



End of Universe Countdown Timer

Objectives:

The goal of this lab was to interface multiple LEDs to the microcontroller and write C code to use the LEDs as a countdown to the end of the universe counter.

- Interfacing LEDs
- C coding

Procedures:

Pre-Lab: Reviewed LED operation and wiring

Design: Created C-Code flow diagram

- Created Code for the counter
- Designed the 4 LED driver circuit
- Built the LED circuits

Test: Downloaded the program onto the microcontroller

- Used button 1 as the “start” input

Verified:

- Count did not start until button 1 pushed
- Counted down
- Stopped at 0000
- Reset put the design back to the beginning

Results:

At first my LEDs did not light up. I determined I had placed them in the board backwards. Once the LEDs were wired properly the design worked. On reset, all 4 LEDs were on. When I pushed the button the LEDs started to count down in a binary pattern until all the LEDs were off.

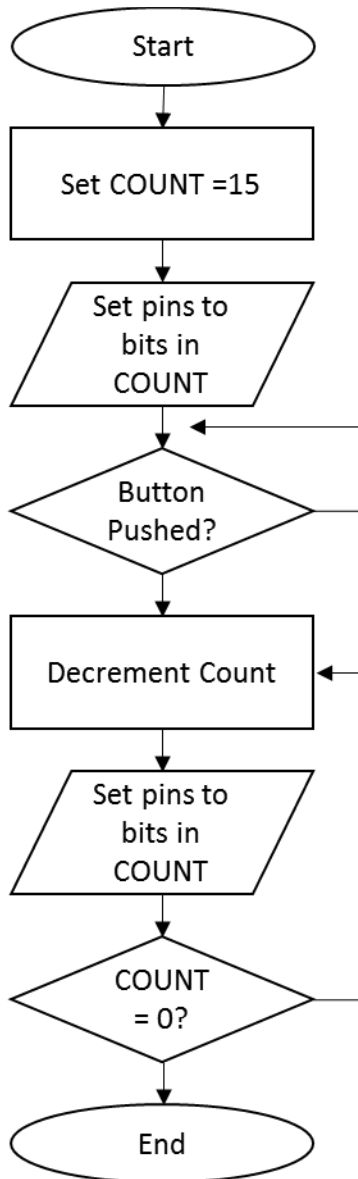
The appendix has the following: C-Code flow diagram, LED circuit design equations, Design schematic, C-Code, Picture of the working design (part way through countdown).

Observations and Conclusions:

I was reminded in this lab that it's important which direction I wire up my LEDs. I also started the design without creating a flow diagram. I quickly realized that I was not sure what to do and once I created the flow diagram the code development went very quickly.

My design met all of the design criteria.

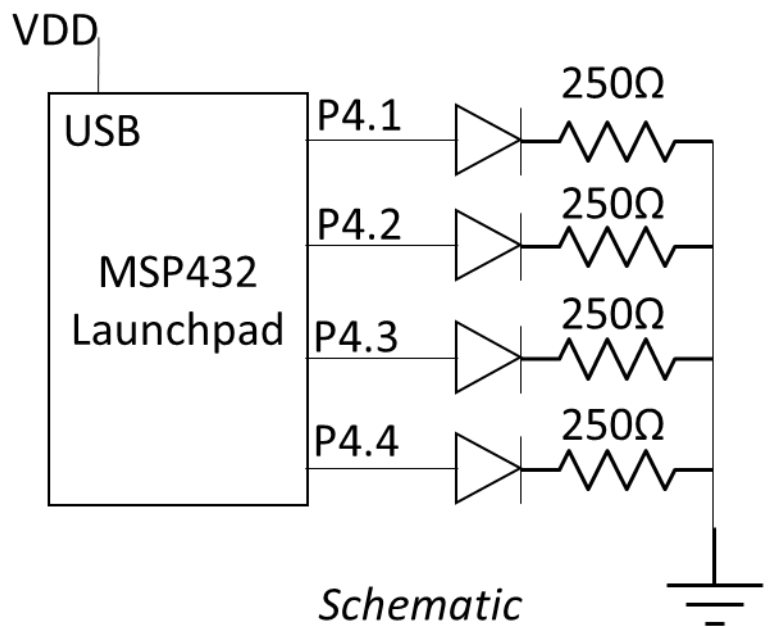
Appendix and References:



Flow Diagram

LED circuit design calculations
 $V+ = 3.3V$
 $V_{diode} = 1.8V$
 $V_{res} = 3.3V - 1.8V = 1.5V$
 $I_{out-max} = 6mA$
 $R = V_{res} / I_{out-max} = 1.5V / 6mA = 250\Omega$

Calculations



Schematic

```

/*
 * Report_Example.c
 *
 * Created on: 9/1, 2017
 * Author: johnsontimoj
 */
//
// LED countdown timer
//
#include <stdio.h>
#include "msp432.h"
#include "msoe_lib_delay.h"

int main(void){
    WDTCTL = WDTPW | WDTHOLD;    // Stop watchdog

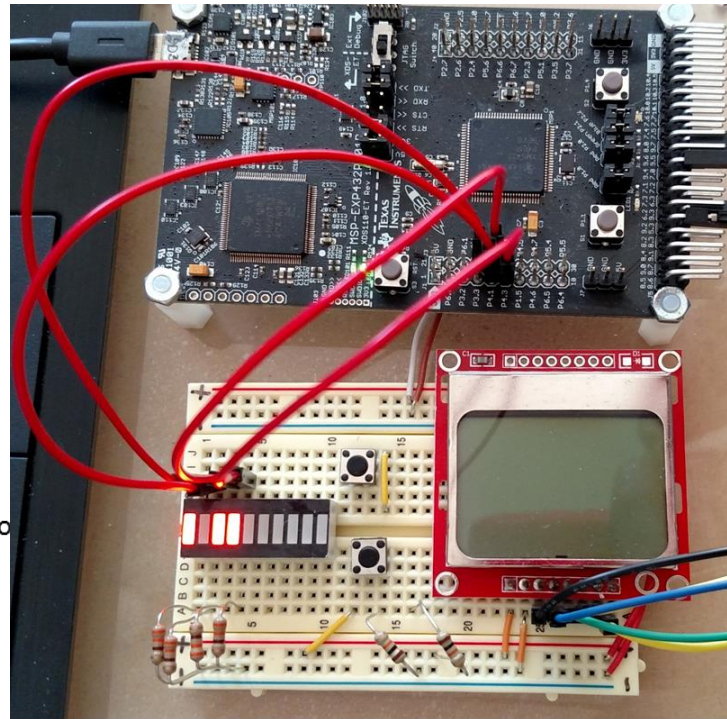
    // setup pins
    // Note port 4, bits 0-3 are pins 24, 5, 25, 6
    //
    P4->DIR |= 0x0F; //set as outputs

    //
    // Inital output setup
    //
    int8_t COUNT = 0x0F;
    P4->OUT = COUNT & 0x0F;
    //
    // Test for start (button)
    //
    while ((P1->IN & 0x02) != 2){
        ;
    } // end while

    //
    // Counter
    //
    for(COUNT=0x0F; COUNT >= 0; COUNT--){
        P4->OUT = COUNT & 0x0F;
        Delay_3MHz_ms(1000);
    } // end for

} // end main

```



Circuit

Code