Self-Driving Miniature Toy Car
Technical Documents

All URL to product specifications, definitions, and explanations will be listed.

Presented to:

University of Southern California
Department of Industrial and Systems Engineering
ISE 511L

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Prepared by:

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Contents

Timeline

1. Arduino attached to car? – Full control of Left, Right, Stop, Forward. Decide for actuation for NW, NE, SW, SE.
2. Ultrasonic sensors calibrated
3. IR Laser calibration
4. Program Stop at Obstacles, distance also calibrated for stopping, before next move.
5. Xbee - RSSI Module Calibrated, RSSI level from 1-10 within range of 50ft?
6. Can car travel towards RSSI level 10? With no obstacles
7. With obstacles, turn random left or right before.
8. With obstacles, check left, right, front, choose the one with most distance measured? If RSSI is lower, reverse back to orginal spot and try 2nd further direction. Discard random turning.

Product Specifications

A. Retrofit RC Car

Start with RC Car Model:

https://www.amazon.com/gp/product/B001TMBQYC/ref=oh_aui_detailpage_o00_s03?ie=UTF8

Remote Control Lamborghini Reventon 1/18 Scale RC

by Lamboughini

- REALISTIC: This RC car has an ultra-detailed exterior, rims and tires with a glossy finish topcoat.
- EASY TO MANEUVER: Full function radio control allows you to take corners with ease and move in all directions: forward, reverse, stop, left and right.
- READY TO GO: Comes factory assembled. The remote control car requires 4 AA batteries and remote takes one 9v battery, not included.
- COMPACT: Based off of 1/18 scale of the iconic Lamborghini Reventon. This vehicle measures in at 9" long.
- WARNING: Choking Hazard - small parts. Not for children under 3 yrs.

&psc=1

Product Description

Color:Colors may vary

Trying to beat another afternoon of boredom? Don't sweat it! Take off with your Lamborghini Reventon replica and finally fulfill your need for speed. Fully functioning and radio controlled, this Lamborghini Reventon can zip around corners like the real thing! It's full function capability allows it to move in any direction: forward, reverse, stop, left and right. Keeps your wheels in perfect alignment with adjustable front wheel alignment. The realistic exterior, rims and tires are detailed to such precision that it's small stature is the only thing that sets it apart from the iconic Ferarri Reventon. The exterior paint is complete with a glossy finish and the body is professionally made with fine-crafted materials. Fly by at speeds of up to 8 mph. This RC car is crafted in a 1:18 scale to an authentic Ferrarri Reventon. Your remote signal will be able to reach up to 30 feet away. Since it's factory assembled, once you open the box it's ready to run! Requires 4 AA batteries (not included) and a 9v battery for the controller (not include. Dimensions: 10" L X 5" W X 3" H.

B. Arduino UNO Microcontroller

Product Features

- Manufacturer: Arduino Product Category: Development Boards & Kits - AVR RoHS: Product: Development Kits Tool Is For Evaluation Of: ATmega328P Core: Interface Type: I2C, ICSP, SPI, USB Brand: Arduino Data Bus Width: 8 bit For Use With: ATmega

Product Description

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started

C. Xbee Shield

Gikifun Xbee Sield V03 Module for Arduino:
https://www.amazon.com/gp/product/B00XX6UKYE/ref=oh_aui_detailpage_o00_s01?ie=UTF8

Gikfun Bluetooth XBee Shield V03 Module For Arduino EK1185_

- This shield V03 can achieve a simple two crunodal ZigBee network
- It is a fully Assembled shield without the XBee module

&psc=1

D. Infrared Laser Sensor

Waveshare Laser Receiver Module Laser Sensor Module Transmitter Module for Arduino AVR PIC:
https://www.amazon.com/gp/product/B00NJNYQ9G/ref=oh_aui_detailpage_o02_s03?ie=UTF8&psc=1#Ask

Waveshare Laser Receiver Module Laser Sensor Module Transmitter Module for Arduino AVR PIC

- Effective distance: 0.8m(typ), 1.5m(max)
- Power: 2.5V ~ 5.0V
- Dimension: 53.0mm * 18.0mm
- Mounting holes size: 2.0mm
- Signal output indicator

Overview

Features boost circuit
Signal output indicator

Specifications

Effective distance: 0.8m(typ), 1.5m(max)
Power: 2.5V ~ 5.0V
Dimension: 47.7mm * 17.9mm
Mounting holes size: 2.0mm

Applications

Obstacle detection
Pipeline counter
Smart robot
Obstacle-avoiding car

How to Use

In the case of working with a MCU:

VCC ↔ 2.5V ~ 5.0V
GND ↔ power supply ground
DOUT ↔ MCU.IO (digital output)

E. Arduino UNO Power Supply and Adapters

5pack 9v Battery Clip with 2.1mm X 5.5mm Male DC Plug for Arduino by Corpco

- Plug Type: 2.1mm x 5.5mm Male to 9V Battery Clip
- Cable length:6 inches
- Great to use for LED strip light or arduino
- Package contains 5 pcs 9v Battery Clips (9V battery is not included)
- Arduino and Battery shown for example only

F. Miniature Breadboards

Phantom YoYo 170 Points Mini Breadboard for Arduino Proto Shield (3)

https://www.amazon.com/gp/product/B016Q6T7Q4/ref=oh_aui_detailpage_o02_s02?ie=UTF8&psc=1

Phantom YoYo 170 Points Mini
Breadboard for Arduino Proto Shie

Product Features

- Color Red + blue + black + white + green + ye
- Material ABS
- Features With 170 tie points
- With self-adhesive tape on the back, make it easy to stick on the Arduino Prototype Shield. Perfect for DIY projects
- Packing List 6 x Mini breadboards comes with random colors.

G. Xbee Module Series 1

Xbee 1mW Wire antenna – Series (802.15.4) (2):

https://www.amazon.com/gp/product/B00LF3WQM6/ref=oh_aui_detailpage_o01_s00?ie=UTF8&psc=1

XBee 1mW Wire Antenna - Series 1 (802.15.4) - 2 Pack

- This is a 2-pack - great for new projects!
- 3.3V @ 50mA
- 250kbps Max data rate 128-bit encryption
- 8 digital IO pins 6 10-bit ADC input pins
- 300ft (100m) range

Product Description

This is the very popular 2.4GHz XBee module from Digi. These modules take the 802.15.4 stack (the basis for Zigbee) and wrap it into a simple to use serial command set. These modules allow a very reliable and simple communication between microcontrollers, computers, systems, really anything with a serial port! Point to point and multi-point networks are supported.

XBee/XBee-PRO S1 802.15.4 Performance specifications

This table describes the performance specifications for the devices.

Specification	XBee	XBee-PRO
Indoor/urban range	Up to 100 ft (30 m)	Up to 300 ft. (90 m), up to 200 ft (60 m) International variant
Outdoor RF line-of-sight range	Up to 300 ft (90 m)	Up to 1 mile (1600 m), up to 2500 ft (750 m) international variant
Transmit power output (software selectable)	1mW (0 dBm)	63 mW (18dBm)* 10 mW (10 dBm) for international variant
RF data rate	250,000 b/s	250,000 b/s
Serial interface data rate (software selectable)	1200 b/s - 250 kb/s (non-standard baud rates also supported)	1200 bps - 250 kb/s (non-standard baud rates also supported)
Receiver sensitivity (typical)	-92 dBm (1% packet error rate)	100 dBm (1% packet error rate)

XBee/XBee-PRO S1 802.15.4 Pin signals

The following graphic shows the XBee/XBee-PRO S1 802.15.4 (Legacy) RF Modules pin number for the devices, with the top sides shown; shields are on the bottom:
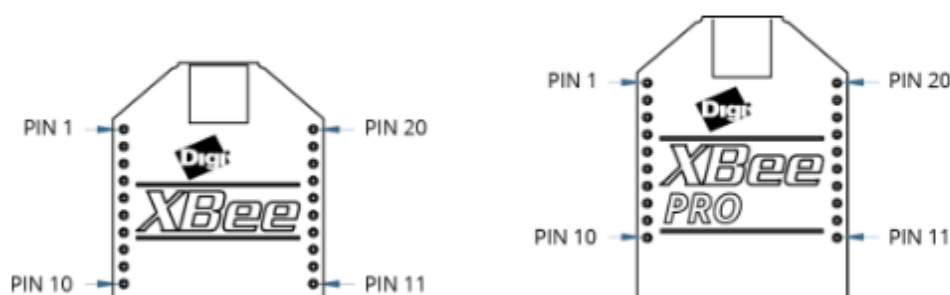
The following table describes the pin assignments for the devices. A horizontal line above the signal name indicates low-asserted signals.

Design notes

The XBee modules do not specifically require any external circuitry specific connections for proper operation. However, there are some general design guidelines that we recommend for help in troubleshooting and building a robust design.

Power supply design

A poor power supply can lead to poor device performance, especially if you do not keep the supply voltage within tolerance or if it is excessively noisy. To help reduce noise, place a 1.0 μF and 8.2 pF capacitor as near as possible to pin 1 on the PCB. If you are using a switching regulator for the power supply, switch the frequencies above 500 kHz. Limit the power supply ripple to a maximum 100 mV peak to peak.

Board layout

We design XBee devices to be self sufficient and have minimal sensitivity to nearby processors, crystals or other printed circuit board (PCB) components. Keep power and ground traces thicker than signal traces and make sure that they are able to comfortably support the maximum current specifications. There are no other special PCB design considerations to integrate XBee devices, with the exception of antennas.

Notes:

- Minimum connections: VCC, GND, DOUT and DIN

- Minimum connections for updating firmware: VCC, GND, DIN, DOUT, RTS and DTR

- Signal direction is specified with respect to the module

- The module includes a 50 kΩ pull-up resistor attached to $\overline{\text{RESET}}$

- You can configure several of the input pull-ups using the PR command

- Leave any unused pins disconnected

XBee/XBee-PRO S1 802.15.4 Pin signals updated on 13 Oct 2016 07:21 AM

Electrical characteristics

The following tables list the electrical characteristics of the XBee/XBee-PRO XBee/XBee-PRO S1 802.15.4 (Legacy) RF Modules.

DC Characteristics (VCC = 2.8 - 3.4 VDC)

Symbol	Characteristic	Condition	Min	Typical	Max	Unit
V_{IL}	Input low voltage	All Digital Inputs	-	-	0.35 * VCC	V
V_{IH}	Input high voltage	All Digital Inputs	0.7 * VCC	-	-	V
V_{OL}	Output low voltage	I_{OL} = 2 mA, VCC >= 2.7 V	-	-	0.5	V
V_{OH}	Output high voltage	I_{OH} = -2 mA, VCC >= 2.7 V	VCC - 0.5	-	-	V
II_{IN}	Input leakage Current	VIN = VCC or GND, all inputs, per pin	-	0.025	1	µA
II_{OZ}	High impedance leakage current	VIN = VCC or GND, all I/O High-Z, per pin	-	0.025	1	µA
TX	Transmit current	VCC = 3.3 V	-	45 (XBee) 215, 140 (XBee-PRO, International)	-	mA
RX	Receive current	VCC = 3.3 V	-	50 (XBee) 55 (XBee-PRO)	-	mA
PWR-DWN	Power-down current	SM parameter = 1	-	<10	-	µA

Pin#	Name	Direction	Description
1	VCC	-	Power supply
2	DOUT	Output	UART data out
3	DIN/$\overline{CONFIG}$	Input	UART data In
4	DO8[1]	Either	Digital output 8
5	$\overline{RESET}$	Input/Open drain output	Module reset (reset pulse must be at least 200 ns).This must be driven as an open drain/collector. The module drives this line low when a reset occurs. Never drive this line high.
6	PWM0/RSSI	Either	PWM output 0 / RX signal strength indicator
7	PWM1	Either	PWM output 1
8	[reserved]	-	Do not connect
9	$\overline{DTR}$/SLEEP_RQ/DI8	Either	Pin sleep control line or digital input 8
10	GND	-	Ground
11	AD4/DIO4	Either	Analog input 4 or digital I/O 4
12	$\overline{CTS}$ /DIO7	Either	Clear-to-send flow control or digital I/O 7
13	ON/$\overline{SLEEP}$	Output	Module status indicator
14	VREF	Input	Voltage reference for A/D inputs
15	Associate/AD5/DIO5	Either	Associated indicator, analog input 5 or digital I/O 5
16	$\overline{RTS}$/DIO6	Either	Request-to-send flow control, or digital I/O 6
17	AD3/DIO3	Either	Analog input 3 or digital I/O 3
18	AD2/DIO2	Either	Analog input 2 or digital I/O 2
19	AD1/DIO1	Either	Analog input 1 or digital I/O 1
20	AD0/DIO0	Either	Analog input 0, digital IO 0

ADC characteristics (operating)

Symbol	Characteristic	Condition	Min	Typical	Max	Unit
V_{REFH}	VREF - analog-to-digital converter reference range		2.08	-	V_{DDAD}[1]	V
I_{REF}	VREF - reference supply current	Enabled	-	200	-	μA
		Disabled or Sleep Mode	-	<0.01	0.02	μA
V_{INDC}	Analog input voltage[2]		V_{SSAD} - 0.3		V_{DDAD} + 0.3	V

1. V_{DDAD} is connected to VCC.

2. Maximum electrical operating range, not valid conversion range.

ADC timing/performance characteristics[1]

Symbol	Characteristic	Condition	Min	Typical	Max	Unit
R_{AS}	Source impedance at input[2]	-		-	-	kW
V_{AIN}	Analog input voltage[3]	-	V_{REFL}	-	V_{REFL}	V
RES	Ideal resolution (1 LSB)[4]	2.08V < VDDAD < 3.6V	2.031	-	3.516	mV
DNL	Differential non-linearity[5]	-	-	±0.5	±1.0	LSB
INL	Integral non-linearity[6]	-	-	±0.5	±1.0	LSB
E_{ZS}	Zero-scale error[7]	-	-	±0.4	±1.0	LSB
F_{FS}	Full-scale error[8]	-	-	±0.4	±1.0	LSB
E_{IL}	Input leakage error[9]	-	-	±0.05	±5.0	LSB
E_{TU}	Total unadjusted error[10]	-	-	±1.1	±2.5	LSB

Antenna performance

Antenna location is important for optimal performance. The following suggestions help you achieve optimal antenna performance. Point the antenna up vertically (upright). Antennas radiate and receive the best signal perpendicular to the direction they point, so a vertical antenna's omnidirectional radiation pattern is strongest across the horizon.

Position the antennas away from metal objects whenever possible. Metal objects between the transmitter and receiver can block the radiation path or reduce the transmission distance. Objects that are often overlooked include:

- metal poles
- metal studs
- structure beams
- concrete, which is usually reinforced with metal rods

If you place the device inside a metal enclosure, use an external antenna. Common objects that have metal enclosures include:

- vehicles
- elevators
- ventilation ducts
- refrigerators
- microwave ovens
- batteries
- tall electrolytic capacitors

Do not place XBee devices with the chip or integrated PCB antenna inside a metal enclosure.

Do not place any ground planes or metal objects above or below the antenna.

For the best results, mount the device at the edge of the host PCB. Ensure that the ground, power, and signal planes are vacant immediately below the antenna section.

Design notes updated on 13 Oct 2016 07:21 AM

H. HC-SR04 Ultrasonic Distance Sensor

Elegoo HC-SR04 Ultrasonic Module Distance Sensor for Arduino UNO MEGA2560 Nano Robot XBee ZigBee

https://www.amazon.com/gp/product/B01COSN7O6/ref=oh_aui_detailpage_o02_s01?ie=UTF8&psc=1

Elegoo HC-SR04 Ultrasonic Module Distance Sensor for Arduino UNO MEGA2560 Nano Robot XBee

- Ultrasonic HC-SR04 Distance Measuring Transducer Sensor
- HC-SR04 consists of ultrasonic transmitter, receiver, and control circuit. When triggered it sends out a series of 40KHz ultrasonic pulses and receives echo from an object. The distance between the unit and the object is calculated by measuring the traveling time of sound and output it as the width of a TTL pulse.
- Power supply: 5V DC; quiescent current: less than 2mA; effectual angle: less than 15°; distance: 2cm~500cm; resolution: 0.3 cm
- Package Content: 5pcs HC-SR04 with a little gift

Product Description

Elegoo Inc. is a professional manufacturer and exporter that is concerned with the design, development production and marketing of arduino, 3d printers, raspberry pi and STM32.
Our Dream is to make the best price and best quality produce for customers.
So we would like to receive your valuable suggestions for our products and we can improve them for you.

Ultrasonic HC-SR04 Distance Measuring Transducer Sensor
HC-SR04 consists of ultrasonic transmitter, receiver, and control circuit.
When trigged it sends out a series of 40KHz ultrasonic pulses and receives echo from an object.
The distance between the unit and the object is calculated by measuring the traveling time of sound and output it as the width of a TTL pulse.

power supply :5V DC
quiescent current : <2mA
effectual angle: <15°
ranging distance : 2cm – 500 cm
resolution : 0.3 cm

Package including:
5 pcs in the Antistatic Resealable Bag
gift : 10pcs female to male cable

I. RC Car Power Supply

4 AA Batteries amounting to 5V (Self-explanatory)

J. Xbee Breakout Board

LinkSprite Breakout Board for Xbee Module with 5V interface to 3.3V Xbee:
https://www.amazon.com/gp/product/B0191IJD36/ref=oh_aui_detailpage_o00_s01?ie=UTF8&psc=

1
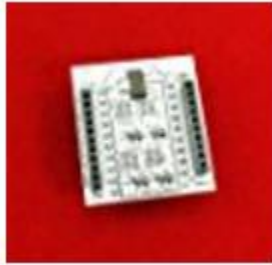
LinkSprite Breakout Board for XBee
Module with 5V interface to 3.3V
Xbee

- simple breakout board
- XBee Module with 5V interface to 3.3V Xbee

K. Xbee Explorer USB

https://www.amazon.com/gp/product/B008O92TZS/ref=oh_aui_detailpage_o00_s01?ie=UTF8&psc
=1

XBEE Explorer USB

Product Features

- USB to serial base unit for XBee modules
- Works with XBee modules Series 1 and Series 2.5, standard and Pro
- XBee module and USB cable NOT INCLUDED

Product Description

This is a simple to use, USB to serial base unit for the XBee line. This unit works with all XBee modules including the Series 1 and Series 2.5, standard and Pro version. Plug the unit into the XBee Explorer, attach a mini USB cable, and you will have direct access to the serial and programming pins on the XBee unit. You get the red board only. XBee modules and USB cable sold below. Note: As of August 2010, all new boards now include a MIC5219 voltage regulator which is good for 500mA. Note: A pull-up on DIN is required for this board to work properly. Thankfully, Series 1 and Series 2 XBee modules have their internal pull-up enabled by default. You will need to manually enable the pull-up on the 900MHz series.
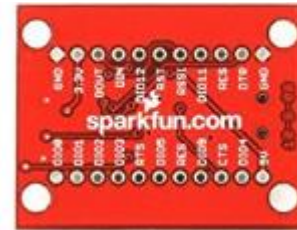
L. Female/ Male and Male/Male Wires

50 PCS Jumper Wires Premium
200mm M/F Male-to-Female

M. HG7881 DC Dual Motor Driver Controller H-Bridge

uxcell DC Dual Stepper Motor Driver Controller H-bridge Board for HG7881

https://www.amazon.com/gp/product/B00W18P4MI/ref=oh_aui_detailpage_o01_s00?ie=UTF8 &psc=1

uxcell DC Dual Stepper Motor Driver Controller H-bridge Board for HG7881

by uxcell
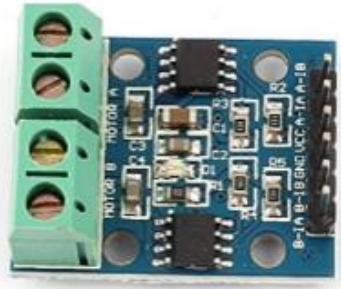
- Power Supply: DC 2.5-12V; Country of Manufacture: CHINA
- Material: Electric Parts; Net Weight: 7g
- Package Content: 1 x DC Dual Motor Driver Controller; Model: for HG7881
- Main Color: Green, Blue
- Size: 29 x 23mm / 1.1" x 0.9"(L*W)

Product Description

Onboard two the L9110S motor control chip
The module can simultaneously drive two DC motors or a 4-wire 2-phase stepper motor
Low static work current
Power supply voltage: DC2.5-12V
Each channel has 800mA continuous current output
Low saturation pressure drop
TTL/CMOS output level compatible, can be connected directly to the CPU
Output built-in clamping diode, apply to the perceptual load
Control and drive integrate in IC
Have pin high pressure protection function
Working temperature: 0-80C

N. Styrene Tubing, 1/8"

Plastruct STFS-4 Square Tubing,1/8", PLS90621

https://www.amazon.com/gp/product/B0000WS8TS/ref=oh_aui_detailpage_o09_s00?ie=UTF8 &psc=1

Plastruct STFS-4 Square Tubing,1/8" (7) PLS90621

O. Miscellaneous Materials

- Soldering Iron, Screwdriver, scissors, wire cutter and insulation remover, and basic assembly tools.

Indoor Navigation

http://www.directionsmag.com/entry/10-things-you-need-to-know-about-indoor-positioning/324602

5. Indoor positioning detects the location of a person or object, but not always its orientation or direction

While indoor positioning systems can determine location, many need additional information to determine which way a person or object is facing. That can make providing directions or pitching a product in a store more challenging.

***The addition of an electronic compass to a receiver (many cell phones now have them), or a microelectromechanical systems (MEMS)** orientation sensor or a prompt to turn toward a particular direction (to scan a bar code or QR code on a poster, for example) can provide more information regarding orientation.*

9. The Federal Communications Commission (FCC) is looking at indoor positioning to enhance emergency response

Results of a study conducted in late 2012 and published March 14, 2013 by the FCC's Communications Security, Reliability and Interoperability Council (CSRIC) suggests a current baseline for indoor positioning for use in emergency response. Three different vendors, using three different indoor technologies, participated (summary).One key concern is determining vertical location, that is, on which floor a person is standing in a multilevel building. The FCC report concludes: "While the location positioning platforms tested provided a relatively high level of yield, as well as improved accuracy performance, the results clearly indicate additional development is required."

10. Indoor positioning requires indoor maps

Locating a person or device indoors is only half of the solution. For the location to be meaningful for navigation or other purposes, service providers need accurate indoor maps. There's a new industry creating those data. Micello recently announced it had mapped 15,000 indoor venues (press release). Google, in addition to collecting its own indoor mapping data (APB coverage), is crowdsourcing maps from its proprietors (APB coverage). Nokia (APB coverage) is collecting indoor data and even OpenStreetMap has a wiki page about indoor maps.

Xbee – RSSI

https://en.wikipedia.org/wiki/Received_signal_strength_indication

http://www.metageek.com/training/resources/understanding-rssi.html

http://www.digi.com/resources/documentation/Digidocs/90000982/reference/r_xb_xbpro_s1_802.15_leg_performance.htm

Xbee Configuration

Seeker SH (Serial Number High): 13A200 | Seeker SL (Serial Number Low): 40F85EE8

Hider SH (Serial Number High): 13A200| Hider SL (Serial Number Low): 40F85EE7

http://docs.digi.com/display/XBeeArduinoCodingPlatform/Treasure+Hunt

Param	Seeker	Hider	Effect
ID	2015	2015	Defines the network that a radio will attach to. This must be the same for all radios on your network.
CE	Coordinator [1]	—	Defines the role of the XBee module.
A1	—	0110b [6]	Auto-associate (bit 2) Scan channels for matching coordinator (bit 1)
A2	110b [6]	—	Allow End Device association (bit 2) Allow channel reassignment (bit 1)
SM	—	Cyclic Sleep Remote [4]	Enables the cyclic sleep remote mode. Sleep on a schedule determined by **SP** and **ST**.
ST	C8	C8	Defines the period of inactivity before going to sleep for sleeping devices (hider). C8 (hexadecimal) = 200 (decimal) x 1 = 200 milliseconds. This value must be the same for both XBees.
SP	14	14	Defines the duration of time spent sleeping for sleeping devices (hider). 14 (hexadecimal) = 20 (decimal) x 10 = 200 milliseconds. This value must be the same for both XBees.

Param	Seeker	Hider	Effect
DP	—	C8	Defines the period to re-associate. C8 (hexadecimal) = 200 (decimal) x 10 = 2 seconds.
AP	API enabled w/PPP [2]	—	Enables API mode with escaping.
D7	Disabled [0]	—	Seeker DIO7 is connected to RESET on the Arduino. This is used to hold the Arduino in reset when the XBee module is sleeping. This reset functionality is unnecessary for the sample application and can cause unintended Arduino reboots when remote nodes are unresponsive.

Seeker:

▼ RF Interfacing
Modify RF interfacing options

PL Power Level	Highest [4]	
CA CCA Threshold	2C	-dBm

▼ Sleep Modes (NonBeacon)
Configure low power options for NonBeacon systems

SM Sleep Mode	No Sleep [0]	
ST Time before Sleep	C8	x 1 ms
SP Cyclic Sleep Period	14	x 10 ms
DP Disassociated... Sleep Period	3E8	x 10 ms
SO Sleep Options	0	

▼ Serial Interfacing
Modify modem interfacing options

BD Interface Data Rate	9600 [3]	
NB Parity	No Parity [0]	
RO Packetization Timeout	3	x character times
AP API Enable	API enabled w/PPP [2]	

▼ I/O Settings
Modify DIO and ADC options

D8 DI8 Configuration	Disabled [0]
D7 DIO7 Configuration	Disabled [0]
D6 DIO6 Configuration	Disabled [0]
D5 DIO5 Configuration	Associated indicator [1]
D4 DIO4 Configuration	Disabled [0]
D3 DIO3 Configuration	Disabled [0]
D2 DIO2 Configuration	Disabled [0]
D1 DIO1 Configuration	Disabled [0]

D1 DIO1 Configuration	Disabled [0] ⌄	
D0 DIO0 Configuration	Disabled [0] ⌄	
PR Pull-up Resistor Enable	FF	
IU I/O Output Enable	Enabled [1] ⌄	
IT Samples before TX	1	
IC DIO Change Detect	0	
IR Sample Rate	0	X 1 ms
P0 PWM0 Configuration	RSSI [1] ⌄	
P1 PWM1 Configuration	Disabled [0] ⌄	
PT PWM Output Timeout	FF	x 100 ms
RP RSSI PWM Timer	28	x 100 ms

▼ I/O Line Passing

IA I/O Input Address	FFFFFFFFFFFFFFFF	
T0 D0 Output Timeout	FF	x 100 ms

T1 D1 Output Timeout	FF	x 100 ms	
T2 D2 Output Timeout	FF	x 100 ms	
T3 D3 Output Timeout	FF	x 100 ms	
T4 D4 Output Timeout	FF	x 100 ms	
T5 D5 Output Timeout	FF	x 100 ms	
T6 D6 Output Timeout	FF	x 100 ms	
T7 D7 Output Timeout	FF	x 100 ms	

▼ **Diagnostics**
Access diagnostic parameters

VR Firmware Version	10EF	
HV Hardware Version	1748	
DB Received Signal Strength	0	
EC CCA Failures	0	
EA ACK Failures	1	
DD Device Type Identifier	10000	

▼ **AT Command Options**
Modify AT Command Mode behavior

CT AT Command...de Timeout	64	x 100ms	
GT Guard Times	3E8	x 1ms	
CC Command Seq...e Character	2B	Recomm...ASCII)	

Hider:

▼ Networking & Security
Modify networking settings

ⓘ	**CH** Channel	C	
ⓘ	**ID** PAN ID	2015	
ⓘ	**DH** Destination Address High	0	
ⓘ	**DL** Destination Address Low	0	
ⓘ	**MY** 16-bit Source Address	0	
ⓘ	**SH** Serial Number High	13A200	
ⓘ	**SL** Serial Number Low	40F85EE7	
ⓘ	**MM** MAC Mode	802.15.4 + MaxStream header w/A ⌄	
ⓘ	**RR** XBee Retries	0	
ⓘ	**RN** Random Delay Slots	0	
ⓘ	**NT** Node Discover Time	19	x 100 ms
ⓘ	**NO** Node Discover Options	0	
ⓘ	**CE** Coordinator Enable	End Device [0] ⌄	

ⓘ	**CE** Coordinator Enable	End Device [0] ⌄	
ⓘ	**SC** Scan Channels	1FFE	Bitfield
ⓘ	**SD** Scan Duration	4	exponent
ⓘ	**A1** End Device Association	0110b [6] ⌄	
ⓘ	**A2** Coordinator Association	000b [0] ⌄	
ⓘ	**AI** Association Indication	0	
ⓘ	**EE** AES Encryption Enable	Disable [0] ⌄	
ⓘ	**KY** AES Encryption Key		
ⓘ	**NI** Node Identifier		

▼ RF Interfacing
Modify RF interfacing options

ⓘ	**PL** Power Level	Highest [4] ⌄	
ⓘ	**CA** CCA Threshold	2C	-dBm

▼ Sleep Modes (NonBeacon)
Configure low power options for NonBeacon systems

ⓘ **SM** Sleep Mode	Cyclic Sleep Remote [4] ⌄	
ⓘ **ST** Time before Sleep	C8	x 1 ms
ⓘ **SP** Cyclic Sleep Period	14	x 10 ms
ⓘ **DP** Disassociated... Sleep Period	C8	x 10 ms
ⓘ **SO** Sleep Options	0	

▼ Serial Interfacing
Modify modem interfacing options

ⓘ **BD** Interface Data Rate	9600 [3] ⌄	
ⓘ **NB** Parity	No Parity [0] ⌄	
ⓘ **RO** Packetization Timeout	3	x character times
ⓘ **AP** API Enable	API disabled [0] ⌄	

I/O Settings
Modify DIO and ADC options

D8 DI8 Configuration	Disabled [0]	
D7 DIO7 Configuration	CTS flow control [1]	
D6 DIO6 Configuration	Disabled [0]	
D5 DIO5 Configuration	Associated indicator [1]	
D4 DIO4 Configuration	Disabled [0]	
D3 DIO3 Configuration	Disabled [0]	
D2 DIO2 Configuration	Disabled [0]	
D1 DIO1 Configuration	Disabled [0]	
D0 DIO0 Configuration	Disabled [0]	
PR Pull-up Resistor Enable	FF	
IU I/O Output Enable	Enabled [1]	
IT Samples before TX	1	
IC DIO Change Detect	0	
IR Sample Rate	0 X 1 ms	

P0 PWM0 Configuration	RSSI [1] ⌄			
P1 PWM1 Configuration	Disabled [0] ⌄			
PT PWM Output Timeout	FF	x 100 ms		
RP RSSI PWM Timer	28	x 100 ms		

▼ I/O Line Passing

IA I/O Input Address	FFFFFFFFFFFFFFFF		
T0 D0 Output Timeout	FF	x 100 ms	
T1 D1 Output Timeout	FF	x 100 ms	
T2 D2 Output Timeout	FF	x 100 ms	
T3 D3 Output Timeout	FF	x 100 ms	
T4 D4 Output Timeout	FF	x 100 ms	
T5 D5 Output Timeout	FF	x 100 ms	
T6 D6 Output Timeout	FF	x 100 ms	
T7 D7 Output Timeout	FF	x 100 ms	

▼ Diagnostics
Access diagnostic parameters

VR Firmware Version	10EF	
HV Hardware Version	1748	
DB Received Signal Strength	0	
EC CCA Failures	0	
EA ACK Failures	1	
DD Device Type Identifier	10000	

▼ AT Command Options
Modify AT Command Mode behavior

CT AT Command...de Timeout	64	x 100ms	
GT Guard Times	3E8	x 1ms	
CC Command Seq...e Character	2B	Recomm...ASCII)	

What is RSSI and what does it mean for a WiFi network?

RSSI, or "Received Signal Strength Indicator", is a measurement of how well your device can hear a signal from an access point or router. It's a value that is useful for determining if you have enough signal to get a good wireless connection.

Note: Because an RSSI value is pulled from the client device's WiFi card (hence "received" signal strength), it is not the same as transmit power from a router or AP.

RSSI vs dBm

dBm and RSSI are different units of measurement that both represent the same thing: signal strength. The difference is that RSSI is a relative index, while dBm is an absolute number representing power levels in mW (milliwatts).

RSSI is a term used to measure the relative **quality** of a received signal to a client device, but has no absolute value. The IEEE 802.11 standard (a big book of documentation for manufacturing WiFi equipment) specifies that RSSI can be on a scale of 0 to up to 255 and that each chipset manufacturer can define their own "RSSI_Max" value. Cisco, for example, uses a 0-100 scale, while Atheros uses 0-60. It's all up to the manufacturer (which is why RSSI is a relative index), but you can infer that the higher the RSSI value is, the better the signal is.

Since RSSI varies greatly between chipset manufacturers, MetaGeek software uses a more standardized, absolute measure of signal strength: received signal power, which is measured in decibels, or **dBm** on a logarithmic scale. There's a lot of math we could get into, but basically, **the closer to 0 dBm, the better the signal is**.

To help leverage your signal strength measurement most effectively so you can make channel planning decisions, inSSIDer Office displays signal strength in two ways.

Acceptable Signal Strengths

Signal Strength	TL;DR		Required for
-30 dBm	Amazing	Max achievable signal strength. The client can only be a few feet from the AP to achieve this. Not typical or desirable in the real world.	N/A
-67 dBm	Very Good	Minimum signal strength for applications that require very reliable, timely delivery of data packets.	VoIP/VoWiFi, streaming video
-70 dBm	Okay	Minimum signal strength for reliable packet delivery.	Email, web
-80 dBm	Not Good	Minimum signal strength for basic connectivity. Packet delivery may be unreliable.	N/A
-90 dBm	Unusable	Approaching or drowning in the noise floor. Any functionality is highly unlikely.	N/A

https://forum.arduino.cc/index.php?topic=63519.0

Not much. First, the signal strength name is RSSI - Relative signal strength indicator. That's like "on a scale of 1 to 5...". In other words, not very accurate.

Second, you'd need a boatload of XBees as receivers, connected to one computer. Not only would that be expensive, but you are limited by the number of serial ports that the computer can support, and the time it takes to poll each receiving XBee for it's relative signal strength indicator value.

Your refresh rate for knowing where the dancer was would be abysmally low.

I'd suggest that you get two XBees. Program them to report RSSI values, and display the values on an LCD. Move one Arduino/XBee/XBee shield/LCD device around, and see how the RSSI values change.

This will tell you whether, or not, in your environment, the RSSI values means anything.

PaulS is correct, you should get a couple of XBees and try the RSSI to see if the granularity is good enough for you. I suspect the problems that PaulS went into will bring you to a halt on using them. The RSSI doesn't seem to change until it almost goes away, if there is enough difference to be able to triangulate I would be surprised. Also as Paul mentioned, the update time is probably much shorter than you want. I suspect the person could move a couple of feet before you knew it.

Indeed, other documents seem to confirm that this kind of tracking can be used with a lo-res granularity ("room identification") only. Too bad.

https://forum.sparkfun.com/viewtopic.php?f=13&t=32336&p=144820&hilit=rssi+indoor&sid=484f449766e180d7d48913596ab8128b#p144820

Re: Xbee distance problem

by **stevech** » Thu May 10, 2012 8:12 pm

XBee series 1 non-Pro model? It's about 2mW. Range depends on antenna types. Worst, it should be 100++ ft line of sight.

Xbee series 1 Pro model - is 60mW. Range again depends on antenna types. Expect 300-1000 ft line of sight.

With gain antennas, 1/2 mile or more line of sight.

Moving with the radius affects nothing, as long as serious RF obstructions aren't present.

At close range (say, 50 ft) all sorts of non-line-of-sight should work.

You can look at the received signal strength (RSSI) with XCTU or your own software to query that register via an AT command or via use of the XBee binary API (there are Arduino and other libraries for that API).

Be sure to read, re-read, re-re-read the XBee OEM manual.

HC-SR04 Ultrasonic DIstance Sensor

- Ultrasonic HC-SR04 Distance Measuring Transducer Sensor
- HC-SR04 consists of ultrasonic transmitter, receiver, and control circuit. When trigged it sends out a series of 40KHz ultrasonic pulses and receives echo from an object. The distance between the unit and the object is calculated by measuring the traveling time of sound and output it as the width of a TTL pulse.
- Power supply: 5V DC;
  quiescent current: less than 2mA;
  effectual angle: less than 15°;
  distance: 2cm~500cm;
  resolution: 0.3 cm
- Package Content: 5pcs HC-SR04 with a little gift

They have decent range, about 5 meters. Unfortunately they have two significant, irreparable flaws. Their timeout is 170ms, which is 19 meters! That means if they don't detect something within 5 meters (about 29ms), they just wait for another 150ms before they stop listening and accept another transmit trigger pulse. That's absolutely unacceptable for any system that needs a reasonable refresh rate.

That issue causes a second problem: If you're scanning an object that isn't directly perpendicular to the sensor, there's a chance the sound reflections won't reach the receiver. That's just a fact of life for active sensors. Unfortunately, if that reflection happens to be missed by the sensor, the ultra-long time out means that the reported range will be 170 ms! If you have a higher refresh rate than that (even at the 36ms that the datasheet recommends), you'll get a random range reported several cycles in the future. If that behavior was clearly explained in the datasheet it would be fine, but it's not.

Other than those significant flaws, they meet the datasheet specifications fairly well. Beamwidth is about 30 degrees up to 2.5 meters, and narrows to about 15 degrees beyond that

HG7881 Dual Motor Channel Driver

http://diyprojects.eu/how-to-use-h-bridge-hg7881-with-external-power-supply-and-arduino/

https://www.bananarobotics.com/shop/How-to-use-the-HG7881-(L9110)-Dual-Channel-Motor-Driver-Module

https://www.amazon.com/gp/product/B00W18P4MI/ref=oh_aui_detailpage_o01_s00?ie=UTF8&psc=1

- Power Supply: DC 2.5-12V; Country of Manufacture: CHINA
- Material: Electric Parts; Net Weight: 7g
- Package Content: 1 x DC Dual Motor Driver Controller; Model: for HG7881
- Main Color: Green, Blue
- Size: 29 x 23mm / 1.1" x 0.9"(L*W)

Waveshare IR Laser Sensor Module

User Manual: http://www.waveshare.com/w/upload/9/93/Laser-Sensor-UserManual.pdf

http://www.waveshare.com/wiki/File:Laser-Sensor-Code.7z

http://www.waveshare.com/laser-sensor.htm

https://www.amazon.com/gp/product/B00NJNYQ9G/ref=oh_aui_detailpage_o02_s03?ie=UTF8&psc=1#Ask

Software Specifications

Sample of System Architecture: http://www.instructables.com/id/Autonomous-Race-Car/?ALLSTEPS

My code sampled the original Arduino architecture of four settings: Full Throttle, Cruise, Avoid, and Reverse within this Instructables page. However I have changed almost all its elements and only retained the function labels, including adding new TurnAway(), Reset_Motors(), and Measure_Distance() functions. The original code is F3E7GSUHZI8QI9Q.ino, my adapted code is Demo_2.ino. Other codes included to test functionality of sensors an etc are also attached to the Elaine Wu_ISE511L_Technical Documents zip file.