NUC240使用GPIO模擬I²C存取EEPROM

NuMicro® 32 位系列微控制器范例代码介绍

文件信息

代码简述	本范例代码使用NUC240的GPIO模拟I²C存取EEPROM
BSP 版本	NUC230_240 Series BSP CMSIS v3.01.001
开发平台	NuEdu-EVB-NUC240 v1.0

1 功能介绍

1.1 简介

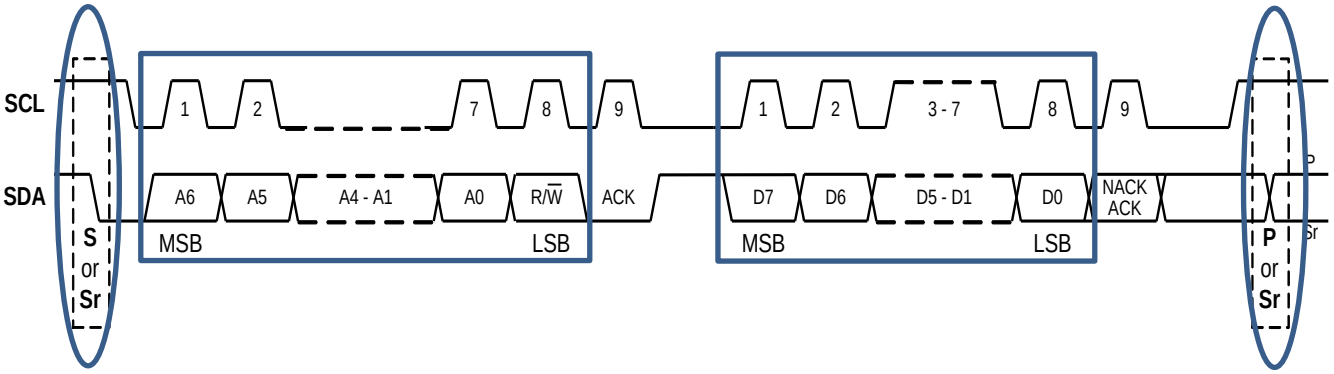
产品开发时，难免会碰到硬件I²C组数不够用，此时便可以用GPIO产生I²C的波形。本范例用软件操作GPIO实现I²C的功能，外部接一个EEPROM，程控去写读EEPROM。本范例提供了2个API，让使用者呼叫：

API	功能
void I2C_GPIO_Write_Byte(uint16_t u16Addr, uint8_t u8Data)	送出字符
void I2C_GPIO_Read_Byte(uint16_t u16Addr, uint8_t* pu8Data)	接收字符

1.2 原理

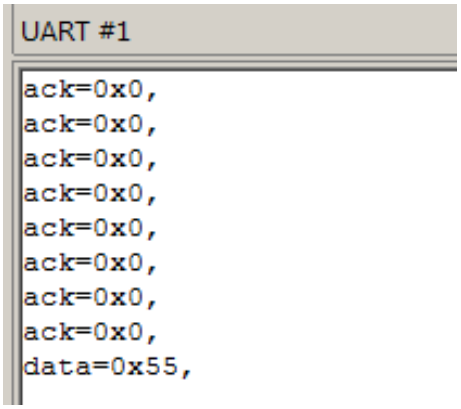
I²C协议分为四个步骤：

1. 产生 START 或 Repeated START 讯号
2. 传输 Slave 地址与读/写 bit
3. 数据传输
4. 产生 STOP 讯号



1.3 执行结果

NUC240开发版的PA11(SCK)连接至NuEdu-Basic01的NU6_10； PA10(SDA)连接至NuEdu-Basic01的NU6_9。编译项目并进入除错模式执行代码， EEPROM透过I²C响应的ACK与读写数值会打印在串口窗口 UART #1。


UART #1
ack=0x0,
ack=0x0,
ack=0x0,
ack=0x0,
ack=0x0,
ack=0x0,
ack=0x0,
ack=0x0,
data=0x55,

2 代码介绍

2.1 软件 I²C 初始化

I2C_Init此函式主要工作为软件I²C的初始化，即将GPIO(PA.10与PA.11)脚位设定成开漏模式，且在空闲时I/O为高电位。

```
void I2C_Init(void)
{
       /* Configure PA10 as open-drain mode */
       GPIO_SetMode(PA, BIT10, GPIO_PMD_OPEN_DRAIN);

       /* Configure PA11 as open-drain mode */
       GPIO_SetMode(PA, BIT11, GPIO_PMD_OPEN_DRAIN);

       /* Control PA11 output status */
       I2C_CLK = 1;

       /* Control PA10 output status */
       I2C_DAT = 1;
}
```

2.2 I²C 字符传送

I2C_GPIO_Write_Byte此函式主要工作为传送I²C字符，需指定EEPROM的地址与欲传输的字符。EEPROM协议请参考EEPROM产品规格手册。

```
void I2C_GPIO_Write_Byte(uint16_t u16Addr, uint8_t u8Data)
{
       uint8_t u8AddrH, u8AddrL;

       u8AddrH = u16Addr >> 8;
       u8AddrL = (uint8_t)u16Addr;

       /* Send Start bit to I2C EEPROM */
       I2C_Start();

       /* Send control byte to I2C EEPROM */
       printf("ack=0x%x,\n\r",I2C_Write(I2C_ADDRESS_W));
```

```
	/* Send I2C EEPROM's High Byte Address */
	printf("ack=0x%x,\n\r",I2C_Write(u8AddrH));

	/* Send I2C EEPROM's Low Byte Address */
	printf("ack=0x%x,\n\r",I2C_Write(u8AddrL));

	/* Send data byte to I2C EEPROM */
	printf("ack=0x%x,\n\r",I2C_Write(u8Data));

	/* Send Stop bit to I2C EEPROM */
	I2C_Stop();
}
```

2.3 I²C 字符接收

I2C_GPIO_Read_Byte此函式主要工作为I²C字符，需指定EEPROM的地址。EEPROM协议请参考EEPROM产品规格手册。

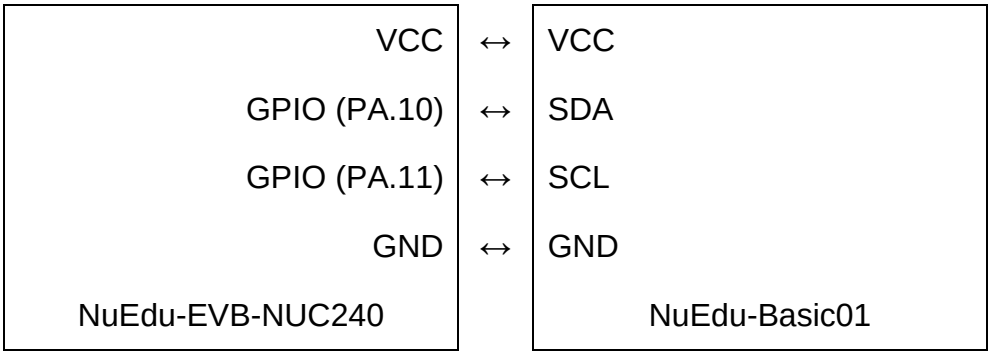
```
void I2C_GPIO_Read_Byte(uint16_t u16Addr, uint8_t* pu8Data)
{
	uint8_t u8AddrH, u8AddrL;

	u8AddrH = u16Addr >> 8;
	u8AddrL = (uint8_t)u16Addr;

	/* Send Start bit to I2C EEPROM */
	I2C_Start();

	/* Send control byte to I2C EEPROM */
	printf("ack=0x%x,\n\r",I2C_Write(I2C_ADDRESS_W));

	/* Send I2C EEPROM's High Byte Address */
	printf("ack=0x%x,\n\r",I2C_Write(u8AddrH));

	/* Send I2C EEPROM's Low Byte Address */
	printf("ack=0x%x,\n\r",I2C_Write(u8AddrL));

	/* Send Start bit to I2C EEPROM */
	I2C_Start();
```

```
    /* Send control byte to I2C EEPROM */
    printf("ack=0x%x,\n\r",I2C_Write(I2C_ADDRESS_R));

    /* Read data byte from EEPROM */
    *pu8Data = I2C_Read(NO_ACK);

    /* Send Stop bit to I2C EEPROM */
    I2C_Stop();
}
```

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 4.74
- 硬件环境
  - 电路组件
    - NuEdu-EVB-NUC240 V1.0
    - NuEdu-Basic01 V2.1
  - 示意图

    NuEdu-EVB-NUC240 使用 PA10 与 PA11 脚位模拟 I^2C 的 SDA 与 SCL 波型来控制在 NuEdu-Basic01 上的EEPROM。



4 目录信息

EC_NUC240_GPIO_I2C_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
NuEdu	Library for NuEdu-SDK-NUC240 board
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_GPIO_I2C.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
Nov. 1, 2019	1.00	1. 初始发布

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