ECE 376 - Homework #6

A/D Converters, Data Collection, Chi-squared Test, Student t-Test. Due Monday, October 10th

Analog Inputs

1) Determine how long it takes to do an A/D conversion with a PIC processor

```
void main(void)
{
    TRISC = 0;
    ADCON1 = 0x0F;

// Turn on the A/D input
    TRISA = 0xFF;
    TRISE = 0x0F;
    ADCON2 = 0x95;
    ADCON1 = 0x07;
    ADCON0 = 0x01;

    while(1) {
        A2D = A2D_Read(0);
        PORTC = PORTC + 1;
        }
    }
}
```

2) Assume the A/D reads 371 for the following circuit.

- What is the voltage, Vx?
- What is the resitance, Rt?
- What is the temperature?

Assume

$$R_t = 1000 \cdot \exp\left(\frac{3905}{T + 273} - \frac{3905}{298}\right) \Omega$$



Analog Inputs

3-5) Design an embedded system which uses the analog input on RA0 (as you adjust the potentiometer on your board, the A/D goes from 0 (0V) to 1023 (5V). Some suggestions are

- Electronic Trombone: Play 400Hz (A/D = 0) to 800Hz (A/D = 1023) when you press RB0
- Electronic Die: Roll an N sided die each time you press and release RB0. N varies from 2-sided (A/D = 0) to 20 sided (A/D = 1023)
- Stepper-Motor Thermometer: Read the temperature with the A/D input. Indicate the temperature with the stepper motor (0 steps = 0 degrees, 100 steps = 100 degrees)
- Other

3) Requirements. Specify

- The inputs (includng at least one analog input)
- The outputs, and
- How they relate (i.e. what it does)

4) C-code and flow chart

5) Testing and validation

• Collect data to verify that you meet the requirements.

Chi-Squared Test

6) Determine experimentaly using a chi-squared test whether or not the following C code produces a fair 6-sided die:

```
while(1) {
   while(!RB0);
   while(RB0) DIE = (DIE + 1) % 6;
   DIE += 1;
   LCD_Move(1,0); LCD_Out(DIE, 1, 0);
   SCI_Out(DIE, 1, 0);
   SCI_CRLF();
  }
```

7) Determine experimentaly using a chi-squared test whether or not the following C code produces a fair 6-sided die:

```
while(1) {
   while(!RB0);
   while(RB0) {
      DIE = (DIE + 1) % 6;
      X = (X + 1) % 101;
      }
   DIE = DIE + 1;
   if(X < 10) DIE = 6;
   LCD_Move(1,0); LCD_Out(DIE, 1, 0);
   SCI_Out(DIE, 1, 0);
   SCI_CRLF();
   }
}</pre>
```

Am I Psychic?

8) Determine whether or not you're psychic:

- Guess which number you're going to roll with the fair 6-sided die.
- Roll the dice a bunch of times and count how many times you're right (N>10)

Use a chi-squared test to determine whether or not you're guessing (correct 1/6th of the time)

Full Code for Problem #6

```
// Global Variables
const unsigned char MSG0[21] = "Electronic Dice
                                                   ";
// Subroutines
#include <pic18.h>
          "lcd_portd.c"
#include
// Main Routine
void main(void)
{
   unsigned int i, DIE, X;
   TRISA = 0;
   TRISB = 0xFF;
   TRISC = 0;
   TRISD = 0;
   TRISE = 0;
   ADCON1 = 0 \times 0F;
  LCD_Init();
   LCD_Move(0,0); for (i=0; i<20; i++) LCD_Write(MSG0[i]);
   Wait_ms(500);
// Initialize Serial Port to 9600 baud
   TRISC = TRISC | 0xC0;
   TXIE = 0;
   RCIE = 0;
   BRGH = 0;
   BRG16 = 1;
   SYNC = 0;
   SPBRG = 255;
   TXSTA = 0x22;
   RCSTA = 0 \times 90;
   while(1) {
      while(!RB0);
      while(RB0) DIE = (DIE + 1) % 6;
      DIE += 1;
      LCD_Move(1,0); LCD_Out(DIE, 1, 0);
      SCI_Out(DIE, 1, 0);
      SCI_CRLF();
      }
   }
```