Get PM2.5 Air Quality

Example Code Introduction for 32-bit NuMicro® Family

Information

Application	This example code demonstrates to get PM2.5 air quality of City using Weather PM2.5 API over Wi-Fi.
BSP Version	M480 Series BSP CMSIS V3.04.000
Hardware	NuMaker-IoT-M487 v1.3

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1 Function Description

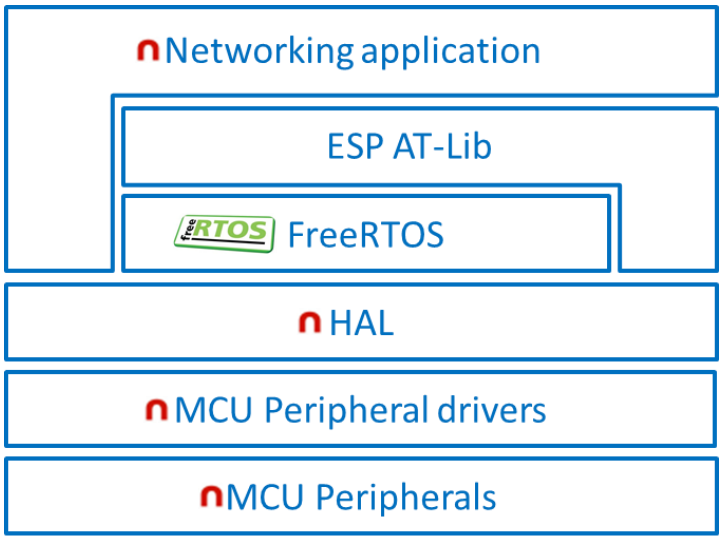
1.1 Introduction

This example code demonstrates to get PM2.5 air quality k780.com provided on internet, over Wi-Fi on NuMaker-IOT-M487 development board.

1.2 Principle

1.2.1 ESP-AT Lib

We implements networking programming is based on ESP-AT Lib Mr.Tilen MAJERLE released in this example code. The ESP-AT Lib provides ESP8266 AT firmware parsing, host driver abstracting implementation, RTOS multi-tasking environment, and BSD-Like API. It is easy to develop complexity networking processing.



1.2.2 Weather PM2.5 API

We enable Station mode of ESP8266 and associate with internet-accessible Wi-Fi router. After associated with Wi-Fi router, station will lease IP address from DHCP server of Wi-Fi router, then create a TCP connection to connect k780 weather service server. Below shown a request content for weather querying and descript responding from server. From responding, we can get AQI value and translate AQI value to city air level on terminate.

http://api.k780.com/?app=weather.pm25&weaid=cityno&appkey=APPKEY&sign=SIGN&format=xml

Parameter	Type	Must	Note
app	String	Y	API name. Here is weather.pm25.
weaid	String	Y	City weather NO. GET
appkey	String	Y	API unique token GET
sign	String	Y	32-byte cipher of MD5 calculated GET
format	{json|xml}	N	Responding data format
jsoncallback	String	N	When JS cross-domain uses jsonp, you can use the parameter.

Example: Query current PM2.5 air quality in Shen-Zhen.

http://api.k780.com/?app=weather.pm25&weaid=169&appkey=10003&sign=b59bc3ef6191eb9f747dd4e83c99f2a4&format=xml

Notice: Shen-Zhen city number is 169. The appkey-10003 is for free-use. Please note server just give limited quota for an IP address every hour. After over-quota, you cannot query correctly and need to wait until next hour.

1.2.3 Weather City API

k780 also provide city number querying. Below shown some city number.

http://api.k780.com/?app=weather.city&appkey=10003&sign=b59bc3ef6191eb9f747dd4e83c99f2a4&format=xml

Parameter	Type	Must	Note
app	String	Y	API name. Here is weather.city
cou	**int**	N	1:domestic city, 2:foreign city, Null: All
format	{json|xml}	N	Responding data format

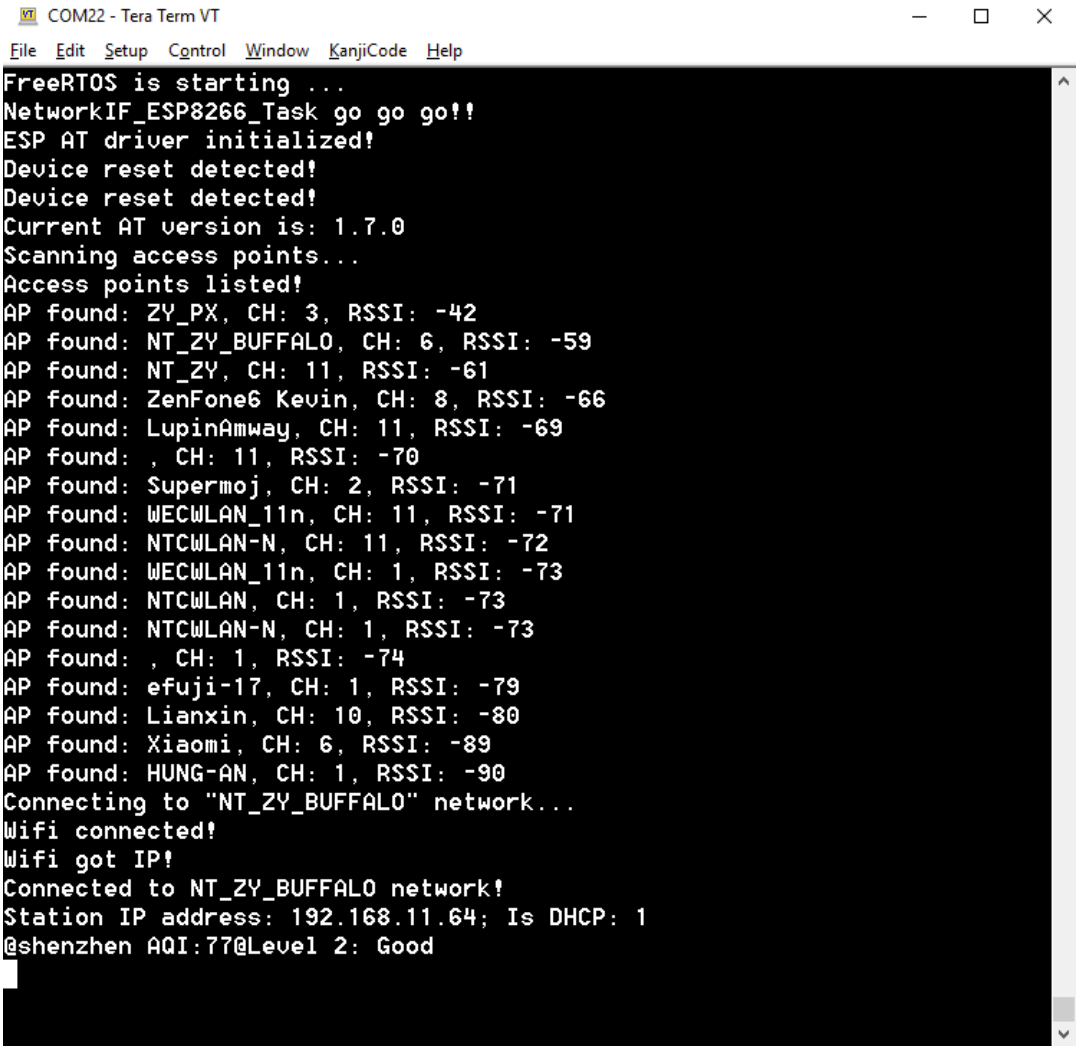
Example: Query some city number result shown as below.

City name	City number
ShenZhen	169
ShangHai	36
Taipei	360
Kaohsiung	361
Hsinchu	2635

1.2.4 PM2.5 Air Quality Index description

AQI	Level	Quality	Note
0-50	1	Excellent	Good
50-100	2	Good	Moderate
101-150	3	Lightly Polluted	Unhealthy for sensitive groups
151-200	4	Moderately Polluted	Unhealthy
201-300	5	Heavily Polluted	Very unhealthy
>300	6	Severely Polluted	Hazardous

1.3 Demo Result



2 Code Description

Set preferred SSID and key of Wi-Fi router in NetworkIF_ESP8266.h file,

```
/*
 * Copyright (c) 2019 Nuvoton Technology Corp.
 * Description:   ESP8266 network interface header file
 */
#ifndef __NETWORKIF_ESP8266_H__
#define __NETWORKIF_ESP8266_H__

/* Preferred access point */
#define DEF_JOIN_AP_SSID   "NT_ZY_BUFFALO"
#define DEF_JOIN_AP_KEY    "12345678"

/* ESP8266 network interface task */
void NetworkIF_ESP8266_Task(void *pvParameter);
#endif
```

Fill preferred city number in GetPM25WeatherAPI.c file.

```
#define DEF_QUERY_CITYNO       169 //@ShenZhen
```

3 Software and Hardware Environment

Software Environment

- BSP version
  - M480 Series BSP CMSIS V3.04.000
- IDE version
  - Keil uVersion 5.26.2.0

Hardware Environment

- Circuit components
  - NuMaker-IoT-M487 v1.3 board
- Diagram

Shown wiring between M487JIDAE chip and ESP8266 module.

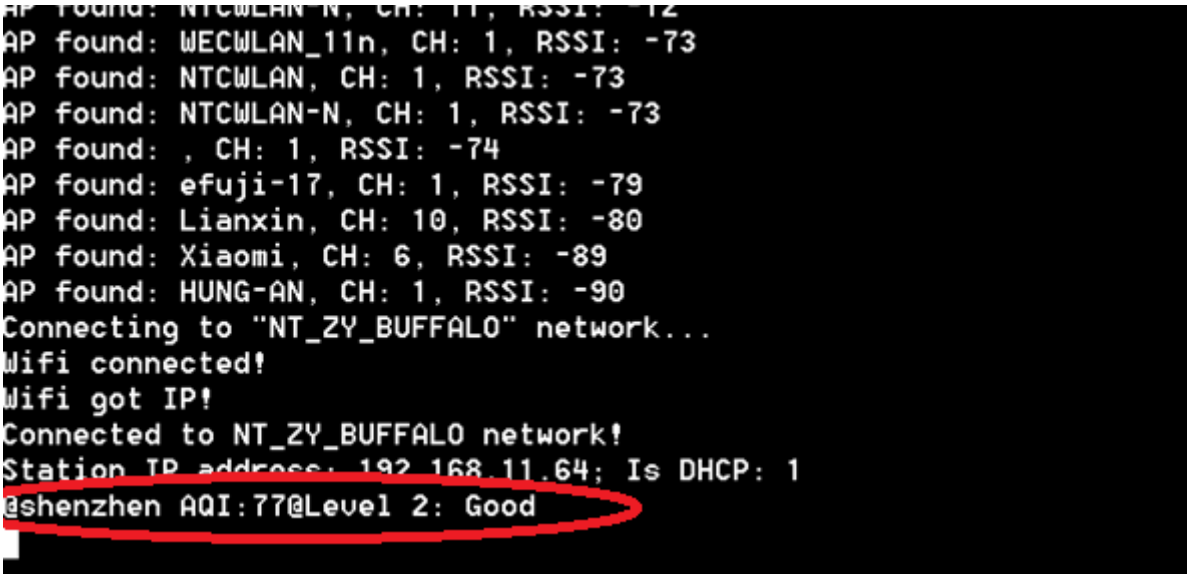
M487JIDAE		ESP-12F
PH.3	→	RESET
UART1_TXD(PH.8)	→	RXD
UART1_RXD(PH.9)	←	TXD
UART1_RTS(PB.8)	→	CTS
UART1_CTS(PB.9)	←	RTS
GND	↔	GND

4 Directory Information

- EC_M480_WeatherAPI_V1.00
  - Library — Sample code header and source files
    - CMSIS — Cortex® Microcontroller Software Interface Standard (CMSIS) by Arm® Corp.
    - Device — CMSIS compliant device header file
    - StdDriver — All peripheral driver header and source files
  - SampleCode
    - ExampleCode — Source file of example code
  - ThirdParty
    - FreeRTOS — A real time operating system available for free download. Its official website is: http://www.freertos.org/
    - ESP_AT_Lib — ESP_AT Library commands parser is generic, platform independent, library for communication with ESP8266 WiFi module using AT commands. Its official website is https://majerle.eu/documentation/esp_at/html/index.html

5 How to Execute Example Code

1. Browsing into sample code folder by Directory Information (section 4) and double click M480_WeatherAPI.uvproj.
2. Enter Keil compile mode
   a. Build
   b. Download
3. Switch SW1, SW2, SW3 of ISW1 to ON position.
4. Press RESET button of NuMaker-IOT-M487 development board
   a. Run
5. Get PM2.5 air quality query result on terminate.



6 Revision History

Date	Revision	Description
Oct. 31, 2019	1.00	1. Initially issued.

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