微處理機系統實習　　Lab4

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一、【實驗目的】：

此次實驗實作了 7-Segment Display、Keypad、RGB 等設備邏輯，透過程式編寫完成系統的設計和效果。

二、【遭遇的問題】：

沒有問題。

三、【解決方法】：

Lab4.1

- 鍵盤輸入一組三位數 (輸入超過三個數字的話只顯示最新的三位數)
- 7-segment 由右到左逐一顯示所輸入數字(數字範圍 1~6),
- 按 → 鍵, 這個三位數以 0.3 秒速度連續右旋轉, 此時 RGB LED 也跟著以 Red-Green-Blue 順序變換顏色 (輸入未滿三位數的話, 按此鍵無效)
- 按 ← 鍵, 這個三位數以 0.3 秒速度連續左旋轉, 此時 RGB LED 也跟著以 Red-Green-Blue 順序變換顏色 (輸入未滿三位數的話, 按此鍵無效)
- 按 C(Clear) 鍵, 7-segment 全暗, 重新開始

```c
#include <stdio.h>
#include <stdlib.h>
#include <stdbool.h>
#include <string.h>
#include "NUC100Series.h"
#include "MCU_init.h"
#include "SYS_init.h"
#include "Scankey.h"
#include "Seven_Segment.h"
#define DELAY (int)(1e5 - 6000)
#define Loop (int)(1000)

int digit[5] = {0}; // from left to right
int rgb[3] = {0, 1, 1};
int digit_len = 1;
int rotate = -1;
int i, j, rgb_idx = 0;
int loop = 0;
bool rgb_play = false;

void Init_GPIO(void)
{
    GPIO_SetMode(PA, BIT12, GPIO_MODE_OUTPUT);
    GPIO_SetMode(PA, BIT13, GPIO_MODE_OUTPUT);
    GPIO_SetMode(PA, BIT14, GPIO_MODE_OUTPUT);
    PA12= PA13 = PA14 = 1;
    loop = 0;
}


// display an integer on four 7-segment LEDs
void Display_7seg()
{
    // 3 2 1 0
    for(i = 0, j = 2; i < 3; i++, j--) {
        CloseSevenSegment();
        if( digit[i] != 0 ) {
            ShowSevenSegment(j, digit[i]);
        }
        CLK_SysTickDelay(2000);
    }
  return;
}

void Display_RGB() {
    for(i = 0; i < 3; i++) rgb[i] = 1;
    rgb[rgb_idx] = 0;
    rgb_idx = ( rgb_idx + 1 ) % 3;
    PA12 = rgb[0];
    PA13 = rgb[1];
    PA14 = rgb[2];
    return;
}
```

```
void rotate_left( ) {

    int tmp[3];
    tmp[0] = digit[1];
    tmp[1] = digit[2];
    tmp[2] = digit[0];
    for(i = 0; i < 3; i++) digit[i] = tmp[i];
    // RGB switch
    return;
}

void rotate_right( ) {
    int tmp[3];
    tmp[0] = digit[2];
    tmp[1] = digit[0];
    tmp[2] = digit[1];
    for(i = 0; i < 3; i++) digit[i] = tmp[i];
    // RGB switch
    return;
}


void solve(int num) {
    if ( num == 7 ) {
        rotate = 1;
        rgb_play = true;
        return;
    } else if( num == 8 ) {
        rotate = -1;
        rgb_play = false;
        PA12 = PA13 = PA14 = 1;
        memset(digit, 0, sizeof(digit));
        digit_len = 1;
        return;
    } else if ( num == 9 ) {
        rotate = 2;
        rgb_play = true;
        return;
    }

    for(i = 0; i < digit_len; i++) {
        digit[i] = digit[i + 1];
    }
    digit[2] = num;
    digit_len++;
    return;
}
```

```c
void effect() {
    if( (Loop * loop) % DELAY == 0 ) {
        if ( rotate == 1 ) {
            rotate_left();
        } else if( rotate == 2 ) {
            rotate_right();
        } if( rgb_play ) {
            Display_RGB(); // RGB effect.
        }
    }

    Display_7seg();

    return;
}


int main(void)
{
    int keyin = 0;
    bool keyPressed = false;
    SYS_Init();
    Init_GPIO();
    OpenKeyPad();
    OpenSevenSegment();

    while(1)
    {
        // handle 7-segmeng and RGB effect..
        effect();
        keyin = ScanKey();
        CLK_SysTickDelay(Loop);
        loop++;


        if( keyin == 0 ) {
            keyPressed = false;
            continue;
        }

        if(keyPressed) {
            continue;
        }

        keyPressed = true;
        solve(keyin);
    }

    return 0;
}
```

Lab4.2

- 按下 R 鍵, random 產生一組四位數 (每個數字範圍 1~9), 並顯示在 7-segment.
  - 左邊兩個數字代表 A, 右邊兩個數字代表 B
  - 如果 A 跟 B 相同, 則重按 R 鍵
- 按下 1 鍵, 計算 A+B, 並顯示在 7-segment (最多為三位數, 千/百/十位數可以顯示 0).
- 按下 2 鍵, 計算 A-B,
  - 如果 A-B 為正, 7-segment 顯示 A-B 的結果.
  - 如果 A-B 為負, 7-segment 顯示 |A-B|的結果, 並且 嗶 兩聲.
- 按下 C(Clear) 鍵, 7-segment 全暗, 重新開始

```c
#include <stdio.h>
#include <stdlib.h>
#include <stdbool.h>
#include <string.h>
#include <math.h>
#include "NUC100Series.h"
#include "MCU_init.h"
#include "SYS_init.h"
#include "Scankey.h"
#include "Seven_Segment.h"
#define DELAY (int)(1e5 - 6000)
#define Loop (int)(1000)

int digit[4] = {-1, -1, -1, -1};
int num1[2] = {0};
int num2[2] = {0};
int i, j;
int loop = 0;
long long seed = 0;

void Buzz(int number)
{
    int i;
    for (i=0; i<number; i++) {
     PB11=0; // PB11 = 0 to turn on Buzzer
      CLK_SysTickDelay(50000);     // Delay
      PB11=1; // PB11 = 1 to turn off Buzzer
      CLK_SysTickDelay(50000);     // Delay
    }
}
```

```c
// display an integer on four 7-segment LEDs
void Display_7seg()
{
    // 3 2 1 0
    for(i = 0, j = 3; i < 4; i++, j--) {
        CloseSevenSegment();
        if( digit[i] != -1 ) {
            ShowSevenSegment(j, digit[i]);
        }
        CLK_SysTickDelay(2000);
    }
  return;
}

void add() {
    int result = num1[0] * 10 + num1[1] + num2[0] * 10 + num2[1];
    memset(digit, -1, sizeof( digit ));
    if( result / 100 != 0 ) {
        digit[1] = result / 100;
        result /= 10;
    }
    if( !(result / 10 == 0 && digit[1] == -1)) {
        digit[2] = result / 10;
    }
    digit[3] = result % 10;
    return;
}

void sub() {
    int result = (num1[0] * 10 + num1[1]) - (num2[0] * 10 + num2[1]);

    if( result < 0 ) {
        Buzz(2);
    }

    result = abs(result);
    memset(digit, -1, sizeof(digit));
    if( result / 10 != 0 ) digit[2] = result / 10;
    digit[3] = result % 10;
    return;
}

void generate() {
    int n1, n2;
    n1 = rand() % 100;
    seed &= 1;
    n2 = rand() % 100;
    num1[0] = n1 / 10;
    num1[1] = n1 % 10;
    num2[0] = n2 / 10;
    num2[1] = n2 % 10;
    digit[0] = num1[0]; digit[1] = num1[1]; digit[2] = num2[0]; digit[3] = num2[1];
    return;
}
```

```
void clearAll() {
    memset(digit, -1, sizeof(digit));
    memset(num1, -1, sizeof(num1));
    memset(num2, -1, sizeof(num2));
    return;
}


void solve(int num) {
    if( num == 1 ) {
        add();
    } else if ( num == 2 ) {
        sub();
    } else if(  num == 8 ) {
        clearAll();
    } else if ( num == 9 ) {
        clearAll();
        generate();
    }
    return;
}


signed main(void)
{
    int keyin = 0;
    bool keyPressed = false;
    SYS_Init();
    OpenKeyPad();
    OpenSevenSegment();

    while(1)
    {
        // handle 7-segmeng and RGB effect..
        Display_7seg();
        keyin = ScanKey();
        loop++;
        seed++;
        seed %= (long long)1e18;
        srand(seed);

        if( keyin == 0 ) {
            keyPressed = false;
            continue;
        }

        if(keyPressed) {
            continue;
        }

        keyPressed = true;
        solve(keyin);
    }

    return 0;
}
```

四、【未能解決的問題】：

沒有未能解決的問題。