Universidad del Valle de Guatemala
Electrónica Digital 2 – Sección 11
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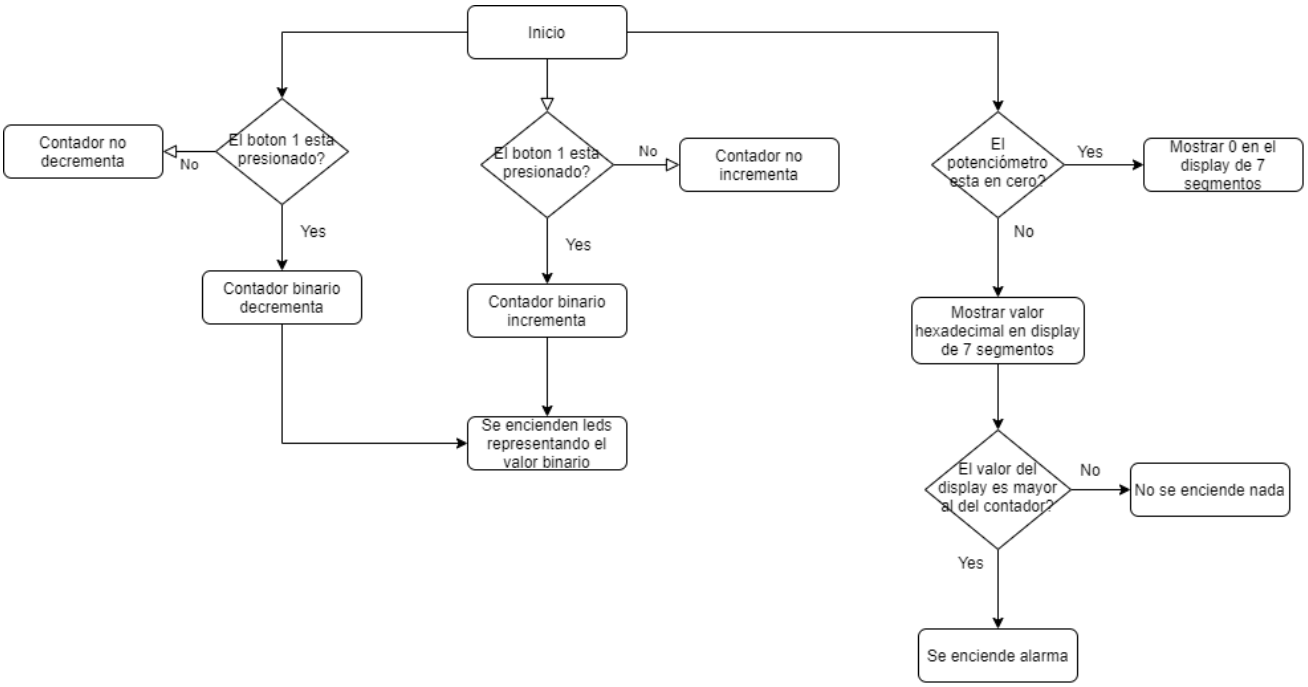
4/02/2021

Laboratorio No. 2

Interrupciones y uso de librerías

Link de GitHub: https://github.com/mon19379/DIGITAL2.git

Pseudocódigo:



Descripción:

El laboratorio consiste en realizar un contador de 8 bits utilizando el interrupt on change en botones para incrementar y decrementar el valor del contador. También consistía en implementar en Analog to Digital converter(ADC) y display de 7 segmentos para mostrar el valor de un potenciómetro en hexadecimal. El contador era una referencia respecto al display ya que una vez el valor del display fuera mayor al del contador, se enciende una alarma.

Código:

Main:

```
/*FRANCISCO MONTÚFAR
 *CARNET 19379
 *ELECTRÓNICA DIGITAL 2
 *LABORATORIO #2
 *LIBRERÍAS E INTERRUPCIONES
 *
 */
//******************************************************************************
// Importación de librerias
//******************************************************************************

#include <xc.h>
#include <stdint.h>
#include "Osc.h"
#include "adc.h"
#include "SIETESEG.h"
//******************************************************************************
// Palabra de configuración
//******************************************************************************
// CONFIG1
#pragma config FOSC = INTRC_NOCLKOUT        // Oscillator Selection bits (XT oscillator: Crystal/resonator on RA6/OSC2/CLKOUT and RA7/OSC1/CLKIN)
#pragma config WDTE = OFF       // Watchdog Timer Enable bit (WDT disabled and can be enabled by SWDTEN bit of the WDTCON register)
#pragma config PWRTE = OFF      // Power-up Timer Enable bit (PWRT disabled)
#pragma config MCLRE = OFF      // RE3/MCLR pin function select bit (RE3/MCLR pin function is digital input, MCLR internally tied to VDD)
```

```
#pragma config CP = OFF         // Code Protection bit (Program memory code protection is disabled)
#pragma config CPD = OFF        // Data Code Protection bit (Data memory code protection is disabled)
#pragma config BOREN = OFF      // Brown Out Reset Selection bits (BOR disabled)
#pragma config IESO = OFF       // Internal External Switchover bit (Internal/External Switchover mode is disabled)
#pragma config FCMEN = OFF      // Fail-Safe Clock Monitor Enabled bit (Fail-Safe Clock Monitor is disabled)
#pragma config LVP = OFF        // Low Voltage Programming Enable bit (RB3 pin has digital I/O, HV on MCLR must be used for programming)

// CONFIG2
#pragma config BOR4V = BOR40V   // Brown-out Reset Selection bit (Brown-out Reset set to 4.0V)
#pragma config WRT = OFF        // Flash Program Memory Self Write Enable bits (Write protection off)


//*****************************************************************************
//Variables
//*****************************************************************************
uint8_t B1 = 0;
uint8_t B2 = 0;
uint8_t NH = 0;
uint8_t NL = 0;
uint8_t pot = 0;
uint8_t FLAG = 0;
```

```
//*****************************************************************************
// Prototipos de funciones
//*****************************************************************************
void Setup(void);
void split(void);
void displays(void);

//*****************************************************************************
//Interrupción
//*****************************************************************************
void __interrupt() isr (void){

   if (T0IF == 1){ //SE REVISA LA BANDERA DE INTERRUPCION DEL TIMER0
      TMR0 = 236; //SE CARGA UN VALOR AL TIMER CERO PARA QUE SEA
DE 20ms
      T0IF = 0;  //SE APAGA LA BANDERA DE INTERRUPCION
      displays(); //SE LLAMA LA RUTINA DE MUTIPLEXACION



   }

   if (ADIF == 1){ //SE REVISA LA BANDERA DE INTERRUPCION DEL ADC
      pot = ADRESH; //SE INGRESA EL VALOR DE ADRESH A UNA VARIABLE
      ADIF = 0;    //SE APAGA LA BANDERA DE INTERRUPCION
      ADCON0bits.GO_nDONE = 1;
   }
```

```
   if (RBIF == 1){ //SE REVISA LA BANDERA DE INTERRUPCION DEL PUERTO
B
      if (PORTBbits.RB0 == 0){ //ANTIREBOTE, SI NO SE PRESIONA EL BOTON
         B1 = 1; // SE ENCIENDE LA BANDERA DEL BOTON DE INCREMENTO
      }

      else{
         if (B1 == 1 && PORTBbits.RB0 == 1 ){ //SE  PRESIONA EL BOTON
            B1 = 0;        //SE APAGA LA BANDERA DE BOTON DE INCREMENTO
            PORTD ++;// SE INCREMENTA EL PUERTOD

         }
   }

      if (PORTBbits.RB1 == 0){ //ANTIREBOTE, SI NO SE PRESIONA EL BOTON
         B2 = 1; // SE ENCIENDE LA BANDERA DEL BOTON DE DECREMENTO
      }

      else{
         if (B2 == 1 && PORTBbits.RB1 == 1 ){ //SE PRESIONA EL BOTON
            B2 = 0;          //SE APAGA LA BANDERA DE BOTON DE
DECREMENTO
            PORTD --;// SE DECREMENTA UN EL PUERTOD

         }
   }

    INTCONbits.RBIF = 0;   //SE APAGA LA BANDERA DE INTERRUPION DEL
PUERTO B
```

```
    }

}
//*****************************************************************************
//Ciclo pincipal
//*****************************************************************************

void main(void) {

    Setup();
    //*****************************************************************************
    // Loop principal
    //*****************************************************************************
    while(1){
        if(pot > PORTD){ //RUTINA DE ALARMA EN DONDE SE COMPARAN EL
ADC Y
            PORTAbits.RA1 = 1;//EL CONTADOR


     }
        else{
            PORTAbits.RA1 = 0;
     }

}
```

```
}
//*****************************************************************************
//Configuracion
//*****************************************************************************
void Setup(void) {

   initOsc(10); //SE LLAMA LA CONFIG DEL OSCILADOR
   configADC(2,0); //SE LLAMA LA CONFIG DEL ADC
   ANSEL = 0; //SE LIMPIA EL ANSEL
   ANSEL = 0b00000001;  // ENTRADAS DIGITALES Y BIT 0 ANALÓGICA
   ANSELH = 0;
   PORTA = 0; //PUERTO A EN 0
   PORTB = 0; //PUERTO B EN 0
   PORTC = 0; //PUERTO C EN 0
   PORTD = 0; //PUERTO D EN 0
   PORTE = 0; //PUERTO E EN 0
   //PINES RA0 Y RA2 COMO ENTRADAS, LOS DEMAS COMO SALIDAS
   TRISA = 0b00000101;
   TRISB = 0b00000011; //PUERTO B
   TRISC = 0; //PUERTO C SALIDAS
   TRISD = 0; //PUERTO D SALIDAS
   TRISE = 0; //PUERTO E SALIDAS
   OPTION_REG = 0b00000111; //SE APAGAN LAS PULLUPS DEL PUERTO B
   INTCONbits.GIE = 1; //SE HABILITAN LAS INTERRUPCIONES GLOBALES
   INTCONbits.T0IE = 1; //SE HABILITA LA INTERRUPCION DEL TIMER0
   INTCONbits.PEIE = 1; //SE HABILITAN LAS INTERRUPCIONES
PERIFERICAS
   PIE1bits.ADIE = 1; //SE HABILITA LA INTERRUPCION DEL ADC
```

```
    INTCONbits.T0IF = 0; // SE LIMPIA LA BANDERA DE INTERRUPCION DEL
TIMER 0
    PIR1bits.ADIF = 0; //SE LIMPIOA LA BANDERA DE INTERRUPCION DEL ADC
    INTCONbits.RBIE = 1; //SE HABILITA LA INTERRUPCION DEL PUERTO B
    INTCONbits.RBIF = 0; //SE LIMPIA LA BANDERA DEL INTERRUPCION DEL
PUERTO B
    IOCB = 3; //SE HABILITA EL INTERRUPT ON CHANGE



}
//*****************************************************************************
// Subrutinas
//*****************************************************************************

void displays(void){
    PORTAbits.RA3 = 0;
    PORTAbits.RA4 = 0; //SE LIMPIA EL PIN DE LOS TRANSISTORES
    if (FLAG == 0){  //MULTIPLEXACIÓN
        NL = pot & 0b00001111;  //SE HACE UN AND
        PORTAbits.RA3 = 1; //SE ENCIENTE EL TRANSISTOR DE ESE DISPLAY
        display(NL); //SE LLAMA LA TABLA
        FLAG = 1; //TOGGLE
    }
    else{
        NH = pot; //SE IGUALA EL NH A LA VARIABLE DEL ADC
        NH = NH & 0b11110000; //SE HACE UN AND PARA MANTENER LOS MSB
        NH = NH>>4; //SE HACE EL SHIFT A LA DERECHA
        PORTAbits.RA4 = 1; //SE ENCIENDE EL TRANSISTOR DE ESE DISPLAY
        display(NH); //SE LLAMA LA TABLA
```

```
        FLAG =0; //TOGGLE
    }
}
```

ADC.H

```
// This is a guard condition so that contents of this file are not included
// more than once.
#ifndef ADC_H
#define         ADC_H

#include <xc.h> // include processor files - each processor file is guarded.
#include <stdint.h>

void configADC(uint8_t fosc, uint8_t chan);




#endif /* ADC_H*/
```

ADC.C

```
#include <pic16f887.h>
#include <xc.h>
#include "adc.h"




//*****************************************************************************
// CONFIGURACION DEL ADC
```

```
//*****************************************************************************
void configADC(uint8_t fosc, uint8_t chan){

    switch (fosc) {

        case 0:
            ADCON0bits.ADCS = 0b00;
            break;

        case 1:
            ADCON0bits.ADCS = 0b01;
            break;

        case 2:
            ADCON0bits.ADCS = 0b10;
            break;

        case 3:
            ADCON0bits.ADCS = 0b11;
            break;

        default:
            ADCON0bits.ADCS = 0b00;
            break;
    }
    switch (chan) {
        case 0:
            ADCON0bits.CHS = 0b0000;
```

```
    break;

case 1:
    ADCON0bits.CHS = 0b0001;
    break;

case 2:
    ADCON0bits.CHS = 0b0010;
    break;

case 3:
    ADCON0bits.CHS = 0b0011;
    break;

case 4:
    ADCON0bits.CHS = 0b0100;
    break;

case 5:
    ADCON0bits.CHS = 0b0101;
    break;

case 6:
    ADCON0bits.CHS = 0b0110;
    break;

case 7:
    ADCON0bits.CHS = 0b0111;
```

```
    break;

case 8:
    ADCON0bits.CHS = 0b1000;
    break;

case 9:
    ADCON0bits.CHS = 0b1001;
    break;

case 10:
    ADCON0bits.CHS = 0b1010;
    break;

case 11:
    ADCON0bits.CHS = 0b1011;
    break;

case 12:
    ADCON0bits.CHS = 0b1100;
    break;

case 13:
    ADCON0bits.CHS = 0b1101;
    break;

case 14:
    ADCON0bits.CHS = 0b1110;
```

```
            break;

        case 15:
            ADCON0bits.CHS = 0b1111;
            break;

        default:
            ADCON0bits.CHS = 0b0000;
            break;


    }


    ADCON0bits.GO_nDONE = 1;



    ADCON0bits.ADON = 1;
    ADCON1 = 0;



    }
```

OSC.H

```
// This is a guard condition so that contents of this file are not included
// more than once.
```

```
#ifndef Osc_H
#define         Osc_H

#include <xc.h> // include processor files - each processor file is guarded.
#include <stdint.h>

void initOsc(uint8_t IRCF);



#endif /* Osc_H */
```

OSC.C

```
#include <pic16f887.h>
#include <xc.h>
#include "Osc.h"
//*****************************************************************************
//Inicialización del oscilador interno pg. 62
//*****************************************************************************
void initOsc(uint8_t IRCF){

   switch (IRCF){

      case 0: //OSCILADOR DE 31 kHz
         OSCCONbits.IRCF2 = 0;
         OSCCONbits.IRCF1 = 0;
         OSCCONbits.IRCF0 = 0;
```

```
    break;

case 1: //OSCILADOR DE 125 kHz
    OSCCONbits.IRCF2 = 0;
    OSCCONbits.IRCF1 = 0;
    OSCCONbits.IRCF0 = 1;
    break;

case 2: //OSCILADOR DE 250 kHz
    OSCCONbits.IRCF2 = 0;
    OSCCONbits.IRCF1 = 1;
    OSCCONbits.IRCF0 = 0;
    break;

case 3: //OSCILADOR DE 500kHz
    OSCCONbits.IRCF2 = 0;
    OSCCONbits.IRCF1 = 1;
    OSCCONbits.IRCF0 = 1;
    break;

case 4: //OSCILADOR DE 1MHz
    OSCCONbits.IRCF2 = 1;
    OSCCONbits.IRCF1 = 0;
    OSCCONbits.IRCF0 = 0;
    break;

case 5: //OSCILADOR DE 2MHz
    OSCCONbits.IRCF2 = 1;
```

```
        OSCCONbits.IRCF1 = 0;
        OSCCONbits.IRCF0 = 1;
        break;


    case 6: //OSCILADOR DE 4MHz
        OSCCONbits.IRCF2 = 1;
        OSCCONbits.IRCF1 = 1;
        OSCCONbits.IRCF0 = 0;
        break;

    case 7: //OSCILADOR DE 8MHz
        OSCCONbits.IRCF2 = 1;
        OSCCONbits.IRCF1 = 1;
        OSCCONbits.IRCF0 = 1;
        break;




    default: //OSCILADOR DE 4MHz
        OSCCONbits.IRCF2 = 1;
        OSCCONbits.IRCF1 = 0;
        OSCCONbits.IRCF0 = 0;
        break;

}
```

```
    OSCCONbits.SCS = 1; //SE VA A USAR EL OSCILADOR INTERNO


}
```

SEGMENT.H

```
// This is a guard condition so that contents of this file are not included
// more than once.
#ifndef SIETESEG_H
#define         SIETESEG_H


#include <xc.h> // include processor files - each processor file is guarded.
#include <stdint.h>

void display(uint8_t segment);


#endif /* SIETESEG_H */
```

SEGMENT.C

```
#include <pic16f887.h>
#include <xc.h>
#include "SIETESEG.h"

void display(uint8_t segment){

    switch (segment){
```

```
case 0: //0
    PORTCbits.RC0 = 0;
    PORTCbits.RC1 = 0;
    PORTCbits.RC2 = 0;
    PORTCbits.RC3 = 0;
    PORTCbits.RC4 = 0;
    PORTCbits.RC5 = 0;
    PORTCbits.RC6 = 1;
    PORTCbits.RC7 = 1;
    break;

case 1: //1
    PORTCbits.RC0 = 1;
    PORTCbits.RC1 = 0;
    PORTCbits.RC2 = 0;
    PORTCbits.RC3 = 1;
    PORTCbits.RC4 = 1;
    PORTCbits.RC5 = 1;
    PORTCbits.RC6 = 1;
    PORTCbits.RC7 = 1;
    break;
case 2: //2
    PORTCbits.RC0 = 0;
    PORTCbits.RC1 = 0;
    PORTCbits.RC2 = 1;
    PORTCbits.RC3 = 0;
    PORTCbits.RC4 = 0;
```

```
    PORTCbits.RC5 = 1;
    PORTCbits.RC6 = 0;
    PORTCbits.RC7 = 1;
    break;
case 3: //3
    PORTCbits.RC0 = 0;
    PORTCbits.RC1 = 0;
    PORTCbits.RC2 = 0;
    PORTCbits.RC3 = 0;
    PORTCbits.RC4 = 1;
    PORTCbits.RC5 = 1;
    PORTCbits.RC6 = 0;
    PORTCbits.RC7 = 1;
    break;
case 4: //4
    PORTCbits.RC0 = 1;
    PORTCbits.RC1 = 0;
    PORTCbits.RC2 = 0;
    PORTCbits.RC3 = 1;
    PORTCbits.RC4 = 1;
    PORTCbits.RC5 = 0;
    PORTCbits.RC6 = 0;
    PORTCbits.RC7 = 1;
    break;
case 5: //5
    PORTCbits.RC0 = 0;
    PORTCbits.RC1 = 1;
    PORTCbits.RC2 = 0;
```

```
    PORTCbits.RC3 = 0;
    PORTCbits.RC4 = 1;
    PORTCbits.RC5 = 0;
    PORTCbits.RC6 = 0;
    PORTCbits.RC7 = 1;
    break;
case 6: //6
    PORTCbits.RC0 = 0;
    PORTCbits.RC1 = 1;
    PORTCbits.RC2 = 0;
    PORTCbits.RC3 = 0;
    PORTCbits.RC4 = 0;
    PORTCbits.RC5 = 0;
    PORTCbits.RC6 = 0;
    PORTCbits.RC7 = 1;
    break;
case 7: // 7
    PORTCbits.RC0 = 0;
    PORTCbits.RC1 = 0;
    PORTCbits.RC2 = 0;
    PORTCbits.RC3 = 1;
    PORTCbits.RC4 = 1;
    PORTCbits.RC5 = 1;
    PORTCbits.RC6 = 1;
    PORTCbits.RC7 = 1;
    break;
case 8: //8
    PORTCbits.RC0 = 0;
```

```
    PORTCbits.RC1 = 0;
    PORTCbits.RC2 = 0;
    PORTCbits.RC3 = 0;
    PORTCbits.RC4 = 0;
    PORTCbits.RC5 = 0;
    PORTCbits.RC6 = 0;
    PORTCbits.RC7 = 1;
    break;
  case 9: //9
    PORTCbits.RC0 = 0;
    PORTCbits.RC1 = 0;
    PORTCbits.RC2 = 0;
    PORTCbits.RC3 = 0;
    PORTCbits.RC4 = 1;
    PORTCbits.RC5 = 0;
    PORTCbits.RC6 = 0;
    PORTCbits.RC7 = 1;
    break;
  case 10: //A
    PORTCbits.RC0 = 0;
    PORTCbits.RC1 = 0;
    PORTCbits.RC2 = 0;
    PORTCbits.RC3 = 1;
    PORTCbits.RC4 = 0;
    PORTCbits.RC5 = 0;
    PORTCbits.RC6 = 0;
    PORTCbits.RC7 = 1;
    break;
```

```
case 11: //b
   PORTCbits.RC0 = 1;
   PORTCbits.RC1 = 1;
   PORTCbits.RC2 = 0;
   PORTCbits.RC3 = 0;
   PORTCbits.RC4 = 0;
   PORTCbits.RC5 = 0;
   PORTCbits.RC6 = 0;
   PORTCbits.RC7 = 1;
   break;
case 12: //C
   PORTCbits.RC0 = 0;
   PORTCbits.RC1 = 1;
   PORTCbits.RC2 = 1;
   PORTCbits.RC3 = 0;
   PORTCbits.RC4 = 0;
   PORTCbits.RC5 = 0;
   PORTCbits.RC6 = 1;
   PORTCbits.RC7 = 1;
   break;
case 13: //d
   PORTCbits.RC0 = 1;
   PORTCbits.RC1 = 0;
   PORTCbits.RC2 = 0;
   PORTCbits.RC3 = 0;
   PORTCbits.RC4 = 0;
   PORTCbits.RC5 = 1;
   PORTCbits.RC6 = 0;
```

```
    PORTCbits.RC7 = 1;
    break;
case 14: //E
    PORTCbits.RC0 = 0;
    PORTCbits.RC1 = 1;
    PORTCbits.RC2 = 1;
    PORTCbits.RC3 = 0;
    PORTCbits.RC4 = 0;
    PORTCbits.RC5 = 0;
    PORTCbits.RC6 = 0;
    PORTCbits.RC7 = 1;
    break;
case 15: //F
    PORTCbits.RC0 = 0;
    PORTCbits.RC1 = 1;
    PORTCbits.RC2 = 1;
    PORTCbits.RC3 = 1;
    PORTCbits.RC4 = 0;
    PORTCbits.RC5 = 0;
    PORTCbits.RC6 = 0;
    PORTCbits.RC7 = 1;
    break;

default:
    PORTCbits.RC0 = 0;
    PORTCbits.RC1 = 0;
    PORTCbits.RC2 = 0;
    PORTCbits.RC3 = 0;
```

```
            PORTCbits.RC4 = 0;
            PORTCbits.RC5 = 0;
            PORTCbits.RC6 = 1;
            PORTCbits.RC7 = 1;
            break;


    }
}
```