

## Design Assignment 3

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Directory: DesignAssignments/DA3

The goal of the assignment was to use GPIO and delays using Timers and Interrupts.

1. Generate three delays using three timers T0, T1, and T2.
  - a. Implement a delay of 0.333ms using Timer 0 in normal mode. Count OVF occurrence if needed. Do not use interrupts. Turn 'on' PB1 LED (also monitor and verify using logic analyzer) for approx. 1 sec and 'off' for 1 sec.

```
// Configure Timer0
TCNT0 = 0; // for 0.333 sec at 16 MHz
TCCR0A = 0x00;
TCCR0B |= (1<<CS02) | (0<<CS01) | (1<<CS00); // Normal mode with 1024 prescaler
TOV0_count = 0; // OVF count
```

```
while(1)
{
    while ((TIFR0 & 0x01) == 0)
    {
        // wait here for overflow flag
    };
    TCNT0 = 0x00; // Reset timer 0
    TIFR0 = 0x01; // clear timer0 overflow flag (write logic 1)
    TOV0_count++;
    if (TOV0_count==20)
    {
        PORTB ^= (0x01 << LEDA); // toggle our LED
        TOV0_count=0; // Reset count
    }
}
```

- b. Implement a delay of 0.999ms using Timer 1 TIMER1\_OVF\_vect interrupt mechanism in normal mode. Count OVF occurrence if needed in the IRQ subroutine. Turn 'on' PB3 LED (also monitor and verify using logic analyzer) for approx. 1 sec and 'off' for 1 sec.

```
ISR (TIMER1_OVF_vect)
{
    PORTB ^= (1 << LEDB); // Toggle our LED
    TCNT1 = 49926; // for 0.999 sec at 16 MHz (65536 - (16 MHz / 1024)*0.999)
```

```
}
```

```
// Configure Timer1
TCNT1 = 49926; // for 0.999 sec at 16 MHz
TCCR1A = 0x00;
TCCR1B |= (1<<CS12) | (0<<CS11) | (1<<CS10); // Normal mode with 1024 prescaler
TIMSK1 |= (1<<TOIE1); // Set timer interrupt
```

- c. Implement a delay of 0.666ms using Timer 2 TIMER2\_COMPA\_vect interrupt mechanism in CTC mode. Count OVF occurrence if needed in the IRQ subroutine. Turn 'on' PB2 LED (also monitor and verify using logic analyzer) for approx. 1.333 sec and 'off' for 1.333 sec.

```
ISR (TIMER2_COMPA_vect)
{
    COMPA_count++; // 16 MHz / (1024 + 1+255)*0.666 = 40.65 compare matches
    if (COMPA_count == 40)
    {
        TCNT2 = 166; // Adjusted final cycle
    }
    if (COMPA_count == 41)
    {
        PORTB ^= (1 << LEDC); // Toggle our LED
        COMPA_count = 0; // Reset OVF counter
        TCNT2 = 0; // Reset timer2 clock
    }
}
```

```
// Configure Timer2
TCNT2 = 0;
OCR2A = 255;
TCCR2A |= (1<<WGM21) | (0<<WGM20); // CTC mode
TCCR2B |= (0<<WGM22) | (1<<CS22) | (1<<CS21) | (1<<CS20); // Prescaler to 1024
TIMSK2 |= (1<<OCIE2A); // Set timer interrupt
COMPA_count = 0; // Compare match count
```

### Schematic Section

The schematics for this assignment are simply three LED and 1k Ohm resistor pairs connected in series from the board to ground.

### Video Links

<https://youtube.com/shorts/qPUMeW9Mpbw?feature=share>

## Captures

