

CPE301 - SPRING 2024
Design Assignment 2

Student Name: Nathan Ramos
Student #: 5006437353
Student Email: ramosn8@unlv.nevada.edu
Primary Github address:
Directory:
Video Playlist:

TASK 2 IN C

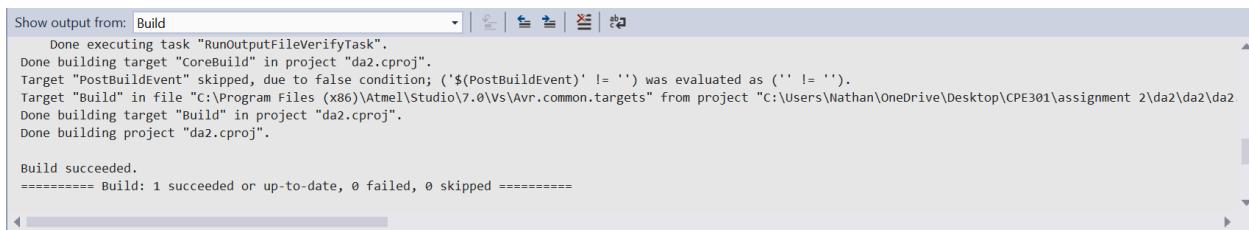
```
#define F_CPU 20000000
#include <avr/io.h>
#include <util/delay.h>

void delay(int thirds) { // takes input for 1/3 of a second
    for (; thirds > 0; thirds--) {
        _delay_ms(333); // loops to delay
    }
}

int main(void)
{
    DDRC = (0 << PINC2); // initialize PINC2 for input
    DDRB = (1 << PINB5); // initialize PINB5 for output

    PORTB = (1 << PINB5) | (1 << PINB4) | (1 << PINB3) | (1 << PINB2); // turn off all LEDs
    while (1)
    {
        if ((PINC & (1 << PINC2)) == (0 << PINC2)) { // check if PINC2 = 0
            PORTB ^= (1 << PINB5); // toggle LED on
            delay(6); // delay 6 * 1/3 seconds
            PORTB ^= (1 << PINB5); // toggle LED off
        }
    }
}
```

COMPILATION SUCCESS



```
Show output from: Build ▾ | ⌂ | ⌂ | ⌂ | ⌂ | ⌂
Done executing task "RunOutputFileVerifyTask".
Done building target "CoreBuild" in project "da2.cproj".
Target "PostBuildEvent" skipped, due to false condition; ('$(PostBuildEvent)' != '') was evaluated as ('' != ''').
Target "Build" in file "C:\Program Files (x86)\Atmel\Studio\7.0\Vs\Avr.common.targets" from project "C:\Users\Nathan\OneDrive\Desktop\CPE301\assignment 2\da2\da2\da2.cproj".
Done building target "Build" in project "da2.cproj".
Done building project "da2.cproj".

Build succeeded.
===== Build: 1 succeeded or up-to-date, 0 failed, 0 skipped ======
```

TASK 2 IN ASM

```
.org 0x0000
    jmp setup

setup:
    // initialization of ports and Interrupts
```

```

ldi r17, 0x00          // load r17 to all 0s
ldi r18, 1 << PINB5    // load register for DDRB & toggling LED
out DDRB, r18          // initialize pins 5 and 4 for output
out DDRC, r17          // initialize all of PORT C for input
// initialization of timer/counter1
ldi r23, 0x02          // register used for OCF1A flag
ldi r20, 0 << WGM10     // sets WGM1[1:0] for ctc
ldi r19, 5              // sets CS1[2:0] for prescalar
ori r19, 1 << WGM12     // sets WGM1[3:2] for ctc
sts TCCR1A, r20         // sets CTC bits
sts TCCR1B, r19         // Sets prescalar = 1024 and CTC bits
sts TIMSK1, r23         // sets OCIE1A bit to enable CTC comparator

A
// sets the high and low bits of OCR1A for CTC mode
ldi r20, 0x19           // 1/3 second delay
ldi r19, 0x6D           // 1/3 second delay
sts OCR1AH, r20         // 1/3 second delay
sts OCR1AL, r19         // 1/3 second delay
mov r16, r18             // set register for data output to PORT B
out PORTB, r18           // initialize LED off

main:
in r22, PINC            // input from port C
andi r22, 1 << PINC2 // mask for only pin C2 input
cpi   r22, 0             // check if PINC2 is Low
brne main
eor r16, r18 // toggle LED on
out PORTB, r16           // output to LED
ldi r21, 6               // load num of 1/3 second delays desired
loopdelay:
cp r21, r17             // check if counter = 0
breq done
rcall delay              // call delay
subi r21, 1               // decrement counter
rjmp loopdelay           // loop
done:
eor r16, r18 // toggle LED off
out PORTB, r16           // output to LED
rjmp main                // normal status

delay:
in r28, TIFR1            // load value of TIFR1
and r28, r23 // mask all bits except OCF1A
cp r28, r23             // check if OCF1A flag is set
brne delay               // check if 1/3 second is reached
out TIFR1, r23           // reset OCF1A flag
ret

```

COMPILATION SUCCESS

```

Done executing task "RunAssemblerTask".
Done building target "CoreBuild" in project "da2_asm.asmproj".
Target "PostBuildEvent" skipped, due to false condition; ('$(PostBuildEvent)' != '') was evaluated as ('' != '').
Target "Build" in file "c:\Program Files (x86)\Atmel\Studio\7.0\Vs\Avr.common.targets" from project "c:\Users\Nathan\OneDrive\Desktop\CPE301\assignment 2\da2_asm\da2_.
Done building target "Build" in project "da2_asm.asmproj".
Done building project "da2_asm.asmproj".

Build succeeded.
=========
Build: 1 succeeded or up-to-date, 0 failed, 0 skipped =====

```

```

TASK 3 IN C
#define F_CPU 20000000
#include <avr/io.h>
#include <avr/interrupt.h>
#include <util/delay.h>

void delay(int thirds) { // takes input for 1/3 of a seconds
    for (; thirds > 0; thirds--) {
        _delay_ms(333); // each loop delays 333ms
    }
}

ISR(INT1_vect) // ISR for INT1 interrupt
{
    cli(); // disable interrupts
    PORTB ^= (1 << PINB4); // toggle led on
    delay(9); // delay 9 * 1/3 seconds
    PORTB ^= (1 << PINB4); // toggle led off
    sei(); // enable interrupts
}

int main(void)
{
    DDRB = (1 << PINB5) | (1 << PINB4); // initialize pin B4/B5 for output
    DDRD = (0 << PIND3); // initialize pin D3 for input
    EIMSK |= (1 << INT1); // enable interrupt 1
    EICRA |= (1 << ISC11) | (1 << ISC10); // trigger INT1 on rising edge
    PORTB = (1 << PINB5) | (1 << PINB4) | (1 << PINB3) | (1 << PINB2); // turn off all LEDs
    PORTD |= (1 << PIND3); // activate pull up resistor for pin D3
    sei(); // enable interrupts
    while (1);
}

```

COMPILATION SUCCESS

```

Show output from: Build | ▾ | ⌂ | ⌃ | ⌁ | ⌂
Done executing task "RunOutputFileVerifyTask".
Done building target "CoreBuild" in project "da2.cproj".
Target "PostBuildEvent" skipped, due to false condition; ('$(PostBuildEvent)' != '') was evaluated as ('' != '').
Target "Build" in file "C:\Program Files (x86)\Atmel\Studio\7.0\Vs\Avr.common.targets" from project "C:\Users\Nathan\OneDrive\Desktop\CPE301\assignment 2\da2\da2\da2".
Done building target "Build" in project "da2.cproj".
Done building project "da2.cproj".

Build succeeded.
===== Build: 1 succeeded or up-to-date, 0 failed, 0 skipped =====
|
```

TASK 3 IN ASM

```

.org 0x0000
    jmp setup
.org 0x0004
    jmp INT1_ISR

setup:
// initialization of ports and Interrupts
ldi r17, 0x00 // load r17 to all 0s

```

```

ldi r18, 0b000110000          // load register for DDRD
out DDRB, r18                 // initialize pins 5 and 4 for output
out DDRD, r17                 // initialize all PORT D for input
out PORTB, r18                // initialize LEDs off
out PORTD, r16                // activate pull-ups for all PORT D
ldi r19, 2                     // load register for EIMSK
out EIMSK, r19                // enable interrupt 1
ldi r19, 0b000001100          // load register for EICRA
sts EICRA, r19                // trigger INT1 on rising edge
// initialization of timer/counter1
ldi r23, 0x02                 // register used for OCF1A flag
ldi r20, 0 << WGM10           // sets WGM1[1:0] for ctc
ldi r19, 5                     // sets CS1[2:0] for prescalar
ori r19, 1 << WGM12           // sets WGM1[3:2] for ctc
sts TCCR1A, r20               // sets CTC bits
sts TCCR1B, r19               // Sets prescalar = 1024 and CTC bits
sts TIMSK1, r23               // sets OCIE1A bit to enable CTC comparator

A
// sets the high and low bits of OCR1A for CTC mode
ldi r20, 0x19                 // 1/3 second delay
ldi r19, 0x6D                 // 1/3 second delay
sts OCR1AH, r20              // 1/3 second delay
sts OCR1AL, r19              // 1/3 second delay
ldi r18, 1 << PINB4           // load register for toggling LED
mov r16, r18                  // set register for data output to PORT B
sei                           // enable interrupts

main:
rjmp main                      // normal status

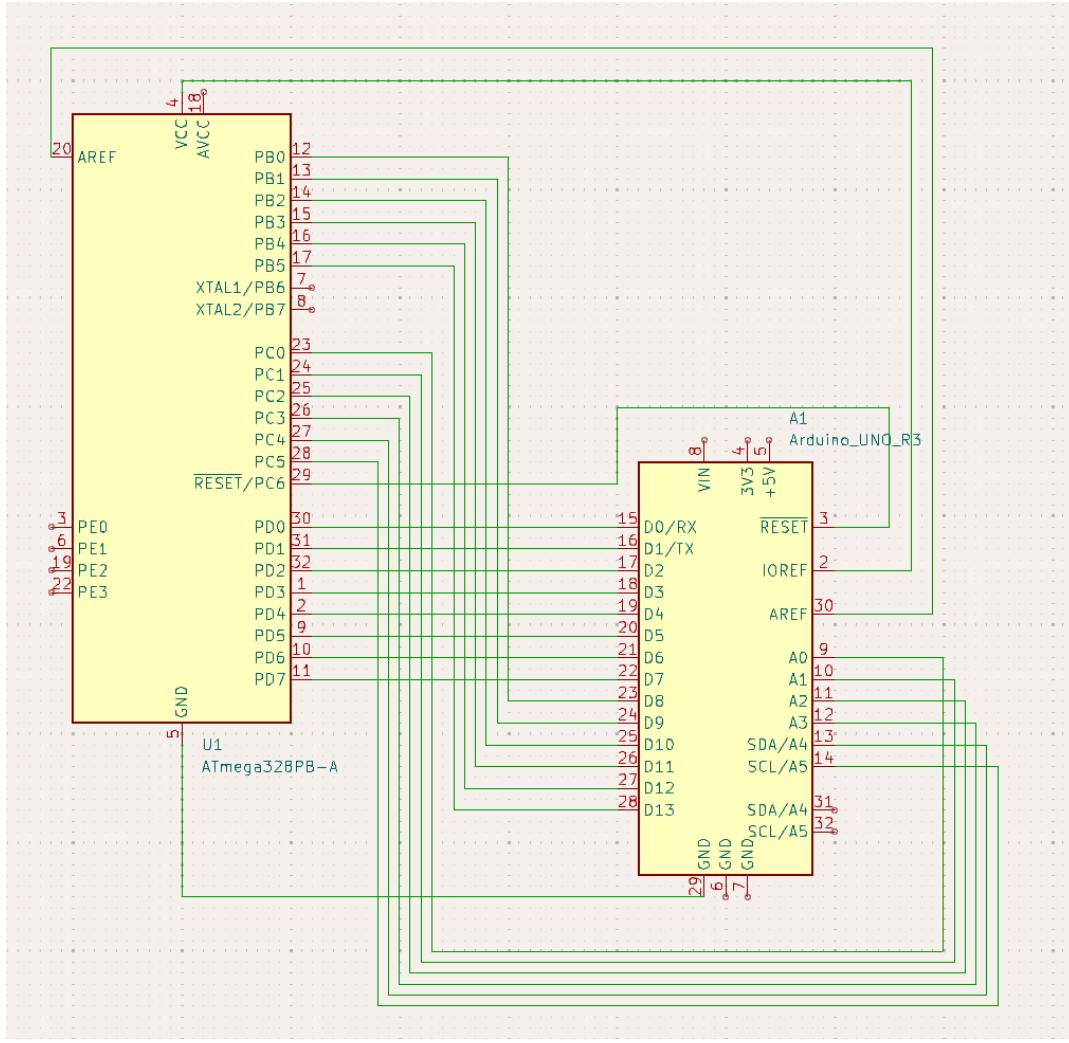
delay:
in r28, TIFR1                 // load value of TIFR1
and r28, r23 // mask all bits except OCF1A
cp r28, r23                   // check if OCF1A flag is set
brne delay                     // check if 1/3 second is reached
out TIFR1, r23                // reset OCF1A flag
ret

INT1_ISR:
cli                          // clear interrupts
eor r16, r18 // toggle LED on
out PORTB, r16                // output to LED
ldi r21, 9                     // load num of 1/3 second delays desired
loopdelay:
cp r21, r17                   // check if counter = 0
breq done
rcall delay                    // call delay
subi r21, 1                    // decrement counter
rjmp loopdelay                // loop

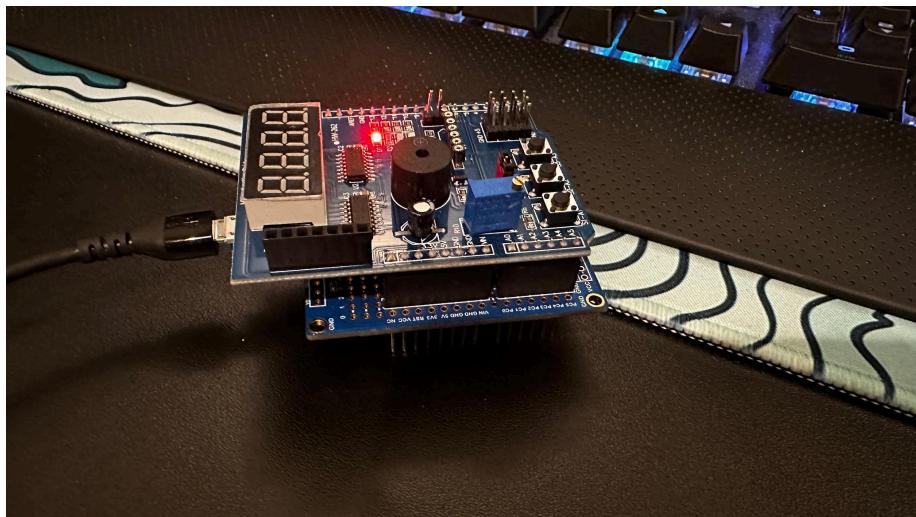
done:
eor r16, r18 // toggle LED off
out PORTB, r16                // output to LED
sei                         // enable interrupts
rjmp main                      // return

```

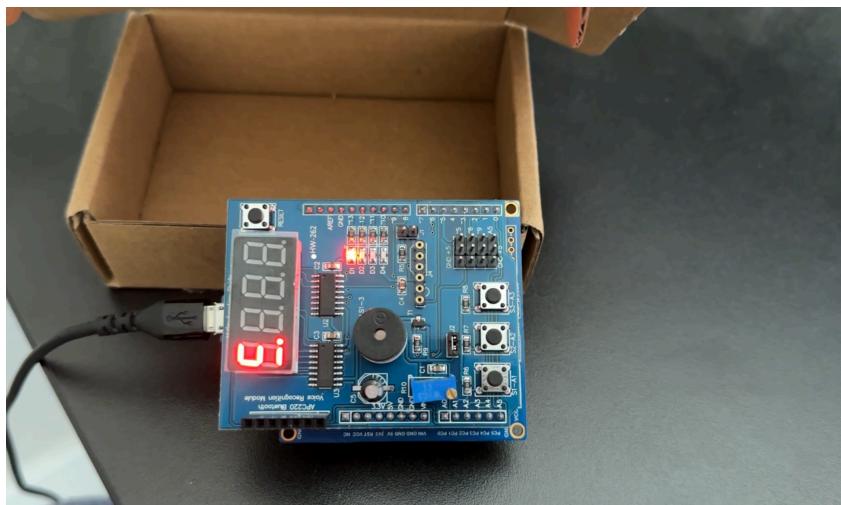
KiCAD Schematics



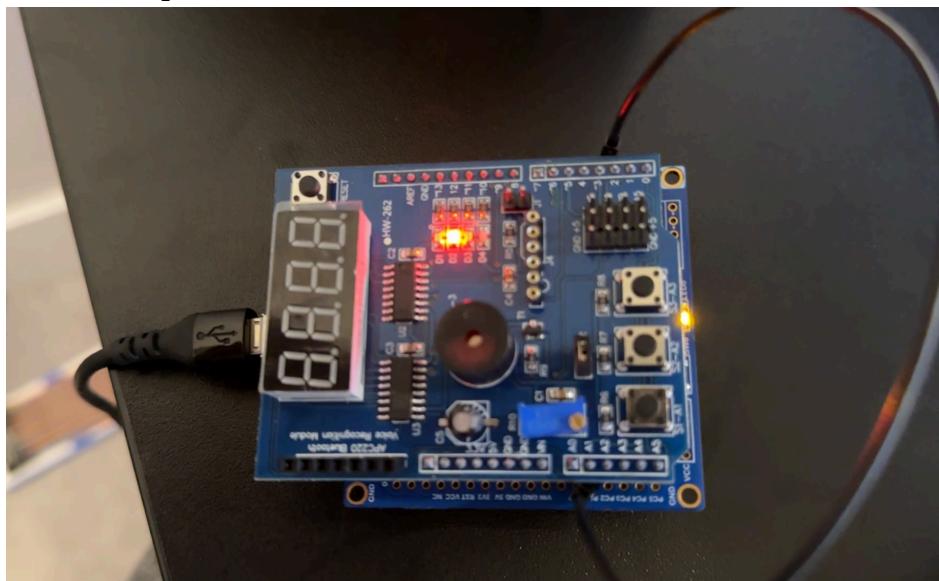
Demo Circuit



Task 2 Output



Task 3 Output



Demo Task 2: <https://youtu.be/UqHTsKzVSrE>

Demo Task 3: https://youtu.be/h1x53dIF_8U

Github: <https://github.com/n8ramos/atmega328pb>