DIGITAL ELECTRONICS 2 LAB ASSIGNMENT 5

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1)

Digit	A	B	C	D	E	F	G	DP
0	0	0	0	0	0	0	1	1
1	1	0	0	1	1	1	1	1
2	0	0	1	0	0	1	0	1
3	0	0	0	0	1	1	0	1
4	1	0	0	1	1	0	0	1
5	0	1	0	0	1	0	0	1
6	0	1	0	0	0	0	0	1
7	0	0	0	1	1	1	1	1
8	0	0	0	0	0	0	0	1
9	0	0	0	0	1	0	0	1

In Common Cathode, as you can understand from the name, for all the leds cathode terminal is same(common).

And in Common Anode this time for the all leds, anode terminal is same(common).

2) <u>Segment.c:</u>

```
/* Includes ------------------------------------------------------------*/
#define F_CPU 16000000
#include <util/delay.h>
#include "gpio.h"
#include "segment.h"

/* Variables -----------------------------------------------------------*/
// Active-low digit 0 to 9
uint8_t segment_value[] = {
       // abcdefgDP
       0b00000011,     // Digit 0
       0b10011111,     // Digit 1
       0b00100101,     // Digit 2
       0b00001101,     // Digit 3
       0b10011001,     // Digit 4
       0b01001001,          // Digit 5
       0b01000001,          // Digit 6
       0b00011111,          // Digit 7
```

```
        0b00000001,          // Digit 8
        0b00001001           // Digit 9
};

// Active-high position 0 to 3
uint8_t segment_position[] = {
        // p3p2p1p0....
        0b00010000,     // Position 0
        0b00100000,     // Position 1
        0b01000000,     // Position 2
        0b10000000           // Position 3
};

/* Function definitions ----------------------------------------------*/
void SEG_init(void)
{
    /* Configuration of SSD signals */
    GPIO_config_output(&DDRD, SEGMENT_LATCH);
    GPIO_config_output(&DDRD, SEGMENT_CLK);
    GPIO_config_output(&DDRB, SEGMENT_DATA);
}

/*-------------------------------------------------------------------------*/
void SEG_update_shift_regs(uint8_t segments, uint8_t position, uint8_t
input_type)
{
    uint8_t bit_number;

       if(input_type == 1) {
              // Getting segment and position values from the arrays
              segments = segment_value[segments];     // 0, 1, ..., 9
              position = segment_position[position];  // 0, 1, 2, 3
       }

    // Pull LATCH, CLK, and DATA low
       GPIO_write_low(&PORTD, SEGMENT_LATCH);  // LATCH
       GPIO_write_low(&PORTD, SEGMENT_CLK);    // CLK
       GPIO_write_low(&PORTB, SEGMENT_DATA);    // DATA

    // Wait 1 us
       _delay_us(1);

    // Loop through the 1st byte (segments)
    // a b c d e f g DP (active low values)
    for (bit_number = 0; bit_number < 8; bit_number++)
    {
        // Output DATA value (bit 0 of "segments")
              if((segments % 2) == 0) // LSB is 0
                     GPIO_write_low(&PORTB, SEGMENT_DATA);
              else
                     GPIO_write_high(&PORTB, SEGMENT_DATA);

        // Wait 1 us
              _delay_us(1);
        // Pull CLK high
              GPIO_write_high(&PORTD, SEGMENT_CLK);
        // Wait 1 us
              _delay_us(1);
        // Pull CLK low
              GPIO_write_low(&PORTD, SEGMENT_CLK);

        // Shift "segments"
```

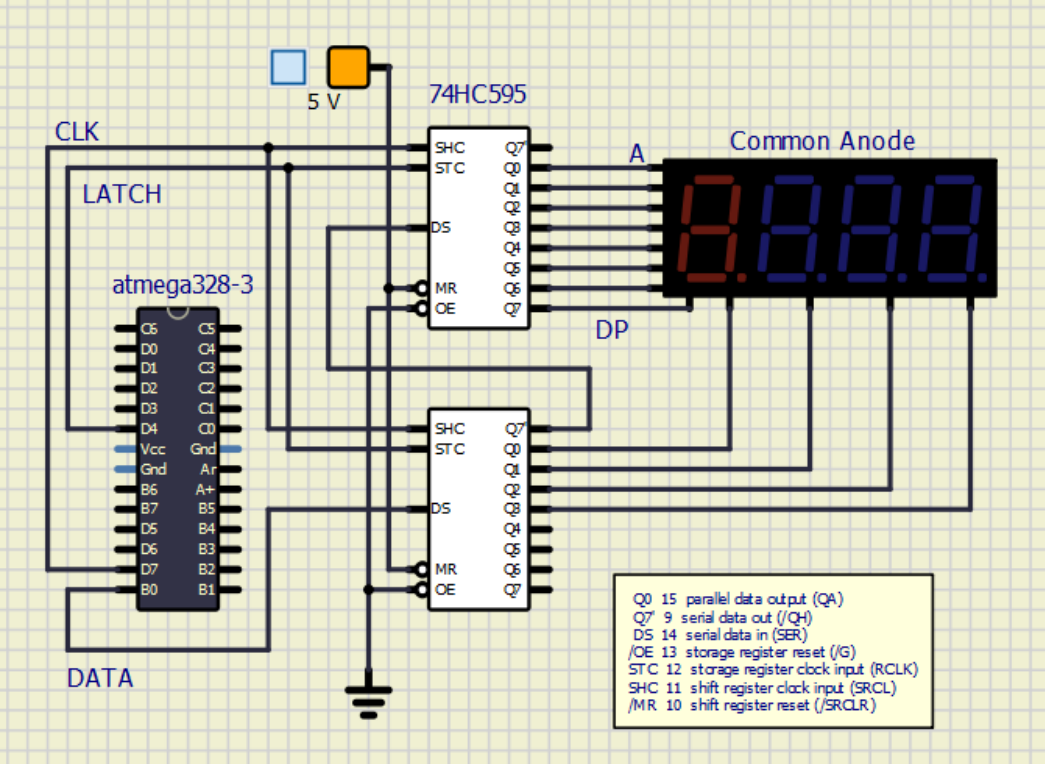
```
        segments = segments >> 1;
    }

    // Loop through the 2nd byte (position)
    // p3 p2 p1 p0 . . . . (active high values)
    for (bit_number = 0; bit_number < 8; bit_number++)
    {
        // Output DATA value (bit 0 of "position")
              if((position % 2) == 0) // LSB is 0
                     GPIO_write_low(&PORTB, SEGMENT_DATA);
              else
                     GPIO_write_high(&PORTB, SEGMENT_DATA);

              // Wait 1 us
              _delay_us(1);
              // Pull CLK high
              GPIO_write_high(&PORTD, SEGMENT_CLK);
              // Wait 1 us
              _delay_us(1);
              // Pull CLK low
              GPIO_write_low(&PORTD, SEGMENT_CLK);

        // Shift "position"
        position = position >> 1;
    }

    // Pull LATCH high
       GPIO_write_high(&PORTD, SEGMENT_LATCH);

    // Wait 1 us
       _delay_us(1);

       }
```

main.c:

```
/* Includes ------------------------------------------------------------*/
#include <avr/io.h>         // AVR device-specific IO definitions
#include <avr/interrupt.h>  // Interrupts standard C library for AVR-GCC
#include "timer.h"          // Timer library for AVR-GCC
#include "segment.h"        // Seven-segment display library for AVR-GCC

/* Variables -----------------------------------------------------------*/
uint8_t cnt0 = 0;                  // Decimal counter value for position 0
uint8_t cnt1 = 0;                  // Decimal counter value for position 1

/* Function definitions ------------------------------------------------*/
/**
 * Main function where the program execution begins. Display decimal
 * counter values on SSD (Seven-segment display) when 16-bit
 * Timer/Counter1 overflows.
 */
int main(void)
{
    // Configure SSD signals
    SEG_init();

    // Test of SSD: display number '3' at position 0
    SEG_update_shift_regs(cnt0, 0, 1);
       SEG_update_shift_regs(cnt0, 2, 1);
```

```
    /* Configure 16-bit Timer/Counter1
     * Set prescaler and enable overflow interrupt */
      TIM1_overflow_1s();
      TIM1_overflow_interrupt_enable();

      /* Configure 8-bit Timer/Counter0
     * Set prescaler and enable overflow interrupt */
      TIM0_overflow_4ms();
      TIM0_overflow_interrupt_enable();

    // Enables interrupts by setting the global interrupt mask
      sei();

    // Infinite loop
    while (1)
    {
        /* Empty loop. All subsequent operations are performed exclusively
         * inside interrupt service routines ISRs */
    }

    // Will never reach this
    return 0;
}

/* Interrupt service routines ----------------------------------------*/
ISR(TIMER0_OVF_vect)
{
       static uint8_t pos = 0;

       if(pos == 0) {
              SEG_update_shift_regs(cnt0, pos, 1);
              pos = 1;
       }else {
              SEG_update_shift_regs(cnt1, pos, 1);
              pos = 0;
       }

}
/**
 * ISR starts when Timer/Counter1 overflows. Increment decimal counter
 * value and display it on SSD.
 */
ISR(TIMER1_OVF_vect)
{
    cnt0++;
      if(cnt0 >= 10) {
              cnt0 = 0;

              cnt1++;
              if(cnt1 >= 6)
                     cnt1 = 0;
       }
}
```

Circuit:



3) Look-up table for the snake application:

	Segment Value	Segment Position
Position 0, Led D	0b11101111	0b00010000
Position 0, Led C	0b11011111	0b00010000
Position 0, Led B	0b10111111	0b00010000
Position 0, Led A	0b01111111	0b00010000
Position 1, Led A	0b01111111	0b00100000
Position 1, Led F	0b11111011	0b00100000
Position 1, Led E	0b11110111	0b00100000
Position 1, Led D	0b11101111	0b00100000

main.c:

```
/*
 * snake_application.c
 *
 * Created: 27.10.2020 11:51:05
 * Author : dkorb
 */

/* Includes ----------------------------------------------------------*/
#define F_CPU 16000000
#include <util/delay.h>
#include <avr/io.h>         // AVR device-specific IO definitions
#include "segment.h"        // Seven-segment display library for AVR-GCC
// Note: Specially for this application, "input_type" parameter added to the
//             "SEG_update_shift_regs" function in segment.h, for setting the
//              input type for the function.

/* Variables ---------------------------------------------------------*/

int main(void)
{
       // Configure SSD signals
       SEG_init();

    /* Replace with your application code */
    while (1)
    {
              SEG_update_shift_regs(0b11101111, 0b00010000, 0); // Position 0, Led D
              _delay_ms(250);
              SEG_update_shift_regs(0b11011111, 0b00010000, 0); // Position 0, Led C
              _delay_ms(250);
              SEG_update_shift_regs(0b10111111, 0b00010000, 0); // Position 0, Led B
              _delay_ms(250);
              SEG_update_shift_regs(0b01111111, 0b00010000, 0); // Position 0, Led A
              _delay_ms(250);
              SEG_update_shift_regs(0b01111111, 0b00100000, 0); // Position 1, Led A
              _delay_ms(250);
              SEG_update_shift_regs(0b11111011, 0b00100000, 0); // Position 1, Led F
              _delay_ms(250);
              SEG_update_shift_regs(0b11110111, 0b00100000, 0); // Position 1, Led E
              _delay_ms(250);
              SEG_update_shift_regs(0b11101111, 0b00100000, 0); // Position 1, Led D
              _delay_ms(250);
    }
}
```