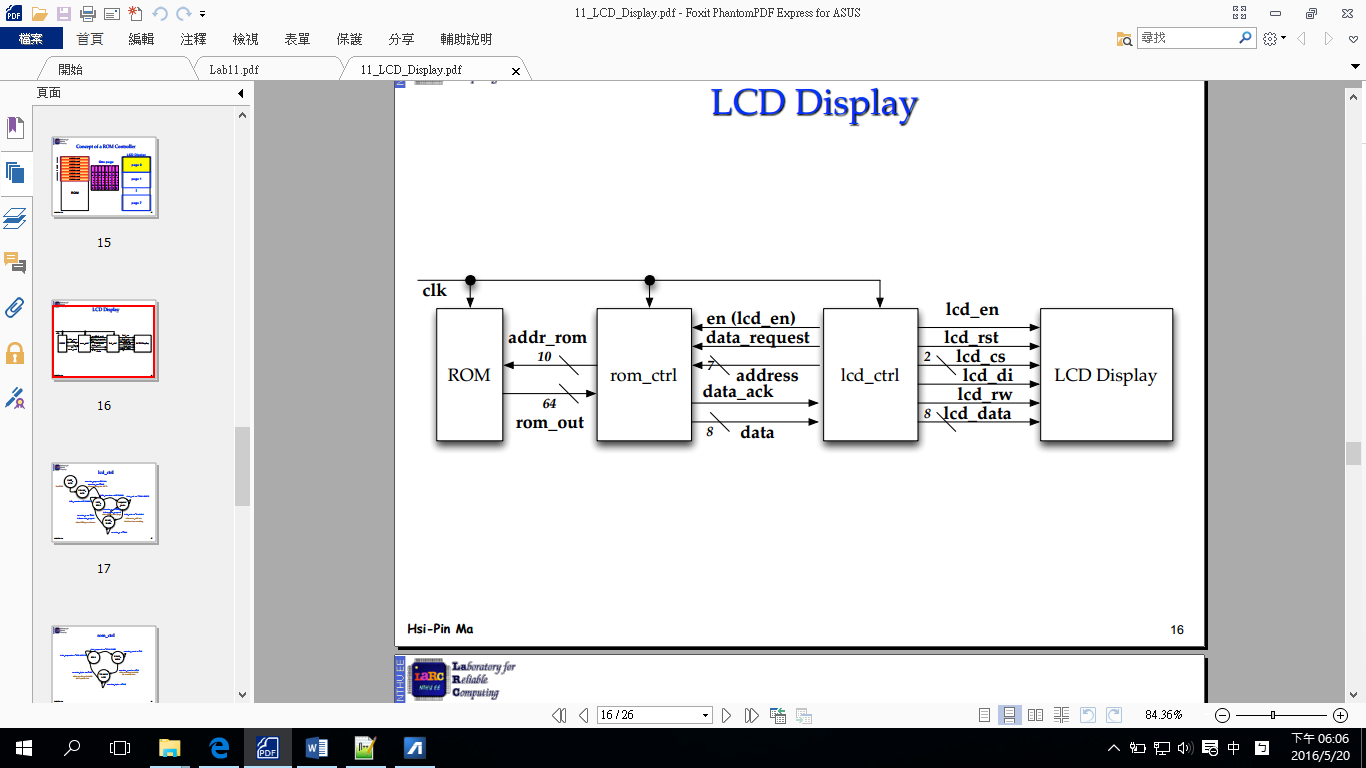
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clk\_d;

[7:0] data; // byte data transfer from buffer

[6:0] addr; // Address for each picture

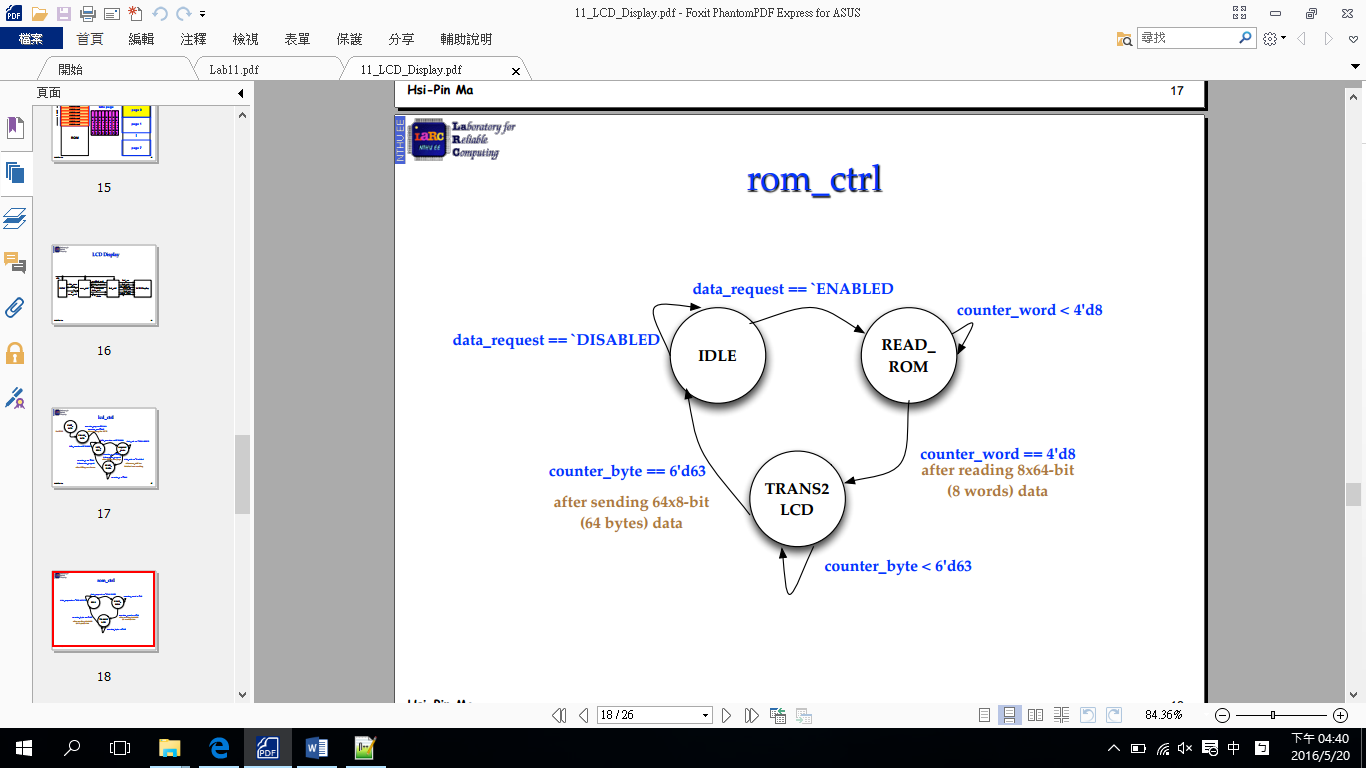
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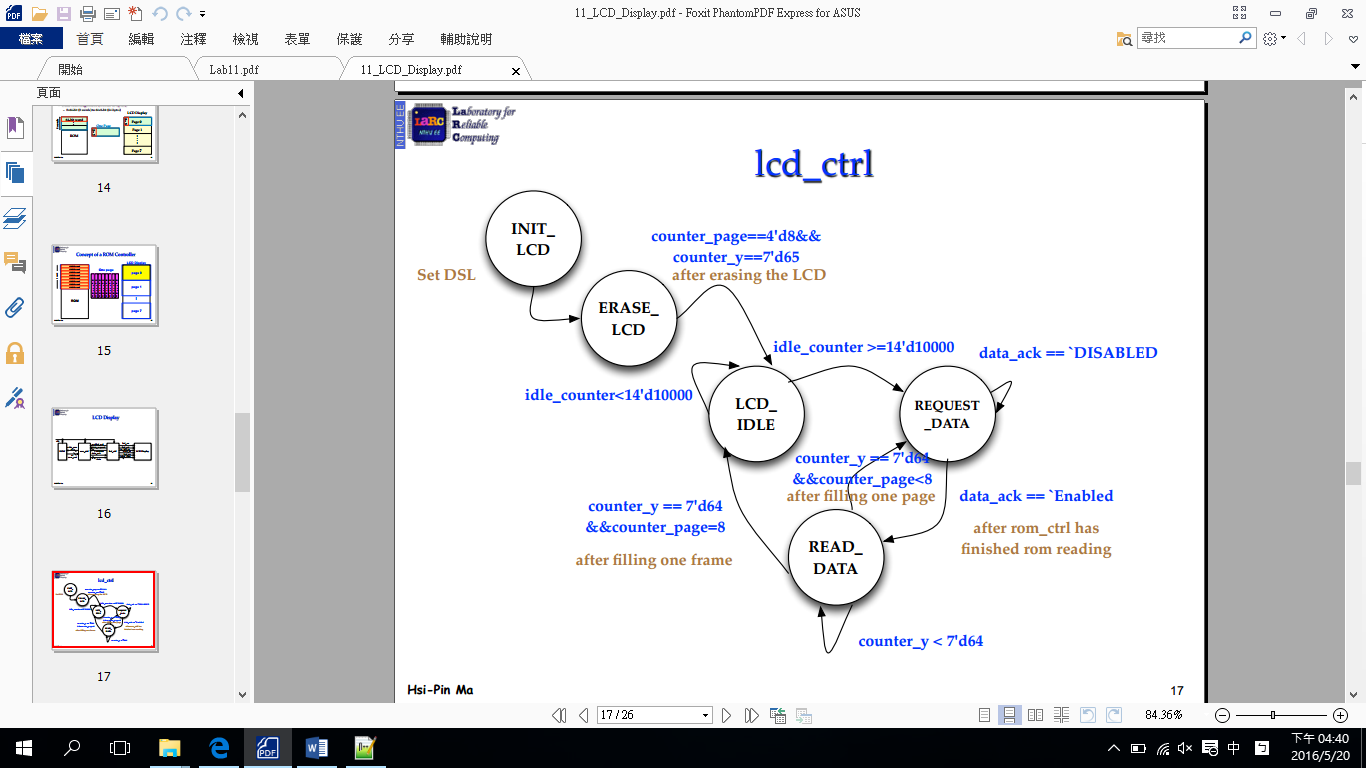
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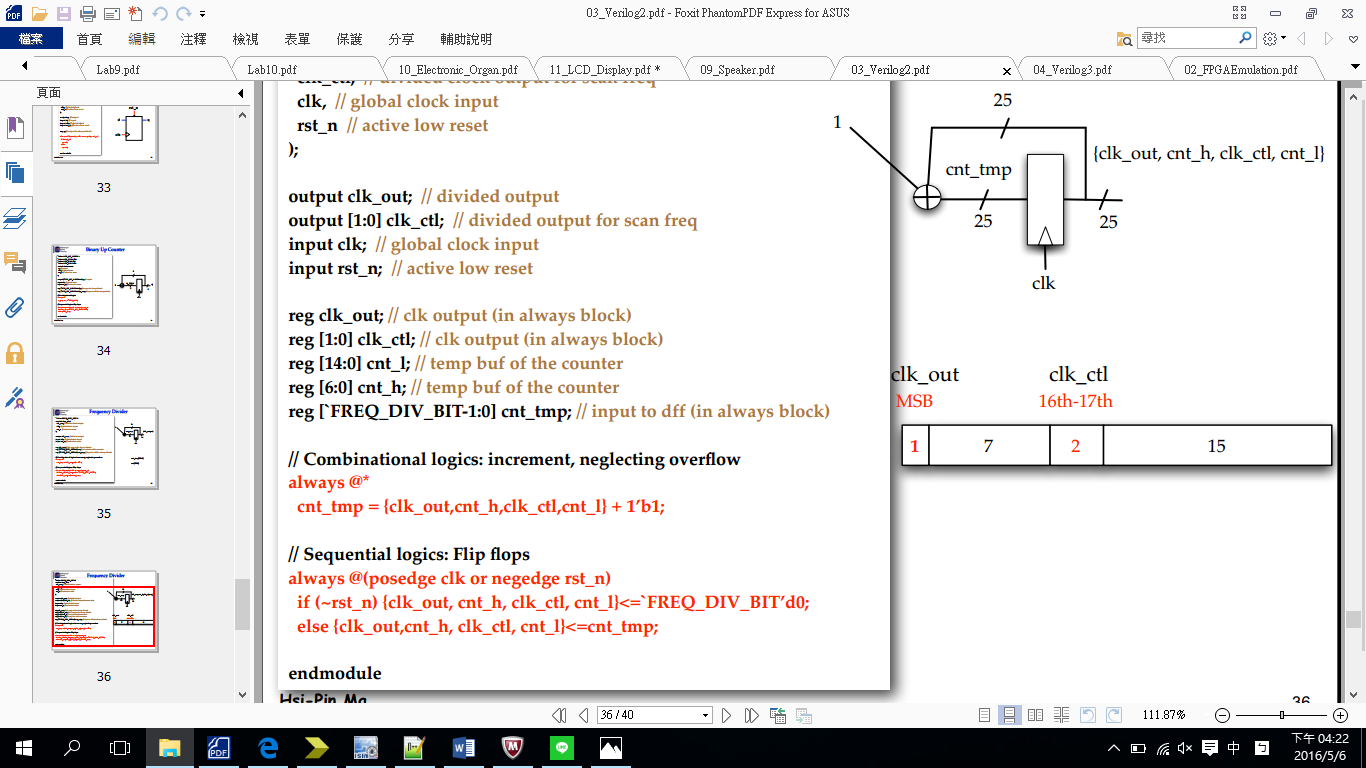
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NET "LCD\_D[0]" LOC = "F6";

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。