由ADC取樣的值調整PWM的佔空比

NuMicro® 32 位系列微控制器範例代碼介紹

文件資訊

代碼簡述	本範例代碼演示經由 ADC 取樣的值，調整 PWM 的占空比，進而改變 LED 燈的亮度。
BSP 版本	NUC230/240 Series BSP v3.01.002
開發平台	NUC240VE3AN NuEdu Board V2.0 + NuEdu-Basic01 V2.0

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1 功能介紹

1.1 簡介

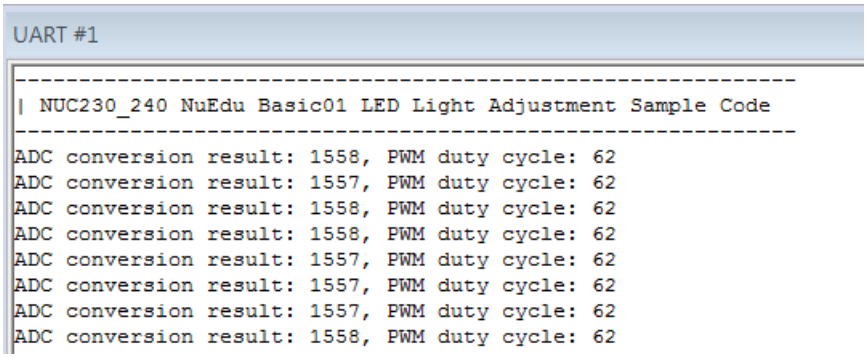
此範例演示當NuEdu-Basic01子板的旋鈕轉動時，子板上的LED燈會改變亮度。

1.2 原理

當NuEdu-Basic01子板的旋鈕轉動時，會改變電阻值，進而使電路的電壓產生變化，而ADC會取樣此電壓值，根據取樣的電壓值來計算PWM的占空比，進而改變LED燈的亮度。

1.3 執行結果

範例執行結果，可進入Keil MDK 偵錯模式，打開UART#1視窗，即可看到輸出訊息如下。



2 代碼介紹

範例程式如下。在 SYS_Init() 中開啟晶振，打開 ADC 和 PWMA 模組並選擇其時鐘源，設置所有使用腳位的 MFP 功能。

設置腳位的 MFP 功能如下：

- PA.0 設置為 ADC channel 0
- PA.12 設置為 PWMA channel 0

```
void SYS_Init(void)
{
    /*---------------------------------------------------------------------------------------------*/
    /* Init System Clock                                                                           */
    /*---------------------------------------------------------------------------------------------*/

    /* Enable Internal RC clock */
    CLK_EnableXtalRC(CLK_PWRCON_OSC22M_EN_Msk);

    /* Waiting for IRC22M clock ready */
    CLK_WaitClockReady(CLK_CLKSTATUS_OSC22M_STB_Msk);

    /* Switch HCLK clock source to Internal RC and HCLK source divide 1 */
    CLK_SetHCLK(CLK_CLKSEL0_HCLK_S_HIRC, CLK_CLKDIV_HCLK(1));

    /* Enable ADC module clock */
    CLK_EnableModuleClock(ADC_MODULE);

    /* Enable PWM module clock */
    CLK_EnableModuleClock(PWM01_MODULE);

    /* ADC clock source is 22.1184MHz, set divider to 7, ADC clock is 22.1184/7 MHz */
    CLK_SetModuleClock(ADC_MODULE, CLK_CLKSEL1_ADC_S_HIRC, CLK_CLKDIV_ADC(7));

    /* Select PWM module clock source */
    CLK_SetModuleClock(PWM01_MODULE, CLK_CLKSEL1_PWM01_S_HIRC, 0);

    /* Reset PWMA channel0~channel3 */
    SYS_ResetModule(PWM03_RST);
```

```
        /* Update System Core Clock */
        SystemCoreClockUpdate();

        /*---------------------------------------------------------------------------------------*/
        /* Init I/O Multi-function                                                               */
        /*---------------------------------------------------------------------------------------*/
        /* Disable the GPA0 digital input path to avoid the leakage current. */
        GPIO_DISABLE_DIGITAL_PATH(PA, 0x01);

        /* Configure the GPA0 ADC analog input pins. */
        SYS->GPA_MFP = (SYS->GPA_MFP & ~(SYS_GPA_MFP_PA0_Msk)) | SYS_GPA_MFP_PA0_ADC0;
        SYS->ALT_MFP1 = (SYS->ALT_MFP1 & ~(SYS_ALT_MFP1_PA0_Msk)) | SYS_ALT_MFP1_PA0_ADC0;

        /* Set GPA multi-function pins for PWMA Channel 0 */
        SYS->GPA_MFP = (SYS->GPA_MFP & ~(SYS_GPA_MFP_PA12_Msk)) | SYS_GPA_MFP_PA12_PWM0;
        SYS->ALT_MFP1 = (SYS->ALT_MFP1 & ~(SYS_ALT_MFP1_PA12_Msk)) |SYS_ALT_MFP1_PA12_PWM0;
    }
```

在 main() 中開啟 ADC 和 PWM 後，會一直在 while 迴圈中呼叫 ADC_GET_CONVERSION_DATA() 抓取 ADC channel 0 取樣的值，接著呼叫 PWM_ConfigOutputChannel()來設置 PWMA channel 0 打出的頻率和占空比。

```
/*---------------------------------------------------------------------------------------*/
/*  Main Function                                                                        */
/*---------------------------------------------------------------------------------------*/
int32_t main(void)
{
    uint32_t u32ADCRawData;

    /* Unlock protected registers */
    SYS_UnlockReg();

    /* Init System, IP clock and multi-function I/O */
    SYS_Init();

    /* Lock protected registers */
    SYS_LockReg();

    printf("-----------------------------------------------------------\n");
    printf("| NUC230_240 NuEdu Basic01 LED Light Adjustment Sample Code\n");
    printf("-----------------------------------------------------------\n");
```

```
    /* Set the ADC operation mode as single, input mode as single-end and enable the
analog input channel 0 */
    ADC_Open(ADC, ADC_ADCR_DIFFEN_SINGLE_END, ADC_ADCR_ADMD_SINGLE, 0x1 << 0);

    /* Power on ADC module */
    ADC_POWER_ON(ADC);

    /* Set PWMA channel 0 output configuration */
    PWM_ConfigOutputChannel(PWMA, PWM_CH0, 100, 50);

    /* Enable PWM Output path for PWMA channel 0 */
    PWM_EnableOutput(PWMA, 0x01);

    /* Start PWM */
    PWM_Start(PWMA, 0x01);

    while(1)
    {
        /* LED4 toggle */
        LED4 ^= 1;

        /* Clear ADC convert complete interrupt flag */
        ADC_CLR_INT_FLAG(ADC, ADC_ADF_INT);

        /* ADC start conversion */
        ADC_START_CONV(ADC);

        /* Wait for ADC convert complete */
        while(ADC_GET_INT_FLAG(ADC,ADC_ADF_INT)!=ADC_ADF_INT);

        /* Get the conversion result */
        u32ADCRawData = ADC_GET_CONVERSION_DATA(ADC,0);

        /* Configure PWM duty cycle to adjust the light of RGB LED by ADC conversion
result */
        PWM_ConfigOutputChannel(PWMA, PWM_CH0, 100, (100 - (u32ADCRawData * 100 / 4096)));

        printf("ADC conversion result: %d, PWM duty cycle: %d\n", u32ADCRawData, (100 -
(u32ADCRawData * 100 / 4096)));

        /* Delay 30000 us */
        CLK_SysTickDelay(30000);
```

```
    }
}
```

3 軟體與硬體環境

● 軟體環境

- ■ BSP 版本
  - ◆ NUC230/240 Series BSP v3.01.002
- ■ IDE 版本
  - ◆ Keil uVersion 5.26

● 硬體環境

- ■ 電路元件
  - ◆ NUC240VE3AN NuEdu Board V2.0
  - ◆ NuEdu-Basic01 V2.0
- ■ 示意圖

NUC240 NuEdu Board V2.0		NuEdu-Basic01 V2.0
VCC	↔	VCC
ADC0 (PA.0)	↔	NU2_1(ADC_MEASURE)
PWM0 (PA.12)	↔	NU5_3(R_LED)
GND	↔	GND

4 目錄資訊

- EC_NUC240_ADC_PWM_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_ADC_PWM.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
Sep. 27, 2019	1.00	1. 初始發布.

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