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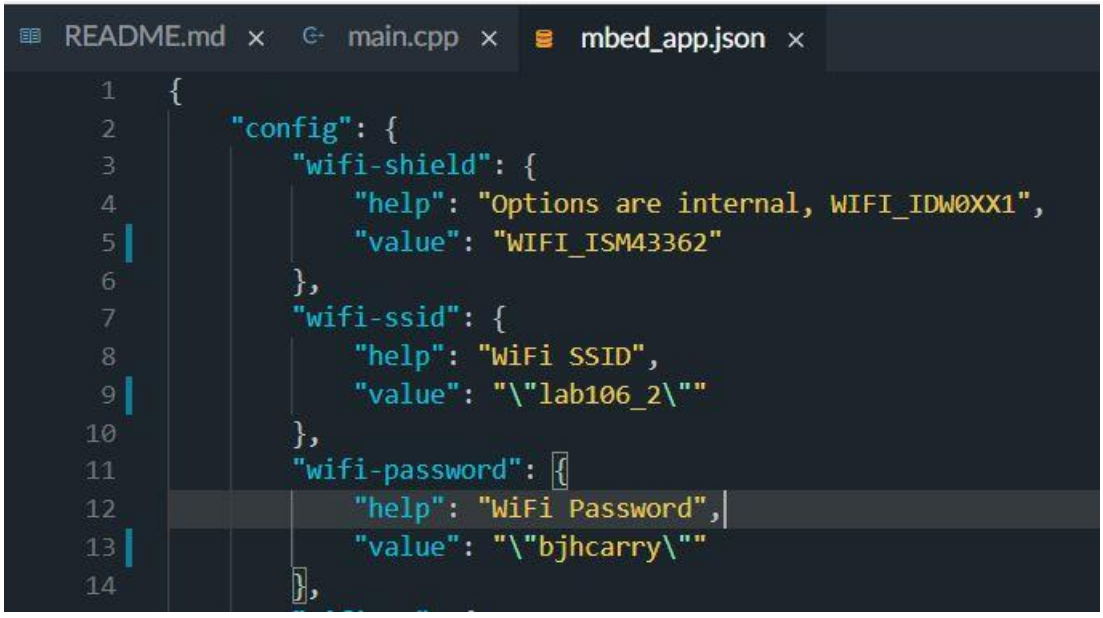
主程式
https://github.com/cyhuangjohn/ES-homework/blob/main/%5BHW-3%5D%20Sensor%20node%20with%20wifi%20and%20socket%20client/server

資料視覺化
https://github.com/cyhuangjohn/ES-homework/blob/main/%5BHW-3%5D%20Sensor%20node%20with%20wifi%20and%20socket%20client/plot

Sensor node with wifi and socket client/server 這次的實驗將 DISCO-L475VG-IOT01A 開發板上所偵測到的資訊如濕度、溫度、大氣壓力、3D Accelerator、3D 陀螺儀等等，透過 wifi 然後發送到電腦(server)，使電腦能夠讀取所偵測到的數值，並且將這些數值視覺化。

首先先將 wifi 的程式碼與 sensor 的程式碼結合使用並且更改 wifi-ssid 與 wifi-password 與電腦相同，如下圖，



```
#include "mbed.h"
#include "TCPSocket.h"
#include "stm32l475e_iot01_tsensor.h"
#include "stm32l475e_iot01_hsensor.h"
#include "stm32l475e_iot01_psensor.h"
#include "stm32l475e_iot01_magneto.h"
#include "stm32l475e_iot01_gyro.h"
#include "stm32l475e_iot01_accelero.h"
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#define WIFI_IDW0XX1    2

#if (defined(TARGET_DISCO_L475VG_IOT01A) || defined(TARGET_DISCO_F413ZH))
#include "ISM43362Interface.h"
ISM43362Interface wifi(false);
#else // External WiFi modules

#if MBED_CONF_APP_WIFI_SHIELD == WIFI_IDW0XX1
#include "SpwfSAInterface.h"
SpwfSAInterface wifi(MBED_CONF_APP_WIFI_TX, MBED_CONF_APP_WIFI_RX);
#endif // MBED_CONF_APP_WIFI_SHIELD == WIFI_IDW0XX1
```

```
void http_demo(NetworkInterface *net,char *buf)
{
    TCPSocket socket;
    nsapi_error_t response;

    printf("Sending HTTP request to www.arm.com...\n");

    // Open a socket on the network interface, and create a TCP connection to www.arm.com
    // Show the network address
    SocketAddress a;
    net->get_ip_address (&a);
    printf("IP address: %s n", a.get_ip_address () ? a.get_ip_address () : "None");
    printf("Sending HTTP request to www.arm. n");

    socket.open(net);
    net->gethostbyname ("192.168.1.236", &a);
    a.set_port(8000);
    response = socket.connect (a);
    if(0 != response) {
        printf("Error connecting: %d\n", response);
        socket.close();
        return;
    }
```

```
    //char sbuffer[] = "GET / HTTP/1.1\r\nHost: 192.168.1.236\r\n\r\n";
    //nsapi_size_t size = strlen(sbuffer);
    char sbuffer[10];
    for(int i=0; i<10; i++){
        sbuffer[i] = buf[i];
    }
    nsapi_size_t size = strlen(sbuffer);
    socket.send(sbuffer, size);
    response = 0;
    while(size)
    {
        response = socket.send(sbuffer+response, size);
        if (response < 0) {
            printf("Error sending data: %d\n", response);
            socket.close();
            return;
        } else {
            size -= response;
            // Check if entire message was sent or not
            //printf("sent %d [%.*s]\n", response, strstr(sbuffer, "\r\n")-sbuffer, sbuffer);
        }
    }
    socket.close();
```

```
void dtostrf(double val, int len, int prec, char* buf, int buf_len) {
    int int_count = 0;
    int index = 0;
    //判斷正負
    if (val < 0) {
        buf[index] = '-';
        index ++;
        val = -val;
    }
    //先數一下整數部分長度
    while ((int) val > 0) {
        val /= 10.0;
        int_count++;
    }
```

```
    while (index < len && index < buf_len) {
        //如果整數部分結束
        if (int_count == 0) {
            //如果一上來就是0
            if (index == 0) {
                buf[index] = '0';
                index++;
            }
            else {
                buf[index] = '.';
                index++;
                int_count--;
            }
        }
        //int_count此時已經是小數長度的相反數
        else if ( int_count >= -prec) {
            val *= 10.0;
            buf[index] = (int)val + '0';
            val -= (double)((int)val);
            index++;
            int_count--;
        }
        else break;
    }
    //強制加'\0'
    if (index == buf_len)  buf[index - 1] = '\0';
    else buf[index] = '\0';
}
```

```
int main()
{
    int count = 0;
    float sensor_value = 0;
    int16_t pDataXYZ[3] = {0};
    float pGyroDataXYZ[3] = {0};
    int k = 0;
    printf("Start sensor init\n");

    BSP_TSENSOR_Init();
    BSP_HSENSOR_Init();
    BSP_PSENSOR_Init();

    BSP_MAGNETO_Init();
    BSP_GYRO_Init();
    BSP_ACCELERO_Init();
```

```
    while(1) {

        sensor_value = BSP_TSENSOR_ReadTemp();
        printf("\nTEMPERATURE = %.2f degC\n", sensor_value);

        char buf[10] = "aefeag";
        dtostrf(sensor_value, 10, 2, buf, 10);

        sensor_value = BSP_HSENSOR_ReadHumidity();
        printf("HUMIDITY    = %.2f %%\n", sensor_value);

        sensor_value = BSP_PSENSOR_ReadPressure();
        printf("PRESSURE is = %.2f mBar\n", sensor_value);

        ThisThread::sleep_for(1s);

        BSP_MAGNETO_GetXYZ(pDataXYZ);
        printf("\nMAGNETO_X = %d\n", pDataXYZ[0]);
        printf("MAGNETO_Y = %d\n", pDataXYZ[1]);
        printf("MAGNETO_Z = %d\n", pDataXYZ[2]);
        int num = pDataXYZ[0];
        BSP_GYRO_GetXYZ(pGyroDataXYZ);
        printf("\nGYRO_X = %.2f\n", pGyroDataXYZ[0]);
        printf("GYRO_Y = %.2f\n", pGyroDataXYZ[1]);
        printf("GYRO_Z = %.2f\n", pGyroDataXYZ[2]);

        BSP_ACCELERO_AccGetXYZ(pDataXYZ);
        printf("\nACCELERO_X = %d\n", pDataXYZ[0]);
        printf("ACCELERO_Y = %d\n", pDataXYZ[1]);
        printf("ACCELERO_Z = %d\n", pDataXYZ[2]);
```

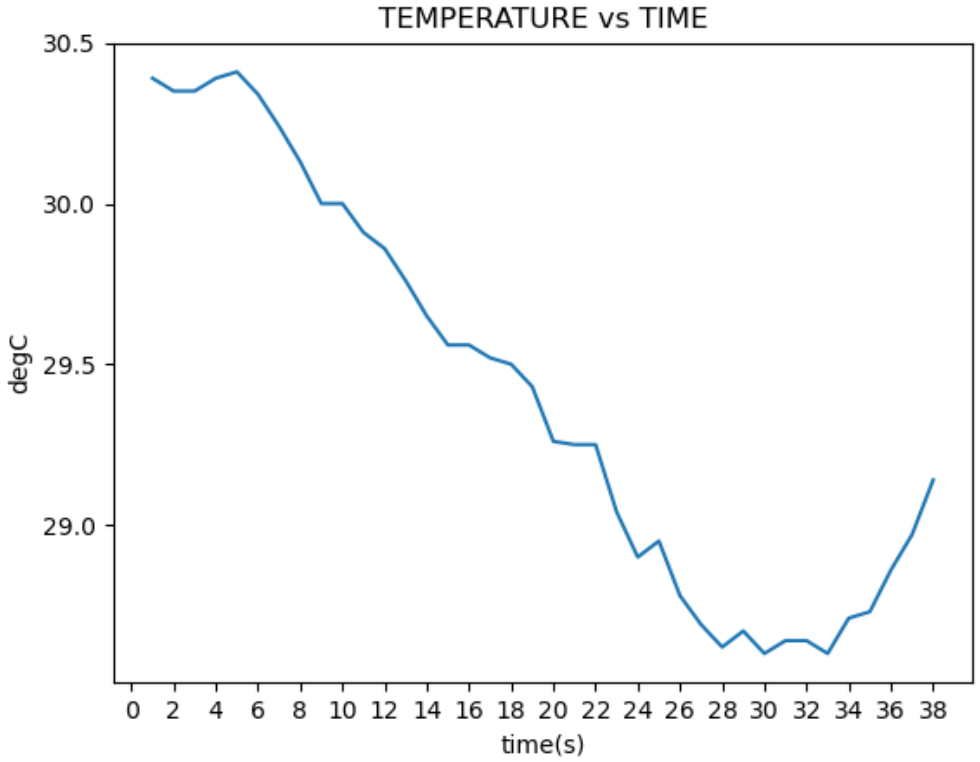
```
        int i=0,j=0;
        char temp[10],str[10];
        while(num)
        {
            temp[i++]=num%10+'0';  //將數字加字元0就變成相應字元
            num/=10;               //此時的字串為逆序
        }
        temp[i]='\0';
        i=i-1;
        while(i>=0)
            str[j++]=temp[i--];   //將逆序的字串轉為正序
        str[j]='\0';              //字串結束標誌

        ThisThread::sleep_for(1s);

        printf("\nConnecting to %s...\n", MBED_CONF_APP_WIFI_SSID);
        int ret = wifi.connect(MBED_CONF_APP_WIFI_SSID, MBED_CONF_APP_WIFI_PASSWORD, NSAPI_SECURITY_WPA_WPA2);

        printf("Success\n\n");
        printf("MAC: %s\n", wifi.get_mac_address());
        printf("IP: %s\n", wifi.get_ip_address());
        printf("Netmask: %s\n", wifi.get_netmask());
        printf("Gateway: %s\n", wifi.get_gateway());
        printf("RSSI: %d\n\n", wifi.get_rssi());

        http_demo(&wifi,buf);

        k++;
        if(k>80){
            break;
        }
```

中間加入了浮點數轉成字串的程式碼，使得溫度、壓力、濕度偵測到的值可以傳送，也加入了整數轉字串的程式碼，使得加速度偵測到的值可以傳送。
將讀取資料與傳送資料的部分放入一個 while 迴圈裡，讓資料可以一直偵測與傳送，傳送到 server 端接收，而 server 端的程式碼如下，

```
import socket
import pandas as pd
from openpyxl import load_workbook
import numpy as np
import matplotlib.pyplot as plt

HOST = '192.168.1.236'  # Standard loopback interface address (localhost)
PORT = 8000        # Port to listen on (non-privileged ports are > 1023)

wb = load_workbook('data.xlsx')
sheet = wb['Sheet1']
i = 1
while True:
    with socket.socket(socket.AF_INET, socket.SOCK_STREAM) as s:
        s.bind((HOST, PORT))
        s.listen()
        conn, addr = s.accept()
        with conn:

            print('Connected by', addr)
            while True:
                s.settimeout(1000)
                data = conn.recv(1024)
                s.settimeout(None)
                if not data:
                    wb.save('data.xlsx')
                    break
                print('Data = ', data)
                data1 = data

                sheet.cell(row=i, column=1, value=data1)
                i = i+1
                conn.sendall(data1)

df = pd.read_excel('data.xlsx')
answer = df[1:57]
print(answer)
plt.xlabel("time(s)")
plt.ylabel("degC")
plt.title('TEMPERATURE vs TIME')
x_ticks = np.arange(0,40,2)
y_ticks = np.arange(25,35,0.5)
plt.xticks(x_ticks)
plt.yticks(y_ticks)
plt.plot(range(1,len(answer)+1),answer)
plt.show()
```

將每次的資料接收後存入名為 data 的 excel 檔裡

而我讀取的資料是溫度隨時間的變化值，並且利用 python 裡的套件 matplotlib 將資訊視覺化，如下圖



測驗的環境是在實驗室，當天的天氣較炎熱，所以溫度來到 30 幾度，一秒測一次數據，總共測了 38 秒，中間利用電風扇降溫，可以看到溫度有明顯的下降，最後尾端溫度又上升，是因為我用雙手握住開發板，使溫度上升。

這次實驗所遇到的困難有 1.開發板連接 wifi 的部分 2.開發板連接不良問題 3.code 問題，第一個問題後來好像後來發現是實驗室網路的問題，後來直接利用內網將 client 連接 server 就沒有問題了，而開發板連接的問題則是需要重新拔除，再連接上去，在 code 方面則是一些資料型態的轉換，與一些存取資料並且實現視覺化的問題，不過皆透過 google 大神解決。