# GPIO 软件防抖

NuMicro® 32 位系列微控制器范例代码介绍

## 文件信息

| | |
|---|---|
| 代码简述 | 使用定时器周期模式，每 1 毫秒产生一次定时器中断，来完成软件按键防抖 |
| BSP 版本 | M031_Series_BSP_CMSIS_V3.02.000 |
| 开发平台 | NuMaker-M032SE V1.3 |

# 1 功能介绍

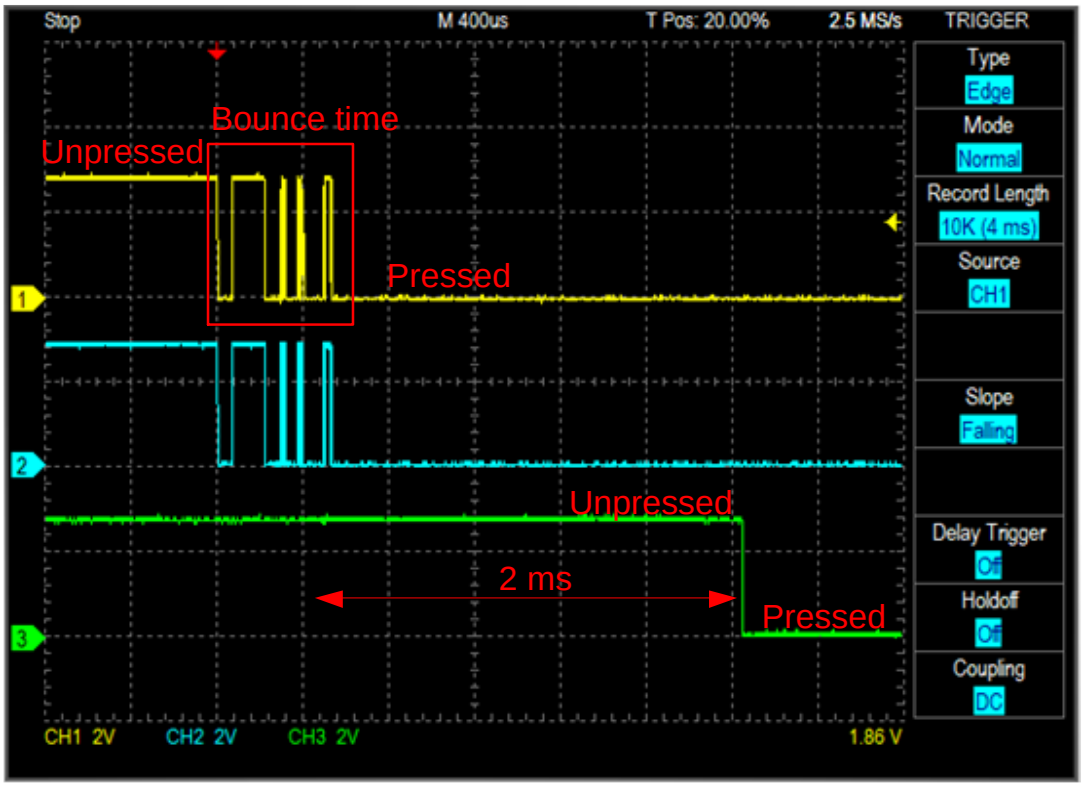
## 1.1 简介

弹跳是由电子设备中触点的闭合或断开产生的多个脉冲信号。 最常见的是机械按钮，当按下按钮一次时，会产生多个脉冲信号， MCU会认为是多次按下并放开按键，而导致误动作，因此需要防抖，以确保获得正确的信号。 本文主要使用定时器和GPIO进行软件防抖实验。

## 1.2 原理

此软件防抖是使用Timer每1ms产生一个中断并将1ms旗标设置为1，然后根据此旗标每1ms确认按钮的状态。 在按钮状态一段时间未改变之后，即可以确定按钮已被稳定地按下或放开。 然后MCU可以将其判断为正确的信号，并将该信号输出到LED。 另外，可以根据不同按钮的稳定时间设置防抖时间。

## 1.3 执行结果




**CH1:** 击键 (PC.14),
**CH2:** 没有防抖的讯号输出 (PB.15),
**CH3:** LED, 有防抖的讯号输出(PB.14)

注: 这个波型的防抖时间设为 2 ms.

# 2 代码介绍

```
/*---------------------------------------------------------------------------*/
/* Define                                                                    */
/*---------------------------------------------------------------------------*/
#define DEBOUNCE_TIME 50            //Press and release button settling time ( ms )
#define BUTTON1 PC14                //Button input port
#define LED PB14                    //Indicator light used to indicate that a button is
                                      pressed(debounced)
#define TEST_PIN PB15               //Used to measure button state without debouncing

/*---------------------------------------------------------------------------*/
/* Global variables                                                          */
/*---------------------------------------------------------------------------*/
uint8_t bTimer_1ms;                 //Timer 1ms flag
uint8_t g_ButtonState;              //BUTTON1's current state
uint8_t g_ButtonStateOld;           //BUTTON1's previous state
uint8_t g_ButtonStateDebounced = 1; //BUTTON1's de-bounced state
uint32_t g_ButtonDebounceCnt = 0;

/*---------------------------------------------------------------------------*/
/* Functions                                                                 */
/*---------------------------------------------------------------------------*/
uint8_t GPIO_Debounce(void);

void TMR0_IRQHandler(void)
{
    /* Set 1ms flag */
    bTimer_1ms = 1;
    /* clear timer interrupt flag */
    TIMER_ClearIntFlag(TIMER0);
}

void SYS_Init(void)
{
    /* Unlock protected registers */
    SYS_UnlockReg();

    /* Enable HIRC */
    CLK_EnableXtalRC(CLK_PWRCTL_HIRCEN_Msk);
```

```
    /* Waiting for HIRC clock ready */
    CLK_WaitClockReady(CLK_STATUS_HIRCSTB_Msk);

    /* Switch HCLK clock source to HIRC */
    CLK_SetHCLK(CLK_CLKSEL0_HCLKSEL_HIRC, CLK_CLKDIV0_HCLK(1));

    /* Set both PCLK0 and PCLK1 as HCLK/2 */
    CLK->PCLKDIV = (CLK_PCLKDIV_APB0DIV_DIV2 | CLK_PCLKDIV_APB1DIV_DIV2);

    /* Switch UART0 clock source to HIRC */
    CLK_SetModuleClock(UART0_MODULE, CLK_CLKSEL1_UART0SEL_HIRC, CLK_CLKDIV0_UART0(1));

    /* Enable UART peripheral clock */
    CLK_EnableModuleClock(UART0_MODULE);

    /* Enable IP clock */
    CLK_EnableModuleClock(TMR0_MODULE);

    /* Select IP clock source */
    CLK_SetModuleClock(TMR0_MODULE, CLK_CLKSEL1_TMR0SEL_HIRC, 0);

    /* Update System Core Clock */
    /* User can use SystemCoreClockUpdate() to calculate PllClock, SystemCoreClock and
       CycylesPerUs automatically. */
    SystemCoreClockUpdate();

    /*---------------------------------------------------------------------*/
    /* Init I/O Multi-function                                             */
    /*---------------------------------------------------------------------*/
    /* Set GPB multi-function pins for UART0 RXD and TXD */
    SYS->GPB_MFPH = (SYS->GPB_MFPH & ~(SYS_GPB_MFPH_PB12MFP_Msk |
                     SYS_GPB_MFPH_PB13MFP_Msk)) |
                    (SYS_GPB_MFPH_PB12MFP_UART0_RXD | SYS_GPB_MFPH_PB13MFP_UART0_TXD);

    /* Lock protected registers */
    SYS_LockReg();
}
```

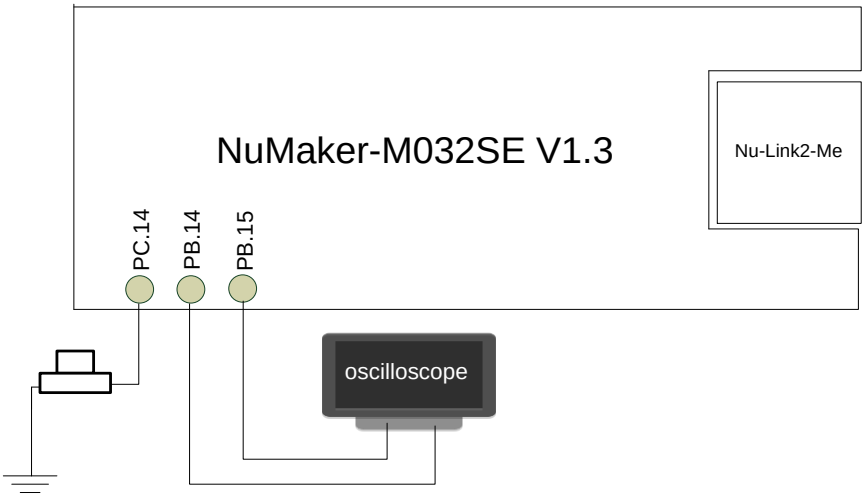
```
/*---------------------------------------------------------------------*/
/* Init UART0                                                          */
/*---------------------------------------------------------------------*/
void UART0_Init(void)
{
    /* Reset UART0 */
    SYS_ResetModule(UART0_RST);

    /* Configure UART0 and set UART0 baud rate */
    UART_Open(UART0, 115200);
}

int main(void)
{
    /* Init System, IP clock and multi-function I/O. */
    SYS_Init();

    /* Init UART0 for printf */
    UART0_Init();

    printf("\nThis sample code use timer to generate interrupt every 1 ms for software
              debouncing test \n");

    /* Set timer frequency to 1000 Hz */
    TIMER_Open(TIMER0, TIMER_PERIODIC_MODE, 1000);

    /* Enable timer interrupt */
    TIMER_EnableInt(TIMER0);
    NVIC_EnableIRQ(TMR0_IRQn);

    /* Start Timer 0 */
    TIMER_Start(TIMER0);

    /* Set PC4 to QUASI mode for BUTTON1 debouncing test*/
    GPIO_SetMode(PC, BIT14, GPIO_MODE_QUASI);

    /* Set PB14 and PB15 to output mode for BUTTON1's debouncing test*/
    GPIO_SetMode(PB, BIT14, GPIO_MODE_OUTPUT);//LED
    GPIO_SetMode(PB, BIT15, GPIO_MODE_OUTPUT);//TEST_PIN



    while (1)
```

```
    {
        /* Output BUTTON1 state to TESE_PIN */
        TEST_PIN = BUTTON1;

        /* Check the BUTTON1 state every 1ms */
        if (bTimer_1ms)
        {
            /* Clear 1ms flag */
            bTimer_1ms = 0;
            /* Output debounced BUTTON1 state to LED */
            LED = GPIO_Debounce();
        }
    }
}


uint8_t GPIO_Debounce(void)
{
    /* Read the BUTTON1 state */
    g_ButtonState = BUTTON1;

    /* Increase g_ButtonState if the previous state is the same as the current state */
    if (g_ButtonStateOld == g_ButtonState)
    {
        g_ButtonDebounceCnt++;

        /*The state is held longer than the button settling time,
          so this state can be treated as the correct state of the button. */
        if (g_ButtonDebounceCnt >= DEBOUNCE_TIME)
        {
            g_ButtonStateDebounced = g_ButtonState;
        }

        /* Clear the count to zero if the current state of the button is different from
           the previous state */
    }
    else
    {
        g_ButtonDebounceCnt = 0;
    }

    g_ButtonStateOld = g_ButtonState;
```

```
    /* Return the correct state of the button */
    return  g_ButtonStateDebounced;
}
```

# 3 软件与硬件环境

- 软件环境
  - BSP 版本
    - M031_Series_BSP_CMSIS_V3.02.000
  - IDE 版本
    - Keil uVersion 5.28
- 硬件环境
  - 电路组件
    - NuMaker-M032SE V1.3
  - 示意图



# 4 目录信息

- EC_M031_GPIO_Software_Debounce_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 EC_M031_GPIO_Software_Debounce.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. 01, 2019 | 1.00 | 1. 初始发布. |

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