由ADC取样的值调整PWM的占空比

NuMicro® 32 位系列微控制器范例代码介绍

文件信息

代码简述	本范例代码演示经由 ADC 取样的值，调整 PWM 的占空比，进而改变 LED 灯的亮度。
BSP 版本	NUC230/240 Series BSP v3.01.002
开发平台	NUC240VE3AN NuEdu Board V2.0 + NuEdu-Basic01 V2.0

The information described in this document is the exclusive intellectual property of Nuvoton Technology Corporation and shall not be reproduced without permission from Nuvoton.

Nuvoton is providing this document only for reference purposes of NuMicro microcontroller based system design. Nuvoton assumes no responsibility for errors or omissions.

All data and specifications are subject to change without notice.

For additional information or questions, please contact: Nuvoton Technology Corporation.

www.nuvoton.com

1 功能介绍

1.1 简介

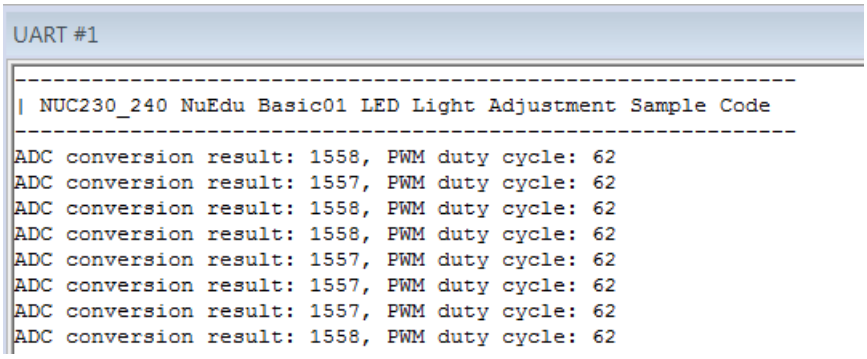
此范例演示当NuEdu-Basic01子板的旋钮转动时，子板上的LED灯会改变亮度。

1.2 原理

当NuEdu-Basic01子板的旋钮转动时，会改变电阻值，进而使电路的电压产生变化，而ADC会取样此电压值，根据取样的电压值来计算PWM的占空比，进而改变LED灯的亮度。

1.3 执行结果

范例执行结果，可进入Keil MDK 侦错模式，打开UART#1窗口，即可看到输出讯息如下。



2 代码介绍

范例程序如下。在 SYS_Init() 中开启晶振，打开 ADC 和 PWMA 模块并选择其时钟源，设置所有使用脚位的 MFP 功能。
设置脚位的 MFP 功能如下：

- PA.0 设置为 ADC channel 0
- PA.12 设置为 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() 中开启 ADC 和 PWM 后，会一直在 while 循环中呼叫 ADC_GET_CONVERSION_DATA() 抓取 ADC channel 0 取样的值，接着呼叫 PWM_ConfigOutputChannel()来设置 PWMA channel 0 打出的频率和占空比。

```
/*---------------------------------------------------------------------------*/
/*  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 软件与硬件环境

- 软件环境
  - BSP 版本
    - NUC230/240 Series BSP v3.01.002
  - IDE 版本
    - Keil uVersion 5.26
- 硬件环境
  - 电路组件
    - NUC240VE3AN NuEdu Board V2.0
    - NuEdu-Basic01 V2.0
  - 示意图

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 目录信息

- 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_ADC_PWM.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
Sep. 27, 2019	1.00	1. 初始发布.

Important Notice

Nuvoton Products are neither intended nor warranted for usage in systems or equipment, any malfunction or failure of which may cause loss of human life, bodily injury or severe property damage. Such applications are deemed, "Insecure Usage".

Insecure usage includes, but is not limited to: equipment for surgical implementation, atomic energy control instruments, airplane or spaceship instruments, the control or operation of dynamic, brake or safety systems designed for vehicular use, traffic signal instruments, all types of safety devices, and other applications intended to support or sustain life.

All Insecure Usage shall be made at customer's risk, and in the event that third parties lay claims to Nuvoton as a result of customer's Insecure Usage, customer shall indemnify the damages and liabilities thus incurred by Nuvoton.

Please note that all data and specifications are subject to change without notice.
All the trademarks of products and companies mentioned in this datasheet belong to their respective owners.