NANYANG POLYTECHNIC
EGR204 Microcontroller Applications

Laboratory Session 5

Course: Diploma in Robotics and Mechatronics

Module: EGR204 Microcontroller Applications

Experiment: 5

Title: Using the 8051 with keypad and LED display

Objective:

- The students will learn how to write 'C' program for the 8051 microcontroller to read data from a standard 4 x 4 numeric keypad and to output the read data to the 4-digit 7-segment LED display panel.

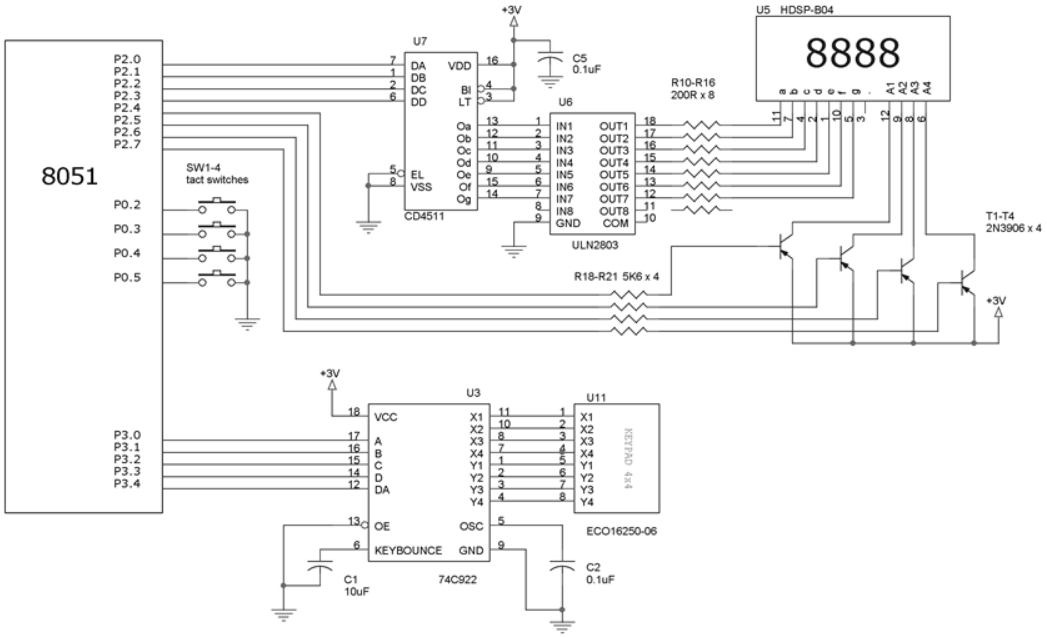
Learning Objectives:

- Recall from lab 4 how to write 'C' program to control the 4-digit 7-segment LED.
- Understand how the 74C922 keyboard encoder chip work.
- Understand how the keyscan and getchar routines work.
- Write a program to control the LED BAR in response to user pressing the keypad.
- Write a stopwatch-like* program using 'C' (* *time accuracy is not important*).

1. Introduction

Figure 1-1 shows how the 8051 is interfaced to a 4-digit 7-segment LED and a 4 x 4 keypad via a 74C922 keyboard encoder chip.

Figure 1-1
Multiplexing and Keypad Circuit



2.1 Exercise 1: Using The getchar( ) Subroutine

The program in listing 2-1 makes use of the getchar( ) function to get the value of the key being pressed from the 4x4 keypad. Analyse the getchar( ) function and make sure you understood it thoroughly.

Listing 2-1

```
#include <f200.h>

void delay(unsigned long duration)
{
   while((duration--)!=0);
}

void setSystem();

void mux_display(a,b,c,d)
unsigned char a,b,c,d;
{
   ……..
}

void display(unsigned int number)
{
   …….
}

void blink_led( )
{
   P1 = ~P1;
   delay(10000);
}

unsigned char getchar ()
{
   unsigned char x;
   while (P34==0); // wait for key pressed.
   x = P3 & 0x0f;
   while (P34==1); // wait for key release.
   return(x);
}


void main()
{
   unsigned char key;
   setSystem();

   for (;;)
   {
      key = getchar( );
      display(key);
      blink_led( );
   }
}
```

2.2 Exercise 2: Using The keyscan() Subroutine

Replace the getchar() function in listing 2-1 with the keyscan function as shown in listing 2-2. Change the main routine as shown in listing 2-2.

Execute the program. How is this program different from that of listing 2-1?

Listing 2-2

```
unsigned char keyscan(unsigned char *key)
{
   if (P34==1) // key pressed.
   {
      *key = P3 & 0x0f;
      return(1);
   }
   else
   {
      return(0);
   }
}

void main()
{
   unsigned char key;
   setSystem();

   for (;;)
   {
      if (keyscan(&key)!=0)
         display(key);
      blink_led();
   }
}
```

3.1 Assignment 1: Controlling LED BAR From The Keypad.

Write a program with the following criteria: When "1" is pressed, one LED lights up. When "2" is pressed, two LEDs light up, and so on. Any other keys beside "1" to "8" are pressed will make all LEDs go off. Use Listing 3-1 as a guide.

The LED BAR is connected to your P0 of the 8051 (refer to lab 2). To turn on the 1st LED, use the instruction:

P1 = 0x01;

To turn on two LEDs, use:

P1 = 0x03;

Listing 3-1

```
void main()
{
   unsigned char key;
   setSystem();

   for (;;)
   {
      if (keyscan(&key)!=0)
      {
         switch(key)
         {
            case 0: ----------
            case 1: ----------
            default: P1 = 0;
         }
      }
   }
}
```

3.2 Assignment 2: Stopwatch-like timer

Remember the stop watch program you did in your previous lab where the stopwatch program in controlled by three push buttons. Change the program so that it will now response to **three keys on the keypad instead**.

1. Display "0000" upon execution.

2. When START button is pressed, the display starts to run. If it hit "9999", it will repeat from "0000"

3. When STOP button is pressed, the display stop running.

4. When the RESET button is pressed, the display reset to "0000".

Use listing 3-2 as your guide.

Listing 3-2

```
#define STOP_MODE   0
#define RUN_MODE     1

void main()
{
   unsigned char mode=STOP_MODE;

   for (;;)
   {
      if (keyscan(&key)!=0)
      {
         switch(key)
         {
            - - - - - - -
         }

         if (mode==RUN_MODE)
         {
            x++;
            if  (x>9999) x = 0;
         }
         display(x);
      }
   }
}
```

4. Program Analysis

Analyse the program in listing 4-1.
What do you think the program does?

Listing 4-1

```
void main( )
{
   unsigned int number=0;
   unsigned char tag, keyCount=0;

   for(;;)
   {
      display(number);
      if (keyscan(&tag)==1)
      {
         number = (number * 10) + tag;
         keyCount++;
         if (keyCount>4)
         {
            number=0;
            keyCount=0;
         }
      }
   }
}
```