Tecnológico de Monterrey

Proyecto final

Laboratorio de Microcontroladores

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Introducción

En este proyecto integraremos todo lo aprendido durante el semestre del Laboratorio de Microcontroladores. A lo largo del curso aplicamos la teoría del PIC18F4550/PIC18F45K50 en diferentes prácticas empezando por el lenguaje ensamblador hasta C. Empezamos aplicando los puertos de entrada y salidas, pasamos por la configuración del PIC y llegamos a utilizar funcionalidades más complejas como el ADC o PWM.

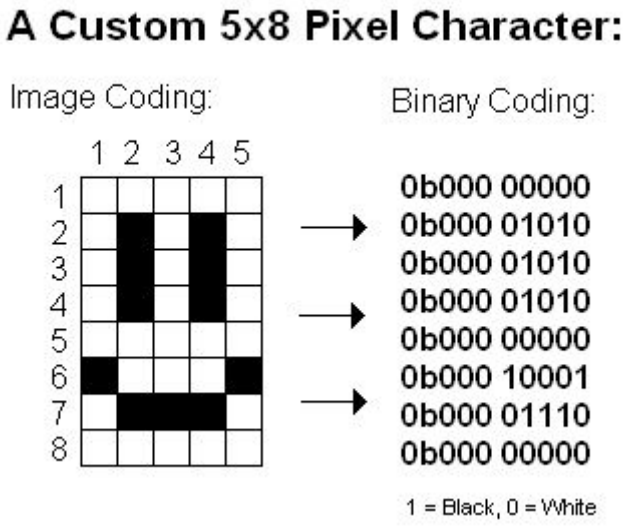
En esta final entrega el reto consiste en diseñar un videojuego utilizando la librería del LCD utilizando convertidor analogico a digital, musica, y un contador que marque el puntaje del jugador. En términos generales, se busca aplicar todos los conceptos anteriores en un sólo programa.

Se utilizó principalmente:

- Interrupciones
- Librería XLCD
- Timers
- ADC
- PWM
- Librería básica C

Desarrollo

Empezamos con una idea para el juego a desarrollar, el equipo decidió hacer un dinosaurio que evitará diferentes obstáculos, cada vez que evite uno sumará al puntaje. Para lograrlo , tuvimos que leer la librería del XLCD para generar nuestro propio personaje, con mucha investigación utilizamos los diferentes comandos para acceder a la memoria de caracteres personalizados.



El LCD tiene espacio empezando por la dirección 0x40 en CGRAM, asignamos 5 bits en 8 filas, dando en total un espacio para 7 caracteres. Así diseñamos y asignamos los bits que guardaremos en memoria.

Lo siguiente fue crear un mapa de juego que simula los obstáculos y dibuje a nuestro carácter, para este caso utilizamos un delay que irá actualizando el display simulando la animación.

Para lograr mover al personaje utilizando el ADC y el primer canal de entrada analogica tendremos conectado un potenciomentro en la entrada RA1, utilizando el comando 0xE en lugar de 0xF. Sabemos que el valor de ADC regresa un número entre 0-1023 por lo que definiremos un rango para moverlo hacia arriba o hacia abajo.

Por último tuvimos que trabajar en el sonido que tiene que emitir el juego, se decidió utilizar dos microcontroladores, como alternativa a trabajar con interrupciones en un solo microcontrolador.

Resultados

Video en youtube: https://youtu.be/rARfFfFCi0k

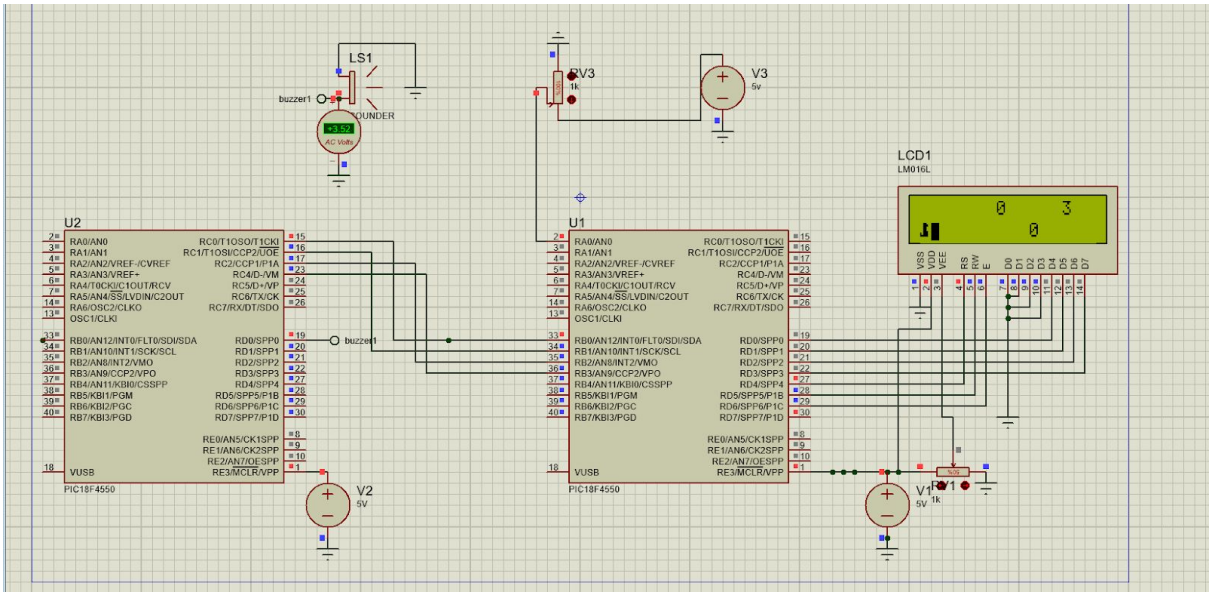


Diagrama de cómo está construido el circuito

Conclusiones

En este proyecto vemos el avance gradual de los conceptos del PIC para un objetivo integrador. El avance de cada concepto está fuertemente relacionado con la electrónica y lógica. El equipo investigó en las hojas de especificaciones para saber qué registros utilizar y sus respectivos bits.

Entendemos como avanzó la electrónica para llegar a objetivos más complejos, aunque cada uno por sí sólo tiene su complicación, en los circuitos más 90’s y 80's muchos estaban construidos de manera más lógica y circuital que en versiones modernas que utilizan más software, en las diferentes consolas se tenía todo los componentes para generar el sonido, el movimiento del personaje y la actualización de la pantalla.

En esta práctica aprendimos la importancia de cada elemento por separado y como los videojuegos tienen grandes retos y no por ser catalogado como entretenimiento no tengan grado de complejidad.

Código C

Código Main del proyecto

```
/**
  Generated Main Source File
  Company:
    Microchip Technology Inc.
  File Name:
    main.c
  Summary:
    This is the main file generated using MPLAB(c) Code Configurator
  Description:
    This header file provides implementations for driver APIs for all modules selected in the
GUI.
    Generation Information :
        Product Revision  :  MPLAB(c) Code Configurator - 3.15.0
        Device            :  PIC18F4550
        Driver Version    :  2.00
    The generated drivers are tested against the following:
        Compiler          :  XC8 1.35
        MPLAB             :  MPLAB X 3.20
*/

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*/

#include "mcc.h"
#include "stdio.h"
#include "stdlib.h"
#include <xlcd.h>

#define _XTAL_FREQ 24000000ul

/*
                         Main application
 */
int changeStages(unsigned char *parameter1, unsigned char *parameter2, int enemPos);
void juego1();
void juego2();
void juego3();
int juego4();
void printscore(int score);

unsigned int ADC_Value, porcHumidity;
unsigned int ADC_Value2, Temp;
unsigned char ADC_Buffer[10];

unsigned char data0 [] = {0x04, 0x0E, 0x0E, 0x0E, 0x0E, 0x1F, 0x04, 0x00};
unsigned char data1 [] = {0x06, 0x07, 0x06, 0x06, 0x07, 0x17, 0x1F, 0x05};


void delayms(int value);
unsigned char ADC_Buffer[10];

//changeStage1

int counter = 0;

void createCharacter(unsigned char * data, unsigned char number){
   unsigned char i = 0;
```

```
    while(BusyXLCD());
    WriteCmdXLCD(0x40 + ((number)*8));
    for(int i = 0; i < 8; i++){
        while(BusyXLCD());
        WriteDataXLCD(data[i]);
    }
};
void printCharacter(unsigned int number){
    while(BusyXLCD());
    WriteDataXLCD(number);
};


void main(void)
{

     // Initialize the device
    SYSTEM_Initialize();

    //Enable the Global Interrupts
    INTERRUPT_GlobalInterruptEnable();

    // Enable the Peripheral Interrupts
    INTERRUPT_PeripheralInterruptEnable();

    // Disable the Global Interrupts
    //INTERRUPT_GlobalInterruptDisable();

    // Disable the Peripheral Interrupts
    //INTERRUPT_PeripheralInterruptDisable();

    createCharacter(data0, 0);
    createCharacter(data1 , 1);

    TRISB = 0b0000000;

    RB0 = 1;
    juego1();
    RB0 = 0;
    RB1 = 1;
    juego2();
    RB1 = 0;
    RB2 = 1;
    juego3();
    RB2 = 0;
    RB3 = 1;
```

```
    int score = juego4();

    while(1){
        printscore(score);
    }




}

void printscore(int score){

    char buffer2[10];
    while(BusyXLCD());
    SetDDRamAddr(0x0);
    putsXLCD("tu score es de:");
    while(BusyXLCD());
    SetDDRamAddr(0x40);
    sprintf(buffer2,"%d",score);
    putsXLCD(buffer2);
}
int changeStages(unsigned char *parameter1, unsigned char *parameter2, int enemPos){
         // Initialize the device
    SYSTEM_Initialize();
    char buffer[10];



       while(BusyXLCD());
        SetDDRamAddr(0x0);
//        sprintf(ADC_Buffer, parameter1);
        putsXLCD(parameter1);
        while(BusyXLCD());
        SetDDRamAddr(0x0D);
        sprintf(buffer,"%d",counter);
        putsXLCD(buffer);
        while(BusyXLCD());
        SetDDRamAddr(0x40);
//        sprintf(ADC_Buffer, parameter2);
        putsXLCD(parameter2);



        int pos;
    //wait until conversion is done
        ADC_Value = ADC_GetConversion(0);
```

```
        if(ADC_Value <= 511){
            while(BusyXLCD());
            SetDDRamAddr(0x00);
            printCharacter(0x01);
            pos = 1;
        }
        else{

            while(BusyXLCD());
            SetDDRamAddr(0x40);
            printCharacter(0x01);
            pos = 2;
        }

        if(pos==enemPos){
            counter=counter-10;
        }
        else{
            //aquí no resta puntaje porque no chocan
        }



        counter = counter+1;
        return counter;
}




void juego1(){
    int pos;
    __delay_ms(550);
    changeStages("          0","          ", 0);

    __delay_ms(550);
    changeStages("         0 ","          ", 0);
    __delay_ms(550);

    changeStages("        0  ","          ", 0);
    __delay_ms(550);

    changeStages("       0   ","         0", 0);
    __delay_ms(550);
```

```
changeStages("      0    ","         0 ", 0);
__delay_ms(550);

changeStages("     0    0","        0  ", 0);
__delay_ms(550);

changeStages("    0    0 ","       0   ", 0);
__delay_ms(550);

changeStages("   0    0  ","      0    ", 0);
__delay_ms(550);

changeStages("  0    0   ","     0     ", 0);
__delay_ms(550);

changeStages(" 0    0    ","    0      ", 0);
__delay_ms(550);

changeStages("0    0     ","   0       ", 1);
__delay_ms(550);

changeStages("    0      ","  0       0", 0);
__delay_ms(550);

changeStages("   0       "," 0       0 ", 0);
__delay_ms(550);

changeStages("  0        ","0       0  ", 2);
__delay_ms(550);

changeStages(" 0         ","       0   ", 0);
__delay_ms(550);

changeStages("0          ","      0    ", 1);
__delay_ms(550);

changeStages("           ","     0     ", 0);
__delay_ms(550);

changeStages("           ","    0      ", 0);
__delay_ms(550);

changeStages("          0","   0       ", 0);
__delay_ms(550);
```

```
    changeStages("         0 "," 0        ", 0);
    __delay_ms(550);

    changeStages("        0  "," 0        ", 0);
    __delay_ms(550);

    changeStages("       0  "," 0         ", 0);
    __delay_ms(550);

    changeStages("      0   ","0          ", 2);
    __delay_ms(550);

    changeStages("     0    ","           ", 0);
    __delay_ms(550);

    changeStages("    0     ","           ", 0);
    __delay_ms(550);

    changeStages("   0      ","           ", 0);
    __delay_ms(550);

    changeStages("  0       ","           ", 0);
    __delay_ms(550);

    changeStages(" 0        ","           ", 0);
    __delay_ms(550);

    changeStages("0         ","           ", 1);
    __delay_ms(550);

    changeStages("          ","           ", 0);
}

void juego2(){
    int pos;
    __delay_ms(400);
    changeStages("          0","          ", 0);

    __delay_ms(400);
    changeStages("         0 ","          ", 0);
    __delay_ms(400);

    changeStages("        0  ","          ", 0);
    __delay_ms(400);

    changeStages("       0   ","         0", 0);
```

```
__delay_ms(400);

changeStages("      0    ","         0 ", 0);
__delay_ms(400);

changeStages("     0    0","        0  ", 0);
__delay_ms(400);

changeStages("    0    0 ","       0   ", 0);
__delay_ms(400);

changeStages("   0    0  ","      0    ", 0);
__delay_ms(400);

changeStages("  0    0   ","     0     ", 0);
__delay_ms(400);

changeStages(" 0    0    ","    0      ", 0);
__delay_ms(400);

changeStages("0    0     ","   0       ", 1);
__delay_ms(400);

changeStages("    0      ","  0       0", 0);
__delay_ms(400);

changeStages("   0       "," 0       0 ", 0);
__delay_ms(400);

changeStages("  0        ","0       0  ", 2);
__delay_ms(400);

changeStages(" 0         ","       0   ", 0);
__delay_ms(400);

changeStages("0          ","      0    ", 1);
__delay_ms(400);

changeStages("           ","     0     ", 0);
__delay_ms(400);

changeStages("           ","    0      ", 0);
__delay_ms(400);

changeStages("          0","   0       ", 0);
__delay_ms(400);
```

```
    changeStages("         0 ","  0        ", 0);
    __delay_ms(400);

    changeStages("        0  "," 0         ", 0);
    __delay_ms(400);

    changeStages("       0  "," 0          ", 0);
    __delay_ms(400);

    changeStages("      0   ","0           ", 2);
    __delay_ms(400);

    changeStages("     0    ","            ", 0);
    __delay_ms(400);

    changeStages("    0     ","            ", 0);
    __delay_ms(400);

    changeStages("   0      ","            ", 0);
    __delay_ms(400);

    changeStages("  0       ","            ", 0);
    __delay_ms(400);

    changeStages(" 0        ","            ", 0);
    __delay_ms(400);

    changeStages("0         ","            ", 1);
    __delay_ms(400);

    changeStages("          ","           ", 0);
}

void juego3(){
    int pos;
    __delay_ms(200);
    changeStages("          0","          ", 0);

    __delay_ms(200);
    changeStages("         0 ","          ", 0);
    __delay_ms(200);

    changeStages("        0  ","          ", 0);
    __delay_ms(200);
```

```
changeStages("       0   ","          0", 0);
__delay_ms(200);

changeStages("      0    ","         0 ", 0);
__delay_ms(200);

changeStages("     0    0","        0  ", 0);
__delay_ms(200);

changeStages("    0    0 ","       0   ", 0);
__delay_ms(200);

changeStages("   0    0  ","      0    ", 0);
__delay_ms(200);

changeStages("  0    0   ","     0     ", 0);
__delay_ms(200);

changeStages(" 0    0    ","    0      ", 0);
__delay_ms(200);

changeStages("0    0     ","   0       ", 1);
__delay_ms(200);

changeStages("    0      ","  0       0", 0);
__delay_ms(200);

changeStages("   0       ," 0       0 ", 0);
__delay_ms(200);

changeStages("  0        ,"0       0  ", 2);
__delay_ms(200);

changeStages(" 0         ","       0   ", 0);
__delay_ms(200);

changeStages("0          ","      0    ", 1);
__delay_ms(200);

changeStages("           ","     0     ", 0);
__delay_ms(200);

changeStages("           ","    0      ", 0);
__delay_ms(200);

changeStages("          0","   0       ", 0);
```

```
    __delay_ms(200);

    changeStages("         0 "," 0        ", 0);
    __delay_ms(200);

    changeStages("        0  "," 0        ", 0);
    __delay_ms(200);

    changeStages("       0  "," 0         ", 0);
    __delay_ms(200);

    changeStages("      0   ","0          ", 2);
    __delay_ms(200);

    changeStages("     0    ","           ", 0);
    __delay_ms(200);

    changeStages("    0     ","           ", 0);
    __delay_ms(200);

    changeStages("   0      ","           ", 0);
    __delay_ms(200);

    changeStages("  0       ","           ", 0);
    __delay_ms(200);

    changeStages(" 0        ","           ", 0);
    __delay_ms(200);

    changeStages("0         ","           ", 1);
    __delay_ms(200);

    changeStages("          ","           ", 0);
}

int juego4(){
    int pos;
    __delay_ms(100);
    changeStages("          0","          ", 0);

    __delay_ms(100);
    changeStages("         0 ","          ", 0);
    __delay_ms(100);

    changeStages("        0  ","          ", 0);
    __delay_ms(100);
```

```
changeStages("       0   ","          0", 0);
__delay_ms(100);

changeStages("      0    ","         0 ", 0);
__delay_ms(100);

changeStages("     0    0","        0  ", 0);
__delay_ms(100);

changeStages("    0    0 ","       0   ", 0);
__delay_ms(100);

changeStages("   0    0  ","      0    ", 0);
__delay_ms(100);

changeStages("  0    0   ","     0     ", 0);
__delay_ms(100);

changeStages(" 0    0    ","    0      ", 0);
__delay_ms(100);

changeStages("0    0     ","   0       ", 1);
__delay_ms(100);

changeStages("    0      ","  0       0", 0);
__delay_ms(100);

changeStages("   0       "," 0       0 ", 0);
__delay_ms(100);

changeStages("  0        ","0       0  ", 2);
__delay_ms(100);

changeStages(" 0         ","        0   ", 0);
__delay_ms(100);

changeStages("0          ","      0    ", 1);
__delay_ms(100);

changeStages("           ","     0     ", 0);
__delay_ms(100);

changeStages("           ","    0      ", 0);
__delay_ms(100);
```

```
    changeStages("          0","   0       ", 0);
    __delay_ms(100);

    changeStages("         0 ","  0        ", 0);
    __delay_ms(100);

    changeStages("        0  "," 0         ", 0);
    __delay_ms(100);

    changeStages("       0  "," 0          ", 0);
    __delay_ms(100);

    changeStages("      0   ","0           ", 2);
    __delay_ms(100);

    changeStages("     0    ","            ", 0);
    __delay_ms(100);

    changeStages("    0     ","            ", 0);
    __delay_ms(100);

    changeStages("   0      ","            ", 0);
    __delay_ms(100);

    changeStages("  0       ","            ", 0);
    __delay_ms(100);

    changeStages(" 0        ","            ", 0);
    __delay_ms(100);

    changeStages("0         ","            ", 1);
    __delay_ms(100);

    int score = changeStages("          ","            ", 0);

    return score;
}



/**
 End of File
*/
```