Lab assignment 6: LCD

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1. Preparation task:

a) Table with LCD signals

Signal(s)	**Pin(s)**	**Purpose**
RS	PB0	Register selection signal. Selection between *Instruction register* (0) and *Data register* (1)
R/W	GND	Selecting reading or writing. GND means only writing is enabled
E	PB1	Enable signal for communication
D[3:0]	N/A	Data transfer in 8-bit mode.
D[7:4]	PD[7:4]	Data transfer in both 8 and 4-bit modes.

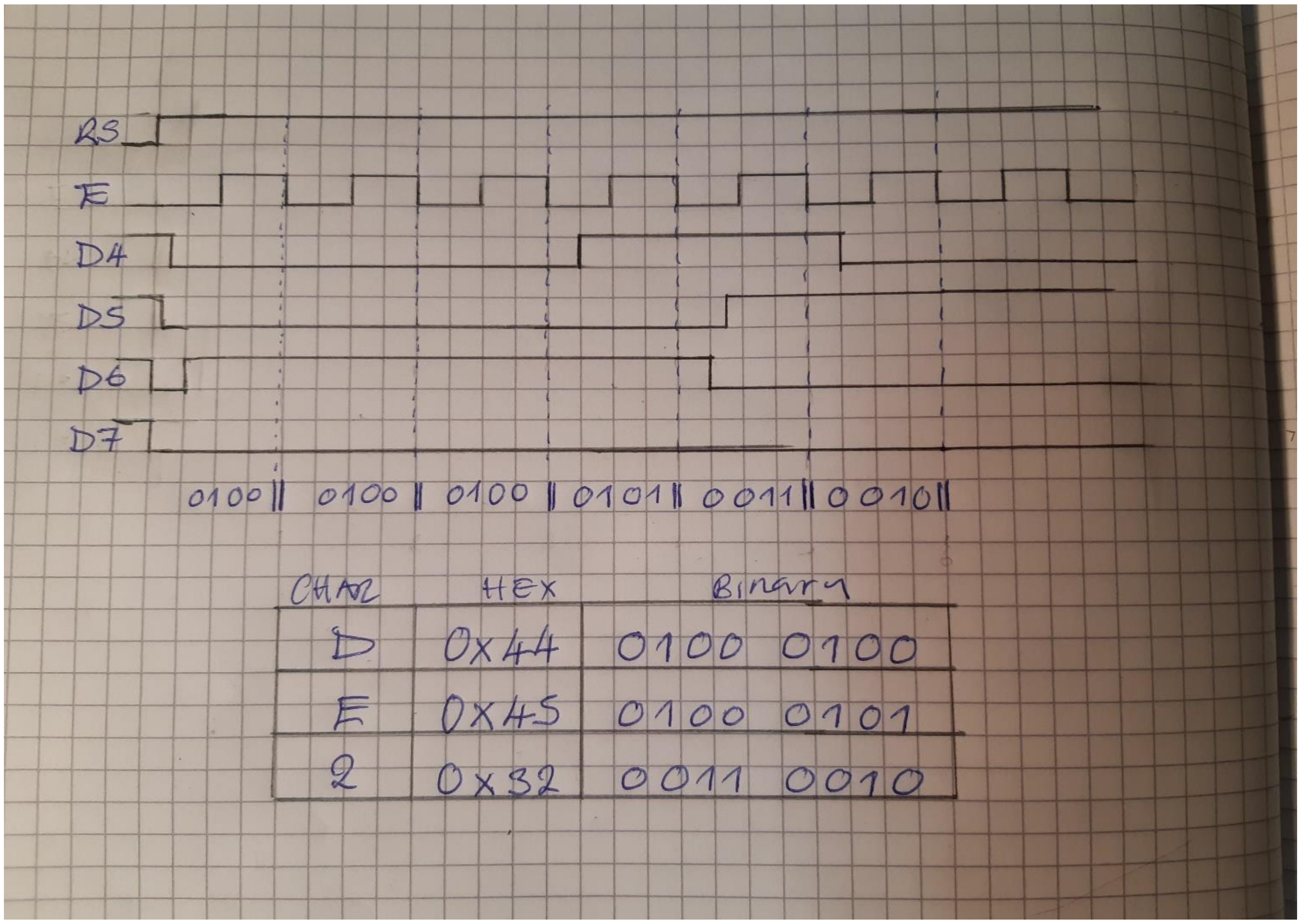
b) ASCII values

CHAR	DEC	HEX	CHAR	DEC	HEX	CHAR	DEC	HEX
0	48	30	A	65	41	a	97	61
1	49	31	B	66	42	b	98	62
2	50	32	C	67	43	c	99	63
3	51	33	D	68	44	d	100	64
4	52	34	E	69	45	e	101	65
5	53	35	F	70	46	f	102	66
6	54	36	G	71	47	g	103	67
7	55	37	H	72	48	h	104	68
8	56	38	I	73	49	i	105	69
9	57	39	J	74	4A	j	106	6A
..	....	....	K	75	4B	k	107	6B
..	....	....	L	76	4C	l	108	6C
..	....	....	M	77	4D	m	109	6D
..	....	....	N	78	4E	n	110	6E
..	....	....	O	79	4F	o	111	6F
..	....	....	P	80	50	p	112	70
..	....	....	Q	81	51	q	113	71
..	....	....	R	82	52	r	114	72
..	....	....	S	83	53	s	115	73
..	....	....	T	84	54	t	116	74
..	....	....	U	85	55	u	117	75
..	....	....	V	86	56	v	118	76
..	....	....	W	87	57	w	119	77
..	....	....	X	88	58	x	120	78
..	....	....	Y	89	59	y	121	79
..	....	....	Z	90	5A	z	122	7A

2. HD44780 communication.

Picture of Time signals between ATmega328p and LCD keypad shield when transmitting “DE2”

DE2 => 0100 0100 _ 0100 0101_0011 0010



CHAR	HEX	Binary
D	0x44	0100 0100
E	0x45	0100 0101
2	0x32	0011 0010

3. STOPWATCH

i) **Listings of TIMER2_OVF_vect**

```
/* Interrupt service routines ----------------------------------------*/
/**
 * ISR starts when Timer/Counter2 overflows. Update the stopwatch on
 * LCD display every sixth overflow, ie approximately every 100 ms
 * (6 x 16 ms = 100 ms).
 */
ISR(TIMER2_OVF_vect)
{
    static uint8_t number_of_overflows = 0;
    static uint8_t tens = 0;        // Tenths of a second
    static uint8_t secs = 0;        // Seconds
       static uint8_t mins = 0;        // Minutes
    char lcd_string[] = "  ";       // String for converting numbers by itoa()
       uint16_t secs_sq = secs*secs;    // Square of seconds

    number_of_overflows++;
    if (number_of_overflows >= 6)
    {
        // Do this every 6 x 16 ms = 100 ms
        number_of_overflows = 0;

              tens++;
              if (tens > 9)
              {
                     tens = 0;
                     secs++;
                     if (secs > 59)
                     {
                            secs = 0;
                            mins++;
                            if (mins > 59)
                            {
                                   mins = 0;
                            }
                     }
              }

              itoa(tens, lcd_string, 10);
              lcd_gotoxy(7, 0);
              lcd_putc(lcd_string[0]);

              // Displaying Seconds
              itoa(secs, lcd_string, 10);
              lcd_gotoxy(4, 0);
              if (secs < 10)
              {
                     lcd_putc('0');
                     lcd_putc(lcd_string[0]);
              }
              else
              {
                     lcd_puts(lcd_string);
              }
```

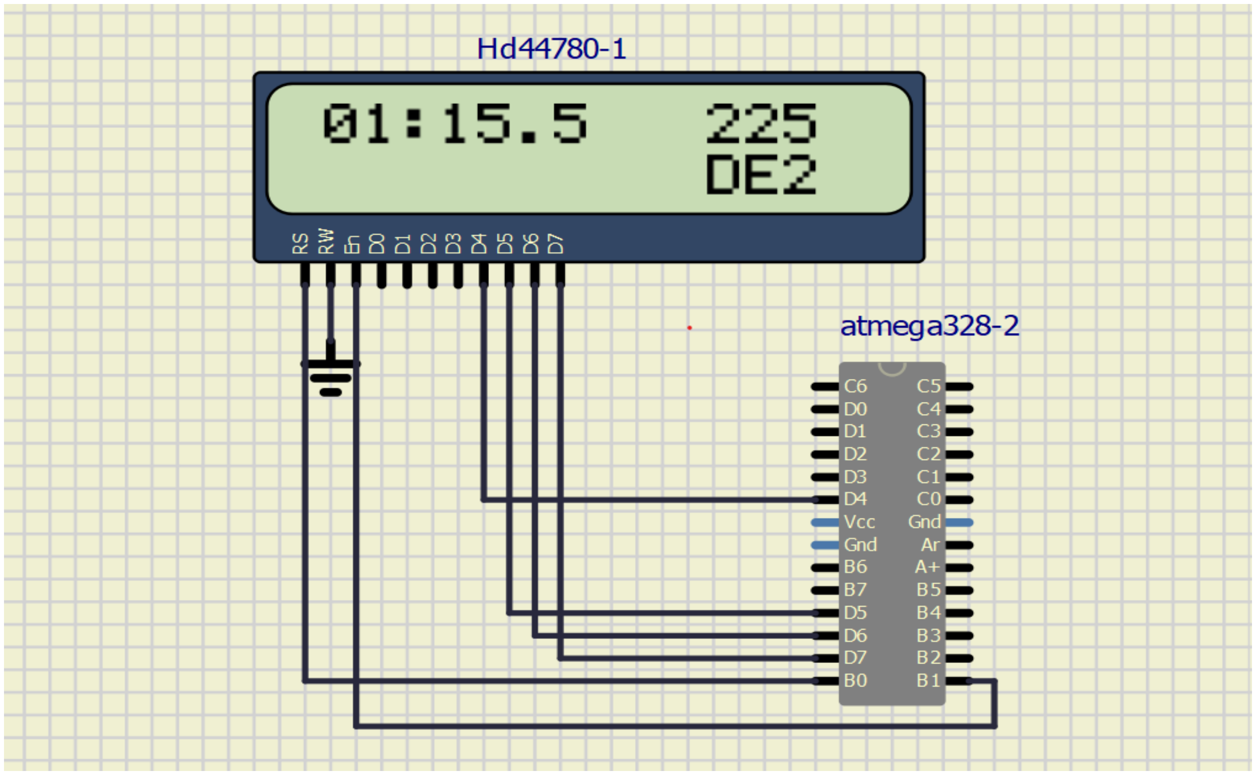
```
            //Displaying minutes
            itoa(mins, lcd_string, 10);
            lcd_gotoxy(1, 0);
            if (mins < 10)
            {
                lcd_putc('0');
                lcd_putc(lcd_string[0]);
            }
            else
            {
                lcd_puts(lcd_string);
            }

            //Displaying square of seconds
            itoa(secs_sq, lcd_string, 10);
            lcd_gotoxy(11, 0);
            lcd_puts(lcd_string);
            if (secs == 0)
            {
                // Clears the position and reset square of secs back to 0
                secs_sq = 0;
                lcd_puts("       ");
            }


    }

}
```

ii) Screenshort of SimulIDE circuit for stopwatch



Hd44780-1
01:15.5   225
            DE2
RS RW En D0 D1 D2 D3 D4 D5 D6 D7
atmega328-2
C6 D0 D1 D2 D3 D4 Vcc Gnd B6 B7 D5 D6 D7 B0
C5 C4 C3 C2 C1 C0 Gnd Ar A+ B5 B4 B3 B2 B1

4. Progress bar

i) Listings of TIMER0_OVF_vect

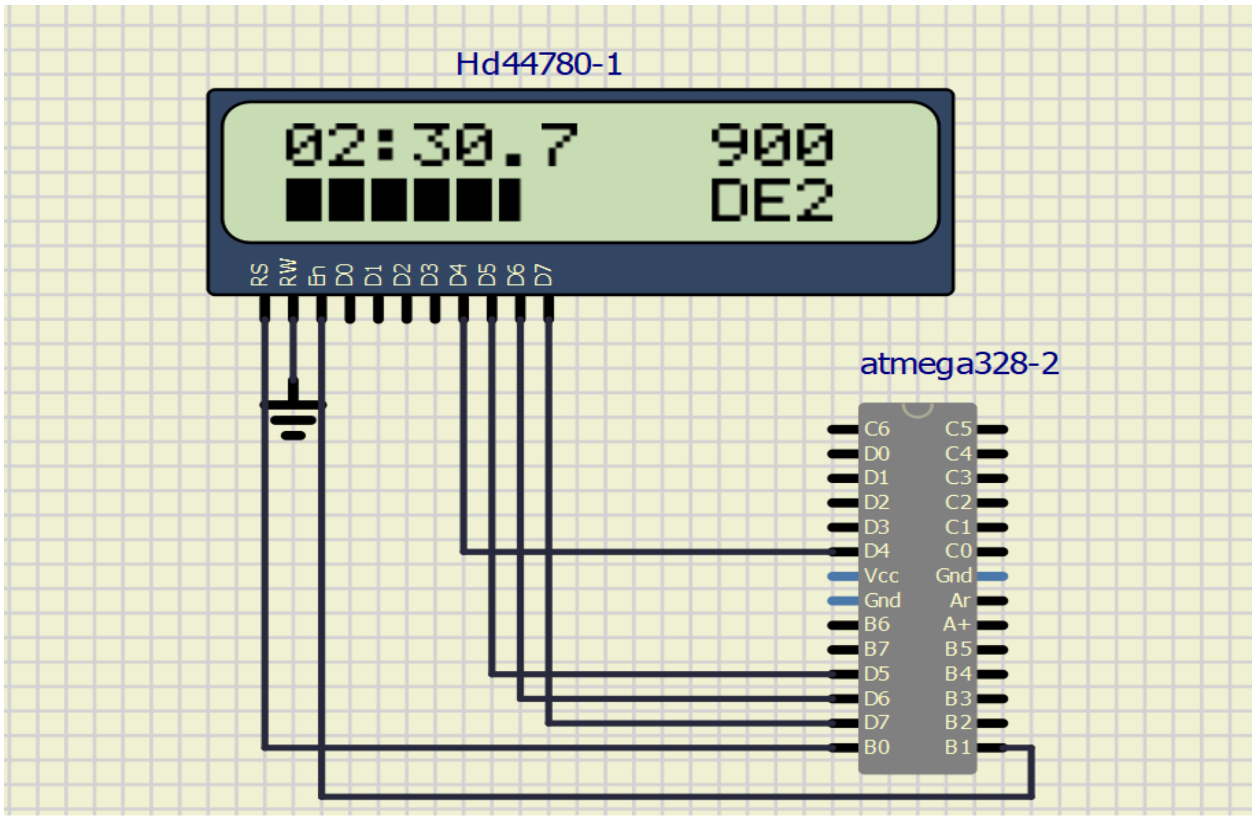
```
/*--------------------------------------------------------------------*/
/**
 * ISR starts when Timer/Counter0 overflows. Update the progress bar on
 * LCD display every 16 ms.
 */
ISR(TIMER0_OVF_vect)
{
        static uint8_t number_of_overflows = 0;
    static uint8_t symbol = 0;
    static uint8_t position = 0;

        number_of_overflows++;
        if (number_of_overflows >=12)  // It takes approximately 12 cycles to fill 1 bar
        {
                number_of_overflows = 0;
                symbol++;
                if(symbol > 5)
                {
                        symbol = 0;
                        position++;
                        if ((position > 7))// Resetting the progress bar when 7th bar filled
                        {
                                position = 0;
                                lcd_gotoxy(1, 1);
                                lcd_puts("         ");

                        }
                }
        }

        lcd_gotoxy(1 + position, 1);
        lcd_putc(symbol);
}
```

ii) Circuit simulation when with progress bar.



Link to repository:

https://github.com/Masauso-L/Digital-electronics-2/tree/master/Labs/06-lcd

https://github.com/Masauso-L/Digital-electronics-2/tree/master/Homework/Task-6