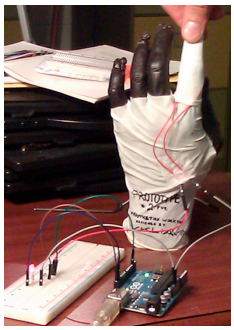
DIY Prosthetics – Environment Sensing



Explore, Design, Build

In Montreal: Nina Czegledy
Javed Gangjee
In Toronto: Adriana Ieraci
Gabby Resch
Isaac Record

Special thanks to Momoko Allard of Hexagram Concordia for all her work coordinating this event.

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EXPLORE

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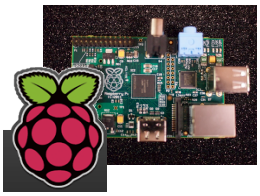
Fabrication and DIY



Cost

Ease
Of Use

instructables

THINGIVERSE

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Hypothesis:
Prosthetics and the DIY Movement

The perfect market for radical innovation by individuals.

Van Phillips, an amputee, invented the Cheetah Foot

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Hypothesis: Innovation in Prosthetic Development

- Any given innovation will have a SMALL Market
  - Less appealing to large corporation, difficult to profit without high cost
- End product HIGHLY Personalized and Specialized
  - Individuals must adapt or customize
- Passionate Community of Users often left to solve their own problems
  - Funding, access, and availability of solutions is a barrier individuals are forced to negotiate

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DESIGN

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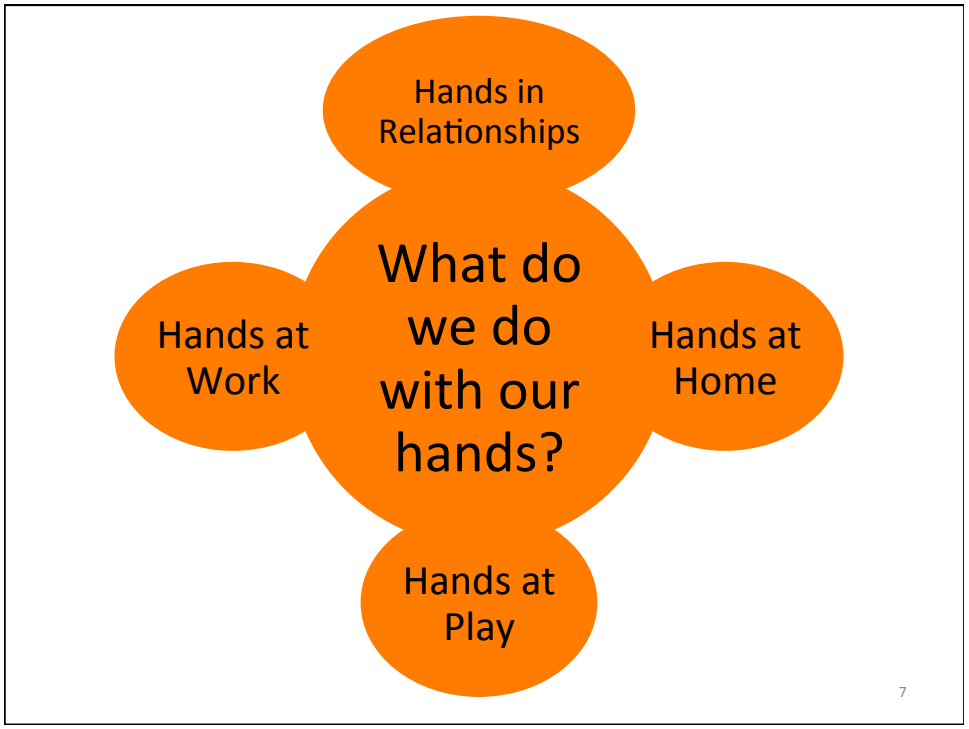
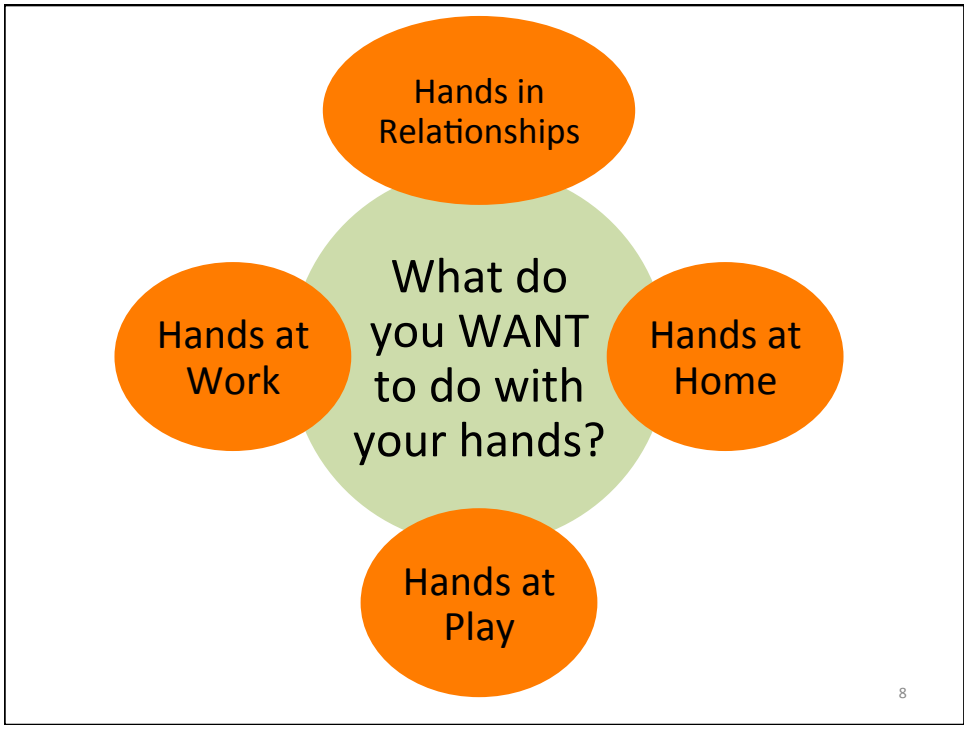

Hands in Relationships
What do we do with our hands?
Hands at Work
Hands at Home
Hands at Play
7


Hands in Relationships
What do you WANT to do with your hands?
Hands at Work
Hands at Home
Hands at Play
8

Today's Challenge

Imagine and Design a Smart Prosthetic for yourself or someone who has lost function of some kind.

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Social Values vs Functional Needs

- Autonomy
- Freedom
- Dignity
- Health
- Fairness

- Function
- Visibility
- Physiology
- Aesthetics
- Privacy

Thinking a little differently:

Scott Summit of Bespoke Innovations discusses his company's work in developing prosthetics and discusses changing the conversation about what a prosthetic is.
http://ecorner.stanford.edu/authorMaterialInfo.html?mid=2808

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Design a Sensing-Actuating Prosthetic

- Inputs
  - Light Sensor
  - Temp Sensor
  - Proximity
  - Tilt Sensor
  - Stretch Sensor
- Outputs
  - Muscle Wire
  - RGB (red, green, blue) LED Light
  - Speaker
  - Vibrating Motor

What Values are important?
What Functional Requirements will you implement?

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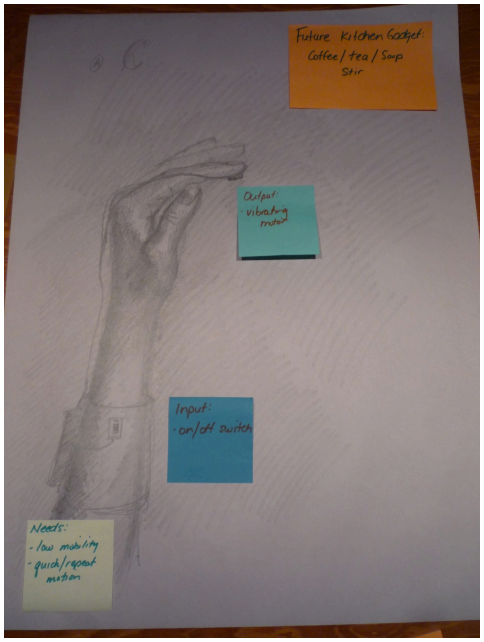
Temperature Tester



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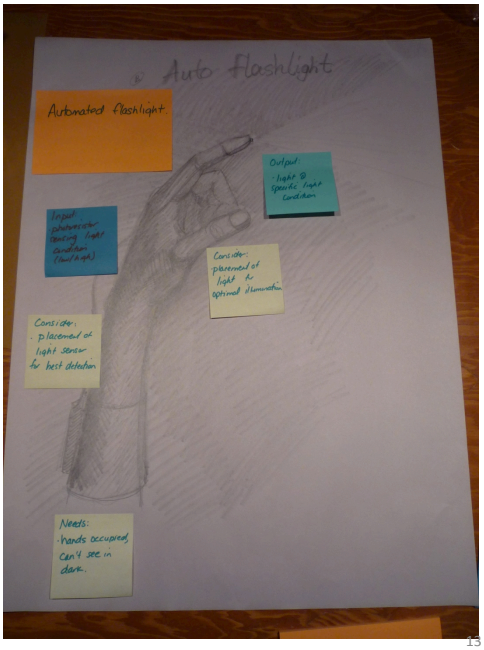
Auto Flashlight



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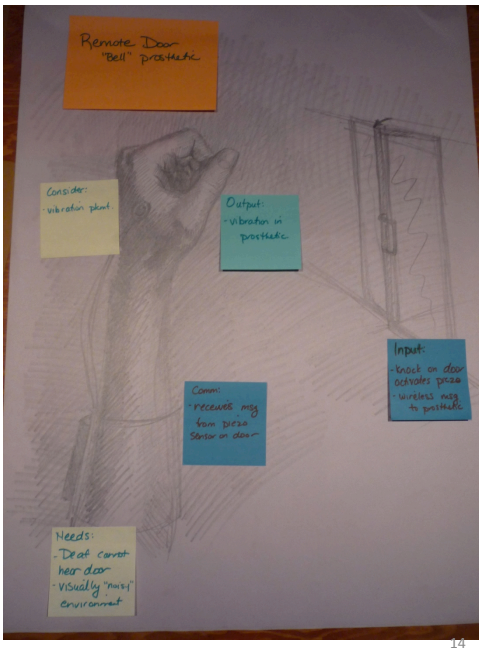
Vibrating Doorbell



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BUILD

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EVERYTHING YOU NEED AT:

http://bit.ly/RzyjJF

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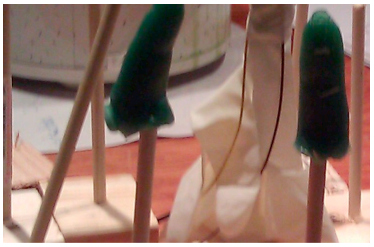
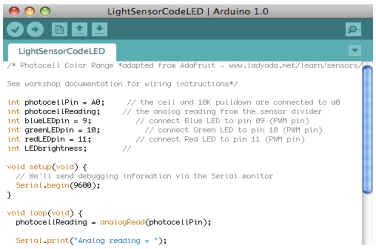
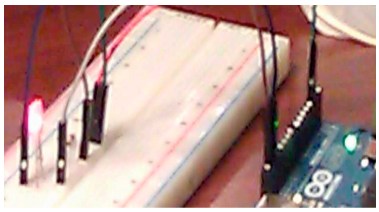
1. Anatomy



3. Logic





2. Circuits

4. Harness

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Anatomy

Tools and Materials:

- Moldable plastic
- Cotton gloves
- Felt and wool
- Plastecine
- Craft Wire
- Needle and Thread
- Popsicle Sticks and Straws
- Spring (in the ballpoint pen)

- Muscle Wire
- Crimp Beads

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Melting Polymorph

1. Warm the Polymorph in a mug of hot water
2. Polymorph melts at approximately 60 to 63 C
3. It is ready to mold when it is clear
4. Mold it into the support structure you require for the prosthetic
5. Remember holes for joint pins and connections for sensors and actuators

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Connecting Muscle Wire

1. The suggested length of wire for a 3V power source (2 D-cells) is 2.6 inches.
2. Bend the muscle wire over at one end two times pinching it with needle nose plyers. The bend should only be about 5mm.
3. Place the crimp bead over the folded muscle wire and pinch it with plyers to create a firm crimp. (you could pinch your connecting wire in it too)
4. TRY IT! Hold the muscle wire down on the paper and mark each end. Manually connect the D-cell battery holder to each end and watch what happens. (Careful! It gets hot!)

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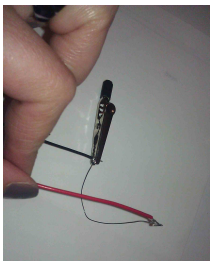

Forming Muscle Wire

1. Use the Third Hands, alligator clips, screws and coupling to clamp the wire into an interesting position.
2. Use the blow torch to heat up the wire – it will be red hot so be sure not to touch any heated metal.
3. TRY IT! Hold the muscle wire down on the paper and mark each end. Manually connect the D-cell battery holder to each end and watch what happens. (Careful! It gets hot!)

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Suggestions

Use the spring as a counter force to stretch out muscle wire.

Use the muscle wire as a tendon.

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Circuits

Tools and Materials:

- Input Sensors (Light, Temperatire, Tilt, Proximity, Stretch)
- Output (RGB LED, Vibrating Motor, Speaker, Muscle Wire)
- Resistors
- Wires
- Breadboard
- Conductive thread (for circuits in fabric)

- Fritzing Diagrams (**http://bit.ly/RzyjJF)**

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Circuits: Try It!

- Circuits must be closed loops.
- Connect power and ground terminals or positive and negative terminals as on a battery.
- Connect the LED or Vibrating Motor to your battery (but not for long).

This is an LED.
Note: the leads (wires) are different lengths.
LEDs are "polarized".

This is a vibrating motor.

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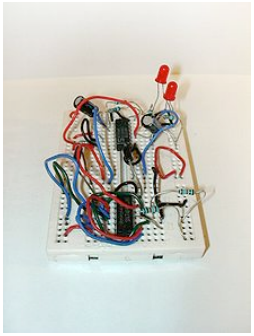
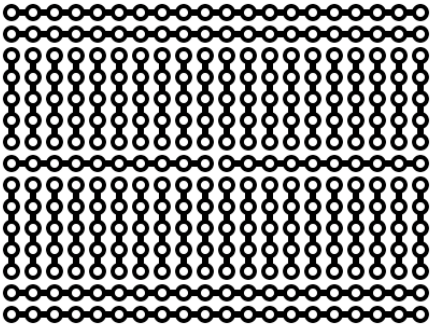
Circuits: Breadboards

- A breadboard helps you easily prototype



- The terminals are connected in rows and columns.



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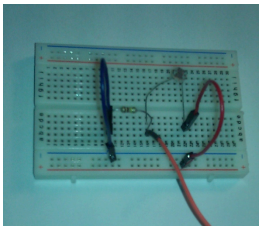
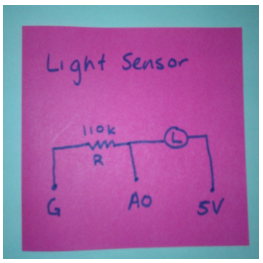
Circuits: Prototyping





- Use the breadboard to prototype your circuit
- G, AO, and 5V correspond to terminals on the Arduino
- Are your ground and power lines connected?

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Logic

Tools and Materials:

- Arduino
- Sample Code (**http://bit.ly/RzyjJF**)

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Logic: Arduino

- Go to arduino.cc and follow the “Getting Started” tab to load the Arduino environment and connect your Arduino
- Connect the Arduino to your computer using the USB cable
- Download the circuit code at **http://bit.ly/RzyjJF**

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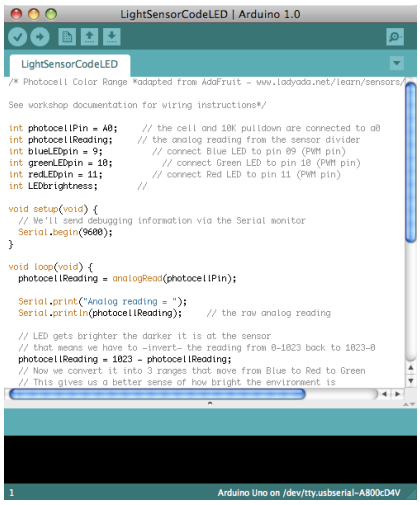
Logic: Code



- Download the code for your design circuits and open it in the Arduino environment.
- Cut and paste the required code into one window.
- Look for the "If…Then.." statement to define the behavior of your circuit.
- Check the variables correspond to the terminals you are using on the Arduino.
- Verify and Upload the code.

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Harness

Tools and Materials:

- Felt and wool
- Pins
- Needle and thread

- Build your own harness to hold the Arduino, Breadboard and Circuit and the Batteries.

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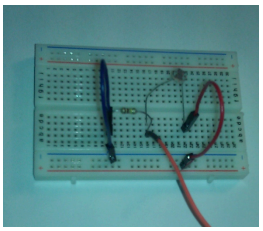
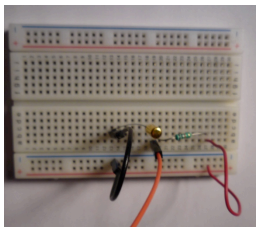
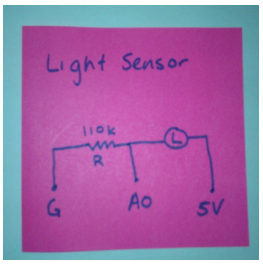
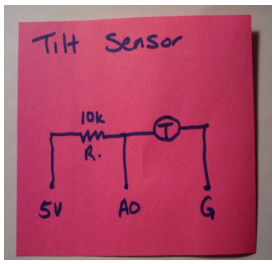
Light Sensor and Tilt Sensor









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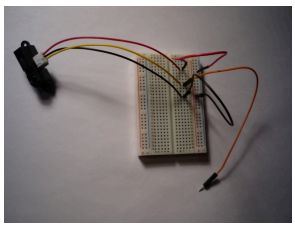
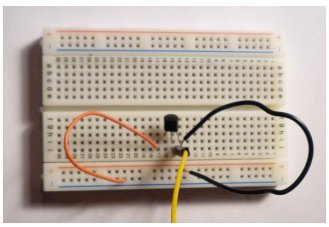
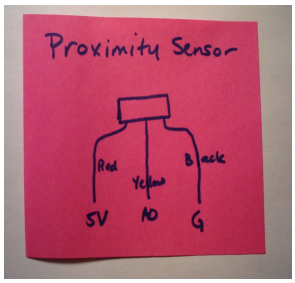
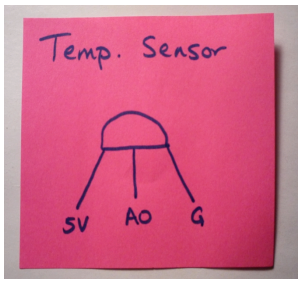
Proximity and Temperature Sensors









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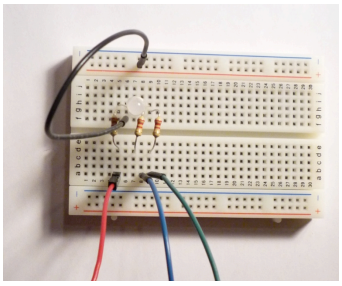
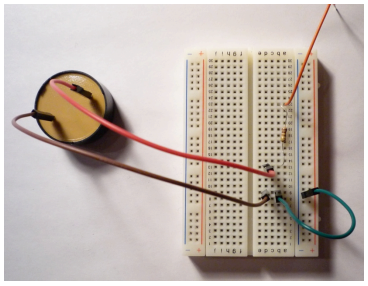
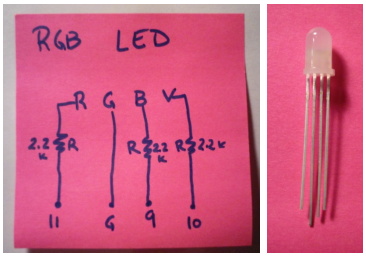
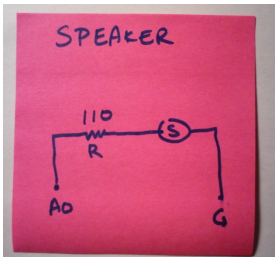
RGB LED and Speaker









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Special Thanks

Past speakers for this workshop have included:

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Technical portion of the workshop has been developed in collaboration with:

Marie Eve Belanger, Valenten Kliaven, and Mike Tissenbaum

Creative Direction:

Nina Czegledy and Adriana Ieraci

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