Lab4 STM32 GPIO System

實驗四 STM32 GPIO System

1. Lab objectives 實驗目的

Understand the principle of using STM32 basic I/O port

Design a simple LED marquee program

Understand the use of buttons and DIP switches

了解STM32基本輸出入I/O port使用原理

設計簡易LED跑馬燈程式

了解按鈕與指撥開關使用原理

2. Lab principle 實驗原理

Please refer to the course GPIO lecture slide and STM32L4x6 Reference manual.

請參考上課 GPIO 講義與 STM32L4x6 Reference manual。

3. Steps 實驗步驟

3.1. Lab4.1 : LED pattern displayer (40%)

Please Refer to the tutorial on the lecture slide for finishing the initialization of GPIO output and constructing 4 active low LED circuits. (Turn off the LED when GPIO output "1", and turn on when GPIO output "0")

Note: Please connect the LEDs to PB3, PB4, PB5, PB6 on board.

參考講義上的教學完成4個 GPIO output 初始化，並在麵包板上完成4個為 **Active Low** 的LED燈電路 (當GPIO輸出 "1" 時 燈暗，"0" 代表燈亮)。

Note: LED 需連接至實驗板上的 PB3, PB4, PB5, PB6

Please complete the program below and let the LEDs blink as the pattern requirement defined.

完成依以下 pattern 閃爍的跑馬燈程式。

3.1.1.Pattern requirement

"1" represents that LED is on, and "0" represents LED is off.

"1" 代表 LED 亮，"0" 代表 LED 暗

Initial state: The rightest LED is on.

初始狀態：最右邊的LED亮

t = 0s	0	0	0	1

Then the LED shift left in order every one second. At this time, there should be two LED illuminated.

接著**每一秒鐘** LED 依序往左位移，此時會有2個 LED 亮

t = 1s	0	0	1	1

t = 2s	0	1	1	0
t = 3s	1	1	0	0

Change the shifting direction to right when the LEDs' state is "1 0 0 0".

當 LED 亮至最左邊時 ("1 0 0 0") 的下一秒改變位移方向，由左至右

t = 4s	1	0	0	0

t = 5s	1	1	0	0
t = 6s	0	1	1	0
t = 7s	0	0	1	1
t = 8s	0	0	0	1

Change the shifting direction to left when the LEDs' state back to the initial state ("0 0 0 1"). Repeat the process above.

當回至初始狀態 ("0 0 0 1") 後在改變位移方向，並重複以上步驟

Please complete the program below and use the variable "leds" to record the LEDs' states. Using function "DisplayLED" to output the "leds" value to the LEDs to display.

Note: You may need to use LSL or LSR instructions to shift bits.

完成以下程式碼，並利用 "leds" 這個變數紀錄目前位移數值，與 "DisplayLED" 函式輸出 "leds" 數值顯示至4個LED上。

Note: 需用位移指令LSL或LSR進行數值位移

```
.data
  leds: .byte 0

.text
   .global main

main:
  BL   GPIO_init
  MOVS R1, #1
  LDR  R0, =leds
  STRB R1, [R0]

Loop:
  //TODO: Write the display pattern into leds variable

  BL    DisplayLED
  BL    Delay
  B     Loop

GPIO_init:
  //TODO: Initial LED GPIO pins as output
  BX LR

DisplayLED :
  //TODO: Display LED by leds
  BX LR

Delay:
   //TODO: Write a delay 1 sec function
   BX  LR
```

3.2. Lab4.2 : Push button (20%)

Please initialize GPIO PC13 as pull-up input and design a program to polling the state of the user button on board. Controlling the scrolling of the LEDs (Lab4.1) stop and start by a click on button. (click once to stop scrolling and once more to start scrolling)

Note: The user button on board is connected to PC13. Please refer to the lecture slides or STM32L476 datasheet to complete the initialization of GPIOC.
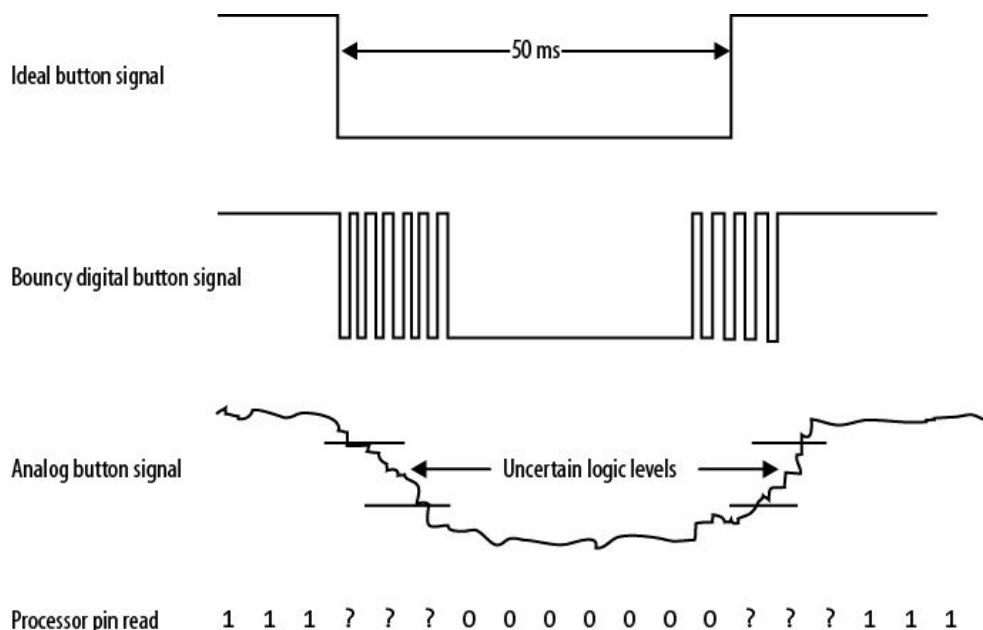
初始化 GPIO PC13 為 pull-up input，並設計一程式輪詢 (polling) 實驗板上的 User button 狀態，藉由按下按鈕去控制跑馬燈 (Lab4.1) 的停止與啟動。(按一次停止再按一次啟動)

Note: 開發板上的 User button 是連接在 PC13 上，請自行參考講義或 STM32L476 datasheet 完成 GPIOC 初始化。

3.2.1. switch bounce 開關彈跳

Please solve the button bounce problem using software debounce.

請使用軟體去彈跳，解決按鍵彈跳問題。

Mechanical bounce of button switch：

The button is a mechanical device. After pressing, the internal knot will bounce back and forth for a few milliseconds before it stabilizes. During the time when the bounce is removed, both low and high signals are detected, causing false positives.
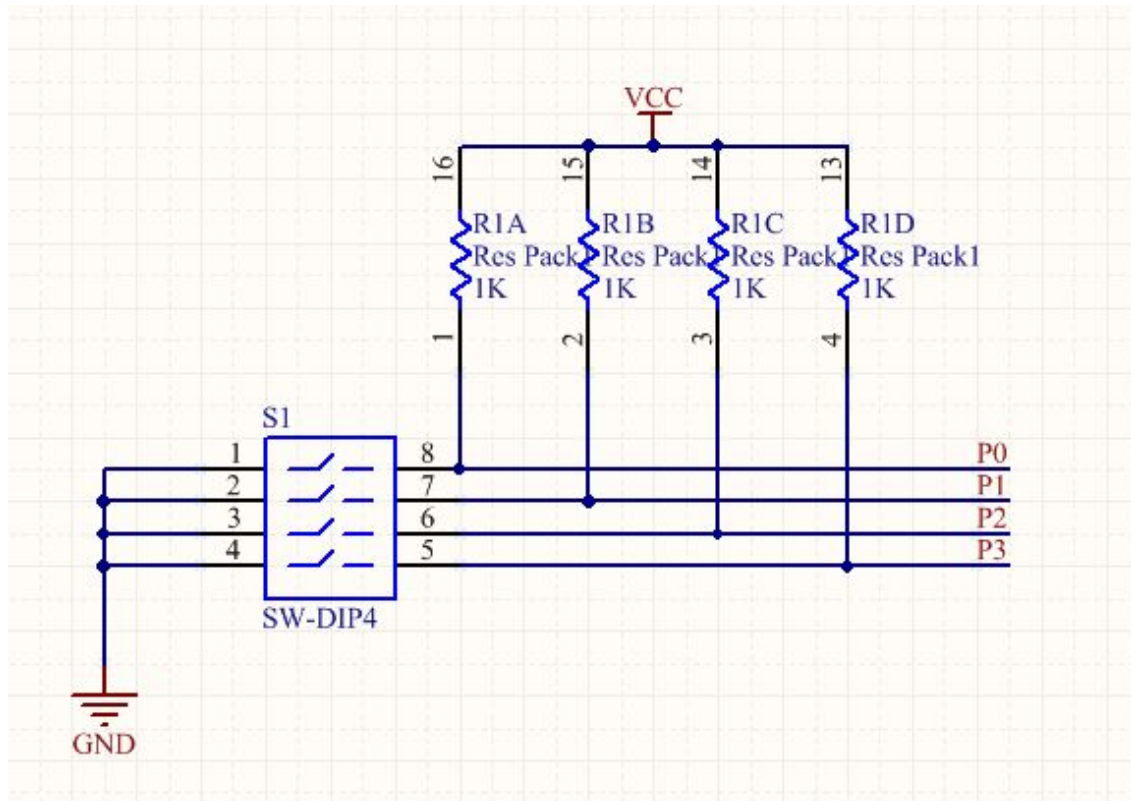
按鍵開關之機械彈跳現象：

按鍵是機械裝置，按壓後，在穩定之前，內部連結會在幾毫秒間來回彈跳。在消除彈跳的這段時間裡，low 和 high 的訊號都會偵測到，造成誤判。

3.3. Lab4.3：密碼鎖 (40%)

Please use breadboard to construct an active low DIP switch circuit and connect P0~P3 to GPIO pins on board. (You could choose the pins by yourselves)

利用麵包板連接 DIP switch的 active low 電路並連接 P0~P3 至實驗板的 GPIO pins (同學可自行決定連接的 pins)

Please declare a 1 byte global variable "password" and implement a simple 4 bits coded lock. Referring to the process below:

在程式中宣告一個 password 1byte 全域變數並實做一個簡易的 4bit 密碼鎖程式，其流程如下：
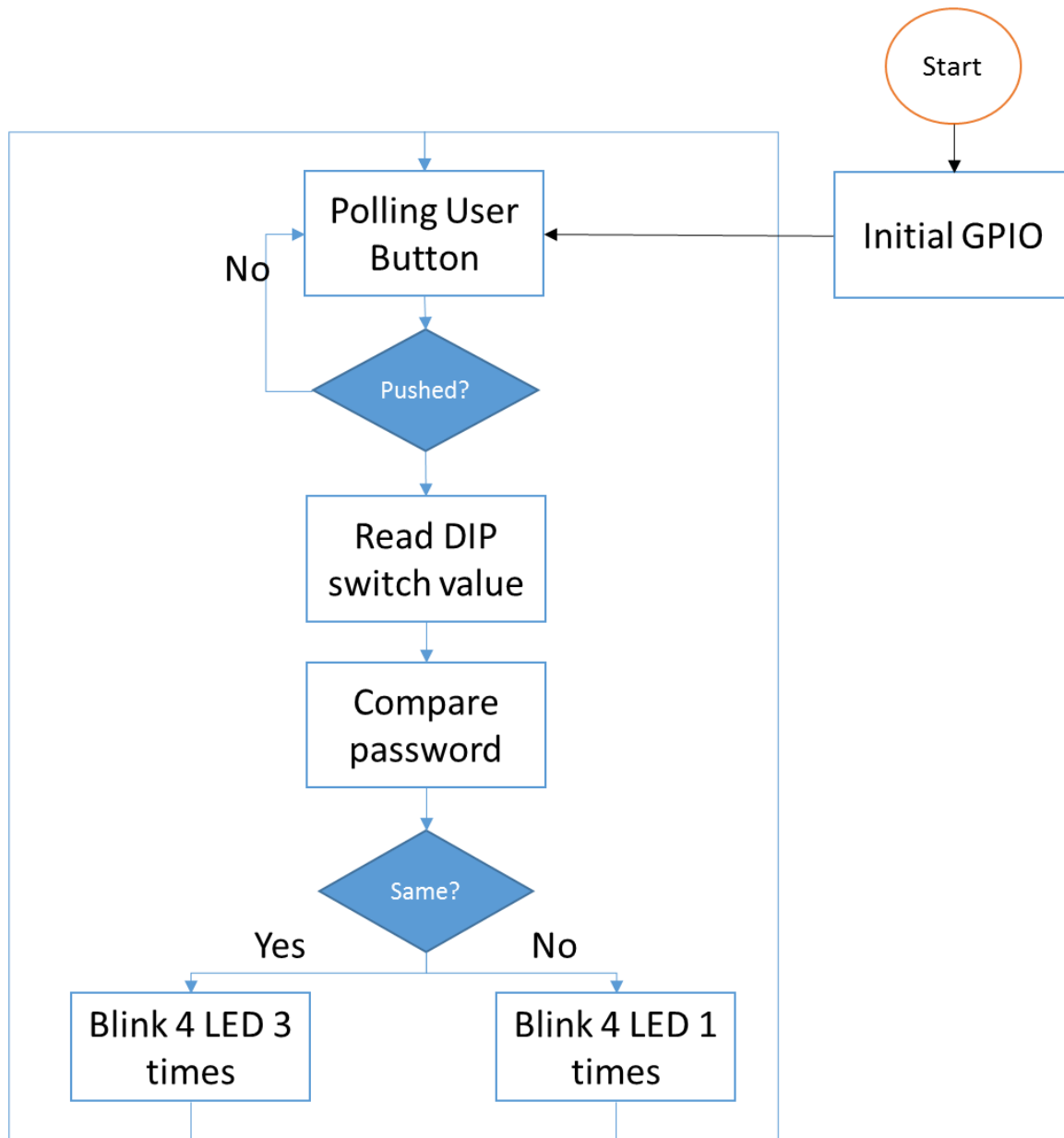
Note: Defining DIP switch ON as "1", OFF as "0". Thus, when user input "ON ON OFF OFF", it's code is "1 1 0 0". Please set the blink frequency to 0.5s.

Note: DIP switch ON 代表 "1", OFF 代表 "0"，若使用者輸入 "ON ON OFF OFF" 則代表 "1 1 0 0"。 Blink 時間間隔 0.5s