Introduction to Embedded System Design

Lab Report

- Lab date： 2023-5-3 (year-month-day)
- Group number：
- Group members: (student ID) (name)

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1. Lab Title:

打地鼠

2. Lab Goal:

結合 LED 、LCD 、七段顯示器和蜂鳴器，讓使用者玩打地鼠遊戲。

3. Lab Description and Steps:

1.首先當使用者按下 reset，LCD 會顯示出 game cover 。

2.開始後，LCD 會顯示出九宮格，在九宮格裡會隨機出現地鼠，LED 燈會亮四顆，代表有四條命。

3.玩家可以藉由 Keypad 來打地鼠，例如地鼠出現在左上角，可以按下 1 ，如果有打到，蜂鳴器會響一聲。

4.每打到一次，蜂鳴器會響一聲，七段顯示器上的數字會加一，當玩家分數越高，地鼠出現的速度會越來越快，如果沒打到，LED 燈會由右至左熄滅一顆，直到所有的 LED 燈熄滅即代表遊戲結束。

5.當遊戲結束後，LCD 會顯示玩家的分數。

6.按下 reset 可以重新開始遊戲。

4. Code:

```
#include <stdio.h>
#include <stdlib.h>
#include "NUC100Series.h"
#include "MCU_init.h"
#include "SYS_init.h"
#include "LCD.h"
#include "Draw2D.h"
#include "Seven_Segment.h"
#include "Scankey.h"

#define    DELAY_TIME 500000

unsigned char DrawBuffer[128*8]; // display buffer

unsigned char bmp_mouse[16] = {
0x00,0x70,0x18,0x7D,0x36,0x34,0x3C,0x3C,0x3C,0x3C,0x34,0x36,0x7D,0x18,0x70,0x00};

unsigned char cover[128*8] = {
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
```

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x80,0xC0,0x60,0x20,0x30,0x10,0x10,0x18,0x08,0x08,0x08,
0x08,0x08,0x08,0x08,0x18,0x10,0x10,0x30,0x20,0x60,0xC0,0x80,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0xC0,
0x70,0x1C,0x06,0x03,0x01,0x00,0x40,0x40,0xC0,0x80,0x80,0x80,0x00,0x00,0x00
,0x00,0x00,0x00,0x00,0x80,0x80,0x80,0xC0,0x40,0x40,0x00,0x01,0x03,0x06,0x1
C,0x70,0xC0,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x
00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x
00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x
00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0xF0,0x1F,0x01,
0x00,0x00,0x00,0x00,0x00,0x00,0x08,0x08,0x08,0x38,0x28,0x38,0x00,0x00,0xC0,
0x40,0xC0,0x00,0x00,0x38,0x28,0x38,0x08,0x08,0x08,0x00,0x00,0x00,0x00,0x00,
0x00,0x01,0x1F,0xF0,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x3F,0x20,0x20,0x20,0x20,0x20,0x25,0x25,0x25,0x20,0x20,0x20,0x20,0x20,0x2C,0x26,0x3F,0x31,0x3F,0x31,0x3F,0x26,0x2C,0x20,0x20,0x20,0x20,0x20,0x25,0x25,0x25,0x20,0x20,0x20,0x20,0x20,0x3F,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x20,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x80,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x80,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x80,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x07,0x3C,0xC0,0xF0,0x0E,0x07,0x3C,0xC0,0xF0,0x0F,0x01,0x00,0xFF,0x04,0x04,0x0C,0xF8,0x00,0x60,0x94,0x94,0x94,0xF8,0x00,0x30,0x48,0x84,0x84,0x84,0x00,0x00,0xFF,0x30,0x48,0x84,0x84,0x00,0x10,0x10,0x10,0x00,0x60,0x94,0x94,0x94,0xF8,0x00,0x00,0x10,0x10,0x10,0x00,0x00,0xFC,0x04,0x04,0xFC,0x08,0x04,0x04,0xF8,0x00,0x30,0xCC,0x84,0x84,0x84,0x78,0x00,0x00,0xFF,0x00,0x70,0xDC,0x94,0x94,0x98,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,

```
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00,
0x00,0x00,0x00,0x00,0x00,0x00,0x00,0x00
};


void displayRound(uint16_t round)
{
uint8_t digit;
uint16_t tmp=round;
digit = round / 1000;
CloseSevenSegment();
if(digit!=0) ShowSevenSegment(3,digit);
CLK_SysTickDelay(5000);


round = round - digit * 1000;
digit = round / 100;
CloseSevenSegment();
if(digit!=0) ShowSevenSegment(2,digit);
CLK_SysTickDelay(5000);
```

```
round = round - digit * 100;
digit = round / 10;
CloseSevenSegment();
if(digit!=0) ShowSevenSegment(1,digit);
CLK_SysTickDelay(5000);

round = round - digit * 10;
digit = round;
CloseSevenSegment();
if(digit!=0) ShowSevenSegment(0,digit);
CLK_SysTickDelay(5000);

displayRound((tmp*10)%10000);
}

void Display_7seg(uint16_t value)
{
uint8_t digit;
digit = value / 1000;
CloseSevenSegment();
ShowSevenSegment(3,digit);
CLK_SysTickDelay(1500);

value = value - digit * 1000;
```

```
digit = value / 100;
CloseSevenSegment();
ShowSevenSegment(2,digit);
CLK_SysTickDelay(1500);

value = value - digit * 100;
digit = value / 10;
CloseSevenSegment();
ShowSevenSegment(1,digit);
CLK_SysTickDelay(1500);

value = value - digit * 10;
digit = value;
CloseSevenSegment();
ShowSevenSegment(0,digit);
CLK_SysTickDelay(1500);
CloseSevenSegment();
}

void Display_7(uint8_t digit)
{
CloseSevenSegment();
ShowSevenSegment(0,digit);
}
```

```
void Buzz(int8_t no)
{
while(no!=0) {
PB11=0;
CLK_SysTickDelay(50000);
PB11=1;
CLK_SysTickDelay(50000);
no--;
}
}

void Init_Buzz(void)
{
GPIO_SetMode(PB, BIT11, GPIO_PMD_OUTPUT);
PB11=1;
}

int main(void)
{
uint8_t i,j, keyin, life;
int count;
long int delay = DELAY_TIME;
char text[25];
```

```
SYS_Init();
init_LCD();
clear_LCD();
OpenSevenSegment();
OpenKeyPad();
GPIO_SetMode(PC, BIT12, GPIO_MODE_OUTPUT);
Init_Buzz();
draw_LCD(cover);
for (i=0;i<4;i++) CLK_SysTickDelay(1000000);
clear_LCD();

count=0, life=4;
while(1) {
i = rand() % 9 + 1;
if( count>0 &&(count/10>(count-1)/10)) delay = delay/2;
draw_Line(24,20,101,20,FG_COLOR, BG_COLOR);    // draw a line
draw_Line(24,41,101,41,FG_COLOR, BG_COLOR);    // draw a line
draw_Line(50,0,50,63,FG_COLOR, BG_COLOR);    // draw a line
draw_Line(76,0,76,63,FG_COLOR, BG_COLOR);    // draw a line
draw_Line(24,0,101,0,FG_COLOR, BG_COLOR);    // draw a line
draw_Line(24,63,101,63,FG_COLOR, BG_COLOR);    // draw a line
draw_Line(24,0,24,63,FG_COLOR, BG_COLOR);    // draw a line
draw_Line(101,0,101,63,FG_COLOR, BG_COLOR);    // draw a line
switch(i) {
```

```
case 1: draw_Bmp16x8(30, 8,FG_COLOR,BG_COLOR, bmp_mouse);
break;
case 2: draw_Bmp16x8(56, 8,FG_COLOR,BG_COLOR, bmp_mouse);
break;
case 3: draw_Bmp16x8(82, 8,FG_COLOR,BG_COLOR, bmp_mouse);
break;
case 4: draw_Bmp16x8(30, 28,FG_COLOR,BG_COLOR, bmp_mouse);
break;
case 5: draw_Bmp16x8(56, 28,FG_COLOR,BG_COLOR, bmp_mouse);
break;
case 6: draw_Bmp16x8(82, 28,FG_COLOR,BG_COLOR, bmp_mouse);
break;
case 7: draw_Bmp16x8(30, 49,FG_COLOR,BG_COLOR, bmp_mouse);
break;
case 8: draw_Bmp16x8(56, 49,FG_COLOR,BG_COLOR, bmp_mouse);
break;
case 9: draw_Bmp16x8(82, 49,FG_COLOR,BG_COLOR, bmp_mouse);
break;
default:break;
}
for(j=0;j<3;j++)
{
CLK_SysTickDelay(delay);
keyin=ScanKey();
```

```
if(keyin==i)
{
count++;
Buzz(1);
break;
}
}
if(keyin!=i)
life--;
switch(life) {
case 1:
PC12 = 0;
PC13 = PC14 = PC15 = 1;
break;
case 2:
PC12 = PC13 = 0;
PC14 = PC15 = 1;
break;
case 3:
PC12 = PC13 = PC14 = 0;
PC15 = 1;
break;
case 4:
PC12 = PC13 = PC14 = PC15 = 0;
```

```
break;
default:
PC12 = PC13 = PC14 = PC15 = 1;
break;
}
if(life==0) break;
switch(i) {
case 1: draw_Bmp16x8(30, 8,BG_COLOR,FG_COLOR, bmp_mouse);
break;
case 2: draw_Bmp16x8(56, 8,BG_COLOR,FG_COLOR, bmp_mouse);
break;
case 3: draw_Bmp16x8(82, 8,BG_COLOR,FG_COLOR, bmp_mouse);
break;
case 4: draw_Bmp16x8(30, 28,BG_COLOR,FG_COLOR, bmp_mouse);
break;
case 5: draw_Bmp16x8(56, 28,BG_COLOR,FG_COLOR, bmp_mouse);
break;
case 6: draw_Bmp16x8(82, 28,BG_COLOR,FG_COLOR, bmp_mouse);
break;
case 7: draw_Bmp16x8(30, 49,BG_COLOR,FG_COLOR, bmp_mouse);
break;
case 8: draw_Bmp16x8(56, 49,BG_COLOR,FG_COLOR, bmp_mouse);
break;
case 9: draw_Bmp16x8(82, 49,BG_COLOR,FG_COLOR, bmp_mouse);
```

```
break;
default:break;
}
for(j = 0; j < 125; j++)
Display_7seg(count);
}
PB11=1;
clear_LCD();
sprintf(text,"FINAL SCORE: %3d",count);
printS(1, 30, text);
return 0;
}
```

5. Lessons:

我們原本是想做飛機大戰，但後來實作的過程中發現有點困難，會因為上方的分數條而影響飛機的移動，最後決定改做打地鼠，這次把開發板上我們有學過的都結合起來，顯得豐富且完整一點。