

# Design Assignment 2

---

Student Name: David Lenzin

Student #: 2001654470

Student Email: lenzin@unlv.nevada.edu

Primary Github address: <https://github.com/dlenzin15/submissions>

Directory: submissions/DA2

Submit the following for all Labs:

1. In the document, for each task submit the modified or included code (only) with highlights and justifications of the modifications. Also, include the comments.
2. Use the previously create a Github repository with a random name (no CPE/301, Lastname, Firstname). Place all labs under the root folder ESD301/DA, sub-folder named LABXX, with one document and one video link file for each lab, place modified asm/c files named as LabXX-TYY.asm/c.
3. If multiple asm/c files or other libraries are used, create a folder LabXX-TYY and place these files inside the folder.
4. The folder should have a) Word document (see template), b) source code file(s) and other include files, c) text file with youtube video links (see template).

## 1. COMPONENTS LIST AND CONNECTION BLOCK DIAGRAM w/ PINS

Atmega328PB board was used. No other hardware was introduced. See schematic below for pin layout.

## 2. INITIAL/MODIFIED/DEVELOPED CODE OF TASK 2

Insert initial code here:

C Code:

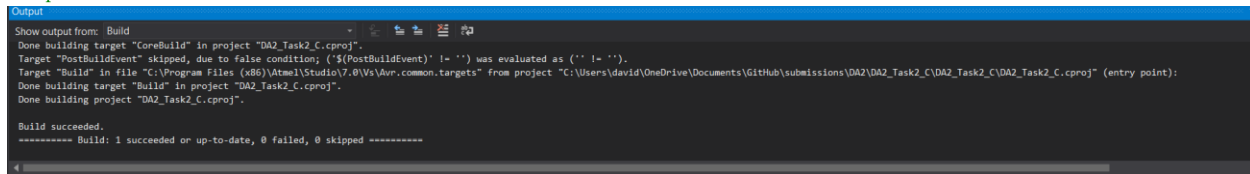
```
/*
 * DA2_Task2_C.c
 *
 * Created: 3/6/2023 7:29:13 PM
 * Author : david
 */

#define F_CPU 16000000UL
#include <avr/io.h>
#include <util/delay.h>

int main(void)
{
    DDRC &= ~(1<<1); //Set PC5 to an input, which is connected to switch 1
    PORTC |= (1<<1);    //Pull-up resistor

    DDRB |= (1<<5); //Set PB5 as an output, which is connected to LED
    PORTB |= (1<<5); //Initially turn LED off
    while (1)
    {
        if (!(PINC & (1 << 1))) { //If switch is pressed
            PORTB &= ~(1 << 5); //Turn on LED
            _delay_ms(1750); //Delay for 1.75 seconds
            PORTB |= (1 << 5); //Turn off the LED
        }
        PORTB |= (1 << 5); //Keep the LED to off if button not pressed
    }
}
```

Compilation:



Output

Show output from: Build

Done building target "CoreBuild" in project "DA2\_Task2\_C.cproj".

Target "PostBuildEvent" skipped, due to false condition; ('\$(PostBuildEvent)' != '') was evaluated as ('' != '').

Target "Build" in file "C:\Program Files (x86)\Atmel\Studio7.0\Vs\Avr.common.targets" from project "C:\Users\david\OneDrive\Documents\GitHub\submissions\DA2\DA2\_Task2\_C\DA2\_Task2\_C.cproj" (entry point):

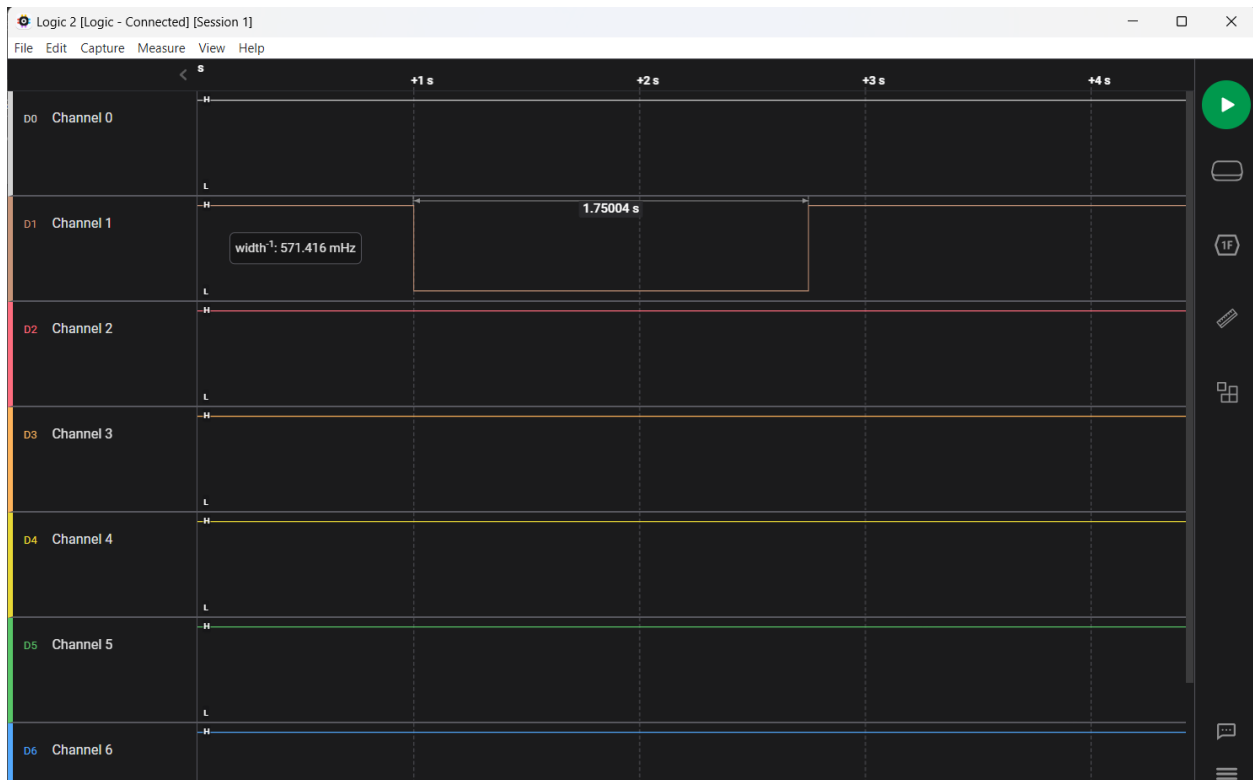
Done building target "Build" in project "DA2\_Task2\_C.cproj".

Done building project "DA2\_Task2\_C.cproj".

Build succeeded.

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

Waveform:



#### Assembly Code:

```
;
; DA2_Task2_Assembly.asm
;
; Created: 3/6/2023 9:39:36 PM
; Author : david
;

.include "m328pbdef.inc"    ; Include the header file for the Atmega328PB board

ldi r16, (1<<5)
out DDRB, r16                ; Set PB5 as an output
out PORTB, r16               ; Initially turn off the LED

loop:
    sbis PINC, 1              ; check if switch at PC1 is pressed
    rjmp led_on              ; jump to button_pressed if it is
    rjmp loop                 ; Loop forever

led_on:
    ldi r16, ~(1<<5)          ; Turn on the LED
    out PORTB, r16
    rjmp delay                ; Jump to delay function

delay:                        ; Delay function to generate a delay of 1.75
seconds
    ldi r21, 143
    ldi r22, 12
    ldi r23, 66
L1: dec r23
```

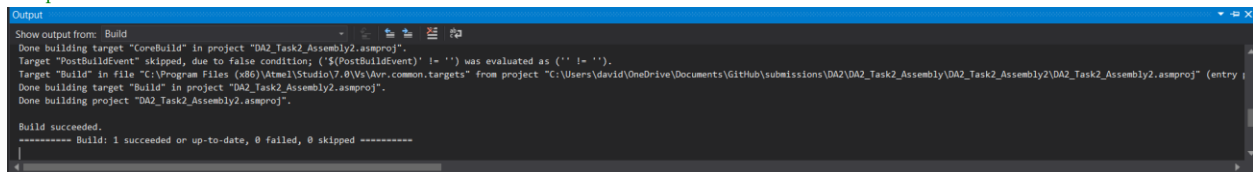
```

brne L1
dec r22
brne L1
dec r21
brne L1

ldi r16, (1<<5)           ; Turn off the LED
out PORTB, r16
rjmp loop                 ; Return to loop

```

### Compilation:



Output

Show output from: Build

Done building target "CoreBuild" in project "DA2\_Task2\_Assembly2.asmproj".

Target "PostBuildEvent" skipped, due to false condition; ('\${PostBuildEvent}' != '') was evaluated as ('' != '').

Target "Build" in file "C:\Program Files (x86)\Atmel\Studio7.0\Vs\Avr.common.targets" from project "C:\Users\david\OneDrive\Documents\GitHub\submissions\DA2\DA2\_Task2\_Assembly2\DA2\_Task2\_Assembly2.asmproj" (entry point "Build" in project "DA2\_Task2\_Assembly2.asmproj").

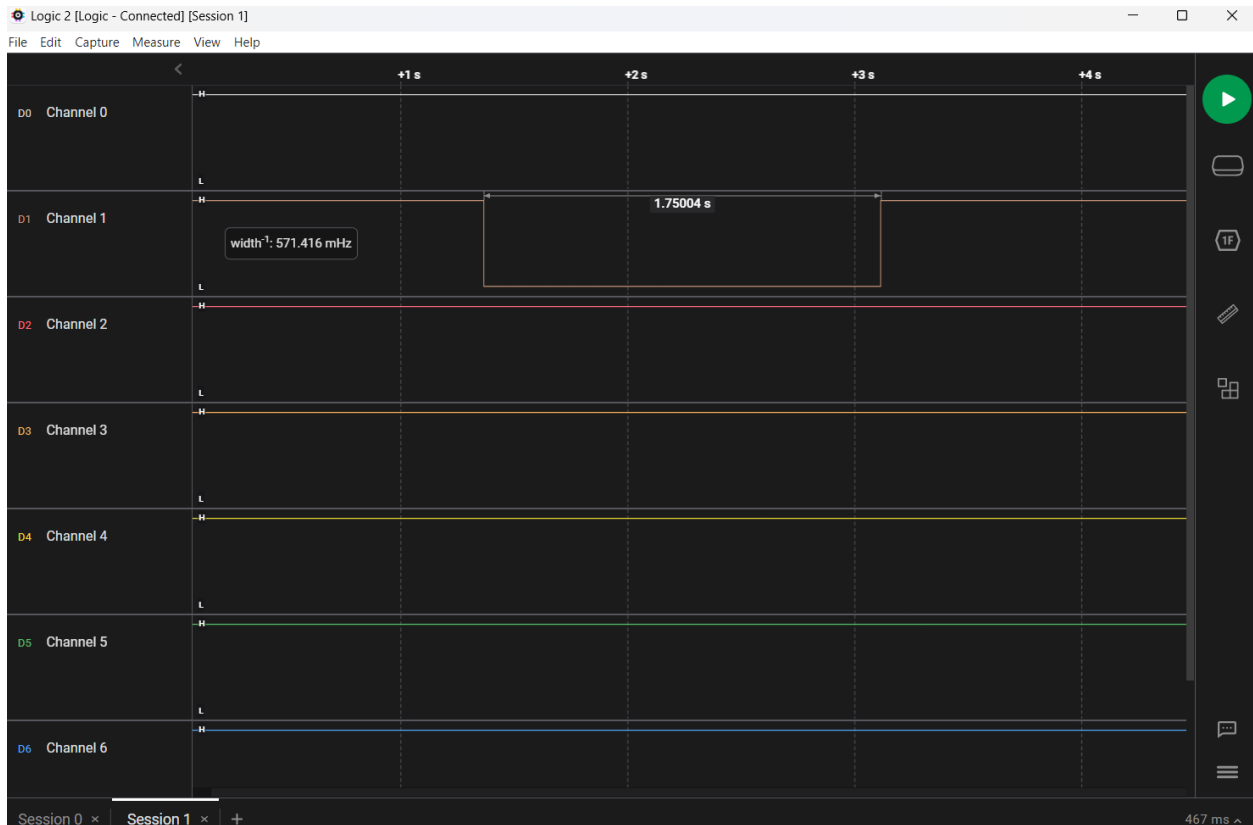
Done building target "Build" in project "DA2\_Task2\_Assembly2.asmproj".

Done building project "DA2\_Task2\_Assembly2.asmproj".

Build succeeded.

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

### Waveform:



## 3. DEVELOPED MODIFIED CODE OF TASK 3

Insert only the modified sections here

C Code:

```

/*
 * DA2_Task3_C.c
 *
 * Created: 3/6/2023 8:36:47 PM
 * Author : david
 */

#define F_CPU 16000000UL
#include <avr/io.h>
#include <util/delay.h>
#include <avr/interrupt.h>

ISR(INT0_vect) {
    PORTB &= ~(1<<5);    //Turn LED on
    _delay_ms(3500);      //Delay for 3.5 seconds
    PORTB |= (1<<5);      //Turn LED off
}

int main(void)
{
    PORTD |= (1<<2);      //Activate Pull-up resistor for INT0 pin

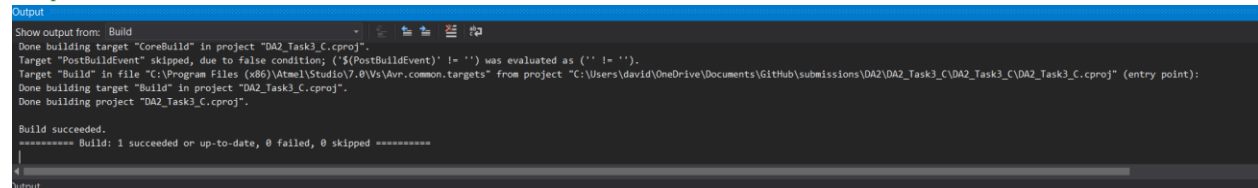
    DDRB |= (1<<5); //Set PB5 as an output, which is connected to LED
    PORTB |= (1<<5); //Initially turn LED off

    EIMSK = (1 << INT0); //Enable interrupts on external pin INT0
    EICRA = 0x03; //The rising edge of INT0 generate an interrupt request
    sei(); //Enable interrupts

    while (1);
}

```

### Compilation:



Output

Show output from: Build

Done building target "CoreBuild" in project "DA2\_Task3\_C.cproj".

Target "PostBuildEvent" skipped, due to false condition; ('\${PostBuildEvent}' != '') was evaluated as ('' != '').

Target "Build" in file "C:\Program Files (x86)\Atmel\Studio7.0\Vs\Avr.common.targets" from project "C:\Users\david\OneDrive\Documents\GitHub\submissions\DA2\DA2\_Task3\_C\DA2\_Task3\_C.cproj" (entry point):

Done building target "Build" in project "DA2\_Task3\_C.cproj".

Done building project "DA2\_Task3\_C.cproj".

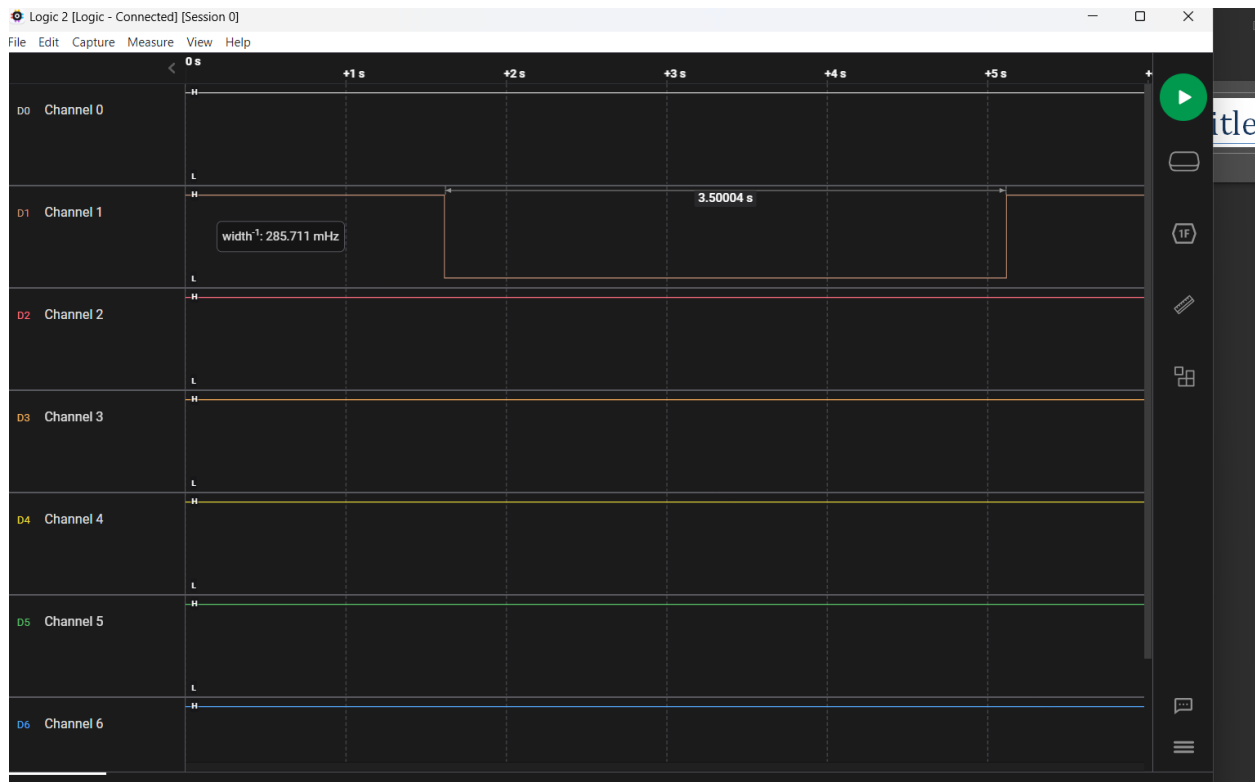
Build succeeded.

\*\*\*\*\* Build: 1 succeeded or up-to-date, 0 failed, 0 skipped \*\*\*\*\*

|

Output

### Waveform:



Assembly:

```
;
; DA2_Task3_Assembly.asm
;
; Created: 3/7/2023 9:04:30 PM
; Author : david
;

.equ F_CPU = 16000000
.include "m328pbdef.inc"           ;Include the header file

.org 0x0000
jmp main

.org 0x0002                         ; External interrupt request 0 vector
jmp INT0_ISR

main:
    ldi r16, (1<<5)
    out DDRB, r16                  ; Set PB5 as an output
    out PORTB, r16                 ; Initially turn off the LED

    ldi r17, (1<<2)
    OUT PORTD, r17                 ; Pull up for INTO pin

    ldi r18, (1<<INT0)
    out EIMSK, r18                 ; load the bit mask for INT0 into r16
                                    ; enable interrupts on external pin
INT0

    ldi r18, 0x03                  ; load the value 0x03 into r16
```

```

        sts EICRA, r18                ; set the rising edge of INT0 to
generate an interrupt request

        sei                          ; enable interrupts globally

loop:
        rjmp loop                    ; Infinite Loop

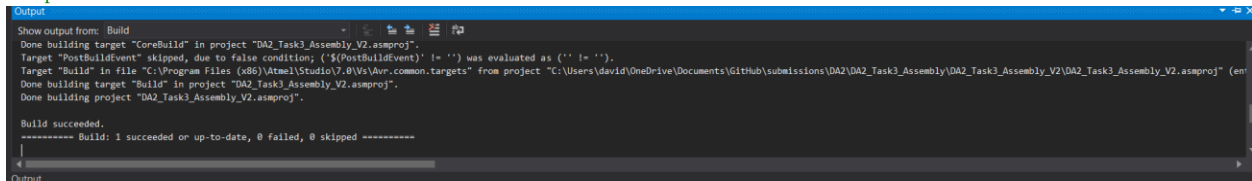
INT0_ISR:
        ldi r16, ~(1<<5)             ; Turn on the LED
        out PORTB, r16

        ; Delay loops to generate a delay of 3.5 seconds
        ldi r21, 2
        ldi r22, 29
        ldi r23, 23
        ldi r24, 133
L1: dec  r24
        brne L1
        dec  r23
        brne L1
        dec  r22
        brne L1
        dec  r21
        brne L1

        ldi r16, (1<<5)              ; Turn off the LED
        out PORTB, r16
        reti                          ; Return from Interrupt

```

#### Compilation:



The screenshot shows the 'Output' window of AVR Studio. It displays the following text:

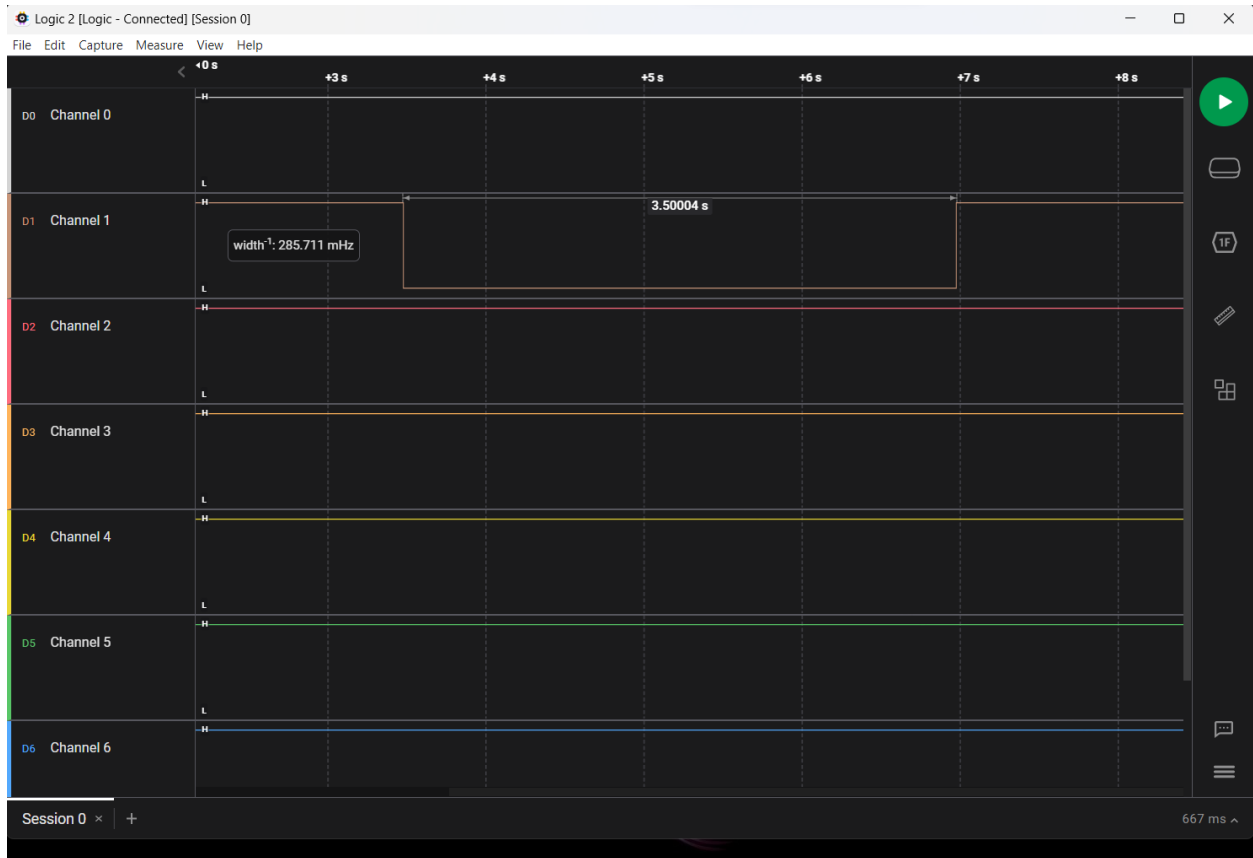
```

Show output from: Build
Done building target "CoreBuild" in project "DA2_Task3_Assembly_V2.asmproj".
Target "PostBuildEvent" skipped, due to false condition; ('$(PostBuildEvent)' != '') was evaluated as ('' != '').
Target "Build" in file "C:\Program Files (x86)\Atmel\Studio\7.0\VsAvr.common.targets" from project "C:\Users\david\OneDrive\Documents\GitHub\submissions\DA2\DA2_Task3_Assembly_V2\DA2_Task3_Assembly_V2.asmproj" (en
Done building target "Build" in project "DA2_Task3_Assembly_V2.asmproj".
Done building project "DA2_Task3_Assembly_V2.asmproj".

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

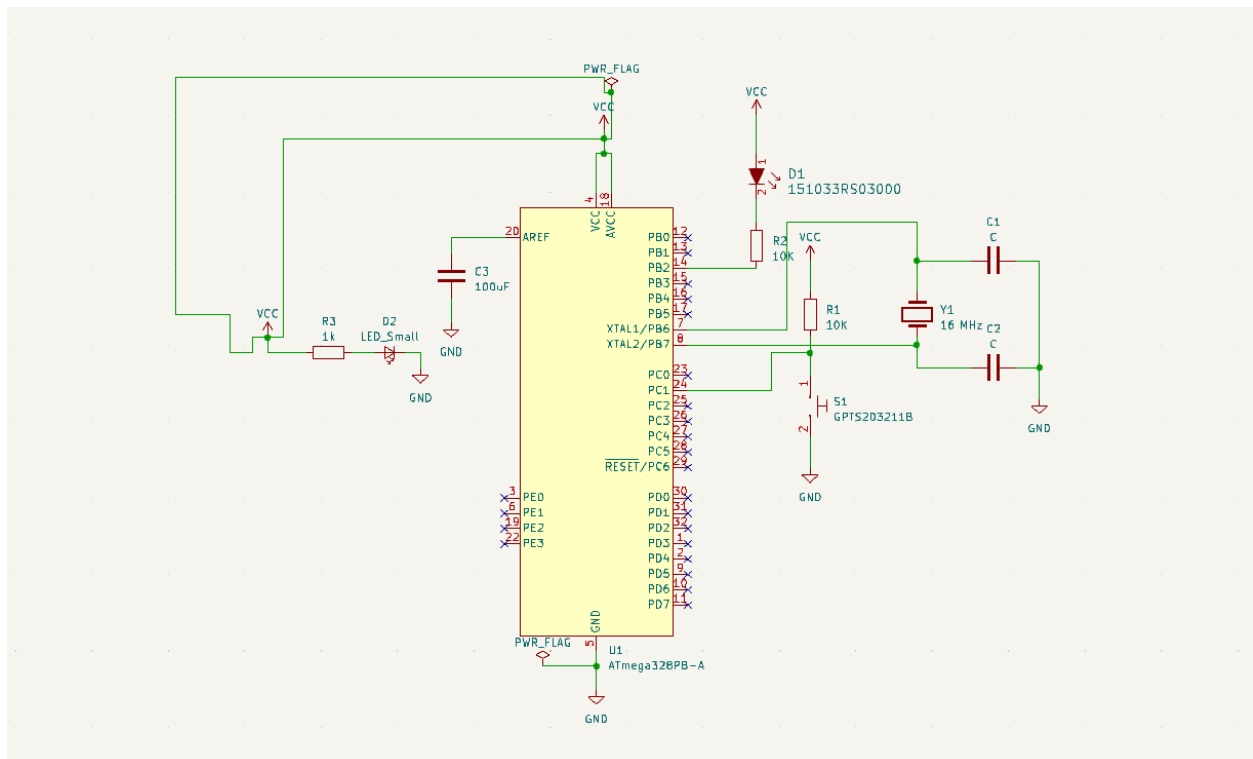
```

#### Waveform:



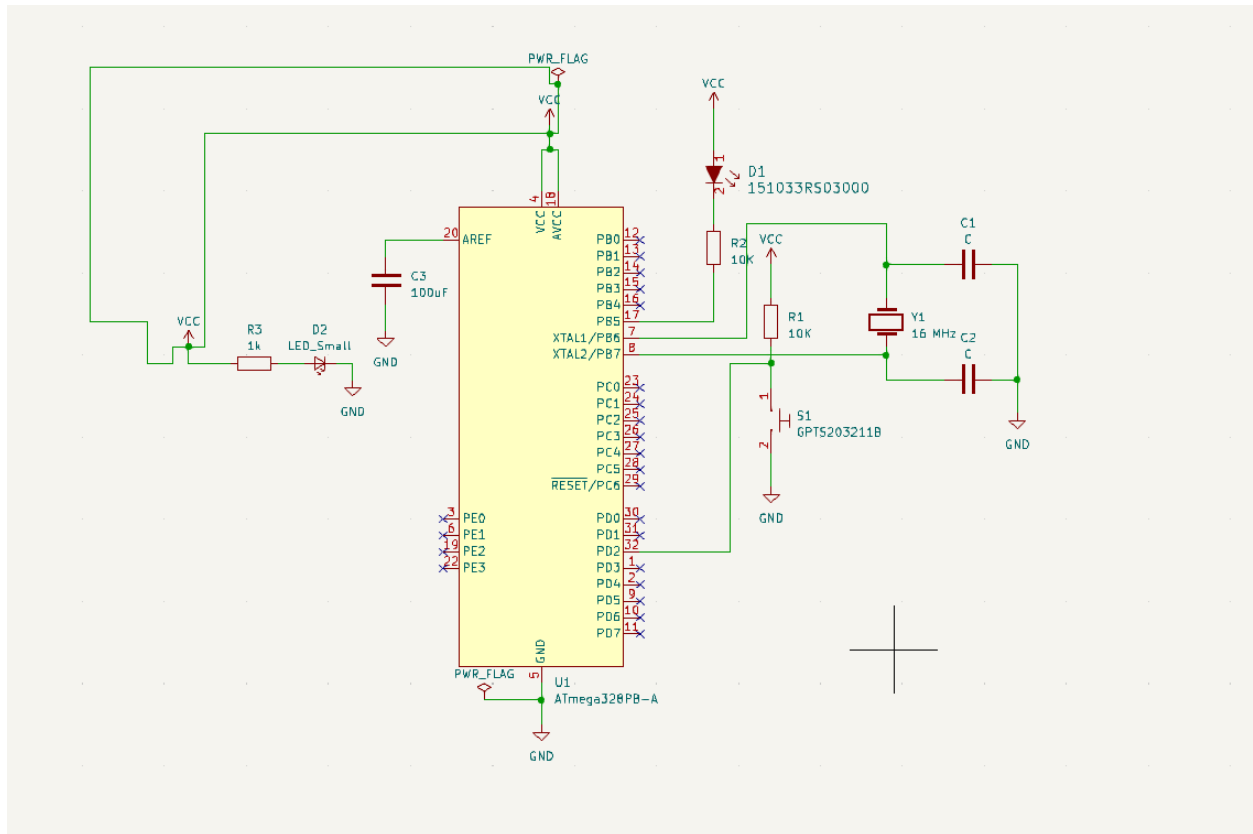
## 4. SCHEMATICS

### Task 2:



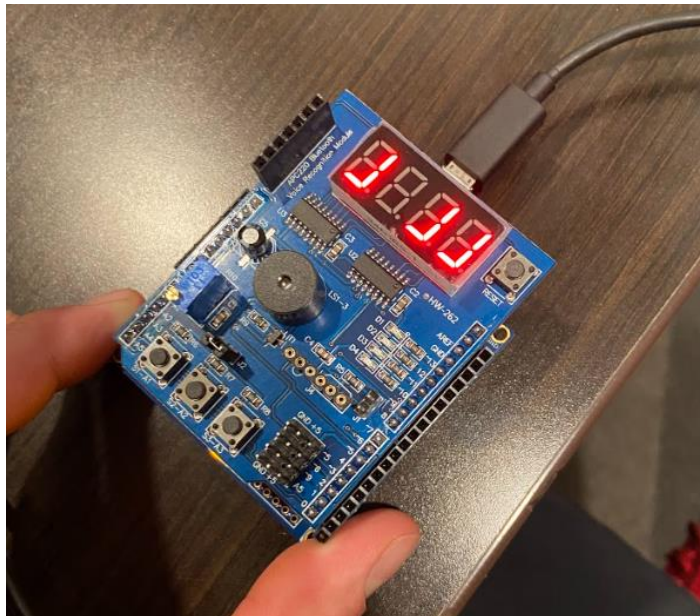


### Task 3:

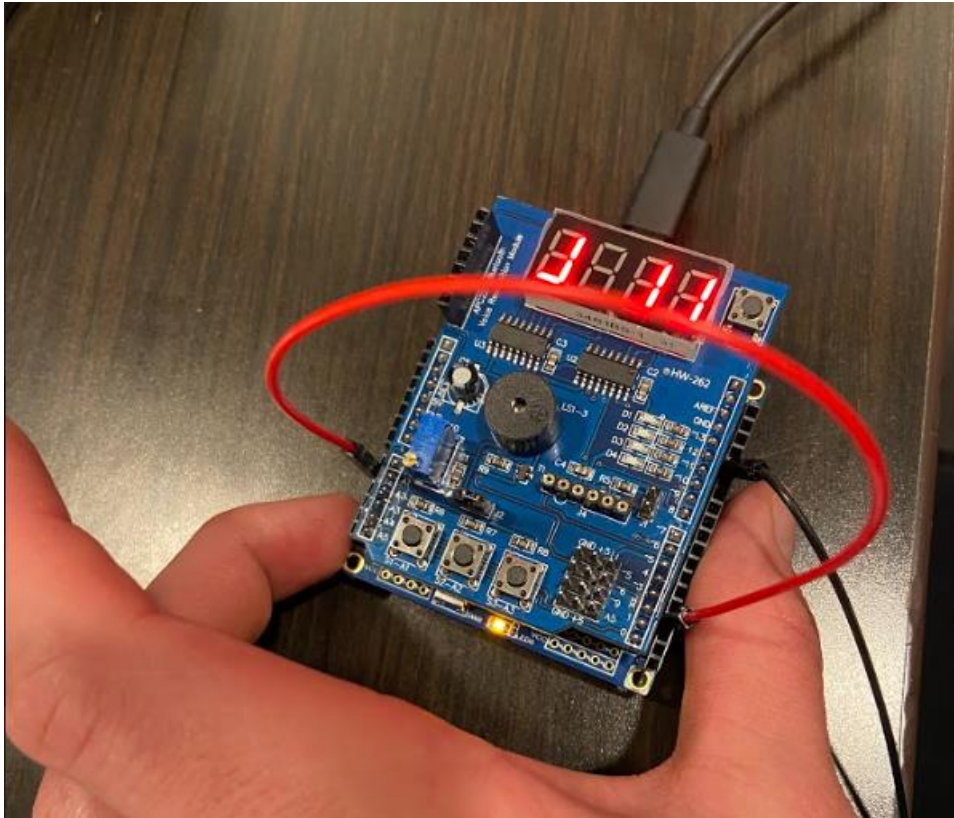


### 5. SCREENSHOT OF EACH DEMO (BOARD SETUP)

#### Task 2:



Task 3:



## 6. VIDEO LINKS OF EACH DEMO

Link to Playlist: <https://www.youtube.com/playlist?list=PLIHKEZIJ23uAW9Wtslh2ZcF6vdceCNBil>

Link to Task 2 C: <https://youtu.be/OvwKFsnboKM>

Link to Task 2 Assembly: [https://youtu.be/ozF4z\\_ViWo8](https://youtu.be/ozF4z_ViWo8)

Link to Task 3 C: <https://youtu.be/cus2H9lzRUw>

Link to Task 3 Assembly: <https://youtu.be/A67nv6Lcltk>

## 7. GITHUB LINK OF THIS DA

<https://github.com/dlenzin15/submissions/tree/main/DA2>

## Student Academic Misconduct Policy

<http://studentconduct.unlv.edu/misconduct/policy.html>

*"This assignment submission is my own, original work".*

NAME OF THE STUDENT