NUC240使用GPIO模擬I²C存取EEPROM

NuMicro® 32 位系列微控制器範例代碼介紹

文件資訊

代碼簡述	本範例代碼使用NUC240的GPIO模擬I²C存取EEPROM
BSP 版本	NUC230_240 Series BSP CMSIS v3.01.001
開發平台	NuEdu-EVB-NUC240 v1.0

1 功能介紹

1.1 簡介

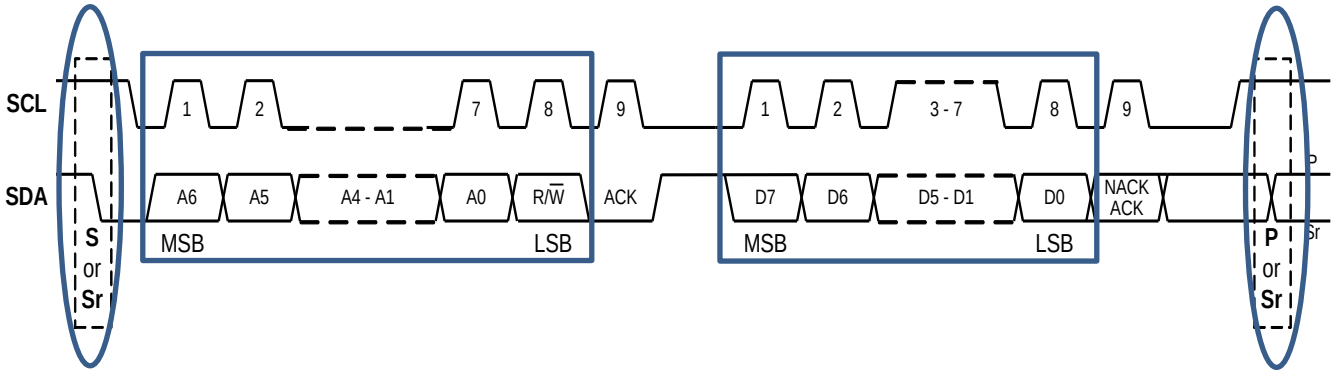
產品開發時，難免會碰到硬體I²C組數不夠用，此時便可以用GPIO產生I²C的波形。本範例用軟體操作GPIO實現I²C的功能，外部接一個EEPROM，程式控制去寫讀EEPROM。本範例提供了2個API，讓使用者呼叫：

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

1.2 原理

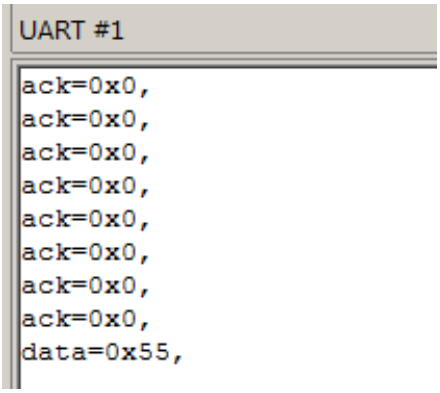
I²C協定分為四個步驟：

1. 產生 START 或 Repeated START 訊號
2. 傳輸 Slave 地址與讀/寫 bit
3. 資料傳輸
4. 產生 STOP 訊號



1.3 執行結果

NUC240開發版的PA11(SCK)連接至NuEdu-Basic01的NU6_10；PA10(SDA)連接至NuEdu-Basic01的NU6_9。編譯專案並進入除錯模式執行程式， EEPROM透過I^{2}C回應的ACK與讀寫數值會列印在Serial Window UART #1。



2 代碼介紹

2.1 軟體 I²C 初始化

I2C_Init()此函式主要工作為軟體 I²C的初始化，即將GPIO(PA.10與PA.11)腳位設定成Open-drain模式，且在空閒時I/O為高電位。

```
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 字元傳送

I2C_GPIO_Write_Byte()此函式主要工作為傳送I²C字元，需指定EEPROM的位址與欲傳輸的字元。EEPROM協定請參考EEPROM產品規格手冊。

```
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 字元接收

I2C_GPIO_Read_Byte此函式主要工作為I²C字元，需指定EEPROM的位址。EEPROM協定請參考EEPROM產品規格手冊。

```
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 軟體與硬體環境

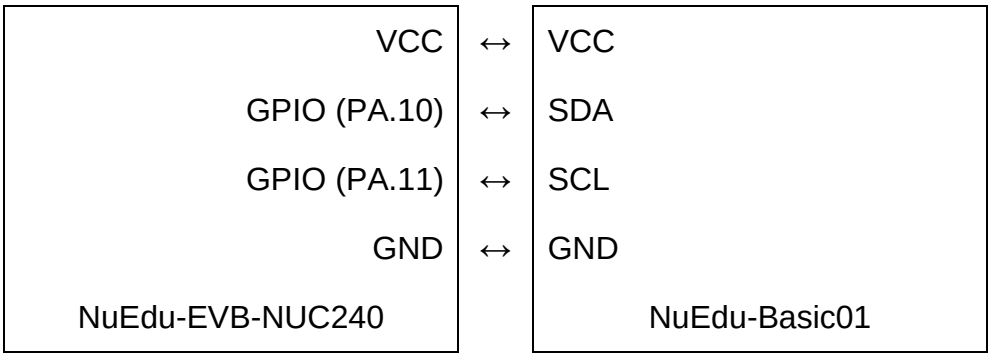
● 軟體環境

- ■ BSP 版本
  - ◆ NUC230_240 Series BSP CMSIS v3.01.001
- ■ IDE 版本
  - ◆ Keil uVersion 4.74

● 硬體環境

- ■ 電路元件
  - ◆ NuEdu-EVB-NUC240 V1.0
  - ◆ NuEdu-Basic01 V2.1
- ■ 示意圖

NuEdu-EVB-NUC240 使用 PA10 與 PA11 腳位模擬 I^2C 的 SDA 與 SCL 波型來控制在 NuEdu-Basic01 上的 EEPROM。



4 目錄資訊

- 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_GPIO_I2C.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
Nov. 1, 2019	1.00	1. 初始發布

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