Name: Clint Furrer Project Number: TI003
Project Description: Safety Walking Lights

Description:

This project addresses the concern and problem of pedestrians walking with automotive traffic. I walk to and from a bus stop every morning and evening for work. There is usually low light due to the sun setting or raising. This is where the WalkSafe project comes into play. It flashes five LED's of different colors to alert motorists that you are walking in the area and to be careful to avoid hitting you. Flashing LED's is not the only thing that is accomplished by the WalkSafe system. It also has a triple axis accelerometer to measure your steps and movement, a LED display to display a menu for selecting different modes and settings, a temperature sensor which is built into the microcontroller, and an ambient light level sensor for automatically turning the LED's on and off.

The brain of the system is a TI MSP430F169 microcontroller. The accelerometer is a Freescale MMA7361LT. The data the is gathered from the accelerometer and ambient light sensor is stored in a 64Mbit flash memory chip. The flash memory chip is from Microchip SST25VF064C. The memory chip interface is SPI. The ambient light sensor is from Vishay TEMT6000. Lastly the LED display is from SparkFun electronics COM-09767 it is interfaced through SPI as well.

The system uses low power parts and the MSP430 microcontroller has low power modes, which makes the whole system ideal for battery-powered operation. The LED's are driven with a ULN2003A transistor array IC. Three push button switches are used to navigate the LED display menu.

The WalkSafe system works as fallows. WalkSafe is placed in the walk mode. In walk mode the LED's flash and movement, temperature, and light levels are recorded to memory. If a high light level is sensed for several seconds the LED's will turn off. Once the memory is filled with data the WalkSafe can be placed into download mode. This will download the data onto your computer to be analyzed. To erase the data off of the WalkSafe it must be placed into the erase mode. This will erase the whole memory chip of any data. The last mode can manually turn the LED's off.

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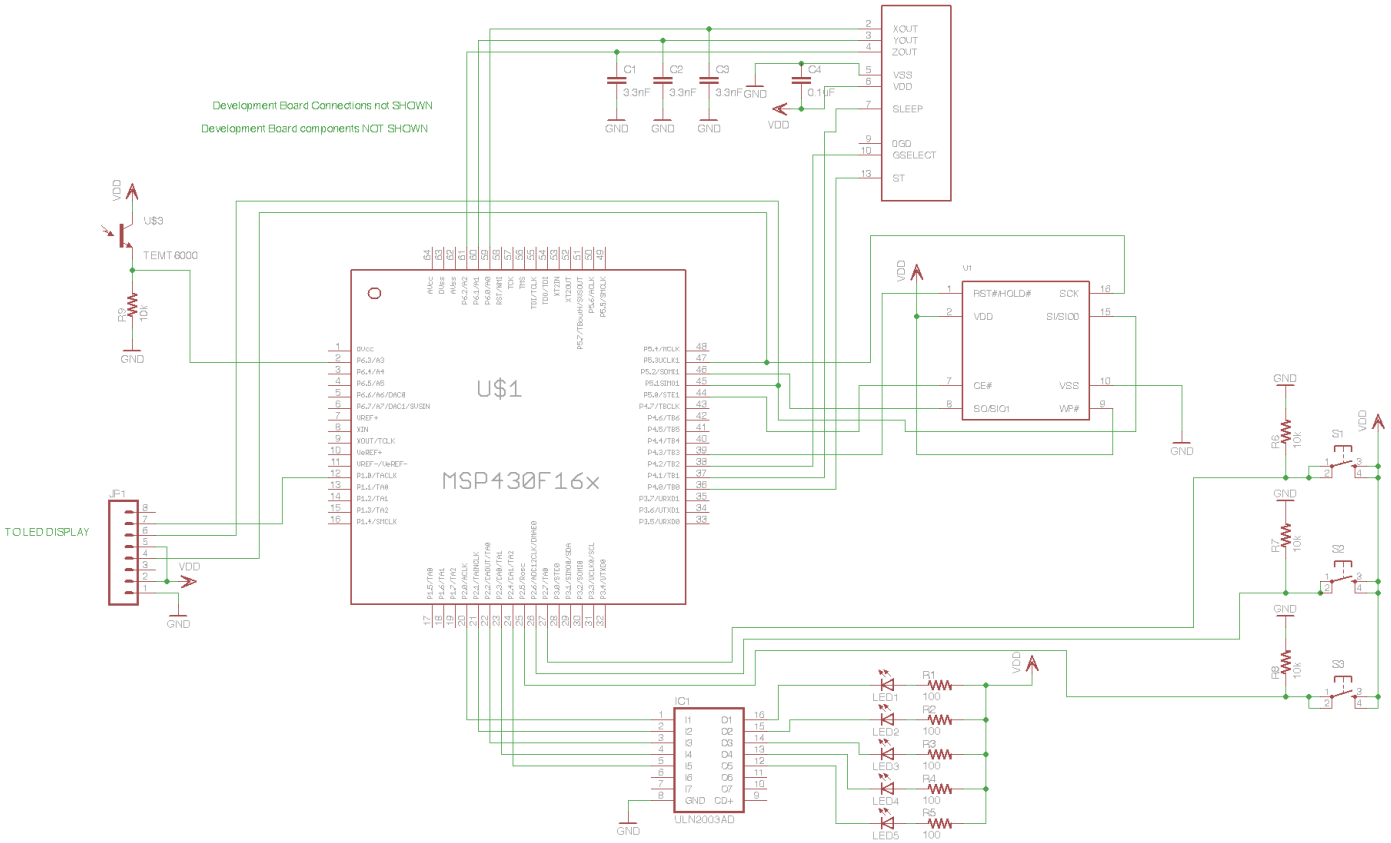
Schematic:



Schematic of the WalkSafe system.

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Bill of Materials:

Part	Value	Device	Package	Description
C1	3.3nF	CAP0603-CAP	0603-CAP	Capacitor
C2	3.3nF	CAP0603-CAP	0603-CAP	Capacitor
C3	3.3nF	CAP0603-CAP	0603-CAP	Capacitor
C4	0.1uF	CAP0603-CAP	0603-CAP	Capacitor
IC1	ULN2003AD	ULN2003AD	SO16	DRIVER ARRAY
JP1		M08	1X08	Header 8
LED1		LED5MM	LED5MM	LED
LED2		LED5MM	LED5MM	LED
LED3		LED5MM	LED5MM	LED
LED4		LED5MM	LED5MM	LED
LED5		LED5MM	LED5MM	LED
R1	100	R-US_0207/10	0207/10	RESISTOR, American symbol
R2	100	R-US_0207/10	0207/10	RESISTOR, American symbol
R3	100	R-US_0207/10	0207/10	RESISTOR, American symbol
R4	100	R-US_0207/10	0207/10	RESISTOR, American symbol
R5	100	R-US_0207/10	0207/10	RESISTOR, American symbol
R6	10k	R-US_0207/10	0207/10	RESISTOR, American symbol
R7	10k	R-US_0207/10	0207/10	RESISTOR, American symbol
R8	10k	R-US_0207/10	0207/10	RESISTOR, American symbol
R9	10k	R-US_0207/10	0207/10	RESISTOR, American symbol
S1		TAC_SWITCHPTH	TACTILE-PTH	Momentary Switch
S2		TAC_SWITCHPTH	TACTILE-PTH	Momentary Switch
S3		TAC_SWITCHPTH	TACTILE-PTH	Momentary Switch
U$1	F16X---PM64	F16X---PM64	PM/PAG64	*** MSP430F169 *** PM64
U$2	MMA7361	MMA7361	LGA14	
U$3	TEMT6000	TEMT6000	TEMT6000-SEN	Ambient Light Sensor
U1		SST64MBIT	SST16SOICW	

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Source code:

```
//*******************************************************************************
***
//
//*******************************************************************************
***
#include<io.h>

#define orange  16
#define purple1 2
#define purple2 4
#define blue    8
#define green   1

#defineupbutton    128
#defineenterbutton 64
#definedownbutton  32

voiddevset(volatilecharreg, volatilechar setting);
void send(int data);
void wait(void);          //delay function
voidswait(void);
void flashy(void);
voidspi_send(char data);
void display(char data[]);

void main(void)
{
  WDTCTL = WDTPW + WDTHOLD;                 // Stop WDT

staticunsignedint results[128];
staticunsignedchar message[] = {0x16,0x26,0x36,0x46};
//static unsigned intA1results[100];
//static unsigned intA2results[100];
//static unsigned intA3results[100];

staticunsignedint A0results;
staticunsignedint A1results;
staticunsignedint A2results;
staticunsignedint A3results;

//static char message[] = {"Hello World"};
staticcharhighB, lowB;

volatileunsignedinti, x, z, index, tempdata, button, exef, stop;

  P1DIR = 0xFF;
  P1OUT = 0x01;

  P3SEL |= 0x30;                            // P3.4,5 = USART0 TXD/RXD

  P4DIR=0xFF;
```

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```
  P4SEL=0x00;                               //control lines
  P4OUT=0x00;

  P5SEL |= 0x0E;                            // P5.1,2,3 SPI option select
  P5DIR |= 0x0B;
  P5OUT |= 0x01;                            // unselect memory chip

  P6SEL = 0x0F;                             // Enable A/D channel inputs

  P2DIR = 0x1F;                             //LEDs and buttons
  P2OUT = 0;


index = 0;
x = 0;
tempdata = 0;
z = 0;
exef = 0;

  BCSCTL1 &= ~XT2OFF;                       // XT2on

do
  {
  IFG1 &= ~OFIFG;                           // Clear OSCFault flag
for (i = 0xFF; i>0; i--);                 // Time for flag to set
  }
while ((IFG1 & OFIFG));                     // OSCFault flag still set?

  BCSCTL2 |= SELM_2 + SELS;                 // MCLK = SMCLK = XT2 (safe)

//UART0
  ME1 |= UTXE0 + URXE0;                     // Enable USART0 TXD/RXD
  UCTL0 |= CHAR;                            // 8-bit character
  UTCTL0 |= SSEL1;                          // UCLK = SMCLK
  UBR00 = 0xA0;                             // 8Mhz/19200 ~ 417
  UBR10 = 0x01;                             //
  UMCTL0 = 0x00;                            // no modulation
  UCTL0 |= 0x01;                            // Initialize USART state machine
  TXBUF0 = 0x00;
  UCTL0 &= 0x10;


//ADC
  ADC12CTL0 = ADC12ON+MSC+SHT0_8;           // Turn on ADC12, extend sampling
time
// to avoid overflow of results
  ADC12CTL1 = SHP+CONSEQ_3;                 // Use sampling timer, repeated
sequence
//ADC12CTL1 |= 0xE0;
  ADC12MCTL0 = INCH_0;                      // ref+=AVcc, channel = A0
  ADC12MCTL1 = INCH_1;                      // ref+=AVcc, channel = A1
  ADC12MCTL2 = INCH_2;                      // ref+=AVcc, channel = A2
  ADC12MCTL3 = INCH_3+EOS;                  // ref+=AVcc, channel = A3, end
seq.
//ADC12IE = 0x08;                         // Enable ADC12IFG.3
  ADC12CTL0 |= ENC;                         // Enable conversions
```

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```
//SPI
  ME2 |= USPIE1;                            // Module enable
  UCTL1 = CHAR + SYNC + MM + SWRST;         // 8-bit, SPI, Master
  UTCTL1 = SSEL1 +SSEL0 + STC;              // Polarity, SMCLK, 3-wire
//UTCTL1 = CKPL + SSEL1 +SSEL0 + STC;       // Polarity, SMCLK, 3-wire
  UBR10 = 0x64;                             // SPICLK = SMCLK/2
  UBR11 = 0x00;
  UMCTL1 = 0x00;

  UCTL1 &= ~SWRST;                          // SPI enable



  P2OUT = 0xFF;                             //LED test
//configure control lines
devset(1,0);                              //self test on
devset(2,0);                              //disable sleep
devset(3,0);                              //1.5g selected
devset(4,0);                              //reset memory
wait();
devset(4,1);                              //set memory to run

  ADC12CTL0 |= ADC12SC;                     // Start conversion
    //main loop



while(1)
  {

// wait();
// wait();
display(message);
//wait();
// wait();
    while(!exef)
        {
    button = P2IN &0xE0;

    if(upbutton)
             {
    //increament command
z = z + 1;
             }
    if(downbutton)
            {
    //decrement command
            z = z + 1;
            }
        if(enterbutton)
            {
//extcute command
            exef = 1;
            }
    if(z <4)
```

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```
            {
    z = 0;
            }
         }
    //run main program
    //command 1 LED's off
    //command 2 exe main program
    //command 3 download data
    //command 4 erase all of external memory

    switch(z)
      {

        case1:
        P2OUT = 0;   //turn off LED's
        break;

        case2:
        button = P2IN &0xE0;
        while(!(button&0x40))
             {
        while(!(ADC12IFG &0x08));
              A0results = ADC12MEM0;             // Move A0 results, IFG is
cleared
              A1results = ADC12MEM1;             // Move A1 results, IFG is
cleared
              A2results = ADC12MEM2;             // Move A2 results, IFG is
cleared
              A3results = ADC12MEM3;             // Move A3 results, IFG is
cleared

        results[index] = A0results;         //move results to TX buffer
        index = index + 1;                  // Increment results index
            results[index] = A1results;
            index = index + 1;                  // Increment results index
            results[index] = A2results;
            index = index + 1;                  // Increment results index
            results[index] = A3results;

            if(index <128)
              {
            for(i=0;i<128;i++)
                  {
            lowB = results[i];    //try?
            highB = results[i] >>8;
            spi_send(lowB);
            spi_send(highB);
                   }
            index = 0;
              }
            flashy();
            }
        break;

        default:
        {
```

```
        break;
        }

    }



   }

}

void display(char data[])
{
    char message[] = {0x11,0x11,0x11,0x11};
    volatileinti;
    P1OUT = 0x00;
for(i=0;i<5;i++)
        {
        P1OUT = 0x00;
        while ((UTCTL1 & TXEPT) ==0);
        U1TXBUF = message[i];
        P1OUT = 0x01;
        }
}

voidspi_send(char data)
{
    while ((UTCTL1 & TXEPT) ==0);
     U1TXBUF = data;
    //while ((IFG2 & URXIFG1)==0);
}

void wait(void)          //delay function
{
volatileinti;        //declare i as volatile int
for(i=0;i<32000;i++);  //repeat 32000 times

}

voidswait(void)
{
volatileinti;        //declare i as volatile int
for(i=0;i<20;i++);  //repeat 2000 times
}

void send(int data)
{
    volatileunsignedchar out[] = {0x00,0x00,0x0D} , temp;
    volatileinti;
    //out[0] = ',';
    out[2] = 0x0D;
    out[0] = data &0x00FF;
    temp = data &0xFF00;
    out[1] = temp >>8;

    for(i=0;i<3;i++)
```

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```
        {
        while(!(UTCTL0 &0x01));
        TXBUF0 = out[i];
        }
}

void flashy(void)       //flashes the led's
{
    P2OUT |= orange + green;
    swait();
    P2OUT &= orange;
    swait();
    P2OUT |= orange + green;

    P2OUT = 0;
    wait();

        P2OUT |= orange + purple1;
    swait();
    P2OUT &= orange;
    swait();
    P2OUT |= orange + purple1;

    P2OUT = 0;
    wait();

    P2OUT |= orange + blue;
    swait();
    P2OUT &= orange;
    swait();
    P2OUT |= orange + blue;

    P2OUT = 0;
    wait();

    P2OUT |= orange + purple2;
    swait();
    P2OUT &= 0;
    swait();
    P2OUT |= orange + purple2;

    P2OUT = 0;
    wait();
    wait();
    P2OUT |= orange;
}

voiddevset(volatilecharreg, volatilechar setting)
{
switch(reg)
        {
        case0x01:
        //self test
        if(setting)
            {
            P4OUT=P4OUT | 0x01; //self test on
```

```
            }
        else
            {
            P4OUT=P4OUT &0xFE; //self test off
            }
        break;

        case0x02:
        //sleep accelerometer
        if(setting)
            {
            P4OUT=P4OUT &0xFD;  //enable sleep
            }
        else
            {
            P4OUT=P4OUT | 0x02; //dis enable sleep
            }
        break;

        case0x03:
        //g-select
        if(setting)
            {
            P4OUT=P4OUT | 0x04;  //6g range
            }
        else
            {
            P4OUT=P4OUT &0xFB; //1.5g range
            }
        break;

        case0x04:
        //memory chip reset
        if(setting)
            {
            P4OUT = P4OUT | 0x08;  //normal run
            }
        else
            {
            P4OUT = P4OUT &0xF7;  //reset
            }
        break;

        default:
        {
        break;
        }

    }
}
```

Pictures:

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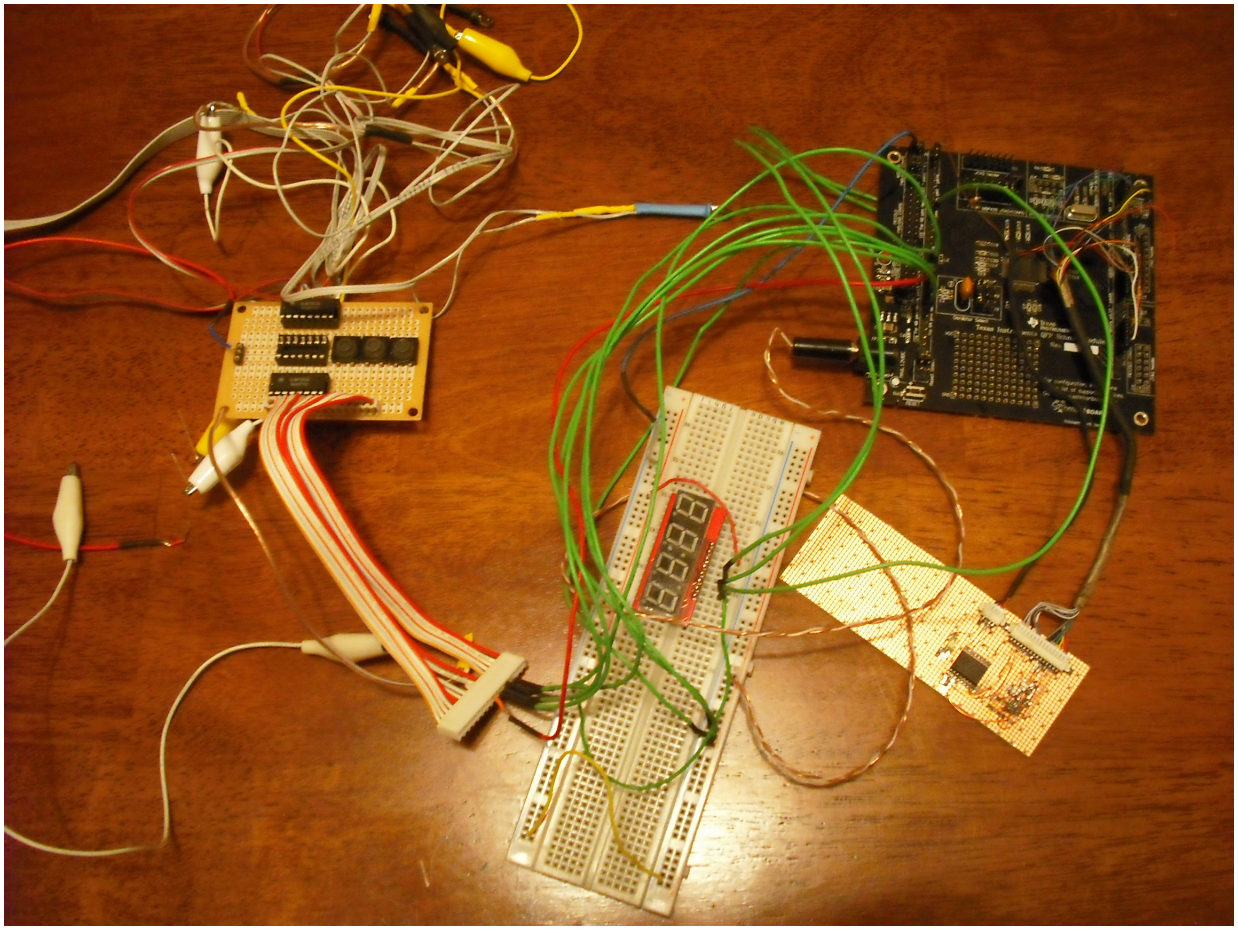

System

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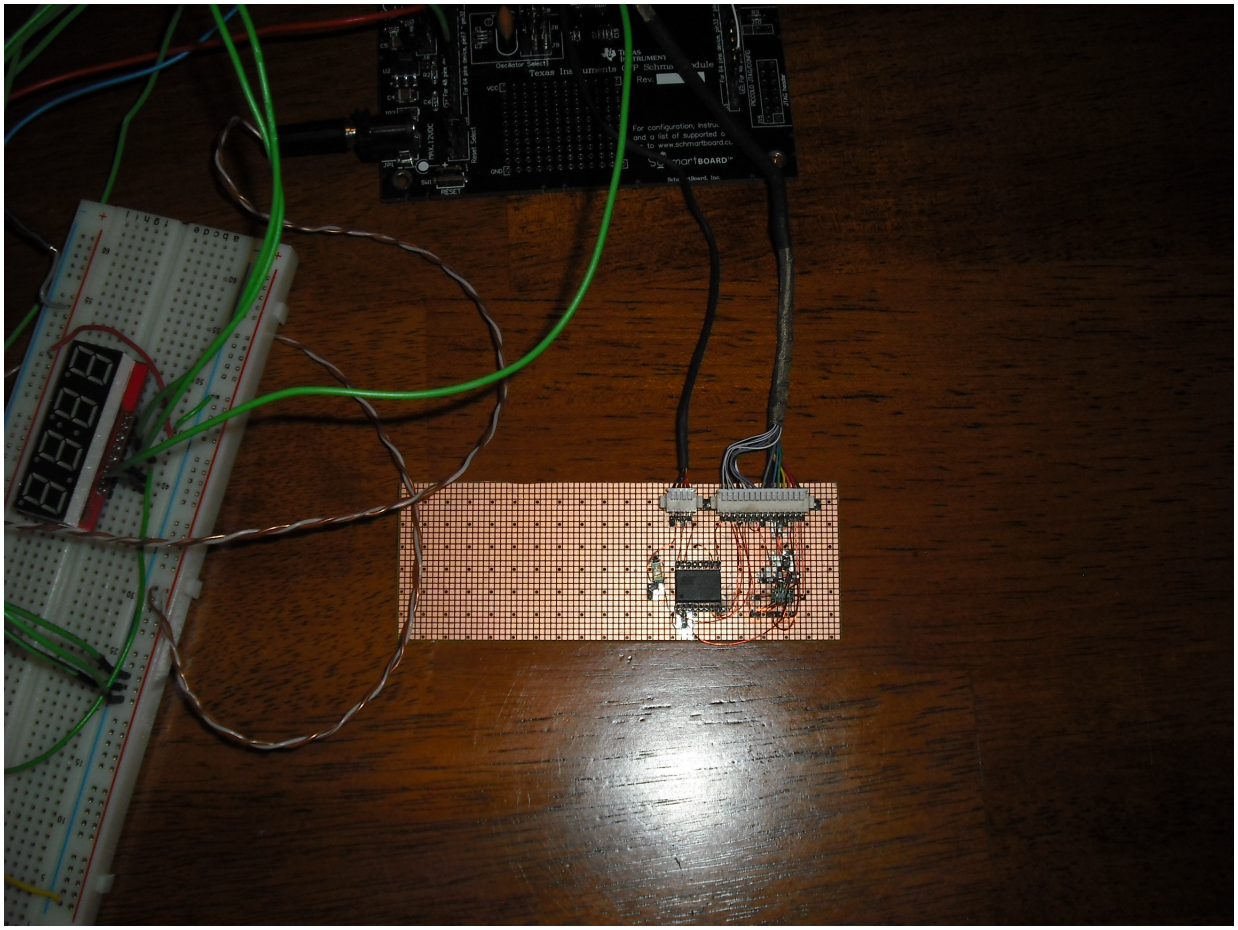

Sensor Board

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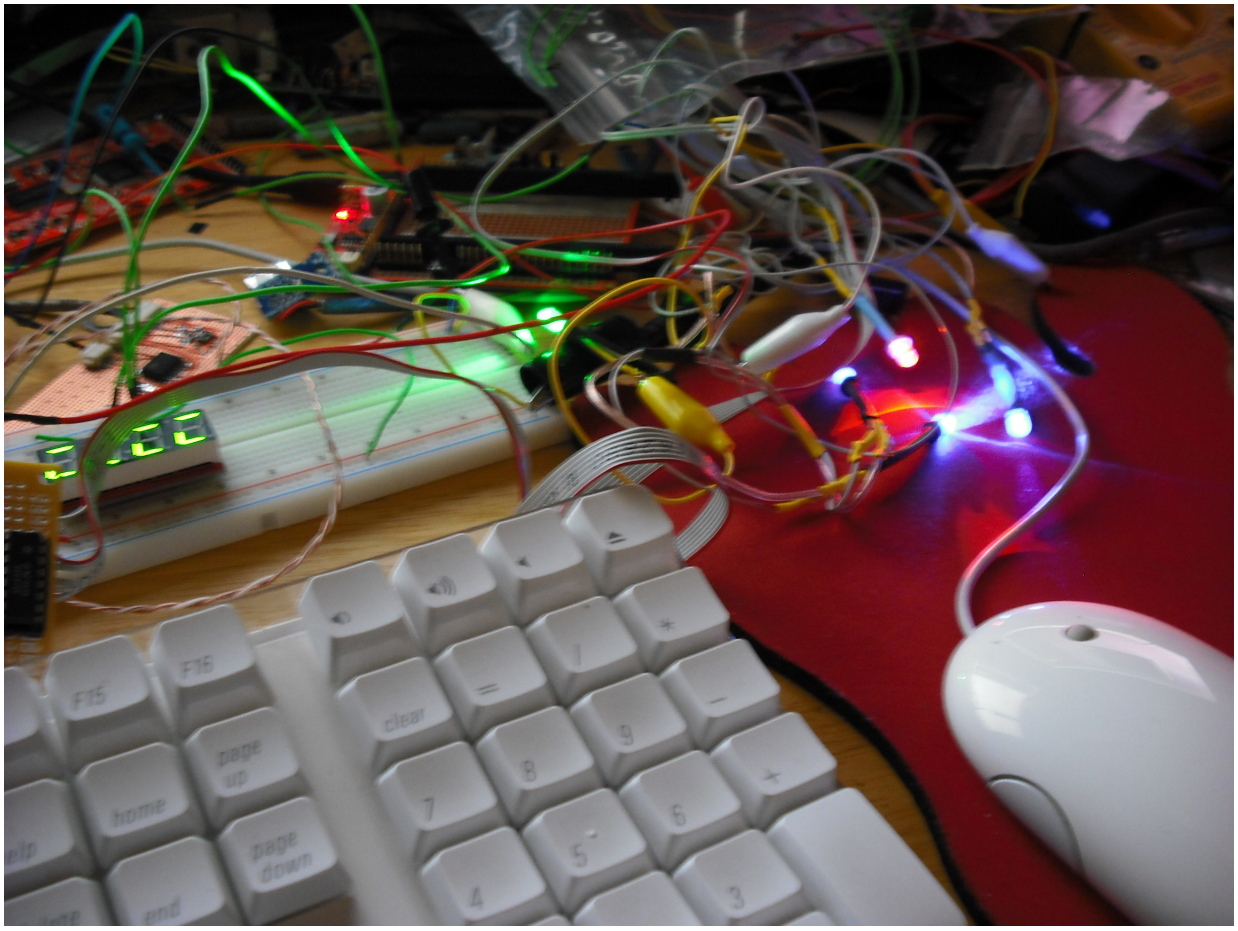

Flashy LED's

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Me with Project