

## Arduino Wireless Animatronic Hand

by [njk144](#) on December 22, 2010

### Table of Contents

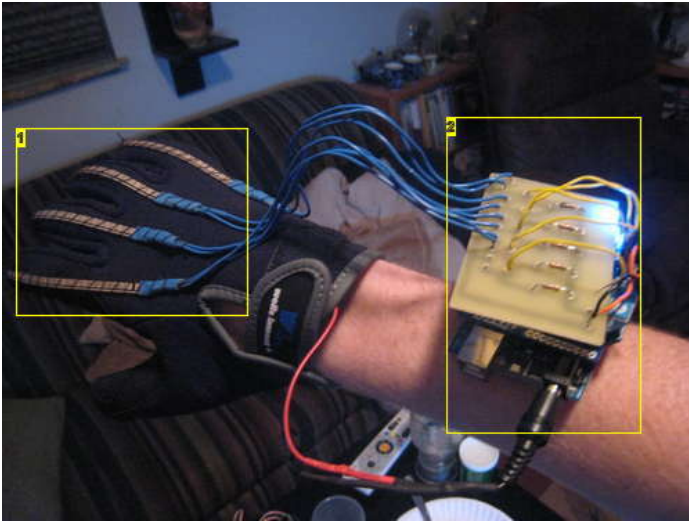
Arduino Wireless Animatronic Hand .....	1
Intro: Arduino Wireless Animatronic Hand .....	2
Step 1: Video .....	2
Step 2: Control Glove .....	3
Step 3: Custom PCB (Glove) .....	3
Step 4: The Hand! .....	4
Step 5: Hand PCB Shield .....	5
Step 6: CODE!!! .....	5
File Downloads .....	7
Step 7: How I Tested This .....	7
Step 8: Results .....	9
File Downloads .....	9
Step 9: Awards!! .....	10
Related Instructables .....	10
Comments .....	11

## Intro: Arduino Wireless Animatronic Hand

BTW!!!! This instructable is awsomeeeeeee

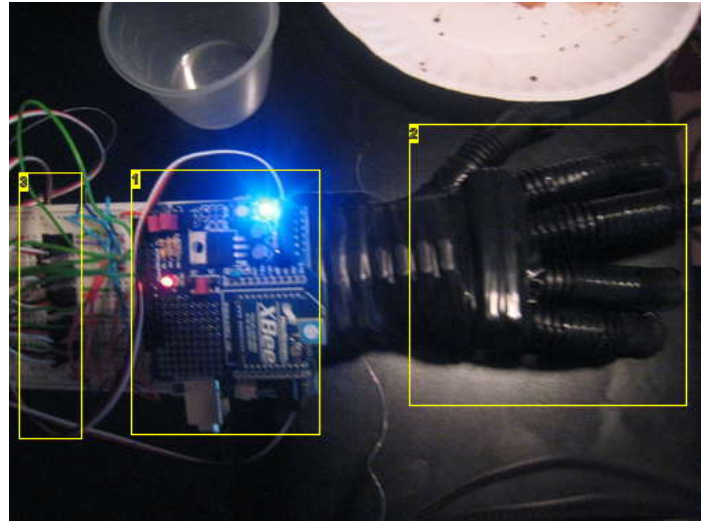
This is a very simple but at the same time a very hard project depending on your skill level. Lets get to building!

What this is, is a wireless animatronic hand that doesn't need a computer to operate. The user wears a control glove and can control the animatronic hand precisely. Bellow are some pictures of the final product:



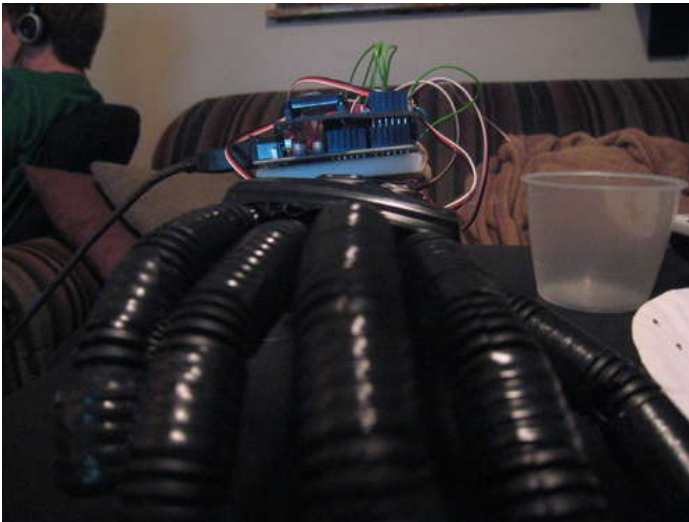
### Image Notes

1. Flex Sensors
2. Custom PCB, Xbee, Arduino



### Image Notes

1. xbee/Arduono
2. Animatronic hand
3. Servos



## Step 1: Video

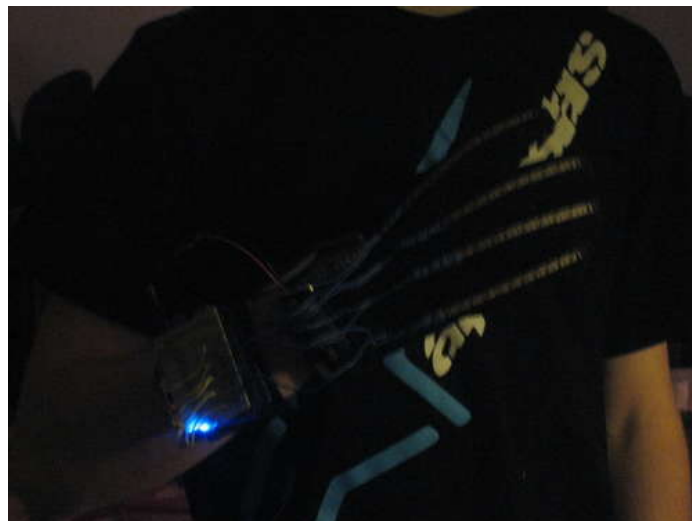


## Step 2: Control Glove

### Materials:

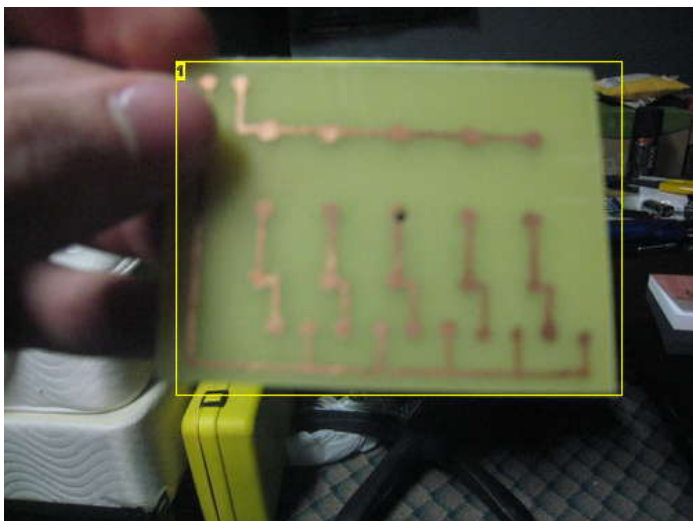
Arduino w/ ATMEGA 328  
Xbee w/ Shield  
5 Flex sensors  
Glove  
9v  
Hook up wire  
Custom PCB making tools  
(5) 10k resistors

1. Power both of the Arduinos to make sure they operate correctly.
2. Assemble the Xbee radio shields.
3. Connect the Xbee shields to the Arduino by placing on top of the Arduino.
4. Connect the Xbee's to the shields and connect them via USB.
5. Take the ATMEGA328 chip off the Arduino so there is a direct link between the computer and the Xbee radio.
6. Configure them in XCTU (default settings will work).
7. From here i built my own PCB (I'm not going to touch on how to do that, there are other very good tutorial out there) I used the data sheet for the sensors from this site, this is also where i got these sensors:  
<http://www.sparkfun.com/products/8606>
8. From here i put all the boards together and tested it out to see if everything worked (powered on).
9. I sewed the flex sensors onto the glove by poking a hole at top and running the string over and under the sensor so it can still freely move.
10. i built the arm band with some elastically and some STRONG double sided tape.



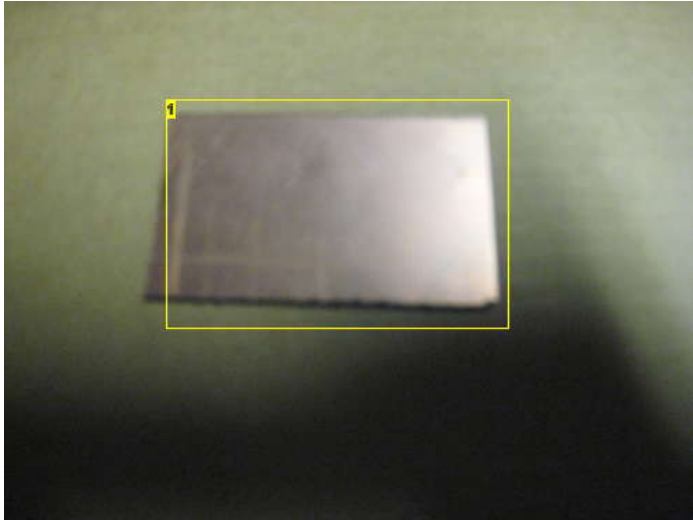
## Step 3: Custom PCB (Glove)

So for the glove i made a custom PCB to connect to the arduino. This PCB is for the 5 flex sensors for arduino inputs. This is my first PCB so it wasn't by any means complex nor professional. I made this in EAGLE CAD and used the Sharpie Method.



**Image Notes**

1. PCB

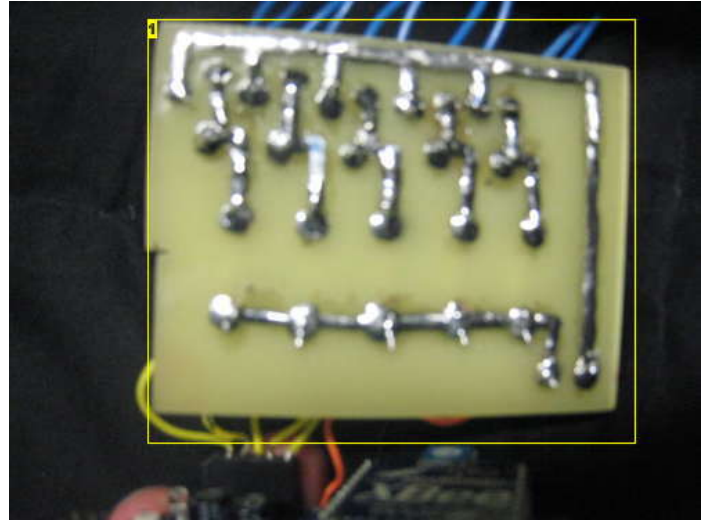


**Image Notes**

1. Copper Board

**Image Notes**

1. Sharpie!!



**Image Notes**

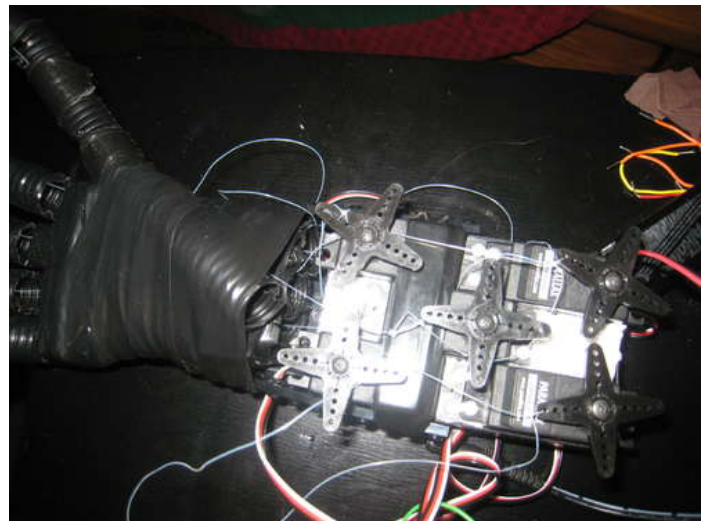
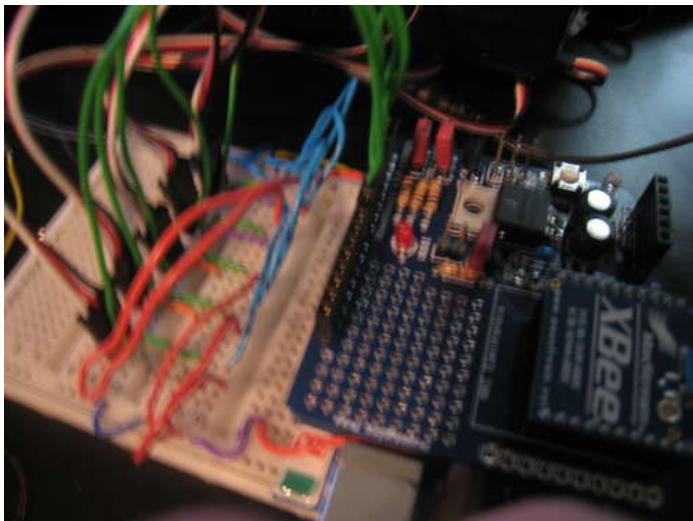
1. Finished!

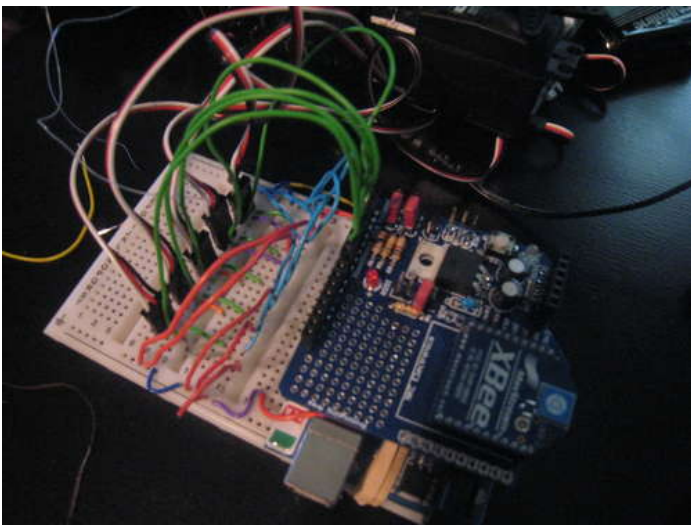
**Step 4: The Hand!**

Materials:  
electrical wire tubes (<http://www.instructables.com/id/Simple-Animatronics-robotic-hand/>)  
fishing tackle  
electrical tape  
LEGOS  
5 servos  
xbee w/ shield  
arduino ATMEGA 328  
exact o knife

This took the longest to build...

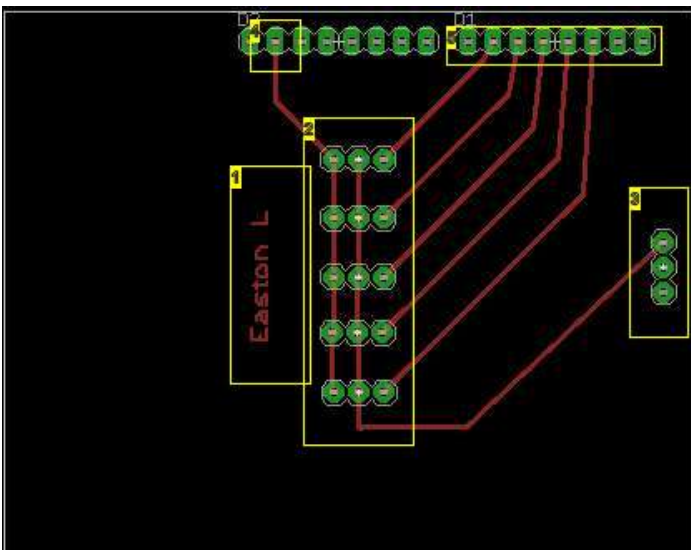
1. I researched hands and found a diagram where the joints are.
2. I then cut the joints with the exacto knife
3. I put all the fingers together without the thumb.
4. i put the four fingers together and reinforced them with legos
5. i taped the securely and put the thumb over those so it would have human like flex.
6. i taped the servos together filling the spaces with Styrofoam
7. i added all 5 servos to the hand with legos and tape
8. I built the circuit on a breadboard with just delivering power the servos and having the control wires into the Digital input on the arduino
9. i ran fishing tackle from the finger tip through the tube and anchored it onto the servo





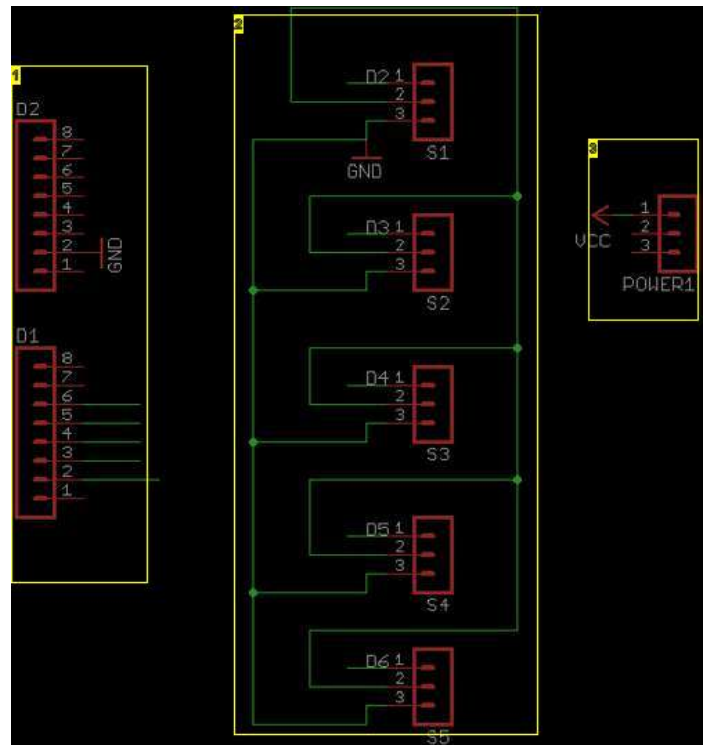
## Step 5: Hand PCB Shield

For the hand i am still in the process in building a pcb to take away the wires and reduce space. This time i am using to toner transfer method. I again made the schematic and board layout in EAGLE CAD. i used magazine paper to print onto. I engineered this to be used as a shield on the arduino.



### Image Notes

1. This needs to be reversed
2. Servos!
3. Power (+)
4. Power (ground)
5. Digital Outputs



### Image Notes

1. Arduino Pins
2. Servo
3. Arduino Power

## Step 6: CODE!!!

The Very first thing you want to do is make sure your shield or xbee's are unplugged from the arduino. Or make sure the correct jumpers are the in the right place (in my case). I have written this code and if you do use it want credit.

This is the code for the sending Arduino:

```
int Finger1 = 0;
int Finger2 = 1;
int Finger3 = 2;
int Finger4 = 3;
int Finger5 = 4;
```

```
void setup()
{
```

<http://www.instructables.com/id/Arduino-Wireless-Animatronic-Hand/>

```

Serial.begin(9600);
}

void loop()
{
byte servoValue1;
byte servoValue2;
byte servoValue3;
byte servoValue4;
byte servoValue5;

int FingerV1 = analogRead(Finger1);
int FingerV2 = analogRead(Finger2);
int FingerV3 = analogRead(Finger3);
int FingerV4 = analogRead(Finger4);
int FingerV5 = analogRead(Finger5);

if (FingerV1 < 200) FingerV1 = 200;
else if (FingerV1 > 460) FingerV1 = 460;
if (FingerV2 < 200) FingerV2 = 200;
else if (FingerV2 > 460) FingerV2 = 460;
if (FingerV3 < 200) FingerV3 = 200;
else if (FingerV3 > 460) FingerV3 = 460;
if (FingerV4 < 200) FingerV4 = 200;
else if (FingerV4 > 460) FingerV4 = 460;
if (FingerV5 < 200) FingerV5 = 200;
else if (FingerV5 > 460) FingerV5 = 460;

byte servoVal1 = map(FingerV1,460, 200, 255, 0);
byte servoVal2 = map(FingerV2,460, 200, 255, 0);
byte servoVal3 = map(FingerV3,460, 200, 255, 0);
byte servoVal4 = map(FingerV4,460, 200, 255, 0);
byte servoVal5 = map(FingerV5,460, 200, 255, 0);

Serial.print(servoVal1);
Serial.print(servoVal2);
Serial.print(servoVal3);
Serial.print(servoVal4);
Serial.print(servoVal5);

delay(100);
}

```

Here is the receiving:

```

#include

Servo myservo1; // create servo object to control a servo
Servo myservo2;
Servo myservo3;
Servo myservo4;
Servo myservo5;

void setup()
{
Serial.begin(9600);

myservo1.attach(2); // attaches the servo on pin 9 to the servo object
myservo2.attach(3);
myservo3.attach(4);
myservo4.attach(5);
myservo5.attach(6);
}

void loop()
{
if(Serial.available() >=5)
{
byte servoAng1 = Serial.read();
byte servoAng2 = Serial.read();
byte servoAng3 = Serial.read();
byte servoAng4 = Serial.read();
byte servoAng5 = Serial.read();

// Send the servo to the position read... (note: you get to make this happen)
myservo1.write(servoAng1);
myservo2.write(servoAng2);
myservo3.write(servoAng3);
myservo4.write(servoAng4);
myservo5.write(servoAng5);
}
}

```



## File Downloads



Xbee\_Receive.pde (831 bytes)

[NOTE: When saving, if you see .tmp as the file ext, rename it to 'Xbee\_Receive.pde']



Xbee\_Send.pde (1 KB)

[NOTE: When saving, if you see .tmp as the file ext, rename it to 'Xbee\_Send.pde']

### Step 7: How I Tested This

I did do this for science fair!

Here is some of my work for it:

So pretty much what i did was take a HD video at 60 fps to get high resolution skills. i came up with three positions to test, fully extended, half extended and unextended. From here i went into geometers sketchpad and found the angle of each finger at each position for both hands. From here i was able to compare a real hand to my animatronic hand.







## Step 8: Results

Upon conduction of the experiment, using the variables finger, angle, sensor value and position, the following results were produced. During the first test I measured the angle relationship between my finger and the corresponding finger on the animatronic hand. I found that the index finger, middle finger, ring finger, and pinky all had about the same sensor value from the flex sensors. The thumb on the other hand was limited in movement compared to the other fingers, and therefore the sensor data was in a smaller range. I then came up with three positions to test, fully extended, half extended, and unextended. From here I created a video of all my fingers at these different positions. I then analyzed the videos through the use of editing software and found the angle of each finger at each position.

I then conducted the same procedure for the animatronic hand, finding the angle of each finger at each position in the process. I found that at the fully extended position the relationship between my finger and the corresponding finger on the animatronic hand was about a 20° difference. At half extended the relationship was the closest at about a 10° difference. At unextended I noticed the most difference with my fingers bending almost 30° more than the animatronic hand. The thumb was the most consistent finger with only about 10° difference on all three tests. Overall, the comparison of my hand compared to the animatronic hand was greater than I thought. The position with the greatest difference was fully flexed. What all this means is that the animatronic hand has a relationship with my hand.



### Image Notes

1. Regional Science Fair New Paper Photo

### File Downloads



sensor value graphs.xls (58 KB)

[NOTE: When saving, if you see .tmp as the file ext, rename it to 'sensor value graphs.xls']

## Step 9: Awards!!

A few weeks ago i attended the regional science fair in Durango Colorado. The first award i won was 1st place in the Air Force Engineering. The second award i won was a Davin chi award which qualified me for the state competition in Fort Collins. The best award i won qualified me to go to the international science fair in LA for a week, all expense paid, to be an official observer. So i pretty much go to LA for a week and get to check out the sweet project whether i do good at state or not.

<http://www.durangoherald.com/article/20110304/NEWS01/703049910/Hands-on-learning>



### Image Notes

1. Regional Science Fair New Paper Photo

## Related Instructables



**Configuring XBees for API Mode** by quasiben



**Wireless Altoids Display** by Alexdlp



**Arduino Controlled Motion Sensor** by LemonSlice



**XBee adapter** by adafruit

















**Wireless Altoids Cycle Computer** by Alexdlp



**Carlitos' Projects: Wireless Speech-Controlled Arduino Robot** by RobotShop

## Comments

28 comments [Add Comment](#)

- 
-  **jrider** says: Jun 29, 2011. 3:53 AM [REPLY](#)  
Is it possible to make a full-scale human body with the same principle as your Instructable?
- 
-  **mwolf2** says: Jun 29, 2011. 2:48 PM [REPLY](#)  
Theoretically, yes, but I think overall you'd have to find some super strong servo's, some super strong yet flexible piping and alot of time to do it. but overall NO, you'd have to create a biped platform for it to move as a human, costing thousands.
- 
-  **jrider** says: Jun 29, 2011. 9:08 PM [REPLY](#)  
Oh, thanks for the answer.
- 
-  **kalsara01** says: Jun 17, 2011. 8:10 AM [REPLY](#)  
GREAT GREAT GREAT WORK..... hats off .. wel done pal
- 
-  **rtty21** says: Jan 27, 2011. 8:59 AM [REPLY](#)  
Add a video!
- 
-  **9ale7** says: Jan 27, 2011. 4:22 PM [REPLY](#)  
yes a video !!! ( and more pictures while it's in action)  
:P  
looks amazing !
- 
-  **njkl44** says: Jan 28, 2011. 4:25 PM [REPLY](#)  
i am going to try this weekend or maybe next week
- 
-  **9ale7** says: Jan 28, 2011. 11:52 PM [REPLY](#)  
will be waiting :)
- 
-  **njkl44** says: Feb 14, 2011. 5:17 PM [REPLY](#)  
here a VIDEO!!!
- 
-  **mcmahanly** says: May 20, 2011. 2:11 PM [REPLY](#)  
camera? lens?
- 
-  **bdur ** says: May 15, 2011. 3:29 PM [REPLY](#)  
not bad for your first one
- 
-  **thunderconan** says: May 6, 2011. 12:13 PM [REPLY](#)  
can you give me ur email pls ????
- 
-  **njkl44** says: May 6, 2011. 3:57 PM [REPLY](#)  
Sure thing its njkl44@gmail.com
- 
-  **joehudy** says: Apr 19, 2011. 3:23 PM [REPLY](#)  
were ded u get the flex sensorsand are thay expensiv  
sorry abought spelling
-



**mased007** says:

When I get older I make this :) Thx for good idea.

Apr 18, 2011. 10:30 AM [REPLY](#)



**TheGreatS** says:

could you place it on the ground, add some wheels to the back and make it crawl?

Apr 15, 2011. 2:52 PM [REPLY](#)



**chsairam\_7** says:

why didn't you map it to 1024 analog values and 180 servo angles; would'nt that be more effective? I made a similar hand months ago and it was pretty cool

Apr 1, 2011. 8:21 AM [REPLY](#)



**zrttner** says:

Cool project. You can clean up that chunk of if's by using the constrain function: [arduino.cc/en/Reference/Constrain](http://arduino.cc/en/Reference/Constrain)

Mar 31, 2011. 5:21 AM [REPLY](#)



**Bombbunny** says:

What program can I use to open up the xbee receive and send files?

Mar 5, 2011. 4:13 AM [REPLY](#)



**njkl44** says:

The code here is actually for the arduino. There is no code for the xbees you have to deal with. You configure the xbees in XCTU but you open the code in the arduino programming program

Mar 5, 2011. 8:04 AM [REPLY](#)



**gale7** says:

looks amazing  
.. what camera did you use?  
:P

Feb 14, 2011. 10:49 PM [REPLY](#)



**Macyoshary** says:

Really cool instructable!

Just one thing, your first line reads "This is my first inscrutable to its kinda bad." change "inscrutable" to "instructable" and (I assume) "to" to "so", (and "its" to "it's" but that's forgivable).

It's just that the first line is the first thing anyone sees, so it's good to get it nice.

Otherwise, great!

Dec 23, 2010. 1:25 PM [REPLY](#)



**Spaceman Spiff** says:

I'd delete the first line all together. Or replace it with, "This instructable is AWESOME!!!"

Dec 24, 2010. 4:31 AM [REPLY](#)



**lolcat360** says:

Calvin and Hobbes FTW!

Jan 29, 2011. 5:29 AM [REPLY](#)



**Macyoshary** says:

Yeah, that could work too :P

Dec 24, 2010. 11:20 AM [REPLY](#)



**kyle brinkerhoff** says:

looks a little like darth vaders hand.... awesome work!

Jan 20, 2011. 1:14 PM [REPLY](#)



**maewert** says:

Very neat!

I see there is no blocking of data being transmitted. I mean within the stream there is no indication where the stream starts. Does this sometimes get confused as to which finger is which, especially if the receiving arduino is powered up after the transmitting arduino? If so then you may want to send a blocking character like '\$' before the first finger is transmitted and then the receiver can look for the symbol to remain in sync with the transmitter.

Cool device. I'll have to try this ;-)

Best Wishes.

Dec 22, 2010. 12:40 PM [REPLY](#)



**njkl44** says:

Dec 22, 2010. 1:40 PM **REPLY**

Hey thank you I'm really glad you like it and there's not a whole lot of problems only about if 30 seconds without use the receiving start sending stuff to the sending wich im nit sure y but I see what you were saying and I may try something like that.

Thanks, Easton

---