Lab 7: ADC, serial communication, UART

Lab prerequisites

Connection of five push buttons: Select, Left, Up, Down, and Right on LCD keypad shield

All buttons have common ground and are connected to a signle pin through voltage divider. Which button is pressed is distinguished by the voltage on the output pin.

Voltage value on pin PC0[A0] if one button is pressed at a time

Push button	PC0[A0] voltage	ADC value (calculated)	ADC value (measured)
Right	0 V	0	
Up	0.495 V	101	
Down	1.203 V	246	
Left	1.969 V	402	
Select	3.182 V	651	
none	5 V	1023	

Table for ADC converter register

Operation	Register(s)	Bit(s)	Description
Voltage reference	ADMUX	REFS1:0	01: AVcc voltage reference, 5V
Input channel	ADMUX	MUX3:0	0000: ADC0, 0001: ADC1, ...
ADC enable	ADCSRA	ADEN	1: ADC Enable, 0: ADC Disable
Start conversion	ADCSRA	ADSC	1:Start conversion, when conversion complete, returns to zero
ADC interrupt enable	ADCSRA	ADIE	1: first bit in SREG is set and the ADC Conversion Complete Interrupt is activated
ADC clock prescaler	ADCSRA	ADPS2:0	000: Division factor 2, 001: 2, 010: 4, ...
ADC result	ADC	ADCL7:0 and ADCH7:0	conversion result

UART description table

Function name	Function parameters	Description	Example

Function name	Function parameters	Description	Example
`uart_init`	`UART_BAUD_SELECT(9600, F_CPU)`	Initialize UART to 8N1 and set baudrate to 9600 Bd	`uart_init(UART_BAUD_SELECT(9600, F_CPU));`
`uart_getc`	void	Get received byte from ringbuffer	`uart_getc();`
`uart_putc`	data(byte)	Put byte to ring buffer	`uart_putc('c');`
`uart_puts`	pointer to string	Put string to ringbuffer	`uart_puts(lcd_string);`

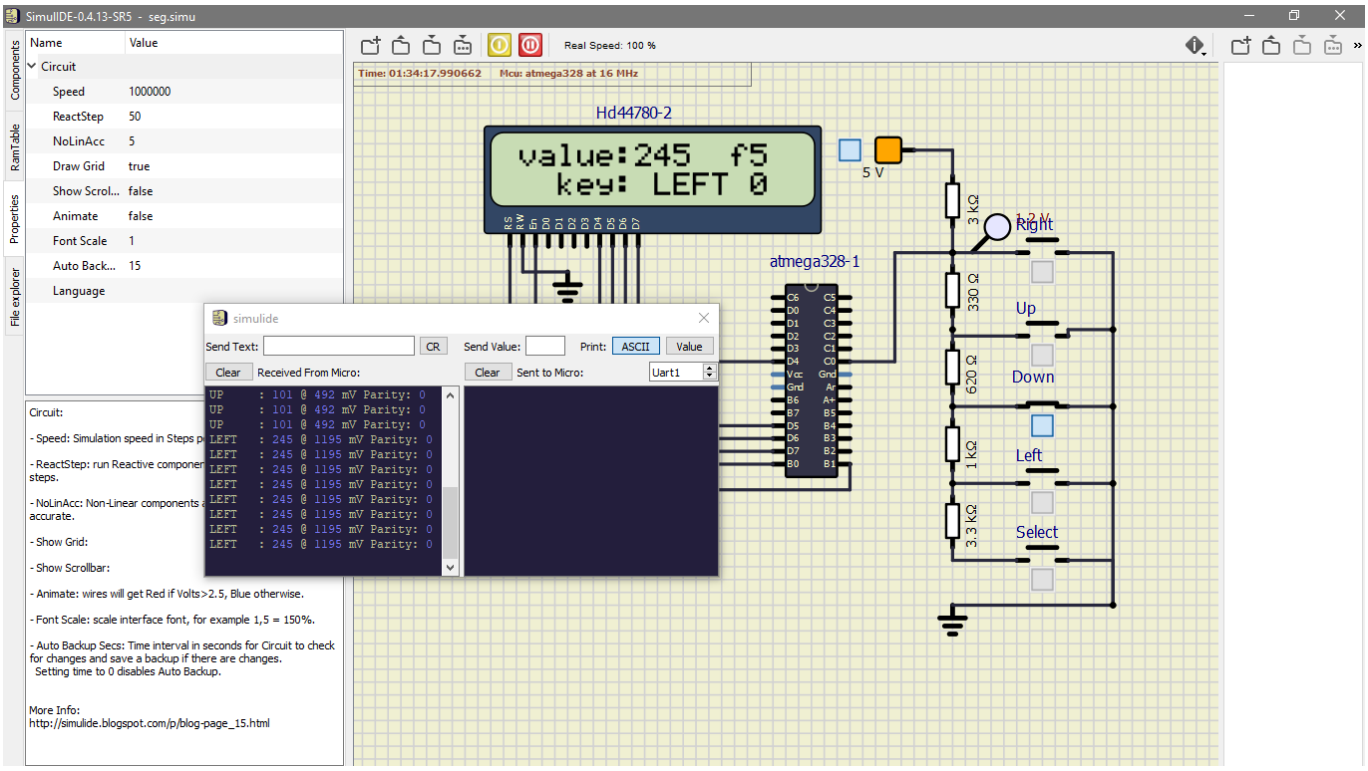
Listing of `ADC_vector` interrupt routine

```
ISR(ADC_vect)
{
     static char buttons[5][7] =
    {
        "RIGHT ",
        "UP    ",
        "LEFT  ",
        "DOWN  ",
        "SELECT"
    };
    static char current_button[7];
    uint16_t value = 0;
    char lcd_string[4] = "    ";
    value = ADC;    // Copy ADC result to 16-bit variable
    lcd_gotoxy(7, 0);
    lcd_puts(lcd_string);
    itoa(value, lcd_string, 10);    // Convert to string in decimal
    lcd_gotoxy(7, 0);
    lcd_puts(lcd_string);
    lcd_gotoxy(12, 0);
    lcd_puts("   ");
    lcd_gotoxy(12, 0);
    itoa(value, lcd_string, 16);
    lcd_puts(lcd_string);
    if(value < 50)
    {
        for(int i = 0; i <= 7; i++)
        {
        current_button[i] = buttons[0][i];
        }
    }
    else if((value > 50) && (value < 180))
    {
```

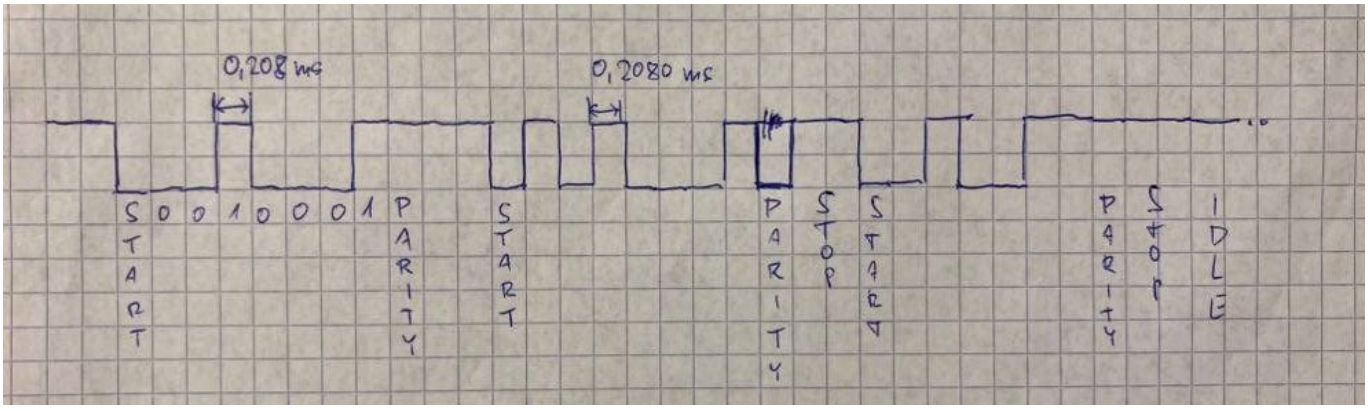
```
        for(int i = 0; i <= 7; i++)
        {
            current_button[i] = buttons[1][i];
        }
    }
    else if((value > 180) && (value < 300))
    {
        for(int i = 0; i <= 7; i++)
        {
            current_button[i] = buttons[2][i];
        }
    }
    else if((value > 300) && (value < 500))
    {
        for(int i = 0; i <= 7; i++)
        {
            current_button[i] = buttons[3][i];
        }
    }
    else if((value > 500) && (value < 800))
    {
        for(int i = 0; i <= 7; i++)
        {
            current_button[i] = buttons[4][i];
        }
    }
    else
    {
        for(int i = 0; i <= 7; i++)
        {
            current_button[i] = ' ';
        }
    }
    uint16_t Voltage = value * 4.88;
    lcd_gotoxy(8, 1);
    lcd_puts(current_button);
    if(value < 1010)
    {
        uart_puts(current_button);
        uart_puts(" : ");
        itoa(value, lcd_string, 10);
        uart_puts(lcd_string);
        uart_puts(" @ ");
        itoa(Voltage, lcd_string, 10);
        uart_puts(lcd_string);
        uart_puts(" mV");
        uart_puts(" Parity: ");
        uint8_t parity = func_parity(value);
        lcd_gotoxy(13, 1);
        itoa(parity, lcd_string, 2);
        lcd_puts(lcd_string);
        uart_puts(lcd_string);
        uart_puts("\r\n");
```

```
        }
    }
```

Screenshot of SimulIDE:



Hand drawn picture of UART signal



Listing of code for calculating parity bit (displaying is in part above)

```
int8_t func_parity( uint16_t n)
{
    uint8_t parity = 0;
    while(n)
    {
        parity = !parity;
        n = n & (n-1);
    }
```

```
        return parity;
    }
```