ZX Distance and Gesture Sensor Hookup Guide

Introduction

The ZX Distance and Gesture Sensor is a collaboration product with XYZ Interactive. The very smart people at XYZ Interactive have created a unique technology that allows for simple infrared beams to be used to detect an object's location in two dimensions.

The ZX Sensor is a touchless sensor that is capable of looking for simple gestures in the air above the sensor (e.g. swipe left or right). Additionally, the sensor can also recognize the distance of an object away from the sensor up to about 10 inches (25 cm), which we will call the "Z" axis, and the location of the object from side to side across the sensor in about a 6 inch (15 cm) span, which we will call the "X" axis.

Covered in This Tutorial

We can use I²C or UART to communicate with the ZX Sensor. In this tutorial, we will show you how to connect the sensor to an Arduino as well as a computer. The tutorial is divided into the following sections:

- Board Overview – We go over the various pins and jumper settings on the ZX Sensor.
- Hardware Hookup – How to connect the sensor to an Arduino.
- Arduino Library Installation – Install the ZX Sensor library if you plan to use it with an Arduino
- Arduino: ZX Example – How to read Z- and X- axis data from the sensor on an Arduino.
- Arduino: Gesture Example – How to read gestures with an Arduino.
- PC: ZX Example – How to read Z- and X- axis data on a Windows computer.

- Resources and Going Further – This section gives you some
  additional resources for getting more use out of the ZX Sensor.

Materials Used

In addition to the sensor itself, you will need a few extra components to
follow along with the Arduino examples:

ZX Gesture and Distance Sensor Hookup Guide SparkFun Wish List
ZX Distance and Gesture Sensor SEN-12780 The ZX Distance and Gesture Sensor is a touchless sensor that is ca…
SparkFun USB Mini-B Cable - 6 Foot CAB-11301 This is a USB 2.0 type A to Mini-B 5-pin cable. You know, the mini-B…
SparkFun RedBoard - Programmed with Arduino DEV-12757 At SparkFun we use many Arduinos and we're always looking for the…
Breadboard - Mini Modular (White) PRT-12043 This white Mini Breadboard is a great way to prototype your small proj…
Jumper Wires Premium 6" M/M Pack of 10 PRT-08431 This is a SparkFun exclusive! These are 155mm long jumpers with m…
Break Away Headers - Straight PRT-00116 A row of headers - break to fit. 40 pins that can be cut to any size. Us…

If you would like to try the ZX Sensor on a Windows-based PC, you will
need an FTDI Breakout:

**SparkFun FTDI Basic
Breakout - 5V**
◉ DEV-09716
$14.95
★ ★ ★ ★ ☆ 37

Recommended Reading

There are a few concepts that you should be familiar with before getting
started with the ZX Sensor. Consider reading some of these tutorials before
continuing:

- What is an Arduino? – Two of the examples use an Arduino to
  control the ZX Sensor
- I^2C – I^2C is the one of the protocols used by the ZX Sensor
- Serial Communication – We use serial communications to program
  the Arduino, view debugging information, and transmit data from the
  ZX Sensor

- How to Use a Breadboard – The breadboard ties the Arduino to the ZX Sensor
- How to Install FTDI Drivers – If you are programming an Arduino or using the ZX Sensor demo app, chances are you will need to use an FTDI

Board Overview

The ZX Sensor works by bouncing infrared (IR) beams of light from the two LEDs on either side off of an object above the sensor. The bounced light returns to the receiver in the center of the sensor, and a microcontroller on the back of the sensor interprets the data. We can read the results using an I²C or UART connection.

Pin Descriptions

The ZX Sensor gives us 2 ports to connect to: I²C and UART.

IMPORTANT: You should only use one of I²C or UART to communicate with the ZX Sensor

Pin Label	Description
GRN	Not used
TXO	UART transmit out from the ZX Sensor
RXI	UART receive. Not used at this time.
VCC	3.3 - 5 V power supply
GND	Connect to ground
BLK	Not used, but connected to GND
DR	Data Ready. High when there is data to be read via I²C
CL	I²C clock
DA	I²C data

Setting the Jumpers

The ZX Sensor has a couple of jumpers on the back of the board that can be opened or closed with a soldering iron.

I2C Pullups - The ZX Sensor, by default, comes with 4.7 kΩ pull-up resistors on the SDA and SCL I²C lines. Remove the solder on this jumper to disconnect the pull-ups.

I2C Addr - By default, this jumper is open. Close it to change the I²C address of the sensor.

Jumper	I²C Address

Open	0x10
Closed	0x11

The Infrared Shields

See those little brass tubes on the LEDs? They are needed to block any IR light going directly from the LEDs (inside the brass tubes) to the receiver (the black domed component in the center of the sensor). We want the light to bounce off an object first.

They are held on with Super Glue. You can remove them, but it might require a bit of acetone. If you plan to mount the ZX Sensors in your own housing, make sure IR light can't travel directly from the sides of the LEDs to the receiver (i.e. you will want to make your own IR shields).

Hardware Hookup

Add Headers

Solder a row of break away male headers to the 9 headers holes on the board.

Connect the Breakout Board

For the Arduino examples, we will be using I^{2}C. Connect the breakout board to the following RedBoard pins:
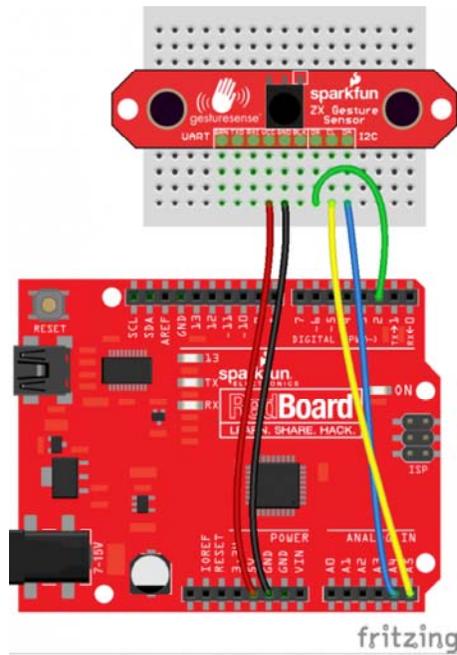
ZX Sensor	RedBoard
VCC	5V
GND	GND
DR	2
CL	A5
DA	A4

Note that we connect the DR pin, but we will only use it in the Arduino: Gesture Example. DR stands for "Data Ready," which is active high whenever data is ready to be read from the ZX Sensor. We can attach this to an Arduino interrupt so we don't have to continuously poll the sensor.
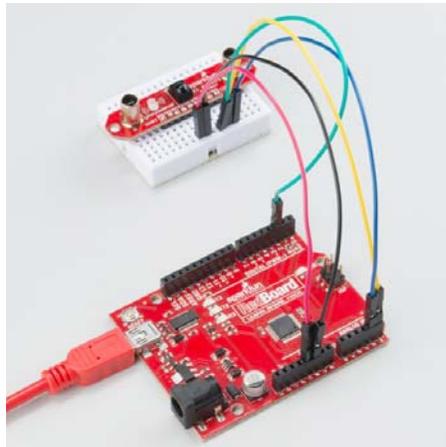
Arduino Library Installation

All of the hard work for the ZX Sensor is being accomplished in the microcontroller on the sensor itself. All we need to do is read the results! We have created an Arduino library to make that even easier for you. Click the button to download the latest version of the ZX Sensor Arduino Library.
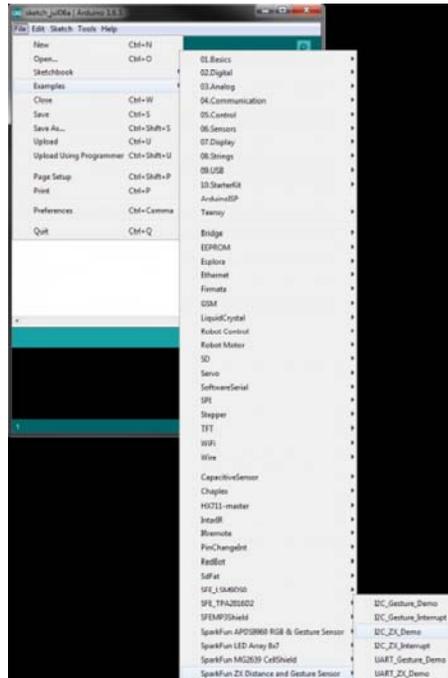
DOWNLOAD THE ZX SENSOR ARDUINO LIBRARY!

Unzip the downloaded file. Follow this guide on installing Arduino libraries to install the files as an Arduino library.

Arduino: ZX Example

Load the ZX Demo

Open up the Arduino program and select File → Examples → SparkFun_ZX_Distance_and_Gesture_Sensor → I2C_ZX_Demo.

Attach a USB mini cable from your computer to the RedBoard. If you have not previously done so, install the FTDI drivers.

For reference, here is the I2C_ZX_Demo.ino sketch.

I2C_ZX_Demo (https://codebender.cc/sketch:80591 ?   ⬇ Download
referrer=ShawnHymel) by ShawnHymel
(https://codebender.cc/user/ShawnHymel?referrer=ShawnHymel)

```
 3   XYZ Interactive ZX Sensor
 4   Shawn Hymel @ SparkFun Electronics
 5   May 6, 2015
 6   https://github.com/sparkfun/SparkFun_ZX_Distance_and_Gestur
 7
 8   Tests the ZX sensor's ability to read ZX data over I2C. Thi
 9   configures the ZX sensor and periodically polls for Z-axis
10
11   Hardware Connections:
12
13    Arduino Pin  ZX Sensor Board  Function
14    -------------------------------------
15    5V           VCC              Power
16    GND          GND              Ground
17    A4           DA               I2C Data
18    A5           CL               I2C Clock
19
20   Resources:
21   Include Wire.h and ZX_Sensor.h
22
23   Development environment specifics:
24   Written in Arduino 1.6.3
25   Tested with a SparkFun RedBoard
26
27   This code is beerware; if you see me (or any other SparkFun
28   employee) at the local, and you've found our code helpful,
29   buy us a round!
30
```

| Arduino Uno ▾ | ▾ | ➜ Run on Arduino |

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Run

Make sure you have the correct serial port selected under Tools → Serial Port and "Arduino Uno" selected under Tools → Board. If you have never used the Arduino IDE before, this turoial should get you started.

Click the Upload button and wait for the program to finish uploading to the Arduino. Select Tools → Serial Monitor to open up the serial terminal. More info on the Serial Terminal can be found here. Note that the Serial Monitor settings are the default settings (9600, 8, n, 1). You should see a couple of messages noting that "ZX Sensor initialization complete."

Hover your hand 4 to 10 inches (10 to 25 cm) above the sensor.

Move your hand around above the sensor, and you should see Z (height above the sensor) and X (position side to side) appear in the serial terminal.

> **NOTE:** Z- and X- data is given as an unsigned integer between 0 and 240 (inclusive).

Arduino: Gesture Example

Load the Gesture Interrupt Demo

In addition to providing Z- and X- axis data about an object, the ZX Sensor is also capable of detecting simple gestures. To see an example of this, open File → Examples → SparkFun_ZX_Distance_and_Gesture_Sensor → I2C_Gesture_Interrupt.

Here is the I2C_Gesture_Interrupt.ino sketch for reference.

I2C_Gesture_Interrupt (https://codeberg.one/sketch:1319?D Download
referrer=ShawnHymel) by ShawnHymel
(https://codeberg.one/user/ShawnHymel?referrer=ShawnHymel)

```
 1   /*****************************
 2
 3   XYZ Interactive ZX Sensor
 4   Shawn Hymel @ SparkFun Electronics
 5   May 6, 2015
 6   https://github.com/sparkfun/SparkFun_ZX_Distance_and_Gestur
 7
 8   Tests the ZX sensor's ability to read gesture data over I2C
 9   an interrupt pin. This program configures I2C and sets up a
10   interrupt to occur whenever the ZX Sensor throws its DR pin
11   The gesture is displayed along with its "speed" (how long i
12   to complete the gesture). Note that higher numbers of "spee
13   indicate a slower speed.
14
15   Hardware Connections:
16
17    Arduino Pin  ZX Sensor Board  Function
18    -------------------------------------
19    5V           VCC              Power
20    GND          GND              Ground
21    A4           DA               I2C Data
22    A5           CL               I2C Clock
23    2            DR               Data Ready
24
25   Resources:
26   Include Wire.h and ZX_Sensor.h
27
28   Development environment specifics:
29   Written in Arduino 1.6.3
30
```

Searching for plugin ...

Arduino Uno   → Run on Arduino

Run

Upload the sketch, and open the Serial Monitor. You should see a message
stating that initialization is complete.

Start with your hand off to one side (a "side" being the one of the infrared LEDs with the brass covers) about 4 to 10 inches (10 to 25 cm) above the sensor. Swipe your hand horizontally across the sensor so that your hand passes over the one infrared LED and then the next infrared LED.
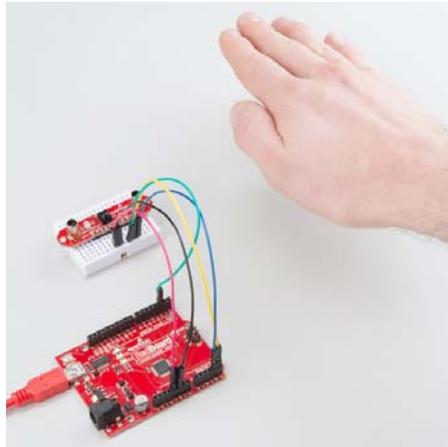
If you performed the gesture correctly, you should see a message appear in the Serial Monitor.

NOTE: The "Speed" of the gesture is a measure of how fast the gesture occurred. Note that the *lower* the number, the *faster* the gesture occurred (e.g. 3 being very fast and 25 being very slow).

Supported Gestures

Here is a list of the currently supported gestures. Make sure each gesture begins outside of the range of the sensor, moves into the range of the sensor, and ends outside the range of the sensor.

Gesture	Description
Right Swipe	A swipe from the left side of the board to the right and out of range of the sensor. Make sure that your wrist/arm is not in the sensor's range at the end of the swipe!
Left Swipe	A swipe from the right side of the board to the left and out of range of the sensor.

Up Swipe	Object starts near the sensor, hovers for at least 1 second, and then moves up above and out of range of the sensor.
No Gesture	The sensor could not correctly determine the gesture being performed.

PC: ZX Example

The ZX Sensor, in addition to responding to I²C commands, continually transmits ZX data over its UART port. We can connect an FTDI Breakout directly to the ZX Sensor and read the output. You can use serial applications or the screen command (Linux or Mac) to view the output.

> **NOTE:** You can use either 3.3 V or 5 V FTDI. 5 V gives you a bit better range with the sensor.

If you are on a Windows computer, you can use the demo application (linked below) provided by XYZ Interactive to test the ZX Sensor.

Setup

Connect the FTDI Breakout board to the ZX Sensor. Ensure the pins on the FTDI Brekaout line up with the pins on the ZX Sensor (e.g. GRN connects to GRN and BLK connects to BLK). Connect the FTDI Breakout to your computer with a USB cable.
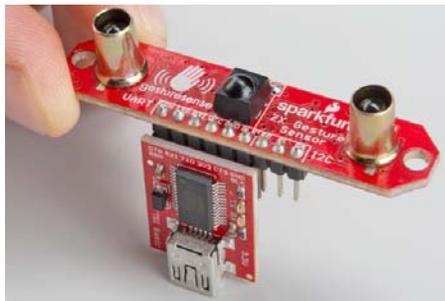
Download the ZX Demo application, and unzip it.

DOWNLOAD THE ZX DEMO APPLICATION

Run

Double-click to run the ZX Demo application. Under "Input:" on the right side, drop down the list and select the COM port that corresponds to your FTDI Breakout (if you need a refresher on find the right COM port, check out this section of the Terminal Basics tutorial). You do not need to choose an "Output:" port.

Click **Open** to connect to the FTDI Breakout.

Move your hand around above the sensor, and you should see the red ball

move.

Try out the other tabs in the application! The Z-Control tab lets your try moving your hand toward and away from the sensor, and the Gestures tab computes a few different gestures based on the Z- and X- data.

Resources and Going Further

After trying the basic ZX and gesture demos, you can try the other examples in the Arduino library. A description of each of the examples is given below:

- **I2C_Gesture_Demo** – Poll the sensor over I²C to see if any gestures have occurred.
- **I2C_Gesture_Interrupt** – The DR pin will go from low to high when a gesture is detected. This example reads the gesture over I2C and tells the sensor to clear DR.
- **I2C_ZX_Demo** – Poll the sensor periodically over I²C for Z- and X-axis data.
- **I2C_ZX_Interrupt** – The ZX Sensor will throw DR high whenever valid ZX data is ready.
- **UART_Gesture_Demo** – **NOTE:** Gestures over UART are not supported at this time. This demo is a placeholder for the time being.
- **UART_ZX_Demo** – Read Z- and X- axis data from a software serial port and display them on the Serial Monitor.
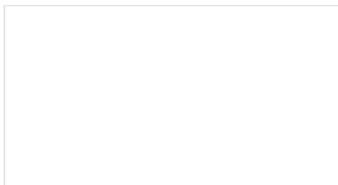
Resources

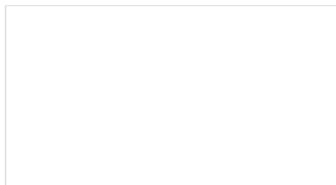Here are some additional resources to help you with the ZX Sensor:

- ZX Sensor Datasheet
- Using the ZX Sensor with Arduino
- ZX Sensor Schematic
- ZX Sensor GitHub Repository

Other Tutorials

What will you make with the ZX Sensor? If you need some inspiration, check out these related tutorials:
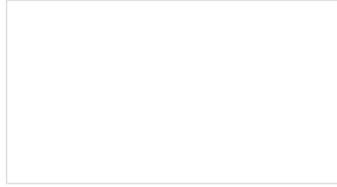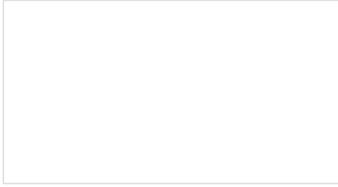

Connecting Arduino to

Serial Graphic LCD Hookup

Processing
Send serial data from Arduino to Processing and back - even at the same time!

Learn how to use the Serial Graphic LCD.

RGB Panel Hookup Guide
Make bright, colorful displays using the 32x32 and 32x16 RGB LED panels. This hookup guide shows how to hook up these panels and control them with an Arduino.

APDS-9960 RGB and Gesture Sensor Hookup Guide
Getting started guide for the Avago APDS-9960 color, proximity, and gesture sensor.