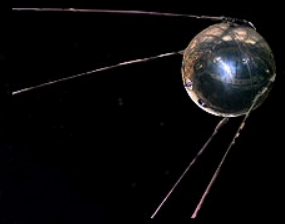
IITBSSP MINIPROJECT

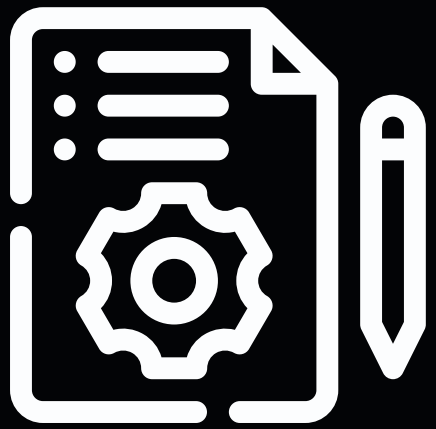


COMMUNICATION PROTOCOL (SPI)

[Dev Arora]

MINI PROJECT

What is this project?



- Software Installation
- Hardware and DataSheet
- UART
- SPI
- LCD

FINAL DELIVERABLE?

TIMELINE

WEEK 1:

- Downloaded Microchip Studio and Real Term
- ATmega128, USBasp
- LED Blink
- UART Understanding

WEEK 2:

- Implemented UART
- SPI Understanding

TIMELINE

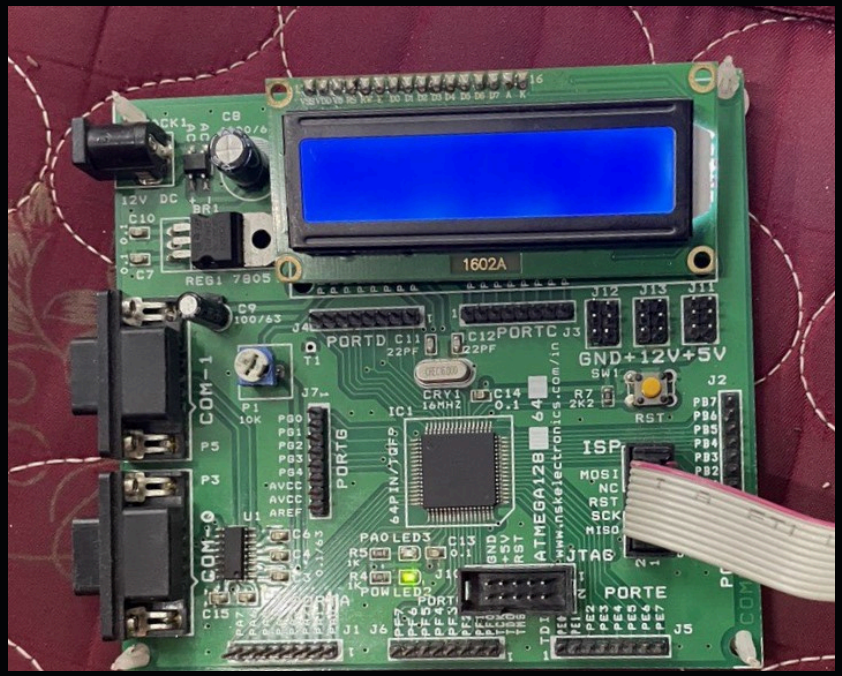
WEEK 3:

- Implemented SPI
- LCD Datasheet
- Implemented LCD
- Implemented Simpler Version of Final Deliverable.

HARDWARE

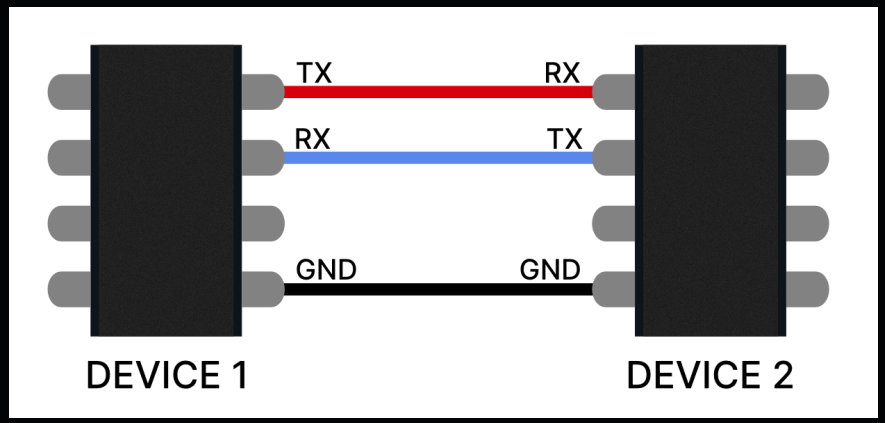
DB9 Cable

ATmega128
Development Board

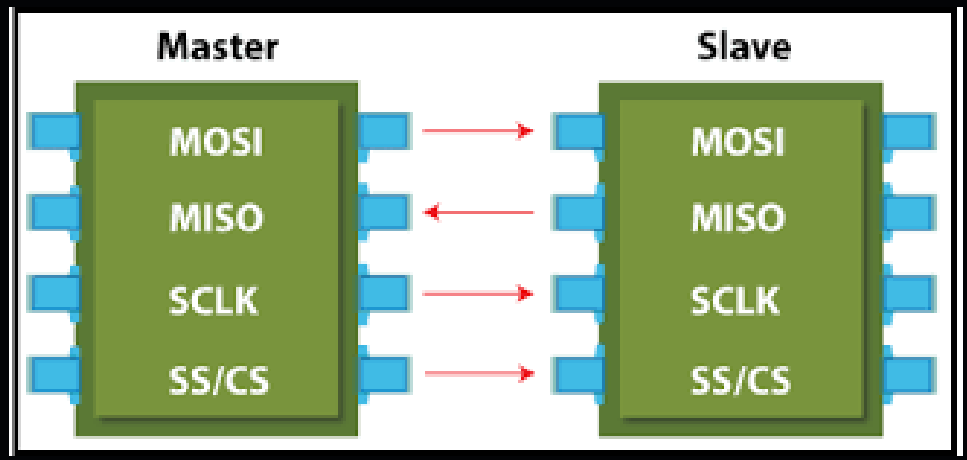


USBasp ISP
Programmer

MAJOR LEARNINGS?



UART



SPI

MAJOR LEARNINGS?

UART:

- 2 wire interface
- 2 devices
- Full Duplex
- Easiest to understand and code.

MAJOR LEARNINGS?

SPI:

- 4 wire interface
- Multiple slaves, 1 master
- Full duplex
- Faster than USART and I2C
- Commonly used for high speed communication

MAJOR LEARNINGS?

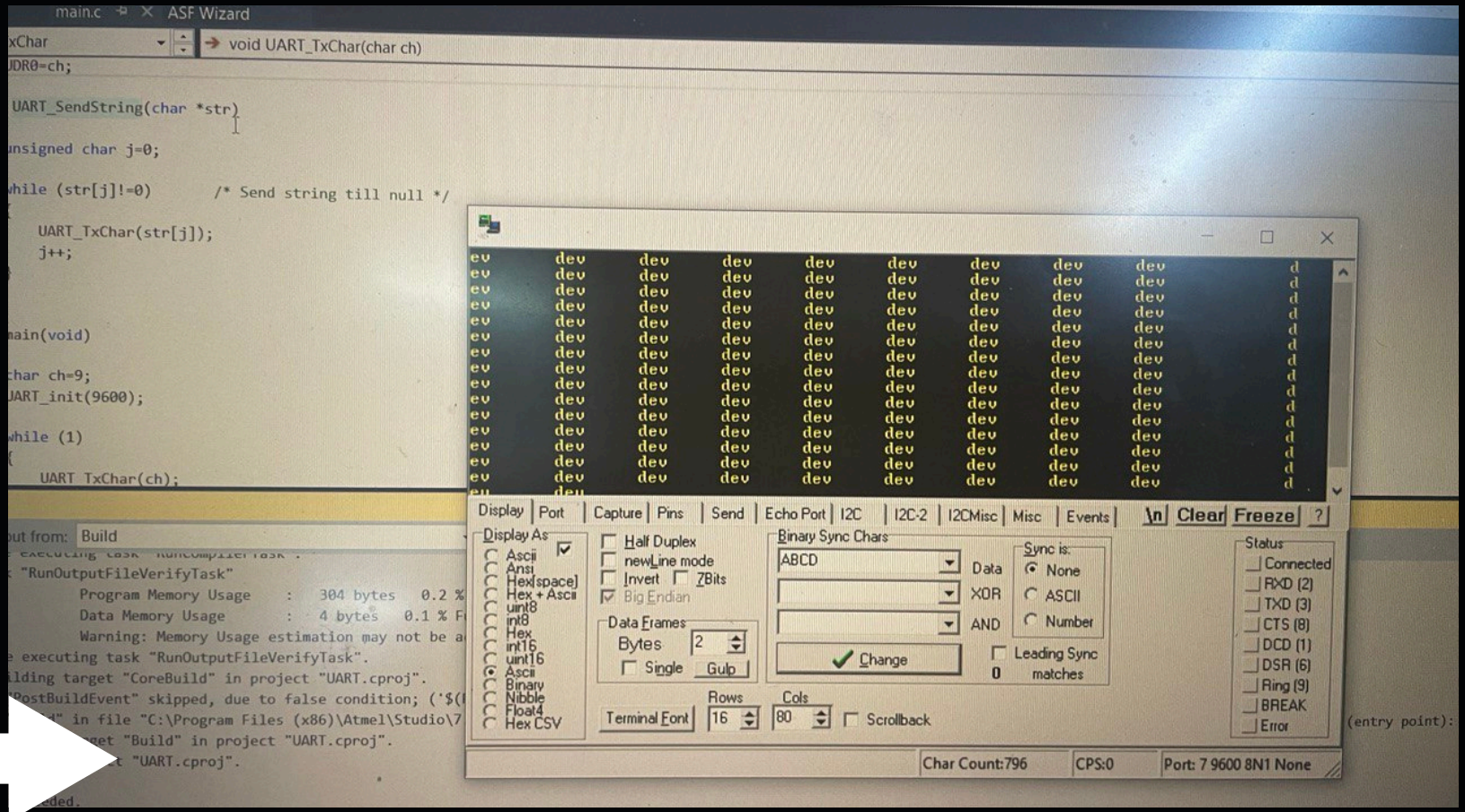
LCD:

Commonly Used LCD16x2 Commands

Code (HEX)	Command to LCD	Execution Time
0x01	Clear the display screen	1.64ms
0x06	Shift the cursor right (e.g. data gets written in an incrementing order, left to right)	40 us
0x0C	Display on, cursor off	40 us
0x0E	Display on, cursor blinking	40 us
0x80	Force the cursor to the beginning of the 1st line	40 us
0xC0	Force the cursor to the beginning of the 2nd line	40 us
0x10	Shift cursor position to the left	40 us
0x14	Shift cursor position to the right	40 us
0x18	Shift entire display to the left	40 us
0x1C	Shift entire display to the right	40 us
0x38	2 lines, 5x8 matrix, 8-bit mode	40 us
0x28	2 lines, 5x8 matrix,4-bit mode	40 us
0x30	1 line, 8-bit mode	40us
0x20	1 line, 4-bit mode	40us

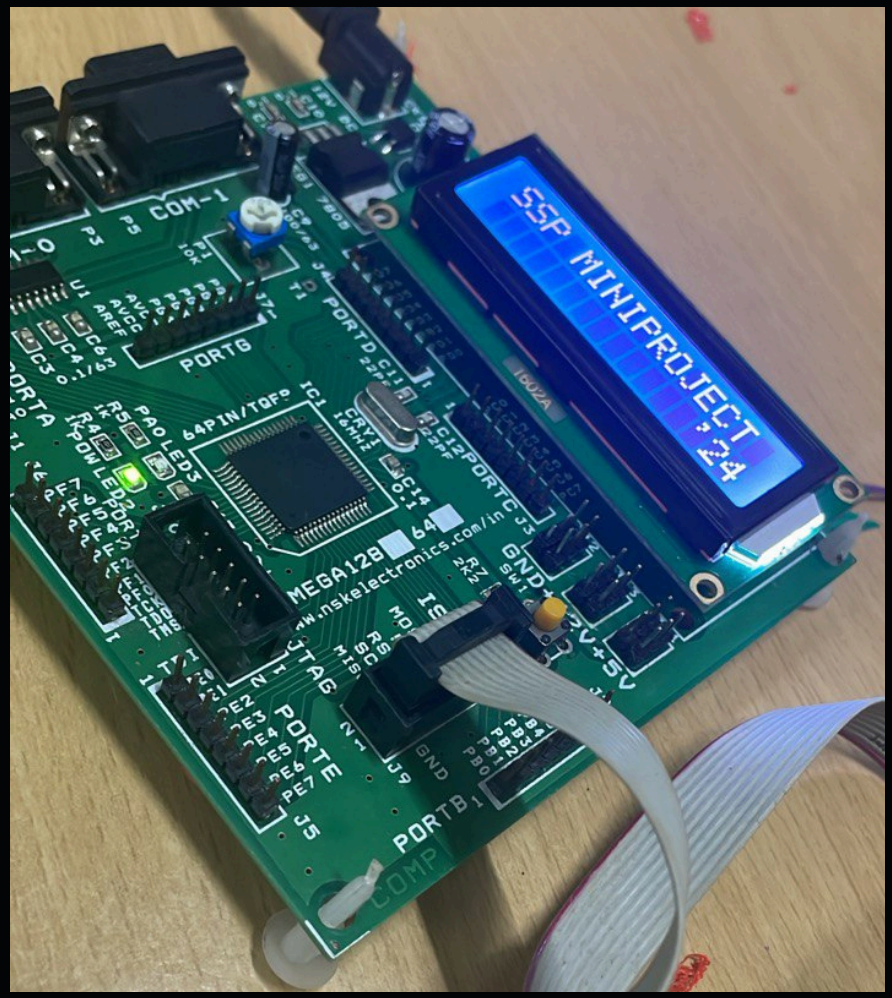
OUTPUTS

UART:



OUTPUTS

LCD:


SSP MINIPROJECT :24
COM-1
PORTG
PORTD
PORTC
PORTB
PORTE
PORTA
64PIN/TQFP
MEGA128
www.nskelectronics.com/in
JTAG
COMP

OUTPUTS

QUEUE:

```
 */
#define F_CPU 16000000UL
#include <avr/io.h>
#include <util/delay.h>
#include <stdlib.h>
#include <stdio.h>
#define Bud 9600UL
#define RS PG2
#define RW PG1
#define EN PG0
#define LCD_Data_Dir DDRC
#define LCD_Command_Dir DDRG
#define LCD_Data_Port PORTC
#define LCD_Command_Port PORTG

void LCD_Command(unsigned char c)
{
    PORTC= c;
    PORTG &= ~(1<<RS);  /* RS=0 command reg. */
    PORTG &= ~(1<<RW);  /* RW=0 Write operation */
    PORTG |= (1<<EN);   /* Enable pulse */
    _delay_us(10);
    PORTG &= ~(1<<EN);
    _delay_ms(3);
}
void LCD_Init (void){
    DDRC=0xff;
    DDRG=0xff;
    _delay_ms(30);
    LCD_Command (0x38);
     delay ms(2);/* Initialization of 16X2 LCD in 8bit */
```

Master

OUTPUTS

QUEUE:

```
    LCD_Command (0x0C);
    _delay_ms(2);   /* Display ON Cursor OFF */
    LCD_Command (0x06);
    _delay_ms(2);   /* Auto Increment cursor */
    LCD_Command (0x01);
    _delay_ms(2);   /* clear display */
    LCD_Command (0x80);
    _delay_ms(2);
}

void LCD_Char (unsigned char char_data) /* LCD data write function */
{
    LCD_Data_Port= char_data;
    LCD_Command_Port |= (1<<RS);    /* RS=1 Data reg. */
    LCD_Command_Port &= ~(1<<RW);   /* RW=0 write operation */
    LCD_Command_Port |= (1<<EN);    /* Enable Pulse */
     _delay_us(1);
    LCD_Command_Port &= ~(1<<EN);
    _delay_ms(1);
}
void LCD_String (char *str)     /* Send string to LCD function */
{
    int i;
    for(i=0;str[i]!=0;i++)      /* Send each char of string till the NULL */
    {
        LCD_Char (str[i]);
    }
}
void LCD_Clear()
{
    LCD_Command (0x01);     /* clear display */
    LCD_Command (0x80);     /* cursor at home position */
}


int main(void){
DDRA=0xff;
```

Master

OUTPUTS

QUEUE:

```
int main(void){
DDRA=0xff;
PORTA=0xff;
_delay_ms(1000);
DDRB=DDRB | (1<<2) |(1<<0);
PORTB=PORTB & 0b11111110;
DDRB=DDRB | (1<<1);
SPCR= SPCR | (1<<SPE) | (1<<MSTR) | (1<<SPR0);
LCD_Init();
LCD_Clear();
char Queue[5];
for(int i=0; i<5; i++){
    Queue[i]='0';
}
DDRF=0X00;
for(int i=0; i<5; i++){
    PORTA=0xff;
    _delay_ms(5000);
    PORTA=0x00;
    if(PINF==0b00000000){
        Queue[i]='1';
        LCD_String("1");
        _delay_ms(10);

    }
    else if(PINF==0B10000000){
        Queue[i]='2';
        LCD_String("2");
        _delay_ms(10);
}
    else if(PINF==0b11000000){
        Queue[i]='3';
        LCD_String("3");
    }
     else {
        Queue[i]='4';
        LCD_String("4");
```

Master

OUTPUTS

QUEUE:

```
    else if(PINF==0b11000000){
        Queue[i]='3';
        LCD_String("3");
    }
     else {
        Queue[i]='4';
        LCD_String("4");
        _delay_ms(10);
    }
}
while(1){
    for(int i=0; i<5; i++){
        SPDR=Queue[i];
        while (!(SPSR & (1<<SPIF)));
        _delay_ms(100);
    }
    SPDR=' ';
    while (!(SPSR & (1<<SPIF)));
    _delay_ms(100);
}

return 0;
}
```

Master

OUTPUTS

QUEUE:

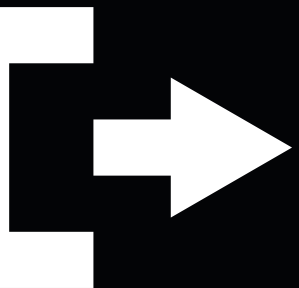
```
#define F_CPU 16000000UL
#include <avr/io.h>
#include <util/delay.h>
#include <stdlib.h>
#include <stdio.h>
#define Bud 9600UL
#define ubrr ((F_CPU / (Bud*16)) - 1)

void UART_init(unsigned long BUD)
{
    UCSR0B = UCSR0B | (1<< TXEN0);
    UCSR0C =  (1<< UCSZ00) | (1<<UCSZ01);
    UBRR0L= ubrr;
    UBRR0H= ubrr >> 8;

}
void UART_TxChar(char ch){
    while (! (UCSR0A & (1<<UDRE0)));
    UDR0=ch;
}

char SPI_SlaveReceive(void)
{
    while(!(SPSR & (1<<SPIF)));
    PORTA^=0xff;
    return SPDR;
}

int main(void)
{

    DDRB =DDRB | (1<<3);
```

Slave

OUTPUTS

QUEUE:

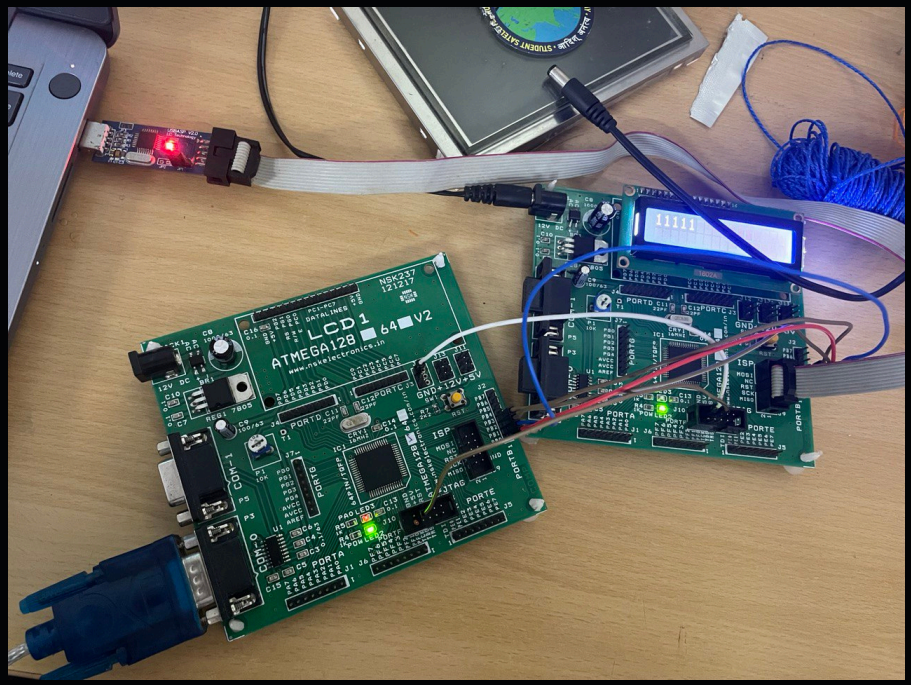
```
int main(void)
{

    DDRB =DDRB | (1<<3);
    SPCR=SPCR | (1 <<SPE);
    UART_init(9600);
    PORTA=0xff;
    _delay_ms(1000);
    while(1){
    char c=SPI_SlaveReceive();
    _delay_ms(50);
    UART_TxChar(c);
    _delay_ms(50);
}
return 0;
}
```

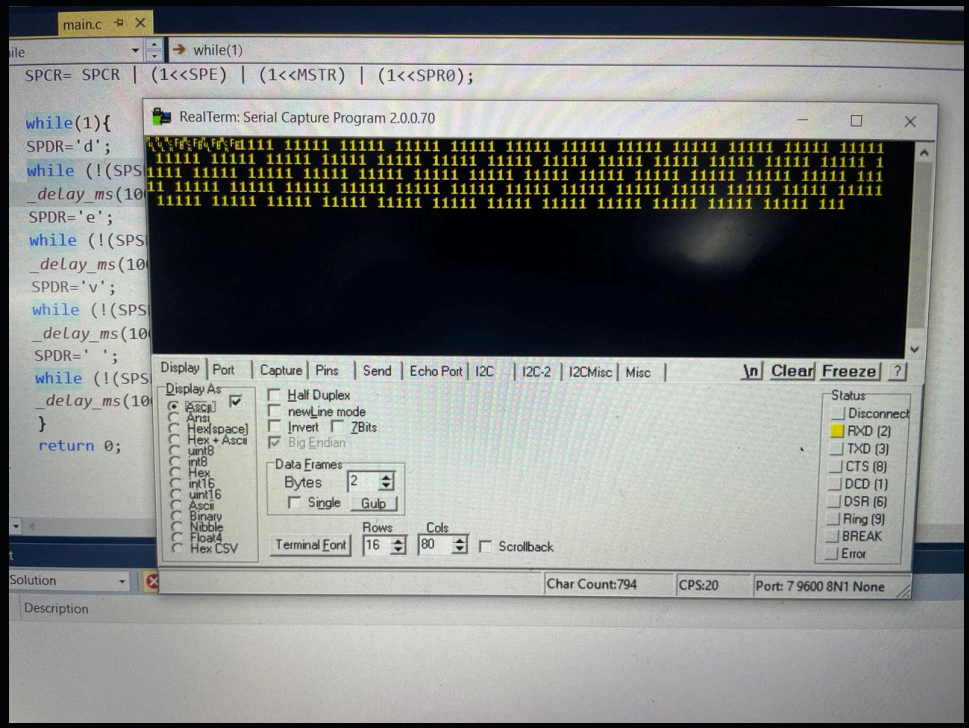


Slave

OUTPUTS

QUEUE:





CHALLENGES FACED

Some Challenges I faced were:

- Software setup, USBasp driver avrdude
- SPI communication, PINS and wrong output
- Hardware issue in LCD and Taking input

ACKNOWLEDGEMENT, MOTIVATION AND FEEDBACK

Thank you!