读取传感器DHT11的湿度和温度数据

NuMicro® 32 位系列微控制器范例代码介绍

文件信息

代码简述	使用NUC240的GPIO (PA.0)和TIMER0读取DHT11的湿度和温度数据
BSP 版本	NUC230/240 Series BSP CMSIS V3.01.001
开发平台	NuTiny-SDK-NUC240V V1.2

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1 功能介绍

1.1 简介

使用GPIO (PA.0)和TIMER0读取DHT11的湿度和温度数据。DHT11是个常见的数字湿度、温度传感器。DHT11使用简化的单总线通讯方式交换数据。数据长度为40位，数据格式如所下表所示：

1st 8 比特	2nd 8 比特	3rd 8 比特	4th 8 比特	5th 8 比特
湿度整数数据	湿度小数数据	温度整数数据	温度小数数据	前4笔资料的校验码

藉由GPIO和TIMER0，使用者可以产生与DHT11通讯的波形。请从以下链接，参考DHT11的规格数据，了解更详细的时序图。
https://osepp.com/downloads/pdf/DHT11-Technical-Data-Sheet-Translated-Version.pdf

1.2 执行结果

每1.5秒读取DHT11的湿度和温度数据。结果如下图所示：

```
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 代码介绍

发送开始讯号给DHT11，使DHT11从低功耗模式切换到执行模式。

```
    /* 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送出开始讯号并且收到DHT11的回复后，NUC240开始读取DHT11的数据。

```
    /* 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秒读取DHT11的湿度和温度数据。

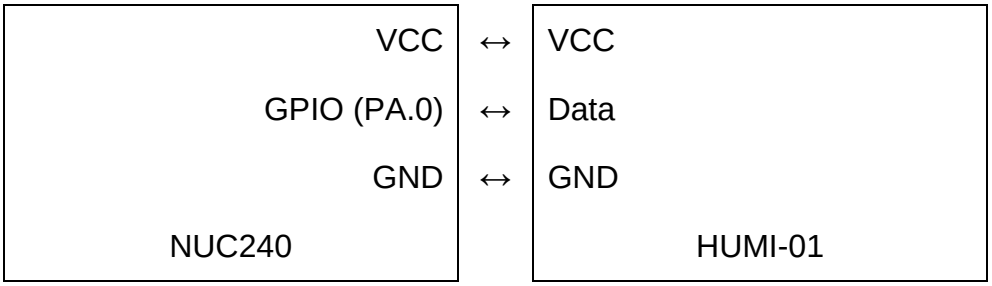
```
while (1)
    {
        /* Delay 1.5 seconds */
        Delay_mS(1500);

        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 软件与硬件环境

- 软件环境
  - BSP 版本
    - NUC230/240 Series BSP CMSIS V3.01.001
  - IDE 版本
    - Keil uVersion 5.26
- 硬件环境
  - 电路组件
    - NuTiny-SDK-NUC240V V1.2
    - 湿度和温度传感器 DHT11 (模块 HUMI-01)
  - 示意图

NUC240使用GPIO (PA.0)连接模块HUMI-01的Data脚位。



4 目录信息

- 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 如何执行范例程序

1. 根据目录信息章节进入 ExampleCode 路径中的 KEIL 文件夹，双击 NUC240_Read_DHT11_Data.uvproj。
2. 进入编译模式接口
   a. 编译
   b. 下载代码至内存
   c. 进入 / 离开除错模式
3. 进入除错模式接口
   a. 执行代码

6 修订纪录

Date	Revision	Description
June 26, 2019	1.00	1. 初始发布.

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