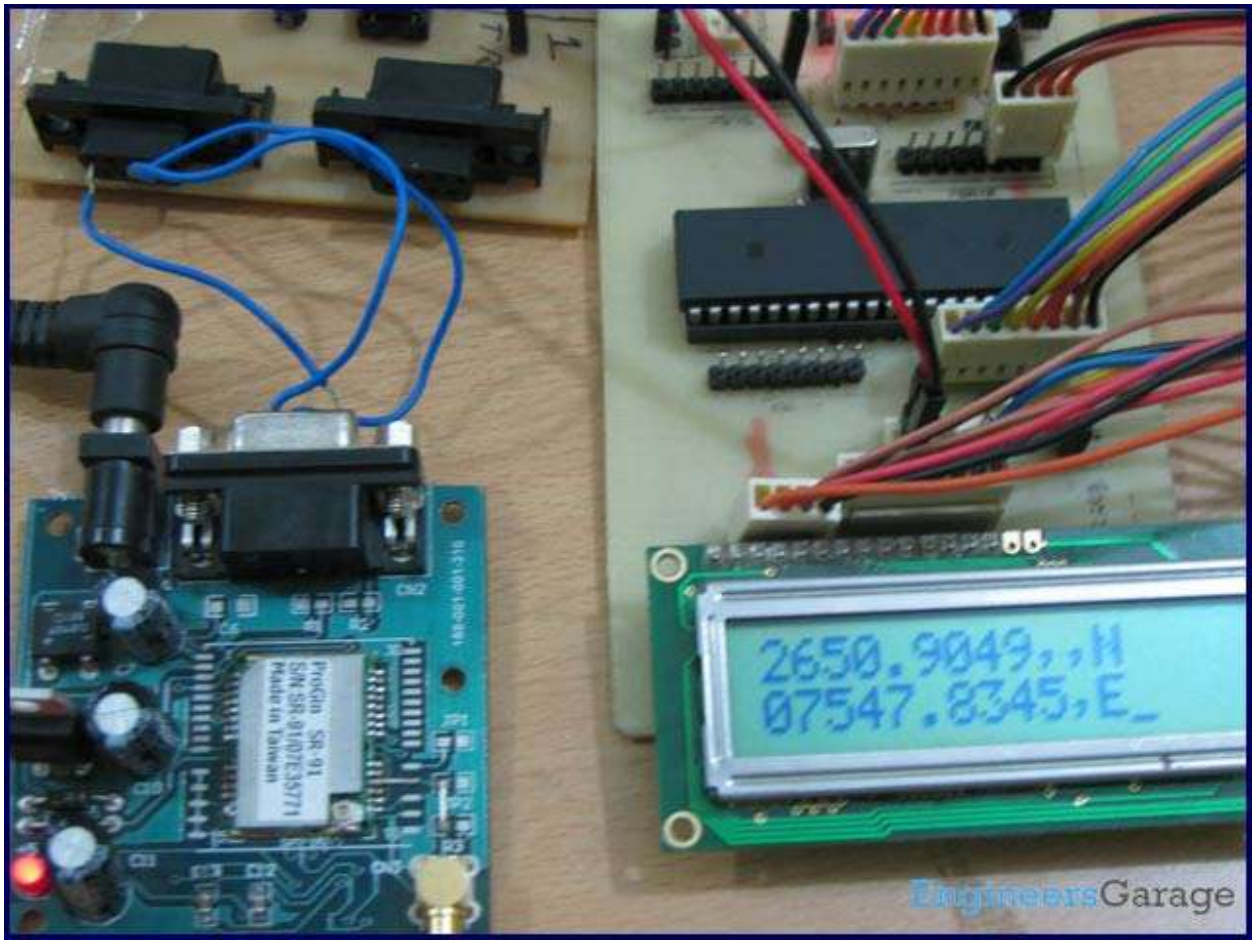
How to interface GPS with AVR microcontroller (ATmega16)

GPS modem is a device which receives signals from satellite and provides information about latitude, longitude, altitude, time etc. The GPS navigator is more famous in mobiles to track the road maps. The GPS modem has an antenna which receives the satellite signals and transfers them to the modem. The modem in turn converts the data into useful information and sends the output in serial RS232 logic level format. The information about latitude, longitude etc is sent continuously and accompanied by an identifier string.
This article shows how to interface the GPS modem with ATmega16 and extract the location (latitude and longitude) from the GPGGA string and display it onLCD.



The connection of GPS modem with AVR microcontroller (ATmega 16) is shown in the circuit diagram. The ground pin of max 232 and serial o/p of GPS modem is made common. Pin2 of MAX232 is

connected to pin 3 of GPS modem and pin 3 of max 232 is connected to pin 2 of modem. This type of connection is called a serial cross cable.

Pin 2 of MAX232	Pin 3 of GPS Modem
Pin 3 of MAX232	Pin 2 of GPS Modem
Pin 5 Ground Pin of MAX232	Pin 5 Ground of GPS Modem

The commonly available GPS modem gives output in serial (RS232) form. The output consists of a series of string.

String format:

The following is an example of the output string from the GPS module with its explanation. This output strings contains information about latitude, longitude, time etc and will always start with $GPGGA.
Refer NMEA Standards for more details on string formats.

An example string has been given and explained below:

$GPGGA,100156.000,2650.9416,N,07547.8441,E,1,08,1.0,442.8,M,-42.5,M,,0000*71

1. A string always start from '$' sign
2. GPGGA :Global Positioning System Fix Data
3. ',' Comma indicates the separation between two values
4. 100156.000 : GMT time as 10(hr):01(min):56(sec):000(ms)
5. 2650.9416,N: Latitude 26(degree) 50(minutes) 9416(sec) NORTH
6. 07547.8441,E: Longitude 075(degree) 47(minutes) 8441(sec) EAST
7. 1 : Fix Quantity 0= invalid data, 1= valid data, 2=DGPS fix
8. 08 : Number of satellites currently viewed.
9. 1.0: HDOP
10. 442.8,M : Altitude (Height above sea level in meter)
11. -42.5,M : Geoids height
12. __ , DGPS data
13. 0000 : DGPS data
14. *71 : checksum

The following algorithm is used to extract the latitude and longitude information from the GPS module using $GPGGA string and display it on a LCD:

1. Get data in UDR and check weather that data is equal to $. If the data matches go to step(2) else get a new data.

2. Get data byte by byte and check if the received byte is equal to GPGGA
3. If the step (2) matches completely then go to step (4) else go back to step(1)
4. Leave first comma and wait till second comma (since we not looking for time).
5. Start taking data in an array lati_value[ ] till the next comma.
6. Get latitude direction in lati_dir
7. Do the same for longitude
8. Display the values on LCD and go back to step (1).

Code :

```
// Program to get latitude and longitude value from GPS modem and display it on LCD:
/*
LCD DATA port----PORT A
signal port------PORT B
        rs-------PB0
        rw-------PB1
        en-------PB2
*/

#define F_CPU 12000000UL

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

#define USART_BAUDRATE 4800
#define BAUD_PRESCALE (((F_CPU / (USART_BAUDRATE * 16UL))) - 1)


#define LCD_DATA PORTA          //LCD data port

#define ctrl PORTB
#define en PB2          //enable signal
#define rw PB1          //read/write signal
#define rs PB0          //resister select signal

void LCD_cmd(unsigned char cmd);
void init_LCD(void);
void LCD_write(unsigned char data);
void LCD_write_string(unsigned char *str);

void usart_init();
unsigned int usart_getch();

unsigned char value,i,lati_value[15],lati_dir, longi_value[15], longi_dir, alti[5] ;

int main(void)
{
        DDRA=0xff;              //LCD_DATA port as out put port
        DDRB=0x07;              //ctrl as out put
        init_LCD();             //initialization of LCD
```

```
_delay_ms(50);           // delay of 50 mili seconds
LCD_write_string("we at");
LCD_cmd(0xC0);
usart_init();            // initialization of USART
while(1)
{
        value=usart_getch();
        if(value=='$')
        {
                value=usart_getch();
                if(value=='G')
                {
                        value=usart_getch();
                        if(value=='P')
                        {
                                value=usart_getch();
                                if(value=='G')
                                {
                                        value=usart_getch();
                                        if(value=='G')
                                        {
                                                value=usart_getch();
                                                if(value=='A')
                                                {

value=usart_getch();
                                                        if(value==',')
                                                        {

value=usart_getch();

while(value!=',')
                                                                {

value=usart_getch();
                                                                }

lati_value[0]=usart_getch();

value=lati_value[0];

for(i=1;value!=',';i++)
                                                                {

lati_value[i]=usart_getch();

value=lati_value[i];
                                                                }

lati_dir=usart_getch();

value=usart_getch();

while(value!=',')
                                                                {
```

```
value=usart_getch();
                                                                    }
longi_value[0]=usart_getch();
value=longi_value[0];
for(i=1;value!=',';i++)
                                                                    {
longi_value[i]=usart_getch();
value=longi_value[i];
                                                                    }
longi_dir=usart_getch();
LCD_cmd(0x01);
_delay_ms(1);
LCD_cmd(0x80);
_delay_ms(1000);
                                                                    i=0;
while(lati_value[i]!='\0')
                                                                    {
LCD_write(lati_value[j]);
j++;
                                                                    }
LCD_write(lati_dir);
LCD_cmd(0xC0);
_delay_ms(1000);
                                                                    i=0;
while(longi_value[i]!='\0')
                                                                    {
LCD_write(longi_value[i]);
i++;
                                                                    }
LCD_write(longi_dir);
_delay_ms(1000);
                                                                }
```

```
                                                        }
                                                    }
                                                }
                                            }
                                        }
                                }
                        }
        }
}

void init_LCD(void)
{
        LCD_cmd(0x38);          //initialization of 16X2 LCD in 8bit mode
        _delay_ms(1);

        LCD_cmd(0x01);          //clear LCD
        _delay_ms(1);

        LCD_cmd(0x0E);          //cursor ON
        _delay_ms(1);

        LCD_cmd(0x80);          // ---8 go to first line and --0 is for 0th
position
        _delay_ms(1);
        return;
}


void LCD_cmd(unsigned char cmd)
{
        LCD_DATA=cmd;
        ctrl =(0<<rs)|(0<<rw)|(1<<en);
        _delay_us(40);
        ctrl =(0<<rs)|(0<<rw)|(0<<en);
        //_delay_ms(50);
        return;
}


void LCD_write(unsigned char data)
{
        LCD_DATA= data;
        ctrl = (1<<rs)|(0<<rw)|(1<<en);
        _delay_us(40);
        ctrl = (1<<rs)|(0<<rw)|(0<<en);
        //_delay_ms(50);
        return ;
}


void usart_init()
{

        UCSRB |= (1<<RXCIE) | (1 << RXEN) | (1 << TXEN);   // Turn on the
transmission and reception circuitry
```

```
        UCSRC |= (1 << URSEL) | (1 << UCSZ0) | (1 << UCSZ1); // Use 8-bit character
sizes

        UBRRL = BAUD_PRESCALE; // Load lower 8-bits of the baud rate value into the
low byte of the UBRR register
        UBRRH = (BAUD_PRESCALE >> 8); // Load upper 8-bits of the baud rate value
into the high byte of the UBRR register
}


unsigned int usart_getch()
{

        while ((UCSRA & (1 << RXC)) == 0); // Do nothing until data have been
recieved and is ready to be read from UDR
        return(UDR); // return the byte
}

void LCD_write_string(unsigned char *str) //take address vaue of the string in
pionter *str
{
        int i=0;
        while(str[i]!='\0')                                 // loop will go on till
the NULL charaters is soon in string
        {
        LCD_write(str[i]);                                  // sending data on CD byte
by byte
        i++;
        }
        return;
}
```