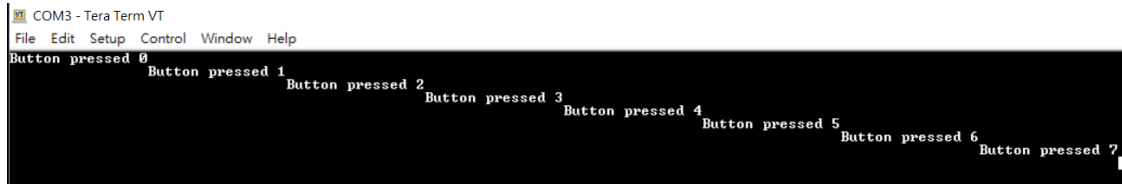


NTUEE Embedded System Lab 1

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1. Digital Input/Output and GPIO

當按下按鈕(Input)時，開發版上的 LED 燈會發光，同時在螢幕上的 stdout (利用 TeraTerm 終端機連接 USB Port 傳送 output)會顯示「Button pressed #」。



A screenshot of a TeraTerm terminal window titled 'COM3 - Tera Term VT'. The terminal displays a sequence of messages: 'Button pressed 0', 'Button pressed 1', 'Button pressed 2', 'Button pressed 3', 'Button pressed 4', 'Button pressed 5', 'Button pressed 6', and 'Button pressed 7'. Each message is printed on a new line, and the cursor is at the end of the last line.



```
1  #include "mbed.h"
2
3  DigitalOut led1(LED1);
4
5  InterruptIn button1(USER_BUTTON);
6  volatile bool button1_pressed = false;
7  volatile bool button1_enabled = true;
8  Timeout button1_timeout;
9
10 void button1_enabled_cb(void)
11 {
12     button1_enabled = true;
13 }
14
15 void button1_onpressed_cb(void)
16 {
17     if (button1_enabled) {
18         button1_enabled = false;
19         button1_pressed = true;
20         button1_timeout.attach(callback(button1_enabled_cb), 0.3);
21     }
22 }
23
24 int main()
25 {
26     button1.fall(callback(button1_onpressed_cb));
27
28     int idx = 0;
29
30     while(1) {
31         if (button1_pressed) {
32             button1_pressed = false;
33             printf("Button pressed %d\n", idx++);
34             led1 = !led1;
35         }
36     }
37 }
38
```

The screenshot shows a code editor window titled 'untitled' containing the C code for the button press experiment. The code includes the mbed.h header, defines a DigitalOut led1, and sets up an InterruptIn button1. It defines two callback functions: button1_enabled_cb and button1_onpressed_cb. The main function calls button1.fall(callback(button1_onpressed_cb)) and enters a while loop that checks for button presses and toggles the LED.

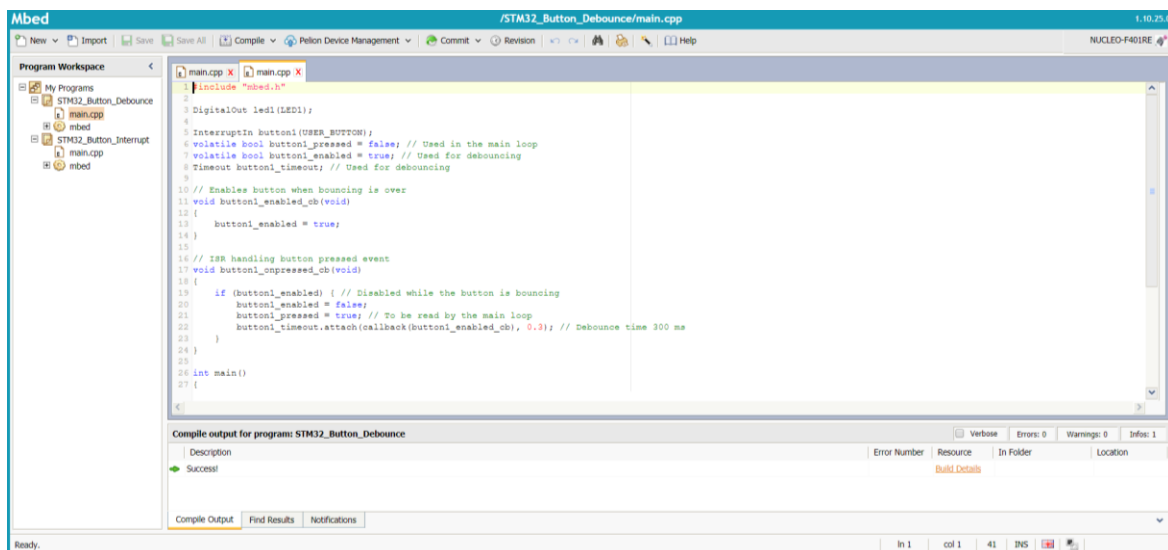
2. Interrupt and Low Power Features

在一般的情況下(無窮迴圈)，LED 燈會以 0.5 秒的週期閃爍；而當使用者壓下 Button 的時候 (Interrupt)，LED 燈會改以 0.1 秒的週期閃爍。

```
1 #include "mbed.h"
2
3 InterruptIn button(USER_BUTTON);
4 DigitalOut led1(LED1);
5
6 double delay = 0.5;
7
8 void pressed()
9 {
10     delay = 0.1;
11 }
12
13 void released()
14 {
15     delay = 0.5;
16 }
17
18 int main()
19 {
20     button.fall(&pressed);
21     button.rise(&released);
22
23     while (1) {
24         led1 = !led1;
25         wait(delay);
26     }
27 }
```

3. Mbed API

Mbed 可以讓使用者直接在瀏覽器上進行嵌入式系統的程式編輯，同時亦可以線上 Debug、編譯，若編譯成功則瀏覽器會自動下載編譯好的 binary 檔案，將這個檔案放進開發版裡即可執行。



心得:

比起使用 Keil IDE 進行開發，ARM 推出的線上 Mbed 讓開發者可以更加專注於系統本身的程式開發而非複雜的環境建置。Mbed 當中也提供了許多的 Template 開發範本，即使是第一次進行嵌入式開發的程式設計師，在依樣畫葫蘆之後便可快速掌握開發時所需要的重要概念，大幅提升開發效率。