ECE 376 - Homework #6

A/D Converters, Chi-squared Test - Due Monday, October 14th

A/D Conversion

NeoPixel Mood Light

1) Requirements:

- Inputs: A/D
- Outputs: LCD Display, NeoPixel
- Relationship: Set the color based upon the A/D input

% of 5V	0/6	1/6	2/6	3/6	4/6	5/6	6/6
color	green	yellow	red	magenta	blue	cyan	green
red	0	125	250	125	0	0	0
green	250	125	0	0	0	125	250
blue	0	0	0	125	250	125	0

- 0V: green
- 1.67V (33%): red
- 3.33V (66%) blue

2) C code and flow chart: Give the corresponding C code and flow chart

```
while(1) {
   A2D   =  A2D_Read(0);
   x   =  0.75*A2D;
   if(x > 750) x = 750;
   if(x < 250) { r = x;    g = 250-x;   b = 0;   }
   else if(x < 500) { b = x-250;   r = 250-b;   g = 0;}
   else { g = x - 500;   b = 250-g;   r = 0; }


   LCD_Move(1,0);   LCD_Out(r, 3, 0);
   LCD_Move(1,5);   LCD_Out(g, 3, 0);
   LCD_Move(1,10);  LCD_Out(b, 3, 0);

   NeoPixel_Display(r, g, b);
   NeoPixel_Display(r, g, b);
   NeoPixel_Display(r, g, b);
   NeoPixel_Display(r, g, b);
   NeoPixel_Display(r, g, b);
   NeoPixel_Display(r, g, b);
   NeoPixel_Display(r, g, b);
   NeoPixel_Display(r, g, b);
   NeoPixel_Display(r, g, b);

   Wait(5);
   }

}
```
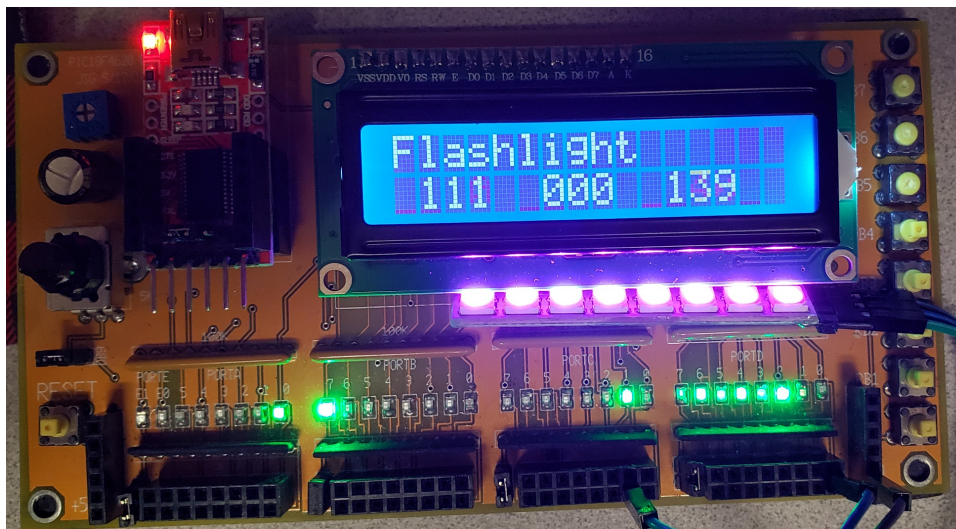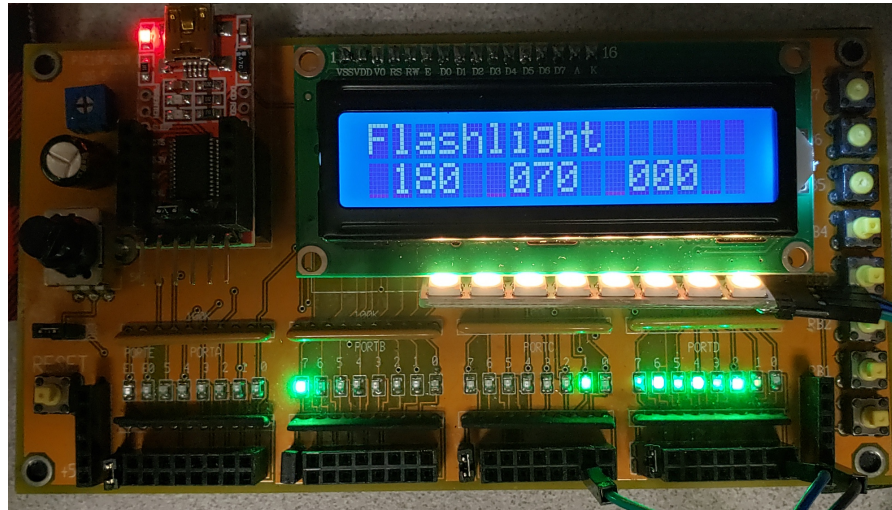
Start

Intialize

Read A/D

Compute r/g/b

update LCD

update NeoPixel
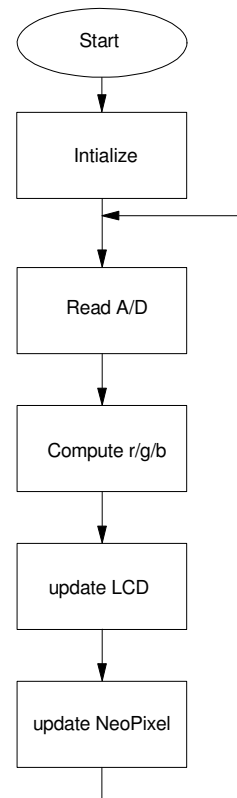
3) Validation: Collect data to verify you met your requirements
   - 0V in (0%) = green
   - 1.67V in (33%) outputs red
   - 3.33V in (66%) outputs blue
   - 5.00V in (100%) outputs green

Fair & Loaded Dice

4) 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();
   }
```

I rolled the dice 176 times...

Die Roll	1	2	3	4	5	6
Frequency	31	36	23	29	28	29

To see if this is a fair die, compute the chi-square score:

Die Roll	p	np	N	chi-squared
1	1/6	29.33	31	0.09
2	1/6	29.33	36	1.52
3	1/6	29.33	23	1.37
4	1/6	29.33	29	0
5	1/6	29.33	28	0.06
6	1/6	29.33	29	0
			Total	**3.05**

From a chi-squared table with five degrees of freedom, a chi-square score of 3.05 corresponds to a probability of 0.30772

There is a 30.772% chance this is not a fair die

> **no conclusion**
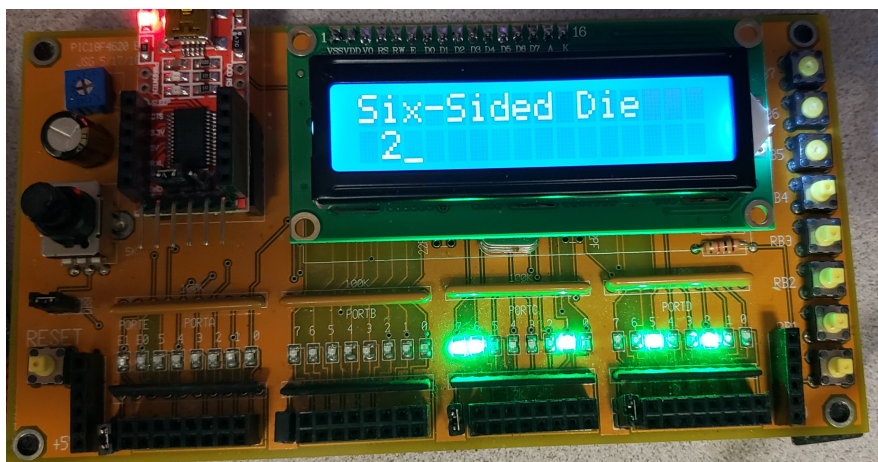
5) Determine experimentaly using a chi-squared test whether or not the following C code produces a fair 6-sided die:

```
while(1) {
   while(!RB0);
   while(RB0) {
      DIE = (DIE + 1) % 6;
      X = (X + 1) % 7;
      }
   DIE = DIE + 1;
   if(X == 0) DIE = 6;

   LCD_Move(1,0);   LCD_Out(DIE, 1, 0);
   SCI_Out(DIE, 1, 0);
   SCI_CRLF();
   }
```

Again, I rolled the dice 149 times and came up with

Die Roll	1	2	3	4	5	6
Frequency	22	21	23	31	14	38

To see if this is a loaded die, find the chi-squared score:

Die Roll	p	np	N	chi-squared
1	1/6	24.83	22	0.32
2	1/6	24.83	21	0.59
3	1/6	24.83	23	0.13
4	1/6	24.83	31	1.53
5	1/6	24.83	14	4.72
6	1/6	24.83	38	6.99
			Total	14.29

From StatTrek, a chi-squared score of 14.29 and five degrees of freedom corresponds to a probability of 0.98613

I am 98.613% certail this is a loaded die
- Not 100% certain
- The results could be due to chance (1.4% chance)

Am I Psychic?

6) Write a C program which tests if you're psychic with a 4-sided die:

- Each round, predict which number is going to come up (0..3)
- Press the corresponding button RB0..RB3.
- When you release the button, a random number in the range of 0..3 is generated
- If you were right, the PIC records that. Likewise if you were wrong.
- The LCD display displays how many times you were right and wrong.

Code:
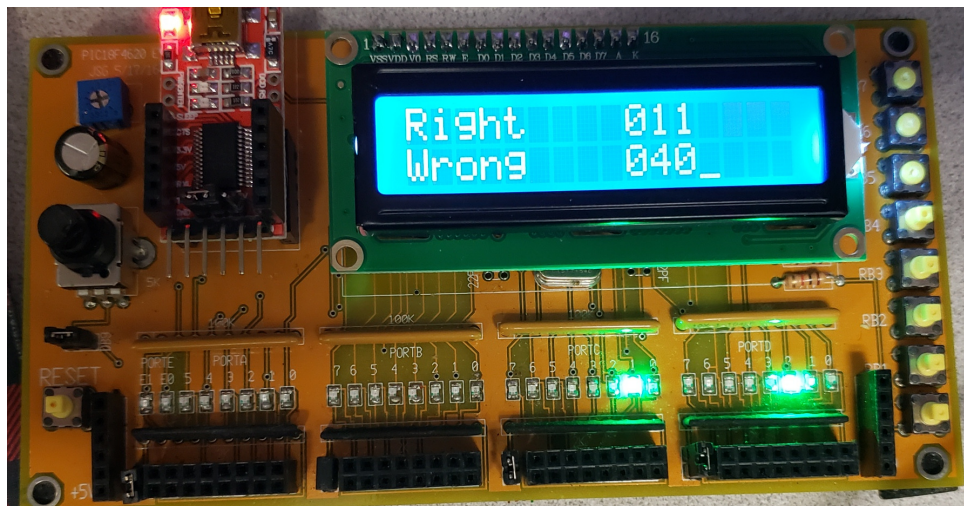
```
while(1) {
    while(PORTB == 0);
    while(PORTB) {
        if(RB0) GUESS = 0;
        if(RB1) GUESS = 1;
        if(RB2) GUESS = 2;
        if(RB3) GUESS = 3;
        X = (X + 1)%3;
    }
    if(GUESS == X) RIGHT += 1;
    else WRONG += 1;

    LCD_Move(0,8);   LCD_Out(RIGHT, 3, 0);
    LCD_Move(1,8);   LCD_Out(WRONG, 3, 0);

}
```

7) Collect data with your program.

Made 51 guesses

- 11 correct
- 40 incorrect

8) Determine the chance that you were not just guessing using a chi-squared test

- Null hypothesis: you are just guessing (correct 25% of the time).

Guess	p	np	N	chi-squared
Correct	1/4	12.75	11	0.24
Incorrect	3/4	38.25	40	0.08
			Total	0.32

From StatTrek, a chi-squared score of 0.32 with one degree of freedom corresponds to a probability of 0.42839

There is a 42.839% chance I'm not just guessing

    no conclusion

    no evidence that I'm psychic (sigh...)