Lab06 Final Report

B1029009 簡鈺晴

1. Problem description

• Basic: (40%)◦ “Draw” a still image, such as an apple, a tree, or a smiling face (Do not show meaningless lines, patches, or squares)◦ Hint: find a tool to generate the 128x64 bitmap of your image (Google may help…)
• Advanced:◦ Initialized in the middle of 128x64 panel (+15%)◦ Animation
• Move the pattern horizontally (+20%) [Note: The animation should pass through both panels!]
• Move the pattern vertically (+15%) [Note: the animation should move one pixel up / down at a time!]

2. Code and explanations

First, we create a DVD video image like the picture 1, then use 小畫家 adjust this picture size be 32x32 pixels and change to .bmp file, at last use LCDAssistant transfer to array, we can also seen in picture 3.

Picture 1: DVD image

Picture 2: LCD Assistant can assist .bmp change to array can use on GLCD

```
const unsigned char DVD[2][32] = {
{0x00, 0xF0, 0xFB, 0x3B, 0x83, 0x83, 0x83, 0x83, 0xE7, 0x7F, 0x3F, 0x03, 0x07, 0x7F, 0xF8, 0xC0,
0xC0, 0x70, 0x1C, 0x0E, 0x07, 0xC3, 0xFB, 0x7B, 0x03, 0x03, 0x83, 0x83, 0xC6, 0x7E, 0x3C, 0x00 },
{0x00, 0x21, 0x31, 0x71, 0x71, 0x51, 0x50, 0x50, 0x58, 0x58, 0x48, 0x78, 0xC8, 0xC8, 0xCB, 0x89,
0x88, 0xC8, 0xC8, 0xC8, 0x78, 0x49, 0x59, 0x59, 0x59, 0x51, 0x51, 0x50, 0x70, 0x30, 0x20, 0x00 }
};
```

Picture 3: the array of DVD image

- Basic + Bonus 1: initialize image at the middle of the GLCD

  When get the array, we should do some action in GLCD, like we need to set the left/right page, and then deal with how to display the image on GLCD. So we first initialize GLCD, and start draw the right side of GLCD and set Display on to change the left/right page which is define on glcd.h can see right = 0x21 and left =0x22 (CS1/CS2-right:0/1 and CS1/CS2-left:1/0) and we will use mode control. At last, use x++ change the page of Y.

```
#define P2_CWORD_TEMPLATE_RIGHT 0x21
#define P2_CWORD_TEMPLATE_LEFT  0x22
```

Picture 4: Left/Right Control Setting

```
void
Set_DisplayOn (int mode)
{
    char P2_cword, P4_cword;

    ///prepare control words
    //right
    if (mode == 0)
        P2_cword = P2_CWORD_TEMPLATE_RIGHT;
    //left
    else
        P2_cword = P2_CWORD_TEMPLATE_LEFT;
    P2_cword = P2_cword & (~P2_RS);      //set RS bit
    P2_cword = P2_cword & (~P2_RW);      //clear RW bit
    P4_cword = P4_Set_Display_TMPL;
    P4_cword = P4_cword | P4_Display_On;    //set display ON bit

    ///flush out control signals
    while (GLCD_IsBusy());
    GLCD_Write (P2_cword, P4_cword);
}//end of function Set_DisplayOn
```

Picture 5: use mode to change left/right page

Instruction	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function
Display on/off	L	L	L	L	H	H	H	H	H	L/H	Controls the display on or off. Internal status and display RAM data is not affected. L:OFF, H:ON
Set address (Y address)	L	L	L	H	Y address (0-63)						Sets the Y address in the Y address counter.
Set page (X address)	L	L	H	L	H	H	H	Page (0-7)			Sets the X address at the X address register.
Display Start line (Z address)	L	L	H	H	Display start line (0-63)						Indicates the display data RAM displayed at the top of the screen.
Status read	L	H	Busy	L	On/ Off	Reset	L	L	L	L	Read status. BUSY L: Ready H: In operation ON/OFF L: Display ON H: Display OFF RESET L: Normal H: Reset
Write display data	H	L	Write data								Writes data (DB0: 7) into display data RAM. After writing instruction, Y address is increased by 1 automatically.
Read display data	H	H	Read data								Reads data (DB0: 7) from display data RAM to the data bus.

Picture 6: Display on Setting in Commend

```
main ()
{
    system_init_config ();

    GLCD_Reset ();

    //draw right
    mode = 0;
    Set_DisplayOn (mode);
    draw(mode);

    //draw left
    mode = 1;
    Set_DisplayOn (mode);
    draw(mode);

    while (1);
}//end of function main
```

```
void draw(int mode) //mode 0 right, 1 left
{
    int i, x;
    Set_DisplayStartLine (0);
    Set_Yaddr (0);
    x = 0;
    Set_Xaddr (x);
    if (!mode) { //draw right
        for (i=16;i<32;i++)
            Send_Data (DVD[x][i]);
    }
    for (i = 16; i < 64; i++)
        Send_Data (0x00);
    if (mode) { //draw left
        for (i=0;i<16;i++)
            Send_Data (DVD[x][i]);
    }

    Set_Xaddr (++x);
    if (!mode) { //draw right
        for (i=16;i<32;i++)
            Send_Data (DVD[x][i]);
    }
    for (i = 16; i < 64; i++)
        Send_Data (0x00);
    if (mode) { //draw left
        for (i=0;i<16;i++)
            Send_Data (DVD[x][i]);
    }
```

Picture 7: main function is control left/right page & draw function follow the main function of control signal to draw the image.

- Bouns2: Move the pattern horizontally + Bonus 3: Move the pattern vertically

Basically, let GLCD be clean and set x =32, y =48 which is at the middle of the screen. And set bound to let the DVD won't disappear. And move_DVD function is that DVD will move by itself. At last, we need to calculate if DVD need to change to right/left page for example x = 33 then we need to let 1 pixel to right page and also use DisplayStartLine to change the y value.

```
main ()
{
    system_init_config ();

    GLCD_Reset ();
    mode = 0;
    GLCD_Clean();
    mode = 1;
    GLCD_Clean();

    P1 = 0x00;
    z_cur = 32;
    y_cur = 48;
    while(1){

        if (z_cur == 16 || z_cur == 63) x_move = (x_move) ? 0 : 1;
        if (y_cur == 0 || y_cur == 97) y_move = (y_move) ? 0 : 1;

        move_DVD(x_move, y_move);

        //draw right
        mode = 0;
        Set_DisplayOn (mode);
        draw(mode, z_cur, y_cur);

        //draw left
        mode = 1;
        Set_DisplayOn (mode);
        draw(mode, z_cur, y_cur);

        GLCD_delay();
    }
}//end of function main
```

```
void draw(int mode, int z_in, int y_in) //mode 0 right, 1 left
{
    int i, x;
    Set_DisplayStartLine (z_in);

    for (x = 0; x < 2; x++) {
        Set_Xaddr (x);

        if (mode && y_in < 64) { //draw left
            Set_Yaddr (y_in);
            for (i=0;i < ((y_in > 32) ? 64 - y_in : 32);i++)
                Send_Data (DVD[x][i]);
        }

        if (!mode && y_in > 32) { //draw right
            Set_Yaddr((y_in < 64)? 0: y_in-64);
            for (i = ((y_in > 63) ? 0 : 64 - y_in);i < 32;i++)
                Send_Data (DVD[x][i]);
        }
    }
}

void move_DVD(int x, int y) {
    (x) ? z_cur-- : z_cur++;
    (y) ? y_cur-- : y_cur++;
    GLCD_delay();
}
```

3. Difficulties you've encountered and your solutions

(1) DVD image cannot transfer to correct image

At the begin we need to change image to array, but always look like fill with 0xff using online bmp transfer. So we look for another tool to transfer and find the suitable size let DVD can display on GLCD normally.

(2) Find how to change the left/right page

We need to display the image on the middle of the screen, and we find that when image display on left side is 0x22(CS1/CS2:1/0) , so right = 0x21 (CS1/CS2:0/1).

(3) How to move in the x dimension of GLCD

If want to move DVD in GLCD, expect for at the start we want to do is calculate the page and let it move, but when we study at the Lab6 ppt find that can use DisplayStartLine this function to move the DVD.

(4) Error at move left/right when change the page

We find that when we change the page and it will have one pixel didn't clean after go right and return back, because it don't clean well, so we let DVD last pixel be 0x00 to solve this problem.