

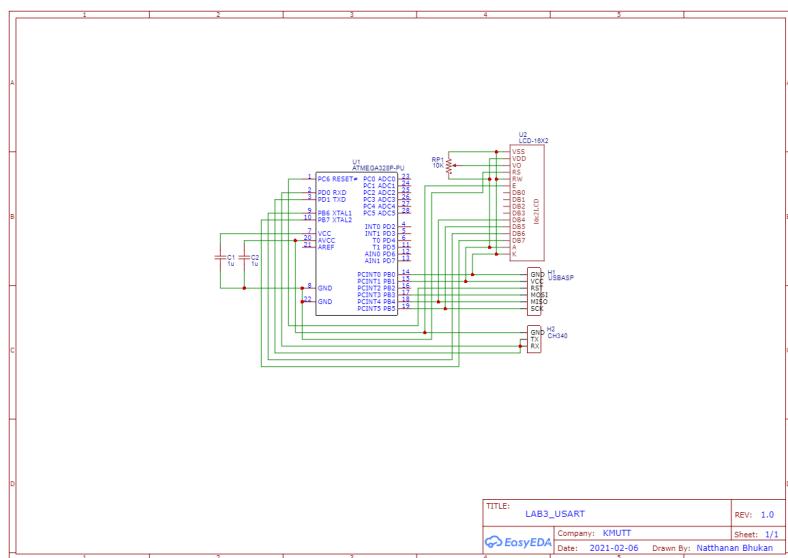


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CPE328 Embedded System, 2/2020

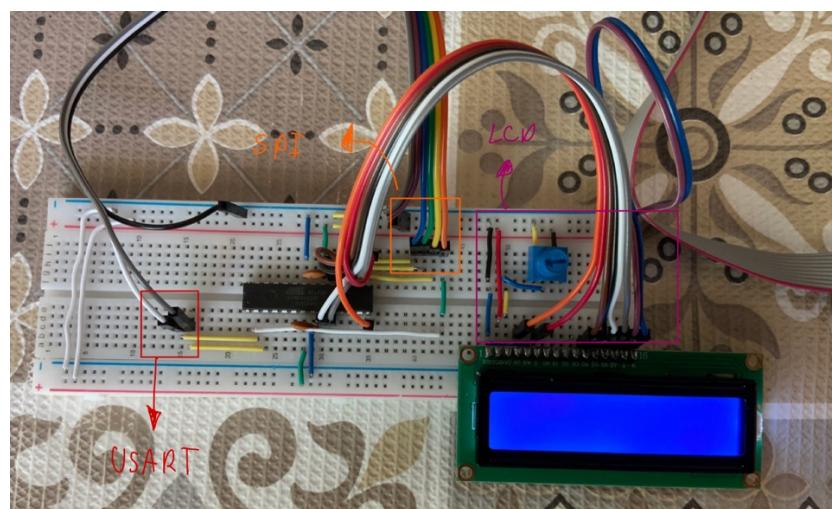
LAB Lecture 3: ABR Parallel & UART Programming

Assign Date: 3 Feb 2021 Due Date: 9 Feb 2021

Schematic Diagram



On board





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1. Write a program to receive your name from the serial port and send “Hello <your name>” back to your PC. Your program should run indefinitely i.e. you should echo “Hello ...” back for every name received.

Code

```

31 #include <avr/io.h>
30 #include <util/delay.h>

22 void USART_Init(unsigned int ubrr) {
21   /* Set baud rate */
20   UBRR0 = ubrr;
19   /* Double Transmission Speed*/
18   UCSR0A |= (1 << U2X0);
17   /* Enable receiver and transmitter */
16   UCSR0B |= (1 << RXEN0)|(1 << TXEN0);
15   /* Set frame format: 8data */
14   UCSR0C |= (1 << UCSZ01)|(1 << UCSZ00);
13 }
12
11 void USART_Transmit( unsigned char data ) {
10   /* Wait for empty transmit buffer */
9    while ( !( UCSR0A & (1 << UDRE0)) ) ;
8    /* Put data into buffer, sends the data */
7    UDR0 = data;
6 }
5 unsigned char USART_Receive() {
4   /* Wait for data to be received */
3   while ( !(UCSR0A & (1 << RXC0)) ) ;
2   /* Get and return received data from buffer */
1   return UDR0;
32 }
1

```



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```

int main(void) {
    USART_Init(103); // USART init
    char text_hello[] = "Hello "; // Hello[space]
    unsigned char text_name[20]; // Buffer to keep char from UART
    int k = 0; // Loop check lenght of text
    int index_con = 0; // index for Concat

    while (1) {
        char receive_char = USART_Receive(); // receive char from USART
        if (receive_char == 0x000a){ // check for new line
            int MAX_BUFFER = sizeof(text_hello) + k;
            char buffer[MAX_BUFFER];

            for(int j=0;j<sizeof(text_hello);j++){ // Concat Hello
                if (text_hello[j] == 0x00){
                    break;
                } else{
                    buffer[index_con] = text_hello[j];
                    index_con++;
                }
            }

            for(int j=0;j<k;j++){ // Concat String
                buffer[index_con] = text_name[j];
                index_con++;
            }

            for(int i=0; i < sizeof(buffer) - 1; i++){ // Sent to computer with USART
                USART_Transmit(buffer[i]);
            }

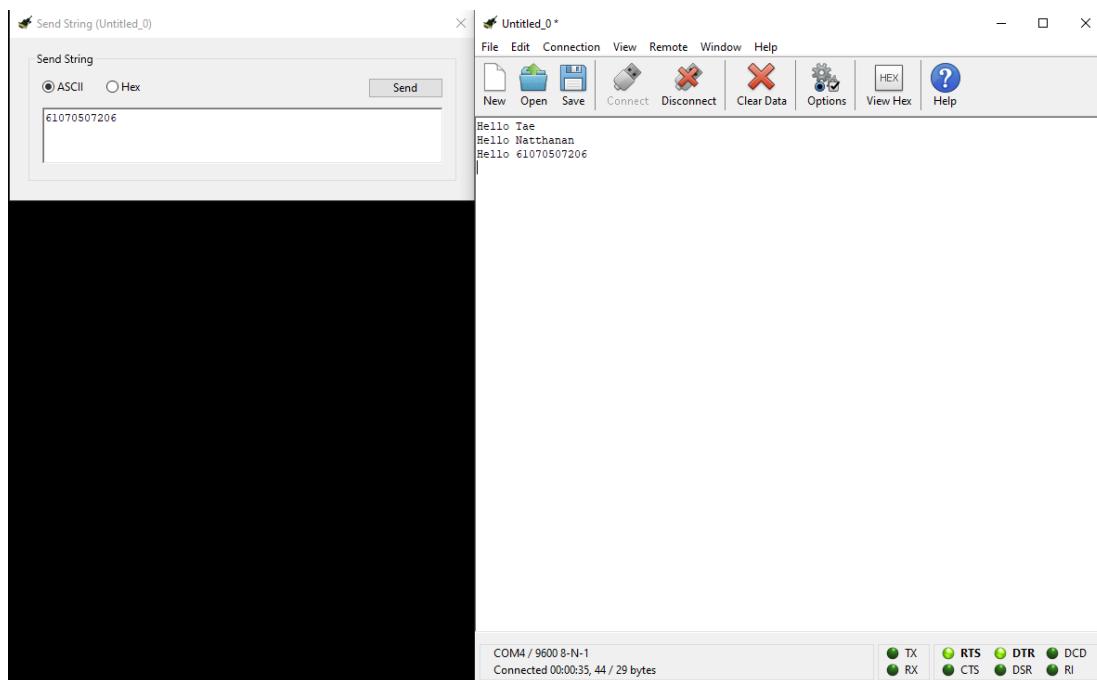
            k=0;
            index_con=0;
        } else {
            text_name[k] = receive_char;
            k++;
        }
    }
}
  
```



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Result





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2. Extend the program from the first problem to display “Hello <your name>” on the LCD screen after received name from the serial port. The message on the LCD screen should update correctly after received new name.

Code

```
#include <avr/io.h>
#include <util/delay.h>

#define LCD_Dir  DDRB      /* Define LCD data port direction */
#define LCD_Port PORTB     /* Define LCD data port */
#define RS  PB0           /* Define Register Select pin */
#define EN  PB1           /* Define Enable signal pin */

void USART_Init(unsigned int ubrr) {
    /* Set baud rate */
    UBRR0 = ubrr;
    /* Double Transmission Speed*/
    UCSR0A |= (1 << U2X0);
    /* Enable receiver and transmitter */
    UCSR0B |= (1 << RXEN0)|(1 << TXEN0);
    /* Set frame format: 8data */
    UCSR0C |= (1 << UCSZ01)|(1 << UCSZ00);
}

void USART_Transmit( unsigned char data ) {
    /* Wait for empty transmit buffer */
    while ( !( UCSR0A & (1 << UDRE0)) );
    /* Put data into buffer, sends the data */
    UDR0 = data;
}

unsigned char USART_Receive() {
    /* Wait for data to be received */
    while ( !(UCSR0A & (1 << RXC0)) );
    /* Get and return received data from buffer */
    return UDR0;
}
```



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```
void LCD_Command( unsigned char cmnd )
{
    LCD_Port = (LCD_Port & 0x0F) | (cmnd & 0xF0); /* sending upper nibble */
    LCD_Port &= ~ (1<<RS); /* RS=0, command reg. */
    LCD_Port |= (1<<EN); /* Enable pulse */
    _delay_us(1);
    LCD_Port &= ~ (1<<EN);

    _delay_us(200);

    LCD_Port = (LCD_Port & 0x0F) | (cmnd << 4); /* sending lower nibble */
    LCD_Port |= (1<<EN);
    _delay_us(1);
    LCD_Port &= ~ (1<<EN);
    _delay_ms(2);
}

void LCD_Char( unsigned char data )
{
    LCD_Port = (LCD_Port & 0x0F) | (data & 0xF0); /* sending upper nibble */
    LCD_Port |= (1<<RS); /* RS=1, data reg. */
    LCD_Port |= (1<<EN);
    _delay_us(1);
    LCD_Port &= ~ (1<<EN);

    _delay_us(200);

    LCD_Port = (LCD_Port & 0x0F) | (data << 4); /* sending lower nibble */
    LCD_Port |= (1<<EN);
    _delay_us(1);
    LCD_Port &= ~ (1<<EN);
    _delay_ms(2);
}
```

```
void LCD_Init (void) /* LCD Initialize function */
{
    LCD_Dir = 0xFF; /* Make LCD port direction as o/p */
    _delay_ms(20); /* LCD Power ON delay always >15ms */

    LCD_Command(0x02); /* send for 4 bit initialization of LCD */
    LCD_Command(0x28); /* 2 line, 5*7 matrix in 4-bit mode */
    LCD_Command(0x0c); /* Display on cursor off*/
    LCD_Command(0x06); /* Increment cursor (shift cursor to right)*/
    LCD_Command(0x01); /* Clear display screen*/
    _delay_ms(2);
}

void LCD_String (char *str) /* Send string to LCD function */
{
    int i;
    for(i=0; str[i]!=0 && str[i]!=0x000D; i++) /* Send each char of string till the NUL */
    {
        LCD_Char(str[i]);
    }
}
```



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```

void LCD_Clear()
{
    LCD_Command (0x01); /* Clear display */
    _delay_ms(2);
    LCD_Command (0x80); /* Cursor at home position */
}

int main(void) {
    USART_Init(103); // USART init
    char text_hello[] = "Hello "; // Hello[space]
    unsigned char text_name[20]; // Buffer to keep char from UART
    int k = 0; // Loop check lenght of text
    int index_con = 0; // index for concat

    LCD_Init(); /* Initialization of LCD*/
    LCD_Clear();
    _delay_ms(1000);

    while (1) {
        char receive_char = USART_Receive(); // receive char from USART

        if (receive_char == 0x000a){ // check for new line
            int MAX_BUFFER = sizeof(text_hello) + k;

            char buffer[MAX_BUFFER];

            for(int j=0;j<sizeof(text_hello);j++){ // Concat Hello
                if (text_hello[j] == 0x00){
                    break;
                } else{
                    buffer[index_con] = text_hello[j];
                    index_con++;
                }
            }

            for(int j=0;j<k;j++){ // Concat String
                buffer[index_con] = text_name[j];
                index_con++;
            }

            for(int i=0; i < sizeof(buffer) - 1; i++){ // Sent to computer with USART
                USART_Transmit(buffer[i]);
            }

            LCD_Clear(); // Clear LCD
            _delay_ms(3000);
            LCD_String(buffer); // Sent Message

            k=0;
            index_con=0;
        } else{
            text_name[k] = receive_char;
            k++;
        }
    }
}

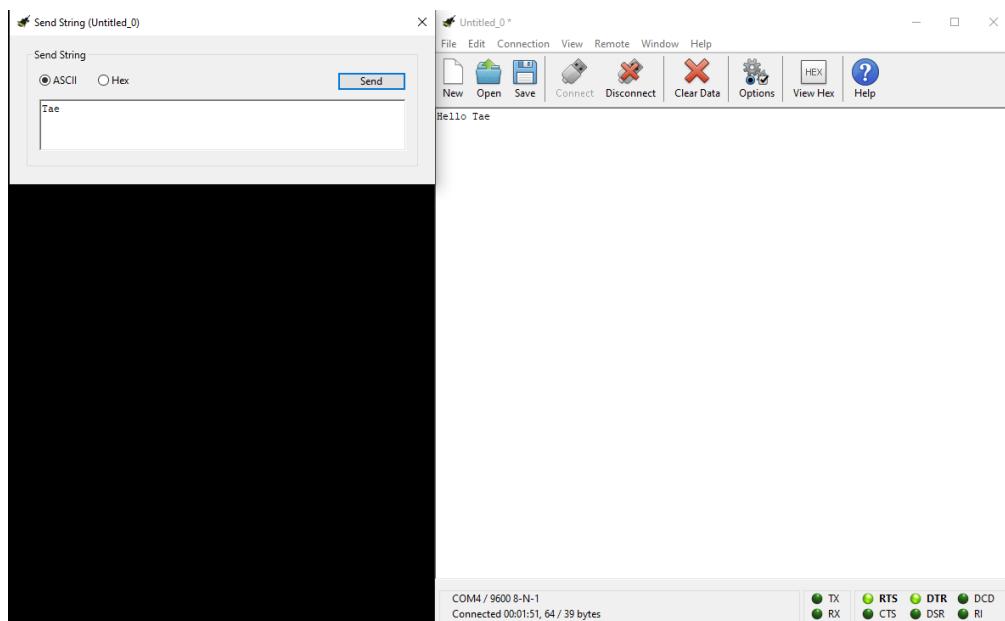
```



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