```
/*
**  flame.c - Sample code for HyperpanelOS ================================  **
**                                                                          **
**  This simple code is located into the application container, it is run    **
**  by the VMK sub-operating system. On the other hand, the I/O container    **
**  runs all the drivers that are VMIO finite state machines.               **
**                                                                          **
**  The goal of this small app is to make a ambient light destection system. **
**                                                                          **
**  ========================================================================  **
*/


/* Documentation for I2C devices ------------------------------------------

   Product used :

   - Ben-Gi Mini ADS115 Module 4 channels 16 bits I2C ADC
     www.amazon.fr/gp/product/B07PK1Z5H1
     datasheet-ads115.pdf - Texas Instruments
                            16-bit Analog-to-Digital Converter

   - LM35 Linear temperature Sensor SKU DFR0023 ot available at

     wiki.dfrobot.com/DFRobot_LM35_Linear_Temperature_Sensor__SKU_DFR0023_

     and also available in LattePanda Starter Sensor at www.lattepanda.com


    Centigrade Temperature Sensor

    - We use the LM35 Temperature Sensor V2 from DfRobot. This sensor deliver
      an analog voltage depends on ambient temperature. The LM34 is a precision
      integrated-circuit temperature sensors. The output voltage is linearly
      proportional to the Celsius (Centigrade) temperature. This sensor does not
      require any external calibration or trimming. It provide typical
      accuracies of (lower thant 1C) temperature in range [-55C,+150C].

    - Sensor specification :

      Sensor Chip Model: LM35
      Supply Voltage: 3.3~5.0V
      Sensor Chip Sensitivity: 10mV/℃
      Measuring Range: 0~150℃
      Precision: ±1℃

    - In this tutorial, we power the temperature sensor with a 3.3V pin (taken
      for example on the free ASY2 scart).

    - Because we have just few info about the temperature sensor and this sensor
      is linear, the app just make a linear conversion from analog read value
      into Celsius. We remark that with the ADC amplifier gain setted to
      FS=4.096V we have directly a comprensible temperature.

    Analog to Digital Converter (ADC):

    - The ADC use the potentiometer as analog input signal et send digital
      output data to the Pyboard via I2C interface.

    - The ADC converter include one single I2C device. There is 4 analog
      input channels. In this app we use Input 0 (data signal). This
       configuration is setted with bit 14-12 of the configuration register.

    -  We select FS=+/-4.096V for the PGA (Programmable gain amplifier) of the
       ADC (cf.  datasheet of the ADC) because we have no info about output
       voltage signal from the temperature sensor. This range seems correct.
```

```
    I2C Interface:

    - I2C address are 0x90 (write) and 0x91 (read).

    - The ADS1115 have a configuration register. The app write de configuration
      in the initialisation step, and read the configuration register to check
      that the write operation is ok. Configuration register is set as follow
      (cf.  datasheet page 18/19/20).

        bit 15       Operational status                      0   (default)
        bit 14-12    Multiplexer config - INp=0 INn=GND    100   (INp=0 Nn=GND)
        bit 11-9     Gain amplifier FS= +/- 6.144V         001   (+/-4.096V)
        bit 8        Device operating mode                   0   (continuous)
        bit 7-5      Data rate                             111   (860SPS)
        bit 4        Comparator mode - Traditional           0   (default)
        bit 3        Comparator polarity - Active low        0   (default)
        bit 2        Nn-latching comparator                  0   (default)
        bit 1-0      Disable comparator                     11   (default)

                                          0100001011100011 = 0x42E3

    Serial output:

     The ASY0 output is use to send information messages about the current
     value read from the temperature sensor.

*/
/* Include files and external reference ----------------------------------------*/

#include <hypos.h>                    // Hyperpanel OS basic interfaces.
#include <drv_asy.h>                  // Prototype of "asy_write()".
#include <drv_i2c.h>                  // Prototype of "i2c_*()".


/* Internal defines of this module ---------------------------------------------*/

#define  TICK                1000     // Code for tick event.

#define ADC_AD_W             0x90     // I2C dev address - ADC (write)
#define ADC_AD_R             0x91     // I2C dev address - ADC (read)

#define CONVERSION_REG       0x00     // I2C register - Converted value
#define CONFIG_REG           0x01     // I2C register - Configuration

#define INIT                    0     // I2C command - ADC initialisation


/*  Internal global variables of this module -----------------------------------*/

    static int      idto            ; // Timer identifier.


/* INIT command ..................................................................*/

    static const char init[]        = // I2C command - ADC initialisation
      {

/*    Length-1, Address, Control byte, Data byte                                */

      3, ADC_AD_W , CONFIG_REG       , // Write the configuration register
                          0x42, 0xE3, // Cf. datasheet page 19)
      0, 0        , 0    , 0         , // End of command set
      }                               ; //

    static char   *command[] =        // I2C commands table
      {                               //
        (char*)&init[0]             , // I2C command - INIT
        (char*)0                      // End of list
```

```
      }                             ; //


/*  Prototypes ----------------------------------------------------------------*/

    static int  loop_app_task(void*) ; // Prototype
    static int  wait_evt(void)       ; // Prototype
    static void set_command(int)     ; // Prototype


/*  Beginning of the code -----------------------------------------------------

    loop_app_tsk         Application entry point
*/

/*  Procedure loop_app_tsk ----------------------------------------------------

    Purpose : This is our task main loop.
*/

int loop_app_tsk (void *param)
  {
    int             ev = TICK        ; // Our event
    char            mess[16]         ; // Message to be sent on ASY0
    unsigned char   frame[16]        ; // I2C read frame
    int             ret = 0          ; // Return procedure code
    int             t                ; // Analog 16 bit value.
    int             e,f              ; // Integer part, fractionnal part.


/* Step 1 - Start a timer that will send an event every second ..............*/

    set_tto(CLOCK      ,               // Timer mode: clock
            500        ,               // Duration in milliseconds
            TICK , 0   ,               // Event code and reserve field
            &idto     );               // Timer identifier


/* Step 2 - ADC initialisation ..............................................*/

    asy_write(0,(unsigned char*)"Init ... ",9);

    set_command(INIT)                ; // ADC initialization

    asy_write(0,(unsigned char*)"done\r\n",6);

    ret = i2c_read(0,ADC_AD_R       ,  // Just for checking, read the register
                frame,2,CONFIG_REG);  // we have just write.

    hsprintf(mess,
        "Configuration register 0x%02x%02x (%d)\r\n",
                              frame[0],frame[1],ret);

    asy_write(0                      , // Write on ASY0 the value of the
        (unsigned char*)mess         , // configuration register.
                 strlen(mess)       ); // Count of bytes to be sent


/* Step 3 - Main loop .......................................................*/

    wait_ev :                          // Beginning of loop label

    if ( ev == TICK )                  // If the event is the tick event
      {                                //
        frame[0]=0                   ; // Reset frame.
        frame[1]=0                   ; // Reset frame.

        ret=i2c_read(0,ADC_AD_R      , // Read the current value get from
```

```
                    frame,2          , // the ADC.
                    CONVERSION_REG) ; //

       t=((frame[0]<<8)+frame[1])    ; // Read the 16bit ADC register value
       e=t/100                       ; // Temperature integer part in Celsius.
       f=(t/10)-e*10                 ; // Temperature fract part in 0.1 Celsius.

        hsprintf(mess                , // Message with analog read and message.

           "Thermometer - Analog read: %3d - Temperature: %d.%dC\r\n",

                                 t,e,f,ret); // Just as approximation:

        asy_write(0                  , // Write on ASY0
              (unsigned char*)mess   , // the "mess" message
              strlen(mess)          ); // Count of bytes to be sent
      }

      ev = wait_evt()                ; // Unschedule until an event is received
      goto wait_ev                   ; // Wait for the next event

      return  0                      ; // Return code of the procedure
    }

/*  Procedure wait_evt ----------------------------------------------------*/
/*
    Purpose : Unschedule until the next event is received, whatever it is.
*/

static int wait_evt (void)
  {
    int             waitlist[1][3]   ; // Parameter of "waitevt_task"
    int             ret              ; // Return code for "waiyevt_task"

/*************************************************************************
 * Step 1 : Build a list with one WAIT_CODEINT entry that will accept all    *
 * ------   the event codes ranging from 0 to 20000. Then call               *
 *          "waitevt_task", we will be unscheduled until the next event will *
 *          be received                                                      *
 *************************************************************************/

    waitlist[0][0]  = WAIT_CODEINT   ; // All events with
    waitlist[0][1]  = 0              ; // a code between 0
    waitlist[0][2]  = 20000          ; // and 20000

    waitevt_task(waitlist ,            // Address of waiting list
                 1        ,            // Size of "waitlist[]"
                 0        ,            // maximum waiting time = no
                 0        ,            // Do not purge previous events
                 &ret       )        ; // Return code

/*************************************************************************
 * Step 2 : Here we are scheduled again. The VMK has written into its        *
 * ------   global variable "task_evt" a copy of the event that has          *
 *          scheduled us again.                                              *
 *************************************************************************/

    return task_evt.code             ; // Return event code
  }


/*  Procedure set_command -------------------------------------------------*/
/*
    Purpose : Send a set of commands to I2C devices.
*/

static void set_command(int cmd)
  {
```

```
  i2c_write(
    0                             ,    // Controller number
   -1                             ,    // Target I2C write address
    (unsigned char*)command[cmd],    // Command
    0                            );   // List of option flags
}
```