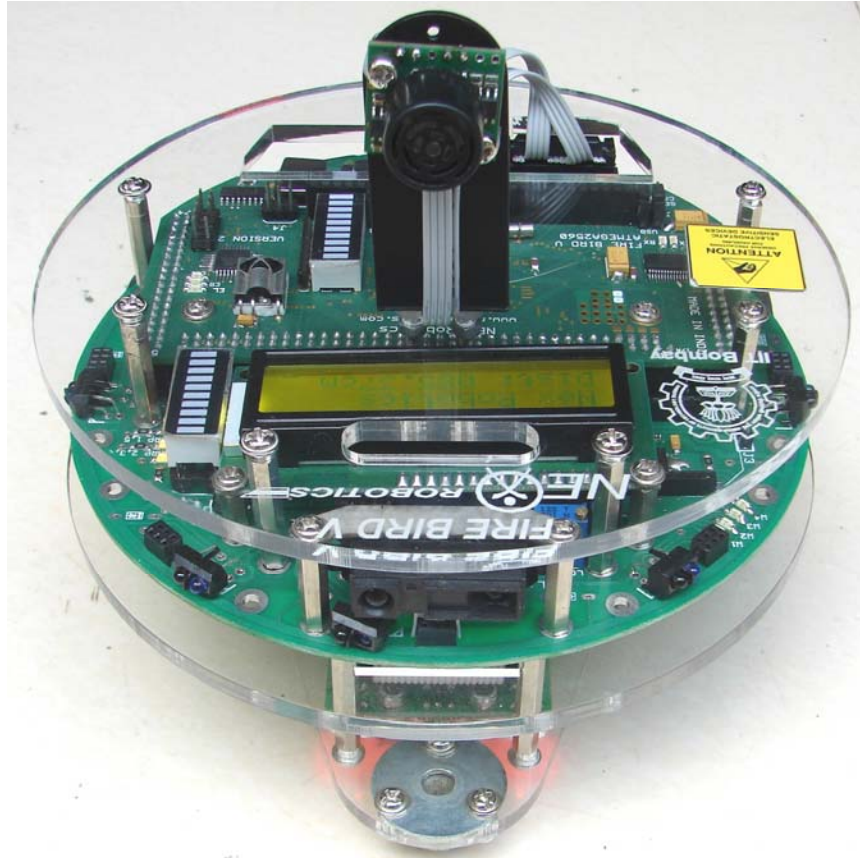# Interfacing MaxBotix Ultrasonic Range Sensor (EZ4) With Fire Bird V ATmega2560 Robot

MaxBotix EZ4 Ultrasonic Range Sensor can measure distance up to 6meters. It has a very narrow beam angle, which makes it most suitable for range sensing application on the mobile robots. This sensor is available in customized sensor module kit for Fire Bird V robot.

EZ4 Ultrasonic Range Sensor Kit contains:
1. MaxBotix EZ4 Ultrasonic Range Sensor: qty 1
2. Sensor mounting plate: Qty 1
3. M3, 16mm Star bolt. Qty:2
4. M3 Nut. Qty:2
5. 3mm plastic spacer. Qty:2
6. Cable tie. Qty:1

Using MaxBotix EZ4 Ultrasonic Range Sensor:

EZ4 sensor gives out distance reading as analog voltage or serial data or as PWM. We are interfacing analog signal with the Fire Bird V ATMEGA2560 Robot.

Figure1: Ultrasonic Range Sensor pin configuration

EZ4 sensor has 7 pins for interfacing. Out of these pins only +5V, Gnd, Rx and AN are used for interfacing. Other pins are left unconnected.

GND: Ground

+5V: Vcc – Operates on 2.5V -5.5V DC.

TX: TX output delivers asynchronous serial with an RS232 format, when BW is set low. When BW is set high, it sends a single pulse, for chaining.

RX: This pin is internally pulled high. The EZ4 will continually measure range and output, if RX data is left unconnected or held high. If held low the EZ4 will stop ranging. Bring high for 20uS or more to command a range reading.

AN: Outputs analog voltage with a scaling factor of (Vcc/512) per inch. A supply of 5V yields ~9.8mV/in. and 3.3V yields ~6.4mV/in.

PW: This pin outputs a pulse width representation of range. The distance can be calculated using the scale factor of 147uS per inch.

BW: Leave open or hold low for serial output on the TX output. When BW pin is held high the TX output sends a pulse (instead of serial data), suitable for low noise chaining.

Mounting of Ultrasonic sensor module on Fire Bird V:

EZ4 sensor is connected to the robot using 16 pin FRC cable. This cable is soldered on the sensor and sensor is mounted on the mounting plate. Mount this sensor mount on the robot as shown in figure 2. Make sure that you keep 3mm Spacer between Robot's top acrylic plate and sensor mount and pass FRC cable in between the spacers. Route the FRC cable and tie with cable tie on the Robot's top acrylic plate as shown in the Figure 2. Insert the FRC cable in the Servo Pod socket.
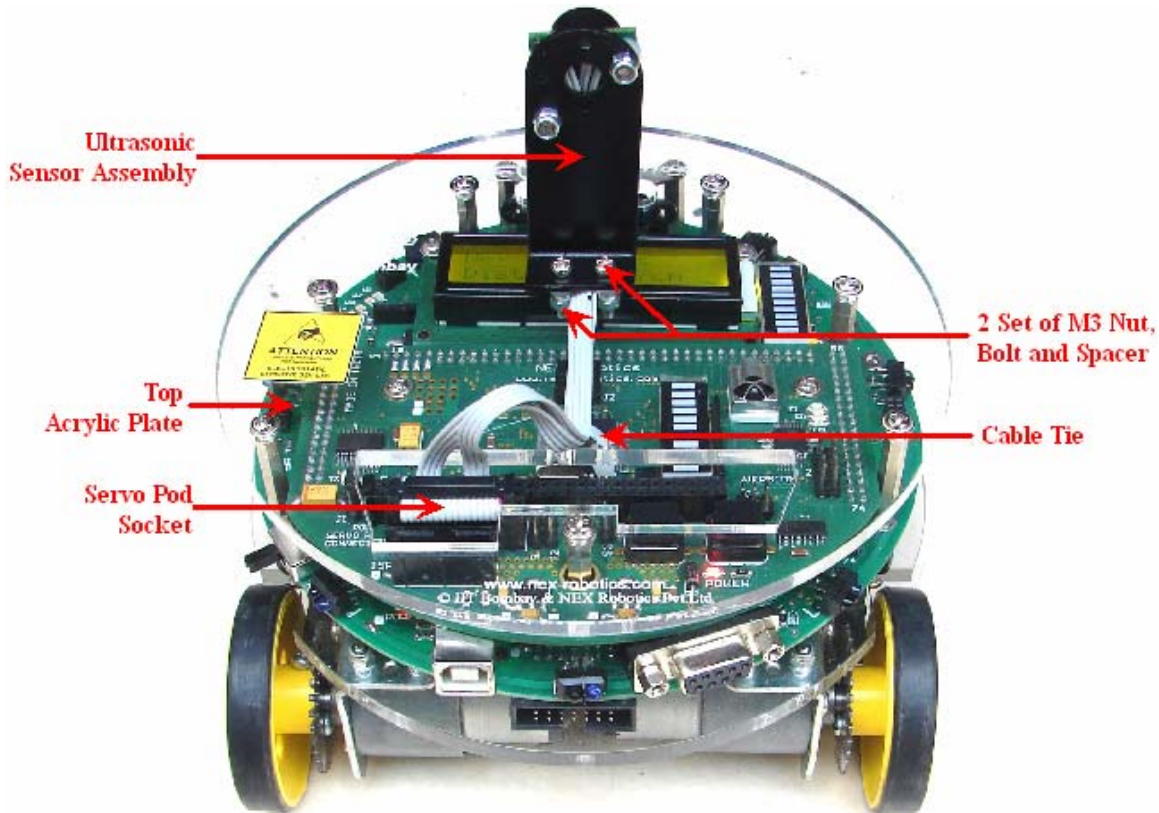
Figure2: Mounting of Ultrasonic Sensor Module on Fire Bird V Robot

Sensor interfacing with the Robot:
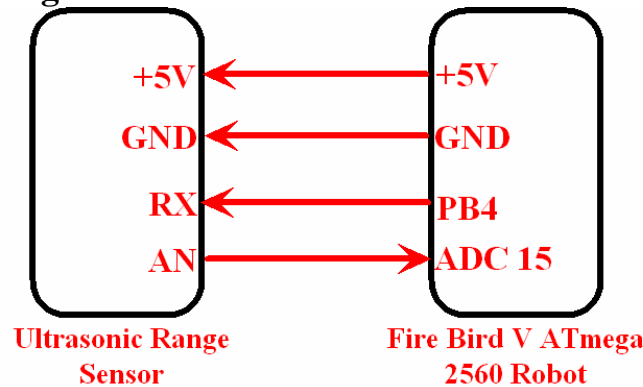
Figure3: Block Diagram

Figure 3 shows interfacing of the EZ4 sensor with the robot. AN pin gives analog voltage proportional to the distance between obstacle and robot. RX pin is triggered to take sensor reading. If this pin is kept at the logic 1, then sensor will take continue reading at 50mSec interval. We can also take a single reading by giving the single pulse of 20uSec to this pin, whenever required. In this case, the last reading is latched as analog voltage on AN pin till the next trigger is applied.

EZ4 sensor is interfaced to the Servo Pod Socket on robot. Table 1 gives pin connections of the Servo Pod Socket.

Figure4: Connection on Fire Bird V Robot

Pin No.	Pin Name	Description
1	Servo POD1	Not used
2		
3	Servo POD2	ATmega2560 ADC channel 15 is connected to Analog output (AN) of Ultrasonic Range Sensor.
4		
5	GPIO	ATmega2560 PB4 pin (Pin no. 23) is connected to RX pin of Ultrasonic Range Sensor for triggering at 50ms interval.
6		
7	Atmega8 ADC	Not used
8		
9	Atmega8 ADC	Not used
10		
11	Ground	Ground
12		
13	V SYS	+ 5V (VCC)
14		
15	V BATT	Not used
16		

Table 1: Servo pod socket pin configuration

Application Example Code:

In the application example 'Ultrasonic_Interfacing_FBV', distance between obstacle and robot is measured and displayed on LCD. In this code, RX pin is triggered with 20uSec pulse at an interval of 150msec to get the reading form the ultrasonic sensor. After reading the analog value & doing Analog to digital conversion distance in cm is displayed on the LCD.

The application example code is located in the same folder as this application note.

Calculation for displaying distance in cm:

EZ4 Ultrasonic Range sensor Outputs analog voltage with a scaling factor of (Vcc/512) per inch.
With 5V supply, we get resolution = 5/512 = 9.8mV/inch.

One inch = 2.54cm
Resolution in cm = 9.765mV/2.54cm= 3.858mV/cm= 0.00385V/cm
ATmega 2560 microcontroller ADC resolution with 10 bit
$= 5/1024 = 4.88mV = 0.00488mV/ADC$ step

For distance in cm = ADC Steps * (0.00488/0.00385)
$= ADC$ Steps * 1.267
Where,
1.267 is the constant multiplier to multiply with ADC output with 10 bit ADC resolution to get the distance in cm.

To run the application, load 'Ultrasonic_Interfacing_FBV.hex' file on ATmega2560 microcontroller of Fire Bird VAtmega2560 robot. For more information on how to load .hex file on the robot, refer to the robot's hardware and software manual.

Now keep the obstacle in front of the Robot, The robot will show the distance measured in centimeter (cm) on LCD mounted on the robot.

Figure5: distance in cm display on LCD of Fire Bird V Robot

References:

1. Ultrasonic Range Sensor EZ4 datasheet from MAXBOTIX
2. FireBird V ATmega2560 Robot Research Hardware manual from Nex Robotics

Notice

The contents of this manual are subject to change without notice. All efforts have been made to ensure the accuracy of contents in this manual. However, should any errors be detected, NEX Robotics welcomes your corrections. You can send us your queries / suggestions at
info@nex-robotics.com

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