用M451的I2C驅動MPU6050

Example Code Introduction for 32-bit NuMicro® Family

Information

Application	本範例代碼使用 M451 I2C 驅動控制六軸傳感器 MPU6050
BSP Version	M451 Series BSP CMSIS v3.01.003
Hardware	SmartM-M451 Mini

1 功能描述

本範例代碼使用 GPIO 模擬 I2C 初始化 6 軸傳感器，並且通過 I2C 讀取 6 軸傳感器數據返回給 M451，M451 通過串口將數據發送給 PC 端的上位機，從而在上位機軟件中可以直觀的看到 6 軸傳感器的位置變化。本代碼使用的 6 軸傳感器為 InvenSense 的 MPU6050，使用 I2C 協議通訊，初始化和控制接口函數可以在 MPU6050.c 中找到函數原型，傳感器的設定和數據獲取請參照 MPU6050 的規格書。

2 代碼描述

首先初始化 MPU6050 並檢查傳感器 ID 是否正確：

```
UINT8 MPU_Init(void)
{
 UINT8 res;
 IIC_Init();
 MPU_Write_Byte(MPU_PWR_MGMT1_REG,0X80);
 Delayms(100);
 MPU_Write_Byte(MPU_PWR_MGMT1_REG,0X00);
 MPU_Set_Gyro_Fsr(3);
 MPU_Set_Accel_Fsr(0);
 MPU_Set_Rate(50);
 MPU_Write_Byte(MPU_INT_EN_REG,0X00);
 MPU_Write_Byte(MPU_USER_CTRL_REG,0X00);
 MPU_Write_Byte(MPU_FIFO_EN_REG,0X00);
 MPU_Write_Byte(MPU_INTBP_CFG_REG,0X80);
 res=MPU_Read_Byte(MPU_DEVICE_ID_REG);
 printf("RES=%x\r\n",res);
 if(res==MPU_ADDR)
 {
     MPU_Write_Byte(MPU_PWR_MGMT1_REG,0X01);
     MPU_Write_Byte(MPU_PWR_MGMT2_REG,0X00);
     MPU_Set_Rate(50);
 }else return 1;
 return 0;
}
```

MCU 獲取 MPU6050 的數據程序如下：

```
u8 mpu_dmp_get_data(float *pitch,float *roll,float *yaw)
{
    float q0=1.0f,q1=0.0f,q2=0.0f,q3=0.0f;
    unsigned long sensor_timestamp;
    short gyro[3], accel[3], sensors;
    unsigned char more;
    long quat[4];
    if(dmp_read_fifo(gyro, accel, quat, &sensor_timestamp, &sensors,&more))return 1;
    if(sensors&INV_WXYZ_QUAT)
    {
        q0 = quat[0] / q30;
        q1 = quat[1] / q30;
        q2 = quat[2] / q30;
        q3 = quat[3] / q30;
        //calculator angle of pitch /roll angle / yaw angle
        *pitch = asin(-2 * q1 * q3 + 2 * q0* q2)* 57.3; // pitch
        *roll  = atan2(2 * q2 * q3 + 2 * q0 * q1, -2 * q1 * q1 - 2 * q2* q2 + 1)* 57.3; // roll
        *yaw   = atan2(2*(q1*q2 + q0*q3),q0*q0+q1*q1-q2*q2-q3*q3) * 57.3; //yaw
    }else return 2;
    return 0;
}
```

通過串口上傳數據到 PC 的程序如下：

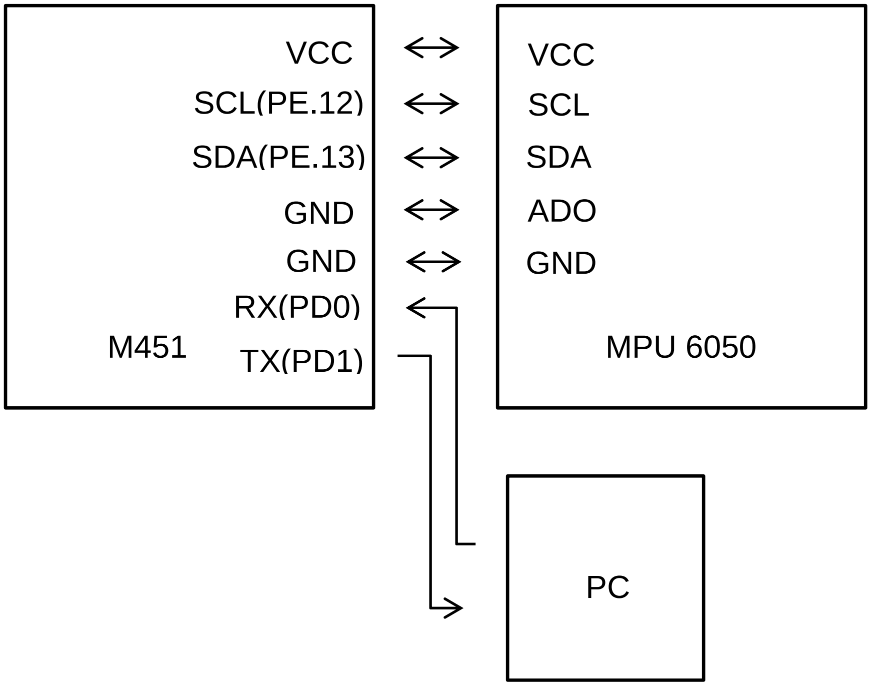
```
void Uart0ReportImu(short aacx,short aacy,short aacz,short gyrox,short gyroy,short gyroz,short roll,short pitch,short yaw)
{
    u8 tbuf[28];
    u8 i;
    for(i=0;i<28;i++)tbuf[i]=0;
    tbuf[0]=(aacx>>8)&0XFF;
    tbuf[1]=aacx&0XFF;
    tbuf[2]=(aacy>>8)&0XFF;
    tbuf[3]=aacy&0XFF;
    tbuf[4]=(aacz>>8)&0XFF;
    tbuf[5]=aacz&0XFF;
    tbuf[6]=(gyrox>>8)&0XFF;
    tbuf[7]=gyrox&0XFF;
    tbuf[8]=(gyroy>>8)&0XFF;
    tbuf[9]=gyroy&0XFF;
    tbuf[10]=(gyroz>>8)&0XFF;
    tbuf[11]=gyroz&0XFF;
    tbuf[18]=(roll>>8)&0XFF;
    tbuf[19]=roll&0XFF;
    tbuf[20]=(pitch>>8)&0XFF;
    tbuf[21]=pitch&0XFF;
    tbuf[22]=(yaw>>8)&0XFF;
    tbuf[23]=yaw&0XFF;
    Uart0NimingReport(0XAF,tbuf,28);
}
```

```
void Uart0NimingReport(u8 fun,u8*data,u8 len)
{
    u8 send_buf[32];
    u8 i;
    if(len>28)return;
    send_buf[len+3]=0;
    send_buf[0]=0X88;
    send_buf[1]=fun;
    send_buf[2]=len;
    for(i=0;i<len;i++)send_buf[3+i]=data[i];
    for(i=0;i<len+3;i++)send_buf[len+3]+=send_buf[i];
    for(i=0;i<len+4;i++)UART_Write(UART0,&send_buf[i],1);
}
```

3 軟件和硬件環境

- **軟體環境**
  - BSP 版本
    - M451 Series BSP CMSIS v3.01.003
  - IDE 版本
    - Keil uVersion 4.6
- **硬體環境**
  - 電路元件
    - SmartM-M451 Mini
    - MPU6050
  - 示意圖

M451 使用 I^2C 來傳輸控制命令至 MPU6050 感測器，使用 UART0 來上報數據到 PC 端。



4 目錄信息

🗁 EC_M451_Six-axis_Sensor_MPU6050_Driver_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 如何執行示例代碼

1. 根據目錄信息章節進入 ExampleCode 路徑中的 KEIL 資料夾，雙擊 M451_Six-axis_Sensor_MPU6050_Driver
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 修訂記錄

Date	Revision	Description
Sep.25, 2019	1.00	1. 初始發佈

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