讀取感測器DHT11的溼度和溫度資料

NuMicro® 32 位系列微控制器範例代碼介紹

文件資訊

代碼簡述	使用 NUC240 的 GPIO (PA.0)和 TIMER0 讀取 DHT11 的溼度和溫度資料
BSP 版本	NUC230/240 Series BSP CMSIS V3.01.001
開發平台	NuTiny-SDK-NUC240V V1.2

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1 功能介紹

1.1 簡介

使用GPIO (PA.0)和TIMER0讀取DHT11的溼度和溫度資料。DHT11是個常見的數位濕度、溫度感測器。DHT11使用簡化的單總線通訊方式交換資料。資料長度為40位元，資料格式如所下表所示：

1st 8 位元	2nd 8 位元	3rd 8 位元	4th 8 位元	5th 8 位元
濕度整數資料	濕度小數資料	溫度整數資料	溫度小數資料	前4筆資料的校驗碼

藉由GPIO和TIMER0，使用者可以產生與DHT11通訊的波形。請從以下連結，參考DHT11的規格資料，了解更詳細的時序圖。
https://osepp.com/downloads/pdf/DHT11-Technical-Data-Sheet-Translated-Version.pdf

1.2 執行結果

每隔1.5秒讀取DHT11的濕度和溫度資料。結果如下圖所示：

```
CPU @ 71884800 Hz
+------------------------------------------------+
|    Read DHT11 data Sample Code                 |
|    Use GPIO(PA.0) and TIMER0 to read DHT11 data|
|    Please connect PA.0 to DHT11 data pin       |
+------------------------------------------------+

Humidity: 72.0, Temperature: 24.9
Humidity: 73.0, Temperature: 24.9
Humidity: 73.0, Temperature: 24.9
Humidity: 73.0, Temperature: 24.9
Humidity: 73.0, Temperature: 24.9
```

2 代碼介紹

發送開始訊號給 DHT11，使 DHT11 從低功耗模式切換到執行模式。

```
    /* The Quasi-bidirection mode could be used as input with pull-up enable */
    GPIO_SetMode(Data_Port, Data_PinMsk, GPIO_PMD_QUASI);

    /* Send out start signal to DHT11 */
    /* Set data pin level from high to low */
    Data_Pin = 1;
    Data_Pin = 0;
    /* Take at least 18 ms to ensure DHT11's detection of signal */
    CLK_SysTickDelay(18000);
    /* Pull up data pin */
    Data_Pin = 1;

    /* Record current timer counter value */
    u32_poll_time = TIMER_GetCounter(TIMER0);

    /* Wait response from DHT11 by pulling down data pin */
    while (1)
    {
        if (Data_Pin == 0)
        {
            break;
        }

        if ((TIMER_GetCounter(TIMER0) - u32_poll_time) > 1000)
            /* DHT11 doesn't response over 1 ms */
            return FALSE;
    }

    /* Wait until DHT11 pulls up data pin level */
    while (1)
    {
        if (Data_Pin == 1)
        {
            break;
        }
    }
```

```
    /* Send start signal successfully */
    return TRUE;
```

在 NUC240 送出開始訊號並且收到 DHT11 的回覆後，NUC240 開始讀取 DHT11 的資料。

```
    /* Init TIMER0 to measure high level time */
    TMR0_Init();

    /* Start communicate with DHT11 */
    if (DHT11_Reset() == TRUE)
    {
        /* Wait until DHT11 starts data transmission */
        while (Data_Pin == 1);

        /* A complete data transmission is 40 bits, DHT11 sends MSB first */
        /* 1st 8 bits is humidity integral data */
        g_u8Humidity_Int = 0;

        for (i = 0; i < 8; i++)
        {
            /* Shift current data for next bit */
            g_u8Humidity_Int = g_u8Humidity_Int << 1;

            /* Wait until DHT11 pull high data pin */
            while (Data_Pin == 0);

            /* Measure the high level time to determine the data bit */
            u32_prev_time = TIMER_GetCounter(TIMER0);

            while (Data_Pin == 1);

            if ((TIMER_GetCounter(TIMER0) - u32_prev_time) > Max_Data0_Time)
            {
                g_u8Humidity_Int |= 0x01;
            }
        }

        /* 2nd 8 bits is humidity decimal data */
        g_u8Humidity_Dec = 0;

        for (i = 0; i < 8; i++)
```

```
    {
        /* Shift current data for next bit */
        g_u8Humidity_Dec = g_u8Humidity_Dec << 1;

        /* Wait until DHT11 pull high data pin */
        while (Data_Pin == 0);

        /* Measure the high level time to determine the data bit */
        u32_prev_time = TIMER_GetCounter(TIMER0);

        while (Data_Pin == 1);

        if ((TIMER_GetCounter(TIMER0) - u32_prev_time) > Max_Data0_Time)
        {
            g_u8Humidity_Dec |= 0x01;
        }
    }

    /* 3rd 8 bits is temperature integral data */
    g_u8Temperature_Int = 0;

    for (i = 0; i < 8; i++)
    {
        /* Shift current data for next bit */
        g_u8Temperature_Int = g_u8Temperature_Int << 1;

        /* Wait until DHT11 pull high data pin */
        while (Data_Pin == 0);

        /* Measure the high level time to determine the data bit */
        u32_prev_time = TIMER_GetCounter(TIMER0);

        while (Data_Pin == 1);

        if ((TIMER_GetCounter(TIMER0) - u32_prev_time) > Max_Data0_Time)
        {
            g_u8Temperature_Int |= 0x01;
        }
    }

    /* 4th 8 bits is temperature decimal data */
```

```
    g_u8Temperature_Dec = 0;

    for (i = 0; i < 8; i++)
    {
        /* Shift current data for next bit */
        g_u8Temperature_Dec = g_u8Temperature_Dec << 1;

        /* Wait until DHT11 pull high data pin */
        while (Data_Pin == 0);

        /* Measure the high level time to determine the data bit */
        u32_prev_time = TIMER_GetCounter(TIMER0);

        while (Data_Pin == 1);

        if ((TIMER_GetCounter(TIMER0) - u32_prev_time) > Max_Data0_Time)
        {
            g_u8Temperature_Dec |= 0x01;
        }
    }

    /* 5th 8 bits is checksum */
    u8Checksum = 0;

    for (i = 0; i < 8; i++)
    {
        /* Shift current data for next bit */
        u8Checksum = u8Checksum << 1;

        /* Wait until DHT11 pull high data pin */
        while (Data_Pin == 0);

        /* Measure the high level time to determine the data bit */
        u32_prev_time = TIMER_GetCounter(TIMER0);

        while (Data_Pin == 1);

        if ((TIMER_GetCounter(TIMER0) - u32_prev_time) > Max_Data0_Time)
        {
            u8Checksum |= 0x01;
        }
```

```
        }

        /* Stop TIMER0 */
        TIMER_Stop(TIMER0);

        /* Compare received data and checksum */
        if ((uint8_t)(g_u8Humidity_Int + g_u8Humidity_Dec + g_u8Temperature_Int +
g_u8Temperature_Dec) == u8Checksum)
        {
            return TRUE;
        }
        else
        {
            printf("Checksum error!\n");

            return FALSE;
        }
    }
    else
    {
        /* Stop TIMER0 */
        TIMER_Stop(TIMER0);

        printf("DHT11 is no response.\n");

        return FALSE;
    }
```

NUC240 每隔 1.5 秒讀取 DHT11 的溼度和溫度資料。

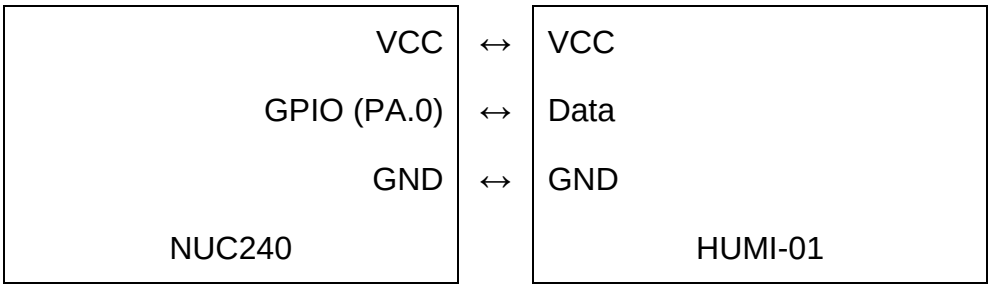
```
while (1)
    {
        /* Delay 1.5 seconds */
        Delay_mS(1500);

        if (DHT11_Read() == TRUE)
        {
            printf("Humidity: %d.%d, ", g_u8Humidity_Int, g_u8Humidity_Dec);
            printf("Temperature: %d.%d\n", g_u8Temperature_Int, g_u8Temperature_Dec);
        }
    }
```

3 軟體與硬體環境

- **軟體環境**
  - BSP 版本
    - NUC230/240 Series BSP CMSIS V3.01.001
  - IDE 版本
    - Keil uVersion 5.26
- **硬體環境**
  - 電路元件
    - NuTiny-SDK-NUC240V V1.2
    - 濕度和溫度感測器 DHT11 (模組 HUMI-01)
  - 示意圖

NUC240 使用 GPIO (PA.0)連接模組 HUMI-01 的 Data 腳位。



4 目錄資訊

- EC_NUC240_Read_DHT11_Data_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

5 如何執行範例程式

1. 根據目錄資訊章節進入 ExampleCode 路徑中的 KEIL 資料夾，雙擊 NUC240_Read_DHT11_Data.uvproj。
2. 進入編譯模式介面
   a. 編譯
   b. 下載代碼至記憶體
   c. 進入 / 離開除錯模式
3. 進入除錯模式介面
   a. 執行代碼

6 修訂紀錄

Date	Revision	Description
June 26, 2019	1.00	1. 初始發布.

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