HY16F3981
HYCON IP User's Manual

Table of Contents

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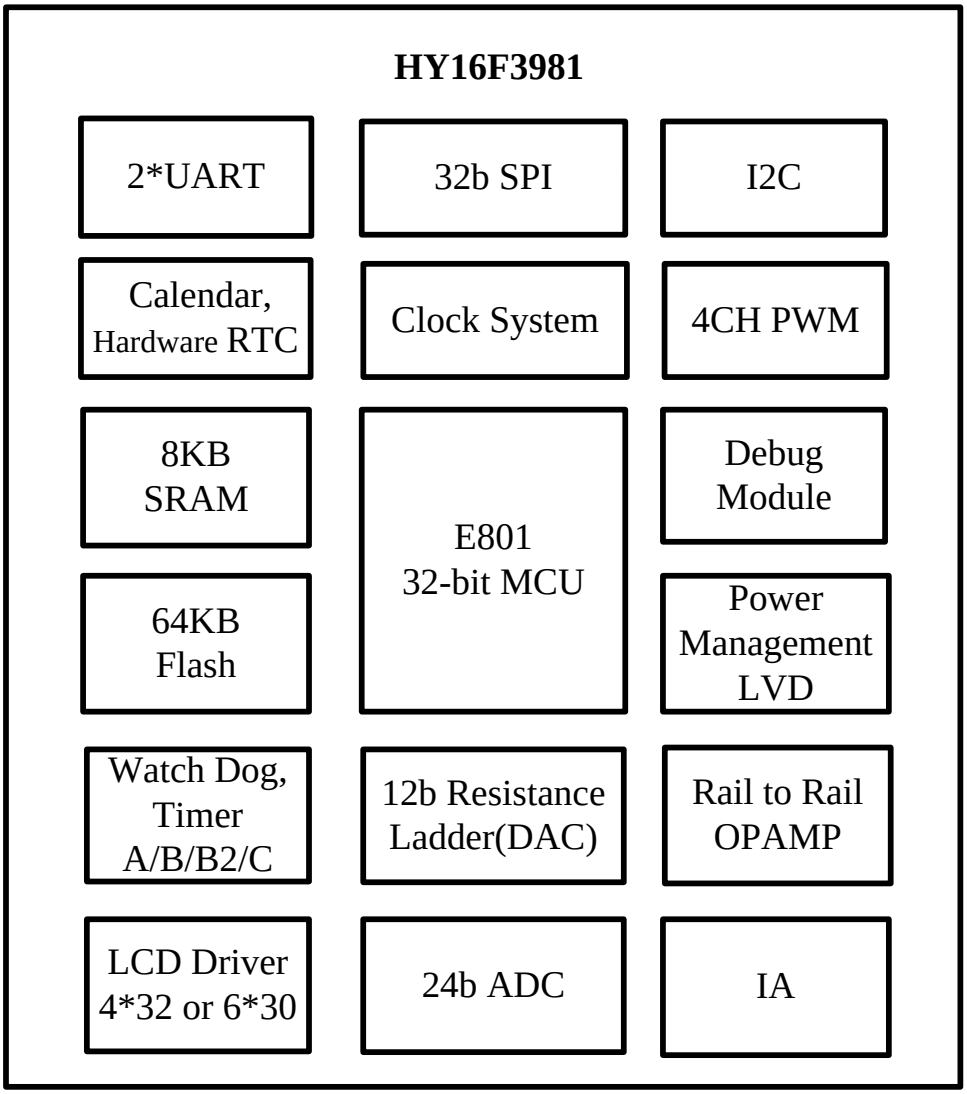
1. Document Description

HYCON IP(Intellectual Property) represents all internal IP of HYCON 32-bit MCU. This document aims at describing SOC IC internal digital, analog, communication and peripheral IP of HY16F3981 Series, of which can be grouped into four categories:

(1) Digital IP : TimerA/TimerB/timerB2/TimerC/WDT/PWM/Hardware RTC/GPIO
(2) Analog IP : 12 bit Resistance Ladder(DAC)/ADC/OPAMP/LCD/IA
(3) Communication IP : Hardware 32-bit SPI/ Hardware UART/ Hardware UART 2/ Hardware I2C
(4) Peripheral IP : Power Management/LVD

2. IC Description

Basic description of each HY16F3981 IP.



(01) Adopting Andes Technology 32-bit CPU core, E801 processor.
(02) Voltage operation range: 2.2~3.6V(No analog power open condition), and temperature operation range: -40℃~85℃.
(03) Support external 16MHz crystal oscillator or internal 16MHz RC oscillator,
(04) Program memory: 64K-Byte Flash ROM
(05) Data memory: 8K-Byte SRAM
(06) BOR and WDT function to prevent CPU from crashing
(07) 24-bit high resolution ΣΔADC
(7.1) Built-in PGA (Programmable Gain Amplifier), 256 times max.
(7.2) Built-in temperature sensor, TPS
(08) Built-in 1 OPA
(09) Built-in hardware 12-bit Resistance Ladder (DAC)
(10) 16-bit Timer A
(11) 16-bit Timer B/B2 module has PWM waveform generating function
(12) 16-bit Timer C module has digital capture function
(13) Hardware serial communication 32-bit SPI/I2C/UART*2 module
(14) Hardware RTC clock function module
(15) LCD Driver

※Interrupt control system

Vector	Interrupt Vector Address	Interrupt Function	Remark
HW0	void HW0_ISR(void)	Communication IP	UART/I2C/32-bit SPI
HW1	void HW1_ISR(void)	Digital IP	Timer A/B/C & WDT/RTC
HW2	void HW2_ISR(void)	ADC IP	SD 24-bit ADC
HW4	void HW4_ISR(void)	PT3 IP	PT3.0~PT3.7 can be independent or can be togetoer to use.
HW5	void HW5_ISR(void)	PT2 IP	PT2.0~PT2.7 can be independent or can be togetoer to use.
HW6	void HW6_ISR(void)	SW Int	
HW7	void HW7_ISR(void)	UART2	
HW8	void HW8_ISR(void)	TMB2	
HW9	void HW9_ISR(void)	OPA IP	Analog OPAMP

3. Digital IP (Timer)

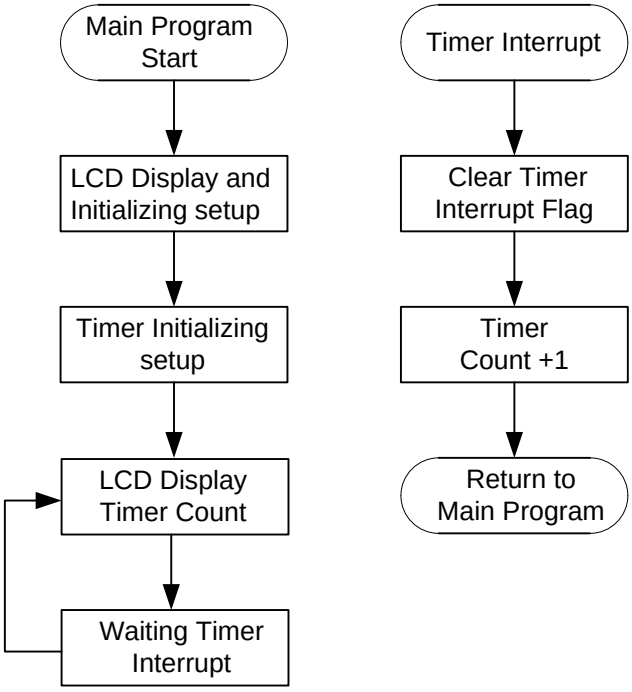
3.1. Example Name

HY16F3981_Timer

3.2. Example Description

(1) Timer A/Timer B/Timer C tutorial.
(2) Using #define to select to compile TMATEST or TMBTEST or TMCTEST.
(3) In this example code, set Timer initializing and Timer overflow condition, enable System GIE and wait Timer interrupt. Timer overflow can decide Timer interrupt frequency.
(4) Everytime Timer interrupt occurs, in the Timer interrupt service routine, variable "Timer Count" to do +1. And then return to main program to show "Timer Count" on LCD.

3.3. Software Flowchart



3.4. Program Description

```
/*******************************************************************************
 *
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 * copyright or other intellectual property right.
 *
 * ------------------------------------------------------------------------
 * Project Name : HY16F3981_Timer
 * IDE tooling   : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.   : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description   : User choose #define TMATEST or TMBTEST or TMCTEST.
 * This program shows Timer count ++ on LCD Display
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *******************************************************************************/
/*---------------------------------------------------------------------------*/
/* Includes                                                                  */
/*---------------------------------------------------------------------------*/
#include "DrvCLOCK.h"
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"
#include "DrvTimer.h"
#include "System.h"
/*---------------------------------------------------------------------------*/
/* STRUCTURES                                                                */
/*---------------------------------------------------------------------------*/
volatile typedef union _MCUSTATUS
{
   char   _byte;
   struct
   {
      unsigned b_ADCdone:1;
      unsigned b_TMAdone:1;
      unsigned b_TMBdone:1;
      unsigned b_TMC0done:1;
      unsigned b_TMC1done:1;
      unsigned b_RTCdone:1;
      unsigned b_UART_TxDone:1;
      unsigned b_UART_RxDone:1;
   };
} MCUSTATUS;

/*---------------------------------------------------------------------------*/
/* DEFINITIONS                                                               */
/*---------------------------------------------------------------------------*/
//#define   TMATEST
//#define   TMBTEST
#define   TMCTEST
```

```
/*---------------------------------------------------------------------------*/
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/
MCUSTATUS    MCUSTATUSbits;
unsigned int TimerA_count, TimerB_count, TimerC0_count, TimerC1_count;

/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);

/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{

   TimerA_count=0;
   TimerB_count=0;
   TimerC0_count=0;
   TimerC1_count=0;
   DisplayInit();
   ClearLCDframe();

#if defined(TMATEST)
   DrvTMA_Open(15,1);                    //Timer A Overflow
                                         //15:taclk/65536/32;TMRDV=---
                                         //01:HS_CK
   DrvTIMER_ClearIntFlag(E_TMA);         //Clear Timer A interrupt flag
   DrvTIMER_EnableInt(E_TMA);            //Timer A interrupt enable
#endif

#if defined(TMBTEST)
   DrvTMBC_Clk_Source(1,3);              //Timer B Prescaler 1
                                         //1: HS_CK,clock source.
                                         //3: clock divider.ur

   DrvTMB_Open(E_TMB_MODE0,E_TMB_NORMAL,0xFFFF);   //Timer B overflow 0xffff
   DrvTIMER_ClearIntFlag(E_TMB);         //Clear Timer B interrupt flag
   DrvTIMER_EnableInt(E_TMB);            //Timer B interrupt enable

#elif defined(TMCTEST)
   DrvTMBC_Clk_Source(1,1);              //Timer B Prescaler 1
                                         //1: HS_CK,clock source.
                                         //1: clock divider.ur

   DrvTMB_Open(E_TMB_MODE0,E_TMB_NORMAL,0xFFFF);   //Timer B overflow 0xffff

   DrvCapture1_Open(2,14,1);             //Timer C0 use as Capture 1
                                         //input source selection
                                         //2:LS_CK
                                         //14:S_CKource selectione 1 0xfff
   DrvCapture2_Open(1,1);                //Timer C1 use as Capture 2
                                         //Input source selection
                                         //1:same as Caputre1
                                         //Falling-edge trigger

   DrvTIMER_ClearIntFlag(E_TMC0);        //Clear TMC0 interrupt flag
   DrvTIMER_ClearIntFlag(E_TMC1);        //Clear TMC1 interrupt flag
   DrvTIMER_EnableInt(E_TMC0);           //Timer C0 interrupt enable
   DrvTIMER_EnableInt(E_TMC1);           //Timer C1 interrupt enable
#endif

   SYS_EnableGIE(4,0x3FF);               //Enable GIE(Global Interrupt)
   MCUSTATUSbits._byte = 0;

   while(1)                              //Wait for Interrupt
```

```
    {

        if(MCUSTATUSbits.b_TMAdone==1)
        {
            LCD_DATA_DISPLAY(TimerA_count);
            MCUSTATUSbits.b_TMAdone=0;
        }

        if(MCUSTATUSbits.b_TMBdone==1)
        {
            LCD_DATA_DISPLAY(TimerB_count);
            MCUSTATUSbits.b_TMBdone=0;
        }

        if(MCUSTATUSbits.b_TMC0done==1)
        {
            LCD_DATA_DISPLAY(TimerC0_count);
            MCUSTATUSbits.b_TMC0done=0;
        }

        if(MCUSTATUSbits.b_TMC1done==1)
        {
            LCD_DATA_DISPLAY(TimerC1_count);
            MCUSTATUSbits.b_TMC1done=0;
        }

    }
    return 0;
}


/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description   : I2C/UART/SPI interrupt Service Routine (HW0).             */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description   : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{
    if(DrvTIMER_GetIntFlag(E_TMA))
    {
        DrvTIMER_ClearIntFlag(E_TMA);           // Clear TMA interrupt flag
        MCUSTATUSbits.b_TMAdone=1;
        TimerA_count++;
    }

    if(DrvTIMER_GetIntFlag(E_TMB))
    {
        DrvTIMER_ClearIntFlag(E_TMB);           // Clear TMB interrupt flag
        MCUSTATUSbits.b_TMBdone=1;
        TimerB_count++;
    }

    if(DrvTIMER_GetIntFlag(E_TMC0))
    {
```

```
        DrvTIMER_ClearIntFlag(E_TMC0);          // Clear TMC0 interrupt flag
        MCUSTATUSbits.b_TMC0done=1;
        TimerC0_count++;
    }

    if(DrvTIMER_GetIntFlag(E_TMC1))
    {
        DrvTIMER_ClearIntFlag(E_TMC1);          // Clear TMC1 interrupt flag
        MCUSTATUSbits.b_TMC1done=1;
        TimerC1_count++;
    }

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description   : PT3 interrupt Service Routine (HW4).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description   : PT2 interrupt Service Routine (HW5).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                  */
/* Description   : UART2 interrupt Service Routine (HW7).                    */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                  */
/* Description   : TMB2 interrupt Service Routine (HW8).                     */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW8_ISR(void)
{
```

```
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                  */
/* Description    : OPA interrupt Service Routine (HW9).                     */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark         :                                                          */
/*---------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                    */
/* Description    : Exception Service Routines.                              */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark         :                                                          */
/*---------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");    //procedure define by customer.
   asm("nop");
}
/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                                */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*---------------------------------------------------------------------------*/
/* End Of File                                                               */
/*---------------------------------------------------------------------------*/
```

4. Digital IP(WDT)

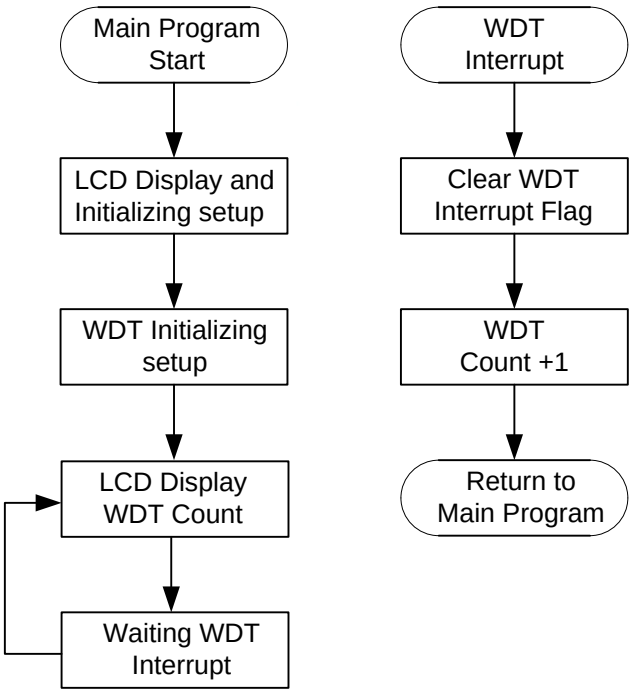
4.1. Example Name

HY16F3981_WDT

4.2. Example Description

(1) WDT tutorial
(2) In this example code, set WDT initializing and WDT overflow condition, enable System GIE and wait WDT interrupt. WDT overflow can decide WDT interrupt frequency.
(3) Everytime WDT interrupt occurs, in the WDT interrupt service routine, variable "WDT Count" to do +1. And then return to main program to show "WDT Count" on LCD.

4.3. Software Flowchart



4.4. Program Description

```
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 * to fitness for a particular purpose, or infringement of any patent,
 * copyright or other intellectual property right.
 *
 * ------------------------------------------------------------------------------
 * Project Name : HY16F3981_WDT
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    : HY16F3981 to do WDT_count++, WDT_count display on LCD
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *******************************************************************************/
/*-------------------------------------------------------------------------*/
/* Includes                                                                */
/*-------------------------------------------------------------------------*/
#include "DrvCLOCK.h"
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"
#include "DrvTimer.h"
#include "System.h"
/*-------------------------------------------------------------------------*/
/* STRUCTURES                                                              */
/*-------------------------------------------------------------------------*/
volatile typedef union _MCUSTATUS
{
   char   _byte;
   struct
   {
      unsigned b_ADCdone:1;
      unsigned b_TMAdone:1;
      unsigned b_TMBdone:1;
      unsigned b_TMC0done:1;
      unsigned b_WDTdone:1;
      unsigned b_RTCdone:1;
      unsigned b_UART_TxDone:1;
      unsigned b_UART_RxDone:1;
   };
} MCUSTATUS;

/*-------------------------------------------------------------------------*/
/* DEFINITIONS                                                             */
/*-------------------------------------------------------------------------*/

/*-------------------------------------------------------------------------*/
/* Global CONSTANTS                                                        */
/*-------------------------------------------------------------------------*/
MCUSTATUS   MCUSTATUSbits;
```

```
unsigned int WDT_count;

/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);

/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{
   WDT_count=0;
   DisplayInit();
   ClearLCDframe();

   DrvWDT_Open(E_IRQ,E_PRE_SCALER_D32);   //WDT IRQ open pre scaler 32
   DrvWDT_ClearWDT();                     //Clear WDT interrupt flag
   DrvTIMER_EnableInt(E_WDT);             //WDT interrupt enable
   SYS_EnableGIE(4,0x3FF);                //Enable GIE(Global Interrupt)
   MCUSTATUSbits._byte = 0;

   while(1)                               //Wait for Interrupt
   {
      if(MCUSTATUSbits.b_WDTdone==1)
      {
         LCD_DATA_DISPLAY(WDT_count);
         MCUSTATUSbits.b_WDTdone=0;
      }
   }
   return 0;
}

/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description   : I2C/UART/SPI interrupt Service Routine (HW0).             */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description   : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{
   if(DrvTIMER_GetIntFlag (E_WDT))
   {
       WDT_count++;
      MCUSTATUSbits.b_WDTdone=1;
      DrvTIMER_ClearIntFlag(E_WDT);     //Clear WDT interrupt flag
   }
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
```

```
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description  : PT3 interrupt Service Routine (HW4).                       */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description  : PT2 interrupt Service Routine (HW5).                       */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                  */
/* Description  : UART2 interrupt Service Routine (HW7).                     */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                  */
/* Description  : TMB2 interrupt Service Routine (HW8).                      */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                  */
/* Description  : OPA interrupt Service Routine (HW9).                       */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                    */
/* Description  : Exception Service Routines.                                */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void tlb_exception_handler()
```

```
{
   asm("nop");    //procedure define by customer.
   asm("nop");
}
/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                                */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*---------------------------------------------------------------------------*/
/* End Of File                                                               */
/*---------------------------------------------------------------------------*/
```

5. Digital IP(WDT Reset)

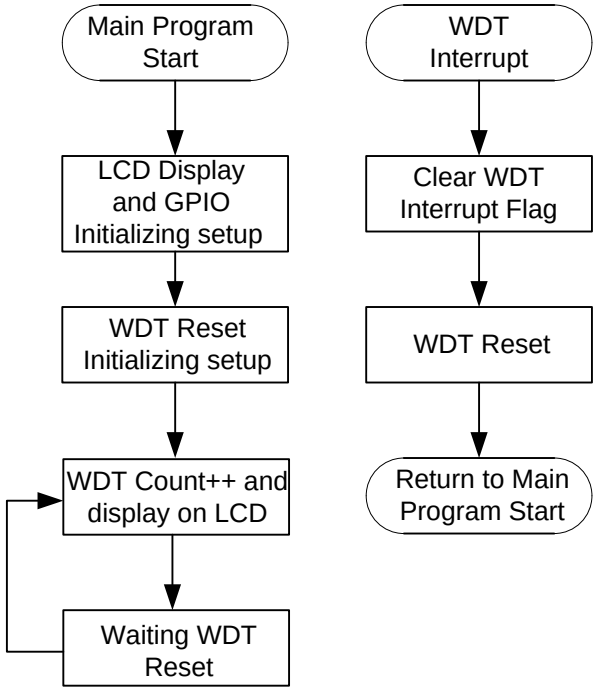
5.1. Example Name

HY16F3981_WDT_Reset

5.2. Example Description

(1) WDT Reset tutorial
(2) In this example code, set WDT initializing and WDT overflow condition, enable System GIE and WDT Reset. Main program start to do variable "WDR Count" +1 and shows on LCD, wait WDT Reset occurrence.
(3) When "WDT Count" count up to 2500~3400, the WDT Reset will occur. Because each IC internal HAO frequency is different, so WDT Reset time is different for each IC.
(4) User can press PT3.0 button to clear WDT counter register. It also set WDT Count=0, restart to do variable "WDT Count" +1.

5.3. Software Flowchart



5.4. Program Description

```
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 *
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 * to fitness for a particular purpose, or infringement of any patent,
 * copyright or other intellectual property right.
 *
 * ----------------------------------------------------------------------------
 * Project Name : HY16F3981_WDT_Reset
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    : HY16F3981 WDT Reset occur on WDT_count near to 2500~3400, it depends on the HAO frequency
setting
 * After WDT_Reset, if PT3.0=Low. Set WDT_count=0, WDT re-count again, start from 0 to count
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *****************************************************************************/
/*---------------------------------------------------------------------------*/
/* Includes                                                                  */
/*---------------------------------------------------------------------------*/
#include "DrvCLOCK.h"
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"
#include "Display.h"
#include "System.h"
#include "DrvGPIO.h"
#include "DrvTimer.h"
/*---------------------------------------------------------------------------*/
/* STRUCTURES                                                                */
/*---------------------------------------------------------------------------*/
volatile typedef union _MCUSTATUS
{
   char   _byte;
   struct
   {
      unsigned b_ADCdone:1;
      unsigned b_TMAdone:1;
      unsigned b_TMBdone:1;
      unsigned b_TMC0done:1;
      unsigned b_WDTdone:1;
      unsigned b_RTCdone:1;
      unsigned b_UART_TxDone:1;
      unsigned b_UART_RxDone:1;
   };
} MCUSTATUS;


typedef union _PTINTSTATUS
{
   char   _byte;
```

```
    struct
    {
        unsigned b_PTINT0done:1;
        unsigned b_PTINT1done:1;
        unsigned b_PTINT2done:1;
        unsigned b_PTINT3done:1;
        unsigned b_PTINT4done:1;
        unsigned b_PTINT5done:1;
        unsigned b_PTINT6Done:1;
        unsigned b_PTINT7Done:1;
    };
} PTINTSTATUS;

/*---------------------------------------------------------------------------*/
/* DEFINITIONS                                                               */
/*---------------------------------------------------------------------------*/
#define KEY_PORT E_PT3
#define KEYIN0 BIT0


/*---------------------------------------------------------------------------*/
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/
MCUSTATUS    MCUSTATUSbits;
PTINTSTATUS    PT3INTSTATUSbits;
unsigned int WDT_count;

/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);

/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{
    WDT_count=0;
    DisplayInit();
    ClearLCDframe();

    DrvWDT_Open(E_NMI,E_PRE_SCALER_D2048);              //WDT IRQ open pre scaler 2048
    DrvWDT_ClearWDT();                                  //Clear WDT_count
    DrvWDT_ResetEnable();                               //set WDNMI=1. 0x40108[6]=1b

    DrvGPIO_ClkGenerator(E_HS_CK,1);                    //Set IO sampling clock input source is HS_CK
    DrvGPIO_Open(KEY_PORT,KEYIN0,E_IO_INPUT);           //set PT3.0 INPUT
    DrvGPIO_Open(KEY_PORT,KEYIN0,E_IO_PullHigh);        //enable PT3.0 pull high R
    DrvGPIO_Open(KEY_PORT,KEYIN0,E_IO_IntEnable);       //PT3.0 interrupt enable
    DrvGPIO_IntTrigger(KEY_PORT,KEYIN0,E_N_Edge);       //PT3.0 interrupt trigger method is negative edge
    DrvGPIO_ClearIntFlag(KEY_PORT,KEYIN0);              //clear PT3 interrupt flag

    PT3INTSTATUSbits._byte = 0;
    MCUSTATUSbits._byte = 0;
    SYS_EnableGIE(4,0x3FF);                             //Enable GIE(Global Interrupt)

    while(1)
    {
        for(WDT_count=0;WDT_count<999999;WDT_count++)
        {
            LCD_DATA_DISPLAY(WDT_count);                //WDT Reset occur on WDT_count=2500~3400, it depends
on the HAO frequency
            Delay(1000);
            if(PT3INTSTATUSbits.b_PTINT0done)           //if PT3.0 low
            {
                WDT_count=0;                            //Set WDT_count=0,
                DrvWDT_ClearWDT();                      //WDT re-count again, start from 0 to count
```

```
            PT3INTSTATUSbits.b_PTINT0done=0;
          }
        }
      }

    return 0;
}

/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description   : I2C/UART/SPI interrupt Service Routine (HW0).             */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description   : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{
    if(DrvTIMER_GetIntFlag(E_WDT))
    {
        MCUSTATUSbits.b_WDTdone=1;
        DrvTIMER_ClearIntFlag(E_WDT);           //Clear WDT interrupt flag
    }
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description   : PT3 interrupt Service Routine (HW4).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{
    uint32_t PORT_IntFlag;

    PORT_IntFlag=DrvGPIO_GetIntFlag(KEY_PORT);
    if((PORT_IntFlag&KEYIN0)==KEYIN0)
    {
        PT3INTSTATUSbits.b_PTINT0done=1;
    }
    DrvGPIO_ClearIntFlag(KEY_PORT,KEYIN0);    //clear PT3.0 interrupt flag

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description   : PT2 interrupt Service Routine (HW5).                      */
```

```
/* Arguments       : None.                                                    */
/* Return Value : None.                                                     */
/* Remark          :                                                        */
/*--------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
/*--------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                 */
/* Description    : UART2 interrupt Service Routine (HW7).                  */
/* Arguments       : None.                                                  */
/* Return Value : None.                                                     */
/* Remark          :                                                        */
/*--------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*--------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                 */
/* Description    : TMB2 interrupt Service Routine (HW8).                   */
/* Arguments       : None.                                                  */
/* Return Value : None.                                                     */
/* Remark          :                                                        */
/*--------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*--------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                 */
/* Description    : OPA interrupt Service Routine (HW9).                    */
/* Arguments       : None.                                                  */
/* Return Value : None.                                                     */
/* Remark          :                                                        */
/*--------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*--------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                   */
/* Description    : Exception Service Routines.                             */
/* Arguments       : None.                                                  */
/* Return Value : None.                                                     */
/* Remark          :                                                        */
/*--------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");    //procedure define by customer.
   asm("nop");
}
/*--------------------------------------------------------------------------*/
/* Software Delay Subroutines                                               */
/*--------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*--------------------------------------------------------------------------*/
/* End Of File                                                              */
/*--------------------------------------------------------------------------*/
```

6. Digital IP(RTC)

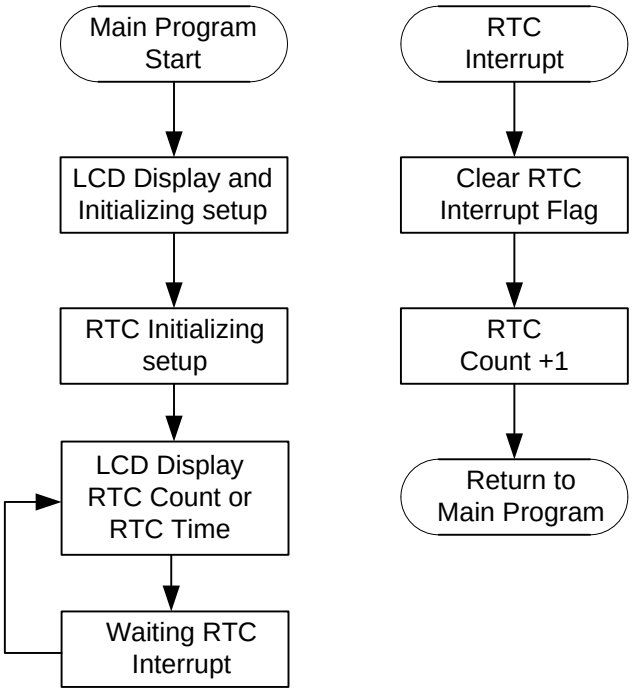
6.1. Example Name

HY16F3981_RTC

6.2. Example Description

(1) RTC tutorial.
(2) Using #define to select to compile RTC_counter_show or TimerDtata_show.
(3) In this example code, set RTC initializing and RTC overflow condition, enable System GIE and wait RTC interrupt.
(4) If select RTC_counter_show, everytime RTC interrupt occurs, in the RTC interrupt service routine, variable "RTC Count" to do +1 and shows on LCD. If select TimerDtata_show, everytime RTC interrupt occurs, to do current time+1 and shows on LCD.

6.3. Software Flowchart



6.4. Program Description

```
/*****************************************************************************
 *
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 * and/or use of this code including liability or warranties relating
 * to fitness for a particular purpose, or infringement of any patent,
 * copyright or other intellectual property right.
 *
 * ----------------------------------------------------------------------------
 * Project Name : HY16F3981_RTC
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    : HY16F3981 display the RTC_counter or TimerDtata on LCD by #define RTC_counter_show or
TimerDtata_show
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *****************************************************************************/
/*---------------------------------------------------------------------------*/
/* Includes                                                                  */
/*---------------------------------------------------------------------------*/
#include "DrvCLOCK.h"
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"
#include "DrvRTC.h"
#include "DrvLCD.h"
#include "Display.h"
#include "System.h"
/*---------------------------------------------------------------------------*/
/* STRUCTURES                                                                */
/*---------------------------------------------------------------------------*/
volatile typedef union _MCUSTATUS
{
   char   _byte;
   struct
   {
      unsigned b_ADCdone:1;
      unsigned b_TMAdone:1;
      unsigned b_TMBdone:1;
      unsigned b_TMC0done:1;
      unsigned b_TMC1done:1;
      unsigned b_RTCdone:1;
      unsigned b_UART_TxDone:1;
      unsigned b_UART_RxDone:1;
   };
} MCUSTATUS;

/*---------------------------------------------------------------------------*/
/* DEFINITIONS                                                               */
/*---------------------------------------------------------------------------*/
//#define   RTC_counter_show
#define   TimerDtata_show

/*---------------------------------------------------------------------------*/
```

```
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/
MCUSTATUS    MCUSTATUSbits;

unsigned int sec,min,hour,week,day,month,year ;
unsigned int RTC_counter;
unsigned int TimerDtata;
/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);
void InitalRTC(void);
int ComputeWeek(int TempYear, int TempMonth, int TempDay);

/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{

   S_DRVRTC_TIME_DATA_T sCurTime;       //Setting Start
   RTC_counter=0;
   TimerDtata=0;

   DisplayInit();
   ClearLCDframe();
   InitalRTC();
   MCUSTATUSbits._byte = 0;
   SYS_EnableGIE(4,0x3FF);                  //Enable GIE(Global Interrupt)

   while(1)
   {
      if(MCUSTATUSbits.b_RTCdone==1)
      {
         DrvRTC_Read(DRVRTC_CURRENT_TIME,&sCurTime);
         TimerDtata=sCurTime.u32cSecond+sCurTime.u32cMinute*100+sCurTime.u32cHour*10000;
#if defined(TimerDtata_show)
           LCD_DATA_DISPLAY(TimerDtata);
#endif
#if defined(RTC_counter_show)
           LCD_DATA_DISPLAY(RTC_counter);
#endif

         sec=sCurTime.u32cSecond;
         min=sCurTime.u32cMinute;
         hour=sCurTime.u32cHour;
         week=sCurTime.u32cDayOfWeek;
         day=sCurTime.u32cDay;
         month=sCurTime.u32cMonth;
         year=sCurTime.u32Year;
         MCUSTATUSbits.b_RTCdone=0;
         }
   }

   return 0;
}

/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description    : I2C/UART/SPI interrupt Service Routine (HW0).            */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark         :                                                          */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{
```

```
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description  : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).   */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{
  if(DrvRTC_ReadState()&&0x2)          //check PTF flag
  {
    DrvRTC_ClearState(E_DRVRTC_CLEAR_ALL);
    DrvRTC_ClearIntFlag();
    RTC_counter++;
    MCUSTATUSbits.b_RTCdone=1;
  }
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description  : ADC interrupt Service Routine (HW2).                       */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description  : PT3 interrupt Service Routine (HW4).                       */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description  : PT2 interrupt Service Routine (HW5).                       */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                  */
/* Description  : UART2 interrupt Service Routine (HW7).                     */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                  */
/* Description  : TMB2 interrupt Service Routine (HW8).                      */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
```

```
/* Remark            :                                                    */
/*---------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                               */
/* Description   : OPA interrupt Service Routine (HW9).                   */
/* Arguments     : None.                                                  */
/* Return Value : None.                                                   */
/* Remark            :                                                    */
/*---------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                 */
/* Description   : Exception Service Routines.                            */
/* Arguments     : None.                                                  */
/* Return Value : None.                                                   */
/* Remark            :                                                    */
/*---------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");   //procedure define by customer.
   asm("nop");
}
/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                             */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}


/*---------------------------------------------------------------------------*/
/* Function Name: InitalRTC()                                             */
/* Description   : RTC Initialization Subroutines.                        */
/* Arguments     : None.                                                  */
/* Return Value : None.                                                   */
/* Remark            :                                                    */
/*---------------------------------------------------------------------------*/
void InitalRTC()
{
   S_DRVRTC_TIME_DATA_T sCurTime;            //Setting Start
   DrvCLOCK_EnableLowOSC(E_EXTERNAL,130000);
   DrvRTC_ClkConfig(2);                      //Set 0x40308 RTCKS=10b, LSXT

   //DRVRTC_CURRENT_TIME or Alarm Time
   DrvRTC_WriteEnable();
   DrvRTC_Read(DRVRTC_CURRENT_TIME,&sCurTime);
   sCurTime.u8cClockDisplay=0;               //DRVRTC_CLOCK_12//DRVRTC_CLOCK_24
   sCurTime.u8cAmPm=0;                       //DRVRTC_AM//DRVRTC_PM
   sCurTime.u32cSecond=40;
   sCurTime.u32cMinute=59;
   sCurTime.u32cHour=23;
   sCurTime.u32cDay=18;
   sCurTime.u32cMonth=2;
   sCurTime.u32Year=2018;
   sCurTime.u32cDayOfWeek=ComputeWeek(sCurTime.u32Year,sCurTime.u32cMonth,sCurTime.u32cDay);
   sCurTime.u8IsEnableWakeUp=0;              //WK
   DrvRTC_Write(DRVRTC_CURRENT_TIME,&sCurTime);
   DrvRTC_HourFormat(E_DRVRTC_HOUR_24);   //1:12hour 0:24hour
```

```
    DrvRTC_Enable();
    DrvRTC_PeriodicTimeEnable(E_DRVRTC_1_8_SEC);
    DrvRTC_ClearIntFlag();
    DrvRTC_EnableInt();                    //Enable RTC interrupt
}

/*---------------------------------------------------------------------------*/
/* Compute Week Subroutines                                                  */
/*---------------------------------------------------------------------------*/
int ComputeWeek(int TempYear, int TempMonth, int TempDay)
{
    int TempWeek;
    if (TempMonth >= 3)
    {
        TempMonth = TempMonth - 2;
    }
    else
    {
        TempMonth = TempMonth + 10;
        TempYear--;
    }

    TempWeek = TempYear + (int)(TempYear / 4) - (int)(TempYear / 100) +(int)(TempYear / 400) + (int)(2.6 * TempMonth -
0.2) + TempDay;
    TempWeek = TempWeek - 7*(int)(TempWeek / 7);
    return (TempWeek);
}
/*---------------------------------------------------------------------------*/
/* End Of File                                                               */
/*---------------------------------------------------------------------------*/
```

7. Digital IP(PWM)

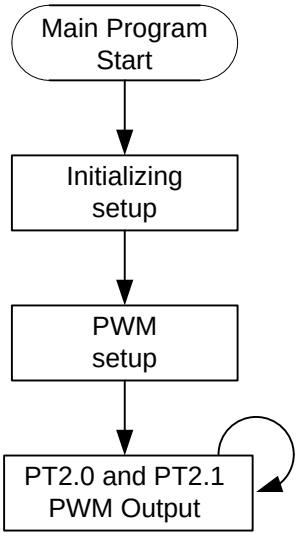
7.1. Example Name

HY16F3981_PWM

7.2. Example Description

(1) PWM tutorial.
(2) Set HAO=4MHz and TimerB overflow condition.
(3) Set PWM register and PWM Duty, setting PWM output I/O port is output mode.
(4) PT2.0 is PWM0 output, PT2.1 is PWM1 output.

7.3. Software Flowchart



7.4. Program Description

```
/*******************************************************************************
 *
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 * and HYCON disclaims any express or implied warranty, relating to sale
 * and/or use of this code including liability or warranties relating
 * to fitness for a particular purpose, or infringement of any patent,
 * copyright or other intellectual property right.
 *
 * ------------------------------------------------------------------------
 * Project Name : HY16F3981_PWM
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    : PT2.0 output PWM0(Mode:PWMA), PT2.1 output PWM1(Mode:PWMA)
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *******************************************************************************/
/*---------------------------------------------------------------------------*/
/* Includes                                                                  */
/*---------------------------------------------------------------------------*/
#include "DrvCLOCK.h"
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"
#include "DrvTimer.h"
#include "System.h"
#include "DrvGPIO.h"
/*---------------------------------------------------------------------------*/
/* STRUCTURES                                                                */
/*---------------------------------------------------------------------------*/


/*---------------------------------------------------------------------------*/
/* DEFINITIONS                                                               */
/*---------------------------------------------------------------------------*/


/*---------------------------------------------------------------------------*/
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/


/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);

/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{
   DrvCLOCK_SelectIHOSC(1);                    // Select HAO 4MHz
```

```
    DrvCLOCK_EnableHighOSC(E_INTERNAL,10);
    SYS_DisableGIE();                                   //Disable GIE

    DrvPWM0_Open(0,1,2);                                //PWM0 Enable Port 2.0 =PWMO0, Port 2.1 =PWMO1(Set
PWM0=PT2.0)
    DrvPWM1_Open(1,1,2);                                //PWM1 Enable Port 2.0 =PWMO0, Port 2.1 =PWMO1(Set
PWM1=PT2.1)
    DrvPWM_CountCondition(0x7fff,0x3fff);               //PWM0 Duty 0X7FFF, PWM0=PT2.0
                                                        //PWM1 Duty 0X3FFF, PWM1=PT2.1
    DrvGPIO_Open(E_PT2,0x01|0x02,E_IO_OUTPUT);          //PT2.0, PT2.1 Set Output
    DrvTMBC_Clk_Source(0,0);                            //TMB Clock Enable/1
    DrvTMB_Open(E_TMB_MODE0,E_TMB_NORMAL,0xffff);   //TMB Overflow 0XFFFF
                                                        //PWM Period 0XFFFF
    while(1);
}

/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description   : I2C/UART/SPI interrupt Service Routine (HW0).             */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description   : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description   : PT3 interrupt Service Routine (HW4).                      */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description   : PT2 interrupt Service Routine (HW5).                      */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
```

```
void HW5_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                  */
/* Description   : UART2 interrupt Service Routine (HW7).                    */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                  */
/* Description   : TMB2 interrupt Service Routine (HW8).                     */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                  */
/* Description   : OPA interrupt Service Routine (HW9).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                    */
/* Description   : Exception Service Routines.                               */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");    //procedure define by customer.
   asm("nop");
}
/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                                */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*---------------------------------------------------------------------------*/
/* End Of File                                                               */
/*---------------------------------------------------------------------------*/
```

8. Digital IP(Flash)

8.1. Example Name

HY16F3981_Flash

8.2. Example Description

(1) Flash burn and read tutorial.
(2) In this example code, first, execute flash burn page and read out and to do verify, if burn page content and read out content is different, LCD display"1" and program stuck in while(1).
(3) Second, execute flash burn word and read out to do verify, if burn page content and read out content is different, program stuck in while(1).
Note1 : User has to do SYS_DisableGIE, before execute Flash burn/read function. Disable system global GIE function, it can prevent program exception when executing Flash burn/read function.
Note2 : VDD3V have to more than 2.7V, it can prevent program burn error when executing Flash burn function.

8.3. Program Description

```
/*******************************************************************************
 *
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 *
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 * and HYCON disclaims any express or implied warranty, relating to sale
 * and/or use of this code including liability or warranties relating
 * to fitness for a particular purpose, or infringement of any patent,
 * copyright or other intellectual property right.
 *
 * ------------------------------------------------------------------------
 * Project Name : HY16F3981_Flash
 * IDE tooling   : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.   : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device    :
 * Description   : ROM_BurnPage on Flash 0x9F000 and then read out to check.
 * DrvFlash_Burn_Word on Flash 0x98014. 0x98010, 0x98020 and then read out to check
 * Created Date : 2018/3/9
 * Created by    : Robert.Wang
 *
 * Program Description:
 * --------------------
 *******************************************************************************/
/*---------------------------------------------------------------------------*/
/* Includes                                                                  */
/*---------------------------------------------------------------------------*/
```

```
#include "DrvCLOCK.h"
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"
#include "DrvFlash.h"
#include "system.h"
/*---------------------------------------------------------------------------*/
/* STRUCTURES                                                                */
/*---------------------------------------------------------------------------*/


/*---------------------------------------------------------------------------*/
/* DEFINITIONS                                                               */
/*---------------------------------------------------------------------------*/



/*---------------------------------------------------------------------------*/
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/


/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);

/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{

   int index,error;
   unsigned int BufferTx[32];
   unsigned int BufferRx[32];

   DisplayInit();
   ClearLCDframe();
   Delay(10000);
   DisplayHYcon();
   Delay(10000);

   SYS_DisableGIE();                    //before execute Flash burn/read function, user have to do that
SYS_DisableGIE();

   for(index=0;index<32;index++)
   {
      BufferTx[index]=index;            //to set BufferTx[0]=0x0....BufferTx[31]=0x1f
      BufferRx[index]=0xFFFFFFFF;       //to set BufferRx[0]=0xFFFFFFFF....BufferRx[31]=0xFFFFFFFF
   }

   ROM_BurnPage(FLASH_KEY_A,0xF000,0x2000,BufferTx);
   ReadPage(0xF000,BufferRx);           //Read BufferRx to make sure BurnPage data

   for(index=0;index<32;index++)
   {
      BufferTx[index]=31-index;         //to set BufferTx[0]=0x1f....BufferTx[31]=0x0
      BufferRx[index]=0xFFFFFFFF;       //to set BufferRx[0]=0xFFFFFFFF....BufferRx[31]=0xFFFFFFFF
   }

   ROM_BurnPage(FLASH_KEY_A,0xF000,0x2000,BufferTx);
   ReadPage(0xF000,BufferRx);        //Read BufferRx to make sure BurnPage data

   //verify the ROM_BurnPage function, if fail to show "1" on the LCD Display
   for(index=0;index<32;index++)
   {
```

```
        if(BufferTx[index]!=BufferRx[index])
        {
          LCD_DATA_DISPLAY(1);
          while(1);
        }
    }


    error=DrvFlash_Burn_Word(0x8014,0x2000,0x12345678);
    if(error==0)                        //if Error=0, it means BurnWord success
    ReadPage(0x8014,BufferRx);

    error=DrvFlash_Burn_Word(0x8010,0x2000,0x12345678);
    if(error==0)                        //if Error=0, it means BurnWord success
    ReadPage(0x8010,BufferRx);

    error=DrvFlash_Burn_Word(0x8020,0x2000,0x12345678);
    if(error==0)                        //if Error=0, it means BurnWord success
    ReadPage(0x8020,BufferRx);

    while(1);

    return 0;
}

/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description   : I2C/UART/SPI interrupt Service Routine (HW0).             */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description   : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description   : PT3 interrupt Service Routine (HW4).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{
```

```
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description   : PT2 interrupt Service Routine (HW5).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                  */
/* Description   : UART2 interrupt Service Routine (HW7).                    */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                  */
/* Description   : TMB2 interrupt Service Routine (HW8).                     */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                  */
/* Description   : OPA interrupt Service Routine (HW9).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                    */
/* Description   : Exception Service Routines.                               */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");    //procedure define by customer.
   asm("nop");
}
/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                                */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*---------------------------------------------------------------------------*/
```

```
/* End Of File                                                                 */
/*-----------------------------------------------------------------------------*/
```

9. Digital IP(GPIO)

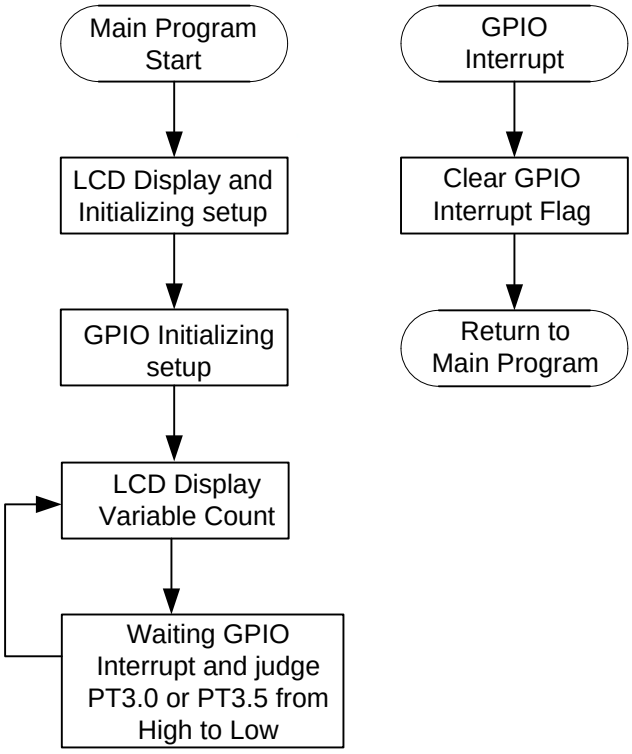
9.1. Example Name

HY16F3981_GPIO

9.2. Example Description

(1) GPIO tutorial
(2) Setup GPIO and LCD initializing.
(3) If press button PT3.0, to do variable count +1 and LCD display count.
(4) If press button PT3.5, to do variable count -1 and LCD display count.

9.3. Software Flowchart



9.4. Program Description

```
/*******************************************************************************
 *
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 * copyright or other intellectual property right.
 *
 * ------------------------------------------------------------------------------
 * Project Name : HY16F3981_GPIO
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    : if PT3.0 low to do count++, if PT3.5 low to do count--
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *******************************************************************************/
/*------------------------------------------------------------------------------*/
/* Includes                                                                     */
/*------------------------------------------------------------------------------*/
#include "DrvCLOCK.h"
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"
#include "DrvGPIO.h"
#include "System.h"
/*------------------------------------------------------------------------------*/
/* STRUCTURES                                                                   */
/*------------------------------------------------------------------------------*/
volatile typedef union _PTINTSTATUS
{
   char   _byte;
   struct
   {
      unsigned b_PTINT0done:1;
      unsigned b_PTINT1done:1;
      unsigned b_PTINT2done:1;
      unsigned b_PTINT3done:1;
      unsigned b_PTINT4done:1;
      unsigned b_PTINT5done:1;
      unsigned b_PTINT6Done:1;
      unsigned b_PTINT7Done:1;
   };
} PTINTSTATUS;

/*------------------------------------------------------------------------------*/
/* DEFINITIONS                                                                  */
/*------------------------------------------------------------------------------*/
#define KEY_PORT E_PT3
#define KEYIN0 BIT0
#define KEYIN1 BIT5

/*------------------------------------------------------------------------------*/
```

```
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/
PTINTSTATUS    PT3INTSTATUSbits;

/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);

/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{

   int count=0;

   DisplayInit();
   ClearLCDframe();
   LCD_DATA_DISPLAY(count);

   DrvGPIO_ClkGenerator(E_HS_CK,1);                    //Set IO sampling clock input source is HS_CK
   DrvGPIO_Open(KEY_PORT,KEYIN1|KEYIN0,E_IO_INPUT);          //set PT3.0/PT3.5 INPUT
   DrvGPIO_Open(KEY_PORT,KEYIN1|KEYIN0,E_IO_PullHigh);     //enable PT3.0/PT3.5 pull high R
   DrvGPIO_Open(KEY_PORT,KEYIN1|KEYIN0,E_IO_IntEnable);    //PT3.0/PT3.5 interrupt enable
   DrvGPIO_IntTrigger(KEY_PORT,KEYIN1|KEYIN0,E_N_Edge);    //PT3.0/PT3.5 interrupt trigger method is negative
edge
   DrvGPIO_ClearIntFlag(KEY_PORT,KEYIN1|KEYIN0);              //clear PT3 interrupt flag
   PT3INTSTATUSbits._byte = 0;
   SYS_EnableGIE(4,0x3FF);                             //Enable GIE(Global Interrupt)

   while(1)
   {
      if(PT3INTSTATUSbits.b_PTINT0done)                //if PT3.0 low
      {
         LCD_DATA_DISPLAY(count++);
         PT3INTSTATUSbits.b_PTINT0done=0;
      }
      if(PT3INTSTATUSbits.b_PTINT5done)                //if PT3.5 low
      {
         LCD_DATA_DISPLAY(count--);
         PT3INTSTATUSbits.b_PTINT5done=0;
      }
   }

}

/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description    : I2C/UART/SPI interrupt Service Routine (HW0).            */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark         :                                                          */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description    : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark         :                                                          */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{
```

```
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description   : PT3 interrupt Service Routine (HW4).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{
  uint32_t PORT_IntFlag;

  PORT_IntFlag=DrvGPIO_GetIntFlag(KEY_PORT);
  if((PORT_IntFlag&KEYIN0)==KEYIN0)
  {
    PT3INTSTATUSbits.b_PTINT0done=1;
  }
    if((PORT_IntFlag&KEYIN1)==KEYIN1)
  {
    PT3INTSTATUSbits.b_PTINT5done=1;
  }
  DrvGPIO_ClearIntFlag(KEY_PORT,KEYIN1|KEYIN0);          //clear PT3.0/PT3.5 interrupt flag

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description   : PT2 interrupt Service Routine (HW5).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                  */
/* Description   : UART2 interrupt Service Routine (HW7).                    */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                  */
/* Description   : TMB2 interrupt Service Routine (HW8).                     */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW8_ISR(void)
{
```

```
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                  */
/* Description    : OPA interrupt Service Routine (HW9).                     */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark         :                                                          */
/*---------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                    */
/* Description    : Exception Service Routines.                              */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark         :                                                          */
/*---------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");    //procedure define by customer.
   asm("nop");
}
/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                                */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*---------------------------------------------------------------------------*/
/* End Of File                                                               */
/*---------------------------------------------------------------------------*/
```

10. Analog IP(12 bit Resistance Ladder DAC)

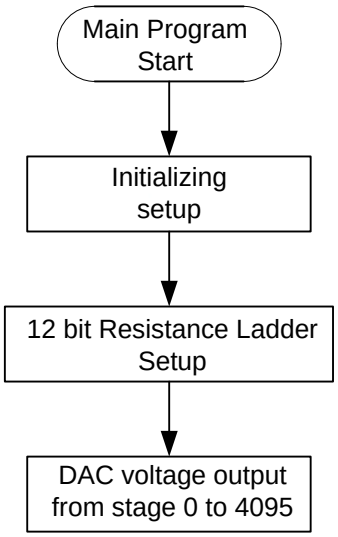
10.1. Example Name

HY16F3981_DAC

10.2. Example Description

(1) 12 bit Resistance ladder DAC tutorial
(2) In this example code, first, enable VDDA, and 12 bit Resistance Ladder positive set as VDDA, negative set as VSS. In this setting, the maximum DAC output is equal to VDDA.
(3) DAC voltage output from stage 0 to 4095, user can measure or observe DAC voltage output from IC pin DAO.

10.3. Software Flowchart



10.4. Program Description

```
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 * and/or use of this code including liability or warranties relating
 * to fitness for a particular purpose, or infringement of any patent,
 * copyright or other intellectual property right.
 *
 * ------------------------------------------------------------------------
 * Project Name : HY16F3981_DAC
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    : HY16F3981 12bit DAC output voltage from stage 0 to 4095
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *******************************************************************************/
/*------------------------------------------------------------------------*/
/* Includes                                                               */
/*------------------------------------------------------------------------*/
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"
#include "DrvDAC.h"
#include "DrvPMU.h"
/*------------------------------------------------------------------------*/
/* STRUCTURES                                                             */
/*------------------------------------------------------------------------*/


/*------------------------------------------------------------------------*/
/* DEFINITIONS                                                            */
/*------------------------------------------------------------------------*/


/*------------------------------------------------------------------------*/
/* Global CONSTANTS                                                       */
/*------------------------------------------------------------------------*/


/*------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                    */
/*------------------------------------------------------------------------*/
void Delay(unsigned int num);

/*------------------------------------------------------------------------*/
/* Main Function                                                          */
/*------------------------------------------------------------------------*/
int main(void)
{
   unsigned char i;

   //Set Power system
```

```
    DrvPMU_VDDA_LDO_Ctrl(E_LDO);                  //LDO ON
    DrvPMU_VDDA_Voltage(E_VDDA2_4);               //VDDA=2.4

    //Set DAC
    DrvDAC_Open(E_DAC_PVDDA,E_DAC_NVSSA,0);    //DAC_Vrefp= VDDA, DAC_Vrefn= VSSA, DAO=0
    DrvDAC_DALH(1);                                 //Set DALH=1b
    DrvDAC_EnableOutput();                         //Enable 12-bit resistance ladder DAC output
    DrvDAC_Enable();                               //Enable 12-bit resistance ladder DAC function

    while(1)
    {
      for(i=0;i<4096;i++)
      {
        DrvDAC_DABIT(i);
        Delay(1000);                                //Delay for reference
          //User can use meter to check the pin14(DAO) to pin2(VSS) to check the DAC output voltage
      }
    }
    return 0;
}

/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description   : I2C/UART/SPI interrupt Service Routine (HW0).             */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description   : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description   : PT3 interrupt Service Routine (HW4).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
```

```
/* Description    : PT2 interrupt Service Routine (HW5).                    */
/* Arguments      : None.                                                   */
/* Return Value : None.                                                     */
/* Remark         :                                                         */
/*--------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
/*--------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                 */
/* Description    : UART2 interrupt Service Routine (HW7).                  */
/* Arguments      : None.                                                   */
/* Return Value : None.                                                     */
/* Remark         :                                                         */
/*--------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*--------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                 */
/* Description    : TMB2 interrupt Service Routine (HW8).                   */
/* Arguments      : None.                                                   */
/* Return Value : None.                                                     */
/* Remark         :                                                         */
/*--------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*--------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                 */
/* Description    : OPA interrupt Service Routine (HW9).                    */
/* Arguments      : None.                                                   */
/* Return Value : None.                                                     */
/* Remark         :                                                         */
/*--------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*--------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                   */
/* Description    : Exception Service Routines.                             */
/* Arguments      : None.                                                   */
/* Return Value : None.                                                     */
/* Remark         :                                                         */
/*--------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");    //procedure define by customer.
   asm("nop");
}
/*--------------------------------------------------------------------------*/
/* Software Delay Subroutines                                               */
/*--------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*--------------------------------------------------------------------------*/
/* End Of File                                                              */
/*--------------------------------------------------------------------------*/
```

11. Analog IP(OPA)

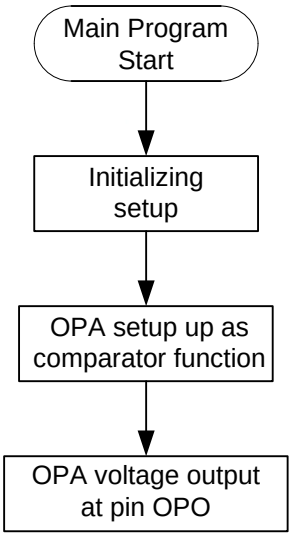
11.1. Example Name

HY16F3981_OPA

11.2. Example Description

(1) OPAMP tutorial
(2) Enable analog power REFO=1.2V
(3) OPAMP positive set as REFO , OPAMP negative set as AIO5.
(4) OPAMP set as comparator function. When REFO voltage more than AIO5, OPO pin(PT3.7) output high, when REFO voltage less than AIO5, OPO pin(PT3.7) output low.
(5) Everytime OPAMP interrupt occur, PT2.0 will do high or low output status changed.

11.3. Software Flowchart



11.4. Program Description

```
/*****************************************************************************
 *
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 * and/or use of this code including liability or warranties relating
 * to fitness for a particular purpose, or infringement of any patent,
 * copyright or other intellectual property right.
 *
 * ----------------------------------------------------------------------
 * Project Name : HY16F3981_Style
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    : HY16F3981 OPA to do voltage compare, if REFO>AIO5, PT3.7=High, IF REFO<AIO5, PT3.7=Low
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *****************************************************************************/
/*---------------------------------------------------------------------------*/
/* Includes                                                                  */
/*---------------------------------------------------------------------------*/
#include "DrvCLOCK.h"
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"
#include "System.h"
#include "DrvPMU.h"
#include "DrvOP.h"
#include "DrvGPIO.h"
/*---------------------------------------------------------------------------*/
/* STRUCTURES                                                                */
/*---------------------------------------------------------------------------*/


/*---------------------------------------------------------------------------*/
/* DEFINITIONS                                                               */
/*---------------------------------------------------------------------------*/


/*---------------------------------------------------------------------------*/
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/
unsigned char i;


/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);

/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{
   i=0;
```

```
    DrvPMU_VDDA_LDO_Ctrl(E_LDO);            //LDO ON
    DrvPMU_VDDA_Voltage(E_VDDA2_4);       //VDDA=2.4
    DrvPMU_REFO_Enable();                      //REFO ON

    DrvGPIO_Open(2,0x01,E_IO_OUTPUT);   //PT2.0 Output

    DrvOP_Open();
    DrvOP_PInput(0x08);                       //OPA positive reference input selection REFO
    DrvOP_NInput(0x02);                       //OPA negative reference input selection AIO5
    DrvOP_OPOoutEnable();                    //OPA Out Enable PT3.7. If REFO>AIO5, PT3.7=High, IF REFO<AIO5,
PT3.7=Low
    DrvOP_OPDEN(1);                           //OPDEN=1b

    DrvOP_EnableInt();
    SYS_EnableGIE(4,0x3FF);                 //Enable GIE(Global Interrupt)

    while(1)
    {
      //If REFO>AIO5, enter HW9_ISR()
    }

    return 0;
}

/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description   : I2C/UART/SPI interrupt Service Routine (HW0).             */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description   : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description   : PT3 interrupt Service Routine (HW4).                      */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{
```

```
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description   : PT2 interrupt Service Routine (HW5).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                  */
/* Description   : UART2 interrupt Service Routine (HW7).                    */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                  */
/* Description   : TMB2 interrupt Service Routine (HW8).                     */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                  */
/* Description   : OPA interrupt Service Routine (HW9).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW9_ISR(void)
{
  if(DrvOP_ReadIntFlag())
  {
    if(i==ENABLE)
    {
      DrvGPIO_ClrPortBits(E_PT2,0);          //PT2.0 Output Low
      i=DISABLE;
    }
    else
    {
      DrvGPIO_SetPortBits(E_PT2,0);          //PT2.0 Output High
      i=ENABLE;
    }
      DrvOP_ClearIntFlag();                  //Clear OPA interrupt flag
  }
}
/*---------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                    */
/* Description   : Exception Service Routines.                               */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void tlb_exception_handler()
```

```
{
   asm("nop");    //procedure define by customer.
   asm("nop");
}
/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                                */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*---------------------------------------------------------------------------*/
/* End Of File                                                               */
/*---------------------------------------------------------------------------*/
```

12. Analog IP(ADC)

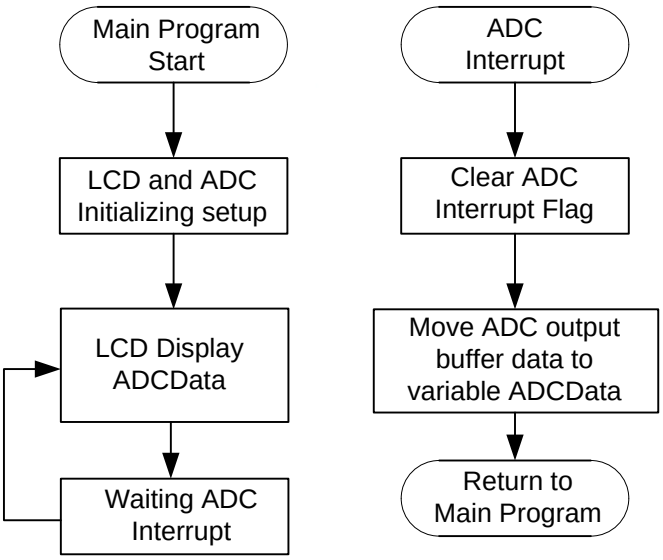
12.1. Example Name

HY16F3981_ADC

12.2. Example Description

(1) ADC tutorial. Implement ADC interrupt function and capture ADC output buffer data.
(2) ADC Initializing, ADC analog power set as VDDA,ADC OSR=32768, ADC output rate=30Hz, ADC input channel set as AIO2-AIO3, ADC reference voltage set as VDDA-VSS.
(3) After ADC Initializing, Enable System GIE and wait ADC interrupt. ADC OSR can decide the ADC interrupt frequency.
(4) LCD Display variable "ADCData"

12.3. Software Flowchart



12.4. Program Description

```
/*******************************************************************************
 *
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 * and/or use of this code including liability or warranties relating
 * to fitness for a particular purpose, or infringement of any patent,
 * copyright or other intellectual property right.
 *
 * ------------------------------------------------------------------------------
 * Project Name : HY16F3981_ADC
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    : Showing high 16 bit ADCData on LCD display
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *******************************************************************************/
/*------------------------------------------------------------------------------*/
/* Includes                                                                     */
/*------------------------------------------------------------------------------*/
#include "DrvCLOCK.h"
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"
#include "System.h"
#include "DrvADC.h"
#include "DrvPMU.h"
/*------------------------------------------------------------------------------*/
/* STRUCTURES                                                                   */
/*------------------------------------------------------------------------------*/
volatile typedef union _MCUSTATUS
{
   char   _byte;
   struct
   {
      unsigned b_ADCdone:1;
      unsigned b_TMAdone:1;
      unsigned b_TMBdone:1;
      unsigned b_TMC0done:1;
      unsigned b_TMC1done:1;
      unsigned b_RTCdone:1;
      unsigned b_UART_TxDone:1;
      unsigned b_UART_RxDone:1;
   };
} MCUSTATUS;

/*------------------------------------------------------------------------------*/
/* DEFINITIONS                                                                  */
/*------------------------------------------------------------------------------*/
//#define HAO_2MHZ
#define HAO_4MHZ
//#define HAO_10MHZ
//#define HAO_16MHZ
```

```
//#define ADC_Chopper

/*---------------------------------------------------------------------------*/
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/
MCUSTATUS    MCUSTATUSbits;
int ADCData;
int ADCData_Array[2];
int ADCData_Chopper;
char i;
/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);
void InitalADC(void);
/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{
   InitalADC();
   DisplayInit();
   ClearLCDframe();
   Delay(10000);
   DisplayHYcon();
   Delay(10000);
   SYS_EnableGIE(4,0x3FF);                  //Enable GIE(Global Interrupt)

   MCUSTATUSbits._byte = 0;

   while(1)
   {

#if defined(ADC_Chopper)
      for(i=0;i<=1;i++)
      {
         switch (i)
         {
            case 0:
            while(MCUSTATUSbits.b_ADCdone==0);
            MCUSTATUSbits.b_ADCdone=0;
            DrvADC_SetADCInputChannel(ADC_Input_AIO2,ADC_Input_AIO3);
            DrvADC_CombFilter(DISABLE);
            DrvADC_CombFilter(ENABLE);
            MCUSTATUSbits.b_ADCdone=0;
            while(MCUSTATUSbits.b_ADCdone==0);
            ADCData_Array[0]=ADCData>>16;
            MCUSTATUSbits.b_ADCdone=0;
            break;

            case 1:
            DrvADC_SetADCInputChannel(ADC_Input_AIO3,ADC_Input_AIO2);
            DrvADC_CombFilter(DISABLE);
            DrvADC_CombFilter(ENABLE);
            MCUSTATUSbits.b_ADCdone=0;
            while(MCUSTATUSbits.b_ADCdone==0);
            ADCData_Array[1]=ADCData>>16;
            ADCData_Chopper=(ADCData_Array[0]-ADCData_Array[1])>>1;
            LCD_DATA_DISPLAY(ADCData_Chopper);
            MCUSTATUSbits.b_ADCdone=0;
            break;
         }
      }
#else    //NO ADC_Chopper mode

      if(MCUSTATUSbits.b_ADCdone)
      {
```

```
        LCD_DATA_DISPLAY(ADCData>>16);     //16bits give up.
        MCUSTATUSbits.b_ADCdone=0;
      }
#endif

   }
   return 0;
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description   : I2C/UART/SPI interrupt Service Routine (HW0).             */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description   : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{
   if(DrvADC_ReadIntFlag())                  //Read ADC Flag
   {
        ADCData=DrvADC_GetConversionData();
        MCUSTATUSbits.b_ADCdone=1;
   }
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description   : PT3 interrupt Service Routine (HW4).                      */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description   : PT2 interrupt Service Routine (HW5).                      */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
```

```
/*---------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                  */
/* Description  : UART2 interrupt Service Routine (HW7).                     */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                  */
/* Description  : TMB2 interrupt Service Routine (HW8).                      */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                  */
/* Description  : OPA interrupt Service Routine (HW9).                       */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                    */
/* Description  : Exception Service Routines.                                */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");    //procedure define by customer.
   asm("nop");
}


/*---------------------------------------------------------------------------*/
/* Function Name: InitalADC()                                                */
/* Description  : ADC Initialization Subroutines.                            */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void InitalADC(void)
{
   //Set ADC Clock
#if defined(HAO_2MHZ)
   DrvCLOCK_EnableHighOSC(E_INTERNAL,10);     //Select HSRC
   DrvCLOCK_SelectIHOSC(0);                    //Select internal 2MHZ=HS_CK
   DrvADC_ClkEnable(2);                       //Setting ADC CLOCK ADCK=HS_CK/4
#endif
#if defined(HAO_4MHZ)
   DrvCLOCK_EnableHighOSC(E_INTERNAL,10);     //Select HSRC
   DrvCLOCK_SelectIHOSC(1);                    //Select internal 4MHZ=HS_CK
   DrvADC_ClkEnable(2);                       //Setting ADC CLOCK ADCK=HS_CK/4
#endif
```

```
#if defined(HAO_10MHZ)
   DrvCLOCK_EnableHighOSC(E_INTERNAL,10);     //Select HSRC
   DrvCLOCK_SelectIHOSC(2);                    //Select internal 10MHZ=HS_CK
   DrvADC_ClkEnable(3);                       //Setting ADC CLOCK ADCK=HS_CK/8
#endif
#if defined(HAO_16MHZ)
   DrvCLOCK_EnableHighOSC(E_INTERNAL,10);     //Select HSRC
   DrvCLOCK_SelectIHOSC(3);                    //Select internal 16MHZ=HS_CK
   DrvADC_ClkEnable(4);                       //Setting ADC CLOCK ADCK=HS_CK/16
#endif

   //Set VDDA voltage
   DrvPMU_VDDA_LDO_Ctrl(E_LDO);
   DrvPMU_VDDA_Voltage(E_VDDA2_4);
   DrvPMU_BandgapEnable();
#if defined(HAO_2MHZ)
   Delay(0x18000);
#endif
#if defined(HAO_4MHZ)
   Delay(0x30000);
#endif
#if defined(HAO_10MHZ)
   Delay(0x60000);
#endif
#if defined(HAO_16MHZ)
   Delay(0xC0000);
#endif
   DrvPMU_AnalogGround(ENABLE);                //ADC analog ground source selection.
                                               //1 : Enable buffer and use internal source(need to work with ADC)

   //Set ADC input pin
   DrvADC_SetADCInputChannel(ADC_Input_AIO2,ADC_Input_AIO3); //Set the ADC positive/negative input voltage
source.
   DrvADC_InputSwitch(OPEN);                   //ADC signal input (positive and negative) short(VISHR) control.
   DrvADC_RefInputShort(OPEN);                 //Set the ADC reference input (positive and negative) short(VRSHR)
control.
   DrvADC_ADGain(0);                           //ADC Gain=1
   DrvADC_DCoffset(0);                        //DC offset input voltage selection (VREF=REFP-REFN)
   DrvADC_RefVoltage(0,0);                    //Set the ADC reference voltage. VDDA-VSSA
   DrvADC_FullRefRange(1);                     //Set the ADC full reference range select.
                                              //0: Full reference range input
                                              //1: 1/2 reference range input
   DrvADC_OSR(0);                              //0 : OSR=32768

   //Set ADC interrupt
   DrvADC_EnableInt();
   DrvADC_Enable();
   DrvADC_CombFilter(ENABLE);                  //Enable comb filter

}

/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                                */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*---------------------------------------------------------------------------*/
/* End Of File                                                               */
/*---------------------------------------------------------------------------*/
```

13. Analog IP(ADC_IA)

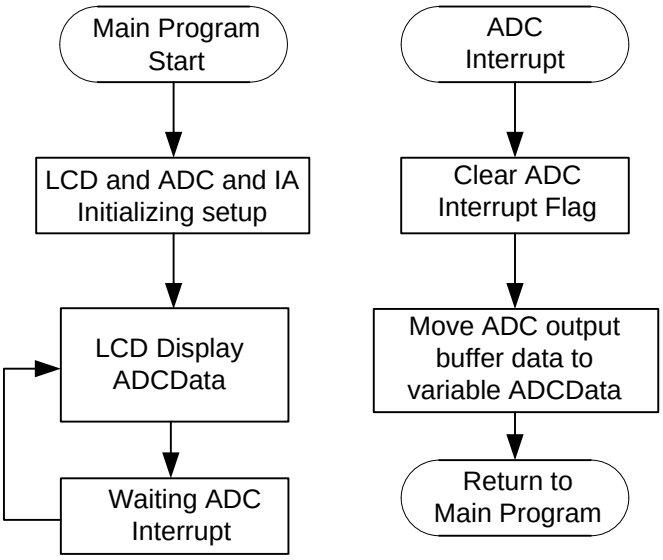
13.1. Example Name

HY16F3981_ADC_IA

13.2. Example Description

(1) ADC and IA tutorial.
(2) ADC and IA Initializing, ADC analog power set as VDDA, ADC OSR=32768, ADC output rate=30Hz, IA input channel set as AIO0(positive channel)-AIO1(negative channel), ADC reference voltage set as VDDA-VSS.
(3) After ADC and IA Initializing, Enable System GIE and wait ADC interrupt. ADC OSR can decide the ADC interrupt frequency.
(4) LCD Display variable "ADCData"
(5) Enable REFO, REFO is common voltage 1.2V. AIO1 connect to REFO. External signal connect to AIO0-AIO1 by IA to do signal measure.
IA measure voltage range : +/-1080mV

13.3. Software Flowchart



13.4. Program Description

```
/*******************************************************************************
 *
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 *
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 * and/or use of this code including liability or warranties relating
 * to fitness for a particular purpose, or infringement of any patent,
 * copyright or other intellectual property right.
 *
 * ------------------------------------------------------------------------------
 * Project Name : HY16F3981_ADC_IA
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    : Showing high 16 bit ADCData on LCD display
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *******************************************************************************/
/*-----------------------------------------------------------------------------*/
/* Includes                                                                    */
/*-----------------------------------------------------------------------------*/
#include "DrvCLOCK.h"
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"
#include "System.h"
#include "DrvADC.h"
#include "DrvPMU.h"
#include "DrvIA.h"
/*-----------------------------------------------------------------------------*/
/* STRUCTURES                                                                  */
/*-----------------------------------------------------------------------------*/
volatile typedef union _MCUSTATUS
{
   char   _byte;
   struct
   {
      unsigned b_ADCdone:1;
      unsigned b_TMAdone:1;
      unsigned b_TMBdone:1;
      unsigned b_TMC0done:1;
      unsigned b_TMC1done:1;
      unsigned b_RTCdone:1;
      unsigned b_UART_TxDone:1;
      unsigned b_UART_RxDone:1;
   };
} MCUSTATUS;

/*-----------------------------------------------------------------------------*/
/* DEFINITIONS                                                                 */
/*-----------------------------------------------------------------------------*/
//#define HAO_2MHZ
#define HAO_4MHZ
//#define HAO_10MHZ
```

```
//#define HAO_16MHZ
#define SW_IA_ADC_Chopper
/*---------------------------------------------------------------------------*/
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/
MCUSTATUS    MCUSTATUSbits;
int ADCData;
int ADCData_Array[2];
int ADCData_Chopper;
char i;
/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);
void InitalADC(void);
/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{
   InitalADC();
   DisplayInit();
   ClearLCDframe();
   Delay(10000);
   DisplayHYcon();
   Delay(10000);
   SYS_EnableGIE(4,0x3FF);                  //Enable GIE(Global Interrupt)

   MCUSTATUSbits._byte = 0;

   while(1)
   {
#if defined(SW_IA_ADC_Chopper)
      for(i=0;i<=1;i++)
      {
         switch (i)
         {
            case 0:
            while(MCUSTATUSbits.b_ADCdone==0);
            MCUSTATUSbits.b_ADCdone=0;
            DrvADC_SetADCInputChannel(IA_Input_AIO0,IA_Input_AIO1);
            DrvADC_CombFilter(DISABLE);
            DrvADC_CombFilter(ENABLE);
            MCUSTATUSbits.b_ADCdone=0;
            while(MCUSTATUSbits.b_ADCdone==0);
            ADCData_Array[0]=ADCData>>16;
            MCUSTATUSbits.b_ADCdone=0;
            break;

            case 1:
            DrvADC_SetADCInputChannel(IA_Input_AIO1,IA_Input_AIO0);
            DrvADC_CombFilter(DISABLE);
            DrvADC_CombFilter(ENABLE);
            MCUSTATUSbits.b_ADCdone=0;
            while(MCUSTATUSbits.b_ADCdone==0);
            ADCData_Array[1]=ADCData>>16;
            ADCData_Chopper=(ADCData_Array[0]-ADCData_Array[1])>>1;
            LCD_DATA_DISPLAY(ADCData_Chopper);
            MCUSTATUSbits.b_ADCdone=0;
            break;
         }
      }
#else    //HW IA_ADC_Chopper mode

      if(MCUSTATUSbits.b_ADCdone)
      {
         LCD_DATA_DISPLAY(ADCData>>16);      //16bits give up.
```

```
            MCUSTATUSbits.b_ADCdone=0;
        }
#endif
    }
    return 0;
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description   : I2C/UART/SPI interrupt Service Routine (HW0).             */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description   : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{
    if(DrvADC_ReadIntFlag())                    //Read ADC Flag
    {
        ADCData=DrvADC_GetConversionData();
        MCUSTATUSbits.b_ADCdone=1;
    }
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description   : PT3 interrupt Service Routine (HW4).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description   : PT2 interrupt Service Routine (HW5).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                  */
```

```
/* Description    : UART2 interrupt Service Routine (HW7).                    */
/* Arguments      : None.                                                     */
/* Return Value : None.                                                       */
/* Remark         :                                                           */
/*----------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*----------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                   */
/* Description    : TMB2 interrupt Service Routine (HW8).                     */
/* Arguments      : None.                                                     */
/* Return Value : None.                                                       */
/* Remark         :                                                           */
/*----------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*----------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                   */
/* Description    : OPA interrupt Service Routine (HW9).                      */
/* Arguments      : None.                                                     */
/* Return Value : None.                                                       */
/* Remark         :                                                           */
/*----------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*----------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                     */
/* Description    : Exception Service Routines.                               */
/* Arguments      : None.                                                     */
/* Return Value : None.                                                       */
/* Remark         :                                                           */
/*----------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");    //procedure define by customer.
   asm("nop");
}


/*----------------------------------------------------------------------------*/
/* Function Name: InitalADC()                                                 */
/* Description    : ADC Initialization Subroutines.                           */
/* Arguments      : None.                                                     */
/* Return Value : None.                                                       */
/* Remark         :                                                           */
/*----------------------------------------------------------------------------*/
void InitalADC(void)
{
   //Set ADC Clock
#if defined(HAO_2MHZ)
   DrvCLOCK_EnableHighOSC(E_INTERNAL,10);     //Select HSRC
   DrvCLOCK_SelectIHOSC(0);                     //Select internal 2MHZ=HS_CK
   DrvADC_ClkEnable(2);                        //Setting ADC CLOCK ADCK=HS_CK/4
#endif
#if defined(HAO_4MHZ)
   DrvCLOCK_EnableHighOSC(E_INTERNAL,10);     //Select HSRC
   DrvCLOCK_SelectIHOSC(1);                     //Select internal 4MHZ=HS_CK
   DrvADC_ClkEnable(2);                        //Setting ADC CLOCK ADCK=HS_CK/4
#endif
#if defined(HAO_10MHZ)
   DrvCLOCK_EnableHighOSC(E_INTERNAL,10);     //Select HSRC
```

```
    DrvCLOCK_SelectIHOSC(2);                    //Select internal 10MHZ=HS_CK
    DrvADC_ClkEnable(3);                        //Setting ADC CLOCK ADCK=HS_CK/8
#endif
#if defined(HAO_16MHZ)
    DrvCLOCK_EnableHighOSC(E_INTERNAL,10);      //Select HSRC
    DrvCLOCK_SelectIHOSC(3);                    //Select internal 16MHZ=HS_CK
    DrvADC_ClkEnable(4);                        //Setting ADC CLOCK ADCK=HS_CK/16
#endif

    //Set VDDA voltage
    DrvPMU_VDDA_LDO_Ctrl(E_LDO);
    DrvPMU_VDDA_Voltage(E_VDDA2_4);
    DrvPMU_BandgapEnable();
    DrvPMU_REFO_Enable();
    Delay(0x1000);
    DrvPMU_AnalogGround(ENABLE);                //ADC analog ground source selection.
                                                //1 : Enable buffer and use internal source(need to work with ADC)

    //Set IA
    DrvIA_SetIAInputChannel(IA_Input_AIO0,IA_Input_AIO1);   //ADC positive=AIO0, negative=AIO1
    DrvIA_IAGain(IA_IAGain_4);                  //IA Gain=4
#if defined(SW_IA_ADC_Chopper)
    DrvIA_IACHM(IA_IACHM_NoChopper);            //IA Chopper Off
#else   //HW IA_ADC_Chopper mode
    DrvIA_IACHM(IA_IACHM_Both);                 //IA Chopper On
#endif
    DrvIA_IAIS(0);                              //Input control=open
    DrvIA_ENIA(0);                              //Disable IA
    DrvIA_ENIA(1);                              //Enable IA

    //Set ADC input pin
    DrvADC_SetADCInputChannel(OP_OP,OP_ON);     //Set the ADC positive/negative input voltage source.
    DrvADC_InputSwitch(OPEN);                   //ADC signal input (positive and negative) short(VISHR) control.
    DrvADC_RefInputShort(OPEN);                 //Set the ADC reference input (positive and negative) short(VRSHR)
control.
    DrvADC_ADGain(0);                           //ADC Gain=1
    DrvADC_DCoffset(0);                         //DC offset input voltage selection (VREF=REFP-REFN)
    DrvADC_RefVoltage(0,0);                     //Set the ADC reference voltage. VDDA-VSSA
    DrvADC_FullRefRange(1);                     //Set the ADC full reference range select.
                                                //0: Full reference range input
                                                //1: 1/2 reference range input
    DrvADC_OSR(0);                              //0 : OSR=32768

    //Set ADC interrupt
    DrvADC_EnableInt();
    DrvADC_Enable();
    DrvADC_CombFilter(ENABLE);                  //Enable comb filter

}

/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                                */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
    for(;num>0;num--)
    asm("NOP");
}
/*---------------------------------------------------------------------------*/
/* End Of File                                                               */
/*---------------------------------------------------------------------------*/
```

14. Analog IP(LCD)

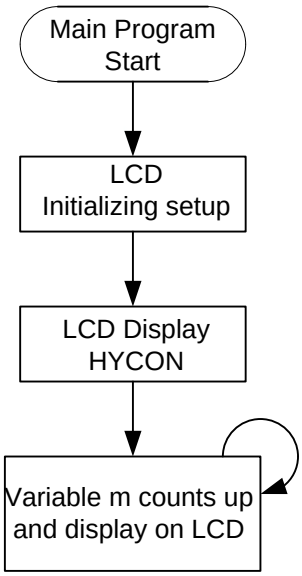
14.1. Example Name

HY16F3981_LCD

14.2. Example Description

(1) LCD tutorial.
(2) Enable LCD, set VLCD voltage and Duty.
(3) LCD I/O port set as LCD Mode.
(4) LCD display "HYCON"
(5) After LCD display "HYCON", variable "m" counts up and display on LCD.

14.3. Software Flowchart



14.4. Program Description

```
/*****************************************************************************
 *
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 *
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 * and HYCON disclaims any express or implied warranty, relating to sale
 * and/or use of this code including liability or warranties relating
 * to fitness for a particular purpose, or infringement of any patent,
 * copyright or other intellectual property right.
 *
 * ----------------------------------------------------------------------------
 * Project Name : HY16F3981_LCD
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    : HY16F3981 to do m++, and then LCD_DATA_DISPLAY(m)
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *****************************************************************************/
/*---------------------------------------------------------------------------*/
/* Includes                                                                  */
/*---------------------------------------------------------------------------*/
#include "DrvCLOCK.h"
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"

/*---------------------------------------------------------------------------*/
/* STRUCTURES                                                                */
/*---------------------------------------------------------------------------*/


/*---------------------------------------------------------------------------*/
/* DEFINITIONS                                                               */
/*---------------------------------------------------------------------------*/


/*---------------------------------------------------------------------------*/
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/

unsigned int m;

/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);

/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{
```

```
    DisplayInit();
    ClearLCDframe();
    DisplayHYcon();
    Delay(500000);
    for(m=0;m<50000;m++)
    {
        LCD_DATA_DISPLAY(m);
      Delay(65535);
    }
    return 0;
}

/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description   : I2C/UART/SPI interrupt Service Routine (HW0).             */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description   : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description   : PT3 interrupt Service Routine (HW4).                      */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description   : PT2 interrupt Service Routine (HW5).                      */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
```

```
/*---------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                  */
/* Description  : UART2 interrupt Service Routine (HW7).                     */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                  */
/* Description  : TMB2 interrupt Service Routine (HW8).                      */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                  */
/* Description  : OPA interrupt Service Routine (HW9).                       */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                    */
/* Description  : Exception Service Routines.                                */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");    //procedure define by customer.
   asm("nop");
}
/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                                */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*---------------------------------------------------------------------------*/
/* End Of File                                                               */
/*---------------------------------------------------------------------------*/
```

15. Communication IP(SPI)

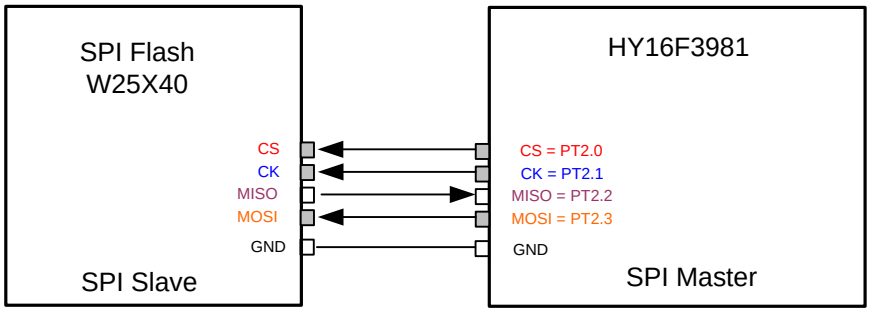
15.1. Example Name

HY16F3981_SPI

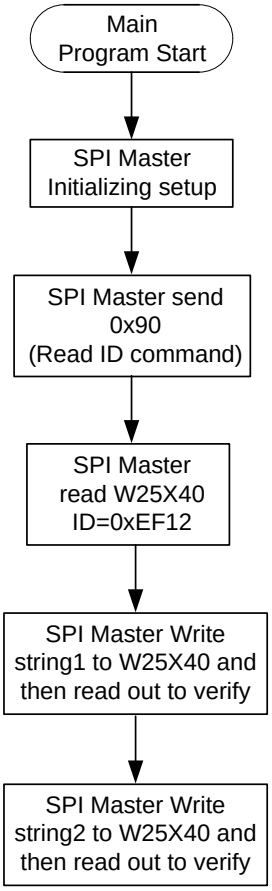
15.2. Example Description

(1) HY16F3981 three-wire SPI Master mode tutorial.
(2)SPI Master communicate with SPI Flash 25X40(Winbond). Because this example code is three-wire SPI Master mode, so CS(Chip Select) funciton by using GPIO to do control, Set PT2.0=CS function.
(3) In this example code, first, read SPI Flash Manufacturer and Device Identification. If it is work correctly, variable Flash_ID is equal to 0xEF12
(4)Second, SPI Master writes a sequence of string "String1" to SPI flash and then read out to verify. If write and read data is equal, LCD Display "0", otherwise, LCD Display "1".
(5)Third, SPI Master writes a sequence of string "String2" to SPI flash and then read out to verify. If write and read data is equal, LCD Display "0", otherwise, LCD Display "123".

15.3. System Description



15.4. Software Flowchart



15.5. Program Description

Explanation : Paste main.c at here for reference only. No shows SPI Master initializing code below.

```
/*******************************************************************************
 *
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 *
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 * HYCON assumes no responsibility for any errors appeared in the code,
 * and HYCON disclaims any express or implied warranty, relating to sale
 * and/or use of this code including liability or warranties relating
 * to fitness for a particular purpose, or infringement of any patent,
 * copyright or other intellectual property right.
 *
 * ------------------------------------------------------------------------
 * Project Name : HY16F3981_SPI
 * IDE tooling   : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.   : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description   : HY16F3981 use SPI interface to communicate with SPI Flash(W25X40)
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *******************************************************************************/
/*------------------------------------------------------------------------*/
/* Includes                                                               */
/*------------------------------------------------------------------------*/
#include "DrvREG32.h"
#include "SpecialMacro.h"
#include "stdint.h"
#include "HY16F3981.h"
#include "Display.h"
#include "System.h"
#include "DrvGPIO.h"
#include "my define.h"
#include "SPI_Flash.h"

/*------------------------------------------------------------------------*/
/* STRUCTURES                                                             */
/*------------------------------------------------------------------------*/


/*------------------------------------------------------------------------*/
/* DEFINITIONS                                                            */
/*------------------------------------------------------------------------*/
#define FlashAddress 0x000000

/*------------------------------------------------------------------------*/
/* Global CONSTANTS                                                       */
/*------------------------------------------------------------------------*/
unsigned char Flash_Write_Buffer[256];
unsigned char Flash_Read_Buffer[256];
unsigned short Flash_ID;
/*------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                    */
/*------------------------------------------------------------------------*/
void Delay(unsigned int num);

/*------------------------------------------------------------------------*/
/* Main Function                                                          */
```

```
/*---------------------------------------------------------------------------*/
int main(void)
{

   const unsigned char String1[]={
   "Hycon Technology was established in July, 2007 in Taipei, Taiwan. We dedicate ourselves to develop high precision
and low drift analog signal related processing ICs." };
   const unsigned char String2[]={
   "The identity stands for the vision and values of Hycon Technology- To be the ideal solution partner in the area of analog
circuit." };
   unsigned short index_d,Size;

   InitalSPI();
   DisplayInit();
   ClearLCDframe();
   Delay(10000);
   DisplayHYcon();
   Delay(10000);

   Flash_ID=SpiFlash_ReadMidDid();                                    //If correct, Flash_ID=0xEF12

   //Test1 : 16F3981 write String1 to Flash, and Read out
   Size=sizeof(String1);
   SpiFlash_ChipErase();                                              //Erase DATA
   Delay(256);
   SpiFlash_ReadData(Flash_Read_Buffer,FlashAddress,Size);            //Read DATA
   Delay(256);

   for( index_d=0;index_d<Size;index_d++)
   {
      Flash_Write_Buffer[index_d]=String1[index_d];
   }
   SpiFlash_PageProgram(Flash_Write_Buffer,FlashAddress,Size);    //Write DATA
   Delay(256);
   SpiFlash_ReadData(Flash_Read_Buffer,FlashAddress,Size);            //Read DATA
   Delay(256);

   for( index_d=0;index_d<Size;index_d++)
   {
      if(Flash_Read_Buffer[index_d]!=String1[index_d])
      {
         LCD_DATA_DISPLAY(1);                                         //If error, LCD Display "1"
         while(1);
      }
      else
         LCD_DATA_DISPLAY(0);                                         //If correct, LCD Display "0"
      }

   //Test2 : 16F3981 write String2 to Flash, and Read out
   Size=sizeof(String2);
   SpiFlash_SectorErase(0x00);                                        //Erase DATA
   Delay(256);
   SpiFlash_ReadData(Flash_Read_Buffer,FlashAddress,Size);            //Read DATA
   Delay(256);

   for( index_d=0;index_d<Size;index_d++)
   {
      Flash_Write_Buffer[index_d]=String2[index_d];
   }
   SpiFlash_PageProgram(Flash_Write_Buffer,FlashAddress,Size);    //Write DATA
   Delay(256);
   SpiFlash_ReadData(Flash_Read_Buffer,FlashAddress,Size);            //Read DATA
   Delay(256);

   for( index_d=0;index_d<Size;index_d++)
   {
      if(Flash_Read_Buffer[index_d]!=String2[index_d])
```

```
    {
      LCD_DATA_DISPLAY(1);                                    //If error, LCD Display "1"
      while(1);
    }
    else
      LCD_DATA_DISPLAY(123);                                  //If correct, LCD Display "123"
    }

  while(1);

  return 0;

}

/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description   : I2C/UART/SPI interrupt Service Routine (HW0).             */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description   : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description   : PT3 interrupt Service Routine (HW4).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description   : PT2 interrupt Service Routine (HW5).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW5_ISR(void)
{
```

```
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                  */
/* Description   : UART2 interrupt Service Routine (HW7).                    */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                  */
/* Description   : TMB2 interrupt Service Routine (HW8).                     */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                  */
/* Description   : OPA interrupt Service Routine (HW9).                      */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                    */
/* Description   : Exception Service Routines.                               */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");    //procedure define by customer.
   asm("nop");
}
/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                                */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*---------------------------------------------------------------------------*/
/* End Of File                                                               */
/*---------------------------------------------------------------------------*/
```

16. Communication IP(UART)

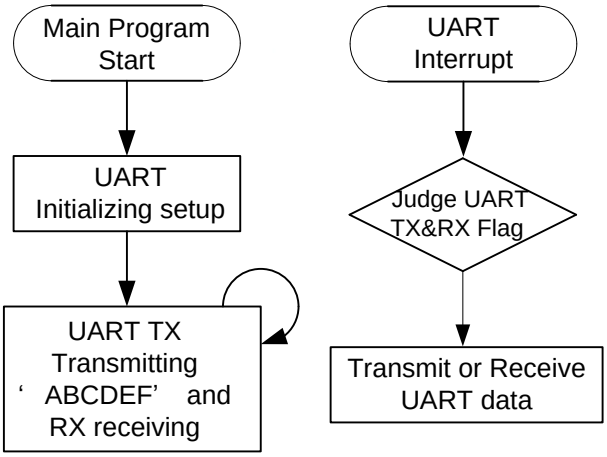
16.1. Example Name

HY16F3981_UART

16.2. Example Description

(1) HY16F3981 UART TX and RX tutorial.
(2) In this example code, using #define to select UART port is PORT9, otherwise UART port is PT2 port. If UART port is Port2, TX=PT2.0, RX=PT2.1. If UART port is PORT9, TX=PT9.4, RX=PT9.5
(3) using #define HAO_2MHZ/ HAO_4MHZ/ HAO_10MHZ/ HAO_16MHZ to select HAO frequency.
(4) UART TX continue transmit 'ABCEDF' until RX receiving 'abcedf' to stop transmit. If RX receiving not equal to 'abcedf', UART TX start to transmit 'ABCEDF'

16.3. Software Flowchart



16.4. Program Description

```
/*****************************************************************************
 *
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 * copyright or other intellectual property right.
 *
 * ----------------------------------------------------------------------------
 * Project Name : HY16F3981_UART
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    : using #define HAO_2MHZ/ HAO_4MHZ/ HAO_10MHZ/ HAO_16MHZ to select HAO frequency.
 * UART TX continue transmit ne HAO_2MHZ/ HAO_4MHZ/ HAO_10MHZ/ HAO_16MHZ to select HAO frequency.ing not
equal to t is Port2, TX=PT2.0, RX=PT2.1. If UART por
 *
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *****************************************************************************/
/*---------------------------------------------------------------------------*/
/* Includes                                                                  */
/*---------------------------------------------------------------------------*/
#include "DrvCLOCK.h"
#include "my define.h"
#include "HY16F3981.h"
#include "DrvUART.h"
#include "DrvGPIO.h"
#include "System.h"
/*---------------------------------------------------------------------------*/
/* STRUCTURES                                                                */
/*---------------------------------------------------------------------------*/
volatile typedef union _MCUSTATUS
{
   char    _byte;
   struct
   {
      unsigned b_ADCdone:1;
      unsigned b_TMAdone:1;
      unsigned b_TMBdone:1;
      unsigned b_TMC0done:1;
      unsigned b_TMC1done:1;
      unsigned b_RTCdone:1;
      unsigned b_UART_TxDone:1;
      unsigned b_UART_RxDone:1;
   };
} MCUSTATUS;

/*---------------------------------------------------------------------------*/
/* DEFINITIONS                                                               */
/*---------------------------------------------------------------------------*/
//#define PORT9
```

```
#define HSRC    //Internal HAO
//#define HSXT    //External 4MHz

#define HAO_2MHZ
//#define HAO_4MHZ
//#define HAO_10MHZ
//#define HAO_16MHZ

#if defined(PORT9)
#define   UART_PORT E_PT9
#define   UART_TXD   BIT4
#define   UART_RXD   BIT5
#else
#define   UART_PORT E_PT2
#define   UART_TXD   BIT0
#define   UART_RXD   BIT1
#endif

#define   Uart_RX_BufferSize 6
#define   Uart_TX_BufferSize 8

/*---------------------------------------------------------------------------*/
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/
unsigned char UartRxBuffer[Uart_RX_BufferSize]={0},UartTxBuffer[Uart_TX_BufferSize]={0};
unsigned char UartTxIndex,UartTxLength,UartRxIndex,UartRxLength;
MCUSTATUS   MCUSTATUSbits;

unsigned char UartRxBuffer_Command[Uart_RX_BufferSize]=
{
0x61,0x62,0x63,0x64,0x65,0x66 //ASCII   KEYWORD = abcdef
};
/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);
void InitalUart(void);
void InitalClock(void);
/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{
   unsigned char Stop_To_Send_UART=DISABLE;
   InitalClock();
   InitalUart();
   MCUSTATUSbits._byte = 0;
   MCUSTATUSbits.b_UART_TxDone=ENABLE;
   SYS_EnableGIE(4,0x3FF);   //Enable GIE(Global Interrupt)

   UartTxIndex=0;
   UartRxIndex=0;

   while(1)
   {

      //UART RX
      if(MCUSTATUSbits.b_UART_RxDone==ENABLE)
      {

         if(
            (UartRxBuffer[5]==UartRxBuffer_Command[5] && UartRxBuffer[4]==UartRxBuffer_Command[4]) &&
            (UartRxBuffer[3]==UartRxBuffer_Command[3] && UartRxBuffer[2]==UartRxBuffer_Command[2]) &&
            (UartRxBuffer[1]==UartRxBuffer_Command[1] && UartRxBuffer[0]==UartRxBuffer_Command[0])
            )
      {
            //if UART receive == 0x61(a)0x62(b)0x63(c)0x64(d)0x65(e)0x66(f)
```

```
            //send out 0x61(a)0x62(b)0x63(c)0x64(d)0x65(e)0x66(f) and stop to send out
            Stop_To_Send_UART=ENABLE;    //UART stop to send out ABCDEF
            for(UartTxLength=0;UartTxLength<=Uart_TX_BufferSize;UartTxLength++)
            {
               UartTxBuffer[UartTxLength]=UartRxBuffer[UartTxLength];
               if(UartTxLength==Uart_RX_BufferSize)
               {
                  UartRxIndex=0;
                  MCUSTATUSbits.b_UART_TxDone=DISABLE;
                  DrvUART_EnableInt(ENABLE,DISABLE);     //Enable UART Tx Interrupt, Disable UART Rx Interrup
                  while(!MCUSTATUSbits.b_UART_TxDone); //If    MCUSTATUSbits.b_UART_TxDone=DISABLE, stop at
here
               }
            }
      }
      else
      {
         //if UART receive != 0x61(a)0x62(b)0x63(c)0x64(d)0x65(e)0x66(f)
         //User defined at here
         Stop_To_Send_UART=DISABLE;     //UART start to send out ABCDEF
      }
         UartRxIndex=0; //When finished the data reception. Set UartRxIndex=0
         MCUSTATUSbits.b_UART_RxDone=DISABLE;
      }

      //UART TX
      if(MCUSTATUSbits.b_UART_TxDone==ENABLE && Stop_To_Send_UART==DISABLE )
      {
         UartTxBuffer[7]='\r';
         UartTxBuffer[6]='\n';
         UartTxBuffer[5]=0x46;   //F
         UartTxBuffer[4]=0x45;   //E
         UartTxBuffer[3]=0x44;   //D
         UartTxBuffer[2]=0x43;   //C
         UartTxBuffer[1]=0x42;   //B
         UartTxBuffer[0]=0x41;   //A
         MCUSTATUSbits.b_UART_TxDone=DISABLE;
         UartTxLength=8;
         UartTxIndex=0;
         DrvUART_EnableInt(ENABLE,ENABLE);        //Enable UART Tx Interrupt;Enable UART Rx Interrupt
         while(!MCUSTATUSbits.b_UART_TxDone);   //If    MCUSTATUSbits.b_UART_TxDone=DISABLE, stop at here
      }

   }

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description   : I2C/UART/SPI interrupt Service Routine (HW0).             */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{
   if(DrvUART_GetRxFlag())
   {
      UartRxBuffer[UartRxIndex]=DrvUART_Read();
      UartRxIndex++;
      if(UartRxIndex>=Uart_RX_BufferSize)
      {
         UartRxIndex=0;
         MCUSTATUSbits.b_UART_RxDone=ENABLE;
      }
         DrvUART_ClrRxFlag();
   }
```

```
    if(DrvUART_GetTxFlag())
    {
      if(MCUSTATUSbits.b_UART_TxDone==DISABLE)
      {
        DrvUART_Write(UartTxBuffer[UartTxIndex++]);
        DrvUART_ClrTxFlag();
        if(UartTxIndex>=UartTxLength)
        {
          DrvUART_EnableInt(ENABLE,ENABLE);    //ENABLE UART Tx Interrupt, ENABLE UART Rx Interrupt
          MCUSTATUSbits.b_UART_TxDone=ENABLE;
          UartTxIndex=0;
        }
      }
      if(MCUSTATUSbits.b_UART_TxDone==ENABLE)
      {
        DrvUART_EnableInt(DISABLE,ENABLE);    //DISABLE UART Tx Interrupt, ENABLE UART Rx Interrupt
        DrvUART_ClrTxFlag();
      }
    }

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description   : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description   : PT3 interrupt Service Routine (HW4).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description   : PT2 interrupt Service Routine (HW5).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                  */
```

```
/* Description    : UART2 interrupt Service Routine (HW7).                    */
/* Arguments      : None.                                                     */
/* Return Value : None.                                                       */
/* Remark         :                                                           */
/*----------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*----------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                   */
/* Description    : TMB2 interrupt Service Routine (HW8).                     */
/* Arguments      : None.                                                     */
/* Return Value : None.                                                       */
/* Remark         :                                                           */
/*----------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*----------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                   */
/* Description    : OPA interrupt Service Routine (HW9).                      */
/* Arguments      : None.                                                     */
/* Return Value : None.                                                       */
/* Remark         :                                                           */
/*----------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*----------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                     */
/* Description    : Exception Service Routines.                               */
/* Arguments      : None.                                                     */
/* Return Value : None.                                                       */
/* Remark         :                                                           */
/*----------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");    //procedure define by customer.
   asm("nop");
}

/*----------------------------------------------------------------------------*/
/* Function Name: InitalClock()                                               */
/* Description    : CLOCK Initial Subroutines.                                */
/* Arguments      : None.                                                     */
/* Return Value : None.                                                       */
/* Remark         :                                                           */
/*----------------------------------------------------------------------------*/
void InitalClock(void)
{

#if defined(HSRC)
   #if defined(HAO_2MHZ)
   //Clock INIT 2MHZ
   DrvCLOCK_EnableHighOSC(E_INTERNAL,10);          //Select HSRC
   DrvCLOCK_SelectIHOSC(0);                       //Select internal 2MHZ
   DrvCLOCK_SelectMCUClock(0,0);                  //CPU CLOCK IS 'hs_ck/1'
   DrvCLOCK_CalibrateHAO(0);                              //Calibration 1.843MHz
   #endif
   #if defined(HAO_4MHZ)
   //Clock INIT 4MHZ
   DrvCLOCK_EnableHighOSC(E_INTERNAL,10);          //Select HSRC
   DrvCLOCK_SelectIHOSC(1);                       //Select internal 4MHZ
   DrvCLOCK_SelectMCUClock(0,0);                  //CPU CLOCK IS 'hs_ck/1'
```

```
    DrvCLOCK_CalibrateHAO(1);                       //Calibration 4.147MHz
    #endif
    #if defined(HAO_10MHZ)
    //Clock INIT 10MHZ
    DrvCLOCK_EnableHighOSC(E_INTERNAL,10);      //Select HSRC
    DrvCLOCK_SelectIHOSC(2);                    //Select internal 10MHZ
    DrvCLOCK_SelectMCUClock(0,0);               //CPU CLOCK IS 'hs_ck/1'
    DrvCLOCK_CalibrateHAO(2);                       //Calibration 9.216MHz
    #endif
    #if defined(HAO_16MHZ)
    //Clock INIT 16MHZ
    DrvCLOCK_EnableHighOSC(E_INTERNAL,10);      //Select HSRC
    DrvCLOCK_SelectIHOSC(3);                    //Select internal 16MHZ
    DrvCLOCK_SelectMCUClock(0,0);               //CPU CLOCK IS 'hs_ck/1'
    DrvCLOCK_CalibrateHAO(3);                       //Calibration 15.667MHz
    #endif
#endif

#if defined(HSXT)
    DrvCLOCK_EnableHighOSC (E_EXTERNAL,50);
#endif
}

/*---------------------------------------------------------------------------*/
/* Function Name: InitalUart()                                               */
/* Description    : UART Initial Subroutines.                                */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void InitalUart(void)
{

#if defined(HSRC)
    DrvUART_ClkEnable(1,0);             //Choose the internal HAO as clock source
    #if defined(PORT9)
        #if defined(HAO_2MHZ)
        DrvUART_Open(1843,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,7);
        #endif
        #if defined(HAO_4MHZ)
        DrvUART_Open(4147,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,7);
        #endif
        #if defined(HAO_10MHZ)
        DrvUART_Open(9216,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,7);
        #endif
        #if defined(HAO_16MHZ)
        DrvUART_Open(15667,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,7);
    #endif
    #else //PORT2
        #if defined(HAO_2MHZ)
        DrvUART_Open(1843,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,2);
        #endif
        #if defined(HAO_4MHZ)
        DrvUART_Open(4147,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,2);
        #endif
        #if defined(HAO_10MHZ)
        DrvUART_Open(9216,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,2);
        #endif
        #if defined(HAO_16MHZ)
        DrvUART_Open(15667,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,2);
        #endif
    #endif
#endif

    //1843 : oscillator frequency 2MHz Unit After Calibration HAO = 1843kHz
    //4147 : oscillator frequency 4MHz Unit After Calibration HAO = 4147kHz
    //9216 : oscillator frequency 10MHz Unit After Calibration HAO = 9216kHz
```

```
   //15667 : oscillator frequency 16MHz Unit After Calibration HAO = 15667kHz
   //None parity
   //8 data bits.
   //7 : Port 9.4 =TX, Port 9.5 =RX
   //2 : Port 2.0 =TX, Port 2.1 =RX

#if defined(HSXT)
   DrvUART_ClkEnable(0,0);                  //Choose the external 4MHz OSC as clock source
   DrvUART_Open(4000,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,2);
#endif

#if defined(PORT9)
   DrvGPIO_LCDIOOpen(UART_PORT, UART_TXD, E_IO_OUTPUT);
   DrvGPIO_LCDIOOpen(UART_PORT, UART_RXD, E_IO_INPUT);
#else
   DrvGPIO_Open(UART_PORT,UART_TXD,E_IO_OUTPUT);
   DrvGPIO_Open(UART_PORT,UART_RXD,E_IO_INPUT);
   DrvGPIO_Open(UART_PORT,UART_RXD|UART_TXD,E_IO_PullHigh);
#endif

   DrvGPIO_ClkGenerator(E_HS_CK,1);
   DrvUART_EnableInt(ENABLE,ENABLE); //Enable UART Tx Interrupt, Enable UART Rx Interrupt
   DrvUART_Disable_AutoBaudrate();
   DrvUART_Close();
   DrvUART_Enable();
}

/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                                */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*---------------------------------------------------------------------------*/
/* End Of File                                                               */
/*---------------------------------------------------------------------------*/
```

17. Communication IP(UART2)

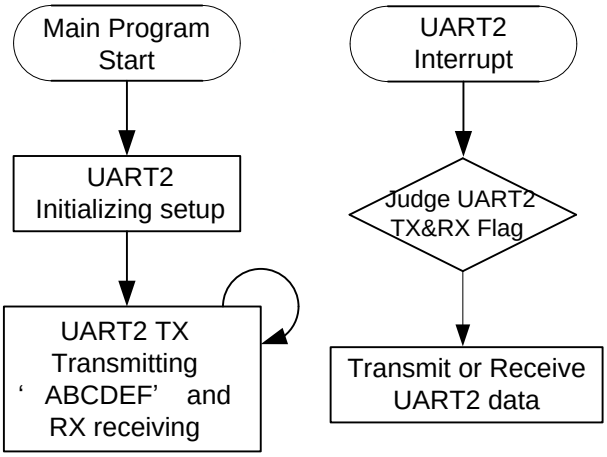
17.1. Example Name

HY16F3981_UART2

17.2. Example Description

(1) HY16F3981 UART2 TX and RX tutorial.
(2) In this example code, using #define to select UART2 port is PORT9, otherwise UART port is PT2 port. If UART2 port is Port2, TX=PT2.2, RX=PT2.3. If UART port is PORT9, TX=PT9.2, RX=PT9.3
(3) using #define HAO_2MHZ/ HAO_4MHZ/ HAO_10MHZ/ HAO_16MHZ to select HAO frequency.
(4) UART2 TX continue transmit 'ABCEDF' until RX receiving 'abcedf' to stop transmit. If RX receiving not equal to 'abcedf', UART2 TX start to transmit 'ABCEDF'

17.3. Software Flowchart



17.4. Program Description

```
/*******************************************************************************
 *
 * Copyright (c) 2016-2026 HYCON Technology, Inc.
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 *
 * HYCON reserves the right to amend this code without notice at any time.
 * HYCON assumes no responsibility for any errors appeared in the code,
 * and HYCON disclaims any express or implied warranty, relating to sale
 * and/or use of this code including liability or warranties relating
 * to fitness for a particular purpose, or infringement of any patent,
 * copyright or other intellectual property right.
 *
 * ----------------------------------------------------------------------------
 * Project Name : HY16F3981_UART2
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    : using #define HAO_2MHZ/ HAO_4MHZ/ HAO_10MHZ/ HAO_16MHZ to select HAO frequency.
 * UART TX continue transmit ne HAO_2MHZ/ HAO_4MHZ/ HAO_10MHZ/ HA to stop transmit. If RX receiving not equal
to ', UARTort2, TX=PT2.0, RX=PT2.1. If UART por
 *
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *******************************************************************************/
/*----------------------------------------------------------------------------*/
/* Includes                                                                   */
/*----------------------------------------------------------------------------*/
#include "DrvCLOCK.h"
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"
#include "System.h"
#include "DrvGPIO.h"
#include "DrvUART.h"
/*----------------------------------------------------------------------------*/
/* STRUCTURES                                                                 */
/*----------------------------------------------------------------------------*/
volatile typedef union _MCUSTATUS
{
   char   _byte;
   struct
   {
      unsigned b_ADCdone:1;
      unsigned b_TMAdone:1;
      unsigned b_TMBdone:1;
      unsigned b_TMC0done:1;
      unsigned b_TMC1done:1;
      unsigned b_RTCdone:1;
      unsigned b_UART2_TxDone:1;
      unsigned b_UART2_RxDone:1;
   };
} MCUSTATUS;


/*----------------------------------------------------------------------------*/
/* DEFINITIONS                                                                */
```

```
/*---------------------------------------------------------------------------*/
//#define PORT9
#define HSRC    //Internal HAO
//#define HSXT    //External 4MHz

#define HAO_2MHZ
//#define HAO_4MHZ
//#define HAO_10MHZ
//#define HAO_16MHZ


#if defined(PORT9)
#define   UART2_PORT E_PT9
#define   UART2_TXD   BIT2
#define   UART2_RXD   BIT3
#else
#define   UART2_PORT E_PT2
#define   UART2_TXD   BIT2
#define   UART2_RXD   BIT3
#endif

#define   Uart2_RX_BufferSize 6
#define   Uart2_TX_BufferSize 8


/*---------------------------------------------------------------------------*/
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/
unsigned char Uart2RxBuffer[Uart2_RX_BufferSize]={0},Uart2TxBuffer[Uart2_TX_BufferSize]={0};
unsigned char Uart2TxIndex,Uart2TxLength,Uart2RxIndex,Uart2RxLength;
MCUSTATUS   MCUSTATUSbits;

unsigned char Uart2RxBuffer_Command[Uart2_RX_BufferSize]=
{
0x61,0x62,0x63,0x64,0x65,0x66 //ASCII   KEYWORD = abcdef
};
/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);
void InitalUart2(void);
void InitalClock(void);
/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{

   unsigned char Stop_To_Send_UART2=DISABLE;
   InitalClock();
   InitalUart2();
   MCUSTATUSbits._byte = 0;
   MCUSTATUSbits.b_UART2_TxDone=ENABLE;
   SYS_EnableGIE(4,0x3FF);   //Enable GIE(Global Interrupt)

   Uart2TxIndex=0;
   Uart2RxIndex=0;

   while(1)
   {

      //UART2 RX
      if(MCUSTATUSbits.b_UART2_RxDone==ENABLE)
      {

         if(
            (Uart2RxBuffer[5]==Uart2RxBuffer_Command[5] && Uart2RxBuffer[4]==Uart2RxBuffer_Command[4]) &&
```

```
            (Uart2RxBuffer[3]==Uart2RxBuffer_Command[3] && Uart2RxBuffer[2]==Uart2RxBuffer_Command[2]) &&
            (Uart2RxBuffer[1]==Uart2RxBuffer_Command[1] && Uart2RxBuffer[0]==Uart2RxBuffer_Command[0])
            )
        {
            //if UART2 receive == 0x61(a)0x62(b)0x63(c)0x64(d)0x65(e)0x66(f)
            //send out 0x61(a)0x62(b)0x63(c)0x64(d)0x65(e)0x66(f) and stop to send out
            Stop_To_Send_UART2=ENABLE;    //UART stop to send out ABCDEF
            for(Uart2TxLength=0;Uart2TxLength<=Uart2_TX_BufferSize;Uart2TxLength++)
            {
               Uart2TxBuffer[Uart2TxLength]=Uart2RxBuffer[Uart2TxLength];
               if(Uart2TxLength==Uart2_RX_BufferSize)
               {
                  Uart2RxIndex=0;
                  MCUSTATUSbits.b_UART2_TxDone=DISABLE;
                  DrvUART2_EnableInt(ENABLE,DISABLE);     //Enable UART2 Tx Interrupt, Disable UART2 Rx Interrup
                  while(!MCUSTATUSbits.b_UART2_TxDone); //If    MCUSTATUSbits.b_UART2_TxDone=DISABLE, stop at
here
               }
            }
        }
        else
        {
           //if UART2 receive != 0x61(a)0x62(b)0x63(c)0x64(d)0x65(e)0x66(f)
           //User defined at here
           Stop_To_Send_UART2=DISABLE;     //UART2 start to send out ABCDEF
        }
           Uart2RxIndex=0; //When finished the data reception. Set Uart2RxIndex=0
           MCUSTATUSbits.b_UART2_RxDone=DISABLE;
        }

        //UART2 TX
        if(MCUSTATUSbits.b_UART2_TxDone==ENABLE && Stop_To_Send_UART2==DISABLE )
        {
           Uart2TxBuffer[7]='\r';
           Uart2TxBuffer[6]='\n';
           Uart2TxBuffer[5]=0x46;    //F
           Uart2TxBuffer[4]=0x45;    //E
           Uart2TxBuffer[3]=0x44;    //D
           Uart2TxBuffer[2]=0x43;    //C
           Uart2TxBuffer[1]=0x42;    //B
           Uart2TxBuffer[0]=0x41;    //A
           MCUSTATUSbits.b_UART2_TxDone=DISABLE;
           Uart2TxLength=8;
           Uart2TxIndex=0;
           DrvUART2_EnableInt(ENABLE,ENABLE);         //Enable UART2 Tx Interrupt;Enable UART2 Rx Interrupt
           while(!MCUSTATUSbits.b_UART2_TxDone);    //If    MCUSTATUSbits.b_UART2_TxDone=DISABLE, stop at here
        }

    }

}

/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description    : I2C/UART/SPI interrupt Service Routine (HW0).            */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark         :                                                          */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description    : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments      : None.                                                    */
```

```
/* Return Value : None.                                                    */
/* Remark       :                                                          */
/*-------------------------------------------------------------------------*/
void HW1_ISR(void)
{

}
/*-------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                */
/* Description  : ADC interrupt Service Routine (HW2).                     */
/* Arguments    : None.                                                    */
/* Return Value : None.                                                    */
/* Remark       :                                                          */
/*-------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*-------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                */
/* Description  : PT3 interrupt Service Routine (HW4).                     */
/* Arguments    : None.                                                    */
/* Return Value : None.                                                    */
/* Remark       :                                                          */
/*-------------------------------------------------------------------------*/
void HW4_ISR(void)
{

}
/*-------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                */
/* Description  : PT2 interrupt Service Routine (HW5).                     */
/* Arguments    : None.                                                    */
/* Return Value : None.                                                    */
/* Remark       :                                                          */
/*-------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
/*-------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                */
/* Description  : UART2 interrupt Service Routine (HW7).                   */
/* Arguments    : None.                                                    */
/* Return Value : None.                                                    */
/* Remark       :                                                          */
/*-------------------------------------------------------------------------*/
void HW7_ISR(void)
{

  if(DrvUART2_GetRxFlag())
  {
    Uart2RxBuffer[Uart2RxIndex]=DrvUART2_Read();
    Uart2RxIndex++;
    if(Uart2RxIndex>=Uart2_RX_BufferSize)
    {
      Uart2RxIndex=0;
      MCUSTATUSbits.b_UART2_RxDone=ENABLE;
    }
      DrvUART2_ClrRxFlag();
  }

  if(DrvUART2_GetTxFlag())
  {
    if(MCUSTATUSbits.b_UART2_TxDone==DISABLE)
    {
      DrvUART2_Write(Uart2TxBuffer[Uart2TxIndex++]);
```

```
        DrvUART2_ClrTxFlag();
        if(Uart2TxIndex>=Uart2TxLength)
        {
          DrvUART2_EnableInt(ENABLE,ENABLE);    //ENABLE UART2 Tx Interrupt, ENABLE UART2 Rx Interrupt
          MCUSTATUSbits.b_UART2_TxDone=ENABLE;
          Uart2TxIndex=0;
        }
      }
        if(MCUSTATUSbits.b_UART2_TxDone==ENABLE)
        {
          DrvUART2_EnableInt(DISABLE,ENABLE);    //DISABLE UART2 Tx Interrupt, ENABLE UART2 Rx Interrupt
          DrvUART2_ClrTxFlag();
        }

    }


}
/*---------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                  */
/* Description    : TMB2 interrupt Service Routine (HW8).                    */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark         :                                                          */
/*---------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                  */
/* Description    : OPA interrupt Service Routine (HW9).                     */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark         :                                                          */
/*---------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                    */
/* Description    : Exception Service Routines.                              */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark         :                                                          */
/*---------------------------------------------------------------------------*/
void tlb_exception_handler()
{
  asm("nop");    //procedure define by customer.
  asm("nop");
}

/*---------------------------------------------------------------------------*/
/* Function Name: InitalClock()                                              */
/* Description    : CLOCK Initial Subroutines.                               */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark         :                                                          */
/*---------------------------------------------------------------------------*/
void InitalClock(void)
{

#if defined(HSRC)
  #if defined(HAO_2MHZ)
  //Clock INIT 2MHZ
  DrvCLOCK_EnableHighOSC(E_INTERNAL,10);          //Select HSRC
```

```
    DrvCLOCK_SelectIHOSC(0);                    //Select internal 2MHZ
    DrvCLOCK_SelectMCUClock(0,0);               //CPU CLOCK IS 'hs_ck/1'
    DrvCLOCK_CalibrateHAO(0);                       //Calibration 1.843MHz
    #endif
    #if defined(HAO_4MHZ)
    //Clock INIT 4MHZ
    DrvCLOCK_EnableHighOSC(E_INTERNAL,10);      //Select HSRC
    DrvCLOCK_SelectIHOSC(1);                    //Select internal 4MHZ
    DrvCLOCK_SelectMCUClock(0,0);               //CPU CLOCK IS 'hs_ck/1'
    DrvCLOCK_CalibrateHAO(1);                       //Calibration 4.147MHz
    #endif
    #if defined(HAO_10MHZ)
    //Clock INIT 10MHZ
    DrvCLOCK_EnableHighOSC(E_INTERNAL,10);      //Select HSRC
    DrvCLOCK_SelectIHOSC(2);                    //Select internal 10MHZ
    DrvCLOCK_SelectMCUClock(0,0);               //CPU CLOCK IS 'hs_ck/1'
    DrvCLOCK_CalibrateHAO(2);                       //Calibration 9.216MHz
    #endif
    #if defined(HAO_16MHZ)
    //Clock INIT 16MHZ
    DrvCLOCK_EnableHighOSC(E_INTERNAL,10);      //Select HSRC
    DrvCLOCK_SelectIHOSC(3);                    //Select internal 16MHZ
    DrvCLOCK_SelectMCUClock(0,0);               //CPU CLOCK IS 'hs_ck/1'
    DrvCLOCK_CalibrateHAO(3);                       //Calibration 15.667MHz
    #endif
#endif

#if defined(HSXT)
    DrvCLOCK_EnableHighOSC (E_EXTERNAL,50);
#endif
}

/*---------------------------------------------------------------------------*/
/* Function Name: InitalUart2()                                              */
/* Description    : UART2 Initial Subroutines.                               */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark         :                                                          */
/*---------------------------------------------------------------------------*/
void InitalUart2(void)
{

#if defined(HSRC)
    DrvUART2_ClkEnable(1,0);            //Choose the internal HAO as clock source
    #if defined(PORT9)
        #if defined(HAO_2MHZ)
        DrvUART2_Open(1843,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,6);
        #endif
        #if defined(HAO_4MHZ)
        DrvUART2_Open(4147,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,6);
        #endif
        #if defined(HAO_10MHZ)
        DrvUART2_Open(9216,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,6);
        #endif
        #if defined(HAO_16MHZ)
        DrvUART2_Open(15667,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,6);
    #endif
    #else //PORT2
        #if defined(HAO_2MHZ)
        DrvUART2_Open(1843,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,2);
        #endif
        #if defined(HAO_4MHZ)
        DrvUART2_Open(4147,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,2);
        #endif
        #if defined(HAO_10MHZ)
        DrvUART2_Open(9216,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,2);
        #endif
```

```
      #if defined(HAO_16MHZ)
      DrvUART2_Open(15667,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,2);
      #endif
   #endif
#endif
   //1843 : oscillator frequency 4MHz Unit After Calibration HAO = 1843kHz
   //4147 : oscillator frequency 4MHz Unit After Calibration HAO = 4147kHz
   //9216 : oscillator frequency 4MHz Unit After Calibration HAO = 9216kHz
   //15667 : oscillator frequency 4MHz Unit After Calibration HAO = 15667kHz
   //None parity
   //8 data bits.
   //6 : Port 9.2 =TX, Port 9.3 =RX
   //2 : Port 2.2 =TX, Port 2.3 =RX

#if defined(HSXT)
   DrvUART2_ClkEnable(0,0);                  //Choose the external OSC as clock source
   DrvUART2_Open(4000,B9600,DRVUART_PARITY_NONE,DRVUART_DATABITS_8,DRVUART_STOPBITS_1,2);
#endif

#if defined(PORT9)
   DrvGPIO_LCDIOOpen(UART2_PORT, UART2_TXD, E_IO_OUTPUT);
   DrvGPIO_LCDIOOpen(UART2_PORT, UART2_RXD, E_IO_INPUT);

#else
   DrvGPIO_Open(UART2_PORT,UART2_TXD,E_IO_OUTPUT);
   DrvGPIO_Open(UART2_PORT,UART2_RXD,E_IO_INPUT);
   DrvGPIO_Open(UART2_PORT,UART2_RXD|UART2_TXD,E_IO_PullHigh);
#endif

   DrvUART2_EnableInt(ENABLE,ENABLE); //ENABLE UART2 Tx Interrupt, ENABLE UART2 Rx Interrupt
   DrvUART2_Disable_AutoBaudrate();
   DrvUART2_Close();
   DrvUART2_Enable();
}


/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                                */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*---------------------------------------------------------------------------*/
/* End Of File                                                               */
/*---------------------------------------------------------------------------*/
```

18. Communication IP(I2C)

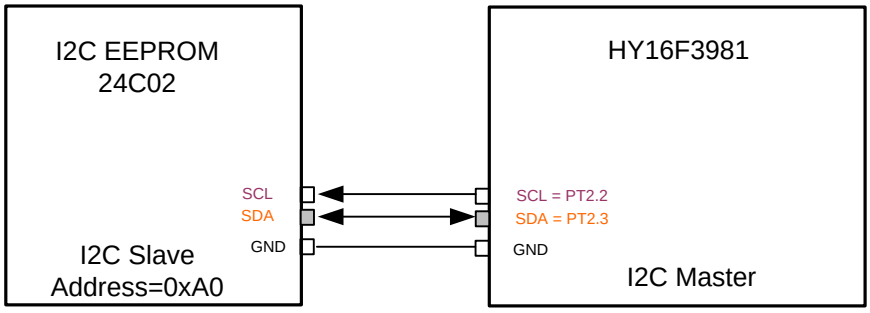
18.1. Example Name

HY16F3981_I2C

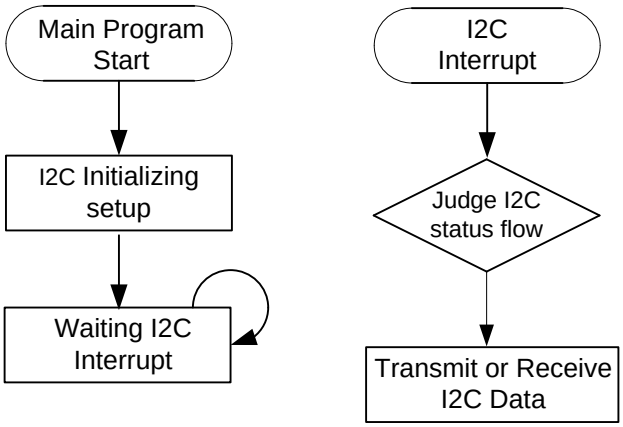
18.2. Example Description

(1) HY16F3981 I2C Master mode tutorial.
(2)I2C Master communicate with I2C EEPROM 24C02, I2C Master single write & read and multiple write & read example.
(3) In this example, first, I2C Master write 0x01 to EEPROM WORD ADDRESS 0x00, and then I2C Master read EEPROM WORD ADDRESS 0x00.
(4) Second, I2C Master write a sequence of 4 bytes data to EEPROM WORD ADDRESS 0x01, and then I2C Master read a sequence of 5 bytes data from EEPROM WORD ADDRESS 0x00.
(5) If finish this example correctly, EEPROM address 0x00 data is equal to 0x01, EEPROM address 0x01 data is equal to 0x02, EEPROM address 0x02 data is equal to 0x03, EEPROM address 0x03 data is equal to 0x04, EEPROM address 0x04 data is equal to 0x05.

18.3. System Description



18.4. Software Flowchart



18.5. Program Description

Explanation : Paste main.c at here for reference only. No shows I2C Master initializing code below.

```
/*******************************************************************************
 *
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 * copyright or other intellectual property right.
 *
 * ------------------------------------------------------------------------
 * Project Name : HY16F3981_I2C
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    : HY16F3981 use I2C interface to communicate with I2C EEPROM(24Cxx)
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *
 * HY16F3981
 * ---------
 *              |                    --------
 *       PT2.3 | SDA <--> SDA |EEPROM|
 *       PT2.2 | SCK ---> SCK --------
 *         GND   |
 *               |
 * ---------
```

```
 ******************************************************************************/
/*---------------------------------------------------------------------------*/
/* Includes                                                                  */
/*---------------------------------------------------------------------------*/
#include "DrvI2C.h"
#include "System.h"
#include "EEPROM_24Cxx.h"
#include "my define.h"
#include "HY16F3981.h"

/*---------------------------------------------------------------------------*/
/* STRUCTURES                                                                */
/*---------------------------------------------------------------------------*/


/*---------------------------------------------------------------------------*/
/* DEFINITIONS                                                               */
/*---------------------------------------------------------------------------*/
#define   I2C_PORT E_PT2
#define   SCL_PIN 2
#define   SDA_PIN 3
#define   SCL_BIT BIT2
#define   SDA_BIT BIT3
#define   I2CBufferSize   256
#define I2C_WRITE     0x00   // I2C WRITE command
#define I2C_READ      0x01   // I2C READ command

/*---------------------------------------------------------------------------*/
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/
unsigned char I2C_Read_Buffer[I2CBufferSize];;
unsigned char I2C_RW;
unsigned char I2C_TARGET;        // Target I2C slave address
unsigned char I2C_Sendbuf[I2CBufferSize];
unsigned char I2C_Recbuf[I2CBufferSize];
unsigned char I2C_EndFlag;
unsigned int I2C_DataTxLen,I2C_DataTxIndex,I2C_DataRxLen,I2C_DataRxIndex;

/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);

/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{
   unsigned int i;
   unsigned char EEPROM_WriteData[4] = {0x02,0x03,0x04,0x05};

   for(i=0;i<=I2CBufferSize;i++)
   {
      I2C_Read_Buffer[i]=0;          //Initial I2C data buffer=0
   }

   DrvI2C_SetIOPin(5);               //Setting io pin, 5: SCL=PT2.2;SDA=PT2.3
   DrvI2C_Open(0x63);                 //Enable I2C function and set I2C baud rate=5kHz
   //Default CPU clock is 2MHz, Data Baud Rate : (I2CLK)/[4x(CRG+1)]= 2000000/[4*(99+1)]=5kHz
   DrvI2C_EnableInt(2);              //Enable I2C interrupt and error interrupt

   SYS_EnableGIE(4,0x3FF);          //Enable GIE(Global Interrupt)

   // I2C single I2C_WRITE & I2C_READ
   EEPROM_ByteWrite(0x00,0x01); //Single Byte I2C_WRITE word address 0x00, and I2C_WRITE data 0x01
   Delay(1000);                        //Delay for EEPROM 24C02 I2C_WRITE Cycle Time 5ms
```

```
   I2C_Read_Buffer[0]=EEPROM_ByteRead(0x00);    //Single Byte I2C_READ word address 0x00, the I2C_READ value
is 0x01
   Delay(1000);                          //Delay for EEPROM 24C02 I2C_WRITE Cycle Time 5ms

   // I2C sequential I2C_WRITE & I2C_READ
   EEPROM_WriteArray(0x01,EEPROM_WriteData,4);    //I2C_WRITE array data to the word address from 0x01 to 0x04
   Delay(1000);                          //Delay for EEPROM 24C02 I2C_WRITE Cycle Time 5ms
   EEPROM_ReadArray(I2C_Read_Buffer, 0x00, 5);    //sequential I2C_READ data from 0x00 to 0x04
   Delay(1000);                          //Delay for EEPROM 24C02 I2C_WRITE Cycle Time 5ms

   while(1);

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description    : I2C/UART/SPI interrupt Service Routine (HW0).            */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark         :                                                          */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{
   unsigned char I2C_Status,I2C_IntFlag;

   I2C_IntFlag=DrvI2C_ReadIntFlag();
   if((I2C_IntFlag == E_DRVI2C_INT)||(I2C_IntFlag == E_DRVI2C_INT_ALL))    //Get I2C Interrupt Flag
   {
      I2C_Status=DrvI2C_GetStatusFlag();        //Get I2C Status Flag
      switch(I2C_Status)
      {
         case 0x90:    //MACTFlag+RWFlag
               {          //START has been transmitted
            DrvI2C_WriteData(I2C_TARGET);    //Send Slave Address & R/W Bit
            DrvI2C_Ctrl(0,0,0,0);               //Clear all I2C flag
            break;
               };
         case 0x84:    //MACTFlag+ACKFlag
               {          //Slave A + W has been transmitted. ACK has been received.
            DrvI2C_WriteData(I2C_Sendbuf[I2C_DataTxIndex++]);    //Send Data to Slave
            DrvI2C_Ctrl(0,0,0,0);         //Clear all I2C flag
            break;
               };
         case 0x80: //MACTFlag
               {         //Slave A + W has been transmitted. ACK has been received.
            DrvI2C_WriteData(I2C_Sendbuf[I2C_DataTxIndex++]);    //Send Data to Slave
            DrvI2C_Ctrl(0,0,0,0);         //Clear all I2C flag
            break;
               };
         case 0x30:
               {
            DrvI2C_Ctrl(0,0,0,0);         //Clear all I2C flag
            I2C_EndFlag=1;
            break;
               };
         case 0x8C:    //MACTFlag+DFFlag+ACKFlag
               {          //DATA has been transmitted and ACK has been received
            if(I2C_DataTxIndex<I2C_DataTxLen)
            {
               DrvI2C_WriteData(I2C_Sendbuf[I2C_DataTxIndex++]);    //Send Data to Slave
               DrvI2C_Ctrl(0,0,0,0);       // Clear all I2C flag
            }
            else
            {
               if(I2C_RW == I2C_WRITE)
               {
                  DrvI2C_Ctrl(0,1,0,0);    //I2C as master sends STOP signal
                  I2C_EndFlag=1;
```

```
                }
                else if(I2C_RW == I2C_READ)
                   DrvI2C_Ctrl(1,0,0,0);    //I2C as master sends START signal
                I2C_DataTxIndex=0;
             }
             break;
          };
       case 0x88:    //MACTFlag+DFFlag
          {          //DATA has been transmitted and NACK has been received
             DrvI2C_Ctrl(0,1,0,0);       //I2C as master sends STOP signal
             I2C_DataTxIndex=0;
             I2C_EndFlag=1;
             break;
          };
       case 0xB0:
          {          //A repeated START has been transmitted.
             DrvI2C_WriteData(I2C_TARGET | I2C_READ);    //Send Slave Address & R/W Bit
             DrvI2C_Ctrl(0,0,0,0);       //Clear all I2C flag
             break;
          }
       case 0x94:    //MACTFlag+RWFlag+ACKFlag
          {          //Slave A + R has been transmitted. ACK has been received.
             if(I2C_DataRxLen>1)
             {
                DrvI2C_Ctrl(0,0,0,1);    //Set ACK bit
             }else{
                DrvI2C_Ctrl(0,0,0,0);    //Clear all I2C flag
             }
             break;
          };
       case 0x9C:    //MACTFlag+RWFlag+DFFlag+ACKFlag
          {          //Data byte has been received. ACK has been transmitted.
             I2C_Recbuf[I2C_DataRxIndex++]=DrvI2C_ReadData();
             if((I2C_DataRxLen-1)>I2C_DataRxIndex)
             {
                DrvI2C_Ctrl(0,0,0,1);    //Set ACK bit
             }
             else
             {
                DrvI2C_Ctrl(0,0,0,0);    //Clear all I2C flag
             }
             break;
          };
       case 0x98:    //MACTFlag+RWFlag+DFFlag
          {          //Data byte has been received. NACK has been transmitted.
             I2C_Recbuf[I2C_DataRxIndex++]=DrvI2C_ReadData();
             DrvI2C_Ctrl(0,1,0,0);    //I2C as master sends STOP signal
             I2C_EndFlag=1;
             break;
          };
       default:
          {
             DrvI2C_Ctrl(0,0,0,0);    //Clear all I2C flag
             I2C_EndFlag=1;
             break;
          };
    }
    DrvI2C_ClearIRQ();
    DrvI2C_ClearEIRQ();                  //Clear EIRQFlag
    DrvI2C_ClearIntFlag(0);              //Clear I2C Interrupt Flag(I2CIF)
}
if((I2C_IntFlag == E_DRVI2C_ERROR_INT)||(I2C_IntFlag == E_DRVI2C_INT_ALL))    //Get I2C Error Interrupt Flag
{
    I2C_EndFlag=1;
    DrvI2C_ClearIRQ();
    DrvI2C_ClearEIRQ();                  //Clear EIRQFlag
    DrvI2C_ClearIntFlag(1);              //Clear I2C Interrupt Flag(I2CEIF)
```

```
    DrvI2C_Ctrl(0,0,0,0);              //Clear all I2C flag
  }
  SYS_EnableGIE(4,0x3FF);              //Enable GIE(Global Interrupt)
}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description   : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description   : PT3 interrupt Service Routine (HW4).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description   : PT2 interrupt Service Routine (HW5).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                  */
/* Description   : UART2 interrupt Service Routine (HW7).                    */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                  */
/* Description   : TMB2 interrupt Service Routine (HW8).                     */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW8_ISR(void)
```

```
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                  */
/* Description  : OPA interrupt Service Routine (HW9).                       */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                    */
/* Description  : Exception Service Routines.                                */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");   //procedure define by customer.
   asm("nop");
}
/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                                */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*---------------------------------------------------------------------------*/
/* End Of File                                                               */
/*---------------------------------------------------------------------------*/
```

19. Peripheral IP(Power)

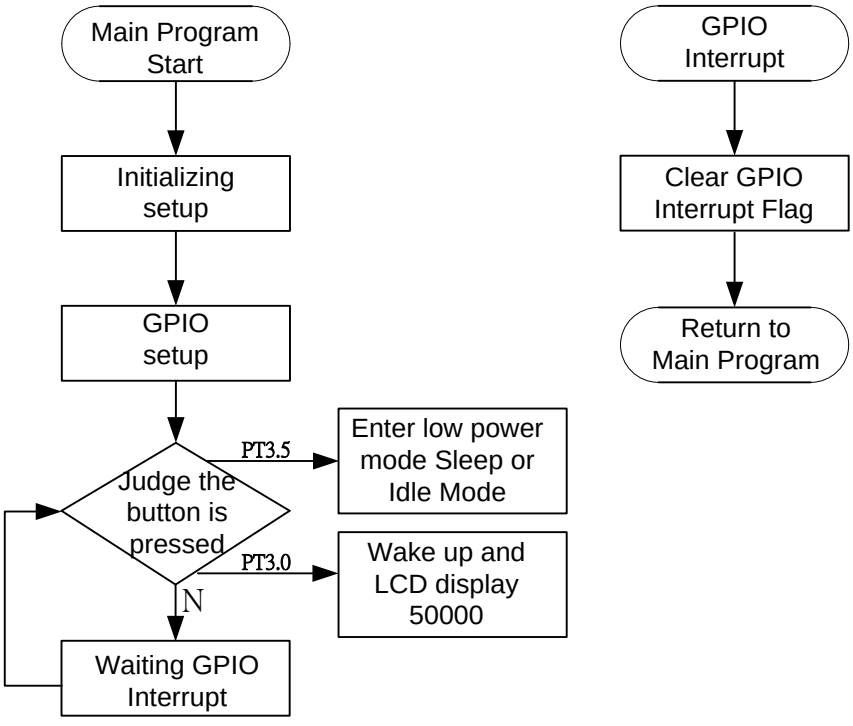
19.1. Example Name

HY16F3981_Power

19.2. Example Description

(1) HY16F3981 Sleep and Idle mode tutorial
(2) If press button PT3.0, wake up and LCD display 50000
(3) If press button PT3.5, enter sleep or idle mode. User can select the #define IDLE_MODE or #define SLEEP_MODE to make a decision on sleep or idle mode
(4) If this example code work on HY16F3981 Development board, user can measure Sleep mode current about 2.5uA, Idle mode current about 3.5uA.

19.3. Software Flowchart



19.4. Program Description

```
/*******************************************************************************
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 * to fitness for a particular purpose, or infringement of any patent,
 * copyright or other intellectual property right.
 *
 * ------------------------------------------------------------------------
 * Project Name : HY16F3981_Power
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    :
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *******************************************************************************/
/*------------------------------------------------------------------------------*/
/* Includes                                                                     */
/*------------------------------------------------------------------------------*/
#include "DrvCLOCK.h"
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"
#include "DrvPMU.h"
#include "System.h"
#include "DrvGPIO.h"

/*------------------------------------------------------------------------------*/
/* STRUCTURES                                                                   */
/*------------------------------------------------------------------------------*/
typedef union _PTINTSTATUS
{
   char    _byte;
   struct
   {
      unsigned b_PTINT0done:1;
      unsigned b_PTINT1done:1;
      unsigned b_PTINT2done:1;
      unsigned b_PTINT3done:1;
      unsigned b_PTINT4done:1;
      unsigned b_PTINT5done:1;
      unsigned b_PTINT6Done:1;
      unsigned b_PTINT7Done:1;
   };
} PTINTSTATUS;

/*------------------------------------------------------------------------------*/
/* DEFINITIONS                                                                  */
/*------------------------------------------------------------------------------*/
#define KEY_PORT E_PT3
#define KEYIN0 BIT0
#define KEYIN1 BIT5
```

```
//#define IDLE_MODE
#define SLEEP_MODE
/*---------------------------------------------------------------------------*/
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/
PTINTSTATUS    PT3INTSTATUSbits;
unsigned int PT30_IDF;
/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);

/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{
   DisplayInit();
   ClearLCDframe();
   DrvGPIO_ClkGenerator(E_HS_CK,1);                          //Set IO sampling clock input source is E_HS_CK
   DrvGPIO_Open(KEY_PORT,KEYIN1|KEYIN0,E_IO_INPUT);          //set PT3.0/PT3.5 INPUT
   DrvGPIO_Open(KEY_PORT,KEYIN1|KEYIN0,E_IO_PullHigh);      //enable PT3.0/PT3.5 pull high R
   DrvGPIO_Open(KEY_PORT,KEYIN1|KEYIN0,E_IO_IntEnable);    //PT3.0/PT3.5 interrupt enable
   DrvGPIO_IntTrigger(KEY_PORT,KEYIN1|KEYIN0,E_N_Edge);    //PT3.0/PT3.5 interrupt trigger method is negative
edge
   DrvGPIO_ClearIntFlag(KEY_PORT,KEYIN1|KEYIN0);             //clear PT3 interrupt flag
   PT3INTSTATUSbits._byte = 0;
   SYS_EnableGIE(4,0x3FF);                                   //Enable GIE(Global Interrupt)

   while(1)
   {
      if(PT3INTSTATUSbits.b_PTINT0done)                      //if PT3.0 low, wake up
      {
         LCD_DATA_DISPLAY(50000);
         PT3INTSTATUSbits.b_PTINT0done=0;
      }

      if(PT3INTSTATUSbits.b_PTINT5done)                      //if PT3.5 low, Enter Sleep or Idle Mode
      {

         PT30_IDF=DrvGPIO_PortIDIF(E_PT3) & 0x01;            //check wake up pin, PT3.0 IDF status
         if(PT30_IDF==0x01)
         {
         //Enter Sleep or Idle Mode setting
         DrvLCD_VLCDMode(E_VLCD_DISABLE);
         while((inw(0x41B00)&(1<<IDF))==0);                  //Wait LCD Idle, IDF=20
         DrvPMU_LDO_LowPower(1);                             //SET low power mode
         DrvCLOCK_SelectMCUClock(E_LS_CK,1);                 //SET CPUCKL=LPO/2
         DrvCLOCK_CloseIHOSC();                              //Close HAO
         #if defined(IDLE_MODE)
         SYS_LowPower(1);                                    //Idle Mode, around 3.5uA
         #endif
         #if defined(SLEEP_MODE)
         SYS_LowPower(0);                                    //sleep mode, around 2.5uA
         #endif
         }
         //If wake up from idle mode, user can enable internal HAO first to do some application
         DrvPMU_LDO_LowPower(0);                             //SET normal power mode
         DrvCLOCK_EnableHighOSC(E_INTERNAL,1);
         DrvCLOCK_SelectMCUClock(E_HS_CK,0);                 //SET CPUCKL=HAO/1
         DrvGPIO_ClkGenerator(E_HS_CK,1);                    //Set IO sampling clock input source is E_HS_CK
         DisplayInit();
         PT3INTSTATUSbits.b_PTINT5done=0;
      }
   }

   return 0;
```

```
}

/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description  : I2C/UART/SPI interrupt Service Routine (HW0).              */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description  : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).   */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description  : ADC interrupt Service Routine (HW2).                       */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description  : PT3 interrupt Service Routine (HW4).                       */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW4_ISR(void)
{

   uint32_t PORT_IntFlag;

   PORT_IntFlag=DrvGPIO_GetIntFlag(KEY_PORT);
   if((PORT_IntFlag&KEYIN0)==KEYIN0)
   {
      PT3INTSTATUSbits.b_PTINT0done=1;
   }
      if((PORT_IntFlag&KEYIN1)==KEYIN1)
   {
      PT3INTSTATUSbits.b_PTINT5done=1;
   }
   DrvGPIO_ClearIntFlag(KEY_PORT,KEYIN1|KEYIN0);          //clear PT3.0/PT3.5 interrupt flag

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                  */
/* Description  : PT2 interrupt Service Routine (HW5).                       */
/* Arguments    : None.                                                      */
/* Return Value : None.                                                      */
/* Remark       :                                                            */
/*---------------------------------------------------------------------------*/
void HW5_ISR(void)
```

```
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                  */
/* Description   : UART2 interrupt Service Routine (HW7).                    */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                  */
/* Description   : TMB2 interrupt Service Routine (HW8).                     */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                  */
/* Description   : OPA interrupt Service Routine (HW9).                      */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                    */
/* Description   : Exception Service Routines.                               */
/* Arguments     : None.                                                     */
/* Return Value : None.                                                      */
/* Remark        :                                                           */
/*---------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");    //procedure define by customer.
   asm("nop");
}
/*---------------------------------------------------------------------------*/
/* Software Delay Subroutines                                                */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num)
{
   for(;num>0;num--)
   asm("NOP");
}
/*---------------------------------------------------------------------------*/
/* End Of File                                                               */
/*---------------------------------------------------------------------------*/
```

20. Peripheral IP(LVD)

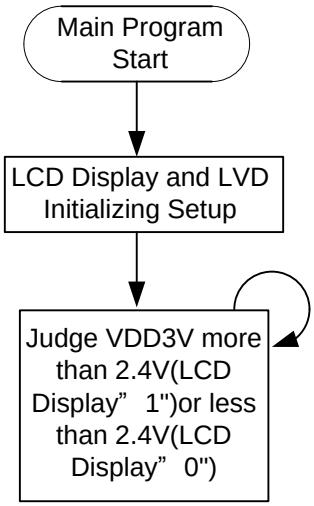
20.1. Example Name

HY16F3981_LVD

20.2. Example Description

(1) HY16F3981 LVD low voltage detection tutorial
(2) LCD Display and LVD initializing, Enable band gap voltage as LVD reference voltage source.
(3) Setting LVD voltage is 2.4V. When VDD3V voltage is less than 2.4V(LCD Display "0"). When VDD3V voltage is more than 2.4V(LCD Display "1")

20.3. Software Flowchart



20.4. Program Description

```
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 *
 * ----------------------------------------------------------------------------
 * Project Name : HY16F3981_LVD
 * IDE tooling    : AndeSight C/C++ IDE, version: 2.1.1 Build ID : 201608241332
 * Device Ver.    : HY16F_RDSp3_DeviceV0.2 crt0.o for HY16F3981 MCU.
 * Library Ver. : 0.2
 * MCU Device     :
 * Description    :
 * Created Date : 2018/3/9
 * Created by     : Robert.Wang
 *
 * Program Description:
 * --------------------
 *****************************************************************************/
/*---------------------------------------------------------------------------*/
/* Includes                                                                  */
/*---------------------------------------------------------------------------*/
#include "DrvCLOCK.h"
#include "Display.h"
#include "my define.h"
#include "HY16F3981.h"
#include "DrvPMU.h"
/*---------------------------------------------------------------------------*/
/* STRUCTURES                                                                */
/*---------------------------------------------------------------------------*/


/*---------------------------------------------------------------------------*/
/* DEFINITIONS                                                               */
/*---------------------------------------------------------------------------*/
#define VOLTAGE_High    1
#define VOLTAGE_LOW     0

/*---------------------------------------------------------------------------*/
/* Global CONSTANTS                                                          */
/*---------------------------------------------------------------------------*/


/*---------------------------------------------------------------------------*/
/* Function PROTOTYPES                                                       */
/*---------------------------------------------------------------------------*/
void Delay(unsigned int num);

/*---------------------------------------------------------------------------*/
/* Main Function                                                             */
/*---------------------------------------------------------------------------*/
int main(void)
{
   unsigned char LVDO_JUDGEMENT;

   DisplayInit();
```

```
    ClearLCDframe();
    Delay(10000);
    DisplayHYcon();

    //Set bandgap voltage
    DrvPMU_VDDA_LDO_Ctrl(E_LDO);
    DrvPMU_VDDA_Voltage(E_VDDA2_4);
    DrvPMU_BandgapEnable();

    //Set LVD
    DrvPMU_SetLVDS(LVD_24V);
    DrvPMU_SetLVD12(LVD_V12_BGR);
    DrvPMU_SetLVDVS(LVD_VDD3V);
    DrvPMU_EnableENLVD();

    while(1)
    {
      LVDO_JUDGEMENT=DrvPMU_GetLVDO();
      if(LVDO_JUDGEMENT==VOLTAGE_High)
      {
          LCD_DATA_DISPLAY(VOLTAGE_High);    //VDD3V>LVDS
      }
      if(LVDO_JUDGEMENT==VOLTAGE_LOW)
      {
          LCD_DATA_DISPLAY(VOLTAGE_LOW);     //VDD3V<LVDS
      }
    }

}

/*---------------------------------------------------------------------------*/
/* Function Name: HW0_ISR()                                                  */
/* Description   : I2C/UART/SPI interrupt Service Routine (HW0).             */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW0_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW1_ISR()                                                  */
/* Description   : WDT & RTC & Timer A/B/C interrupt Service Routine (HW1).  */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW1_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW2_ISR()                                                  */
/* Description   : ADC interrupt Service Routine (HW2).                      */
/* Arguments      : None.                                                    */
/* Return Value : None.                                                      */
/* Remark          :                                                         */
/*---------------------------------------------------------------------------*/
void HW2_ISR(void)
{

}
/*---------------------------------------------------------------------------*/
/* Function Name: HW4_ISR()                                                  */
/* Description   : PT3 interrupt Service Routine (HW4).                      */
/* Arguments      : None.                                                    */
```

```
/* Return Value : None.                                                    */
/* Remark       :                                                          */
/*-------------------------------------------------------------------------*/
void HW4_ISR(void)
{

}
/*-------------------------------------------------------------------------*/
/* Function Name: HW5_ISR()                                                */
/* Description  : PT2 interrupt Service Routine (HW5).                     */
/* Arguments    : None.                                                    */
/* Return Value : None.                                                    */
/* Remark       :                                                          */
/*-------------------------------------------------------------------------*/
void HW5_ISR(void)
{

}
/*-------------------------------------------------------------------------*/
/* Function Name: HW7_ISR()                                                */
/* Description  : UART2 interrupt Service Routine (HW7).                   */
/* Arguments    : None.                                                    */
/* Return Value : None.                                                    */
/* Remark       :                                                          */
/*-------------------------------------------------------------------------*/
void HW7_ISR(void)
{

}
/*-------------------------------------------------------------------------*/
/* Function Name: HW8_ISR()                                                */
/* Description  : TMB2 interrupt Service Routine (HW8).                    */
/* Arguments    : None.                                                    */
/* Return Value : None.                                                    */
/* Remark       :                                                          */
/*-------------------------------------------------------------------------*/
void HW8_ISR(void)
{

}
/*-------------------------------------------------------------------------*/
/* Function Name: HW9_ISR()                                                */
/* Description  : OPA interrupt Service Routine (HW9).                     */
/* Arguments    : None.                                                    */
/* Return Value : None.                                                    */
/* Remark       :                                                          */
/*-------------------------------------------------------------------------*/
void HW9_ISR(void)
{

}
/*-------------------------------------------------------------------------*/
/* Function Name: tlb_exception_handler()                                  */
/* Description  : Exception Service Routines.                              */
/* Arguments    : None.                                                    */
/* Return Value : None.                                                    */
/* Remark       :                                                          */
/*-------------------------------------------------------------------------*/
void tlb_exception_handler()
{
   asm("nop");   //procedure define by customer.
   asm("nop");
}
/*-------------------------------------------------------------------------*/
/* Software Delay Subroutines                                              */
/*-------------------------------------------------------------------------*/
void Delay(unsigned int num)
```

```
{
   for(;num>0;num--)
   asm("NOP");
}
/*-------------------------------------------------------------------------*/
/* End Of File                                                             */
/*-------------------------------------------------------------------------*/
```

21. Revisions

The following describes the major changes made to the document, excluding the punctuation and font changes.

Version	Date	Page	Summary of Changes
V01	2017/4/20	All	First Edition
V02	2018/7/13	All	- HY16F3981_ADC : Add HAO 2MHz/4MHz/10MHz/16MHz clock setting. Add #define ADC_Chopper setting - HY16F3981_GPIO : Modify the GPIO initialization(GPIO setting-->Clear GPIO Flag-->judgement GPIO INT) - HY16F3981_I2C : Modify the I2C_EndFlag judgement - HY16F3981_UART : Modify the UART initialization, avoid to occur the first byte error issue. Modify the demo code application. - HY16F3981_UART2 : Add the UART2 demo code - HY16F3981_LVD : Add the LVD demo code - HY16F3981_Power : Modify the GPIO initialization(GPIO setting-->Clear GPIO Flag-->judgement GPIO INT) Added the DrvGPIO_PortIDIF judgement before enter sleep or idle mode - HY16F3981_ADC_IA : Add HAO 2MHz/4MHz/10MHz/16MHz clock setting and modify the IA initialization(Using IA_IACHM_Both) Add #define SW_IA_ADC_Chopper setting